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Modal Shifts from the Mississippi River & Duluth/Superior to Land Transportation

by

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Any errors or omissions are, of course, the sole responsibility of the authors.

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List of Common Abbreviations (used in this report)

AI: Aggregate Industries

AIS: American Iron - references the earlier name of “American Iron and Steel” which is associated with the river facility; “AIS” is used to distinguish from “AI” (above).

BN: Burlington Northern Railroad

CP: Canadian Pacific Railroad

FHWA: U.S. Federal Highway Administration, part of the U.S. DOT

HCAS: Highway Cost Allocation Study

HPMS: Highway Performance Monitoring System, a national set of highway statistics

LPMS: Lock Performance Monitoring System, data system of all cargo moving through river locks, maintained by the USACE (see below)

Mn/DOT: Minnesota Department of Transportation

NHPN: National Highway Planning Network, road lines linked to the HPMS, for mapping

TCW: Twin Cities and Western Railroad

UHT: Upper Harbor Terminal

USACE: U.S. Army Corps of Engineers – operators of the river locks

USDOT: United States Department of Transportation

Executive Summary

As in many other urban areas, industrial use at the Minneapolis Upper Harbor is coming into conflict with residential and recreational use as the waterfront becomes a desirable location. There have been several proposals to discontinue barging in the Upper Harbor, most notably *Above the Falls: A Master Plan for the Upper River in Minneapolis* [1] which appears to assume that elimination of freight facilities at the Upper Harbor (or loss of their access to water) would lead to the disappearance of any truck traffic associated with these facilities. The primary public policy intent of this study is to advance understanding of the likely impacts of the loss of water access to facilities located on the Minneapolis Upper Harbor. We interpret the primary purpose of this study as follows:

> If the Minneapolis Upper Harbor loses access to barge transport, what changes in truck traffic are expected to result; what are the expected routes of this traffic; and what are the expected private and public costs. The public costs to be considered include highway maintenance costs and public externalities such as emissions, congestion, and accidents.

The Minneapolis Upper Harbor contains three facilities that currently handle water (barge) traffic and which would be affected by a loss of access to the river (note that 'upbound' cargo, below, moves into these facilities by water and 'downbound' moves out of these facilities):

i. **Aggregate Industries (AI) Minneapolis Yard** (co-located with the Cemstone Minneapolis concrete plant) has only upbound barge traffic, consisting of aggregates (limestone, sand, and gravel) from the AI plants on Gray Cloud Island.
ii. **Upper Harbor Terminal (UHT)** has both downbound and upbound barge traffic, generally consisting of grain and potash downbound, and fertilizer, coal, salt, steel, general cargo, and some specialized aggregates upbound.
iii. **American Iron and Steel (AIS)** has only downbound traffic, of scrap metals.

Holcim Cement Co. is a fourth (and the only other) Upper Harbor facility currently handling water traffic, consisting of upbound cement. However, Holcim is in the process of phasing out this facility in favor of a St. Paul facility. Since a modal shift away from water is already planned to occur for this facility, it is not included in the calculation of the "estimated overall impact" of a prospective future Upper Harbor modal shift.

Normally, information on commercial transportation costs and volumes is difficult to obtain, particularly for commodity industries where it is a key part of competitiveness and pricing strategies. However, the Upper Harbor presented a unique situation in several respects, which allowed access to detailed data through both the Lock Performance Monitoring System (LPMS), and intensive interviews with all facility operators, who had an interest in cooperating with this study so that the impacts of their loss of access to the water can be quantified.

A primary goal of the methodology used in this study is credibility for the expected usage. It is expected that the results of this study will be used to claim that there would be substantial private and public economic impacts if water access to the Upper Harbor were lost. Therefore this analysis has been biased towards underestimating these impacts. Conservative assumptions of truck volumes, distances, and costs are used unless there is strong evidence to the contrary.

A key point in this analysis flows from a simple observation of the location of the Minneapolis Upper Harbor ports, which is northwest of the alternative ports in the St. Paul area. Cargo will only currently use the Minneapolis ports if these ports are closer to the cargo's origin or destination. Otherwise, the cargo would already be using the St. Paul ports, and saving the costs of the additional river miles (and three locks) between St. Paul and Minneapolis. Thus, the Minneapolis ports capture cargo moving to Minneapolis itself, western suburbs, and to/from northwest of Minneapolis. If the river mode to Minneapolis is unavailable, cargo will move to and from Minneapolis, and northwest of Minneapolis, by the most direct possible route to/from the St. Paul ports. Most of these routes will be directly through St. Paul and Minneapolis via I94, with the rest close to the northern and western boundaries of Minneapolis (on I694 and I494).

This study derives a "most likely" scenario of the changed traffic patterns following a loss of water access to the Upper Harbor, with estimated impacts of:

- An increase of 648 heavy truck trips per weekday during the 32 week barge season, with 512 of these trips on I94 between St. Paul and Minneapolis.
- Total public sector and public externality cost increases of $1.088 million per year. These costs are a summation of all the costs that can be calculated using the change in truck vehicle miles traveled (VMT) and the Federal Highway Administration's Highway Cost Allocation Study (HCAS) cost coefficients. These increases are composed of "Public Sector Costs" (road maintenance) of $601 thousand per year and "Public Externality Costs" (congestion, emission, crash, and noise) of $488 thousand.
- Net private cost increases, for haulage by truck rather than barge, of $4.1 million per year, consisting of $4.9 million per year in new trucking costs offset by saved barge costs of $722 thousand per year. Included in these costs is an increase in diesel fuel consumption of 406,000 gallons per year, or 7.8 times the fuel consumption of barges moving this cargo.
- The increases in private costs mean that shippers currently using the Upper Harbor Terminal (UHT) will pay an additional $2.50 per ton to move their products. These shippers include farmers for grain and fertilizer, or the final customers for coal and general cargo. There will be a reduction of up to $4.50 per ton in price paid to suppliers of scrap to American Iron. There will be an increase of by $2.88 per ton for Minneapolis-area purchasers of aggregates from Aggregate Industries. A primary purchaser of this aggregate is the Cemstone Minneapolis concrete plant; the aggregate cost increase means an increase of $4.60 per yard of concrete in the Minneapolis area.

The study also derives a "transitional scenario" of aggregate movements by truck all the way from their source at Grey Cloud Island, rather than the "most likely" scenario of truck movement from the AI St. Paul facility. This scenario has greater costs than the "most likely" in all categories, with the most significant, from a public policy perspective, being an additional $328 thousand per year in predicted road maintenance costs. Most of these additional costs would occur on Grey Cloud Island and St. Paul Park area roads (from the AI Nelson/Larson Plants). This cost figure probably represents a significant underestimate of the actual maintenance costs for these roads, and does not include likely construction costs for upgrades to the road and bridge structures on the road, which would be quickly needed if an intensive gravel haul occurs.

Truck freight is forecast to continue increasing throughout the nation, and particularly in urban areas. So is road congestion, and the two trends exacerbate each other. Solutions are difficult to find. One of the few realistic opportunities is moving truck traffic onto other modes. But the economics of urban truck costs, discussed in this report, work against this. This tendency is amplified by failures in public policy.

This study finds that the Upper Harbor Terminal would disappear if freight could no longer move by water to/from the Minneapolis Upper Harbor. However, the freight traffic currently using the UHT would not disappear; it would be replaced by truck trips through the Metro area on I694 and I35E to St. Paul. The other Upper Harbor facilities would stay or, with significant private and public expenditure on new infrastructure (and possible public expenditure on financial compensation), move towards the northwest. With or without relocation, there would be substantial additional truck traffic through and between St. Paul and Minneapolis on I94.

The overall issue posed by the discussion about the Upper Harbor is: what do we do with freight? This study indicates that a decision to eliminate water access to the Upper Harbor would have very significant costs to both the City of Minneapolis and the Metro area. The recent Twin Cities Transportation and Regional Growth (TRG) Study [9] points out that “No community can develop in a way that avoids impact upon other communities” (p17). A primary recommendation of the TRG Study is that “A policy of expanding choices would make the region more competitive” (pp. vi and 26).

The City of Minneapolis owes and controls the Upper Harbor Terminal and the land upon which it sits. The UHT has access to public (road and water) and private (rail) transportation facilities which would be expensive, or impossible, to reproduce elsewhere in the Minneapolis area. Given the significant transportation challenges facing the region, and the difficulty of reversing a change in use, should the City retain the current use for land and a facility that they own and control? Examples such as New York City’s trash disposal dilemma illustrate the perils of foreclosing upon a significant intermodal transportation option. Given this uncertainty, it would appear to be in the interests of the City, the Metro area, and the state to maintain the Upper Harbor Terminal.

Chapter 1: Introduction and Methodology

Problem Statement

This study was contracted for by the Minnesota Department of Transportation (Mn/DOT). The contract for this study has the following project description:

> *Analyze the key economic, environmental, and safety impacts of shifting commodity movements from a water mode to a land mode for three major movements that currently move or historically moved by water. These are:*
>
> *a) The potential shift of multiple commodities from Mississippi River barges to trucks if the Minneapolis Upper Harbor and adjacent areas are closed to barge traffic.*
>
> *b) The shift in the mid 1990s of shipments of petroleum products from area refineries from barges to trucks due to the increase in carriers' potential liability as a result of the Federal Oil Pollution Act of 1990.*
>
> *c) The shift of freight traffic from the Incan Superior railcar ferry from water and rail to truck as a consequence of a large increase in the Federal Harbor Maintenance Tax.*
>
> *The impacts that will be measured or estimated include: operating cost differences, differences in fuel and energy consumption, changes in air emissions, highway congestion impacts, highway accident rates, and changes in highway maintenance requirements.*

The primary public policy intent of this study is to advance understanding of the likely impacts of the loss of water access to facilities located on the Minneapolis Upper Harbor. We interpret the primary purpose of this Study as follows:

> *If the Minneapolis Upper Harbor loses access to barge transport, what changes in truck traffic are expected to result, what are the expected routes of this traffic, and what are the expected private and public costs. The public costs to be considered include highway maintenance costs and public externalities such as emissions, congestion, and accidents.*

Report Organization

This report is divided into the following Chapters:

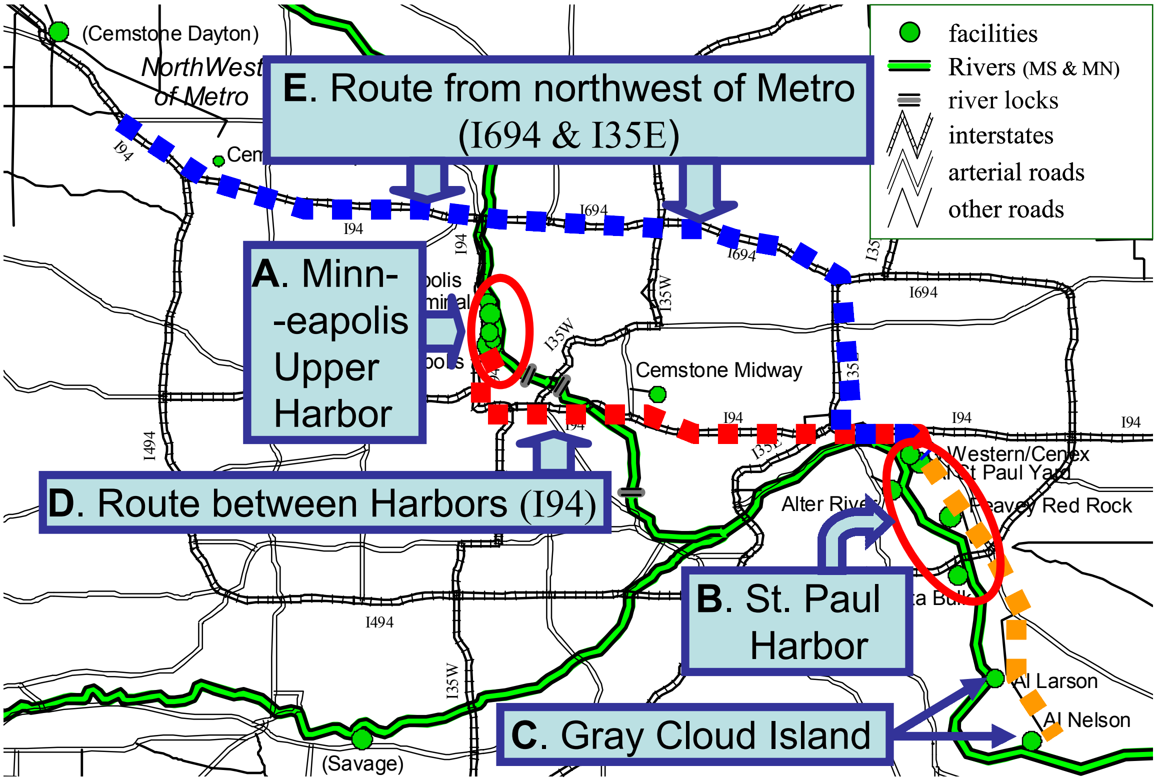
Chapter 1: Introduction and Methodology
Chapter 2: Freight Volumes and Interviews
Chapter 3: Truck Route Analysis
Chapter 4: Cost Estimation
Chapter 5: Summary of Results for Upper Harbor Modal Shifts
Chapter 6: Policy Implications
Appendix A: Truck Route Maps

In this Chapter we introduce and define the problem. We then summarize the relevant background, including local geography and economic theory needed to address the problem. Finally, we provide an overview of the methodology used to generate the results.

Background

Overview of the Minneapolis Upper Harbor Facility

Figure 1.1: Map of Study Area



The Minneapolis Upper Harbor (the red oval at **A** in Figure 1.1) is separated by three river locks and approximately 20 Mississippi river miles from the ports at St. Paul (the red oval at **B**), and 25 to 30 river miles from the two aggregate plants at Grey Cloud Island (**C**). This study has found that, if the river was unavailable, most cargo using the Upper Harbor would divert to truck between the two harbors along highway I94 (the red dotted line at **D**), or between northwest of the Metro and the St. Paul ports along highways I694 & I35E (the blue dotted line at **E**).

The Minneapolis Upper Harbor contains three facilities that currently handle water (barge) traffic and which would be affected by a loss of access to the river (note that 'upbound' cargo, below moves into these facilities by water and 'downbound' moves out of these facilities):

1. **Aggregate Industries (AI) Minneapolis Yard** (co-located with a Cemstone cement plant) – has only upbound barge traffic, consisting of aggregates (limestone, sand, and gravel) from the AI plants on Gray Cloud Island.
2. **Upper Harbor Terminal** (River Services, Inc.) – has both downbound and upbound barge traffic, generally consisting of grain and potash downbound, and fertilizer, coal, salt, steel, general cargo, and some specialized aggregates upbound.
3. **American Iron and Steel (AIS)** – has only downbound traffic, of scrap metals.

> **Holcim Cement Co.** is a fourth (and only other) Upper Harbor facility currently handling water traffic, consisting of upbound cement. However, Holcim is in the process of phasing out this facility in favor of a St. Paul facility. Since a modal shift away from water is already planned to occur for this facility, it is not included in the calculation of the "estimated overall impact" of a prospective future Upper Harbor modal shift. Holcim costs are calculated in this study, but are reported separately from the primary Upper Harbor estimated impacts.

As in many other urban areas, industrial use at the Upper Harbor is coming into conflict with residential and recreational use, particularly as the waterfront becomes a desirable location. There have been several proposals to discontinue use barging in the Upper Harbor, most notably *Above the Falls: A Master Plan for the Upper River in Minneapolis* [1]:

> *"The Upper River Master Plan explores the potential benefits to completing a continuous riverfront park system on both banks of the Upper River, leading a transition away from barging and heavy industry to a new, more stable era of land use.*
>
> *…Terminals in St. Paul can easily absorb the much smaller volumes moving through the Upper River. If barging were discontinued on the Upper River, it is likely that truck traffic in the study area would substantially decrease, as commodities would no longer be transported into and out of the area on barge and trucks".*[1]

Above the Falls obviously assumes that elimination of freight facilities at the Upper Harbor (or loss of their access to water) would lead to the disappearance of any truck traffic associated with these facilities. This study investigates whether that assumption is correct by forecasting the net change in traffic, and associated impacts, that would be expected to occur if water access was, in fact, no longer available at the Minneapolis Upper Harbor.

Relevant Literature

Monetary Cost of a Modal Shift [2], by Mn/DOT's Dick Lambert (1997), established the basic methodology for this study: forecast net changes in traffic by mode, and multiply these by the best available "coefficients" to establish:

- i) total impacts of these changes by mode; and
- ii) the net overall impact (by subtracting the impacts "saved" in the replaced mode from the impacts incurred by use of the new mode).

Lambert developed fuel consumption, emissions, and accident rate coefficients for ton-miles of cargo movement, for barge, rail, and truck modes. He applied this methodology to one of the Upper Harbor cargo movements included in this study (aggregates from Gray Cloud Island), and to the petroleum product and Incan Superior modal shifts that are secondary topics of this study.

The US Department of Transportation's (USDOT) *Environmental Advantages of Inland Barge Transportation* [3], the U.S. Department of Energy's *Transportation Energy Databook Edition 23* [4] and Todd Litman's *Transportation Cost Analysis Summary* [5] all contain ton-mile based measures that are comparable Lambert's coefficients, but none were found that are clearly superior to those used by Lambert [2].

A significant resource that was unavailable to Lambert is the *Highway Cost Allocation Study* (HCAS) [6], released by the Federal Highway Administration (FHWA) in 1997, and the *Addendum to the Highway Cost Allocation Study HCAS* (HCAS Addendum) [7], released in May 2000. The HCAS Addendum developed national coefficients specific to heavy trucks, based upon vehicle miles traveled (VMT), versus the ton-miles used by Lambert [2].

In August 2000 the University of Minnesota Center for Transportation Studies released *The Full Cost of Transportation in the Twin Cities Region* [8], as part of the *Transportation and Regional Growth Study* (TRG Study) [9], a research and educational effort designed to aid the Twin Cities (Minneapolis/St. Paul) region in understanding the relationship of transportation and land use. The TRG Study is designed to investigate how transportation-related alternatives might be used in the Twin Cities region to accommodate growth and the demand for travel while holding down the costs of transportation and maximizing the benefits. The Full Cost study specifically recommends the HCAS for understanding the specific costs of heavy trucks (page E-1).

A key resource for understanding the economics of the modal choice between truck and rail, and the impacts of heavy trucks, is the *Comprehensive Truck Size and Weight (TS&W) Study* [10], released in August 2000 by the FHWA, and related proceedings [11].

The primary data sources for this study are: the 2001 edition of Mn/DOT's *Minnesota's River Terminals* [12], for information about Mississippi and Minnesota river facilities and river mileages; the U.S. Army Corps of Engineers' (USACE) *Lock Performance Monitoring System* (LPMS) [13] dataset, for information about cargo types and volumes on the river; the FHWA's Highway Performance Monitoring System (HPMS) [14] [15] [16], for information about highway types, and the associated FHWA National Highway Planning Network (NHPN) [17], for highway routing and mapping. All other data was assembled from original sources as reported in the interviews of Chapter 2.

Methodology

With and Without Analysis

The fundamental economic methodology applied to this problem is with and without analysis: cargo movement, and associated costs, with access to the river at the Upper Harbor are compared to the cargo movement, and associated costs, that would occur without access to the river. A key part of such analysis is determining the follow-on effects flowing from the without alternative.

> *[When performing with and without analysis] In particular, it is necessary to be completely clear about what is being held constant and what is being allowed to vary between any pair of alternatives that are being compared.* ([18] p. 420)

Removing river access would have several follow-on effects, each of which must be explicitly understood to properly model the without scenarios:

a) Facilities which exist wholly due to access to the river would disappear, and traffic using those facilities would relocate to alternative facilities.

b) Facilities which exist for another purpose, but use the river, would either relocate or simply switch modes, depending upon the underlying economic rationale for the location and the relative importance of transportation costs compared to this rationale.

c) The choice of replacement mode and the route of the replacement trip depends upon the economics of the remaining transportation choices, which are determined by the facility location and the nature of the movement.

   A crucial factor in the nature of the movement is whether it is arriving at or leaving the facility as part of another trip which can simply be rerouted, or whether an entirely new trip is generated. This distinguishes whether a trip is an incremental trip or a whole-movement trip. As described in the section "Truck Haul Terms Used In This Study" later in this Chapter (p. 8), an incremental trip means that the "without" scenario only needs to consider the cost of additional distance; whereas a whole-move trip means the "without" scenario also needs to consider the cost of an additional load/unload step

Computation of Expected Costs

The types of costs developed in this study are explained later in this Chapter, in "Private, Public Sector, and Public Externality Costs" (page 9). To predict these expected costs, we first need to predict cargo modal choices, volumes, and distances. Distances depend upon routes, which depend upon facility locations (and relocations, as discussed above) and the origins/destinations of cargo to/from the affected facilities. Cargo volumes are estimated through available statistics and interviews. Routes and modal choice (i.e. what moves by truck) are estimated from interviews and from an understanding of the economics of modal choice (see page 7), local geography, and facility location (i.e. where will products need to be moved to and from). It should be emphasized that the routings are used to derive generic distances by road type. This study does not derive engineering-type costs specific to the actual roads in the route.

As indicated in the discussion of relevant literature, there are two major types of cost analysis available to then turn volumes and distances, by mode, into predicted costs:

1) costs by ton-mile; and
2) for heavy trucks, costs by vehicle-mile traveled (VMT).

Costs by VMT require the additional step of determining vehicle "load factors" to convert tonnage vehicle volumes into vehicle trips. In Chapter 2 we report the freight volumes and origins, destinations, truck load factors, and other information derived from statistical sources and from interviews, primarily with representatives of facilities on the Upper Harbor.

In Chapter 3 we refine the origins, destinations, and volumes of cargo flows and develop "most likely" routes for these cargo flows, leading to ton-miles and VMT. In Chapter 4 we apply the appropriate coefficients, to the ton-miles and VMT from Chapter 3, to develop costs. The specific steps of this methodology are fully described as they are applied in Chapters 3 and 4.

Availability of Necessary Data

Normally, information on commercial transportation costs and volumes is difficult to obtain, particularly for commodity or transportation industries where it is a key part of their competitiveness and pricing strategies. However, the Upper Harbor presents a unique situation in several respects:

- Since the Upper Harbor is the only harbor past the last set of locks on the Mississippi, the exact monthly volumes of commodities are known through the Lock Performance Monitoring System (LPMS) [13], a data system of all cargo moving through U.S. river locks. LPMS statistics for all other Mississippi locks would include through traffic.
- Since there are a limited number of facilities, facility operators can be identified and intensively interviewed.
- Facility operators have an interest in cooperating with this study, so that the impacts of their loss of access to the water can be quantified.

Goals of the Methodology

A primary goal of the methodology is credibility for the expected usage. It is expected that the results of this study will be used to claim that there would be substantial private and public economic impacts if water access to the Upper Harbor was lost. Therefore this analysis has been biased towards underestimating these impacts. Conservative assumptions of truck volumes, distances, and costs are used unless there is strong evidence to the contrary.

Other goals of the methodology are:

- simplicity in approach and results, which enhances usability in a public policy context by creating results that are easily explained;
- an analytic framework that can be reused and updated; and
- results that can be compared to other projects, at other times and/or other places.

> *Current energy models are already complex, and it is already difficult to collect the model inputs. Hence, new approaches should be transparent and not lead to extremely complex models that try to ''do everything''. The model structure will be determined by the questions that need to be answered. A good understanding of the decision making framework of policy makers and clear communication on the needs are essential to make any future energy modeling effort successful. There is a need to better understand the effects of policy on future energy use, emissions and the economy.* [19]

As illustrated in Chapter 4, the above goals are accomplished through use of the standardized cost coefficients in the *Addendum to the Highway Cost Allocation Study*.[7], supplemented by the ton-mile coefficients developed by Lambert, and a ton-mile based cost model developed to estimate (private) haulage costs. The HCAS coefficients, in particular, are part of a national standard that is being developed by the FHWA. As the coefficients are refined, or extended to new cost categories, the results of this study can be quite easily ‘updated’, and thus compared to other projects using newer coefficients, by simply multiplying the VMT derived in this study by the new coefficients.

Overview of the Economics of Modal Choice

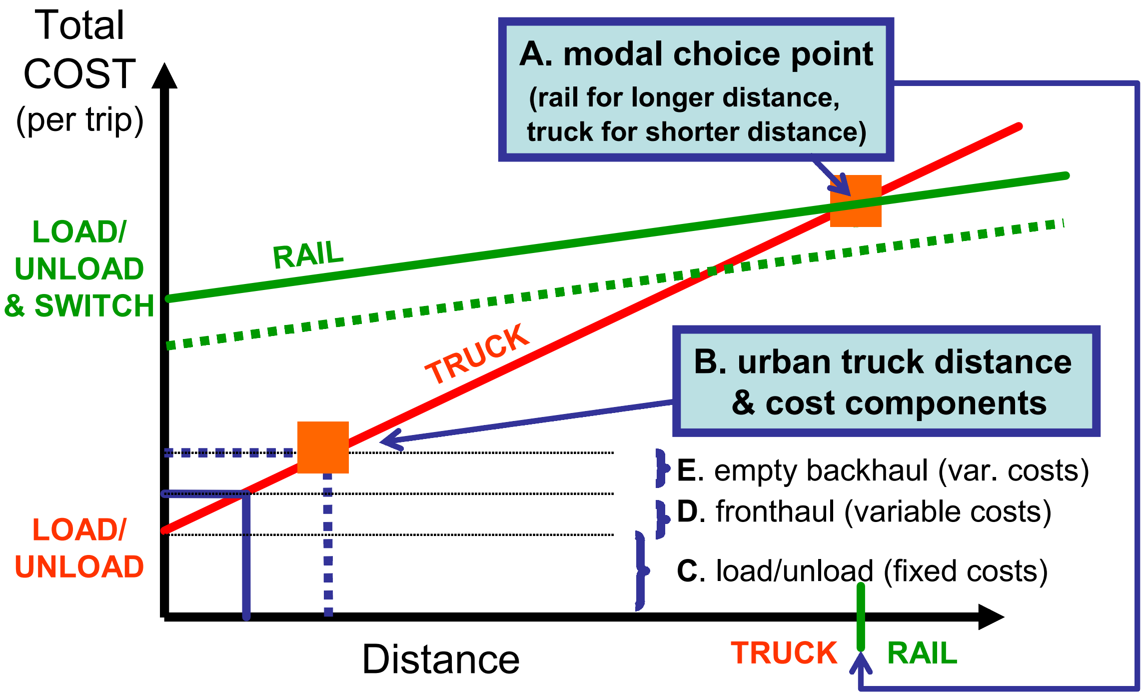
"Modal choice" refers to which freight transport mode, truck or rail, would be used to replace the water mode for Upper Harbor cargo.

Fixed and Variable Cost Portions of a Freight Trip

This study needs to predict which trips would divert to truck (from the water) and how decisions would be made between competing routes (with varying distances) for these truck trips. Such prediction requires an understanding of the basic economics of transportation trip costs, which uses a "fixed cost" and "variable cost" construct. This same construct can also be used to predict the modal choice that will occur.

Loading and unloading are a significant cost for most freight transportation trips. These costs are referred to as fixed costs: they happen regardless of the time or distance required for the trip. Costs that vary by time or distance of the trip are referred to as variable costs. Fixed costs represent a 'hurdle', and once this hurdle is crossed trip distance can be increased at a relatively small percentage of the overall cost (i.e. much less than the percentage increase in distance).

Figure 1.2: Modal Choice Illustration



The relationship between fixed and variable costs varies substantially between modes. Rail costs less per mile than truck, but load and unload costs are higher (illustrated in the green Rail cost line and the red Truck cost line in Figure 1.2). Fixed costs of rail are increased by other non-distance costs such as "switching" (i.e. the transfer of rail cars or trains between railways; there is a fee for switching, and generally waiting time; the addition of switching costs for rail is illustrated by the higher, solid, green rail cost line). Thus a relatively long rail trip is required before the fixed cost disadvantage with trucks is offset by variable cost savings. This modal choice point is illustrated as A in figure 1.2. At distances less than this choice point, trucks will be used. At distances greater than this choice point, rail will be used.

This distance is generally far greater than the distances involved in this study. For example, the TS&W [10] study, which extensively studies rail to truck diversion, used a cutoff of 200 miles before the possibility of use of the rail mode would even be considered (i.e. the modal choice point would always be greater than 200 miles):

> *A decision was made to set short haul [truck only] limits at 200 miles. Short haul was differentiated from long haul in the study because they have different operational characteristics, truck types, and available data.* [11] p. 15

River costs are lower per mile than even rail. River load and unload costs can also be very low on a per-ton basis. But, of course, the river is only available in limited locations and at limited seasons of the year. Generally, truck or rail transport is required either to or from the river, or both (and rail transport also often requires truck trips on one or both ends).

In short trips, such as urban movements, the distance portion of a truck trip cost is often roughly similar to, or less than, the loading/unloading costs. In fact, urban truck services are generally charged based upon time in urban areas (longer, non-urban, trips are generally charged based upon shipment weight and distance). A typical urban truck distance is illustrated at point **B** in Figure 1.2, with **C** representing load/unload costs, and **E** + **D** representing total distance-related costs; it can be seen that C is roughly equal to E+D. Thus, as compared to a "long-haul" trip (by any mode), changes in distance of a short-haul urban trip are a relatively small component of the overall cost, and will thus have limited effect once it has been decided to make the trip (i.e. to incur the load/unload costs).

The impact of these effects, for this analysis, is twofold:

- diversion to rail will be very limited – the distances are simply too short to justify the fixed costs; and,
- differences in distance will not have a large impact on route choices, once the decision is made to move the product.

Truck Haul Terms Used In This Study

Since fixed and variable truck costs are of similar magnitude in the trips under study in this analysis, and we want to know how these costs will change if the river is not available, it is important to distinguish between:

- "**incremental trip**" movements, which are only extensions to trips which would already occur – thus only increased variable costs should be added to the without scenarios; and
- "**whole trip**" movements, which are entirely new trips resulting from the without scenarios – thus incurring both fixed (load/unload) costs and increased variable costs.

Trips where a truck load/unload already occurs are classified as "incremental trip". In the Upper Harbor modal shift, this includes all the trips involving the Upper Harbor Terminal, and about half the trips involving Aggregate Industries. The load or unload step that currently occurs at the

UHT or AI Minneapolis will merely occur at some other location, with the only additional cost being the associated change in trip distance.

Trips where no load/unload currently occurs (i.e. currently using only the river) are classified as "whole trip". This includes all the trips involving American Iron and half of the trips involving Aggregate Industries. It is important to note that there are current load/unload trips involving both facilities: scrap into American Iron, and concrete (containing aggregate) out from the Cemstone facility linked to Aggregate Industries Minneapolis Yard. These trips will continue to occur regardless of whether the river mode is available, so are not included in this analysis.

Truck "backhaul" refers to the return trip portion of a truck trip (i.e. after it unloads). A backhaul can either be empty backhaul, where no cargo is hauled in the return trip, or paid backhaul, where a cargo is moved on the return trip as well. Note that the original, loaded portion of the trip is commonly referred to as fronthaul. A paid backhaul generally involves a different customer. Paid backhauls are an important factor in longer trips, by any mode, since the empty trip can represent close to half the cost in a long haul. But they generally represent a quarter, or less, of the cost of urban movements, and the savings of a paid backhaul can be easily offset by the 'repositioning' costs of moving the truck to the other customer's location.

Private, Public Sector, and Public Externality Costs

In accord with standard economic practice [8], the costs estimated in this study are divided into three major categories based on "who pays":

Private costs are incurred as direct expenses to individuals or corporation. In this study these costs occur as haulage costs charged by a barge or trucking company to move the traffic. Net private costs consist of new truck haulage costs incurred minus barge haulage costs saved.

Public sector costs represent the direct costs to public road authorities, for road maintenance. Public externality costs represent "hidden" costs to the public as a whole, including emissions, congestion, crash, and noise costs. Both these sets of costs are derived from predicted truck VMT using the HCAS Addendum coefficients [7] for each cost.

As supplementary information, the ton-mile coefficients developed by Lambert [2] are used to develop alternative estimates of fuel consumptions and associated emissions, and accident rates. Note that the emission and accident rates developed with this approach are not strictly comparable to those developed using VMT and the HCAS Addendum coefficients. Also, the fuel consumption modeled by this approach would already be captured in the modeled private haulage costs. Thus this last set of costs is a duplication of costs that are already modeled through the alternative approaches.

All the above costs are developed in Chapter 4. Chapter 4 first describes the methodology for each cost type, and applies each to the Upper Harbor scenarios modeled in Chapter 3. Chapter 4 then applies the same methodologies to the Holcim and Incan Superior movements.

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Chapter 2: Freight Volumes and Interviews

General Notes

1. A typical semi-trailer truck has a maximum gross vehicle weight (GVW) of 80,000 pounds. This is the maximum GVW allowable on Interstate highways (which form a major portion of the preferred routes of the traffic under study). After the equipment weight of the truck and trailer are subtracted from this total, there is a remaining maximum cargo capacity of up to 26 tons, depending upon the weight of the trailer. The availability of weighing facilities at the loading site is also a factor in how much of a "safety margin" needs to be left below the maximum cargo weight. Holcim cement estimates a cargo weight of 25 tons, with lightweight aluminum trailers and a product that is quite precisely weighed as it is loaded.

   Trailers made of lighter material, such as aluminum, are more expensive and more susceptible to damage, and thus are generally not used for 'coarse' cargo such as aggregates. Aggregate shippers (Cemstone) estimate about 23 tons of cargo capacity per truck. This is due both to heavier trailer materials, and the weight of lift equipment attached to the trailers. American Iron often uses gravel-type trucks and estimates a similar, or lower, cargo capacity. Upper Harbor Terminals estimate a typical load of 24 to 24.5 tons for a fully loaded truck, but observe a very wide variety in the cargo weights of the trucks coming into their facilities.

   Based upon the interviews reported in this Chapter, the "truck payload" weights were developed for each major shipper. These weights are used to convert cargo-tons to loaded truck-loads:

   - American Iron and Aggregate Industries: 23 tons per truckload
   - Upper Harbor Terminal: 24 tons per truckload
   - Holcim: 25 tons per truckload
   - Incan Superior: 21 tons per truckload

2. The U.S. Army Corps of Engineers (USACE) data provides river barge tonnages in addition to a count of barges. Where tonnages are not known, a conversion factor of 1,500 tons per barge is used (except for barges classified as 'empty').
3. An estimate of truckloads was not possible for the Petroleum Product Movement scenario. The modal shift turns out to have been primarily to pipeline; no net changes in truck movements can be associated with this modal shift.
4. River facilities whose locations are not specifically listed in this memo appear, with locations, in the 2001 edition of "Minnesota's River Terminals" [12].

A. Minneapolis Upper Harbor

1. The Upper Harbor contains four facilities that currently handle water (barge) traffic. 'Upbound' (on the river) traffic moves into these facilities by water and 'downbound' traffic moves out of these facilities by water:
    - **Aggregate Industries (AI Minneapolis)** and Cemstone – has only upbound traffic (aggregates – limestone, sand, and gravel)
    - **Upper Harbor Terminal** (River Services, Inc.) – has both downbound and upbound traffic (generally, grain and potash downbound; fertilizer, coal, salt, steel, general cargo, and some specialized aggregates upbound)
    - **American Iron and Steel** – has only downbound traffic (scrap metals)
    - **Holcim Cement Co.** – has only upbound traffic (cement); Holcim plans to phase out this facility in favor of a St. Paul facility.

    Note: *The Holcim facility is part of the Minneapolis Upper Harbor, but a modal shift away from water is already planned to occur for this facility so it will not be included in the calculation of the "estimated overall impact" of a prospective future Upper Harbor modal shift. To indicate this Holcim is listed separately (as "B") from the three other Upper Harbor facilities.*

2. River traffic to the Upper Harbor moves through locks that are smaller than the rest of the Mississippi system. The locks accommodate only two barges at a time along with a special (smaller) towboat. Room for maneuver in the channel is also tight, so barges are moved two at a time to/from marshalling areas in the St. Paul harbor.
3. "Table 2.1: Upper Harbor Total Tonnages" (next page), is derived from U.S. Army Corps of Engineers (USACE) data based upon actual barge movements through the Upper St. Anthony Falls Lock at river mile 853.9, recorded in the Lock Performance Monitoring System (LPMS) [13]. Due to revisions underway in this data system at the time of this analysis (autumn 2003), only data through 1999 were available at the level of detail required by this study. The years 1995 through 1999 are used to derive a five-year average.
4. As discussed in Chapter 1, this analysis deliberately uses conservative estimates. The LPMS tonnages are actual observed movements. A five year average is used to account for annual fluctuations in traffic.
5. In general, the interviews and data analysis found that commodities from the LPMS data can be clearly assigned to specific facilities, and reasonable diversion scenarios are known for each facility/commodity pair. "Diversion scenarios" are the broadly predicted route and mode that will be used, by traffic currently moving through the Upper Harbor by water, if the river mode (barge) is not available. In the few cases where more than one facility handles a given commodity, it has been possible to estimate the share of each facility based upon confidential tonnage information given by the facility operators.
6. "Table 2.2: Upper Harbor Tonnages/Truckloads Diverting to Truck", following Table 2.1, applies the information derived from the interviews to forecast annual tonnages that will divert to truck trips if the river mode (barge) is not available at the Minneapolis Upper Harbor facilities.

Table 2.1: Upper Harbor Total Tonnages and Barges

5-year average tonnages through mile 853.9 Upper St. Anthony Falls Locks
(USACE LPMS 1995 through 1999)

Commodity		AVG_TONS			AVG_BARGES		
grouping	reported category	downbnd	upbound	**total**	Dnbnd	Upbnd	**total**
n/a	01: Empty barges	0	0	**0**	709	150	**860**
Aggregate AI (UHT)	43: Sand, Gravel, Stone; Limestone Flux & Calcareous Stone; Phosphate	4,230	890,250	**894,480**	3	600	**603**
Cement Holcim (UHT)	52: Building Cement & Concrete; Lime; Glass	3,000	150,900	**153,900**	2	101	**103**
Iron/Scrap AIS (UHT)	44: Iron Ore,Iron Steel Waster & Scrap	92,100	7,980	**100,080**	61	6	**66**
Iron/Scrap UHT	53: Primary Iron & Steel Products (Incl. Ingots, Tubes, Pipes, Bars, Plates)	2,000	43,494	**45,494**	1	30	**31**
Iron/Scrap AIS (UHT)	46: Non-Ferrous Metallic Ores, Waste & Scrap	4,500	1,100	**5,600**	3	2	**5**
Grain UHT	63: Corn	193,810	3,000	**196,810**	129	2	**131**
Grain UHT	65: Oilseeds-Soybean, Flaxseed, and Others	122,100	3,000	**125,100**	79	2	**81**
Grain UHT	62: Wheat	16,660	1,500	**18,160**	11	1	**12**
Grain UHT	64: Rye, Barley, Rice, Sorghum & Oats	13,200	1,500	**14,700**	9	1	**10**
Grain UHT	67: Animal Feed, Grain Mill Products, Flour and Other Processed Grains	3,000		**3,000**	2		**2**
Fertilizer UHT	31: Fertilizer-Nitrogenous, Potassic, Phosphatic & Others	66,360	55,200	**121,560**	44	37	**81**
Coal UHT	10: Coal, Lignite & Coke	5,020	123,932	**128,952**	4	85	**88**
General UHT	47: Sulphur, Liquid & Dry; Clay; Salt	4,500	74,100	**78,600**	3	49	**52**
General UHT	60: Food & Farm Products	3,000	5,250	**8,250**	2	4	**5**
General UHT	70: All Manufactured Equipment and Machinery	1,774	3,748	**5,522**	4	6	**10**
General UHT	68: Other Agricultural Products (Incl. Food and Kindred Products)		4,750	**4,750**		4	**4**
General UHT	32: Organic & Inorganic Industrial Chemicals & Synthetic Materials		4,500	**4,500**		3	**3**
General UHT	54: Primary non-Ferrous Metallic Products; Fabricated Metal Products	200	3,800	**4,000**	1	3	**4**
General UHT	50: Primary Manufactured Goods		3,800	**3,800**		3	**3**
General UHT	42: Pulp, Waste Products		3,000	**3,000**		2	**2**
General UHT	48: Slag		3,000	**3,000**		2	**2**
General UHT	99: Commodity is Unknown or cannot be located on this list	1,000	1,667	**2,667**	3	3	**6**
General UHT	30: Chemicals & Related Products	2,250		**2,250**	2		**2**
General UHT	40: Crude Materials, Inedible, except Fuels	300	1,500	**1,800**	2	1	**3**
General UHT	21: Crude Petroleum		1,500	**1,500**		1	**1**
General UHT	51: Paper & Allied Products		1,500	**1,500**		1	**1**
	Total per year (5 year average)	539,004	1,393,970	**1,932,974**	1,075	1,095	**2,170**

source: USACE LPMS (U.S. Army Corps of Engineers - Lock Performance Management System)
(ftp.crrel.usace.army.mil/iwr/ndc/lpms/dbf/comm/Comm_mi.zip accessed from www.iwr.usace.army.mil/ndc/data/datapms.htm

Table 2.2: Upper Harbor Tonnages/Truckloads Diverting to Truck

Minneapolis Upper Harbor Forecast Annual Truck Diversions from water

based upon USACE 5 year LPMS average tonnages (1995-99) and interviews with Upper Harbor shippers

Aggregate Industries/Cemstone

			AVG_TONS		tons/	truckload equivalent		
flow	Commodity	Comments	downbnd	upbound	truck	Dnbnd	Upbnd	**total**
Agg1a	Aggregate	90% of upbound volumes	0	801,225	23	0	34,836	**34,836**

Holcim

			AVG_TONS		tons/	truckload equivalent		
flow	Commodity	Comments	downbnd	upbound	truck	Dnbnd	Upbnd	**total**
Cem1a	Cement	all upbound volumes	0	150,900	25	0	6,036	**6,036**

American Iron (AIS)

			AVG_TONS		tons/	truckload equivalent		
flow	Commodity	Comments	downbnd	upbound	truck	Dnbnd	Upbnd	**total**
I/S1a-alt1	Iron/Scrap	all current downbound volumes	98,600	0	23	4,287	0	**4,287**
I/S1a-alt2	Iron/Scrap	forecast doubling with shredder	197,200	0	23	8,574	0	**8,574**

Upper Harbor Terminal (UHT)

			AVG_TONS		tons/	truckload equivalent		
flow	Commodity	Comments	downbnd	upbound	truck	Dnbnd	Upbnd	**total**
Agg1b	Aggregate	10% of upbound , all downbnd	4,230	89,025	24	176	3,709	**3,886**
Cem1b	Cement	all downbound volumes	3,000	0	24	125	0	**125**
I/S1b	Iron/Scrap	all upbound volumes	0	52,574	24	0	2,191	**2,191**
Grain_Metro	Grain	all upbnd, reported Metro downbnd	18,000	9,000	24	750	375	**1,125**
Grain_NW	Grain	downbnd from NW of Metro	60,000	0	24	2,500	0	**2,500**
Fert1	Fertilizer	all upbound volumes	0	55,200	24	0	2,300	**2,300**
Coal1	Coal	all volumes (both directions)	5,020	123,932	24	209	5,164	**5,373**
Salt1	Salt	all volumes (both directions)	4,500	74,100	24	188	3,088	**3,275**
Gen1	General	all volumes (both directions)	8,524	38,015	24	355	1,584	**1,939**
UHT-tot	total	total - all UHT truck movements	103,274	441,845	24	4,303	18,410	**22,713**
UHT Trainload Diversions								
Grain_train	Grain		271,000	0		10,840	0	**10,840**
Fert_train	Fertilizer		66,125	0		2,645	0	**2,645**
Total 1: Current Upper Harbor Volumes (truck and train)			538,999	1,393,970		22,075	59,282	**81,357**
Total 2: Current Upper Harbor Truck Diversion Volumes			201,874	1,393,970		8,590	59,282	**67,872**
Total 3: Current Truck Diversion Volumes without Holcim			201,874	1,243,070		8,590	53,246	**61,836**
Total 4: Forecast Truck Volumes w/o Holcim, with shredde			300,474	1,243,070		12,877	53,246	**66,123**

Table 2.2 applies the information derived from the interviews to the average annual traffic derived in Table 2.1, to forecast the annual tonnages that will divert to truck trips if the barge mode is not available at the Minneapolis Upper Harbor facilities. In Table 2.2 (above):

- Total 1 represents the totals of all movements reported by the USACE LPMS.
- Total 2 removes the tonnages that arrive at the UHT by rail and are forecast to divert by rail rather than truck (see UHT discussion, A.ii following).
- Total 3 removes the tonnages associated with Holcim (see Holcim discussion, B following).
- Total 4 adds the AIS shredder tonnages (see AIS discussion, A.i following) and thus represents the forecast volumes of one-way loaded trucks that would result if the water mode (barge) was unavailable, in the future, to facilities at the Minneapolis Upper Harbor.

American Iron (AIS)

Contacts:
Mark Newbury, Thomas Rogers, & Daryl Parks, American Iron
Lloyd Host, Twin Cities and Western RR (TCW, regarding rail service)

Note: *The abbreviation "AIS" references the earlier name of "American Iron and Steel". "AIS" is used to distinguish from "AI" which represents "Aggregate Industries", another Upper Harbor facility. More information about AIS is available at www.scrappy.com*

1. American Iron (AIS) collects and resells scrap metals. AIS processes this scrap by sorting it and reducing its volume. This reduces shipping costs substantially by allowing barges, railcars, or trucks to be loaded to their full weight capacity, rather than being filled by volume before the full weight capacity is reached. Primary customers are steel mills, many of whom have receiving facilities on the river system. AIS collects scrap metals primarily from Minneapolis and to the west and north, from as far as North Dakota and beyond. Two of their competitors are general river freight yards in St. Paul (Great Western and Alter) who collect from the St. Paul area and east of the Metro. As discussed below, diversion is predicted to occur by truck if the river is not available. Diversion would be primarily to Dakota Bulk in South St. Paul (rather than to St. Paul facilities that are competitors in the scrap business).

2. AIS currently loads approximately 70 barges per year, which accounts for about 65% of their outbound product. The rest leaves by rail and truck. AIS can accommodate up to 12 rail cars and usually loads 8 to 12 at a time, which are handled as a unit. AIS averages one outbound train per day. This is judged by AIS to be the full capacity of outbound rail from their facility. Increasing train capacity would require either more frequent trains, or a larger siding to accommodate more rail cars in a train. Both are unlikely. Scheduling just one train a day is already difficult (see below). Expanded siding capacity would require more land, which is unavailable. Even if land were available a significant capital investment would be required by Canadian Pacific RR (CP), AIS, or both.

   Note: *Railways and shippers in this situation often find themselves at an impasse; neither side wants to invest in expanded facilities without service or volume commitments that the other side may not be ready to make.*

3. Rail service is from the north by CP only (Twin Cities & Western RR (TCW) only goes as far as "Camden" - the Upper Harbor Terminal). American Iron is an "open reciprocal switching" area: rail cars to/from the Burlington Northern RR (BN) network are moved by CP to/from an interchange point, for an interchange fee. "Although the rates are not high, time is a problem; we generally lose 24 hours at a time when switching".

4. In addition to mileage-based rates and switching charges for the rail cars, there are also charges of $225 to $250 to weigh a railcar. This is close to the trucking costs to St. Paul for the same weight. There are difficulties in scheduling service at both AIS and the receiving end. Scheduling problems create storage capacity problems, which will be even more critical when volumes increase due to the shredder (below). For these reasons, it is AIS' opinion that rail service is already a limiting factor, and rail could not replace their existing or future river traffic – it would be trucked to the nearest appropriate river loading points.

5. Truck movement to St. Paul is expected to cost $5-$6 per ton (versus $0.50 by barge), This truck rate is assuming half an hour to load and another half hour to unload, plus a half hour

loaded trip, at rate of $55 to $70 per hour (typically at the higher end of this range). Gravel trucks are often used, and a backhaul might be a viable option if the (adjacent) AI Minneapolis facility was hauling gravel from the St. Paul port area.

6. AIS has commenced a multi-million dollar investment in a "shredder". All the required regulatory approvals are in place. Part of this investment will be upgrades to their storage areas and expansion of their river loading site to accommodate 3 barges. The shredder will allow a significant increase in AIS processing capacity. They expect their outbound barge tonnage to at least double. Ground was broken for the site work in November 2003, with an 18 month timeline to commencement of operation of the shredder.
7. Processing in the shredder significantly increases the value of scrap by further increasing its density. The primary benefit is to the steel mill, which achieves much higher efficiency in its processing facilities. There is also a possibility of using inbound barges to provide product for the shredder to process, but no firm scenarios are in place for this.
8. Proximity to scrap metal sources and the facility improvements associated with the shredder make a change of location very unlikely (or very expensive, if relocation is forced). However, it is important to note that even if AIS closed at its current location, truckloads of scrap metal would still move through Minneapolis to collection at St. Paul river points. Since unprocessed scrap fills up a truck quickly, these trucks would be lighter but several times greater in number than the number of truckloads predicted in a modal diversion.
9. Two volume scenarios will be modeled for the AIS tonnages:
    a. volumes without the shredder (current USACE average); and,
    b. volumes with a conservative forecast of the tonnages added by the shredder (forecast at twice the current USACE average)
10. It is useful to note that AIS activities themselves have obvious environmental benefits, in reducing the volumes to landfill, and replacing raw material extraction to produce steel product. For example, AIS disposes of all discarded appliances in the City of Minneapolis, and processes 4 to 5 trucks per day from the Hennepin County Incinerator.

Upper Harbor Terminal (River Services, Inc.)

Contacts:
Ken Anderson & Jerry Christensen, River Services
Lloyd Host, Twin Cities and Western RR (TCWR, regarding rail service)
Cindy Pratt, Canadian Pacific (CP, regarding rail service)
Chuck Dillerud (regarding alternative general cargo on the river)

1. The Upper Harbor Terminal (UHT) is owned by the City of Minneapolis and is currently operated, on contract, by River Services Inc. The UHT both loads and unloads barges, and also unloads some rail for transload to truck. Barge unloads are moved exclusively to truck and constitute a range of commodities and products (see Table 2.3, next page). In general, the destination of these trucks is either to Minneapolis and its western suburbs, or to the west and north-west of the Twin Cities.

2. Rail service to the Upper Harbor Terminal loops in from the north, parallel to the river, and is provided by CP and TCWR (Twin Cities and Western RR). The rail station name is <u>Camden</u>. In the autumn of 2001, TCWR completed a rail spur to the grain facilities at Savage. TCWR's grain tonnage to the UHT has fallen steadily since that time. TCWR claims that one of the factors in the decision to build the spur was uncertainty about the future of Camden (UHT).

3. Corn currently accounts for the majority of grain movements through the Upper Harbor. River Services staff expect that corn exports through all Upper Mississippi ports will generally fall over the coming years as an increasing amount of corn is diverted to Ethanol production, with Minnesota corn particularly susceptible to such diversion since it is effectively most distant from export markets.

4. Rail provides only inbound traffic to the UHT. The UHT has a siding capable of accommodating up to 150 rail cars (with room for expansion, if necessary). Rail provides the majority of the downbound barge tonnages. These are various grains, and some potash from Canada (CP rail). The grains arrive from west-central & north-west MN, primarily as 30 car unit trains from the TCWR. The TCWR grain unit trains would be expected to divert to Savage. Potash rail traffic would likely divert to Peavy Red Rock in St. Paul, which already competes for this traffic with UHT.

5. UHT **Inbound Trucks/Trains – becoming Downbound Barges:**

As stated above, grains and potash that arrive by train, for downbound movement by barge, are not expected to become truck traffic. All other inbound traffic (which becomes downbound on water) is considered to be by truck, which would divert to alternate ports.

a. The entire downbound "fertilizer" volumes from the LPMS statistics are considered to represent potash train volumes (all other fertilizers are only upbound to the UHT), and are subtracted from the expected truck diversions of Table 2.2.

b. Downbound grains that arrive by truck fall into two categories:

   - Grain that is held in storage at UHT and later loaded to barge - this is delivered by farmer-coop members from northwest of the Metro ("Osseo area") and typically accounts for 60,000 tons per year (= 40 barges or 2,400 truckloads). This traffic is forecast to divert, by truck, to the independent grain facilities at St. Paul.
   - Grain delivered by truck for a 'direct hit' to a barge averages 12 barges per year (equal to 18,000 tons or 720 truckloads). This grain arrives from processor-associated storage facilities just across the river from the UHT and is predicted to divert to the grain facilities at St. Paul. The most direct route to St. Paul is obtained by crossing the river to I94; in effect going right past the UHT site.

c. The above two grainflows are indicated as "Grain_NW" and "Grain_Metro", respectively, in Table 2.2. The entire remaining downbound grain tonnages, from the LPMS statistics, are treated as arriving by rail. This rail traffic is subtracted from the tonnages that would be expected to divert to truck. The small amount of upbound grain tonnages reported in the LPMS are most likely into processing facilities in the vicinity of the UHT and are thus included in the "Grain_Metro" truck flows.

6. UHT **Inbound Barges – becoming Outbound Trucks:**
The statistics in Table 2.3, below, are for the 2002 shipping season. They are used to determine the routings for the tonnages reported by the LPMS.

Note: *Since the reported tonnages represent only one year they do not always match the LPMS figures. Where outbound flows do not match inbound, inventory was held in the UHT between shipping seasons. LPMS shows small amounts of both downbound and upbound general cargo that do not clearly belong to other Upper Harbor facilities. These are modeled as truck diversions to/from the general cargo docks at St. Paul.*

Table 2.3: UHT Inbound Barges

	inbound barges		**outbound trucks**		
Commodity	Tons	trucks	Tons	trucks	General destination & diversion scenario
Twine	6,825	273	12,550	502	west-central & north-west MN; ND; Canada > would divert to St. Paul docks (GW or Alter)
Pipe	8,750	350	6,550	262	Minneapolis & western suburbs > already lost as UHT traffic
Steel	27,225	1,089	24,450	978	Minneapolis & western suburbs > would divert to St. Paul docks (Dakota Bulk)
Coal	96,575	3,863	103,150	4,126	St. Cloud area > would divert to St. Paul docks (GW or Alter)
Salt	26,575	1,063	26,575	1,063	Minneapolis & western suburbs > would divert to St. Paul docks, Dakota Bulk, or Savage
Fertilizer	120,900	4,863	141,425	5,657	west-central & north-west MN; ND; Canada > would divert to St. Paul docks (Peavy) – would not divert to Savage since this is only Cargill
Aggregate	11,225	449	42,075	1,683	Minneapolis & western suburbs > would divert to St. Paul docks
Grain	a very small amount (inbound) included in the "Grain_Metro" flow, discussed previously				

7. Diversion traffic from the UHT vicinity to the west side St. Paul ports is predicted to travel on I94 and then south on Highway 52. Diversion traffic to the east side of the river is predicted to travel on I94 and then south on Highway 61. UHT estimates that shippers save \$3 per ton for a truck trip to UHT versus to/from St. Paul ports, and the barge movement only costs 50 cents per ton. Typical outbound trucks carry 24 to 24.5 tons (UHT has a scale) whereas inbound vary widely and may average 23 tons. If a backhaul is available at St. Paul the trip savings at UHT may only be \$2 per ton.

8. UHT manages to roughly balance upbound and downbound barge volumes for <u>all</u> traffic using the Upper Harbor except the dedicated barges used by Aggregate Industries.

Aggregate Industries Minneapolis Yard and Cemstone

Contacts:

Mark Duncan, Aggregate Industries (www.aggregate-us.com/_aius/regions/nc/nc_home.cfm)
Dan Lindemann, Materials Manager, Cemstone (www.cemstone.com)
Marcel Jouseau, Met Council (regarding aggregate supplies in the Metro area)

1. Truck Conversion factor: 23 tons of aggregate per truckload is used; representing the cargo capacity of a fully-loaded gravel truck.
2. Aggregate Industries (AI) moves 800,000 tons/year of aggregate by barge into the AI Minneapolis Yard (formerly called AI Yard D) in the Upper Harbor. AI mines aggregate from the Nelson Plant & crushed limestone from Larson Plant, on Grey Cloud Island on the Mississippi (river mile 825.0 & 826.6 respectively), and moves these products by barge to the AI St. Paul Yard (formerly called AI Yard A, river mile 837.1) and to the Minneapolis Yard (river mile 855.9). AI estimates that 100,000 tons per year of the volume into AI Minneapolis is crushed limestone from the Larson Plant (the remaining tonnages are thus from the Nelson Plant).
3. Aggregate Industries – Locations of Interest

   AI Minneapolis Yard: 26th Ave. N and Pacific St., Minneapolis

   AI St. Paul Yard: 1177 Childs Road, St Paul

   AI Nelson Plant (Grey Cloud Island): 11250 Grey Cloud Trail, Cottage Grove

   AI Larson Plant (Grey Cloud Island): 10120 Grey Cloud Island Dr. S, St. Paul Park
4. AI St. Paul Yard is at capacity. If AI Minneapolis or some other river-accessible facility was not available, the most available option would be to move product by truck directly from the Nelson/Larson Plants, despite a road infrastructure in the Grey Cloud Island area (which is also an expanding residential area) that would be poorly suited for significant truck volumes.
5. The river shipping season is approximately working 160 days (32 weeks at 5 days per week), during which there are generally two tows to AI Minneapolis per day, with two barges per tow, for a total of four barges per day. Aggregate is unloaded from the barges by a backhoe onto a conveyor system that moves it to stockpiles.
6. 60% of the AI Minneapolis product is used by Cemstone, with most of this (close to half the total AI Minneapolis volume) being used by the adjacent Cemstone Minneapolis concrete ready-mix facility. A conveyer system moves this aggregate to the Cemstone facility. The rest (40%) is trucked to other facilities, with 90% of this volume moving northwest on I94.
7. Cemstone uses 1.6 tons of aggregate (1,750 lbs of gravel, 1,500 lbs of sand) in a cubic yard of concrete.

8. Cemstone also brings in cement to the Minneapolis facility, moved by truck primarily from an adjacent Lafarge plant (which receives inbound product by rail only) and from the Upper Harbor Holcim plant (which receives inbound product by barge and rail). A yard of concrete requires about one-quarter of a ton (500 lbs) of concrete, so Cemstone's Minneapolis facility would require 58,750 tons per year which is roughly 2350 truckloads (at 25 tons / truckload).

   Note: *As discussed in the Holcim section and subsequent Chapters, none of the cement truck trips are included in the truck diversion tonnages.*

9. Cemstone – Locations of Interest (a complete Cemstone facilities and service area map for the Twin Cities area is available at www.cemstone.com/products/concrete/DSG2002.pdf

   Facility 19 **- Minneapolis** (adjacent to AI Minneapolis Yard)
   65 – 26TH AVE N, MINNEAPOLIS 55411

   Facility 3 - **Blaine**
   8502 CENTRAL AVE NE, BLAINE 55434
   > receives all aggregate by truck, including some from AI Minneapolis

   Facility 18 - **Midway**
   2058 ENERGY PARK DR, ST PAUL 55108
   > receives all aggregate by truck, including small amounts from AI Minneapolis

   Facility 4 - **Burnsville**
   2300 WEST CLIFF RD, BURNSVILLE > receives small amounts by truck from AI Minneapolis; all materials in and out of this facility move by truck, despite river proximity; it is unlikely that river use in this area could ever expand (for example, there are proposals to use the river access area to create an amphitheatre).

   Facility 17 **- Maple Grove**
   11600 85TH AVE N, MAPLE GROVE
   > currently has its own aggregate pit, due for closure, will use truck delivery

   New Facility (in planning/project stage) – **Dayton, MN** > this is a new facility, northwest of Maple Grove, which will have a unit train rail unloading site.

10. Cemstone must maintain a facility close to downtown Minneapolis. Concrete generally cannot travel more than half an hour in the delivery truck. Major construction projects in downtown Minneapolis and environs generally require 100 yards per hour, which requires a fully-loaded truck every 6 minutes – usually a seven truck rotation is used for such service.

11. Burnsville, Midway, and Blaine, the facilities surrounding the Minneapolis facility, are all operating at full capacity and could not serve the Minneapolis facility's market area (delivery time constraints would also be a problem).

12. An average concrete load size for Cemstone in the Twin Cities area is 3.5 yards. Average load size from the Minneapolis facility is 7.5 yards. Maximum load size is 10 yards (1 yard weighs 4,000 lbs, truck weighs 37,000 lbs. empty, max total truck weight is 80,000 lbs.).

13. Cemstone sells 50% of the concrete in the Twin Cities market area. There are only two major competitors, each with approximately 20-25% market share. Increases in cost due to increased aggregate transportation costs (using truck rather than barge) can be expected to

result in similar increases in the price of the final product. This will negatively impact Minneapolis' construction costs.

14. Scheduling aggregate and concrete movements is complex due to truck, facility, and product availability. Loads do not always move shortest distances.

15. Gravel trucks will use the Interstates as much as possible – it is not easy for such trucks to "jump on and off the freeway". Interstates will be used despite congestion since the expected tradeoff in peak traffic periods would be to be stuck in street and traffic-light traffic anyway. Movements to/from the south will use primarily 35W, to/from the east or northwest will use I-94; to/from directly west will use I-394.

16. A rail unloading facility takes a much higher capital investment (approx. $5 million) than a barge site, and requires at least half a mile of rail siding to accommodate unit trains, with access to existing rail trackage. It is unlikely that such a site could be located in Minneapolis.

17. Given capacity constraints at AI St. Paul, forecasting movements of gravel by truck from AI St. Paul to the AI Minneapolis facility is a very conservative estimate. At a minimum investments in handling facilities would be required to allow greater throughput upon a limited land base; product would likely still be stockpiled at AI Minneapolis (for winter use when the river is closed). Volumes that could not be accommodated through AI St. Paul would have to come by truck all the way from Grey Cloud Island.

18. In the longer term, aggregate supplies in general are seen as a future constraint to growth in the Twin Cities (ref. Met Council, Marcel Jouseau; Chuck Dillerud). The river provides access to supplies from downstream on the Mississippi/Ohio.

B. Holcim Cement Co.

Contacts:
Brian Furuholmen, Holcim
Kevin Hartwell, Holcim

1. Cement arrives to the Holcim cement elevator by rail and river barge, and is moved outbound by truck only. A fully loaded truck with a lightweight trailer typically hauls 25 tons. This facility provides cement to the Minneapolis area.
2. A major competitor is the nearby Lafarge facility (see the Aggregate Industries / Cemstone description) which receives product only by rail, despite being located right beside the river. The Lafarge rail operation is apparently very noisy, due to use of a "shaker" to dislodge cement from the cars.
3. Holcim has recently opened a St. Paul facility and has stated plans to phase out the Upper Harbor facility. It is interesting to note that Holcim reportedly (note that this information was not from a Holcim representative) attempted to find new terminal space, but was unable to do so and ended up leasing space at Dakota Bulk, in South St. Paul. Holcim is building a new facility there that is expected to be operational about 10/1/04. Holcim claims that one of the factors in their decision was longer-term uncertainty about water access at the Upper Harbor.
4. Due to Holcim's stated current plans to phase out river handling at the Upper Harbor, diversion of the current cement traffic on the river will not be included in the estimate of the impacts of a forced modal shift from water to truck (since the Holcim shift would not be a result of the scenario under study).
5. However, it will be useful to observe what shifts in Holcim's service areas actually occur in future years – i.e. what are the impacts of the self-chosen modal shift. It is an open question as to whether this shift will even actually occur. Holcim may find it difficult to compete with Lafarge for Minneapolis business from their St. Paul terminal.

C. Petroleum Product Movement (Koch Petroleum)

Contacts:
Dick Lambert, MN/DOT (interviews, and "Monetary Cost of A Modal Shift", 1997)
Don Kern, Brett Webb (marketing group), Flint Hills Resources

1. Following the Oil Pollution Act of 1990 (OPA 90), the financial risks of an oil spill increased substantially. In 1993, partly due to this new liability, Koch Petroleum discontinued a river barge movement of petroleum products. This movement was from the Pine Bend refinery to distribution terminals at "Gasoline Alley" in St. Paul. At the time of the discontinuation, the river movement was averaging 814,509 tons per year. At a truck cargo capacity of 20 tons, this was calculated to represent 40,725 annual loaded (one-way) truck trips (Lambert, 1997).

2. Since 1993 the Koch Petroleum facility has been renamed Flint Hills Resources (FHR) (which is apparently still owned by the Koch family). Interviews with FHR indicate that the river movement has been completely replaced by a pipeline movement (Williams) from the refinery to a distribution center in Roseville. The river facility (Koch St. Paul dock) was part of a collection of distribution centers on the river ("Gasoline Alley") that have now all closed. This was part of a general phase-out to pipeline distribution (by companies including Texaco, Sinclair, Mobil, Clark Oil, and Unocal) that started in the 1980's.

3. The service area of the previous Koch St. Paul dock and distribution center is now primarily served by Roseville. The refinery itself has always had its own distribution facility (truck racks) that serves the south Metro. Truck volumes at the refinery expanded only minimally following the discontinuance of the river movement. The change in net truck movements out of Roseville are essentially a wash – the truck distances to serve back towards St. Paul (Otto Avenue) are offset by the distance savings to serve the growing northern Metro areas from Roseville. Current distribution patterns are affected much more by competition (with other companies and outstate facilities of Koch itself) than any legacy of the modal shift. It would thus be impossible to isolate truck pattern effects of the modal shift alone. Forecasts of truck traffic are not appropriate for this modal shift scenario.

4. Pipeline is generally considered to be the one mode that has clear-cut cost and environmental advantages over water, after the initial cost of construction. FHR considers the current pipeline solution to be far superior to water in all aspects: cost, cleanliness, and operational efficiency. Of course, pipelines can only move a limited range of products. It is also important to note that, since the 9/11 terrorist attacks, data on pipeline systems have become difficult to access.

5. Locations of Interest:

   Pine Bend Refinery – Jct. of Hwy 52 & 55, Inver Grove Hts. (river mile 824.2)

   "**Gasoline Alley**" – former facilities in vicinity of Otto Avenue in St. Paul (on the north bank of the Mississippi just NE of the current I35E bridge; Koch Fuels Inc. St Paul dock was at river mile 842.2)

D. Incan Superior Railcar Ferry (Duluth-Superior)

Contacts:
Dick Lambert, MN/DOT (interviews, and “Monetary Cost of A Modal Shift”, 1997)
Richard Stewart (interview and “Twin Ports Intermodal Freight Terminal Study” [20])
Bob Buchanan, A.N. Deringer Inc., Duluth (customs broker)
Davis Helberg, Ron Johnson, Port of Duluth/Superior
Bill McGiffert, Hallet Docks (Duluth)

1. In 1974 the M.V. Incan Superior began offering a railcar ferry service between the Twin Ports (Duluth MN/Superior WI) and Thunder Bay, ON. The Incan Superior made 162 annual round trip voyages per year. The vessel had a cargo capacity of 2,665 tons and could carry 26 rail cars, each carrying approximately 78 tons of cargo. The Incan Superior railcars primarily carried paper products and general freight (Stewart 2003, [20] p.55). Note that these railcars were all boxcars (rail container service was only in its genesis at this time).
2. Effective July 1991, the US Government raised the Harbor Maintenance Tax (HMT) by 212%. The HMT (imposed on exporters and importers) was raised to a rate of 0.125% of the value of the cargo ($1.25 per $1,000) passing through a U.S. port. The tax was increased under the assumption that the average vessel trading foreign would only clear Customs roughly fifteen times a year. However the Incan Superior was entering the Twin Ports five times each week ([20] p. 55). The HMT originally went into effect in 1987 at a rate of $0.40 per $1,000 of cargo value. Helberg points out that the stated purpose of the HMT was to finance maintenance dredging through a user tax, but with a loaded draft of about 17 feet in a navigation channel of 27 feet the Incan Superior was not a beneficiary of dredging but nonetheless paid between $50,000 and $70,000 per year at the 1897 rate, rising to nearly $200,000 per year at the 1991 rate.
3. The Incan Superior service was terminated in 1992. At that time the service was moving an average of 375,000 tons per year in 4,750 railcars per year. It is useful to note that the Incan Superior also illustrates the extremely long lifespan of commercial vessels (versus trucks): it is still in commercial service, as a railcar ferry serving Vancouver Island (Helberg).
4. The alternatives to the Incan Superior are overland rail or truck. The only feasible route for trucks between Thunder Bay and Duluth is Highway 61, a principally two-lane road along the north shore of Lake Superior. This is a scenic route that has a high volume of tourist traffic. For CN railway, the rail movement into the U.S. requires a backwards-movement all the way west to International Falls, MN. CP has to “backtrack” all the way to Pembina, ND.
5. The primary cargo on the Incan Superior was newsprint to U.S. cities from the then “Great Lakes Paper” pulp mill in Thunder Bay. This mill is now owned by Bowater Forest Products. Past and current truck and rail volumes from Bowater to the U.S. are commercially sensitive information, and are not available for this study.
6. The Incan Superior service was apparently operating at capacity. There was substantial truck traffic, from Great Lakes Paper, on Highway 61, at the same time. The Incan Superior’s one-way trip time was about 13 hours, but with weather and railcar delays round trips times averaged 42-44 hours, allowing four round trips per week (Buchanan & Helberg).

7. A past employee of Great Lakes Paper during the time of the Incan Superior provided additional information about this movement:
    a. Great Lakes Paper's decision on whether to use rail or truck depended primarily on the receiving facilities of the customer (some could receive only rail, some only truck, some either). Product would stay in that mode all the way to the customer since newsprint is easily damaged during transloading.
    b. Newsprint can also only be divided into individual rolls for shipment. The maximum number of rolls that are still under the U.S. Interstate weight limit (80,000 pounds gvw) create a 21 ton payload (the 375,000 tons moved by the Incan Superior would thus require 17,800 truckloads).
    c. The Incan Superior did not replace truck movements; it only provided an alternate rail outlet whereby railcars could be shipped to Duluth and then via U.S. railways, rather than CN or CP. The discontinuation of the Incan Superior service thus created a diversion to longer rail trips, not to truck.
8. A 2003 report by Dr. Richard Stewart [20] looked in depth at a "potential marine intermodal service" that would parallel the Incan Superior route. The report found that a year-round service is technically feasible, and that current freight volumes could support such a service. Several shippers provided data to that study under a promise of confidentiality (that data was not available to this study).
9. The report found that the service would have to compete with a current average truck rate, to move a 53 foot trailer from Thunder Bay to Duluth, of $350 U.S. The report found that multiple sites in the Duluth-Superior area could be a terminus for the proposed intermodal service (the Port in Duluth will be used as a representative terminus in the routing scenarios in Chapter 3 of this study).
10. The major investments in a service like the Incan Superior are at the terminals; another ship would have been an incremental cost. Stewart found that these volumes could have provided a traffic base for increased service frequency (interview and [20]), which in turn could attract more time-sensitive traffic and further increase the traffic volume attracted away from trucks.
11. Buchanan Forest Products currently moves finished lumber from Thunder Bay to Duluth by barge. During the 2001 shipping season, approximately 120,000 tons was shipped in this movement (on the barges "Twolan" and "McAllister 132"). (Stewart 2003 [20])
12. Interviews with staff at the Port of Duluth/Superior provided other information of interest:
    - Duluth receives significant volumes of grain by truck all the way from eastern North Dakota (250+ miles) – previously most of this grain came by rail.
    - The Port in Duluth is encountering "gentrification" of the surrounding waterfront, particularly on the north side (adjacent to downtown Duluth). This district has become a tourist attraction and restaurant/boutique district. This is creating pressures to convert working areas of the harbor into alternate land uses, despite the working ships and harbor activities being a major factor in the area's attraction for tourism and recreation.

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Chapter 3: Truck Route Analysis

This Chapter derives estimates of total Loaded Truck Trips (LTT), Truck Vehicle Miles Traveled (LT_VMT), and ton miles (both by truck, and replaced ton miles by water) that would be produced by the modal shifts under study.

Loaded Truck Vehicle Miles Traveled (LT_VMT)

Vehicle Miles Traveled (VMT) is "a measure of the extent of motor vehicle operation; the total number of vehicle miles traveled within a specific geographic area over a given period of time." (U.S. EPA Terminology Reference System, www.epa.gov/trs). Since the development of the national HPMS (Highway Performance Monitoring System, described later in this Chapter), VMT has become the standard denominator of measurement for most highway-related cost and environmental factors. For example, if air pollution costs are estimated at 4.4 cents per VMT, this coefficient can simply be multiplied by the forecast change in VMT to produce a forecast of the air pollution cost.

In this study, the abbreviation **LT_VMT** is used to specify that the VMT under discussion are for **Loaded Trucks**, based upon one-way truck-load trips that would be required to move the commodity tonnages that would be expected to shift from water (barge) to truck. Backhaul trips are not included in LT_VMT, but will be derived in later chapters of this analysis.

LT_VMT is derived by multiplying:

- loaded truck trips (**LTT**) that would be required to move the commodity tonnages expected to divert from water to truck (derived in Chapter 2); by
- route miles traveled (**RMT**) by the loaded trucks on the expected diversion routes.

$$\text{or, } \boxed{LT\_VMT = LTT * RMT} \text{ (formula 1)}$$

The "expected truck diversion routes" from which RMT are derived can only be speculative, since they have not actually occurred (in the case of the Minneapolis Upper Harbor modal shift) or cannot be definitively quantified. To derive defensible estimates of RMT, the LTT estimates from Chapter 2 were grouped together into movements of commodities that could be expected to have the same origins and destinations, and thus the same road route, if they shift from water to truck. These routes each involve various road types. These road types are grouped into several categories, and total route mileages are calculated for each road category. The categories are described in "HPMS, Routing, and Road Types" (page 29).

In several cases there are multiple possible routes (for example, to competing St. Paul ports) by which a movement could be accomplished. In other cases, the total commodity volume (and thus, LTT) of the movement will vary based upon which assumptions are made about the actual response which will occur following the modal shift. Thus each movement may have multiple scenarios, which are a combination of routes and volumes.

Based on the interviews of Chapter 2 and other information (such as facility locations and which facilities handle which commodities), this Chapter develops a set of feasible scenarios for each movement. Each scenario has associated with it RMT (route miles travelled) by road category, and LTT (loaded truck trips), which are then used to derive LT_VMT by road category.

As explained in Chapter 1, it is important to distinguish between incremental -trip and whole-move movements of the expected loaded truck trips. An incremental movement is less costly, on a per mile basis, than a whole-move truck movement. This distinction is important primarily for estimating the (private) haulage costs. Often a movement can be expected to be entirely one or the other. Where necessary, movements are divided into incremental and whole-move portions in the scenarios.

The development of movements and scenarios was an iterative process: analysis of one route revealed other possible routes that should be analyzed, and these possible routes determined which commodities could be grouped together into movements. Note that the use of "movements" is primarily a convenience for presentation of the data, to avoid many maps that convey similar routing information.

Later in this Chapter, the modal shifts and associated movements, scenarios, and routes are illustrated with route maps, and tables of road mileage and associated LT_VMT.

Important Points To Note

- The LTT, "truck load", and LT_VMT figures all represent only loaded (one-way) truck trips. In the types of truck traffic that would result from the modal shifts under study (particularly the short, intensive, urban movements in the Minneapolis Upper Harbor modal shift), it is expected that most loaded truck trips will also have an empty "backhaul" trip **(**the major exception are trucks moving relatively long distances, such as many cargos to/from the Upper Harbor Terminal).

  However, some of the operating and environmental costs will be different for empty versus loaded trucks. These differences between empty and loaded trucks will vary by the type of cost under study. For example, fuel consumption can be expected to be significantly lower for an empty truck. Thus, for simplicity, the analysis in this Chapter derives only loaded trips. In chapter 4, the LTT and LT_VMT will be scaled up by appropriate factors to represent the expected number of empty backhaul trips.
- The calculations and route choices used to construct the LT_VMT forecasts are deliberately biased towards estimates that underestimate, rather than overestimate, the total LT_VMT. The intent of this is to produce a defensible forecast of the minimum estimated impacts of the modal shift – the actual impacts can thus be expected to be somewhat higher than this estimate.
- The commodity volume estimates upon which the truckload "movement" estimates are based exclude volumes that are not expected to divert to truck**.** The interviews did not identify any volumes that would shift **to** rail rather than truck (from water) but there are several shipments that arrive at the water by rail and are directly transloaded to barge. It is expected that these rail shipments would divert by rail to another port, and these

volumes are thus excluded from the truck trip “movements” and “scenarios” and associated LT_VMT.

- In Chapter 2, once the tonnages were identified a truck payload factor was used to convert the tonnages to truckloads. Due to specialized truck equipment used to move specific commodities, and varying “load break” weights, the appropriate truck payload factor will vary by commodity.

  An appropriate payload factor is used, based on the information collected in Chapter 2, for each movement. This represents a full payload for a 5 or 6 axle truck at the Interstate Highway weight limit of 80,000 lbs. gross vehicle weight (GVW - the weight of the vehicle and its payload).

HPMS, Routing, and Road Types

The road routings for this study were determined using TransCAD software and the 2003 NHPN (National Highway Planning Network) data, which includes year 2000 AADT (“average annual daily traffic” – the standard measurement unit of road traffic volumes). The routings were based on calculation of “shortest time” routes (a function of posted speed limit and distance) between origins and destinations that were identified in the interview process.

Note: *TransCAD is a product of Caliper Corp. (www.caliper.com/tcovu.htm). The authors and the Minnesota Department of Transportation and/or Center for Transportation Studies do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to this report.*

TransCAD is a geographical software product for routing, travel demand forecasting, logistics, and site planning analyses. The National Highway Planning Network (NHPN) is a 1:100,000 scale network database that contains line features representing just over 450,000 miles of current and planned highways in the U.S. The NHPN consists of interstates, principal arterials, and rural minor arterials [17]. Routings derived with TransCAD and the NHPN are widely used in the transportation planning industry, including federal, state, and local DOTs, environmental agencies, and consultants. Such routings are commonly used to derive VMT estimates, which are used in turn to derive environmental and operational cost estimates.

A shortcoming of the NHPN is lack of local road information. Most of the sites under study are quite close to NHPN facilities so this is not a major issue. In keeping with the principal of using conservative estimates, a shortest-path local road connection was imputed from the nearest NHPN access point (ex. a ramp for Interstates) to the location of the facility. This will somewhat underestimate actual local road miles.

It is important to note that the TransCAD routing confirms the overall routing patterns suggested in the interviews: the truck trips under study will primarily use the Interstate system where it provides relatively direct routes**.** In most of the Upper Harbor scenarios I94, through and between St. Paul and Minneapolis, provides such routes and thus is a principal part of these scenarios.

The primary value of using the NHPN road data is that it links with the national Highway Performance Monitoring System (HPMS) data. HPMS is a database of the total mileages of roads by functional class (and other attributes) which is used nationally as a basis of state and local highway performance measures, including air quality analyses.

> *The Highway Performance Monitoring System (HPMS) provides data that reflects the extent, condition, performance, use, and operating characteristics of the Nation's highways. It was developed in 1978 as a national highway transportation system database. It includes limited data on all public roads, more detailed data for a sample of the arterial and collector functional systems, and certain statewide summary information. HPMS replaced numerous uncoordinated annual State data reports as well as biennial special studies conducted by each State. These special studies had been conducted to support a 1965 congressional requirement that a report on the condition of the Nation's highway needs be submitted to Congress every two years.*
>
> *The HPMS data form the basis of the analyses that support the biennial Condition and Performance Reports to Congress. These reports provide a comprehensive, factual background to support development and evaluation of the Administration's legislative, program, and budget options. They provide the rationale for requested Federal-aid Highway Program funding levels, and are used for apportioning Federal-aid funds back to the States under TEA-21; both of these activities ultimately affect every State that contributes data to the HPMS.*
>
> *These data are also used for assessing highway system performance under FHWA's strategic planning process. Pavement condition data, congestion-related data, and traffic data used to determine fatality and injury rates are used extensively by the Administration to measure FHWA's and the State's progress in meeting the objectives embodied in the Vital Few, FHWA's Performance Plan, and other strategic goals.*
>
> *In addition, the HPMS serves needs of the States, MPOs and local government and other customers in assessing highway condition, performance, air quality trends, and future investment requirements. Many States rely on traffic and travel data from the HPMS to conduct air quality analyses and make assessments related to determining air quality conformity, and are now using the same analysis models used by FHWA to assess their own highway investment needs.* [14]

Figure 3.1: The HPMS Functional Classification System

Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of service they are intended to provide. Basic to this process is the recognition that individual roads and streets do not serve travel independently in any major way. Rather, most travel involves movement through a network of roads. It becomes necessary then to determine how this travel can be channelized within the network in a logical and efficient manner. Functional classification defines the nature of this channelization process by defining the part that any particular road or street should play in serving the flow of trips through a highway network.

Table II-1 -- The Hierarchy of functional systems

Rural areas	Urbanized areas	Small Urban areas
Principal arterials	Principal arterials	Principal arterials
Minor arterial roads	Minor arterial streets	Minor arterial strets
Collector roads	Collector streets	Collector streets
Local roads	Local streets	Local streets

Extent of mileage and travel on urban systems

Table 11-3 contains guideline ranges of travel volume (VMT) and mileage of each of the four functional systems for urbanized areas. Systems developed for each area using the criteria herein will usually fall within the percentage ranges shown.

Table II-3 -- Guidelines on extent of urban functional systems

System	Range (percent)	
	VMT	Miles
Principal arterial system	40 -65	5 -10
Principal arterial plus minor arterial street systems	65 -80	15 -25
Collector street system	5 -10	5 -10
Local street system	10 -30	65 -80

source: FHWA Functional Classification Guidelines [15]

The Road Types used in this analysis are based upon HPMS functional class (explained in more detail in Figure 3.1: The HPMS Functional Classification System, above). This will allow matching with the most current road environmental cost figures, which are calculated for road types based upon functional classes. The functional class of a given road is ultimately derived from its speed limit and capacity, and is thus implicitly related to its traffic volumes. Within a given area, like the Metro area, roads of similar functional classes can be expected to have broadly similar traffic volumes (or can be expected to eventually have such volumes).

Road Type Categories

For this analysis, we will group HPMS Functional Classes into three categories:

CAT1: Interstate and controlled access Expressways

CAT2: Major and Minor Arterials

CAT3: All other road types (collector, local, and unclassified)

Figure 3.2: Road Type Categories

road type Category	HPMS FCLASS	HPMS FCLASS (Functional Class) description
CAT1	01	Rural Interstate
"	11	Urban Interstate
"	12	Urban Freeway or Expressway
CAT2	02	Rural Principal Arterial
"	06	Rural Minor Arterial
"	14	Urban Principal Arterial
"	16	Urban Minor Arterial
CAT3	07	Rural Major Collector
"	08	Rural Minor Collector
"	09	Rural Local
"	17	Urban Collector
"	19	Urban Local

The HPMS functional classification system distinguishes between urban and rural roads. Many environmental cost figures that will be used in subsequent sections are significantly different for urban versus rural portions of what are otherwise similar road classifications (for example, Interstates). The road type categories (CAT1, CAT2, CAT3) used for this analysis do not distinguish between rural and urban roads. An analysis of the underlying data determined that all Metro-area roads can be treated as urban. All roads in the Metro analysis area fit the urban definition used for the HPMS system:

> *The … urban area is determined on the basis of the latest decennial (or special inter-decennial) Census designation … Areas meeting the 200,000, 50,000, or 5,000 census-determined population thresholds should use codes 4, 3, or 2, respectively, for reporting HPMS Data Item 13. All Sections outside of these areas should be coded 1, Rural.* [16]

The routes for the Incan Superior movement are primarily rural (along the north shore of Lake Superior). The analysis for Incan Superior lists separate sets of route mileages (by category) and associated LT_VMT; one for rural areas and another for urban (Duluth). Note that Canadian data is not included in U.S. NHPN or HPMS and Canadian distances and associated categorization are estimates derived from a map.

Summary of Modal Shift Scenarios

The following pages of this Chapter are the route analyses of the individual modal shifts. Each modal shift, and each movement within each modal shift, are discussed separately. Each movement includes at least one route map. Where there are multiple routes, similar routes within a single movement are grouped onto a single map. The maps themselves are reproduced separately in Appendix A. The title of each set of routes includes the letter number of the associated map. The map, in turn, has the same title as the associated set of routes.

Modal Shifts:

A. Minneapolis Upper Harbor (Mississippi river) - forecast modal shift
The "estimated overall impact" is a summation of several movements:

i) American Iron (AIS) movement:
has two possible volume scenarios, and two route possibilities;

ii) Upper Harbor Terminal (UHT):
has multiple movements of multiple commodities - commodities that would shift to alternate ports by truck are identified; a weighted average of these ports is developed, using all known information for UHT cargos and 'reasonable assumptions' of port shares for the remaining cargos; and,

iii) Aggregate Industries Minneapolis Plant movement:
has multiple possible route scenarios, each mapped separately

B. Holcim Cement (Minneapolis Upper Harbor) – modal shift underway

This facility is part of the Minneapolis Upper Harbor, but the modal shift is already planned to occur (due to a facility relocation), so it will not be included in the calculation of the "estimated overall impact" of a prospective future Upper Harbor modal shift.

C. Petroleum Products on Upper Mississippi – past modal shift
This modal shift was primarily to pipeline; the truck impacts cannot be accurately modeled (see explanation in Chapter 2).

D. Incan Superior on Lake Superior (Thunder Bay to Duluth) – past modal shift
1 route, and 1 volume scenario are estimated. Chapter 2 indicates that this modal shift was to longer land rail routes, but an estimate of the truck volumes of a hypothetical parallel movement (on US 61) are derived for information purposes.

Explanation of Data Table Headings

The data table formats described, following, are used for all routes and scenarios in the Twin City Metro area. The Incan Superior movement has the additional complications of extending into Canada and over both rural and urban roads; thus a slightly different heading format is used, but the basic layout is similar. The data associated with routes and scenarios is broken into three types of tables, illustrating:

- route distance (Table A format);
- annual loaded truck VMT (Table B format); and,
- annual ton-miles (Table C format)

In most cases, all three types of tables are presented for each scenario. The tables for a given scenario are grouped together into a Table Set.

Figure 3.3: Table A Format - Route Distances by Road Type

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	

Table A reports "Route Distances by Road Type". Each line in the table corresponds to a single route/volume scenario, which is given an abbreviated name, for reference, in the scenario column. The route is described in the next three columns: route (a reference number), origin, and destination. All three of these items are also indicated on the associated maps.

The subsequent columns report trip length miles by each of the road type categories used in this study: CAT1, CAT2, and CAT3, (see previous "Road Type Categories" for a description), then the total miles in all three categories. The next two columns indicate whether the route passes through the section of I94 that merges with I35W (just south of downtown Minneapolis), as I94 and I35W, and/or through the section of I94 that merges with I35E (just northwest of downtown St. Paul), as I94 and I35E. A '1' indicates 'yes' and a '0' indicates 'no'. These two merge points are of particular interest in analysis of congestion points on the Metro road system. These fields are not relevant to the Incan Superior analysis and thus do not appear in those data tables.

The *volume* involved in the scenario is indicated as one-way loaded truck loads in the final column. Where there are multiple volume scenarios in one set of tables, the data rows for each scenario are separated by a title line describing the volume assumption.

For the more complicated Upper Harbor movements, a weighted average scenario is developed and explained in one grouping, with associated map, and then referenced with summary lines in subsequent scenarios. In this case, the mileages no longer correspond to specific routes. Instead, they are an average of the specific route mileages weighted by the percentage of the overall movement tonnage that is expected to use that route. The weighting percentages add up to 100%.

Figure 3.4: Table B Format - Annual Loaded Truck VMT by Road Type

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	

Table B reports "Annual LT_VMT by Road Type". The scenario and route information are the same as in the first table. Table B is produced by multiplying truck loads by the trip length (miles) and I94/I35W and I94/I35E columns, all from Table A.

The road category fields now report annual truckload VMT, in thousands, for each of CAT1, CAT2, and CAT3, and their total. The I94/I35W and I94/I35E columns report the annual number of loaded truck trips through that point.

In the Upper Harbor movement scenarios, these reported total truckloads represent new trips through the Metro area. For example: trips from northwest of the Metro that now stop at the Upper Harbor Terminal are counted as "new" trips if they are extended through the Metro (to/from St. Paul ports). Note that these trips would, however, also be categorized as "incremental" rather than "whole-move" movements.

Figure 3.5: Table C Format - Total Annual Ton Miles By Mode

Table C:	Ton-Miles (Thousand Annual)			truck by road type category				WATER		cargo
	by Mode and Road Type			thousand annual ton miles				water	ton	thous
scenario	route	origin	destination	CAT1	CAT2	CAT3	total	miles	miles	tons

Table C reports "Total Ton Miles by mode" (water versus truck). The water miles (or "river miles") that correspond to the water route replaced by each route in Table A are summarized in the water miles field. The water miles are derived from Mn/DOT data [12]. Table C is derived by multiplying cargo tons for each movement by the Table A truck route miles and the Table A water miles. All ton miles are reported in thousands.

The water miles will vary depending upon which ports are actually modeled to replace the existing usage of the UHT. For example, traffic moving by truck from the Upper Harbor Terminal will replace 25.2 river miles if moving to Dakota Bulk, but only 19.5 if moving to Great Western. Where a weighted average is used for a scenario, the same weights are applied to the water distances, corresponding to two route points, as were used for the truck movements between the same two points.

The water ton-miles number is generally negative since water movements are being replaced and thus reduced. The exception is Savage, where the Bunge Terminal is actually slightly further than the Upper Harbor Terminal from the confluence of the Minnesota and Mississippi rivers (however, it is important to note that access is faster since there are no locks on the Minnesota river, versus three locks to get to the Upper Harbor). The Savage movement is a very small part of the weighted average movement used for the Upper Harbor Terminal Movements.

A. Minneapolis Upper Harbor Modal Shift (Map A)

Chapter 2 developed forecast volumes of freight by commodity, based upon statistics of what actually moves through the locks to/from the Upper Harbor. Chapter 2 also reports interviews with Minneapolis Upper Harbor shippers, which were used to determine:

- which volumes of which commodities are associated with specific facilities;
- the alternative facilities , below the Minneapolis Upper Harbor, to which the commodity flows would be expected to shift; and,
- the proportions of each commodity movement, to alternative facilities, that would be expected to move by truck.

The above information was then used to break the Upper Harbor data into appropriate movement volume estimates, which are summarized in the table on the next page.

Note: *As defined previously (page 27), a movement is a group of commodities that could be expected to have the same origins and destinations, and thus the same route, if they shift from water to truck.*

The total estimated LT_VMT impacts of these movements are developed in two steps on the following pages. In the first step, each movement is discussed individually:

- American Iron (AIS) movement: two volume scenarios, two route scenarios;
- Upper Harbor Terminal (UHT): multiple movements of multiple commodities; commodities that would shift to alternate ports by truck are identified, and a weighted average of these ports is developed, using all known information for UHT cargos and 'reasonable assumptions' of port shares for the remaining cargos;
- Aggregate Industries/Cemstone movement: multiple possible route scenarios, each mapped and described separately

Following the discussion of individual movements, the second step ("Forecast Total Annual Increase in Loaded Truck-Miles", page 48) develops "summary scenarios" as a total of the "most likely" LT_VMT of the individual movements.

Holcim Cement movements are not included in the Upper Harbor modal shift summary scenarios since this modal shift is already underway and thus would not be impacted by loss of water access to the Upper Harbor (unless Holcim decides to maintain its Minneapolis terminal at a reduced volume). However, for information, the route miles and associated loaded truck VMT are calculated in a similar manner to the other Upper Harbor facilities, following the Upper Harbor summary scenarios (page 50).

A key point in this analysis flows from a simple observation of the location of the Minneapolis Upper Harbor ports, which is northwest of the alternative ports in the St. Paul area. Cargo will only use the Minneapolis ports if these ports are closer to the cargo's origin or destination. Otherwise, the cargo would already be using the St. Paul ports, and save the costs of the additional river miles (and three locks) between St. Paul and Minneapolis. Thus, the Minneapolis ports capture cargo moving to Minneapolis itself, western suburbs, and **to/from northwest of Minneapolis. This observation was continually confirmed in the Chapter 2 interviews. I**f the river mode to Minneapolis is unavailable, cargo will move to and from Minneapolis, and northwest of Minneapolis, by the most direct possible route to/from the St. Paul ports. Many of these routes will be directly through St. Paul and Minneapolis via I94, and the rest will be very close to the northern and western boundaries of Minneapolis (on I694 and I494). As discussed in Chapter 2 and the detailed scenarios analysis for the Upper Harbor Terminal (page 43), the Savage ports are a very limited alternative to St. Paul ports.

An overview map of the points discussed in this modal shift analysis is presented in Map A (in Appendix A). Terminal locations and associated information (river miles, and cargo types handled) were derived from Mn/DOT data [12]. Note that Great Western, Cenex, and Alter River terminals are treated as one point: Great Western and Cenex are side by side, and there is no way to distinguish between traffic that will go to the Alter River port and the Great Western Port, since they handle similar cargo and involve very similar road and river mileages.

Table 3.1: Truckload Estimates (summary from Chapter 2)

Aggregate Industries/Cemstone

			THOU TONS			truckload equivalent		
flow	Commodity	Comments	dnbnd	upbnd	tons/ truck	dnbnd	upbnd	total
Agg1a	Aggregate	90% of upbound volumes	0	801	23	0	34,836	34,836

American Iron (AIS)

			THOU TONS			truckload equivalent		
flow	Commodity	Comments	dnbnd	upbnd	tons/ truck	dnbnd	upbnd	total
I/S1a-alt1	Iron/Scrap	all downbound volumes	99	0	23	4,287	0	4,287
I/S1a-alt2	Iron/Scrap	forecast doubling with shredder	197	0	23	8,574	0	8,574

Upper Harbor Terminal (UHT)

			THOU TONS			truckload equivalent		
flow	Commodity	Comments (rail volumes are excluded below)	dnbnd	upbnd	tons/ truck	dnbnd	upbnd	total
Agg1b	Aggregate	10% of upbound , all downbnd	4	89	24	176	3,709	3,886
Cem1b	Cement	all downbound volumes	3	0	24	125	0	125
I/S1b	Iron/Scrap	all upbound volumes	0	53	24	0	2,191	2,191
Grain_Metro	Grain	all upbnd, reported Metro downbnd	18	9	24	750	375	1,125
Grain_NW	Grain	downbnd from NW of Metro	60	0	24	2,500	0	2,500
Fert1	Fertilizer	all upbound volumes	0	55	24	0	2,300	2,300
Coal1	Coal	all volumes (both directions)	5	124	24	209	5,164	5,373
Salt1	Salt	all volumes (both directions)	5	74	24	188	3,088	3,275
Gen1	General	all volumes (both directions)	9	38	24	355	1,584	1,939
UHT-tot	total	total - all UHT truck movements	103	442	24	4,303	18,410	22,713

Mineapolis Upper Harbor Total Forecast Diversions to Truck

		total with curent AIS	210	1,281		8,945	54,830	61,836
FORECAST TOTAL:		**total with AIS shredder**	**309**	**1,281**		13,232	54,830	**66,123**

Holcim (not included in Forecast Diversions)

			THOU TONS		truckload equivalent		
flow	Commodity	Comments	dnbnd	upbnd	dnbnd	upbnd	total
Cem1a	Cement	all upbound volumes	0	151	0	6,036	6,036

i) American Iron (AIS)

American Iron (AIS) to St. Paul Ports (Map B)

Note: *The abbreviation "AIS" references the earlier name of "American Iron and Steel". "AIS" is used to distinguish from "AI" which represents "Aggregate Industries", another Upper Harbor user.*

American Iron (AIS) sends scrap metal outbound on the river. No Savage ports handle general cargo, such as iron scrap. The three possible St. Paul diversion ports are the three "general cargo" terminals: Dakota Bulk (in South St. Paul), Alter River, and Great Western. As discussed previously, Great Western, Cenex (which handles only grain), and Alter River are all treated as the same location in this analysis. Great Western and Alter River (scenarios AIS-2 and AIS-4) currently compete with American Iron in the scrap handling business. American Iron clearly indicated (Chapter 2 interviews) that they would be unlikely to ship through a competitor. The incremental truck cost of using Dakota Bulk would also be low. Therefore, it is judged likely this business would be directed to the Dakota Bulk terminal (scenarios AIS-1 and AIS-3).

The interviews in Chapter 2 indicate that the outbound river volume of the American Iron facility is expected to at least double with the addition of a "shredder". It is stated by American Iron, and is a reasonable assumption given their substantial investment, that the shredder will operate regardless of whether water access is available at the shredder site.

Thus, the “most likely” scenario is “shredder” volume levels to Dakota Bulk (scenario AIS-3, below). As indicated in Tables B & C of Table Set 3.2, below, this amounts to an annual total increase of 196 thousand loaded truck VMT from 8,574 one-way (loaded) whole-move truck trips, equivalent to 4.52 million ton miles and displacing 4.87 million water ton miles.

Due to the general use of gravel trucks for these hauls, it is highly likely that backhauls could be available if Aggregate Industries is also doing a “return” gravel haul to their AI Minneapolis plant. These trips are thus expected to have 0% empty backhaul.

Table Set 3.2: American Iron (AIS) to St. Paul ports

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
American Iron at current volumes										
AIS-1	R3A	Am Iron	Dakota	15.90	5.64	1.35	**22.90**	1	1	4,287
AIS-2	R3D	Am Iron	GW/Cenx	13.91	1.70	1.07	**16.69**	1	1	4,287
American Iron at minimum forecast volumes with shredder										
AIS-3	R3A	Am Iron	Dakota	15.90	5.64	1.35	**22.90**	1	1	8,574
AIS-4	R3D	Am Iron	GW/Cenx	13.91	1.70	1.07	**16.69**	1	1	8,574

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
AIS-3	R3A	Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo
								water	**ton**	thous
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**miles**	**miles**	tons
AIS-3	R3A	Am Iron	Dakota	3,136	1,113	267	**4,515**	-24.7	-4,871	197.2

ii) Upper Harbor Terminal (UHT)

Upper Harbor Terminal to Alternate Ports (Map C)

The Upper Harbor Terminal is abbreviated below as "the UHT" (the rail system refers to this facility as "Camden Station"). The UHT movements are both inbound and outbound. Note, as discussed previously, that:

- The St. Paul ports of Great Western (handles general cargo), Cenex (handles grain), and Alter River (handles general cargo) are all treated as the same location; and,
- the Minneapolis Upper Harbor Terminal captures cargo moving to Minneapolis itself (and western suburbs), and to/from northwest of Minneapolis.

No products currently leave the UHT by rail. 271,000 tons of grain that comes into the UHT by rail is expected to divert (by rail) to Savage or Peavey Red Rock; 66,125 tons of Potash is expected to divert (by rail) to Peavey Red Rock. These train route diversions were identified in the Chapter 2 interviews and have been excluded from the commodity volumes used to generate truckloads for this analysis.

The UHT is served by a very direct route from I94 – the Dowling Ave. exit. Thus I94 trips moving to and from the UHT follow a very similar route. The routes to and from the St. Paul ports are also similar whether entering or leaving these ports to/from I94. Thus the direction of the routes is not a significant factor in the road type mileages, and the LT_VMT analysis thus does not distinguish between inbound and outbound traffic. (Note that all other Upper Harbor movements are only in a single direction).

Two sets of routes are developed for each alternate port:

- routes to/from the UHT itself, for cargo to/from Minneapolis or western suburbs – route distances are indicated in Table Set 3.3a, below:

Table Set 3.3a: UHT to Alternate Ports

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
total distance from UHT										
UHT_Gen-1	R4A	Upper Harbor Term.	Peavey Red Rock	17.15	4.72	1.96	**23.84**	1	1	
UHT_Gen-2	R4D	Upper Harbor Term.	Dakota Bulk	16.98	5.64	0.58	**23.21**	1	1	
UHT_Gen-3	R4C	Upper Harbor Term.	G Western/Cenex	14.99	1.70	0.39	**17.09**	1	1	

- routes to/from northwest of the Metro:

  This traffic was originally modeled to/from an arbitrary point in "Osseo" (a stated grain origin and fertilizer destination in Chapter 2) but it became obvious that new routes would only replace existing trip portions up to a "route split point" at the intersection of I94 and I694 (see Map C in Appendix A). Current trips turn south on I94 at this point, to the UHT. If the UHT were not available, the most efficient route would be to continue on I694 and then down I35E. In the scenario "UHT stub", the mileage (by road type) of the current trips from the route split point (I94 & I694) to the UHT is subtracted from the route mileage from I94 & I694 to the St. Paul ports, to derive the incremental route distance. These distances are then used to derive an incremental LT_VMT (and associated incremental ton-miles) which would occur as truck trips are extended due to the UHT port no longer being available. This route analysis also applies to coal moving to St. Cloud. The incremental road distances associated with these routes are indicated in Table Set 3.3b, below.

Note: *The use of the term incremental distance, above, has a distinct meaning from "incremental-trip" truck movements. However, the two concepts are strongly related since the movements which have incremental distance are also incremental trips.*

A similar process is used to calculate the incremental route distances to Savage (with a "route split point" further west, at the intersection of I94 & I494), which are described in the discussion of Map D (in Appendix A) that follows this section. The Savage distances are included in Table Set 3.3b, below. For brevity, only the adjustment "UHT stub" distance and the final net (incremental) distances are shown in the table below.

Table Set 3.3b: UHT to Alternate Ports

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
adjustment for distance savings from I94/I694 south to UHT										
UHT stub	R5D	I94(Ebnd) & I694	Upper Harbor Termina	3.20	0.00	0.26	**3.46**	0	0	
net (incremental) distance from northwest of Twin City Metro										
UHT_NW-1	R5G	NW of Metro	Peavey Red Rock	15.37	4.72	1.44	**21.53**	0	0	
UHT_NW-2	R5H	NW of Metro	Dakota Bulk	15.20	5.64	0.14	**20.99**	0	0	
UHT_NW-3	R5I	NW of Metro	G Western/Cenex	13.21	1.70	-0.14	**14.78**	0	0	
incremental distances for diversion from NW of Metro to Savage (see Map D):										
Oss_1net	R5A	Savage	NW of Metro	6.44	7.93	0.00	**14.37**	0	0	

The choice of port/route to replace the UHT depends upon distance and rates, service, cargo handling capabilities, and market relationships at a given facility. Thus it is highly unlikely that a single, closest facility would capture all the truck traffic currently using the UHT. To account for all these interacting effects, a weighted average of the routes to alternative ports is developed to represent the predicted diversion of current UHT truck traffic. The interviews of Chapter 2 and the routing analysis indicated that the Savage ports are generally not a strong alternative for truck movements currently using the UHT. However, Savage was stated to be a strong alternative to the UHT for salt movements and is thus modeled as such. The routing analysis for Savage is illustrated in Map D (following). It indicates that there are very limited truck miles savings (less than 1 mile) versus the closest St. Paul ports, and would leave the cargo with a "river mile" disadvantage versus St. Paul ports.

The two tables following develop the basis of a weighting between the various route possibilities for the UHT cargo. Table 3.4 indicates the truckloads and direction by commodity type. The "Distribution Comments" and the split of grain traffic into that from NW of the Metro ("Grain_NW") and that to/from the Metro itself (urban storage/processing facilities close to the UHT, "Grain_Metro") are derived from the UHT observations in Chapter 2.

Table 3.5 then splits each of the commodities into percentage shares by ports and routes. These percentage shares are then multiplied by the commodity's percentage share of the truck volume (this calculation is not shown in the table), and totaled into a "port/route weighting" for each port/route combination (the second-last line in Table 3.5). The last line in Table 3.5 indicates the equivalent in truckloads that each port/route is predicted to capture, based on its weighted share of the total of 21,805 truckload equivalents for all the UHT movements that are expected to occur by truck.

As a rule of thumb, where ports were unknown, at least 67% was assigned to “G.West”, as representing the three closest ports. Not all was assigned to “G.West” since other ports would capture some of this traffic despite greater distances. Note that for Aggregate movements, AI St. Paul Yard is also adjacent to Great Western and is included in that point.

Table 3.4: UHT Truckloads and Port Distribution Comments

UHT truckloads and port distribution comments						
		truckload equivalent			% of	
flow	Commodity	dnbnd	upbnd	total	total	Distribution Comments
Agg1b	Aggregate	169	3,561	**3,730**	**17.1%**	St. Paul ports to UHT
Cem1b	Cement	120	0	**120**	**0.6%**	UHT to St. Paul ports
I/S1b	Iron/Scrap	0	2,103	**2,103**	**9.6%**	steel - St. Paul to UHT (Minn. & west)
Grain_Metro	Grain	720	360	**1,080**	**5.0%**	from UHT area
Grain_NW	Grain	2,400	0	**2,400**	**11.0%**	from NW of Metro
Fert1	Fertilizer	0	2,208	**2,208**	**10.1%**	Peavy to NW of Metro
Coal1	Coal	201	4,957	**5,158**	**23.7%**	St. Paul to NW
Salt1	Salt	180	2,964	**3,144**	**14.4%**	Dakota/Savage to UHT
Gen1	General	341	1,521	**1,862**	**8.5%**	St. Paul to UHT and NW
UHT-tot	total	4,131	17,674	**21,805**	**100.0%**	

Table 3.5: UHT Port/Route Weightings

UHT percentage of volume, and derived weightings by port/route									
		% of	**UHT to/from**			**NW of Metro to/from**			
flow	Commodity	total	Peavey	Dakota	G. West	Peavey	Dakota	G. West	Savage
Agg1b	Aggregate	**17.1%**			100.0%				
Cem1b	Cement	**0.6%**			100.0%				
I/S1b	Iron/Scrap	**9.6%**		50.0%	50.0%				
Grain_Metro	Grain	**5.0%**	50.0%		50.0%				
Grain_NW	Grain	**11.0%**				33.0%		67.0%	
Fert1	Fertilizer	**10.1%**				100.0%			
Coal1	Coal	**23.7%**					25.0%	75.0%	
Salt1	Salt	**14.4%**					50.0%		50.0%
Gen1	General	**8.5%**		10.0%	40.0%		10.0%	40.0%	
		port/route weighting:	2.5%	5.7%	28.4%	13.8%	14.0%	28.5%	7.2%
		weighted truckloads:	540	1,238	6,186	3,000	3,048	6,221	1,572

The above weightings are use to create a single weighted average to represent the individual route distances, in Table 3.6 (next page). The scenario “UHT_avg”, at the bottom of Table 3.6, will thus be used to represent these route miles in the subsequent steps of this analysis.

Table 3.6: UHT Port/Route Weighted Average

Route Distance Weighting				trip length (miles) by road type category				**I94** and		weight
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	**%**
	R4A	UHTerm	Peavey RR	17.15	4.72	1.96	**23.84**	1	1	2%
	R4D	UHTerm	Dakota	16.98	5.64	0.58	**23.21**	1	1	6%
	R4C	UHTerm	GW/Cenx	14.99	1.70	0.39	**17.09**	1	1	28%
	R5G	NW of Metro	Peavey RR	15.37	4.72	1.44	**21.53**	0	0	14%
	R5H	NW of Metro	Dakota	15.20	5.64	0.14	**20.99**	0	0	14%
	R5I	NW of Metro	GW/Cenx	13.21	1.70	-0.14	**14.78**	0	0	29%
	R5A	Savage	NW Metro	6.44	7.93	0.18	**14.37**	0	0	7%
Weighted Average of UHT traffic to alternate ports/routes (all incremantal trips)										
UHT_avg	A&C	UHT cargo traffic	port/route average	14.12	3.42	0.38	**17.90**	0.37	0.37	100%

Truck trips carrying cargo to/from the UHT would extend their trips to the other ports. Since these trips currently do not pass through the Metro, but would under the diversion scenarios, they are counted as new truck trips through the Metro in the final truckloads count maintained in Table B, and carried through to the summary scenarios. These trips are also all "incremental trips". Note that this categorization has no effect on the calculated LT_VMT or ton-miles, or the counts of trucks passing through the merge points of I94/I35W and I94/I35E.

Table Set 3.7: UHT to Alternate Ports

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
UHT_avg	A&C	UHT cargo traffic	port/route average	321	78	9	**407**	8,296	8,296	22,713

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo thous tons
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**water miles**	**ton miles**	
UHT_avg	A&C	UHT cargo traffic	port/route average	7,694	1,863	208	**9,760**	-19.7	-10,740	545.1

Thus, as indicated in Tables B & C of Table Set 3.7 (next page), the "weighted average" scenario (UHT_AVG) produces an annual total increase of 407 thousand loaded truck VMT from 22,713 one-way (loaded) incremental truck trips. This is equivalent to 9,760 thousand truck ton miles, which would be offset by a reduction of 10,740 thousand ton-miles in river barge traffic.

Truck trips to and from the UHT are, generally, significantly longer than those that would occur from the other locations in the Upper Harbor. Many grain and fertilizer movements to the Twin Cities (including Savage and St. Paul ports) extend to western Minnesota and into North Dakota. UHT reports that many trucks leaving their facilities with fertilizer have brought in grain to other facilities. However, they also report that their grain shippers (inbound) tend not to have backhaul; they are either intense "direct hit" movements that are similar to other urban movements, or relatively short inbound trips from northwest of the Metro. As indicated in the weighting analysis, these grain shipments account for 16% of the modeled truck trips, all of which would have empty backhaul. It is unlikely that as much as 50% of the overall trips would have backhauls, but a figure of 50% backhaul will be used to produce a conservative analysis (i.e. a higher backhaul rate reduces the expected impact). This figure corresponds, of course, to a 50% empty backhaul rate.

Suitability of Savage Ports for UHT Cargo (Map D)

The routing analysis for Savage is illustrated in Map D (in Appendix A). The technique is similar to that used for routes from the northwest to St. Paul, except the “route split point” is further west, at the intersection of I94 & I494. The “distance adjustment” for the saved trip to the UHT is thus extended back to that same point. The derived mileages, in Table Set 3.8, below, indicate that there are very limited truck miles savings (less than 1 mile) versus the closest St. Paul ports, and would leave the cargo with a “river mile” disadvantage versus St. Paul ports. Also, the actual truck route time to Savage would be expected to be longer than to St. Paul, since much of the Savage route is not on expressways (CAT1 road type).

The Bunge port is used as the representative Savage point, and it is 1.8 river miles further from the St. Paul ports than the UHT (but without intervening locks). The Savage ports handle grain, fertilizer, salt, and aggregates, but not general cargo. The primary facilities are owned by large organizations such as Cargill and Bunge. Traffic to the UHT is generally cargo that wants to use independent facilities (otherwise it would likely already be going to Savage), and would thus not likely reroute to the Savage facilities.

Table Set 3.8: UHT/Savage Distance Adjustment

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
adjustment for distance savings from I94/I494 to UHT										
savings	R5C	junction I94/I494	Upper Harbor Term.	11.37	0.00	0.18	**11.54**	0	0	
net (additional) distance from northwest of Twin City Metro										
Oss_1net	R5A	NW of Metro	Savage	6.44	7.93	0.00	**14.37**	0	0	

iii) AI Minneapolis Yard/Cemstone Minneapolis

Overview of the AI Aggregate Movement

Aggregate Industries (AI) moves aggregate into the AI Minneapolis Yard/Cemstone Minneapolis complex from the AI Nelson and Larson Plants (quarries) downriver on Grey Cloud Island. This inbound movement is the majority of the volume of the overall Upper Harbor modal shift, and is referred to as the “AI Minneapolis Yard” movement.

Close to 50% of the volume at the Minneapolis Yard is used by the adjacent Cemstone Minneapolis facility(which is supplied by conveyor from the Minneapolis Yard stockpiles). It is assumed that this point would continue to be supplied, and this portion of the current AI Minneapolis volume is referred to as the “core movement” which would consist entirely of whole-move movements. Core movement is rounded to a simple 50% of the total current tonnage to AI Minneapolis.

The remaining volume is currently moved by truck to other locations, and are incremental trips in the diversion scenarios. These incremental trips include amounts to Cemstone Blaine, northwest of the Minneapolis Yard (and thus similar to the other movements discussed), and small amounts to Cemstone Burnsville and Cemstone Midway which occur due to day to day logistical constraints such as the capacity constraints at AI St. Paul Yard. The Chapter 2 interviews indicated that these movements are overwhelmingly to the north and west of the Minneapolis Plant, but not at sufficient distance that I694 would be used instead of I94. So the incremental moves can be simply modeled from the new supply point to the AI Minneapolis location; any additional distances would be distances already occurring in the current flows from the Minneapolis Yard to its customer locations.

A key point in analysis of the Minneapolis Yard movement is that, if there is a water movement involved, product must be stockpiled for the winter months, when the river is not available (as stated in Chapter 2, Aggregate Industries' river season averages 32 weeks). Stockpiles also play a secondary role in day-to-day logistical considerations of filling variable demand, for variable product formulations, at multiple locations. The "AI St. Paul Plant" scenario requires that the river is still used for part of the movement. The Chapter 2 interviews indicated that one-quarter of the "non-core" truck demand is winter. This amount becomes "whole-move" rather than incremental (i.e. an entirely separate trip occurs for the pick-up in winter). This adjustment means that, for this scenario, 62.5% (equal to the entire 50% of the core movement, plus one-quarter of the remaining 50%) is modeled as whole-move. The remaining 37.5% is thus incremental. For the other two scenarios, with no water movement, this adjustment does not have to be made and the split is 50% whole-move and 50% incremental.

Due to the intense and short-urban nature of these trips, and use of gravel trucks, which cannot effectively move products such as grain, it would normally be expected that 100% of the trips will have an empty backhaul trip. However, Chapter 2 interviews indicated that American Iron may have an available backhaul move for one-quarter of these trips (i.e. the ratio of forecast American Iron movement truck trips to Aggregate Industries movement truck trips). Thus it is estimated that 75% of these trips will have an empty backhaul trip.

AI Minneapolis Yard from AI St. Paul Yard (Map E)

In this scenario ("AI St. Paul") the entire current Minneapolis Yard volume is supplied directly by truck from St. Paul Yard. The product is stockpiled at the Minneapolis Yard and current movement out of the Yard in winter occurs as if the product had arrived by barge – thus there are whole-move truck trips for this portion (note that another "whole-trip" will then occur when the product is delivered; but these trips are not included in the model since they already occur and are not extended). As discussed above, this means that 62.5% of trips are modeled as whole-move and 37.5% as incremental (scenarios AI_whole and AI_inc, respectively).

Table Set 3.9: AI Minneapolis from AI St. Paul

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
AI_whole	R2A	AI St Paul	AI Minn	13.70	1.73	1.19	**16.62**	1	1	21,772
AI_inc	R2A	AI St Paul	AI Minn	13.70	1.73	1.19	**16.62**	1	1	13,063

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
AI_whole	R2A	AI St Paul	AI Minn	298	38	26	**362**	21,772	21,772	21,772
AI_inc	R2A	AI St Paul	AI Minn	179	23	16	**217**	13,063	13,063	13,063
Total		AI St Paul	AI Minn	477	60	41	**579**	34,836	34,836	34,836

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**water miles**	**ton miles**	thous tons
AI_whole	R2A	AI St Paul	AI Minn	6,862	868	595	8,325	-18.8	-9,414	500.8
AI_inc	R2A	AI St Paul	AI Minn	4,117	521	357	4,995	-18.8	-5,649	300.5
Total		AI St Paul	AI Minn	10,979	1,389	951	**13,319**	-18.8	-15,063	801.2

As indicated in Tables B & C of Table Set 3.9 (above), this scenario (AI/C-1) produces an annual total increase of 579 thousand loaded truck VMT from 34,836 *new* loaded truck trips through the Metro. This is equivalent to 13.32 million truck ton miles, which would be offset by a reduction of 15.01 million river barge ton-miles. As explained in "discussion and rational" several pages following, this scenario is used in the "most likely" summary scenario I.

AI Minneapolis Yard from AI Nelson & Larson Plants (Map F)

In this scenario ("AI Nelson/Larson"), the entire current Minneapolis Yard volume is supplied directly by truck from the Nelson/Larson plants. Winter stockpiling at the AI Minneapolis Yard is not necessary in this scenario, since no water movement is involved. Thus a trip split of 50% whole-move and 50% incremental is used (scenarios NL_whole and NL_inc, respectively).

The Nelson/Larson plant scenarios have the complication of two distinct origin points. Gravel aggregates are produced at the AI Nelson plant. Limestone aggregates are produced at the AI Larson plant. The vast majority of product moved to Minneapolis Yard is gravel from the AI Nelson plant, which is also the more distant (downriver). The methodology used to properly account for both origin points is to simply weight the route distances by the respective shares of the tonnages from the Nelson (7/8) and Larson (1/8) Plants, similarly to the technique used for the UHT calculations (see the first table in Table Set 3.10, below).

Table Set 3.10: AI Minneapolis from AI Nelson/Larson

Route Distance Weighting				trip length (miles) by road type category				**I94** and	
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**
AI Nelson/AI Larson Distance Weighting by volumes									
87.5%	R2B	AI Nelson	AI Minn	15.86	7.56	6.02	**29.44**	1	1
12.5%	R2F	AI Larson	AI Minn	15.86	7.56	0.90	**24.33**	1	1
NL_avg	adj	AI Larson Plant	AI Nelson Plant	15.86	7.56	5.38	**28.80**	1	1

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
NL_whole	adj	AI Larson Plant	AI Nelson Plant	15.86	7.56	5.38	**28.80**	1	1	17,418
NL_inc	adj	AI Larson Plant	AI Nelson Plant	15.86	7.56	5.38	**28.80**	1	1	17,418

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
NL_whole	adj	AI Larson Plant	AI Nelson Plant	276	132	94	**502**	17,418	17,418	17,418
NL_inc	adj	AI Larson Plant	AI Nelson Plant	276	132	94	**502**	17,418	17,418	17,418
Total		AI Larson Plant	AI Nelson Plant	553	264	187	**1,003**	34,836	34,836	34,836

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo thous tons
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**water miles**	**ton miles**	
NL_whole	adj	AI Larson Plant	AI Nelson Plant	6,354	3,031	2,155	**11,540**	-30.7	-12,299	400.6
NL_inc	adj	AI Larson Plant	AI Nelson Plant	6,354	3,031	2,155	**11,540**	-30.7	-12,299	400.6
Total		AI Larson Plant	AI Nelson Plant	12,708	6,061	4,310	**23,079**	-30.7	-24,598	801.2

Thus, as indicated in Tables B & C of Table Set 3.10 (above), this scenario (AI/C-2) produces an annual total increase of 1,003 thousand loaded truck VMT from 34,836 loaded truck trips through the Metro. This is equivalent to 23.08 million truck ton miles, which would be offset by a reduction of 24.599 million river barge ton-miles.

AI Minneapolis Yard from Cemstone Dayton (Map G)

This scenario ("Cemstone Dayton") uses supply from the prospective Cemstone Dayton facility. Again, no stockpiling would be required at the AI Minneapolis Yard since no water movement is involved. Thus a trip split of 50% whole-move and 50% incremental is used (scenarios CDytn_inc and CDytn_whl, respectively).

Cemstone Dayton, which will receive product by rail, is an alternative source that would be available to Cemstone, although probably at a higher product cost than Aggregate Industries. An arbitrary point was chosen for Cemstone Dayton in the route analysis: at the I 94 W overpass on Brockton LN N, which is adjacent to the rail line. This point also captures some CAT2 roads for the route, since I94 cannot be entered directly at this overpass. The actual location will probably be a greater distance than the route modeled.

Since Cemstone Dayton is northwest of AI Minneapolis, many of the incremental trips (i.e. non-core movement) will now move a shorter distance than they would if coming from AI Minneapolis. To account for this, the incremental moves use a route table with mileages reduced by one-third from those used for the whole-move volumes.

Table Set 3.11: AI Minneapolis from Cemstone Dayton

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
Cemstone Dayton to AI Minneapolis										
CDytn_whl	R2C	Cem Dayton	AI Minn	15.75	0.00	5.27	**21.02**	0	0	17,418
CDytn_inc	R2C	Cem Dayton	AI Minn	10.49	0.00	3.51	**14.00**	0	0	17,418

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
CDytn_whl	R2C	Cem Dayton	AI Minn	274	0	92	**366**	0	0	17,418
CDytn_inc	R2C	Cem Dayton	AI Minn	183	0	61	**244**	0	0	17,418
Total		Cem Dayton	AI Minn	457	0	153	**610**	0	0	34,836

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo thous tons
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**water miles**	**ton miles**	
CDytn_whl	R2C	Cem Dayton	AI Minn	6,308	0	2,111	8,419	-30.7	-12,299	400.6
CDytn_inc	R2C	Cem Dayton	AI Minn	4,201	0	1,406	5,607	-30.7	-12,299	400.6
Total		Cem Dayton	AI Minn	10,509	0	3,517	**14,026**	-30.7	-24,598	801.2

Thus, as indicated in Tables B & C of Table Set 3.11 (previous page), this scenario produces an annual total increase of 610 thousand loaded truck VMT from from 34,836 loaded truck trips into (not through) the Metro. This is equivalent to 14.03 million truck ton miles, which would be offset by a reduction of 24.60 million river barge ton-miles. Note again that the distances, and thus the associated VMT and ton miles, are very likely understated for this prospective facility.

AI Movement Scenario Discussion and Rationale

The first scenario ("AI St. Paul") posits (i.e. what would happen if) the current AI Minneapolis Yard water movement being replaced by truck trips from the AI St. Paul Yard. However, shippers interviewed in Chapter 2 claim that the AI St. Paul Yard is already operating at full capacity and could not stockpile additional product. Even expanding the truck transloading facilities (to supply Minneapolis Yard by truck) would be difficult, since it would impinge on stockpile capacity.

Shippers thus indicate a possible alternative scenario whereby all existing Minneapolis Yard supplies would move by truck directly from the Nelson and Larson plants, where the aggregate is produced. This is the second scenario modeled ("AI Nelson/Larson").

It is quite possible that this scenario could apply for at least a transitional period, and perhaps longer. However, the truck load VMT for this scenario is significantly higher for the "AI St. Paul" scenario or the "Cemstone Dayton"scenario. The planned Cemstone Dayton facility, which will receive product by rail, is a future alternative source that would be available to Cemstone, although probably at a higher product cost than Aggregate Industries (see the Cemstone Dayton scenario discussion).

Thus it is expected that the higher truck operational costs of the "AI Nelson/Larson"scenario, and potential competition from the prospective Cemstone Dayton facility, would provide a strong incentive for Aggregate Industries to make operational changes and equipment investments to support expanded barge to truck transloading at St. Paul Yard to supply Minneapolis Yard ("AI St. Paul" scenario). An additional point not fully captured in the road type modeling is that the roads around the AI Nelson and Larson plants (Grey Cloud Island and St. Paul Park) are very unsuited for an intensive truck haul, providing another incentive to reduce these trips. Note that this is not a direct economic incentive to the shipper, but a desire to maintain good relations with the community surrounding the Plants, and the operational problems of using inadequate roads, will still be strong motivators to Aggregate Industries.

So, the "AI St. Paul" scenario is judged to be the "most likely", at least in the longer term.

However, stockpile space would remain very tight at St. Paul Yard, and would probably be exacerbated by the expanded truck loading facilities. Note also that there is apparently no adjacent land realistically available for St. Paul Yard expansion. The tight situation at St. Paul Yard means that very little "replacement" of current winter truck movements from Minneapolis Yard could be expected to occur from the AI St. Paul Yard. Also, truck cost incremental-trip distance savings (in the shorter trips from St. Paul Yard than the Nelson/Larson plants) would be offset by the additional handling costs (i.e. the barge trip before transloading to truck at the AI St. Paul Yard), versus truck delivery directly from the Nelson/Larson plants. This again would provide incentives to ship product directly from the Larson/Nelson plants.

Forecast Total Annual Increase in Loaded Truck-Miles

The Minneapolis Upper Harbor modal shift involves multiple movements, each with its own set of feasible scenarios. Calculation of the estimated overall impact of the Upper Harbor modal shift consists of selecting the single most likely scenario for each movement, and then simply adding together these most likely scenarios (one for each movement) into a summary scenario of total estimated LT_VMT, by road type, for all movements in the modal shift.

The scenarios judged to be most likely, and thus used for the overall forecast, are:

i) Existing plus new “shredder” American Iron (AIS) volumes move by truck to the Dakota Bulk port at St. Paul (scenario AIS-4).

ii) Various cargos moving through the Upper Harbor Terminal move instead by truck to/from a weighted average of the ports at St. Paul and Savage (scenario UHT_avg). Since these trips only extend current truck trips, only an estimate of the net incremental mileage, and associated LT_VMT, is needed.

iii) Aggregates to the AI Minneapolis Yard/Cemstone Minneapolis are moved by truck from the AI St. Paul Yard, which is supplied by water (“AI St. Paul” scenario). Some current truck trips from the Minneapolis Yard become incremental trips, but others remain whole-moves because aggregate is stockpiled at the AI Minneapolis Yard for winter use (due to lack of capacity at the AI St. Paul Yard).

The above are illustrated below as the “most likely” summary scenario I. The analysis of the AI Minneapolis Yard movement also suggested a strong possibility that the AI Minneapolis Yard could be supplied directly from the AI Nelson and Larson plants (“AI Nelson/Larson”scenario), at least for a transitional period. A “transitional” summary scenario II is thus also illustrated below, replacing the “AI St. Paul” scenario with the “AI Nelson/Larson” scenario for the AI Minneapolis Yard movement.

The “most likely” summary scenario I is a conservative estimate of the likely impacts. The actual volumes are expected to fall somewhere between this summary scenario and the “transitional” summary scenario II.

Several points explained elsewhere are important notes for this analysis:

- The truck VMT represent one-way loaded trips only – most trips will have empty backhauls, so total VMT will be approximately double the LT_VMT estimates.
- The estimates developed in the scenarios deliberately tend towards the conservative (lower) estimates.

- Holcim cement movements are not included in the modal shift summary scenarios for the Upper Harbor since this modal shift is already underway and thus would not be impacted by loss of water access to the Upper Harbor. The truckload equivalents of the Holcim movement are discussed separately (on page 50).

Table Set 3.12: "Most Likely" Scenario

Table B: (ml)	**Annual truck loads and LT_VMT** **by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
AIS-3	R3A	Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574
ii) Upper Harbor Terminal, weighted average of routes										
UHT_avg	A&C	UHT cargo traffic	port/route average	321	78	9	**407**	8,296	8,296	22,713
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
Total		AI St Paul	AI Minn	477	60	41	**579**	34,836	34,836	34,836
			total forecast annual increase:	934	186	62	**1,182**	51,706	51,706	66,123

Table C: (ml)	**Ton-Miles (Thousand Annual)** **by Road Type**			truck by road type category thousand annual ton miles				WATER		cargo thous tons
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**river miles**	**ton miles**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
AIS-3	R3A	Am Iron	Dakota	3,136	1,113	267	**4,515**	-24.7	-4,871	197.2
ii) Upper Harbor Terminal, weighted average of routes										
UHT_avg	A&C	UHT cargo traffic	port/route average	7,694	1,863	208	**9,760**	-19.7	-10,740	545.1
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
Total	0	AI St Paul	AI Minn	10,979	1,389	951	**13,319**	-18.8	-15,063	801.2
			total forecast annual increase:	21,809	4,364	1,427	**27,595**		-30,674	1,543.5

As indicated in Table Set 3.12 (above), the "most likely" total predicted impact, if the water mode of transport is not available to the Minneapolis Upper Harbor Port facilities, is 1.182 million annual loaded truck miles of traffic from 66,123 new one-way (loaded) truck trips through the Metro area. This is equivalent to 27.60 million truck ton miles, which would offset a reduction of 30.67 million ton-miles in river barge traffic. Note that this predicted increase is in addition to expected diversions of some rail mode traffic, which would continue on rail to alternative transload points (Savage or St. Paul ports).

Table Set 3.13: "Transitional" Scenario

Table B: (t)	**Annual truck loads and LT_VMT** **by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
AIS-3	R3A	Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574
ii) Upper Harbor Terminal, weighted average of routes										
UHT_avg	A&C	UHT cargo traffic	port/route average	321	78	9	**407**	8,296	8,296	22,713
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI Nelson/Larson Plants										
Total	0	AI Larson Plant	AI Nelson Plant	553	264	187	**1,003**	34,836	34,836	34,836
			total forecast annual increase:	1,009	390	208	**1,606**	51,706	51,706	66,123

Table C: (t)	Ton-Miles (Thousand Annual) by Mode and Road Type			truck by road type category thousand annual ton miles				WATER		cargo
								river	ton	thous
scenario	route	origin	destination	CAT1	CAT2	CAT3	total	miles	miles	tons
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
AIS-3	R3A	Am Iron	Dakota	3,136	1,113	267	**4,515**	-24.7	-4,871	197.2
ii) Upper Harbor Terminal, weighted average of routes										
UHT_avg	A&C	UHT cargo traffic	port/route averag	7,694	1,863	208	**9,760**	-19.7	-10,740	545.1
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI Nelson/Larson Plants										
Total	0	AI Larson Plant	AI Nelson Plant	12,708	6,061	4,310	**23,079**	-30.7	-24,598	801.2
			total forecast annual increase:	23,538	9,036	4,786	**37,354**		-40,208	1,543.5

As indicated in Table Set 3.13 (above), the alternative “transitional” modal shift scenario has a total predicted impact of 1.606 million annual loaded truck miles of traffic from 66,123 new one-way (loaded) truck trips through the Metro area. This is equivalent to 37.35 million truck ton miles, which would offset a reduction of 40.21 million ton-miles in river barge traffic. Note that this predicted increase is in addition to expected diversions of some rail mode traffic, which would continue on rail to alternative transload points (Savage or St. Paul ports).

B. Holcim Cement

Holcim Minneapolis from St. Paul Dakota Bulk (Map H)

Holcim Cement movements are not included in the Upper Harbor modal shift summary scenarios since this modal shift is already underway and thus would not be impacted by loss of water access to the Upper Harbor. Cement to the Holcim cement elevator is part of the historic commodity volumes to the Upper Harbor used for this analysis. However, the interviews of Chapter 2 indicated that Holcim is in the process of discontinuing the operation of the Upper Harbor facility, in favor of delivery from a new facility at the Dakota Bulk port in St. Paul.

The route miles and associated loaded truck VMT are calculated in a similar manner to the other Upper Harbor facilities, illustrated in Table Set 3.14 (next page). Modeling this scenario (Holcim) in a similar manner to the other Upper Harbor movements produces an annual total increase of 140 thousand loaded truck VMT from 6,036 whole-move loaded truck trips through the Metro. This is equivalent to 3,502 thousand truck ton miles, which would be offset by a reduction of 3,893 thousand river barge ton-miles.

However, the actual movements are not expected to use this route pattern, since there would be very little benefit to re-handling the product at the Upper Harbor location (which is thus slated for eventual closure). There is the additional factor of strong competitive response from the remaining Upper Harbor Lafarge location (which receives inbound product by rail only). Due to this highly competitive environment, and the uncertain nature of future distribution patterns, detailed data is not available from Holcim. One interviewee thought that Holcim may find it necessary to maintain operations at the Upper Harbor location to maintain their market share in that area. If so, it can also be expected that this facility will continue to be supplied by water.

Table Set 3.14: Holcim Minneapolis from St. Paul Dakota Bulk

Table A:	**Route Distances by Road Type**			trip length (miles) by road type category				**I94** and		truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
Holcim	R3B	Dakota	Holcim Minn	16.98	5.64	0.58	**23.21**	1	1	6,036

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	loads
Holcim	R3B	Dakota	Holcim Minn	103	34	4	**140**	6,036	6,036	6,036

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo
								water	**ton**	thous
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**miles**	**miles**	tons
Holcim	R3B	Dakota	Holcim Minn	2,563	851	88	3,502	-25.8	-3,893	150.9

Previous Modal Shifts

C. Koch Petroleum Modal Shift (Map I)

As discussed in Chapter 2, the Koch Petroleum diversion from water occurred to pipeline. No known direct truck effects occurred from the modal shift. It is likely that indirect effects exist, but these cannot be accurately modeled.

D. Incan Superior Modal Shift (Map J: Thunder Bay to Duluth)

As discussed in Chapter 2, this modal shift was apparently to longer land rail routes, not to truck. However, an estimate of the truck volumes of a hypothetical parallel movement (on US 61) is derived for information purposes, using the figures from Lambert 1997 [2], which are estimates of truck volumes representing the Incan Superior tonnage capacity.

Canadian data is not included in the U.S. NHPN or HPMS. Canadian distances and associated categorization are estimates derived from a map. The route points mapped were Bowater Forest Products (2001 Neebing Ave Thunder Bay, ON Canada) to Hallett Dock 5, 200 S 37th Ave W, Duluth. Hallet Dock 5 was used because it is capable of transloading inbound trucks and barges to rail – an 'actual' transload site could not be used since the modeled truck movements are not actually occurring.

As illustrated in Table Set 3.15 (next page), this scenario predicts 3.51 million loaded-truck VMT, from 17,857 truckloads, representing 62.88 million truck ton miles replacing 69 million water ton-miles.

Table Set 3.15: Incan Superior Movement

Route Distances by Road Type			**area type**	trip length (miles) by road type category			
route	**origin**	**destination**		**CAT1**	**CAT2**	**CAT3**	**total**
R1A	U.S. Border	Hallett Dock 5	Rural	0.00	142.00	0.00	142.00
R1A	U.S. Border	Hallett Dock 5	Urban	5.81	7.89	3.73	17.43
R1A	**total U.S. distances**			5.81	149.89	3.73	**159.43**
	Thunder Bay	U.S. Border	Rural	0.00	26.25	0.00	26.25
	Thunder Bay	U.S. Border	Urban	0.00	10.00	1.50	11.50
R1A (Can)	**total Canadian distances**			0.00	36.25	1.50	**37.75**

Total Distances (U.S. and Canada):

	Thunder Bay	Hallett Dock 5	Rural	0.00	168.25	0.00	168.25
	Thunder Bay	Hallett Dock 5	Urban	5.81	17.89	5.23	28.93
R1A+Can	**total (U.S. & Can.) distances**			**5.81**	**186.14**	**5.23**	**197.18**

(Note: the VMT and truckloads below are only loaded trips)

Table B:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94** and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
Rural	Thunder Bay to Hallet Dock5 , Duluth			0	3,004	0	**3,004**	na	na	17,857
Urban	Thunder Bay to Hallet Dock5 , Duluth			104	319	93	**517**	na	na	17,857
Total	Thunder Bay to Hallet Dock5 , Duluth			104	3,324	93	**3,521**	na	na	17,857

Table C:	**Ton-Miles (Thousand Annual) by Mode and Road Type**			truck by road type category thousand annual ton miles				WATER		cargo thous tons
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**water miles**	**ton miles**	
Rural	Thunder Bay to Hallet Dock5 , Duluth			0	63,094	0	63,094	184.0	69,000	375.0
Urban	Thunder Bay to Hallet Dock5 , Duluth			2,179	6,709	1,961	10,849			
Total	Thunder Bay to Hallet Dock5 , Duluth			2,179	69,803	1,961	**73,943**	184.0	69,000	375.0

Chapter 4: Cost Estimation

Overview

As discussed in Chapter 1, two types of cost analysis are used in this study:

1. Costs by ton-mile, consisting of:
    - Private haulage costs; and
    - fuel consumption, emissions, and accidents from the Lambert coefficients.
2. Costs by heavy-truck VMT, using the HCAS coefficients to produce:
    - Public Sector (road maintenance) costs; and,
    - Public Externality (emission, congestion, crash and noise) costs.

Each type of cost analysis discussed individually in turn. For reference purposes, tables are again grouped into Table Sets. This Chapter first describes the methodology for each cost type, and applies each to the Minneapolis Upper Harbor scenarios. This Chapter then applies the same methodologies to the Holcim and Incan Superior movements.

Summary of Truck Trips by Type

Table Set 4.1 (below) summarizes the information developed in Chapter 3 and the interviews in Chapter 2. This information is used in the subsequent steps of this analysis.

Table Set 4.1: Summary of Truck Trips by Type

I. "Most Likely" Summary Scenario		WATER		ROAD							
								truck trip type			
								backhaul			
scenario	cargo thous tons	water miles	thous ton miles	annual truck-loads	thous TL_VMT	road miles	thous ton miles	empty	paid	incr trip	whole move
Am. Iron with shredder	197	-24.7	-4,871	8,574	196	22.9	4,515	0%	100%	0%	100%
UHT weighted average	545	-19.7	-10,740	22,713	407	17.9	9,760	50%	50%	100%	0%
Al Minn from Al St Paul	801	-18.8	-15,063	34,836	579	16.6	13,319	75%	25%	38%	63%
	1,544		**-30,674**	**66,123**	**1,182**		**27,595**				

II. "Transitional" Summary Scenario		WATER		ROAD							
								truck trip type			
								backhaul			
scenario	cargo thous tons	water miles	thous ton miles	annual truck-loads	thous TL_VMT	road miles	thous ton miles	empty	paid	incr trip	whole move
Am. Iron with shredder	197	-24.7	-4,871	8,574	196	22.9	4,515	0%	100%	0%	100%
UHT weighted average	545	-19.7	-10,740	22,713	407	17.9	9,760	50%	50%	100%	0%
Al Minn from Nelson/Larson	801	-30.7	-24,598	34,836	1,003	28.8	23,079	75%	25%	50%	50%
	1,544			**66,123**	**1,606**		**37,354**				

Calculations by ton-mile

Fuel Use, Emissions, and Accidents

This analysis is based upon information contained in *Monetary Costs of a Modal Shift*, Lambert, 1997 [2]. As discussed in Chapter 1, a literature search was conducted for updated information, but none of comparable applicability was found.

These figures develop emissions and accident rates. An EPA estimate of the public externality cost of some types of emissions was also used by Lambert to construct an approximate cost of these emissions. These cannot be directly compared to the costs developed from vehicle VMT (several of the bases of measurement are very different). However, the "emission cost ratio" and "accident ratio" could be usefully applied to the predicted truck costs from the VMT analysis, to create a somewhat comparable estimate of the barge costs for "crash" (accidents) and "air pollution" (emissions). This step is not performed in this study.

Note that Lambert also estimated the cost of truck tires for these trips. This and similar operating costs (ex. engines, frame wear, etc.) certainly occur but are assumed to be captured in the haulage rates charged by operators (next section) and are thus not estimated separately.

Table 4.2 below indicates the Lambert 1997 rates (coefficients). Table 4.3 applies these rates to the ton-miles, for truck and barge, in the two summary scenarios developed in Chapter 3. Note that the 'fuel use ratio' and 'accident ratio' (each ratio is equal to the truck rate divided by the barge rate) in Table 4.3 are larger than Table 4.2. This is because the Table 4.3 ratios also account for differences in ton-miles needed to move the cargos. The barge routes are somewhat longer than the truck routes, so this factor alone slightly increases the barge emissions and accidents relative to truck. As illustrated in Table 4.3 (next page), the analysis finds that:

- in the 'most likely' scenario, the truck movement is expected to have 7.8 times the fuel use (466 versus 60 thousand gallons of diesel per year), 33 times the accidents, and 150 times the emissions 'cost' of the barge movement; and,
- in the 'transitional' scenario, the truck movement is expected to have 8.1 times the fuel use (631 versus 78 thousand gallons of diesel per year), 34 times the accidents, and 155 times the emissions 'cost' of the barge movement.

Note that the huge difference in emissions costs, between trucks and barges, is due to the fact that trucks emit approximately 20 times the nitrous oxide, per gallon of fuel consumed, as barges and nitrous oxide is by far the most 'costly' of the emissions.

Table 4.2: Lambert 1997 Coefficients (translated to thousand ton-miles)

Diesel Fuel Use, Emissions, and Accident Rates per thousand ton miles, by mode									
	RATES per Thousand Ton-Miles								
	gallons diesel	pounds hydro-carbons	pounds carbon monoxide	pounds nitrous oxide	emission costs	**fuel use ratio**	emission **cost ratio**	accidents (per million ton miles)	accident **ratio**
Truck	16.89	0.6301	1.9003	10.1706	$17.20	8.7	166.8	0.0613	36.8
Rail	4.95	0.4599	0.6401	1.8302	$0.91	2.5	8.8	0.0039	2.3
Barge	1.95	0.0899	0.1996	0.5288	$0.10	1.0	1.0	0.0017	1.0
		unknown	$0.0005	$0.1000	<< emissions cost in $/pound				
	source of above rates: Lambert 1997, referencing EPA 1992 and Eastman 1980								

Table 4.3: Estimated Fuel Use, Emissions & Accidents (using Lambert 1997)

Diesel Fuel Use, Emissions, and Accident Rates, & ratios weighted by differences in ton miles										
	cargo ton miles	gallons diesel	pounds hydro-carbons	pounds carbon monoxide	pounds nitrous oxide	emission costs	**fuel use ratio**	emission **cost ratio**	accidents (per million ton miles)	accident **ratio**
I. "Most Likely" Summary Scenario										
Truck	**27,595**	466,124	17,386	52,439	280,653	$474,520	**7.8**	**150.1**	1.691	**33.1**
Barge	**-30,674**	-59,676	-2,757	-6,123	-16,220	-$3,162	1.0	1.0	-0.051	1.0
net change	**-3,079**	406,448	14,629	46,316	264,433	$471,358			1.640	
II. "Transitional" Summary Scenario										
Truck	**37,354**	630,986	23,536	70,986	379,916	$642,350	**8.1**	**155.0**	2.289	**34.2**
Barge	**-40,208**	-78,226	-3,614	-8,026	-21,262	-$4,144	1.0	1.0	-0.067	1.0
net change	**-2,854**	552,760	19,922	62,960	358,655	$638,206			2.222	
using rates per thousand ton miles derived from Lambert 1997, referencing EPA 1992 and Eastman 1980										

Truck and Barge Haulage Costs

Chapter 1 explained that truck rates can be broken into four parts: load; fronthaul; unload; and return trip (which is either an empty or paid backhaul). In urban areas, truck "rates" are typically based upon time and an hourly rate. Rates "per ton" are actually only the typical trip cost (based upon time of trip) divided by the cargo payload. Nonetheless, shippers are most concerned with how much it costs to move their cargo by ton, and typically calculate "average rates" based upon average or total truck costs divided by the appropriate tonnage. Similar calculations apply to the barge "rates" for movements to and from the Upper Harbor.

The interviews of Chapter 2 revealed that, for trips between the Upper Harbor and St. Paul ports, the truck times can be roughly divided into one-quarter for each step: half-hour load; half-hour fronthaul; half-hour unload; and half-hour return trip. UHT estimates a cost for the incremental portion only of $3 per ton (i.e. only extending a trip that would normally be to/from the UHT, to/from St. Paul instead, thus excluding costs for the load and unload steps). UHT also estimates that a paid backhaul would reduce this rate by about one-third, or $1 per ton. These rates are used as the cost of an incremental truck trip ("incr trip") for all movements to St. Paul ports in the "truck rate $/ton" columns in Table Set 4.4 and 4.5 (next page). Also, one dollar per ton is deducted as an estimated saving for every paid backhaul trip (in the "paid backhaul" column).

American Iron estimates $5-$6 per ton for a full move due to half-hour load and half-hour unload, so $5 per ton is used for their whole-moves. An intensive gravel haul should be able to cut load/unload times in half, so $4 is used for the Aggregate Industries incremental trips to St. Paul ports. Note that no whole-moves occur for the UHT.

Due to the differences in route miles, which are primarily on local roads (half or less the speed of CAT1 roads) the Aggregate Industries: truck trip to Nelson/Larson is double the trip time so $2 per ton is added to both types of trip rate for this movement. Note that the backhaul reduction is not changed since it is highly unlikely that a backhaul would be all the way from Nelson/Larson (trucks would need to return at least to the St. Paul ports).

Barge costs between the Upper Harbor and St. Paul are commonly estimated at 50 cents per ton. No firm information on their barge costs was available from Aggregate Industries. This cost (and their actual cost for intensive truck gravel hauls) are very commercially sensitive information. Nelson/Larson is assigned $1 per ton barge saving because of both a longer trip and the elimination of the load/unload of the barge in the logistic chain (i.e. one less handling step, versus movement through AI St Paul, for the product moving to the AI Minneapolis Yard). Note that the cost per mile for this trip portion (i.e. only to AI St. Paul) will be lower than to the Upper Harbor due to the elimination of the time (and distance) to move through the locks, and because a larger barge tow is used (6 barges at a time versus the two barge tow used through the locks).

In the “most likely” scenario, illustrated in Table Set 4.4 (below), the calculated net trucking costs are $4.856 million per year. This would be offset by saved barge costs of $722 thousand per year, for a net cost increase of $4.084 million per year to move the cargo to the Upper Harbor by truck rather than by barge.

In the “transitional” scenario, illustrated in Table Set 4.5 (next page), the calculated net trucking costs are $6.358 million per year. This would be offset by saved barge costs of $1.172 million per year, for a net cost increase of $5.186 million per year to move the cargo to the Upper Harbor by truck rather than by barge.

Table Set 4.4: “Most Likely” Scenario Haulage Costs

I. "Most Likely" Summary Scenario									
Trip Type Tonnages	ROAD	WATER	**cargo**	truck trip type		paid			
	road	river	**thous**	incr	whole	back-			
scenario	miles	miles	**tons**	trip	move	haul		Barge	
Am. Iron with shredder	22.9	-24.7	**197**	0%	100%	100%		100%	
UHT weighted average	17.9	-19.7	**545**	100%	0%	50%		100%	
AI Minn from AI St Paul	16.6	-18.8	**801**	38%	63%	25%		100%	

I. "Most Likely" Summary Scenario				**truck rate $/ton**					
Rates/Ton by Trip Type	ROAD	WATER	**cargo**	truck trip type		paid		Barge	
	road	river	**thous**	incr	whole	back-		Rate	
scenario	miles	miles	**tons**	trip	move	haul		$/ton	
Am. Iron with shredder	22.9	-24.7	**197**		$5.00	-$1.00		$0.50	
UHT weighted average	17.9	-19.7	**545**	$3.00		-$1.00		$0.50	
AI Minn from AI St Paul	16.6	-18.8	**801**	$3.00	$4.00	-$1.00		$0.50	

I. "Most Likely" Summary Scenario				**truck cost $thousands**					
Haulage Costs by mode	ROAD	WATER	**cargo**	truck trip type		paid	net	Barge	**NET**
	road	river	**thous**	incr	whole	back-	truck	Cost	**cost**
scenario	miles	miles	**tons**	trip	move	haul	cost	$ thous	**$ thous**
Am. Iron with shredder	22.9	-24.7	**197**	$0	$986	-$197	$789	-$99	**$690**
UHT weighted average	17.9	-19.7	**545**	$1,635	$0	-$273	$1,363	-$273	**$1,090**
AI Minn from AI St Paul	16.6	-18.8	**801**	$901	$2,003	-$200	$2,704	-$401	**$2,304**
			1,544	$2,537	$2,989	-$670	$4,856	-$772	**$4,084**

Table Set 4.5: “Transitional” Scenario Haulage Costs

II. "Transitional" Summary Scenario									
Trip Type Tonnages	ROAD	WATER	**cargo**	truck trip type		paid			
	road	river	**thous**	incr	whole	back-			
scenario	miles	miles	**tons**	trip	move	haul		Barge	
Am. Iron with shredder	22.9	-24.7	**197**	0%	100%	100%		100%	
UHT weighted average	17.9	-19.7	**545**	100%	0%	50%		100%	
AI Minn from Nelson/Larson	28.8	-30.7	**801**	50%	50%	25%		100%	

II. "Transitional" Summary Scenario				truck rate $/ton					
Rates/Ton by Trip Type	ROAD	WATER	**cargo**	truck trip type		paid		Barge	
	road	river	**thous**	incr	whole	back-		Rate	
scenario	miles	miles	**tons**	trip	move	haul		$/ton	
Am. Iron with shredder	22.9	-24.7	**197**		$5.00	-$1.00		$0.50	
UHT weighted average	17.9	-19.7	**545**	$3.00		-$1.00		$0.50	
Al Minn from Nelson/Larson	28.8	-30.7	**801**	$5.00	$6.00	-$1.00		$1.00	

II. "Transitional" Summary Scenario				truck cost $thousands					
Haulage Costs by mode	ROAD	WATER	**cargo**	truck trip type		paid	net	Barge	**NET**
	road	river	**thous**	incr	whole	back-	truck	Cost	**cost**
scenario	miles	miles	**tons**	trip	move	haul	cost	$ thous	**$ thous**
Am. Iron with shredder	22.9	-24.7	**197**	$0	$986	-$197	$789	-$99	**$690**
UHT weighted average	17.9	-19.7	**545**	$1,635	$0	-$273	$1,363	-$273	**$1,090**
Al Minn from Nelson/Larson	28.8	-30.7	**801**	$2,003	$2,404	-$200	$4,206	-$801	**$3,405**
			1,544	$3,638	$3,390	-$670	$6,358	-$1,172	**$5,186**

Holcim Costs

See "Holcim and Incan Superior Analysis", page 72.

Incan Superior Costs

See "Holcim and Incan Superior Analysis", page 72.

Description and Summaries of Calculations by VMT

Highway Cost Allocation Study (HCAS)

This study uses "marginal costs of highway use" developed by the Federal Highway Administration (FHWA) in the Addendum to the Highway Cost Allocation Study (HCAS Addendum) [7]. These are nationally comparable cost coefficients, which the FHWA has committed to update and refine on a regular basis.

> *Costs of air pollution, congestion, and other impacts of highway use not borne by transportation agencies represent social and economic costs incurred by affected individuals, not engineering costs to comply with standards or to mitigate adverse impacts as the term "costs" is often used in the environmental literature.... Marginal costs of highway use reflect changes in total costs associated with an additional increment of travel. Marginal costs include incremental costs to the highway user (e.g., added vehicle operating cost and travel time), costs to public agencies (added use-related rehabilitation and maintenance costs), and external costs such as air pollution and congestion costs imposed on others. … Table 13 shows estimates of marginal pavement, congestion, crash, air pollution, and noise costs in 2000 for selected vehicles operating under different conditions. Costs reflect typical or average conditions; in certain locations, costs could be expected to vary from values shown. The relative costs of pavement damage, congestion, crashes, air pollution, and noise for different vehicle classes operating in rural and urban areas are as important as the individual costs themselves.* (HCAS Addendum) [7]

Specific coefficients, for both rural and urban Interstates, have been developed, in the HCAS Addendum, for the fully-loaded 5 axle trucks which will move the cargo under study. The coefficients for the line “80 kip 5-axle Com/Urban Interstate” in Table 4.6: HCAS Table 13 (below) are used for the Metro-area traffic. Note that “80 kip” means a fully-loaded 80,000 pound gvw vehicle. As stated in Chapter 2, the roads in the Metro area are all “urban” in the FHWA categorization. Only “Interstate” coefficients are currently available, but Interstate travel both represents the majority of the modeled VMT, and can be expected to represent conditions close to the other major roads used by truck traffic.

To more closely match these other roads (CAT2 and CAT3 roads, as developed and defined in Chapter 3) to the Interstates (CAT1 roads), this analysis also uses “road category cost factors” to conservatively scale up the coefficients used for CAT2 and CAT3 VMT (relative to CAT1 VMT) where there are widely known and accepted differences in impacts (such as pavement maintenance costs). Also, since the vehicle type represents a fully-loaded truck, a “backhaul cost factor” is used to scale down coefficients used for backhaul VMT, relative to loaded fronthaul VMT, where there are widely known and accepted differences in impacts (again, such as in pavement maintenance costs). The rationale for each factor is explained with the summary of each cost type, on the following pages. A summary of the factors is presented in Table 4.7: “HCAS Road Category and Backhaul Cost Factors” (below).

Table 4.6: HCAS “Table 13”

2000 Addendum to 1997 FHWA Highway Cost Allocation Study (HCAS) **Table 13. 2000 Pavement, Congestion, Crash, Air Pollution, and Noise Costs** **for Illustrative Vehicles Under Specific Conditions**						
	$ per thousand VMT					
Vehicle Class/Highway Class	**Pavement**	**Congestion**	**Crash**	**Air Pollution**	**Noise**	**Total**
Autos/Rural Interstate	$0.0	$7.8	$9.8	$11.4	$0.1	$29.1
Autos/Urban Interstate	$1.0	$77.0	$11.9	$13.3	$0.9	$104.1
40 kip 4-axle S.U. Truck/Rural Interstate	$10.0	$24.5	$4.7	$38.5	$0.9	$78.6
40 kip 4-axle S.U. Truck/Urban Interstate	$31.0	$244.8	$8.6	$44.9	$15.0	$344.3
60 kip 4-axle S.U. Truck/Rural Interstate	$56.0	$32.7	$4.7	$38.5	$1.1	$133.0
60 kip 4-axle S.U. Truck/Urban Interstate	$181.0	$326.4	$8.6	$44.9	$16.8	$577.7
60 kip 5-axle Comb/Rural Interstate	$33.0	$18.8	$8.8	$38.5	$1.7	$100.8
60 kip 5-axle Comb/Urban Interstate	$105.0	$183.9	$11.5	$44.9	$27.5	$372.8
80 kip 5-axle Comb/Rural Interstate	$127.0	$22.3	$8.8	$38.5	$1.9	$198.5
80 kip 5-axle Comb/Urban Interstate	$409.0	$200.6	$11.5	$44.9	$30.4	$696.4

Table 4.7: HCAS Road Category and Backhaul Cost Factors

Road Category and Empty Backhaul Cost Factors applied to HCAS, by Cost Type					
	Pavement	**Congestion**	**Crash**	**Air Pollution**	**Noise**
road category cost factor: ratio of CAT2 & CAT3 to CAT1 VMT	**200%**	100%	**200%**	100%	100%
backhaul cost factor: ratio of empty backhaul VMT to loaded truck VMT	**5%**	**75%**	100%	**75%**	100%

The adjusted HCAS coefficients are simply multiplied by the forecast change in truck VMT, to produce estimated annual cost increases under the “most likely” and “transitional” scenarios.

However, first the “loaded truck VMT” (“LT_VMT”) developed in Chapter 3 must be converted to total additional truck VMT, by adding in associated empty backhaul trips. This is done by applying the estimates of percentage of empty backhaul, also developed in Chapter 3, to the loaded truck VMT. Note that "empty backhaul" is equal to 100% minus "paid backhaul", i.e. all trips have either an empty or paid backhaul. The backhaul VMTs are also maintained separately to allow use of the "backhaul scaled" HCAS coefficients.

The subsequent pages present first a section with summaries of the total VMT and HCAS cost calculations, then a following section with the details of the same calculations.

Total Truck Trips, and Truck Trips per Season-Day

This section calculates total VMT (i.e. loaded truck VMT plus associated empty backhaul trips). For information purposes, this total VMT is then divided by "season-days" to derive the expected increase in week day truck trips during the barge season (spring/summer/fall, including loaded fronthaul trips and empty backhaul). There are 160 season-days in a year (5 weekdays times the 32 week barge season).

As illustrated in Table Sets 4.8 and 4.9 (below), the calculated increases in daily truck trips during the 32 week barge season are:

- 648 trips per weekday (with 512 trips per day passing through the interchanges of I94/I35E and I94/I35W) under the "most likely" scenario; and,
- 648 trips per weekday (with 512 trips per day passing through the interchanges of I94/I35E and I94/I35W) under the "transitional" scenario.

Table Set 4.8: Summary of Total & Daily Truck Trips, "Most Likely" Scenario

C. Total for ALL trips (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Table 2: Annual truck TRIPS and trip VMT TOTAL TRIPS by Road Type	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
TOTAL HAUL annual increase:	1,453	270	97	**1,820**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

I. "Most Likely" Summary Scenario							
Table 2: DAILY truck TRIPS and trip VMT SEASON-DAY TRIPS by Road Type	truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
all-trip increase per SEASON-DAY:	9.1	1.7	0.6	11.4	**512**	**512**	**648**

Table Set 4.9: Summary of Total & Daily Truck Trips, "Transitional" Scenario

C. Total for ALL trips (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Table 2: Annual truck TRIPS and trip VMT TOTAL TRIPS by Road Type	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
TOTAL HAUL annual increase:	1,584	626	353	**2,562**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

II. "Transitional" Summary Scenario							
Table 2: DAILY truck TRIPS and trip VMT SEASON-DAY TRIPS by Road Type	truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
all-trip increase per SEASON-DAY:	8.4	3.2	1.7	13.3	**417**	**417**	**552**

Total HCAS Costs

As illustrated in Table Sets 4.10 and 4.11 (below), the calculated net impacts are $1.088 million per year in cost increases under the "most likely" scenario, and $1.617 million per year under the "transitional" scenario. These cost are a summation of all the costs that can be calculated using the HCAS cost coefficients for pavement maintenance, congestion, crash, air pollution, and noise. These costs are sub-totaled into "Public Sector Costs" (road maintenance, amounting to $601 thousand per year in cost increases under the "most likely" scenario, and $929 thousand per year under the "transitional" scenario) and "Public Externality Costs" (congestion, emission, crash, and noise, amounting to $488 thousand per year in cost increases under the "most likely" scenario, and $689 thousand per year under the "transitional" scenario).

Note that close to the entire $328 thousand per year difference in predicted road impact costs, between the "transitional" and "most likely" scenarios, would occur on Grey Cloud Island area and St. Paul Park roads (from the Nelson/Larson Plants). Even this cost figure likely represents a significant underestimate of the costs for these roads, and does not include likely construction costs for upgrades to the road and bridge structures on the road which would probably be quickly needed once an intensive gravel haul begins. A similar under-estimation is likely for crash and noise cost differences between the two scenarios.

Table Set 4.10: Summary of All HCAS Costs, "Most Likely" Scenario

I. "Most Likely" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$778.4	$231.6	$78.7	**$1,088.7**		1,820	103,607

I. "Most Likely" Summary Scenario							
HCAS Public Sector Costs (Pavement Maintenance Costs)	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$392.7	$155.9	$51.9	**$600.5**		1,820	103,607

I. "Most Likely" Summary Scenario							
HCAS Public Externality Costs (congestion, emission, crash & noise costs)	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$385.7	$75.7	$26.8	**$488.2**		1,820	103,607

Table Set 4.11: Summary of All HCAS Costs, "Transitional" Scenario

II. "Transitional" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$844.6	$500.9	$272.3	**$1,617.8**		2,562	103,607

II. "Transitional" Summary Scenario							
HCAS Public Sector Costs (Pavement Maintenance Costs)	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$424.6	$328.3	$175.8	**$928.7**		2,562	103,607

II. "Transitional" Summary Scenario							
HCAS Public Externality Costs (congestion, emission, crash & noise costs)	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$420.0	$172.6	$96.5	**$689.1**		2,562	103,607

Pavement Maintenance Costs

Heavy Trucks create much less pavement damage when empty (though still much more than normal traffic, since the unit can still weigh as much as 15 tons). Thus a factor of 5% was applied for empty backhaul trips. CAT2 and CAT3 type roads cost much more to maintain, per mile of heavy vehicle travel, than CAT1 (interstate-class) roads (which are specifically constructed to accommodate such travel at relatively low maintenance rates, though at an initial construction cost, excluding land costs, that is in turn much higher than CAT1/CAT2 roads). Thus a very conservative factor of 200% was applied for CAT2 and CAT3 roads.

As illustrated in Table Set 4.12 (below), the calculated impacts are $600.5 thousand per year under the “most likely” scenario, and $928.7 thousand per year under the “transitional” scenario.

Table Set 4.12: Summary of HCAS Pavement Maintenance Costs

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$392.7	$155.9	$51.9	**$600.5**		1,820	103,607

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$424.6	$328.3	$175.8	**$928.7**		2,562	103,607

Congestion Costs

Heavy vehicles are much better able to match traffic flows when empty, particularly in stop/start (i.e. congested) traffic and at ramps and merges. Thus a factor of 75% was applied for empty backhaul trips.

As illustrated in Table Set 4.13 (below), the calculated impacts are $333 thousand per year under the “most likely” scenario, and $466 thousand per year under the “transitional” scenario.

Table Set 4.13: Summary of HCAS Congestion Costs

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$265.4	$50.0	$17.7	**$333.1**		1,820	103,607

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$289.0	$113.7	$63.5	**$466.1**		2,562	103,607

Crash Costs

The divided highway and controlled access formation of CAT1 roads produces significantly lower crash rates (and associated costs) than CAT2 and CAT3 roads. Thus a conservative factor of 200% was applied for CAT2 and CAT3 roads.

As illustrated in Table Set 4.14 (below), the calculated impacts are $25.2 thousand per year under the “most likely” scenario, and $40.7 thousand per year under the “transitional” scenario.

Table Set 4.14: Summary of HCAS Crash Costs

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$16.7	$6.2	$2.2	**$25.2**		1,820	103,607

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$18.2	$14.4	$8.1	**$40.7**		2,562	103,607

Air Pollution Costs

Heavy vehicles can be expected to use less fuel (which is the source of air pollution) and be less affected by congestion (a major factor in air pollution rates for a given amount of travel) when empty. Thus a factor of 75% was applied for empty backhaul trips

As illustrated in Table Set 4.15 (below), the calculated net impacts are $75 thousand per year under the "most likely" scenario, and $104 thousand per year under the "transitional" scenario.

Table Set 4.15: Summary of HCAS Air Pollution Costs

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$59.4	$11.2	$4.0	**$74.6**		1,820	103,607

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$64.7	$25.5	$14.2	**$104.3**		2,562	103,607

Noise Costs

As illustrated in Table Set 4.16 (below), the calculated net impacts are $55 thousand per year under the "most likely" scenario, and $78 thousand per year under the "transitional" scenario.

Table Set 4.16: Summary of HCAS Noise Costs

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$44.2	$8.2	$2.9	**$55.3**		1,820	103,607

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$48.2	$19.0	$10.7	**$77.9**		2,562	103,607

Holcim Costs: See "Holcim and Incan Superior Analysis", page 72.

Incan Superior Costs: See "Holcim and Incan Superior Analysis", page 72.

Details of Calculations by VMT

Summary of Annual & Daily Truck Trips

Table Set 4.17: Summary of Annual & Daily Truck Trips

1. "Most Likely" Scenario

A. Loaded Fronthaul Trips

I. "Most Likely" Summary Scenario							
Table 2: Annual truck loads and LT_VMT LOADED HAUL by Road Type	truckload VMT by road type category thousand annual VMT				annual truckloads **I94 and**		annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
LOADED HAUL annual increase:	934	186	62	**1,182**	51,706	51,706	66,123

B. Empty Backhaul Trips

I. "Most Likely" Summary Scenario							
Table 2: Annual truck TRIPS and trip VMT EMPTY BACKHAUL by Road Type	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
empty backhaul annual increase:	518	84	35	**638**	30,275	30,275	37,484

C. Total for ALL trips (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
Table 2: Annual truck TRIPS and trip VMT TOTAL TRIPS by Road Type	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
TOTAL HAUL annual increase:	1,453	270	97	**1,820**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

I. "Most Likely" Summary Scenario							
Table 2: DAILY truck TRIPS and trip VMT SEASON-DAY TRIPS by Road Type	truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
all-trip increase per SEASON-DAY:	9.1	1.7	0.6	11.4	**512**	**512**	**648**

2. "Transitional" Scenario

A. Loaded Fronthaul Trips

II. "Transitional" Summary Scenario							
Table 2: Annual truck loads and LT_VMT LOADED HAUL by Road Type	truckload VMT by road type category thousand annual VMT				annual truckloads **I94 and**		annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
LOADED HAUL annual increase:	1,009	390	208	**1,606**	51,706	51,706	66,123

B. Empty Backhaul Trips

II. "Transitional" Summary Scenario							
Table 2: Annual truck TRIPS and trip VMT EMPTY BACKHAUL by Road Type	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
empty backhaul annual increase:	575	236	145	**956**	30,275	30,275	37,484

C. Total for ALL trips (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
Table 2: Annual truck TRIPS and trip VMT TOTAL TRIPS by Road Type	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
TOTAL HAUL annual increase:	1,584	626	353	**2,562**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

II. "Transitional" Summary Scenario							
Table 2: DAILY truck TRIPS and trip VMT SEASON-DAY TRIPS by Road Type	truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck-trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
all-trip increase per SEASON-DAY:	8.4	3.2	1.7	13.3	**417**	**417**	**552**

Details of Annual & Daily Truck Trips

Table Set 4.18: Detail of Annual & Daily Truck Trips

Most Likely Scenario

A. Loaded Fronthaul Trips

I. "Most Likely" Summary Scenario

Table 2:	Annual truck loads and LT_VMT LOADED HAUL by Road Type			truckload VMT by road type category thousand annual VMT				annual truckloads I94 and		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
AIS-3	R3A	Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574
ii) Upper Harbor Terminal, weighted average of routes										
UHT_avg	A&C	UHT cargo traffic	port/route average	321	78	9	**407**	8,296	8,296	22,713
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
Total	0	AI St Paul	AI Minn	477	60	41	**579**	34,836	34,836	34,836
			LOADED HAUL annual increase:	934	186	62	**1,182**	51,706	51,706	66,123

B. Empty Backhaul Trips

I. "Most Likely" Summary Scenario

Table 2:	Annual truck TRIPS and trip VMT EMPTY BACKHAUL by Road Type			truck-trip VMT by road type category thousand annual VMT				annual truck-trips I94 and		annual truck-trips
				CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
0.0%		Am Iron	Dakota	0	0	0	**0**	0	0	0
ii) Upper Harbor Terminal, weighted average of routes										
50.0%		UHT cargo traffic	port/route average	160	39	4	**203**	4,148	4,148	11,357
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
75.0%		AI St Paul	AI Minn	358	45	31	**434**	26,127	26,127	26,127
(weighted average empty)										
67.4%			**empty backhaul annual increase:**	518	84	35	**638**	30,275	30,275	37,484

C. Total for ALL trips (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario

Table 2:	Annual truck TRIPS and trip VMT TOTAL TRIPS by Road Type			truck-trip VMT by road type category thousand annual VMT				annual truck-trips I94 and		annual truck-trips
				CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
0.0%		Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574
ii) Upper Harbor Terminal, weighted average of routes										
50.0%		UHT cargo traffic	port/route average	481	116	13	**610**	12,444	12,444	34,070
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
75.0%		AI St Paul	AI Minn	835	106	72	**1,013**	60,963	60,963	60,963
			TOTAL HAUL annual increase:	1,453	270	97	**1,820**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

I. "Most Likely" Summary Scenario

Table 2:	DAILY truck TRIPS and trip VMT SEASON-DAY TRIPS by Road Type			truck-trip VMT by road type category thousand daily VMT				daily truck-trips I94 and		daily truck-trips
				CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
0.0%		Am Iron	Dakota	0.852	0.302	0.073	**1.227**	54	54	54
ii) Upper Harbor Terminal, weighted average of routes										
50.0%		UHT cargo traffic	port/route average	3.006	0.728	0.081	**3.812**	78	78	213
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
75.0%		AI St Paul	AI Minn	5.221	0.660	0.452	**6.334**	381	381	381
			all-trip increase per SEASON-DAY:	9.079	1.690	0.606	**11.373**	512	512	648

TRANSITIONAL SCENARIO

A. Loaded Fronthaul Trips

II. "Transitional" Summary Scenario										
Table 2:	**Annual truck loads and LT_VMT LOADED HAUL by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94 and**		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
AIS-3	R3A	Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574
ii) Upper Harbor Terminal, weighted average of routes										
UHT_avg	A&C	UHT cargo traffic	port/route average	321	78	9	**407**	8,296	8,296	22,713
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI Nelson/Larson Plants										
Total	0	AI Larson Plant	AI Nelson Plant	553	264	187	**1,003**	34,836	34,836	34,836
			LOADED HAUL annual increase:	1,009	390	208	**1,606**	51,706	51,706	66,123

B. Empty Backhaul Trips

II. "Transitional" Summary Scenario										
Table 2:	**Annual truck TRIPS and trip VMT EMPTY BACKHAUL by Road Type**			truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
				CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
0.0%		Am Iron	Dakota	0	0	0	**0**	0	0	0
ii) Upper Harbor Terminal, weighted average of routes										
50.0%		UHT cargo traffic	port/route average	160	39	4	**203**	4,148	4,148	11,357
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
75.0%		AI Larson Plant	AI Nelson Plant	414	198	141	**753**	26,127	26,127	26,127
(weighted average empty)										
67.4%			**empty backhaul annual increase:**	575	236	145	**956**	30,275	30,275	37,484

C. Total for ALL trips (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario										
Table 2:	**Annual truck TRIPS and trip VMT TOTAL TRIPS by Road Type**			truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck-trips
				CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
0.0%		Am Iron	Dakota	136	48	12	**196**	8,574	8,574	8,574
ii) Upper Harbor Terminal, weighted average of routes										
50.0%		UHT cargo traffic	port/route average	481	116	13	**610**	12,444	12,444	34,070
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
75.0%		AI Larson Plant	AI Nelson Plant	967	461	328	**1,756**	60,963	60,963	60,963
			TOTAL HAUL annual increase:	1,584	626	353	**2,562**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

II. "Transitional" Summary Scenario										
Table 2:	**DAILY truck TRIPS and trip VMT SEASON-DAY TRIPS by Road Type**			truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck-trips
				CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
i) American Iron at minimum forecast volumes with shredder, to Dakota Bulk										
0.0%		Am Iron	Dakota	0.852	0.302	0.073	**1.227**	54	54	54
ii) Upper Harbor Terminal, weighted average of routes										
50.0%		UHT cargo traffic	port/route average	3.006	0.728	0.081	**3.812**	78	78	213
iii) Aggregate Industries trucking current AI Minneapolis volumes from AI ST. Paul										
75.0%		AI Larson Plant	AI Nelson Plant	4.532	2.162	1.537	**8.231**	286	286	286
			all-trip increase per SEASON-DAY:	8.390	3.192	1.691	**13.271**	417	417	552

Pavement Maintenance Cost Detail

Table Set 4.19: Detail of HCAS Pavement Maintenance Costs

Pavement Maintenance Costs

Pavement Maintenance Costs May 2000 Addendum to 1997 FHWA HCAS	costs by road type category annual cost per thousand VMT				
	CAT1	**CAT2**	**CAT3**	**total**	
HCAS 80 kip 5-axle Comb/Urban Interstate		200%	200%		< road category cost factor
loaded fronthaul costs	**$409.0**	$818.0	$818.0		
adjusted empty backhaul costs	$20.5	$40.9	$40.9	5%	< backhaul cost factor

1. "Most Likely" Scenario

A. Loaded Fronthaul Costs

I. "Most Likely" Summary Scenario

Pavement Maintenance Costs **Loaded Fronthaul Costs**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$382.1	$152.4	$50.4	**$585.0**		1,182	66,123

B. Empty Backhaul Costs

I. "Most Likely" Summary Scenario

Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$10.6	$3.4	$1.4	**$15.5**		638	37,484

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario

Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$392.7	$155.9	$51.9	**$600.5**		1,820	103,607

2. "Transitional" Scenario

A. Loaded Fronthaul Costs

II. "Transitional" Summary Scenario

Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$412.9	$318.6	$169.9	**$901.4**		1,606	66,123

B. Empty Backhaul Costs

II. "Transitional" Summary Scenario

Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$11.8	$9.7	$5.9	**$27.3**		956	37,484

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario

Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$424.6	$328.3	$175.8	**$928.7**		2,562	103,607

Congestion Cost Detail

Table Set 4.20: Detail of HCAS Congestion Costs

Congestion Costs

Congestion Costs	costs by road type category annual cost per thousand VMT				
May 2000 Addendum to 1997 FHWA HCAS	**CAT1**	**CAT2**	**CAT3**	**total**	
HCAS 80 kip 5-axle Comb/Urban Interstate		100%	100%		< road category cost factor
loaded fronthaul costs	**$200.6**	$200.6	$200.6		
adjusted empty backhaul costs	$150.5	$150.5	$150.5	75%	< backhaul cost factor

1. "Most Likely" Scenario

A. Loaded Fronthaul Costs

I. "Most Likely" Summary Scenario

Congestion Costs **Loaded Fronthaul Costs**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$187.4	$37.4	$12.4	**$237.2**		1,182	66,123

B. Empty Backhaul Costs

I. "Most Likely" Summary Scenario

Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$78.0	$12.7	$5.3	**$96.0**		638	37,484

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario

Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$265.4	$50.0	$17.7	**$333.1**		1,820	103,607

2. "Transitional" Scenario

A. Loaded Fronthaul Costs

II. "Transitional" Summary Scenario

Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$202.5	$78.1	$41.7	**$322.3**		1,606	66,123

B. Empty Backhaul Costs

II. "Transitional" Summary Scenario

Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$86.5	$35.6	$21.8	**$143.8**		956	37,484

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario

Congestion Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$289.0	$113.7	$63.5	**$466.1**		2,562	103,607

Crash Cost Detail

Table Set 4.21: Detail of HCAS Crash Costs

Crash Economic Impacts

Crash Economic Impacts May 2000 Addendum to 1997 FHWA HCAS	costs by road type category annual cost per thousand VMT **CAT1**	 **CAT2**	 **CAT3**	 **total**	
HCAS 80 kip 5-axle Comb/Urban Interstate		200%	200%		< road category cost factor
loaded fronthaul costs	**$11.5**	$23.0	$23.0		
adjusted empty backhaul costs	$11.5	$23.0	$23.0	100%	< backhaul cost factor

1. "Most Likely" Scenario

A. Loaded Fronthaul Costs

I. "Most Likely" Summary Scenario

Crash Economic Impacts **Loaded Fronthaul Costs**	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	 **CAT2**	 **CAT3**	 **total**		thousand annual VMT	annual truck-loads
LOADED HAUL annual cost increase:	$10.7	$4.3	$1.4	**$16.4**		1,182	66,123

B. Empty Backhaul Costs

I. "Most Likely" Summary Scenario

Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	 **CAT2**	 **CAT3**	 **total**		thousand annual VMT	annual truck-trips
empty backhaul annual cost increase:	$6.0	$1.9	$0.8	**$8.7**		638	37,484

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario

Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	 **CAT2**	 **CAT3**	 **total**		thousand annual VMT	annual truck-trips
TOTAL HAUL annual cost increase:	$16.7	$6.2	$2.2	**$25.2**		1,820	103,607

2. "Transitional" Scenario

A. Loaded Fronthaul Costs

II. "Transitional" Summary Scenario

Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	 **CAT2**	 **CAT3**	 **total**		thousand annual VMT	annual truck-loads
LOADED HAUL annual cost increase:	$11.6	$9.0	$4.8	**$25.3**		1,606	66,123

B. Empty Backhaul Costs

II. "Transitional" Summary Scenario

Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	 **CAT2**	 **CAT3**	 **total**		thousand annual VMT	annual truck-trips
empty backhaul annual cost increase:	$6.6	$5.4	$3.3	**$15.4**		956	37,484

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario

Crash Economic Impacts	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	 **CAT2**	 **CAT3**	 **total**		thousand annual VMT	annual truck-trips
TOTAL HAUL annual cost increase:	$18.2	$14.4	$8.1	**$40.7**		2,562	103,607

Air Pollution Cost Detail

Table Set 4.22: Detail of HCAS Air Pollution Costs

Air Pollution Costs

Air Pollution Costs	costs by road type category annual cost per thousand VMT				
May 2000 Addendum to 1997 FHWA HCAS	**CAT1**	**CAT2**	**CAT3**	**total**	
HCAS 80 kip 5-axle Comb/Urban Interstate		100%	100%		< road category cost factor
loaded fronthaul costs	**$44.9**	$44.9	$44.9		
adjusted empty backhaul costs	$33.7	$33.7	$33.7	75%	< backhaul cost factor

1. "Most Likely" Scenario

A. Loaded Fronthaul Costs

I. "Most Likely" Summary Scenario

Air Pollution Costs **Loaded Fronthaul Costs**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$41.9	$8.4	$2.8	**$53.1**		1,182	66,123

B. Empty Backhaul Costs

I. "Most Likely" Summary Scenario

Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$17.5	$2.8	$1.2	**$21.5**		638	37,484

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario

Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$59.4	$11.2	$4.0	**$74.6**		1,820	103,607

2. "Transitional" Scenario

A. Loaded Fronthaul Costs

II. "Transitional" Summary Scenario

Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$45.3	$17.5	$9.3	**$72.1**		1,606	66,123

B. Empty Backhaul Costs

II. "Transitional" Summary Scenario

Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$19.4	$8.0	$4.9	**$32.2**		956	37,484

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario

Air Pollution Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$64.7	$25.5	$14.2	**$104.3**		2,562	103,607

Noise Cost Detail

Table Set 4.23: Detail of HCAS Noise Costs

Noise Costs

Noise Costs May 2000 Addendum to 1997 FHWA HCAS	costs by road type category annual cost per thousand VMT **CAT1**	**CAT2**	**CAT3**	**total**	
HCAS 80 kip 5-axle Comb/Urban Interstate		100%	100%		< road category cost factor
loaded fronthaul costs	**$30.4**	$30.4	$30.4		
adjusted empty backhaul costs	$30.4	$30.4	$30.4	100%	< backhaul cost factor

1. "Most Likely" Scenario

A. Loaded Fronthaul Costs

I. "Most Likely" Summary Scenario

Noise Costs **Loaded Fronthaul Costs**	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	**CAT2**	**CAT3**	**total**		thousand annual VMT	annual truck-loads
LOADED HAUL annual cost increase:	$28.4	$5.7	$1.9	**$35.9**		1,182	66,123

B. Empty Backhaul Costs

I. "Most Likely" Summary Scenario

Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	**CAT2**	**CAT3**	**total**		thousand annual VMT	annual truck-trips
empty backhaul annual cost increase:	$15.8	$2.6	$1.1	**$19.4**		638	37,484

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario

Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	**CAT2**	**CAT3**	**total**		thousand annual VMT	annual truck-trips
TOTAL HAUL annual cost increase:	$44.2	$8.2	$2.9	**$55.3**		1,820	103,607

2. "Transitional" Scenario

A. Loaded Fronthaul Costs

II. "Transitional" Summary Scenario

Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	**CAT2**	**CAT3**	**total**		thousand annual VMT	annual truck-loads
LOADED HAUL annual cost increase:	$30.7	$11.8	$6.3	**$48.8**		1,606	66,123

B. Empty Backhaul Costs

II. "Transitional" Summary Scenario

Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	**CAT2**	**CAT3**	**total**		thousand annual VMT	annual truck-trips
empty backhaul annual cost increase:	$17.5	$7.2	$4.4	**$29.1**		956	37,484

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario

Noise Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars **CAT1**	**CAT2**	**CAT3**	**total**		thousand annual VMT	annual truck-trips
TOTAL HAUL annual cost increase:	$48.2	$19.0	$10.7	**$77.9**		2,562	103,607

Total HCAS Cost Detail

Table Set 4.24: Detail of HCAS Total Costs

TOTAL Costs, all HCAS

TOTAL Costs, all HCAS May 2000 Addendum to 1997 FHWA HCAS	costs by road type category annual cost per thousand VMT				
	CAT1	**CAT2**	**CAT3**	**total**	
HCAS 80 kip 5-axle Comb/Urban Interstate		200%	200%		< road category cost factor
loaded fronthaul costs	**$409.0**	$818.0	$818.0		
adjusted empty backhaul costs	$20.5	$40.9	$40.9	5%	< backhaul cost factor

1. "Most Likely" Scenario

A. Loaded Fronthaul Costs

I. "Most Likely" Summary Scenario							
TOTAL Costs, all HCAS **Loaded Fronthaul Costs**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$650.6	$208.2	$68.9	**$927.7**		1,182	66,123

B. Empty Backhaul Costs

I. "Most Likely" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$127.8	$23.4	$9.8	**$161.0**		638	37,484

C. Total Costs (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$778.4	$231.6	$78.7	**$1,088.7**		1,820	103,607

2. "Transitional" Scenario

A. Loaded Fronthaul Costs

II. "Transitional" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-loads
	CAT1	**CAT2**	**CAT3**	**total**			
LOADED HAUL annual cost increase:	$703.0	$435.0	$232.0	**$1,370.0**		1,606	66,123

B. Empty Backhaul Costs

II. "Transitional" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
empty backhaul annual cost increase:	$141.6	$65.8	$40.3	**$247.8**		956	37,484

C. Total Costs (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$844.6	$500.9	$272.3	**$1,617.8**		2,562	103,607

Holcim and Incan Superior Analysis

This section repeats the methodologies described previously in this Chapter, and applies them to the Holcim and Incan Superior movements.

Summary of Truck Trips by Type

Tables 4.25 and 4.26 (below) summarizes the information developed in Section 3 and the interviews in section 2. This information is used in the subsequent steps of this analysis. Unless otherwise noted, the analysis steps are as performed for the Upper Harbor movements.

Table 4.25: Summary of Holcim Truck Trips

Holcim Scenario		**WATER**		**ROAD**							
								truck trip type			
								backhaul			
scenario	cargo thous tons	water miles	thous ton miles	annual truck-loads	thous TL_VMT	road miles	thous ton miles	empty	paid	incr trip	whole move
Holcim	151	-25.8	-3,893	6,036	140	23.2	3,502	100%	0%	100%	0%

Table 4.26: Summary of Incan Superior Truck Trips

INCAN-Superior Scenario		**WATER**		**ROAD**							
								truck trip type			
								backhaul			
scenario	cargo thous tons	water miles	thous ton miles	annual truck-loads	thous TL_VMT	road miles	thous ton miles	empty	paid	incr trip	whole move
Incan-Superior total	375	184.0	69,000	17,857	3,521	197.2	73,943	100%	0%	100%	0%

Truck and Barge Haulage Costs

Table Set 4.27: Holcim Truck & Barge Haulage Costs

Holcim Scenario									
Trip Type Tonnages	ROAD	WATER	**cargo**	truck trip type		paid			
scenario	road miles	river miles	**thous tons**	incr trip	whole move	back-haul		Barge	
Holcim	23.2	-25.8	**151**	100%	0%	0%		100%	

Holcim Scenario			**truck rate $/ton**						
Rates/Ton by Trip Type	ROAD	WATER	**cargo**	truck trip type		paid			
scenario	road miles	river miles	**thous tons**	incr trip	whole move	back-haul		Barge Rate $/ton	
Holcim	23.2	-25.8	**151**	$3.00				$0.50	

Holcim Scenario			**truck cost $thousands**						
Haulage Costs by mode	ROAD	WATER	**cargo**	truck trip type		paid			
scenario	road miles	river miles	**thous tons**	incr trip	whole move	back-haul	net truck cost	Barge Cost $ thous	**NET cost $ thous**
Holcim	23.2	-25.8	**151**	$453			$453	-$75	**$377**

Table Set 4.28: Incan Superior Truck & Barge Haulage Costs

INCAN-Superior Scenario									
Trip Type Tonnages	ROAD	WATER	**cargo**	truck trip type		paid			
scenario	road miles	river miles	**thous tons**	incr trip	whole move	back-haul		INCAN	
Incan-Superior total	197.2	184.0	**375**	100%	0%	0%		100%	

INCAN-Superior Scenario			**truck rate $/ton**						
Rates/Ton by Trip Type	ROAD	WATER	**cargo**	truck trip type		paid			
scenario	road miles	river miles	**thous tons**	incr trip	whole move	back-haul		INCAN Rate $/ton	
Incan-Superior total	197.2	184.0	**375**	$16.67					

INCAN-Superior Scenario			**truck cost $thousands**						
Haulage Costs by mode	ROAD	WATER	**cargo**	truck trip type		paid			
scenario	road miles	river miles	**thous tons**	incr trip	whole move	back-haul	net truck cost	INCAN Cost $ thous	**truck cost $ thous**
Incan-Superior total	197.2	184.0	**375**	$6,250			$6,250		**$6,250**

Note that Incan Superior truck rates are calculated by $350 per trip/21 tons per trip, which is the truck rate reported in the Chapter 2 interviews.

Description and Summaries of Calculations by VMT

HCAS Road Category and Backhaul Cost Factors

Note that this movement is split into Urban and Rural highway components, as discussed in “Road Type Categories”, page 31), with separate HCAS coefficients for each (from HCAS Table 13, in Table 4.6, page 57). The “scaling factors” (also page 57) used for the Urban portions correspond to those used in the Upper Harbor movement. The scaling factors used for the Rural portions are discussed as the summary statistics are derived on the following pages.

Table Set 4.29: Urban and Rural HCAS factors

URBAN Road Category and Empty Backhaul Cost Factors applied to HCAS, by Cost Type					
	Pavement	**Congestion**	**Crash**	**Air Pollution**	**Noise**
road category cost factor: ratio of CAT2 & CAT3 to CAT1 VMT	**200%**	100%	**200%**	100%	100%
backhaul cost factor: ratio of empty backhaul VMT to loaded truck VMT	**5%**	**75%**	100%	**75%**	100%

RURAL Road Category and Empty Backhaul Cost Factors applied to HCAS, by Cost Type					
	Pavement	**Congestion**	**Crash**	**Air Pollution**	**Noise**
road category cost factor: ratio of CAT2 & CAT3 to CAT1 VMT	**100%**	100%	**200%**	100%	100%
backhaul cost factor: ratio of empty backhaul VMT to loaded truck VMT	**5%**	**75%**	100%	**75%**	100%

Total Truck Trips, and Truck Trips per Season-Day

Table Set 4.30: Annual and Daily Holcim Truck Trips

C. Total for ALL trips (fronthaul and empty backhaul)

Holcim Scenario										
Table 2:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94 and**		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
			TOTAL HAUL annual increase:	205	68	7	**280**	12,072	12,072	12,072

D. TOTAL TRIPS per SEASON-DAY

Holcim Scenario										
Table 2:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94 and**		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
			all-trip increase per SEASON-DAY:	0.961	0.319	0.033	**1.313**	57	57	57

Table Set 4.31: Total Incan Superior Truck Trips (includes backhaul)

C. Total for ALL trips (fronthaul and empty backhaul)

INCAN-Superior Scenario										
Table 2:	**Annual truck loads and LT_VMT by Road Type**			truckload VMT by road type category thousand annual VMT				annual truckloads **I94 and**		annual truck-loads
scenario	**route**	**origin**	**destination**	**CAT1**	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
Rural	Thunder Bay to Hallet Dock5 , Duluth			0	6,009	0	**6,009**	na	na	35,714
Urban	Thunder Bay to Hallet Dock5 , Duluth			208	639	187	**1,033**	na	na	35,714
			TOTAL HAUL annual increase:	208	6,648	187	**7,042**	na	na	35,714

Total HCAS Costs

Table Set 4.32: Holcim Total HCAS Costs

C. Total Costs (fronthaul and empty backhaul)

Holcim scenario							
Total Public Cost Summary	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$96.7	$47.5	$4.9	**$149.1**		280	12,072

C. Total Costs (fronthaul and empty backhaul)

Holcim scenario							
A. Pavement Maintenance Costs	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$44.0	$29.3	$3.0	**$76.3**		280	12,072

C. Total Costs (fronthaul and empty backhaul)

Holcim scenario							
Public Externality Cost Summary	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$52.6	$18.3	$1.9	**$72.8**		280	12,072

For rural pavement maintenance (for Incan Superior, below), we used a 100% factor for CAT2 and CAT3 RURAL roads (vs. the 200% used in URBAN roads). Note that urban HCAS costs are approximately 4 times rural, and with the 200% factor for urban CAT2/CAT3 (versus 100% for rural), the urban road maintenance costs are assumed to be approximately 8 times the rural costs for CAT2 and CAT3 roads.

Table Set 4.33: Incan Superior Total HCAS Costs

C. Total Costs (fronthaul and empty backhaul)

INCAN-Superior scenario								
Total Public Cost Summary		costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
		CAT1	**CAT2**	**CAT3**	**total**			
URBAN	**TOTAL HAUL annual cost increase:**	$97.8	$445.8	$130.3	**$673.9**		6,009	35,714
RURAL	**TOTAL HAUL annual cost increase:**	$0.0	$837.5	$0.0	**$837.5**		1,033	35,714
RUR/URB	**TOTAL HAUL annual cost increase:**	$97.8	$1,283.3	$130.3	**$1,511.4**		7,042	35,714

C. Total Costs (fronthaul and empty backhaul)

INCAN-Superior scenario								
A. Pavement Maintenance Costs		costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
		CAT1	**CAT2**	**CAT3**	**total**			
URBAN	**TOTAL HAUL annual cost increase:**	$44.6	$274.4	$80.2	**$399.2**		6,009	35,714
RURAL	**TOTAL HAUL annual cost increase:**	$0.0	$400.6	$0.0	**$400.6**		1,033	35,714
RUR/URB	**TOTAL HAUL annual cost increase:**	$44.6	$675.0	$80.2	**$799.8**		7,042	35,714

C. Total Costs (fronthaul and empty backhaul)

INCAN-Superior scenario								
Public Externality Cost Summary		costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
		CAT1	**CAT2**	**CAT3**	**total**			
URBAN	**TOTAL HAUL annual cost increase:**	$53.3	$171.4	$50.1	**$274.7**		6,009	35,714
RURAL	**TOTAL HAUL annual cost increase:**	$0.0	$436.8	$0.0	**$436.8**		1,033	35,714
RUR/URB	**TOTAL HAUL annual cost increase:**	$53.3	$608.2	$50.1	**$711.6**		7,042	35,714

Chapter 5: Summary of Results for Upper Harbor Modal Shifts

A key point in this analysis flows from a simple observation of the location of the Minneapolis Upper Harbor ports, which is northwest of the alternative ports in the St. Paul area. Cargo currently only uses the Minneapolis ports if these ports are closer to the cargo's origin or destination. Otherwise, the cargo would already be using the St. Paul ports, and save the costs of the additional river miles (and three locks) between St. Paul and Minneapolis. Thus, **the Minneapolis ports capture cargo moving to Minneapolis itself, western suburbs, and to/from northwest of Minneapolis**.

This observation was continually confirmed in the Chapter 2 interviews. If the river mode to Minneapolis is unavailable, cargo will move to and from Minneapolis, and northwest of Minneapolis, by the most direct possible route to/from the St. Paul ports. Most of these routes will be directly through St. Paul and Minneapolis via I94, and the rest will be very close to the northern and western boundaries of Minneapolis (on I694 and I494). The interviews and analysis indicate that the Savage ports are a very limited alternative to St. Paul ports.

The Minneapolis Upper Harbor modal shift involves multiple movements, each with its own set of feasible scenarios. Calculation of the estimated overall impact of the Upper Harbor modal shift consists of selecting the single most likely scenario for each movement, and then simply adding together these most likely scenarios (one for each movement) into a summary scenario of total estimated VMT, by road type, for all movements in the modal shift.

Note: *The analysis initially develops "LT_VMT" which represent the VMT of Loaded Truck trips only, total VMT is then derived by calculating the empty backhaul trips and adding them to LT_VMT.*

The scenarios judged to be most likely, and thus used for the overall forecast, are:

i) Existing plus new "shredder" American Iron (AIS) volumes move by truck to the Dakota Bulk port at St. Paul.

ii) Various cargos moving through the Upper Harbor Terminal move instead by truck to/from a weighted average of the ports at St. Paul and Savage . Since these trips are all incremental trips, extending current truck trips, only an estimate of the net incremental mileage is needed.

iii) Aggregates to Aggregate Industries (AI) Minneapolis Yard/Cemstone Minneapolis are moved by truck from the AI St. Paul Yard, which is supplied by water. Most current truck trips from the Minneapolis Yard become incremental trips, but others remain whole-moves because aggregate is stockpiled at the AI Minneapolis Yard for winter use (due to lack of capacity at AI St. Paul).

The above are termed the **"most likely" summary scenario I**. The analysis of the AI Minneapolis Yard movement also suggested a strong possibility that the AI Minneapolis Yard could be supplied directly from the AI Nelson and Larson plants, at least for a transitional period. A **"transitional" summary scenario II** is thus also analyzed, which replaces the "AI St. Paul" origin with an "AI Nelson/Larson" origin for the AI Minneapolis Yard movement.

The “most likely” summary scenario I is a conservative estimate of the likely impacts. The actual volumes are expected to fall somewhere **between** this summary scenario and the “transitional” summary scenario II.

Volumes and Routes

Table Set 5.1 (below) summarizes the information developed in Chapter 3 and the interviews in chapter 2. This information is used in the subsequent steps of the Chapter 4 analysis of each summary scenario.

Table Set 5.1: Summary of Scenario Volumes, Trips, VMT and Ton-Miles

I. "Most Likely" Summary Scenario		WATER		ROAD							
								truck trip type			
								backhaul			
scenario	cargo thous tons	water miles	thous ton miles	annual truck-loads	thous TL_VMT	road miles	thous ton miles	empty	paid	incr trip	whole move
Am. Iron with shredder	197	-24.7	-4,871	8,574	196	22.9	4,515	0%	100%	0%	100%
UHT weighted average	545	-19.7	-10,740	22,713	407	17.9	9,760	50%	50%	100%	0%
Al Minn from Al St Paul	801	-18.8	-15,063	34,836	579	16.6	13,319	75%	25%	38%	63%
	1,544		**-30,674**	**66,123**	**1,182**		**27,595**				

II. "Transitional" Summary Scenario		WATER		ROAD							
								truck trip type			
								backhaul			
scenario	cargo thous tons	water miles	thous ton miles	annual truck-loads	thous TL_VMT	road miles	thous ton miles	empty	paid	incr trip	whole move
Am. Iron with shredder	197	-24.7	-4,871	8,574	196	22.9	4,515	0%	100%	0%	100%
UHT weighted average	545	-19.7	-10,740	22,713	407	17.9	9,760	50%	50%	100%	0%
Al Minn from Nelson/Larson	801	-30.7	-24,598	34,836	1,003	28.8	23,079	75%	25%	50%	50%
	1,544		**-40,208**	**66,123**	**1,606**		**37,354**				

Note: *The subsequent tables indicate results by three categories of roads: CAT1 (Interstate/ expressway); CAT2 (major thoroughfares that are not expressways); and CAT3 (local roads).*

Total Truck Trips & Truck Trips per Season-Day

The tables on the next page summarize total VMT, which includes both loaded fronthaul trips and empty backhaul trips. These figures are derived in “Description and Summaries of Calculations by VMT” in Chapter 4 (page 57). For information purposes, this total VMT is also divided by “season-days” to derive the expected increase in weekday truck trips during the barge season (spring/summer/fall). There are 160 season-days in a year (5 weekdays times the 32 week barge season).

As illustrated in Table Set 5.2 (next page), the calculated increases in weekday truck trips during the 32 week barge season are:

- 648 trips per weekday (with 512 trips per day passing through the interchanges of I94/I35E and I94/I35W) under the “most likely” scenario; and,
- 552 trips per weekday (with 417 trips per day passing through the interchanges of I94/I35E and I94/I35W) under the “transitional” scenario.

Note that although both scenarios represent the same total number of annual truck trips, the peak daily trips (during the shipping season) are less for the “transitional” scenario. Since no water movement is involved for the Aggregate Industries movement in this scenario (by truck all the way from the production site at the AI Nelson/Larson Plants), it is estimated that only 75% of the movement needs to occur during the river shipping season, versus 100% if the movement were form the AI St. Paul yard.

Table Set 5.2: Annual/Daily Trips and VMT – "Most Likely" Scenario

C. Total for ALL trips (fronthaul and empty backhaul)

I. "Most Likely" Summary Scenario							
(ml) **Annual truck TRIPS and trip VMT** **TOTAL TRIPS by Road Type**	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck- trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
TOTAL HAUL annual increase:	1,453	270	97	**1,820**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

I. "Most Likely" Summary Scenario							
(ml) **DAILY truck TRIPS and trip VMT** **SEASON-DAY TRIPS by Road Type**	truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck- trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
all-trip increase per SEASON-DAY:	9.1	1.7	0.6	11.4	**512**	**512**	**648**

Table Set 5.3: Annual/Daily Trips and VMT – "Transitional" Scenario

C. Total for ALL trips (fronthaul and empty backhaul)

II. "Transitional" Summary Scenario							
(t) **Annual truck TRIPS and trip VMT** **TOTAL TRIPS by Road Type**	truck-trip VMT by road type category thousand annual VMT				annual truck-trips **I94 and**		annual truck- trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
TOTAL HAUL annual increase:	1,584	626	353	**2,562**	81,980	81,980	103,607

D. TOTAL TRIPS per SEASON-DAY

II. "Transitional" Summary Scenario							
(t) **DAILY truck TRIPS and trip VMT** **SEASON-DAY TRIPS by Road Type**	truck-trip VMT by road type category thousand daily VMT				daily truck-trips **I94 and**		daily truck- trips
	CAT1	**CAT2**	**CAT3**	**total**	**I35W**	**I35E**	
all-trip increase per SEASON-DAY:	8.4	3.2	1.7	13.3	**417**	**417**	**552**

Total HCAS (Public Sector and Public Externality) Costs

The public sector and public externality costs represent the costs to public road authorities, and to the public as a whole (in "hidden costs"), respectively. They are derived from the Highway Cost Allocation Study [7] cost coefficients for each cost multiplied by the scenario VMT derived in Chapter 3. The detail for this is contained in Chapter 4: "Description and Summaries of Calculations by VMT" (p. 57).

As illustrated in Table Sets 5.4 and 5.5 (next page), the calculated net public sector and public externality impacts are $1.088 million per year in cost increases under the "most likely" scenario, and $1.617 million per year under the "transitional" scenario. These costs are a summation of all the costs that can be calculated using the change in truck VMT and the HCAS cost coefficients for pavement maintenance, congestion, crash, air pollution, and noise. These costs are sub-totaled into "Public Sector Costs" (road maintenance, amounting to $601 thousand per year in cost increases under the "most likely" scenario, and $929 thousand per year under the "transitional" scenario) and "Public Externality Costs" (congestion, emission, crash, and noise, amounting to $488 thousand per year in cost increases under the "most likely" scenario, and $689 thousand per year under the "transitional" scenario).

Note that close to the entire $328 thousand per year difference in predicted road maintenance costs, between the "transitional" and "most likely" scenarios, would occur on Grey Cloud Island and St. Paul Park area roads (from the Nelson/Larson Plants). Even this cost figure likely represents a significant underestimate of the maintenance costs for these roads, and does not include likely construction costs for upgrades to the road and bridge structures on the road which would probably be quickly needed once an intensive gravel haul begins. A similar under-estimation is likely for crash and noise cost differences between the two scenarios.

Table Set 5.4: Summary of HCAS Costs – "Most Likely" Scenario

I. "Most Likely" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$778.4	$231.6	$78.7	**$1,088.7**		1,820	103,607

I. "Most Likely" Summary Scenario							
HCAS Public Sector Costs **(Pavement Maintenance Costs)**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$392.7	$155.9	$51.9	**$600.5**		1,820	103,607

I. "Most Likely" Summary Scenario							
HCAS Public Externality Costs **(congestion, emission, crash & noise costs)**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$385.7	$75.7	$26.8	**$488.2**		1,820	103,607

Table Set 5.5: Summary of HCAS Costs – "Transitional" Scenario

II. "Transitional" Summary Scenario							
TOTAL Costs, all HCAS	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$844.6	$500.9	$272.3	**$1,617.8**		2,562	103,607

II. "Transitional" Summary Scenario							
HCAS Public Sector Costs **(Pavement Maintenance Costs)**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$424.6	$328.3	$175.8	**$928.7**		2,562	103,607

II. "Transitional" Summary Scenario							
HCAS Public Externality Costs **(congestion, emission, crash & noise costs)**	costs by road type category annual $ cost in **thousands**, year 2000 dollars					thousand annual VMT	annual truck-trips
	CAT1	**CAT2**	**CAT3**	**total**			
TOTAL HAUL annual cost increase:	$420.0	$172.6	$96.5	**$689.1**		2,562	103,607

Estimated Truck and Barge Haulage (Private) Costs

The section "Truck and Barge Haulage Costs" (p. 55) of Chapter 4 develops a model of truck and barge costs (per ton) based upon information from the Chapter 2 interviews and the economic theory discussed in Chapter 1.

As illustrated in Table Sets 5.6 and 5.7 (next page):

- In the "most likely" scenario, calculated net trucking costs are $4.856 million per year. This would be offset by saved barge costs of $722 thousand, for a net cost increase of $4.084 million per year to move the cargo to the Upper Harbor by truck rather than by barge.

- In the “transitional” scenario, calculated net trucking costs are $6.358 million per year. This would be offset by saved barge costs of $1.172 million, for a net cost increase of $5.186 million per year to move the cargo to the Upper Harbor by truck rather than by barge.

Table Set 5.6: Truck & Barge Haulage Costs – “Most Likely” Scenario

I. "Most Likely" Summary Scenario				**truck cost $thousands**					
Haulage Costs by mode	ROAD	WATER	**cargo**	truck trip type		paid	net	Barge	**NET**
	road	river	**thous**	incr	whole	back-	truck	Cost	**cost**
scenario	miles	miles	**tons**	trip	move	haul	cost	$ thous	**$ thous**
Am. Iron with shredder	22.9	-24.7	**197**	$0	$986	-$197	$789	-$99	**$690**
UHT weighted average	17.9	-19.7	**545**	$1,635	$0	-$273	$1,363	-$273	**$1,090**
Al Minn from Al St Paul	16.6	-18.8	**801**	$901	$2,003	-$200	$2,704	-$401	**$2,304**
			1,544	$2,537	$2,989	-$670	$4,856	-$772	**$4,084**

Table Set 5.7: Truck & Barge Haulage Costs – “Transitional” Scenario

I. "Most Likely" Summary Scenario				**truck cost $thousands**					
Haulage Costs by mode	ROAD	WATER	**cargo**	truck trip type		paid	net	Barge	**NET**
	road	river	**thous**	incr	whole	back-	truck	Cost	**cost**
scenario	miles	miles	**tons**	trip	move	haul	cost	$ thous	**$ thous**
Am. Iron with shredder	22.9	-24.7	**197**	$0	$986	-$197	$789	-$99	**$690**
UHT weighted average	17.9	-19.7	**545**	$1,635	$0	-$273	$1,363	-$273	**$1,090**
Al Minn from Nelson/Larson	28.8	-30.7	**801**	$2,003	$2,404	-$200	$4,206	-$801	**$3,405**
			1,544	$3,638	$3,390	-$670	$6,358	-$1,172	**$5,186**

Estimated Change in Fuel Use, Emissions, and Accidents

Chapter 4 “Fuel Use, Emissions, and Accidents” (p. 53) describes the methodology used to develop an estimate of the change in (diesel) fuel consumption, emissions (from the fuel use) and accidents, under the study scenario. This analysis is based upon information contained in work done by Lambert in 1997 [2]. Lambert also constructed an approximate cost of these emissions. These cannot be directly compared to the HCAS costs developed from vehicle VMT (several of the bases of measurement are very different). Note that Lambert also estimated the cost of truck tires for these trips. This and similar operating costs (ex engines, frame wear, etc.) certainly occur but are assumed to be captured, along with fuel costs, in the haulage rates charged by operators (previous section).

Table 5.x applies these rates to the ton-miles, for truck and barge, in the two summary scenarios developed in Chapter 3. Note that Table 5.8 ratios (comparing the two rates) also account for differences in ton-miles needed to move the cargos. The barge routes are somewhat longer than the truck routes, so this factor alone slightly increases the barge emissions and accidents relative to truck. Thus, as illustrated in Table 5.8 (next page), the analysis finds that:

- in the ‘most likely’ scenario, the truck movement is expected to have 7.8 times the fuel use (466 versus 60 thousand gallons of diesel per year), 33 times the accidents, and 150 times the emissions ‘cost’ of the barge movement; and,
- in the ‘most likely’ scenario, the truck movement is expected to have 8.1 times the fuel use (631 versus 78 thousand gallons of diesel per year), 34 times the accidents, and 155 times the emissions ‘cost’ of the barge movement.

Note that the huge difference in emissions costs is due to the fact that trucks emit approximately 20 time the nitrous oxide, per gallon of fuel consumed, as barges and nitrous oxide is the most ‘costly’ of the emissions.

Table 5.8: Estimated Change in Fuel Use, Emissions & Accidents (Lambert 1997)

Diesel Fuel Use, Emissions, and Accident Rates, & ratios weighted by differences in ton miles										
	cargo ton miles	gallons diesel	pounds hydro-carbons	pounds carbon monoxide	pounds nitrous oxide	emission costs	**fuel use ratio**	emission **cost ratio**	accidents (per million ton miles)	accident **ratio**
I. "Most Likely" Summary Scenario										
Truck	**27,595**	466,124	17,386	52,439	280,653	$474,520	**7.8**	**150.1**	1.691	**33.1**
Barge	**-30,674**	-59,676	-2,757	-6,123	-16,220	-$3,162	1.0	1.0	-0.051	1.0
net change	**-3,079**	406,448	14,629	46,316	264,433	$471,358			1.640	
II. "Transitional" Summary Scenario										
Truck	**37,354**	630,986	23,536	70,986	379,916	$642,350	**8.1**	**155.0**	2.289	**34.2**
Barge	**-40,208**	-78,226	-3,614	-8,026	-21,262	-$4,144	1.0	1.0	-0.067	1.0
net change	**-2,854**	552,760	19,922	62,960	358,655	$638,206			2.222	
using rates per thousand ton miles derived from Lambert 1997, referencing EPA 1992 and Eastman 1980										

Present Value of "Most Likely" Estimated Cost Increases

Table 5.9 indicates the present value of the "most likely" scenario cost increases, by major cost category, over 10, 20, and 30 year cost streams using an annual discount rate of 3%. Thus if the "most likely" costs are assumed to continue for 10 years, their total present value is $55.1 million. If the costs are assumed to continue for 30 years, their total present value is $165.2 million. Road maintenance costs, alone, have a present value of $6.0 million if assumed to continue for 10 years, and $17.9 million if assumed to continue for 30 years.

Table 5.9: Present Value of Estimated Cost Increases

present value of "most likely" costs at 3% annual discount rate	millions of $			
	annual	present value over:		
	cost	10 years	20 years	30 years
Public Sector Costs (road maintenance)	$0.601	$6.0	$11.9	$17.9
Public Externality Costs	$0.488	$4.8	$9.7	$14.5
Private Costs (truck haulage)	$4.084	$42.8	$85.5	$128.3
TOTAL	$5.173	$55.1	$110.1	$165.2

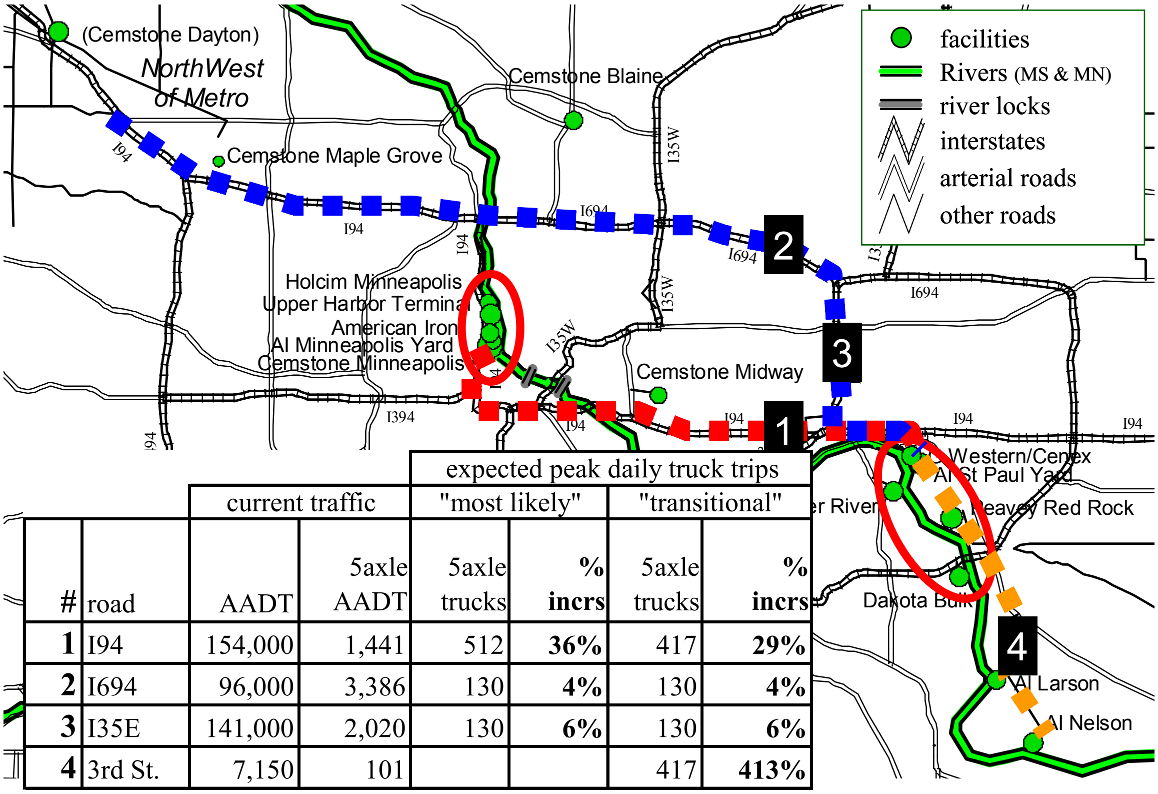
Truck Trip Increases as a Percentage of Current Truck Traffic

Figure 5.1 below illustrates the forecast increases in weekday truck trips, during the barge season, as a percentage of known truck counts along the Metro area routes that these trucks are expected to take. Point #1 is on I94 between St. Paul and Minneapolis. The increase of 512 truck trips per day (loaded and unloaded, during the barge shipping season) in the “most likely” scenario represents an over one-third increase (36%) in 5 axle truck trips on this route, through the hearts of both Cities on the busiest transportation artery in the Metro area. Note that “transition scenario” impacts would be lower (26%), but would represent an average increase over the entire year (weekdays) rather than just the during the barge season, since this scenario eliminates the water trip for aggregates from the AI Nelson and Larson Plants.

Points #2 & #3 are on the routes that would be taken by (former) Upper Harbor Terminal trucks to/from northwest of the Metro that are diverting to St. Paul ports. These trips would create an average 5% increase in 5 axle truck traffic on these routes, during the barge season (“most likely” scenario). “Transition scenario” impacts would be the same, since this traffic only moves during the barge season in all scenarios.

Point #4 is on Broadway, just off 3rd Street in St. Paul Park. New truck traffic would only occur at this point in the “transition scenario” where aggregate is trucked all the way from the AI Nelson and Larson Plants. These trips would be a 413% increase over current 5axle truck volumes, occurring year round since the trip is no longer limited to the barge season.

Figure 5.1: Truck Trip Increases as a % of Current Traffic



		current traffic		expected peak daily truck trips "most likely"		"transitional"	
#	road	AADT	5axle AADT	5axle trucks	% incrs	5axle trucks	% incrs
1	I94	154,000	1,441	512	**36%**	417	**29%**
2	I694	96,000	3,386	130	**4%**	130	**4%**
3	I35E	141,000	2,020	130	**6%**	130	**6%**
4	3rd St.	7,150	101			417	**413%**

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Chapter 6: Policy Implications

As discussed in Chapter 1, *Above the Falls* [1], the proposed master plan for the Upper River in Minneapolis, assumes that elimination of freight facilities at the Upper Harbor would mean the disappearance of any truck traffic associated with these facilities. This study has investigated whether that assumption is correct. Chapters 2 and 3 illustrated that the underlying dynamics that generate the traffic will remain, and thus forecasted a substantial increase in heavy truck traffic through Minneapolis and the Metro. Chapters 4 and 5 quantified and summarized the costs of this increase in traffic.

The results of this study lead to several additional questions which have policy implications. These questions cannot be directly quantified as the costs were, but the interviews and cost findings can provide some insight into:

- What Facility Relocation Would Occur;
- Who Will Pay the Costs of Increased Traffic;
- Lessons from Previous Modal Shifts; and,
- Future of the Upper Harbor Terminal.

What Facility Relocation Would Occur

It is highly unlikely that the AI Minneapolis or American Iron facilities would relocate. AI Minneapolis is tied to AI Cemstone, which supplies the majority of the concrete to the City of Minneapolis and must be within a short distance of this market (concrete must be delivered within very tight timelines after it is loaded onto the truck). Many other cities have concrete facilities that are completely surrounded by "higher use" activities such as retail and even residential. American Iron is unlikely to move due to their site investments related to their shredder facility.

However, even if one or both of these facilities *were* to move, the underlying traffic flow dynamics would not change. The facilities would relocate towards the northwest; truck trips would be generated to replace the water movements; and these trips would be to or from St. Paul ports on I94, through the heart of Minneapolis.

The UHT would not relocate – it would simply close. It has no economic purpose without access to the river. This will result in longer trips, for existing truck, and rerouting for existing rail. These trips would likely divert around the core of the Metro, on I694, but the private, public sector, and public externality costs would still occur in the Metro area.

Operation of the Upper and Lower St Anthony Falls, and Ford Dam Locks is the responsibility of the US Army Corps of Engineers and is funded by the federal government. It is unlikely that reduced barge traffic, if the UHT was closed, would lead to closure of these locks in the near term. However cost reduction measures such as reduced hours of operation are quite likely. In the long run, a reduction in barge traffic through the locks would put them high on lists for possible closures prepared by federal budget cutters and critics of USACE projects. Absent such closures, recreational and excursion (Jonathan Paddleford) use of the locks can be expected to increase as residential and recreation expansion, which are the impetus for proposals to close the Upper Harbor to water freight, continues on the Upper River.

Further, it is probable that the role of the St. Anthony Falls Dams and the Ford Dam in water flow, flood control, and water supply would be unchanged. Flow control is an important function of the dams in times of either high or low water. In addition, the Mississippi River above the dams is the primary source of potable water for the Minneapolis area.

Who Will Pay The Costs of Increased Traffic

Private Haulage Costs

Increases in private haulage costs can be translated to changes in cost per ton by simply dividing each facility's calculated total net change in haulage costs, reported in Chapter 5, by the volume of cargo (in tons). Who absorbs such cost changes is ultimately determined by relative market power. For products bought and sold at prices determined outside the Metro area (i.e. "world prices"), which includes the vast majority of cargo moving through the UHT and American Iron, the buyer (for inbound cargo) or supplier (for outbound cargo) pays the transportation costs, and thus will also pay any increases in these costs.

For the Upper Harbor Terminal (UHT), shippers currently using the UHT will pay an additional $2.50 per ton to move their products. These shippers include farmers for grain (sold at a world price less transportation costs) and fertilizer (bought at a world price plus transportation costs), or the final customers for coal and general cargo. The UHT is essentially a handling facility. This handling would merely occur somewhere else on the river, with customers paying directly for the additional costs to transport to/from this alternative facility.

For American Iron, there will be a reduction of up to $4.50 per ton in price paid to suppliers of scrap. Scrap essentially has a price set at the end customers (steel mills). A supplier such as American Iron pays the transport costs to these mills, and essentially acts as a handler for this scrap since it already passes as much as possible of the net price (price paid at the mill less transport costs) along to customers to attract product. Thus an increase in transport costs translates directly to a lower price paid to customers. This will reduce incentives to recycle in Minneapolis and northwest. Also, some customers who are relatively close to competing facilities in the St. Paul ports will haul product there instead. Both effects lower the overall volume available to American Iron. This decrease in volume may put the viability of American Iron's business at risk, particularly after they start operating the shredder.

For Aggregate Industries, the "most likely" haulage costs increase by $2.88 per ton. Since there are very limited alternative supplies in this market area, and such alternatives would need to be trucked similar or greater distances, all this increase would be passed along to current users (who are primarily located in Minneapolis). Cemstone concrete produced with this aggregate would similarly pass aggregate cost increases along to the final user. A yard of concrete requires 1.6 tons of aggregate, so 1.6 times the aggregate cost increase means an increase of $4.60 per yard of concrete in the Minneapolis area. This increase would be, in effect, a "silent tax" on every business in Minneapolis that requires concrete to expand or maintain its facilities.

The "transitional" scenario cost increase would be $4.25 per ton of aggregate or $6.80 per yard of concrete.

An additional factor in both scenarios is that the Cemstone plant would lose some business at the edges of its current market area. This would mean a lower overall volume to pay the fixed costs of operating the Cemstone facilty, which in turn could mean another increase in price to the Minneapolis customers who remain most 'captive' (i.e. closest) to the facility.

Public Sector and Public Externality Costs

In all cases, public sector costs are paid by federal, state, and local governments. Public externality costs are imposed on all citizens in the area, primarily road users for congestion and crashes, the residents near routes for noise, and the population of the Metro area for emissions.

There are also existing public sector costs of maintaining barge navigation to and from the Upper Harbor area. These are primarily costs of the federal government that are paid by the U.S. Army Corps of Engineers through its O&M budget. It is important to note that even a complete cessation of freight traffic through the locks to the Upper Harbor would be unlikely to appreciably change these costs as long as the locks remain in operation for other uses.

These federal public sector costs are estimated to be approximately $3.6 million per year. This consists of one million per year to operate each of the 3 locks and average annual dredging costs for channel maintenance of $270,000 in pool 1 and $330,000 for channel maintenance above the upper locks. Locks are operated 24 hours a day during the river season (i.e. unfrozen). Each lock is manned by 2 people for 24 hours, 7 days a week. During the off-season, there is a corps employee at each of the three facilities 24 hours a day for safety and security purposes. Consequently, it requires a staff of 12-13 permanent federal employees to operate the locks. Of these, 7 or 8 are year round employees and 4 to 5 are permanent seasonal employees who work during the 8 month river season. If the locks remain open, it is not likely that personnel costs can be substantially reduced because of the manning requirements for each lock. (This information is from an interview with USACE personnel by J. Fruin, Feb. 2004).

There would also be substantial public costs of new infrastructure at any new locations. This is in contrast to the current fortuitous location of these facilities, particularly the substantial investments already made in the Dowling Ave/ I94 interchange and Washington Avenue. Note that the calculated HCAS road maintenance costs do not include such new construction. There is generally a substantial response time in state highway investment, particularly new construction. Any relocation of facilities (i.e. Aggregate Industries, Cemstone, and American Iron) would be very unlikely to be as close to state-maintained highways as the current locations, creating very large road maintenance cost impacts to local authorities. Since a large part of the "draw" market for these facilities is Minneapolis, a large part of these impacts would occur on Minneapolis roads. Note that costs per truck VMT on these road types can be expected to be substantially higher than the Interstate cost HCAS coefficients. These costs are not estimated in this study.

Finally, there are the large road impact and public externality (particularly crash and noise) costs that would occur on Grey Cloud Island area roads if the "transitional scenario" (of AI Minneapolis supply from the Nelson/Larson Plants) were to occur. Again, the costs estimated in this "transitional scenario" do not include new construction, which would almost certainly be required. It is suggested that the local road authorities at Grey Cloud Island should pay close attention to any negotiations to remove water access to the Upper Harbor.

Lessons From Previous Modal Shifts

Study of the Incan Superior modal shift, and associated study of the harbors at Duluth-Superior, conveyed three policy lessons that reinforce the findings for the Minneapolis Upper Harbor and/or indicate policy implications that should to be considered in determining the future of the Minneapolis Upper Harbor:

1. Incan Superior and Duluth provide two examples of the length of truck trips that occur even when a rail alternative is available:
    - the truck trip from Thunder Bay to U.S. markets, where the 200 miles between Thunder Bay and Duluth (paralleling the Incan Superior route) is only *part* of the trip; and,
    - truck trips delivering grain from eastern ND to ships at Duluth, a distance of 260+ miles.

    Both these trips choose the truck mode over rail at distances that are several times the distances involved in the Upper Harbor modal shift, reinforcing the conclusion that trucks would generally be used for the Upper Harbor movements.
2. As in Minneapolis, harbor activities at Duluth are being pressured by gentrification, as the waterfront becomes a desirable location for retail/restaurant and even residential use.
3. A recent study on the viability of new intermodal container services at Duluth-Superior [20] found that it is very difficult to establish a new service that crosses current commercial / institutional boundaries, despite widespread agreement on potential, volumes, and public benefits. This suggests that an existing intermodal facility, such as the Upper Harbor Terminal, would be very difficult to re-establish if it were discontinued. The parallel to Duluth would likely hold even though the UHT is not an intermodal *container* facility; if the forthcoming container-on-barge study (discussed at the end of this Chapter) finds potential for container traffic at the UHT, then the parallel is even more apt.

The New York Times had a recent example [21] of another modal shift, of trash disposal shifted from water to truck, that New York is now trying desperately to reverse:

> *The Bloomberg administration has concluded that its plan to compact mountains of residential trash and export it by barge or rail will take much longer and cost nearly twice as much as it projected, and officials now say they are once again looking for new ideas. … [the eight Marine Transfer Stations] cannot simply be renovated; they must, in most cases, be demolished, expanded and rebuilt … doing that would cost $400 million and take six years.*

> *New York City's distinctive white trash trucks now make about 240,000 trips a year to and from New Jersey, mostly over the George Washington Bridge, taking at least 30 minutes to travel each way. In addition, 250,000 or so trips are made on the region's highways by tractor-trailers taking the waste to landfills in Pennsylvania, Virginia and Ohio. …As a result, the total cost of disposing of a single ton of trash in 2002 was $257, 40 percent more than the $183 it cost in 1996.*

Truck freight is forecast to continue increasing throughout the nation, and particularly in urban areas. So is road congestion, and the two trends exacerbate each other. Solutions are difficult to find. One of the few realistic opportunities is moving truck traffic onto other modes. But the economics of urban truck costs, discussed earlier, work against this. This tendency is amplified by failures in public policy.

A recent report [22] explores solutions to "congestion along access routes to port, airports, and other freight hubs" which threatens cost, reliability, and efficiency of US freight movement. "Typically, improved access to cargo hubs requires highway and/or rail improvements, in developed urban areas where local priorities generally emphasize solving commuter bottlenecks, not improving cargo transfer facilities. … if many users are involved, it is often difficult to reach a consensus on solutions and their financing".

Future of the Upper Harbor Terminal

This study has found that the Upper Harbor Terminal (UHT) would disappear if freight could no longer move by water to/from the Minneapolis Upper Harbor. However, the freight traffic currently using the UHT would not disappear; it would be replaced by truck trips through the Metro area on I694 and I35E to St. Paul. The other Upper Harbor facilities would stay or, with significant private and public expenditure on new infrastructure (and possible public expenditure on financial compensation), move towards the northwest. With or without relocation, there would be substantial new truck traffic through and between both St. Paul and Minneapolis on I94 (this traffic would still be far under the distance threshold for rail service).

Even if is not killed deliberately by public policy, the UHT, specifically, is still threatened simply by the current uncertainty about the future of the Upper Harbor. The Chapter 2 interviews indicated a significant role for this uncertainly in lost rail traffic from the UHT (diverted to Savage), and the decision to move the Holcim facility. If shippers begin to lose confidence in the availability of the UHT, and enter into long term agreements with "more reliable" options, a public policy decision about the future of the UHT could be made by default.

The Recent Transportation and Regional Growth (TRG) Study for the Twin Cities [9] lays out the significant transportation challenges facing the Metro area in future years, notably the addition of over a million people within 30 years, in an urban area that is already tied for Atlanta for first in the nation in the rate of growth in traffic congestion (p. 1). Even the current congestion problems came upon the Metro area quite rapidly, in a region that had thought congestion was "other cities' problem".

The overall issue posed by the discussion about the Upper Harbor is: what do we do with freight? This study indicates that a decision to eliminate water access to the Upper Harbor would have very significant costs to both the City of Minneapolis and the Metro area. The TRG Study [9] points out that "No community can develop in a way that avoids impact upon other communities" (p17). A primary recommendation of the TRG Study is that "A policy of expanding choices would make the region more competitive" (pp. vi and 26).

The City of Minneapolis owes and controls the Upper Harbor Terminal and the land upon which it sits. The UHT has access to public (road and water) and private (rail) transportation facilities which would be expensive, or impossible, to reproduce elsewhere in the Minneapolis area. Given the significant transportation challenges facing the region, and the difficulty of reversing a change in use, should the City retain the current use for land and a facility that they own and control? New York City's trash disposal dilemma illustrates the perils of foreclosing upon a significant intermodal transportation option. Given this uncertainty, it would appear to be in the interests of the City, the Metro area, and the state to maintain the Upper Harbor Terminal.

Of course, transportation facilities do not represent the classic urban planning ideal of "highest and best use" in an area that is increasing in value as a residential and light commercial area. In this theory, transportation facility relocation constitutes a desirable evolution of an urban area.

However, a recent Wilbur Smith Associates (WSA) study [23] describes the impacts of continual transportation facility relocation upon urban sprawl. Transportation facilities typically start out in low cost, underdeveloped areas close to transportation links. But these facilities are often the leading edge of development that makes the area attractive to other uses, which begin to encroach into the new area. Once encroachment occurs, land values escalate and traffic conditions deteriorate, making it too costly for transport-related operations and hence forcing relocation. The WSA study describes the emerging alternative concept of a "freight village", where modes and freight facilities co-locate and encroachment is limited by zoning. The Upper Harbor Terminal appears to meet most of the "freight village" criteria. It is unlikely that any other location in Minneapolis proper, or near to it, could do so.

Another issue in the future of the UHT is its continued financial viability, which depend upon cargo volumes. These volumes have proven adequate thus far to support the facility. Although not a focus of this study, the information collected in the interview process also indicated potential for alternate cargos at the UHT:

- The feared loss of corn export traffic to Ethanol production may be overstated. The prospective switch from soybean acreage to corn, due to competition from South American soybean crops, will probably generate large increases in corn production and thus increases in export volumes through the Mississippi.
- There may be potential to move road salt and aggregates, from supplies further down the Mississippi and Ohio rivers, through the UHT.
- There may be potential to move low-value container cargoes on the river, including empty containers, waste paper, low value consumer products, etc. This potential is the topic of a current container-on-barge study being conducted for MnDOT by the University of Minnesota.

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Appendix A: Truck Route Maps

Table of Route Maps

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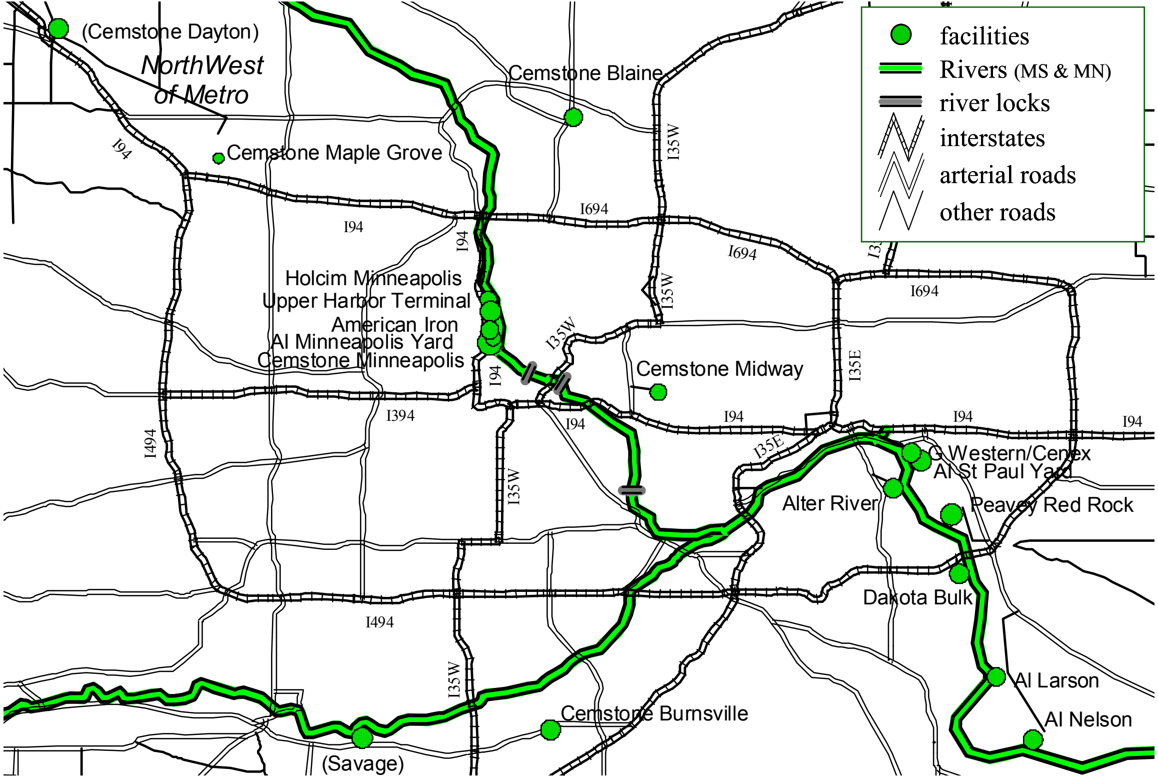
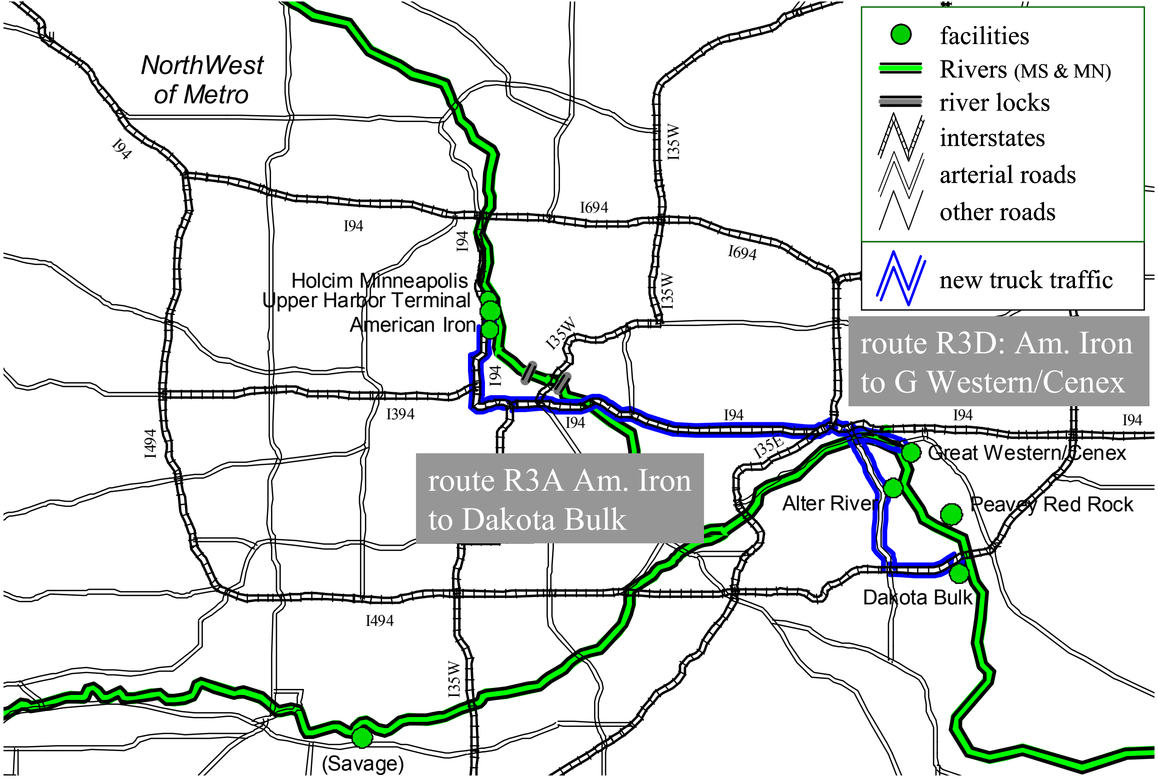
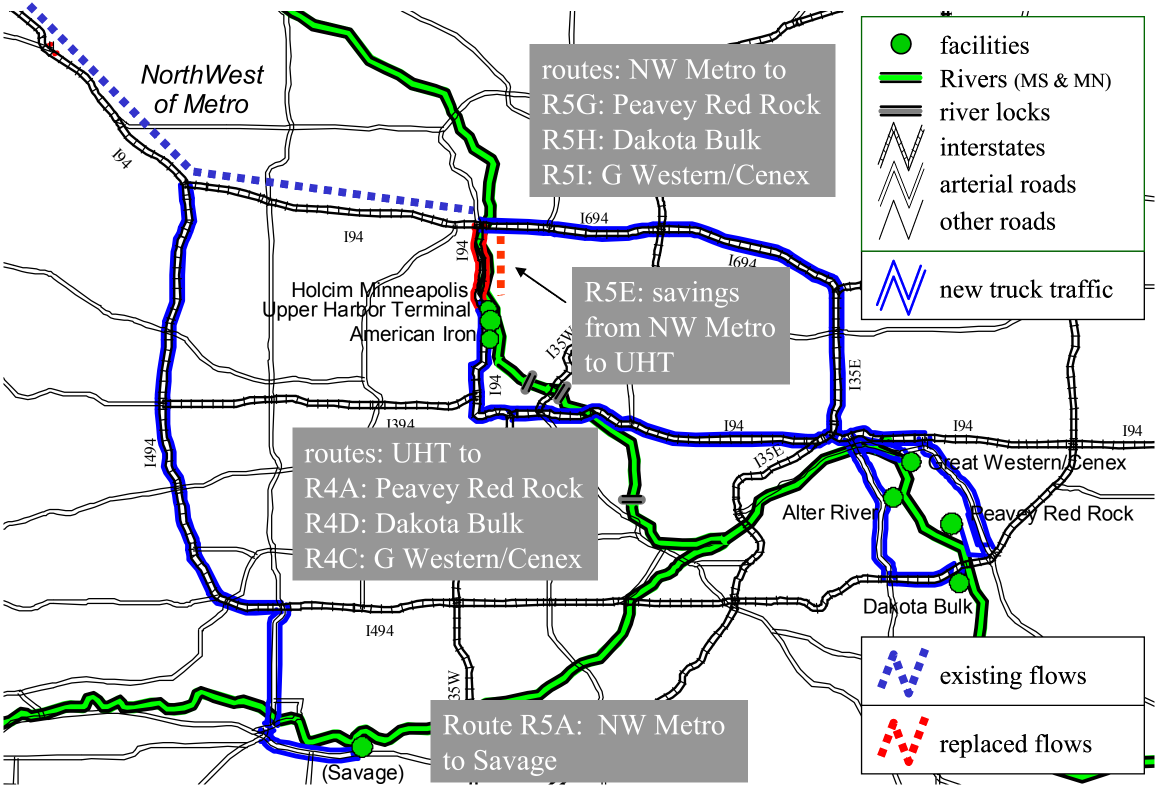
Map A: Overview of Minneapolis Upper Harbor Modal Shift



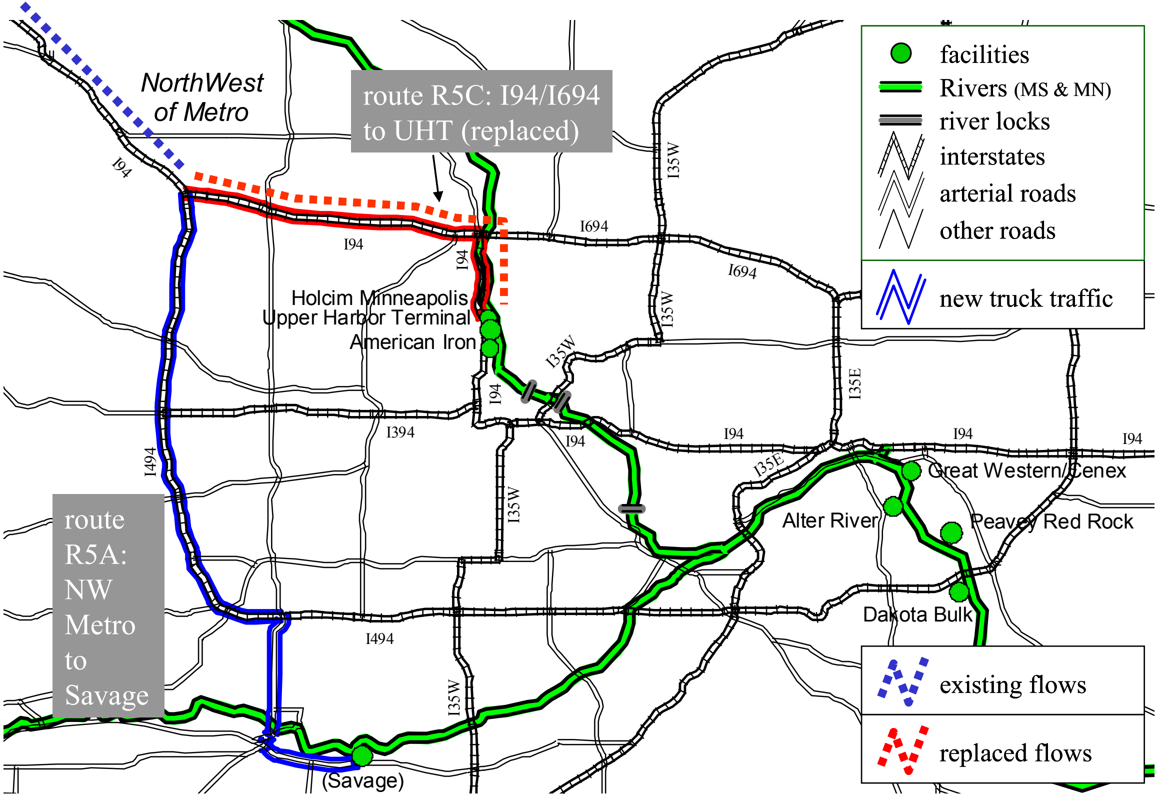
Map B: American Iron (AIS) to St. Paul ports



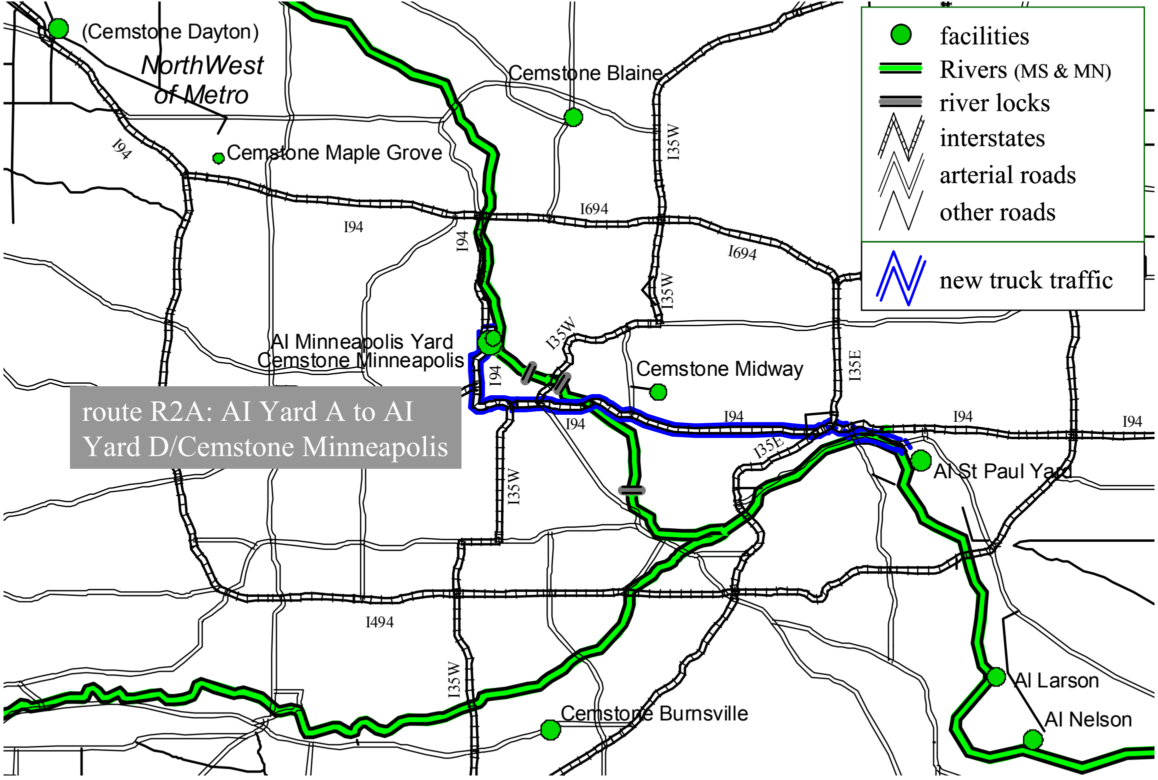
Map C: Upper Harbor Terminal (UHT) to Alternate Ports



Map D: Suitability of Savage Ports for UHT Cargo

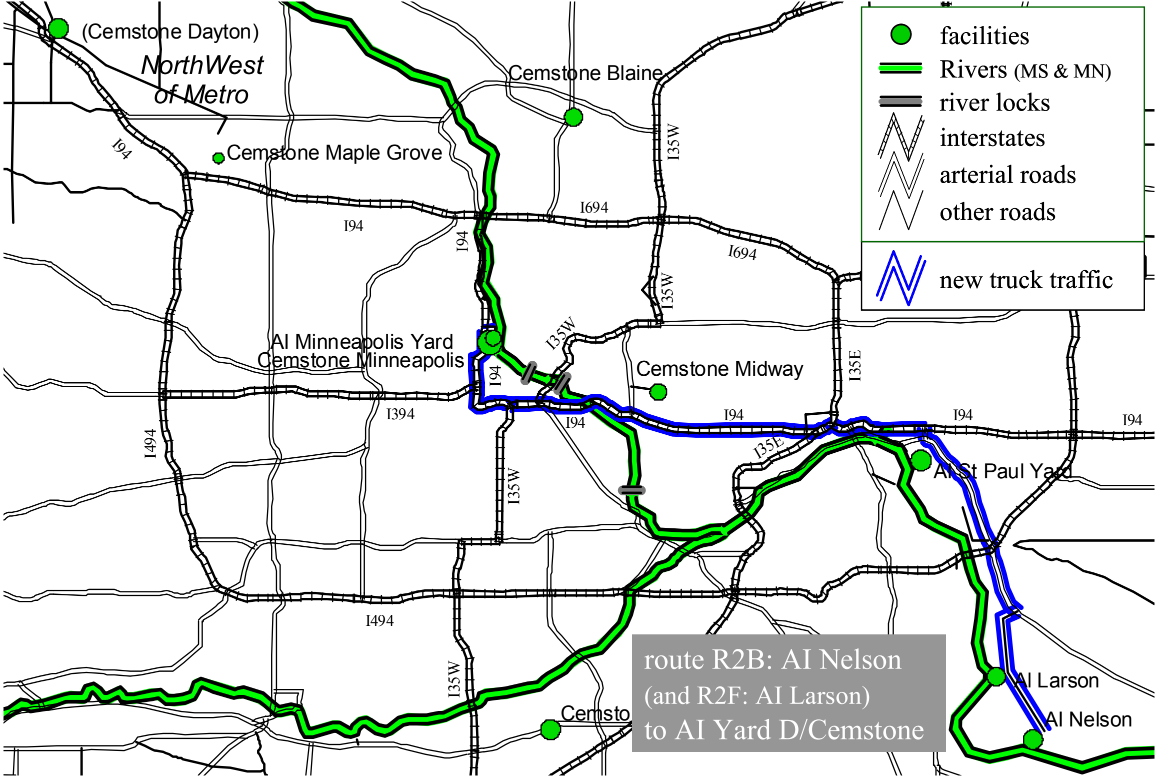


Map E: AI Minneapolis Yard from AI St. Paul Yard



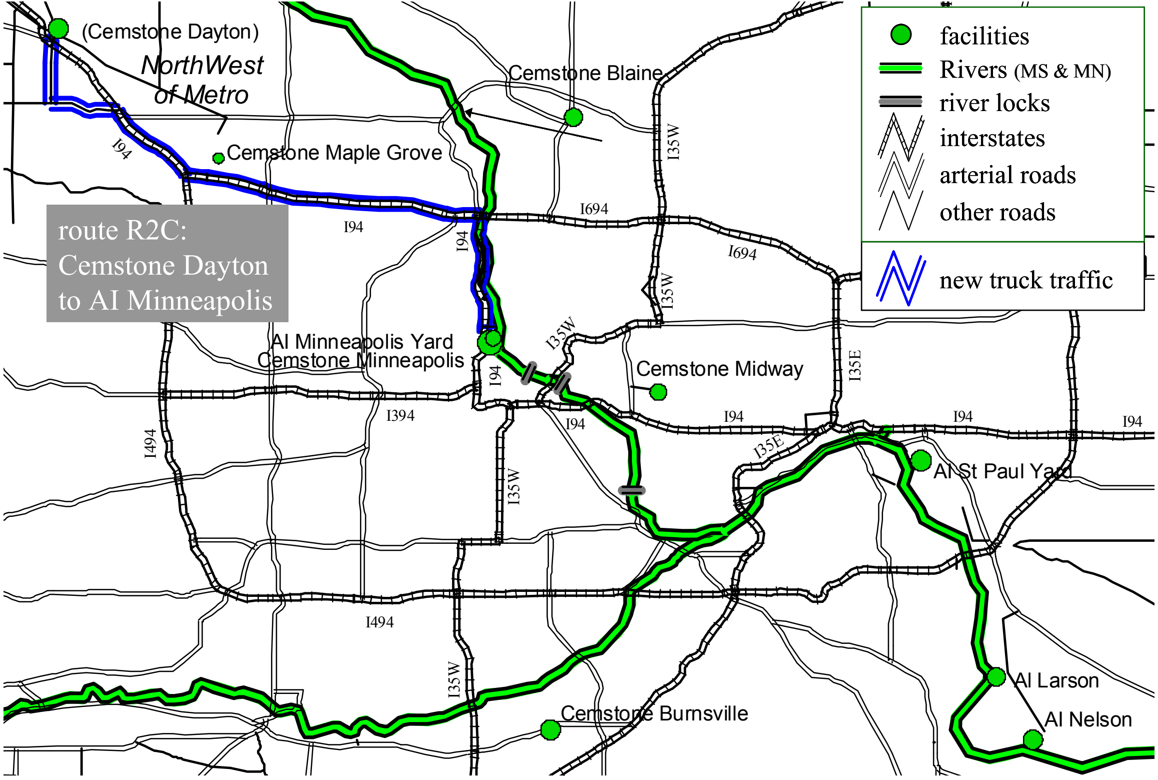
route R2A: AI Yard A to AI Yard D/Cemstone Minneapolis

Map F: AI Minneapolis Yard from AI Nelson & Larson Plants

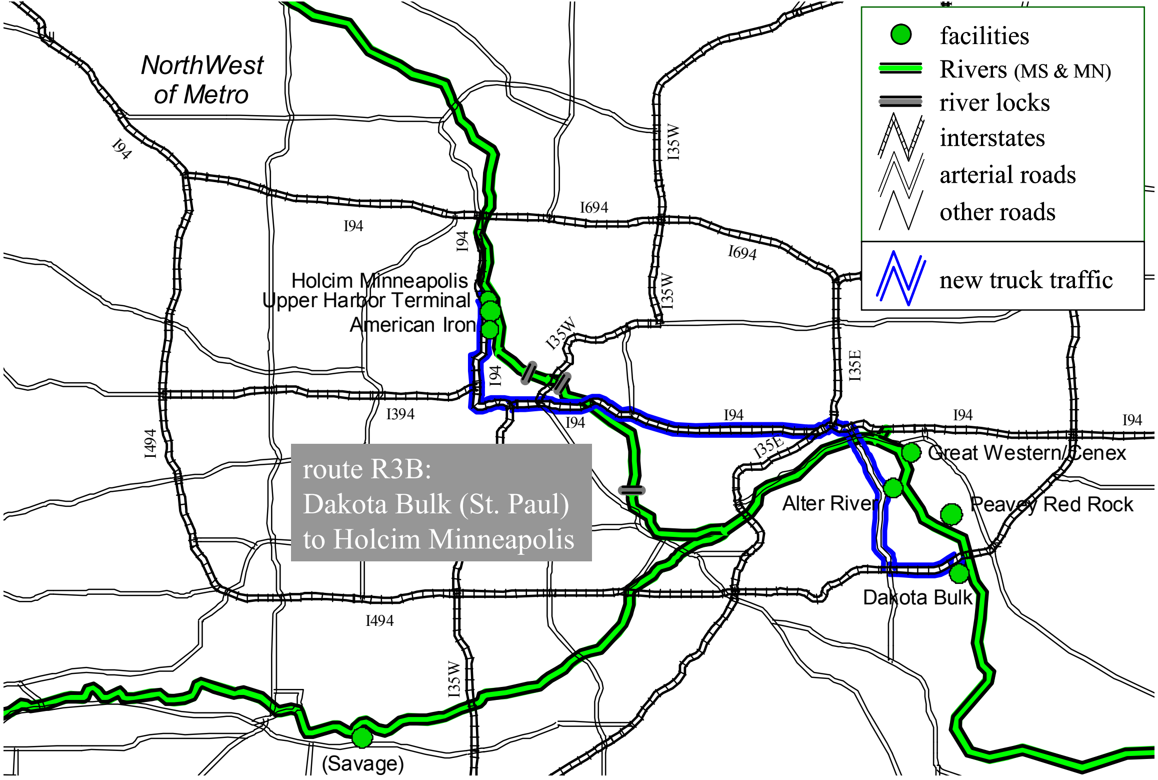


route R2B: AI Nelson (and R2F: AI Larson) to AI Yard D/Cemstone

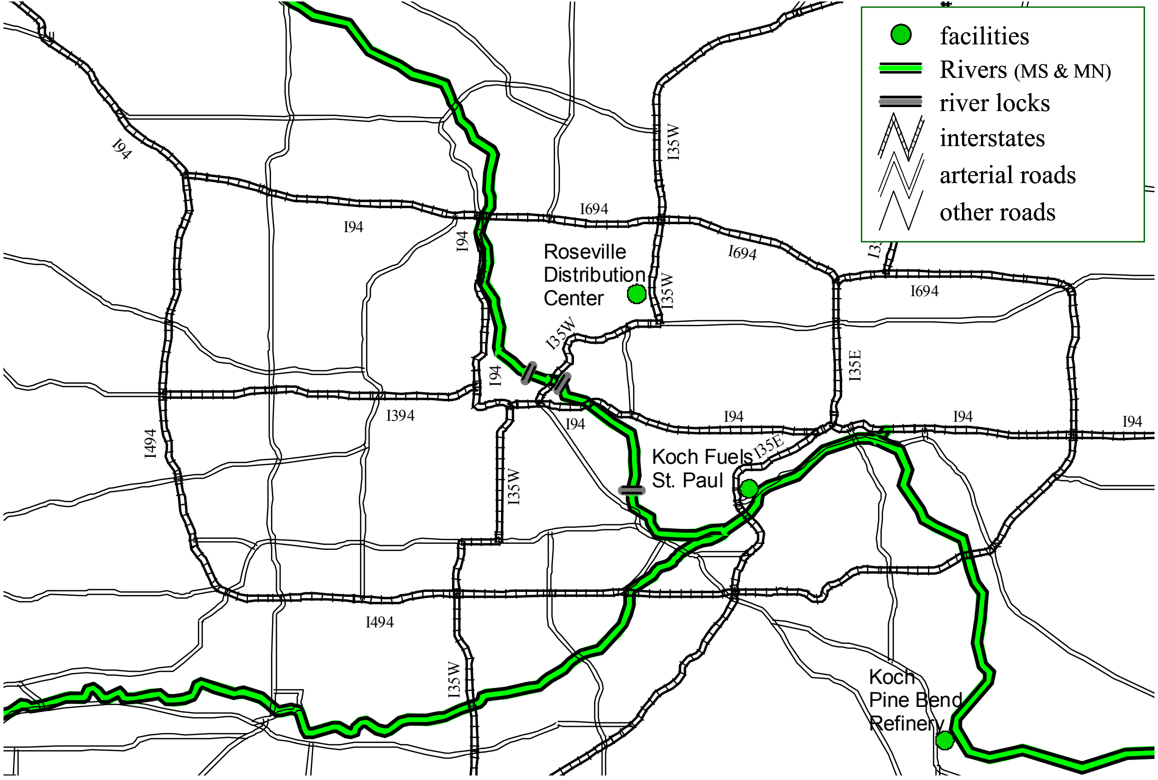
Map G: AI Minneapolis Yard from Cemstone Dayton



Map H: Holcim Minneapolis from St. Paul Dakota Bulk



Map I: Koch Petroleum Modal Shift



Map J: Incan Superior Modal Shift (Thunder Bay to Duluth)