INLAND NAVIGATION ECONOMICS WEBINAR SERIES

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Great Lakes Navigation Economics 101

Buffalo District, Buffalo New York

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Planning Center of Expertise for Inland Navigation

US Army Corps of Engineers

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Great Lakes Navigation Economics 101

1. The Great Lakes Navigation System-

Lakes, Connecting Channels

Locks

2. Historical Tonnages-

Iron Ore

Coal

Limestone

Grain

3. Fleets

Corps Vessel Class

Types Of Vessels- Bulkers, Self Unloaders, Cement Carriers, Tankers

U.S. Versus Canadian Fleet

4. Types Of Projects

Harbor Deepening

Harbor Justification- For inclusion into budgetary requests

Harbor Improvements that Will Allow Continued Harbor Maintenance

5. Deep Draft Commercial Navigation Benefits

Vessel Transportation Cost Increases Avoided

6. Data Needed For Benefit Evaluation

Representative Vessel Movements -Origin/Destination/Commodity Movements

Vessel Operating Costs- Per Hour by vessel type

Time Needed To Make Round Trips by Channel Depth

Costs Incurred to Make Round Trips by Channel Depth

Shoaling Rates

Time Stream Of Vessel Transportation Costs Under WOP and WP Tonnage Projections-

Average Annual Benefits

7. Data Needed For Dredging Cost Evaluation

Dredging Costs Per Dredging Event (mob/demob costs, cubic yards removed per dredging event, dredging costs per cubic yard (removal from channel, transport to CDF/open lake, CDF placement costs), contingencies, E&D, S&A, EtcE

Frequency of Dredging Event

Shoaling Rate

Channel Maintenance Plans Being Evaluated

8. Harbor Benefit Cost Ratio By Maintained Channel Depth

The Great Lakes Navigation System-

1. Lakes
2. Connecting Channels
3. Locks
4. Ports

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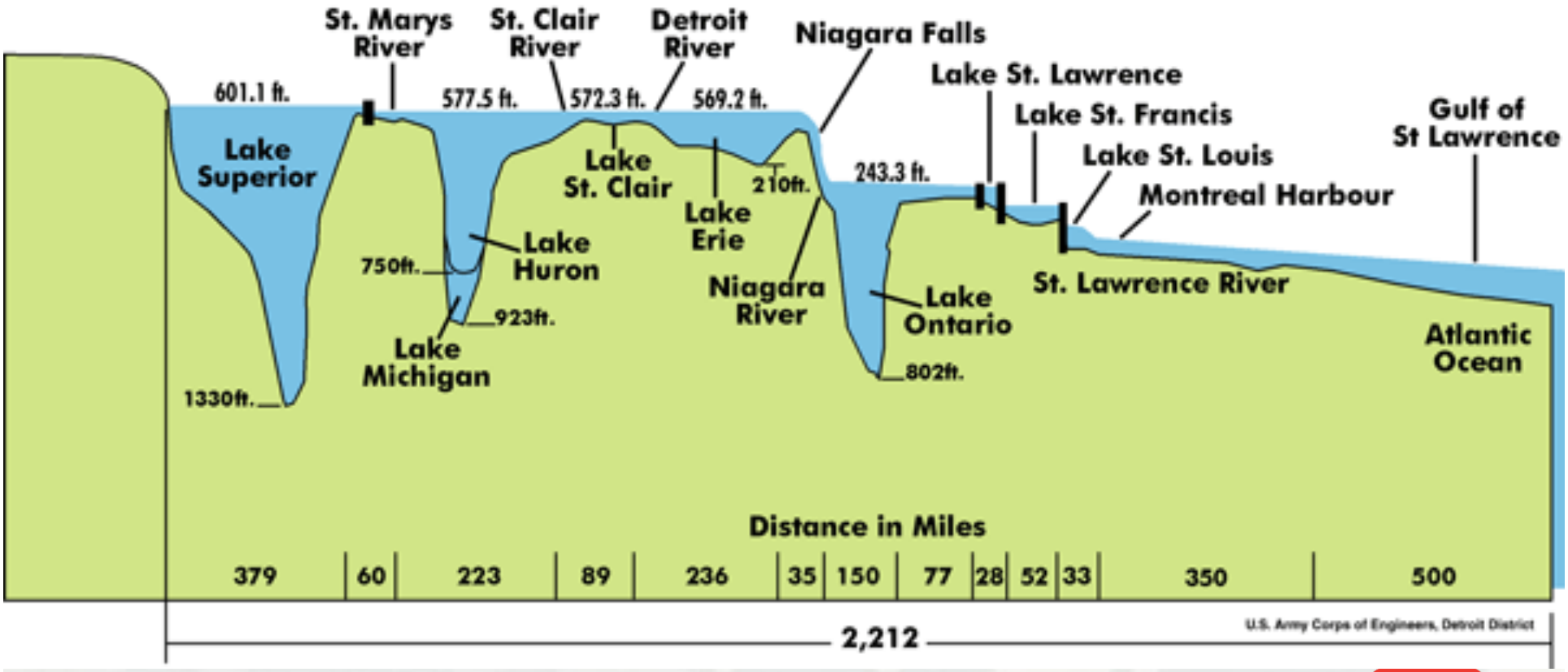
1. Great Lakes Physical System Description

Great Lakes System Profile



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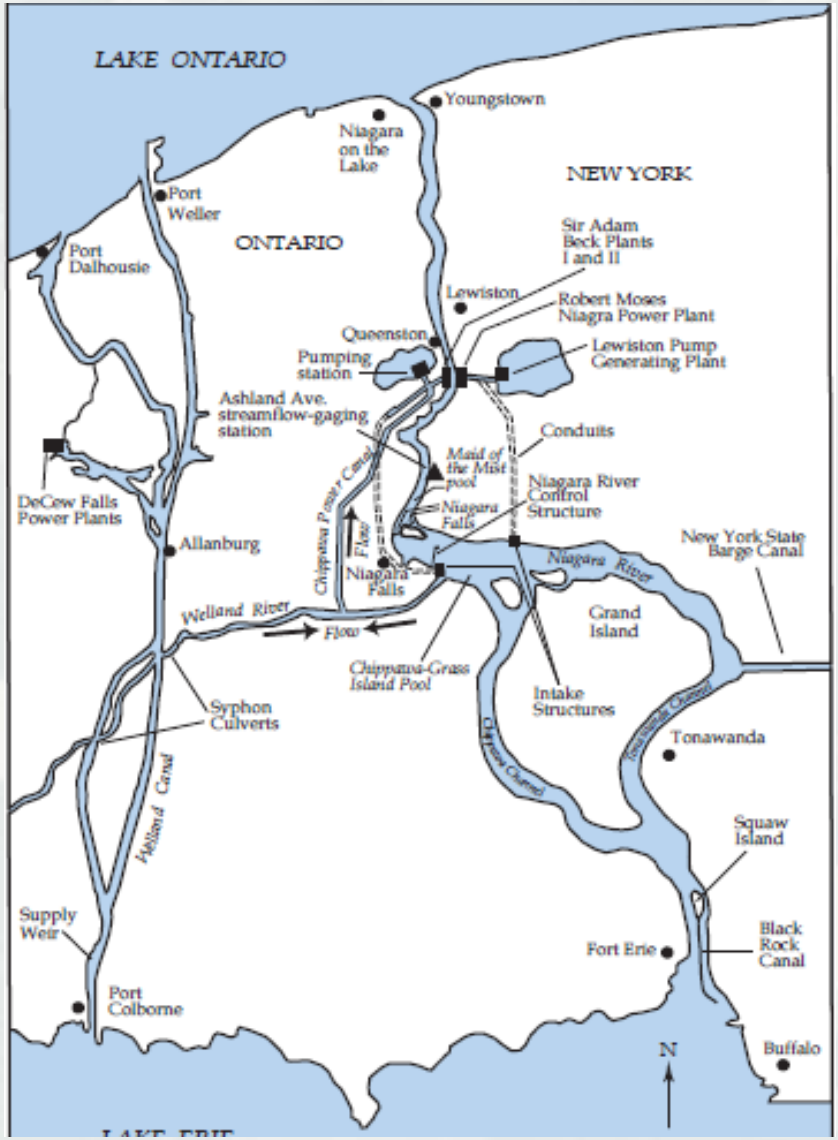
2. MAJOR LOCKS AND CHANNELS

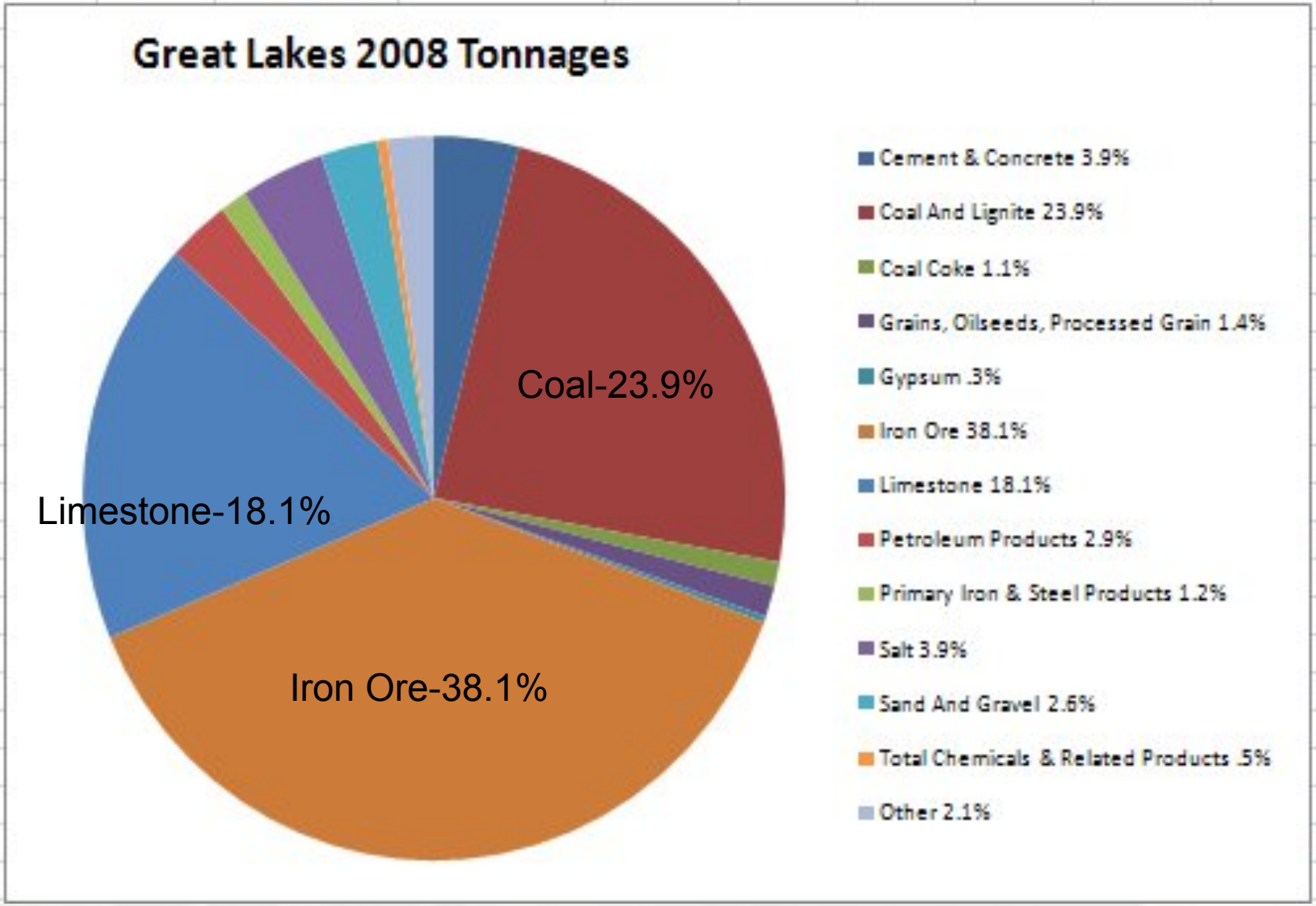
Soo Locks

Welland Canal Schematic



2. Major Commodities Moved On The Great Lakes

2008 Major Commodities

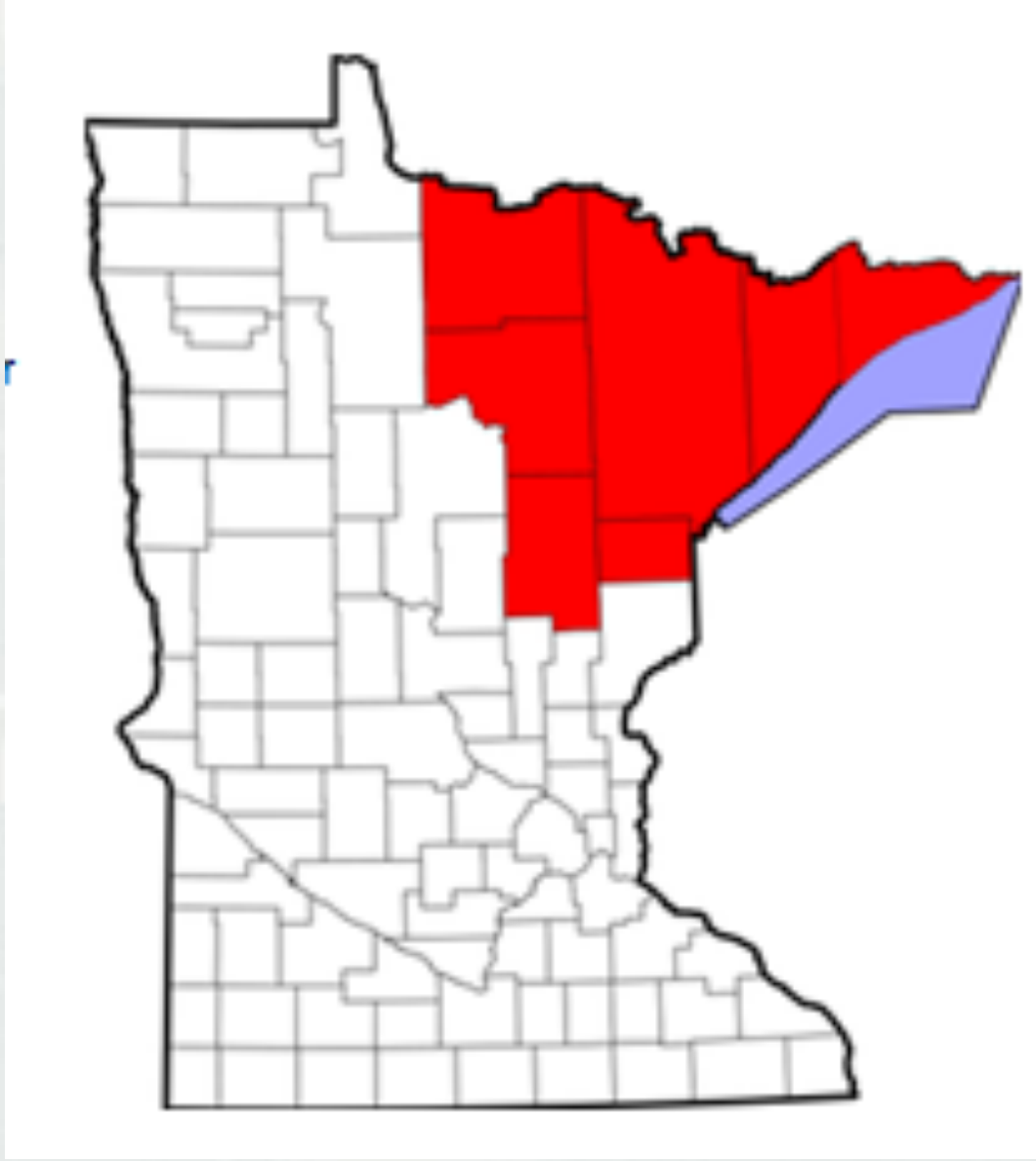


2008 Tonnages By Commodity

Data From Waterborne Commerce Statistics- 2008		
	2008	
Commodity	**Tonnages**	**Percent**
Iron Ore	58,129,000	38.1%
Coal And Lignite	36,471,000	23.9%
Limestone	27,624,000	18.1%
Cement & Concrete	5,931,000	3.9%
Salt	5,886,000	3.9%
Petroleum Products	4,348,000	2.9%
Sand And Gravel	3,984,000	2.6%
Other	3,225,000	2.1%
Grains, Oilseeds, Processed Grain	2,110,000	1.4%
Primary Iron & Steel Products	1,883,000	1.2%
Coal Coke	1,645,000	1.1%
Total Chemicals & Related Products	723,000	0.5%
Gypsum	422,000	0.3%

Total	152,381,000	100.0%

Iron Ore Sources-Northern Minnesota



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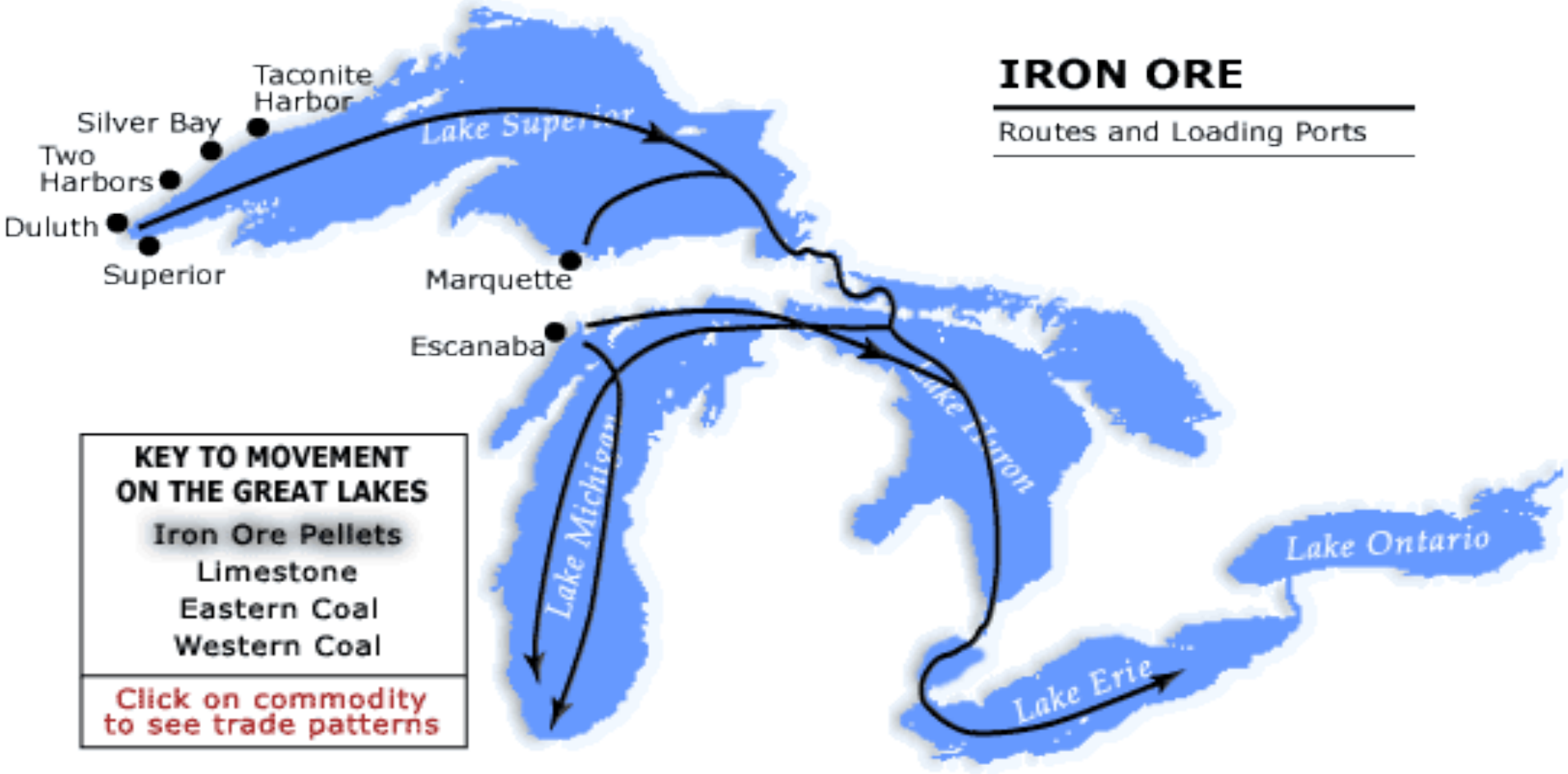
Iron Ore-Sources, Harbors Routes



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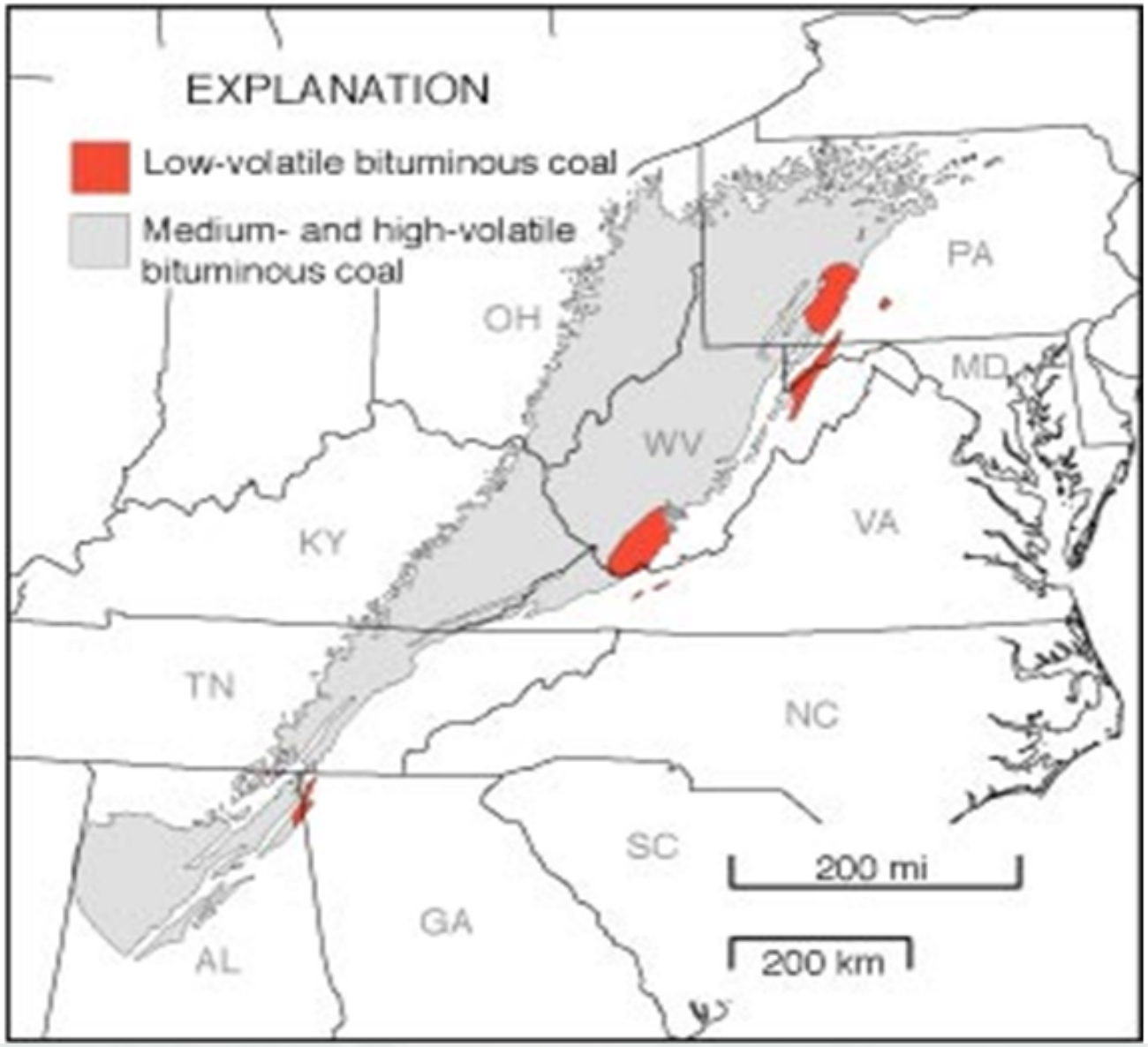
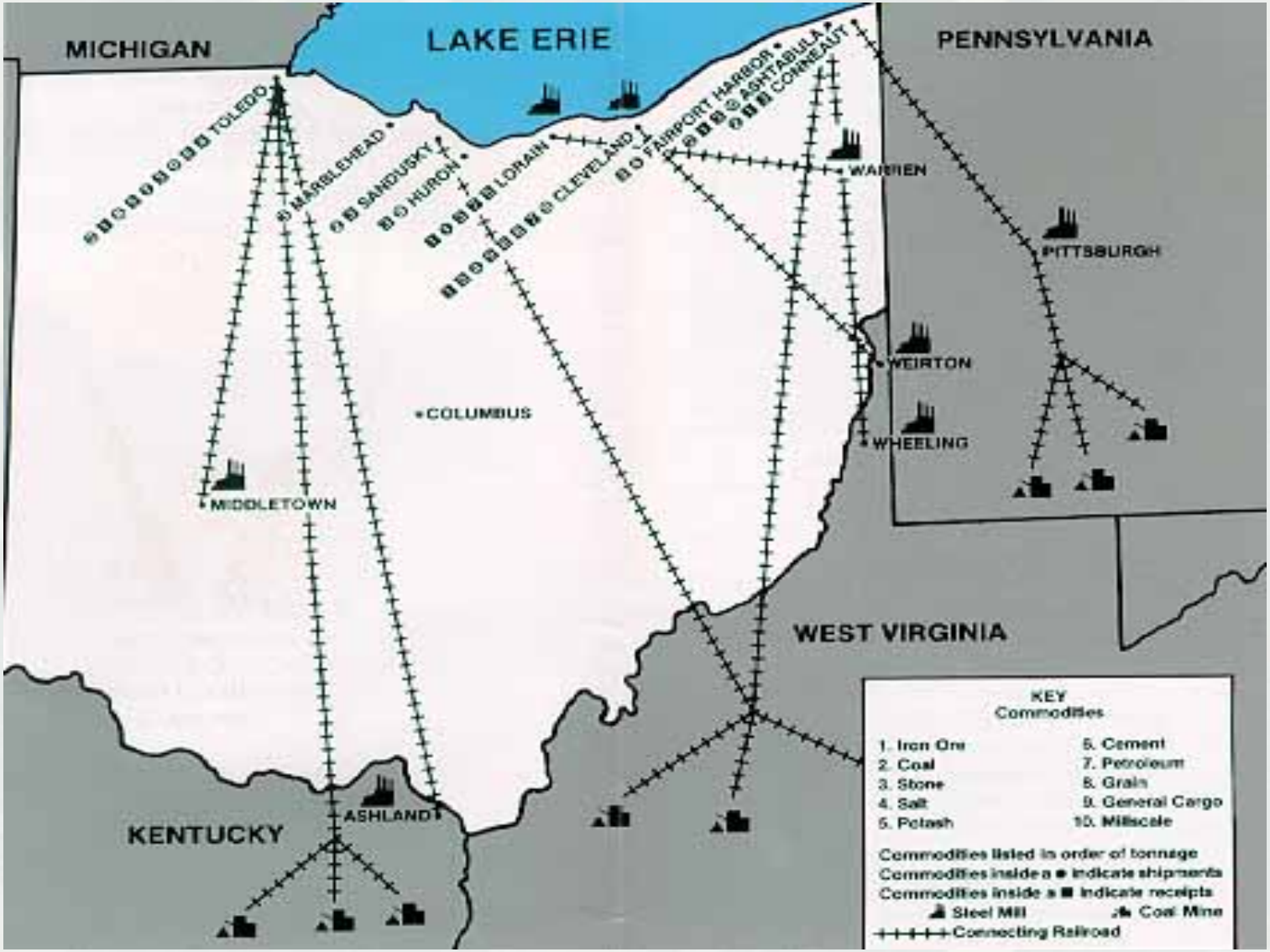
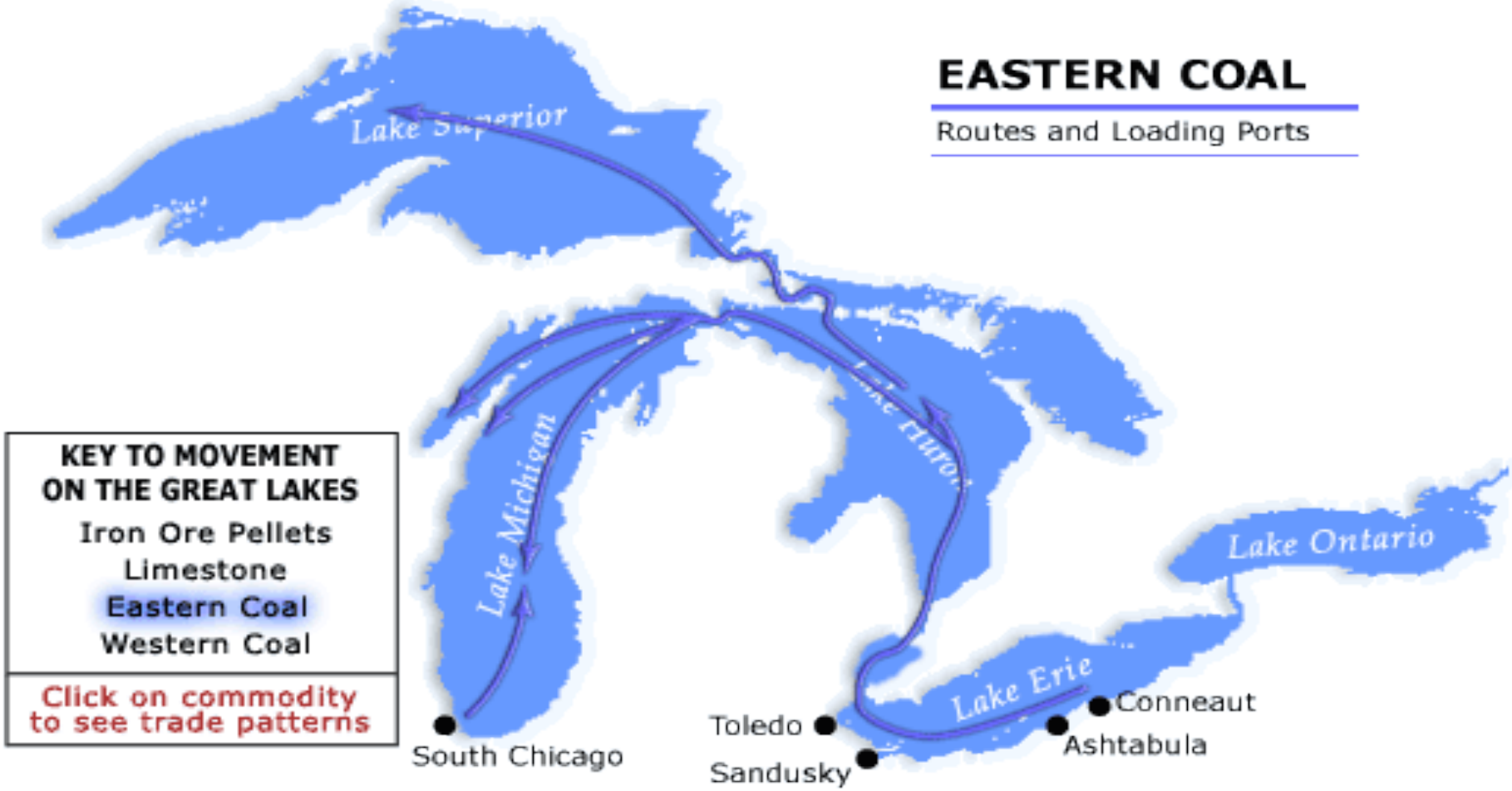
Appalachian Coal Sources



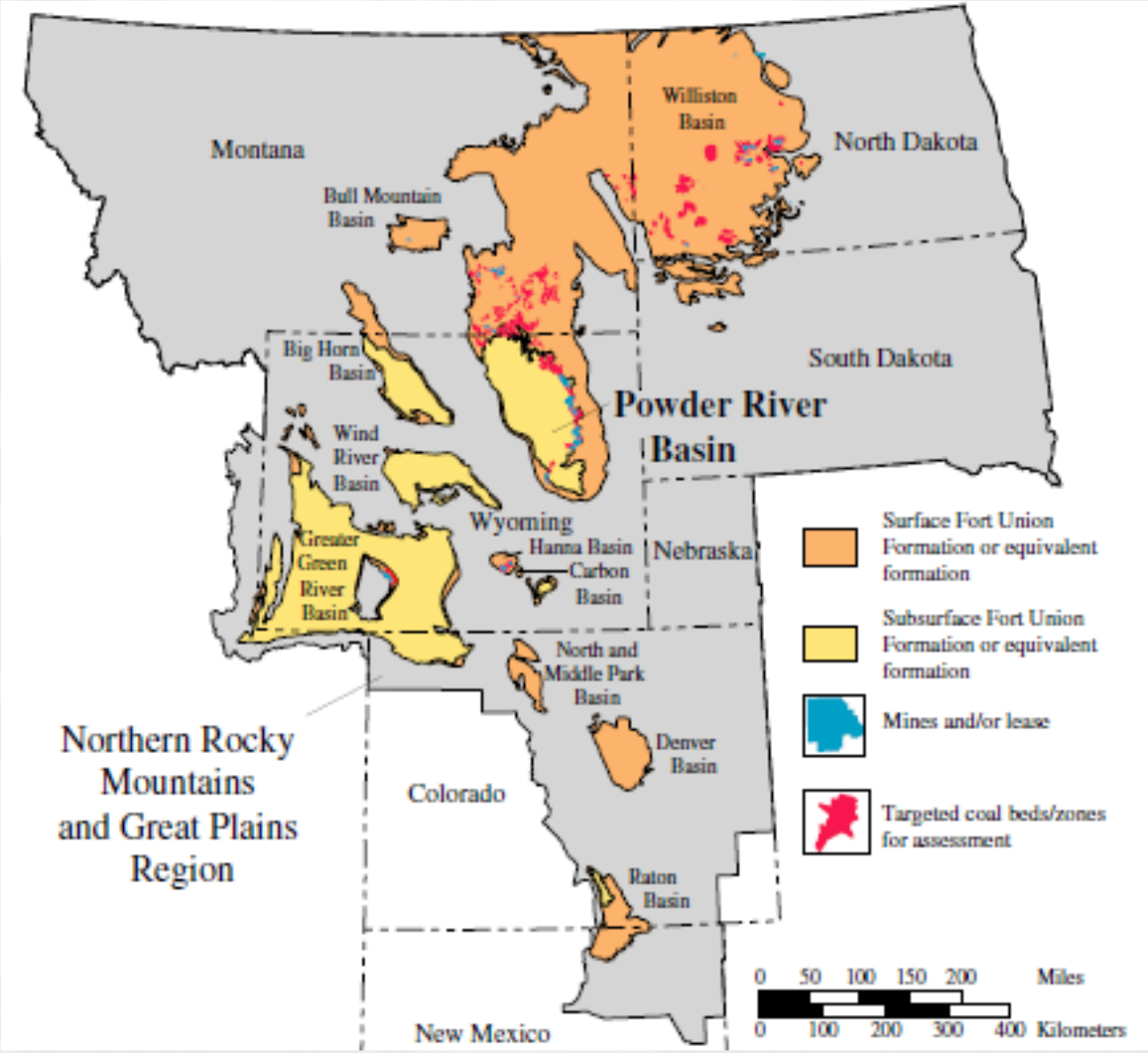
Rail Routes Of Eastern Coal



Eastern Coal- Major Shipping Ports



Western Coal- Powder River Basin



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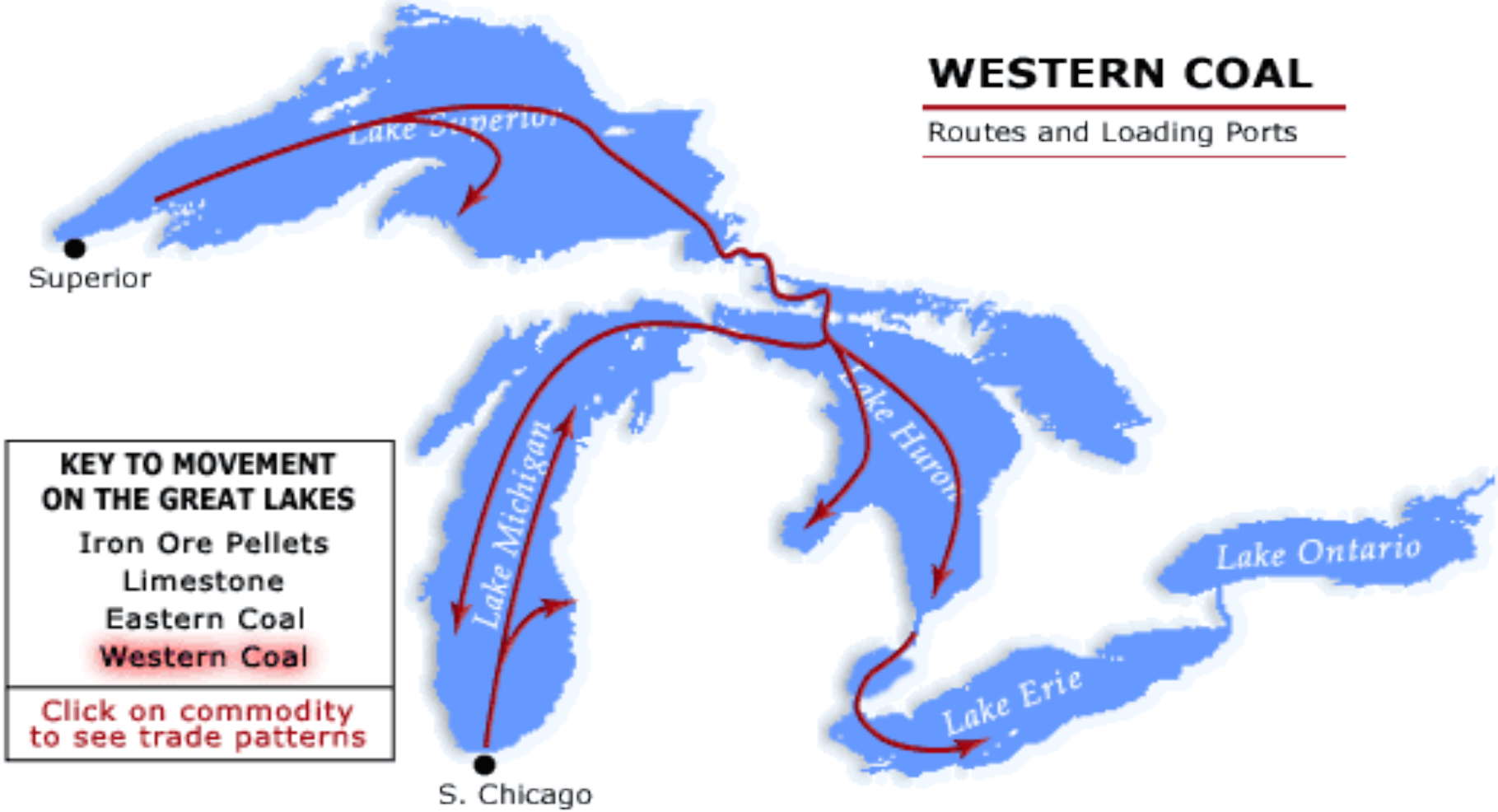
Western Coal- Major Routes



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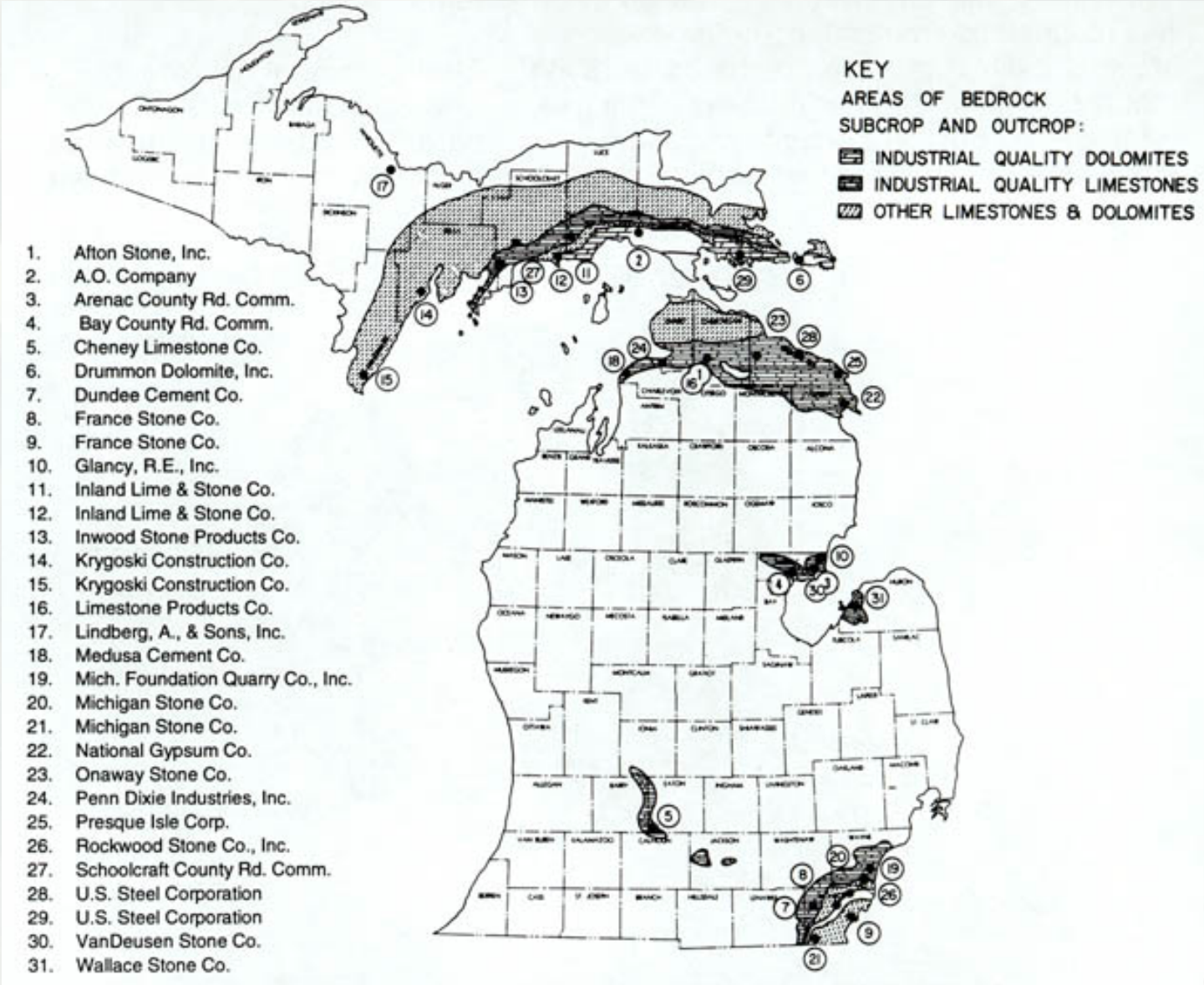
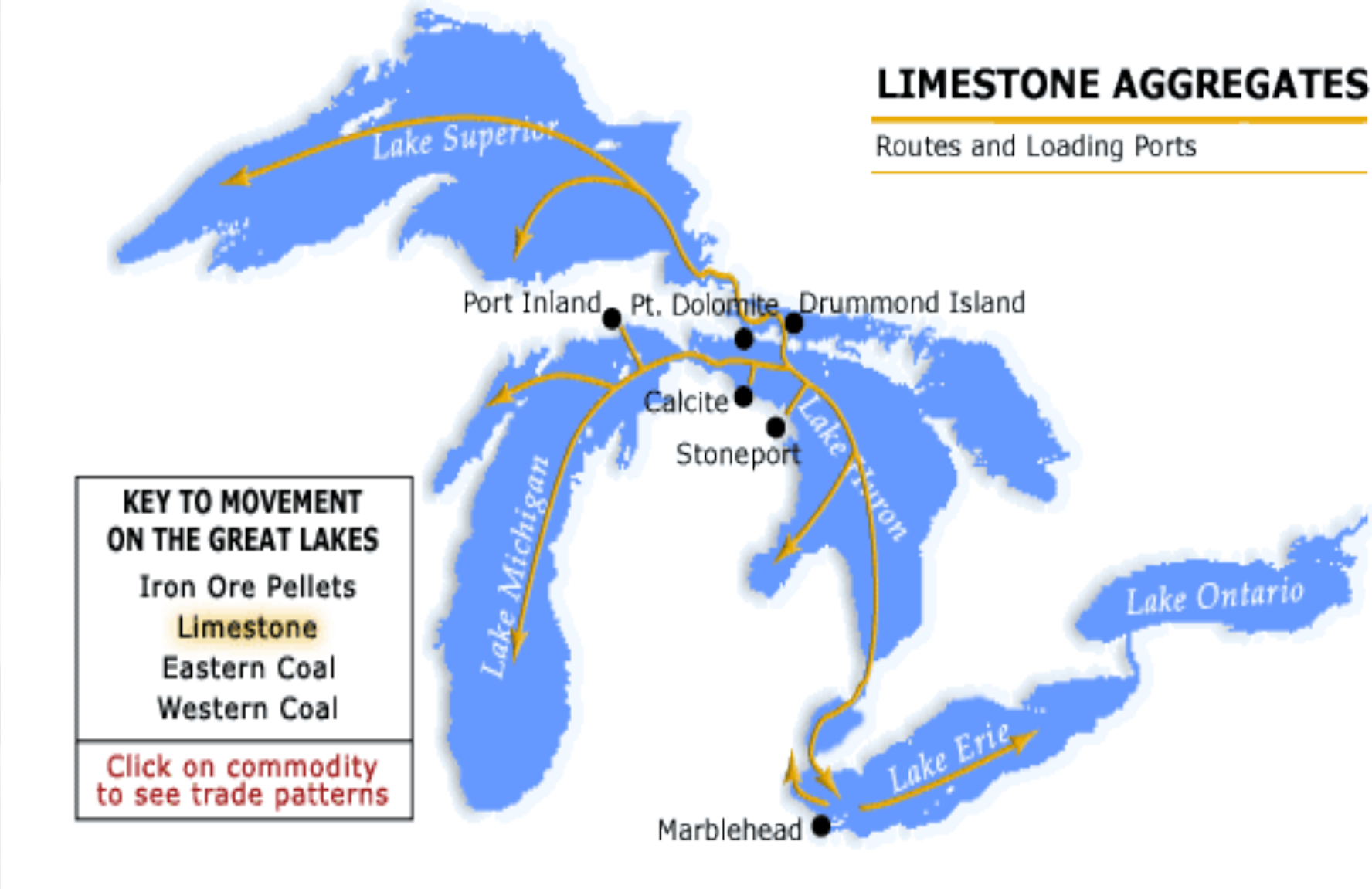
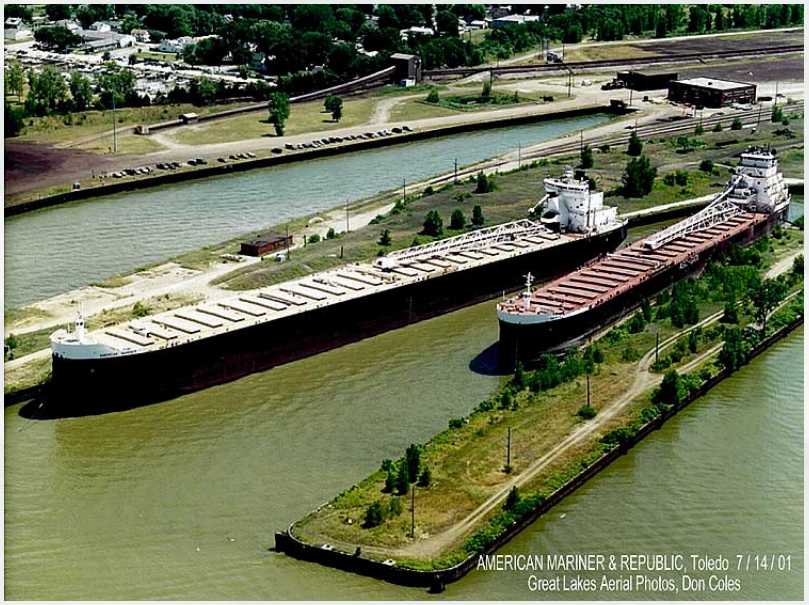
Limestone – Sources



Limestone – Major Shipping Ports



3. Great Lakes Fleet



Corps Of Engineers Vessel Classes

Class 1	=	400' or less
Class 2	=	400' – 499'
Class 3	=	500' – 549'
Class 4	=	550' – 599'
Class 5	=	600' – 649'
Class 6	=	650' – 699'
Class 7	=	700' – 730'
Class 8	=	731' – 849'
Class 9	=	850' – 949'
Class 10	=	950' – 1,099'

Great Lakes Vessel Types

1. Bulk Freighters
2. Self Unloaders
3. Integrated Tug Barges
4. Chemical Carriers
5. Cement Carriers
6. New GL Vessel Concept

Major Bulk And Self Unloading Vessels In The Great Lakes Fleet- 2010

	United States				Canada					
	Self Unloader	Self Unloader ITB	Bulk Freighter	Sub Total	Self Unloader	Self Unloader ITB	Bulk Freighter	Sub Total	Total	Fleet %
Vessel Class 1		1	7	8	6		3	9	17	12%
Vessel Class 2			5	5			3	3	8	6%
Vessel Class 3		1	2	3				0	3	2%
Vessel Class 4			1	1	1			1	2	1%
Vessel Class 5	15	2		17	4		1	5	22	16%
Vessel Class 6	7			7	3	1		4	11	8%
Vessel Class 7	4	1	1	6	20		17	37	43	31%
Vessel Class 8	10	1	1	12	6		1	7	19	14%
Vessel Class 9	1			1				0	1	1%
Vessel Class 10	12	1		13				0	13	9%
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	49	7	17	**73**	40	1	25	**66**	**139**	100%
	35.3%	5.0%	12.2%	52.5%	28.8%	0.7%	18.0%	47.5%		

4. Types Of Projects

1. Harbor Deepening
2. Harbor Justification- For inclusion into budgetary requests
3. Harbor Improvements that Will Allow Continued Harbor Maintenance

5. Deep Draft Commercial Navigation Benefits

Vessel Transportation Cost Increases Avoided

Conneaut Harbor- Ohio

2010 O&M Evaluation

WOP AA Vessel Transportation Costs	$120,064,300
WP AA Vessel Transportation Costs	$113,318,200
Benefits	$ 6,746,100

6. Data Needed For Benefit Evaluation

A. Representative Vessel Movements -Origin/Destination/Commodity Movements

B. Vessel Operating Costs- Per Hour by vessel type

C. Time Needed To Make Round Trips by Channel Depth

D. Costs Incurred to Make Round Trips by Channel Depth

E. Shoaling Rates

F. Time Stream Of Vessel Transportation Costs Under WOP and WP Tonnage Projections-

G. Conversion Of Time Streams to Average Annual Values

6A. Representative Vessel Movements - Origin/Destination/Commodity Movements

1. Waterborne Commerce Statistics Center New Orleans-Detailed
   - From U.S. port to U.S. Port
   - From U.S. Port To Canadian Port

2. Waterborne Commerce Statistics Center New Orleans-Summary
   - Canadian Port To U.S. Port
   - Foreign Port To U.S. Port

6b. Vessel Operating Costs- Per Hour by vessel type

1. Maritime Administration- MarAd
2. Economic Guidance Memorandum –Deep Draft Vessel Operating Costs
3. Fleet Operator Surveys

Great Lakes Vessel Operating Costs

Great Lakes Vessel Operating Costs– January 2012 Prices

Interest rate =	4.0000%	Profit Factor	10%
1+% Rate	1.040000	Overhead Factor	12%
Season Length	275		

Great Lakes Vessel Costs		Class 5	Class 6	Class 7	Class 8	Class 9	Class 10
Daily Variable Operating Costs							
Wages		$10,911	$11,093	$11,429	$12,230	$13,956	$13,956
Subsistence		$336	$336	$392	$392	$392	$392
Stores, Supplies & Equip		$715	$807	$868	$1,032	$1,144	$1,144
Insurance		$1,251	$1,484	$1,808	$2,361	$2,909	$2,909
Maintenance & Repair		$4,617	$4,687	$4,888	$5,103	$4,947	$4,947
Fuel		$13,106	$9,198	$9,657	$14,267	$19,835	$18,579
Other		$1,289	$1,316	$1,354	$1,398	$1,428	$1,428
Total		$32,224	$28,921	$30,395	$36,783	$44,611	$43,355
Construction Costs	4.0000%	$76,131,316	$86,683,928	$100,937,240	$124,381,347	$146,266,954	$146,266,954
Total Daily Fixed Costs							
Construction Costs		$76,131,316	$86,683,928	$100,937,240	$124,381,347	$146,266,954	$146,266,954
Amortization Rate		0.04655	0.04655	0.04655	0.04655	0.04655	0.04655
Annual Fixed Cost/Year		$3,543,928	$4,035,154	$4,698,649	$5,789,977	$6,808,756	$6,808,756
Season Length	275	275	275	275	275	275	275
Fixed Costs Per Day		$12,887	$14,673	$17,086	$21,054	$24,759	$24,759
Profit Factor	10.00%	10%	10%	10%	10%	10%	10%
Total Daily Fixed Costs		$14,176	$16,141	$18,795	$23,160	$27,235	$27,235
Total Daily Variable Costs							
Daily Variable Costs		$32,224	$28,921	$30,395	$36,783	$44,611	$43,355
Overhead Factor	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%
Total Daily Variable Costs		$36,091	$32,392	$34,042	$41,197	$49,965	$48,558
Total Hourly Vessel Costs							
Total Daily Fixed Costs		$14,176	$16,141	$18,795	$23,160	$27,235	$27,235
Total Daily Variable Costs		$36,091	$32,392	$34,042	$41,197	$49,965	$48,558
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Total Daily Vessel Costs		$50,266	$48,532	$52,837	$64,357	$77,200	$75,793
January 2012 Daily Vessel Operating Cost		$50,266	$48,532	$52,837	$64,357	$77,200	$75,793
January 2012 Hourly Vessel Operating Co		$ 2,094	$ 2,022	$ 2,202	$ 2,682	$ 3,217	$ 3,158

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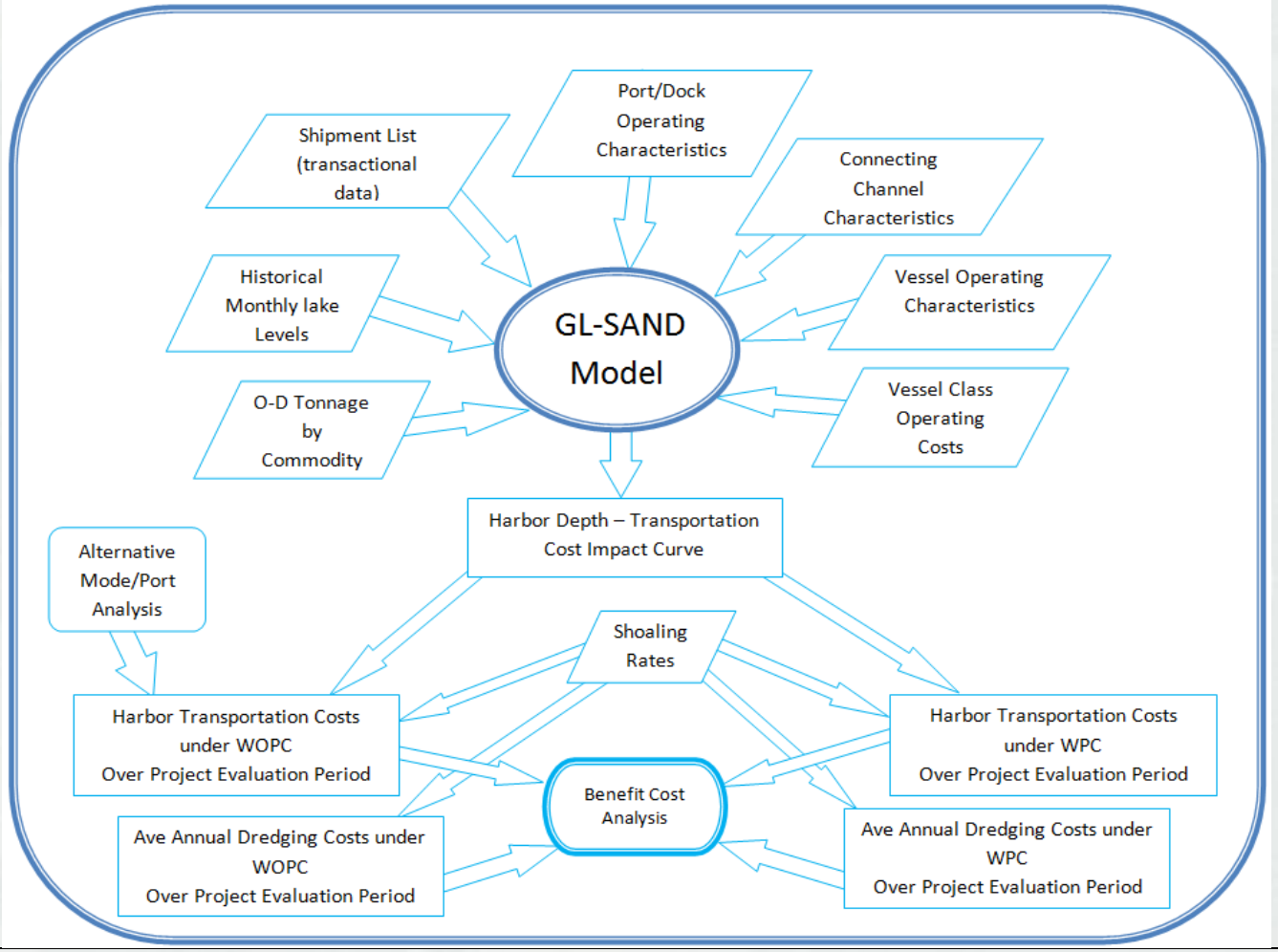
6C. Time Needed To Make Round Trips For Various Channel Depths

1. Develop round Trip costs via a spreadsheet
2. Develop A Computer Model That Calculates Round trip Costs

6c.- Components of Round Trip Costs

1. Loading Times At Origin Port: (loading rate (Tons per hour) by commodity, ships carrying capacity
2. Inner Harbor Maneuvering Time At Origin Port (distance traveled, vessel speed)
3. Open lake Time (Distance to Destination port- open lake vessel speed)
5. Time In Locks
6. Inner Harbor Maneuvering Time At Destination (distance traveled, vessel speed)
7. UnLoading Times At Destination Port: (Unloading rate (Tons per hour) by commodity, ships carrying capacity
8. Inner Harbor Maneuvering Time At Destination Port (distance traveled, vessel speed)
9. Open lake Time – From Destination Port back to the origin Port (Distance to Origin port- open lake vessel speed)
10. Time In Locks
11. Inner Harbor Maneuvering Time At Origin Port (distance traveled, vessel speed)

Great Lakes Navigation Planning Studies



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6d. Costs Incurred to Make Round Trips by Channel Depth

1. Hours per round trip by vessel class size, by channel depth
2. Vessel Operating Cost Per Hour, by vessel class size
3. Hours times dollars equal costs by channel depth

6d. GLSAND Output

Erie Harbor Pa. O&M Evaluation 2011

Transportation costs by channel depth by commodity by Origin Destination Port

Annual Water Transportation Costs By Commodity, By Channel Depth

	COMMODITIES			
Channel Depth	Coal	Sand	Salt	Limestone
28/27	$ 71,759	$ 1,880,857	$ 414,145	$ 5,997,332
27/26	$ 71,759	$ 1,882,128	$ 414,145	$ 6,001,385
26/25	$ 71,759	$ 1,884,798	$ 414,145	$ 6,009,898
25/24	$ 71,759	$ 1,905,064	$ 414,145	$ 6,165,599
24/23	$ 71,759	$ 1,958,264	$ 414,650	$ 6,417,863
23/22	$ 71,759	$ 2,062,131	$ 414,650	$ 6,711,788
22/21	$ 71,759	$ 2,203,997	$ 416,667	$ 7,039,452
21/20	$ 71,759	$ 2,373,730	$ 421,207	$ 7,400,471
20/19	$ 71,759	$ 2,578,930	$ 429,278	$ 7,804,093

6e. Shoaling Rate

1. Comparing Before And After harbor Dredging Soundings
2. Historical Sets Of Before And After harbor Dredging Soundings
3. Identification of the Critical Shoal

6 F. Time Stream Of Vessel Transportation Costs Under WOP and WP Tonnage Projections

1. WOP Vessel Transportation Cost Time Streams - Erie Harbor O&M 2011

Coal

Tons Evaluated	10,889	
Shoaling Rate	0.33	feet per year

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 71,759	0.96038	$ 68,916
2	26.67	$ 71,759	0.92234	$ 66,186
3	26.34	$ 71,759	0.88580	$ 63,564
4	26.00	$ 71,759	0.85071	$ 61,045
5	25.67	$ 71,759	0.81701	$ 58,627
6	25.34	$ 71,759	0.78464	$ 56,305
7	25.00	$ 71,759	0.75355	$ 54,074
8	24.67	$ 71,759	0.72370	$ 51,932
9	24.34	$ 71,759	0.69503	$ 49,874
10	24.00	$ 71,759	0.66750	$ 47,899
11	23.67	$ 71,759	0.64105	$ 46,001
12	23.34	$ 71,759	0.61566	$ 44,179
13	23.00	$ 71,759	0.59127	$ 42,429
14	22.67	$ 71,759	0.56784	$ 40,748
15	22.34	$ 71,759	0.54535	$ 39,133
16	22.00	$ 71,759	0.52374	$ 37,583
17	21.67	$ 71,759	0.50300	$ 36,094
18	21.34	$ 71,759	0.48307	$ 34,664
19	21.00	$ 71,759	0.46393	$ 33,291
20	20.67	$ 71,759	0.44555	$ 31,972
21	20.34	$ 71,759		----------
22	20.00	$ 71,759		$ 964,516
		Partial Payment Factor		0.07440

		Average Annual Value		$ 71,759
		Rnded AA Value		$ 71,800

Sand

Tons Evaluated	253,333	
Shoaling Rate	0.33	

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 1,880,857	0.96038	$ 1,806,345
2	26.67	$ 1,881,280	0.92234	$ 1,735,176
3	26.34	$ 1,881,704	0.88580	$ 1,666,811
4	26.00	$ 1,882,128	0.85071	$ 1,601,139
5	25.67	$ 1,883,018	0.81701	$ 1,538,436
6	25.34	$ 1,883,908	0.78464	$ 1,478,187
7	25.00	$ 1,884,798	0.75355	$ 1,420,298
8	24.67	$ 1,891,553	0.72370	$ 1,368,921
9	24.34	$ 1,898,309	0.69503	$ 1,319,385
10	24.00	$ 1,905,064	0.66750	$ 1,271,626
11	23.67	$ 1,922,797	0.64105	$ 1,232,618
12	23.34	$ 1,940,531	0.61566	$ 1,194,704
13	23.00	$ 1,958,264	0.59127	$ 1,157,860
14	22.67	$ 1,992,886	0.56784	$ 1,131,650
15	22.34	$ 2,027,508	0.54535	$ 1,105,700
16	22.00	$ 2,062,131	0.52374	$ 1,080,030
17	21.67	$ 2,109,419	0.50300	$ 1,061,030
18	21.34	$ 2,156,708	0.48307	$ 1,041,840
19	21.00	$ 2,203,997	0.46393	$ 1,022,506
20	20.67	$ 2,260,575	0.44555	$ 1,007,207
21	20.34	$ 2,317,153	0.42790	----------
22	20.00	$ 2,373,730	0.41095	$ 26,241,470
		Partial Payment Factor		0.07440

		Average Annual Value		$ 1,952,326
		Rnded AA Value		$ 1,952,300

Salt

Tons Evaluated	50,444	
Shoaling Rate	0.33	

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 414,145	0.96038	$ 397,739
2	26.67	$ 414,145	0.92234	$ 381,982
3	26.34	$ 414,145	0.88580	$ 366,849
4	26.00	$ 414,145	0.85071	$ 352,316
5	25.67	$ 414,145	0.81701	$ 338,359
6	25.34	$ 414,145	0.78464	$ 324,955
7	25.00	$ 414,145	0.75355	$ 312,081
8	24.67	$ 414,145	0.72370	$ 299,718
9	24.34	$ 414,145	0.69503	$ 287,844
10	24.00	$ 414,145	0.66750	$ 276,441
11	23.67	$ 414,313	0.64105	$ 265,597
12	23.34	$ 414,482	0.61566	$ 255,179
13	23.00	$ 414,650	0.59127	$ 245,169
14	22.67	$ 414,650	0.56784	$ 235,457
15	22.34	$ 414,650	0.54535	$ 226,129
16	22.00	$ 414,650	0.52374	$ 217,171
17	21.67	$ 415,322	0.50300	$ 208,906
18	21.34	$ 415,995	0.48307	$ 200,954
19	21.00	$ 416,667	0.46393	$ 193,306
20	20.67	$ 418,181	0.44555	$ 186,322
21	20.34	$ 419,694	0.42790	----------
22	20.00	$ 421,207	0.41095	$ 5,572,473
		Partial Payment Facto		0.07440

		Average Annual Value		$ 414,584
		Rnded AA Value		$ 414,600

Limestone

Tons Evaluated	820,889	
Shoaling Rate	0.33	

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 5,997,332	0.96038	$ 5,759,742
2	26.67	$ 5,998,683	0.92234	$ 5,532,812
3	26.34	$ 6,000,034	0.88580	$ 5,314,821
4	26.00	$ 6,001,385	0.85071	$ 5,105,420
5	25.67	$ 6,004,223	0.81701	$ 4,905,482
6	25.34	$ 6,007,060	0.78464	$ 4,713,374
7	25.00	$ 6,009,898	0.75355	$ 4,528,788
8	24.67	$ 6,061,798	0.72370	$ 4,386,937
9	24.34	$ 6,113,699	0.69503	$ 4,249,217
10	24.00	$ 6,165,599	0.66750	$ 4,115,524
11	23.67	$ 6,249,687	0.64105	$ 4,006,389
12	23.34	$ 6,333,775	0.61566	$ 3,899,442
13	23.00	$ 6,417,863	0.59127	$ 3,794,681
14	22.67	$ 6,515,838	0.56784	$ 3,699,986
15	22.34	$ 6,613,813	0.54535	$ 3,606,838
16	22.00	$ 6,711,788	0.52374	$ 3,515,264
17	21.67	$ 6,821,009	0.50300	$ 3,430,942
18	21.34	$ 6,930,231	0.48307	$ 3,347,784
19	21.00	$ 7,039,452	0.46393	$ 3,265,830
20	20.67	$ 7,159,792	0.44555	$ 3,190,069
21	20.34	$ 7,280,132	0.42790	----------
22	20.00	$ 7,400,471	0.41095	$ 84,369,343
		Partial Payment Factor		0.07440

		Average Annual Value		$ 6,276,953
		Rnded AA Value		$ 6,277,000

6 F. Time Stream Of Vessel Transportation Costs Under WOP and WP Tonnage Projections

2. WP Vessel Transportation Cost Time Streams- 27 foot Maintained Depth-Erie O&M-2011

WITH PROJECT CONDITION- 27 Foot Channel

Coal

Erie Pa. to Arcelor Mittal
Tons Evaluated 10,889
Shoaling Rate 0.33 feet per year

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 71,759	0.96038	$ 68,916
2	27.00	$ 71,759	0.92234	$ 66,186
3	27.00	$ 71,759	0.88580	$ 63,564
4	27.00	$ 71,759	0.85071	$ 61,045
5	27.00	$ 71,759	0.81701	$ 58,627
6	27.00	$ 71,759	0.78464	$ 56,305
7	27.00	$ 71,759	0.75355	$ 54,074
8	27.00	$ 71,759	0.72370	$ 51,932
9	27.00	$ 71,759	0.69503	$ 49,874
10	27.00	$ 71,759	0.66750	$ 47,899
11	27.00	$ 71,759	0.64105	$ 46,001
12	27.00	$ 71,759	0.61566	$ 44,179
13	27.00	$ 71,759	0.59127	$ 42,429
14	27.00	$ 71,759	0.56784	$ 40,748
15	27.00	$ 71,759	0.54535	$ 39,133
16	27.00	$ 71,759	0.52374	$ 37,583
17	27.00	$ 71,759	0.50300	$ 36,094
18	27.00	$ 71,759	0.48307	$ 34,664
19	27.00	$ 71,759	0.46393	$ 33,291
20	27.00	$ 71,759	0.44555	$ 31,972

				$ 964,516
		Partial Payment Factor		0.07440

		Average Annual Value		$ 71,759
		Rnded AA Value		$ 71,800

Sand

Bruce Mines To Erie Dock
Tons Evaluated 253,333
Shoaling Rate 0.33

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 1,880,857	0.96038	$ 1,806,345
2	27.00	$ 1,880,857	0.92234	$ 1,734,785
3	27.00	$ 1,880,857	0.88580	$ 1,666,060
4	27.00	$ 1,880,857	0.85071	$ 1,600,058
5	27.00	$ 1,880,857	0.81701	$ 1,536,670
6	27.00	$ 1,880,857	0.78464	$ 1,475,794
7	27.00	$ 1,880,857	0.75355	$ 1,417,329
8	27.00	$ 1,880,857	0.72370	$ 1,361,180
9	27.00	$ 1,880,857	0.69503	$ 1,307,256
10	27.00	$ 1,880,857	0.66750	$ 1,255,468
11	27.00	$ 1,880,857	0.64105	$ 1,205,731
12	27.00	$ 1,880,857	0.61566	$ 1,157,965
13	27.00	$ 1,880,857	0.59127	$ 1,112,091
14	27.00	$ 1,880,857	0.56784	$ 1,068,035
15	27.00	$ 1,880,857	0.54535	$ 1,025,724
16	27.00	$ 1,880,857	0.52374	$ 985,089
17	27.00	$ 1,880,857	0.50300	$ 946,064
18	27.00	$ 1,880,857	0.48307	$ 908,585
19	27.00	$ 1,880,857	0.46393	$ 872,590
20	27.00	$ 1,880,857	0.44555	$ 838,022

				$ 25,280,840
		Partial Payment Factor		0.07440

		Average Annual Value		$ 1,880,857
		Rnded AA Value		$ 1,880,900

Salt

Fairport Harbor to Erie Dock
Tons Evaluated 50,444
Shoaling Rate 0.33

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 414,145	0.96038	$ 397,739
2	27.00	$ 414,145	0.92234	$ 381,982
3	27.00	$ 414,145	0.88580	$ 366,849
4	27.00	$ 414,145	0.85071	$ 352,316
5	27.00	$ 414,145	0.81701	$ 338,359
6	27.00	$ 414,145	0.78464	$ 324,955
7	27.00	$ 414,145	0.75355	$ 312,081
8	27.00	$ 414,145	0.72370	$ 299,718
9	27.00	$ 414,145	0.69503	$ 287,844
10	27.00	$ 414,145	0.66750	$ 276,441
11	27.00	$ 414,145	0.64105	$ 265,490
12	27.00	$ 414,145	0.61566	$ 254,972
13	27.00	$ 414,145	0.59127	$ 244,871
14	27.00	$ 414,145	0.56784	$ 235,170
15	27.00	$ 414,145	0.54535	$ 225,854
16	27.00	$ 414,145	0.52374	$ 216,906
17	27.00	$ 414,145	0.50300	$ 208,314
18	27.00	$ 414,145	0.48307	$ 200,061
19	27.00	$ 414,145	0.46393	$ 192,135
20	27.00	$ 414,145	0.44555	$ 184,524

				$5,566,580
		Partial Payment Factor		0.07440

		Average Annual Value		$ 414,145
		Rnded AA Value		$ 414,100

6 F. Time Stream Of Vessel Transportation Costs Under WOP and WP Tonnage Projections

3. WP Vessel Transportation Cost Time Streams- 25 foot Maintained Depth-Erie O&M 2011

Coal

Tons Evaluated	10,889	
Shoaling Rate	0.33	feet per year

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 71,759	0.96038	$ 68,916
2	26.67	$ 71,759	0.92234	$ 66,186
3	26.34	$ 71,759	0.88580	$ 63,564
4	26.00	$ 71,759	0.85071	$ 61,045
5	25.67	$ 71,759	0.81701	$ 58,627
6	25.34	$ 71,759	0.78464	$ 56,305
7	25.00	$ 71,759	0.75355	$ 54,074
8	25.00	$ 71,759	0.72370	$ 51,932
9	25.00	$ 71,759	0.69503	$ 49,874
10	25.00	$ 71,759	0.66750	$ 47,899
11	25.00	$ 71,759	0.64105	$ 46,001
12	25.00	$ 71,759	0.61566	$ 44,179
13	25.00	$ 71,759	0.59127	$ 42,429
14	25.00	$ 71,759	0.56784	$ 40,748
15	25.00	$ 71,759	0.54535	$ 39,133
16	25.00	$ 71,759	0.52374	$ 37,583
17	25.00	$ 71,759	0.50300	$ 36,094
18	25.00	$ 71,759	0.48307	$ 34,664
19	25.00	$ 71,759	0.46393	$ 33,291
20	25.00	$ 71,759	0.44555	$ 31,972
				$ 964,516
		Partial Payment Factor		0.07440
		Average Annual Value		$ 71,759
		Rnded AA Value		$ 71,800

Sand

Tons Evaluated	253,333	
Shoaling Rate	0.33	

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 1,880,857	0.96038	$ 1,806,345
2	26.67	$ 1,881,280	0.92234	$ 1,735,176
3	26.34	$ 1,881,704	0.88580	$ 1,666,811
4	26.00	$ 1,882,128	0.85071	$ 1,601,139
5	25.67	$ 1,883,018	0.81701	$ 1,538,436
6	25.34	$ 1,883,908	0.78464	$ 1,478,187
7	25.00	$ 1,884,798	0.75355	$ 1,420,298
8	25.00	$ 1,884,798	0.72370	$ 1,364,032
9	25.00	$ 1,884,798	0.69503	$ 1,309,995
10	25.00	$ 1,884,798	0.66750	$ 1,258,098
11	25.00	$ 1,884,798	0.64105	$ 1,208,258
12	25.00	$ 1,884,798	0.61566	$ 1,160,391
13	25.00	$ 1,884,798	0.59127	$ 1,114,422
14	25.00	$ 1,884,798	0.56784	$ 1,070,273
15	25.00	$ 1,884,798	0.54535	$ 1,027,873
16	25.00	$ 1,884,798	0.52374	$ 987,153
17	25.00	$ 1,884,798	0.50300	$ 948,046
18	25.00	$ 1,884,798	0.48307	$ 910,488
19	25.00	$ 1,884,798	0.46393	$ 874,419
20	25.00	$ 1,884,798	0.44555	$ 839,778
				$ 25,319,618
		Partial Payment Factor		0.07440
		Average Annual Value		$ 1,883,742
		Rnded AA Value		$ 1,883,700

Salt

Tons Evaluated	50,444	
Shoaling Rate	0.33	

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 414,145	0.96038	$ 397,739
2	26.67	$ 414,145	0.92234	$ 381,982
3	26.34	$ 414,145	0.88580	$ 366,849
4	26.00	$ 414,145	0.85071	$ 352,316
5	25.67	$ 414,145	0.81701	$ 338,359
6	25.34	$ 414,145	0.78464	$ 324,955
7	25.00	$ 414,145	0.75355	$ 312,081
8	25.00	$ 414,145	0.72370	$ 299,718
9	25.00	$ 414,145	0.69503	$ 287,844
10	25.00	$ 414,145	0.66750	$ 276,441
11	25.00	$ 414,145	0.64105	$ 265,490
12	25.00	$ 414,145	0.61566	$ 254,972
13	25.00	$ 414,145	0.59127	$ 244,871
14	25.00	$ 414,145	0.56784	$ 235,170
15	25.00	$ 414,145	0.54535	$ 225,854
16	25.00	$ 414,145	0.52374	$ 216,906
17	25.00	$ 414,145	0.50300	$ 208,314
18	25.00	$ 414,145	0.48307	$ 200,061
19	25.00	$ 414,145	0.46393	$ 192,135
20	25.00	$ 414,145	0.44555	$ 184,524
				$ 5,566,580
				0.07440
		Average Annual Value		$ 414,145
		Rnded AA Value		$ 414,100

Limestone

Tons Evaluated	820,889	
Shoaling Rate	0.33	

Project Year	Channel Depth	Trans Cost	Present Worth Factor	Present Worth Costs
1	27.00	$ 5,997,332	0.96038	$ 5,759,742
2	26.67	$ 5,998,683	0.92234	$ 5,532,812
3	26.34	$ 6,000,034	0.88580	$ 5,314,821
4	26.00	$ 6,001,385	0.85071	$ 5,105,420
5	25.67	$ 6,004,223	0.81701	$ 4,905,482
6	25.34	$ 6,007,060	0.78464	$ 4,713,374
7	25.00	$ 6,009,898	0.75355	$ 4,528,788
8	25.00	$ 6,009,898	0.72370	$ 4,349,376
9	25.00	$ 6,009,898	0.69503	$ 4,177,072
10	25.00	$ 6,009,898	0.66750	$ 4,011,594
11	25.00	$ 6,009,898	0.64105	$ 3,852,671
12	25.00	$ 6,009,898	0.61566	$ 3,700,044
13	25.00	$ 6,009,898	0.59127	$ 3,553,464
14	25.00	$ 6,009,898	0.56784	$ 3,412,690
15	25.00	$ 6,009,898	0.54535	$ 3,277,494
16	25.00	$ 6,009,898	0.52374	$ 3,147,653
17	25.00	$ 6,009,898	0.50300	$ 3,022,956
18	25.00	$ 6,009,898	0.48307	$ 2,903,199
19	25.00	$ 6,009,898	0.46393	$ 2,788,187
20	25.00	$ 6,009,898	0.44555	$ 2,677,730
				$ 80,734,570
		Partial Payment Factor		0.07440
		Average Annual Value		$ 6,006,531
		Rnded AA Value		$ 6,006,500

6 G. Average Annual Benefits

1. Benefits=AA WOP Transportation Costs – AA WP Transportation Costs-Erie O&M 2011

Commodities	Average Annual WOP Trans Costs	Average Annual WP Trans Costs 27 Foot Channel	Average Annual WP Trans Costs 26 Foot Channel	Average Annual WP Trans Costs 25 Foot Channel	Average Annual WP Trans Costs 24 Foot Channel	Average Annual WP Trans Costs 23 Foot Channel	Average Annual WP Trans Costs 22 Foot Channel	Average Annual WP Trans Costs 21 Foot Channel
Coal	$ 71,800	$ 71,800	$ 71,800	$ 71,800	$ 71,800	$ 71,800	$ 71,800	$ 71,800
Sand	$ 1,952,300	$ 1,880,900	$ 1,882,000	$ 1,883,700	$ 1,893,900	$ 1,927,200	$ 1,935,700	$ 1,950,500
Salt	$ 414,600	$ 414,100	$ 414,100	$ 414,100	$ 414,100	$ 414,300	$ 414,300	$ 414,500
Limestone	$ 6,277,000	$ 5,997,300	$ 6,000,800	$ 6,006,500	$ 6,084,700	$ 6,225,000	$ 6,238,900	$ 6,272,900
	$ 8,715,700	$ 8,364,100	$ 8,368,700	$ 8,376,100	$ 8,464,500	$ 8,638,300	$ 8,660,700	$ 8,709,700
Benefits								
Coal		$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sand		$ 71,400	$ 70,300	$ 68,600	$ 58,400	$ 25,100	$ 16,600	$ 1,800
Salt		$ 500	$ 500	$ 500	$ 500	$ 300	$ 300	$ 100
Limestone		$ 279,700	$ 276,200	$ 270,500	$ 192,300	$ 52,000	$ 38,100	$ 4,100
Benefits		$ 351,600	$ 347,000	$ 339,600	$ 251,200	$ 77,400	$ 55,000	$ 6,000

7. Data Needed For Dredging Cost Evaluation

1. Dredging Costs Per Dredging Event- Erie O&M 2011

Maintain A 28/27 Foot Channel Depth

Cubic yrds removed per dreging cycle		105,000
Dredging Cost per cubic yard		$ 6.25
Dredging costs		$ 656,250
Mob & Demob costs		$ 149,000
Engineering & Design	10%	$ 65,625
Supervision & Administration	10%	$ 65,625
Total dredging costs per cycle		$ 936,500

Project Year	Channel Depth	Dredging Costs Per Cycle	Present Worth Factor	Present Worth Value
1	27.00	$ 936,500	0.96038	$ 899,400
2	27.00		0.92234	$ -
3	27.00		0.88580	$ -
4	27.00	$ 936,500	0.85071	$ 796,687
5	27.00		0.81701	$ -
6	27.00		0.78464	$ -
7	27.00	$ 936,500	0.75355	$ 705,704
8	27.00		0.72370	$ -
9	27.00		0.69503	$ -
10	27.00	$ 936,500	0.66750	$ 625,112
11	27.00		0.64105	$ -
12	27.00		0.61566	$ -
13	27.00	$ 936,500	0.59127	$ 553,723
14	27.00		0.56784	$ -
15	27.00		0.54535	$ -
16	27.00	$ 936,500	0.52374	$ 490,487
17	27.00		0.50300	$ -
18	27.00		0.48307	$ -
19	27.00	$ 936,500	0.46393	$ 434,473
20	27.00		0.44555	$ -
		Present Worth Value		$ 4,505,585
		Partial Payment Factor		0.0744
		Average Annual Value		$ 335,209
		Rounded		$ 335,200

Maintain A 27/26 Foot Channel Depth

Cubic yrds removed per dreging cycle		105,000
Dredging Cost per cubic yard		$ 6.25
Dredging costs		$ 656,250
Mob & Demob costs		$ 149,000
Engineering & Design	10%	$ 65,625
Supervision & Administration	10%	$ 65,625
Total dredging costs per cycle		$ 936,500

Project Year	Channel Depth	Dredging Costs Per Cycle	Present Worth Factor	Present Worth Value
1	27.00		0.96038	$ -
2	26.67		0.92234	$ -
3	26.34		0.88580	$ -
4	26.00	$ 936,500	0.85071	$ 796,687
5	26.00		0.81701	$ -
6	26.00		0.78464	$ -
7	26.00	$ 936,500	0.75355	$ 705,704
8	26.00		0.72370	$ -
9	26.00		0.69503	$ -
10	26.00	$ 936,500	0.66750	$ 625,112
11	26.00		0.64105	$ -
12	26.00		0.61566	$ -
13	26.00	$ 936,500	0.59127	$ 553,723
14	26.00		0.56784	$ -
15	26.00		0.54535	$ -
16	26.00	$ 936,500	0.52374	$ 490,487
17	26.00		0.50300	$ -
18	26.00		0.48307	$ -
19	26.00	$ 936,500	0.46393	$ 434,473
20	26.00		0.44555	$ -
		Present Worth Value		$3,606,186
		Partial Payment Factor		0.0744
		Average Annual Value		$ 268,295
		Rounded		$ 268,300

Maintain A 26/25 Foot Channel Depth

Cubic yrds removed per dreging cycle		105,000
Dredging Cost per cubic yard		$ 6.25
Dredging costs		$ 656,250
Mob & Demob costs		$ 149,000
Engineering & Design	10%	$ 65,625
Supervision & Administration	10%	$ 65,625
Total dredging costs per cycle		$ 936,500

Project Year	Channel Depth	Dredging Costs Per Cycle	Present Worth Factor	Present Worth Value
1	27.00		0.96038	$ -
2	26.67		0.92234	$ -
3	26.34		0.88580	$ -
4	26.00		0.85071	$ -
5	25.67		0.81701	$ -
6	25.34		0.78464	$ -
7	25.00	$ 936,500	0.75355	$ 705,704
8	25.00		0.72370	$ -
9	25.00		0.69503	$ -
10	25.00	$ 936,500	0.66750	$ 625,112
11	25.00		0.64105	$ -
12	25.00		0.61566	$ -
13	25.00	$ 936,500	0.59127	$ 553,723
14	25.00		0.56784	$ -
15	25.00		0.54535	$ -
16	25.00	$ 936,500	0.52374	$ 490,487
17	25.00		0.50300	$ -
18	25.00		0.48307	$ -
19	25.00	$ 936,500	0.46393	$ 434,473
20	25.00		0.44555	$ -
		Present Worth Value		$ 2,809,499
		Partial Payment Factor		0.0744
		Average Annual Value		$ 209,022
		Rounded		$ 209,000

8. Harbor Benefit Cost Ratio By Maintained Channel Depth Erie Harbor O&M 2011

		27 Foot Channel	26 Foot Channel	25 Foot Channel	24 Foot Channel	23 Foot Channel	22 Foot Channel	21 Foot Channel
AA Benefits		$ 351,600	$ 347,000	$ 339,600	$ 251,200	$ 77,400	$ 55,000	$ 6,000
AA Costs		$ 335,200	$ 268,300	$ 209,000	$ 156,500	$ 110,000	$ 68,800	$ 32,300
BC Ratio		1.05	1.29	1.62	1.61	0.70	0.80	0.19
Net Benefits		$ 16,400	$ 78,700	$ 130,600	$ 94,700	$ (32,600)	$ (13,800)	$ (26,300)

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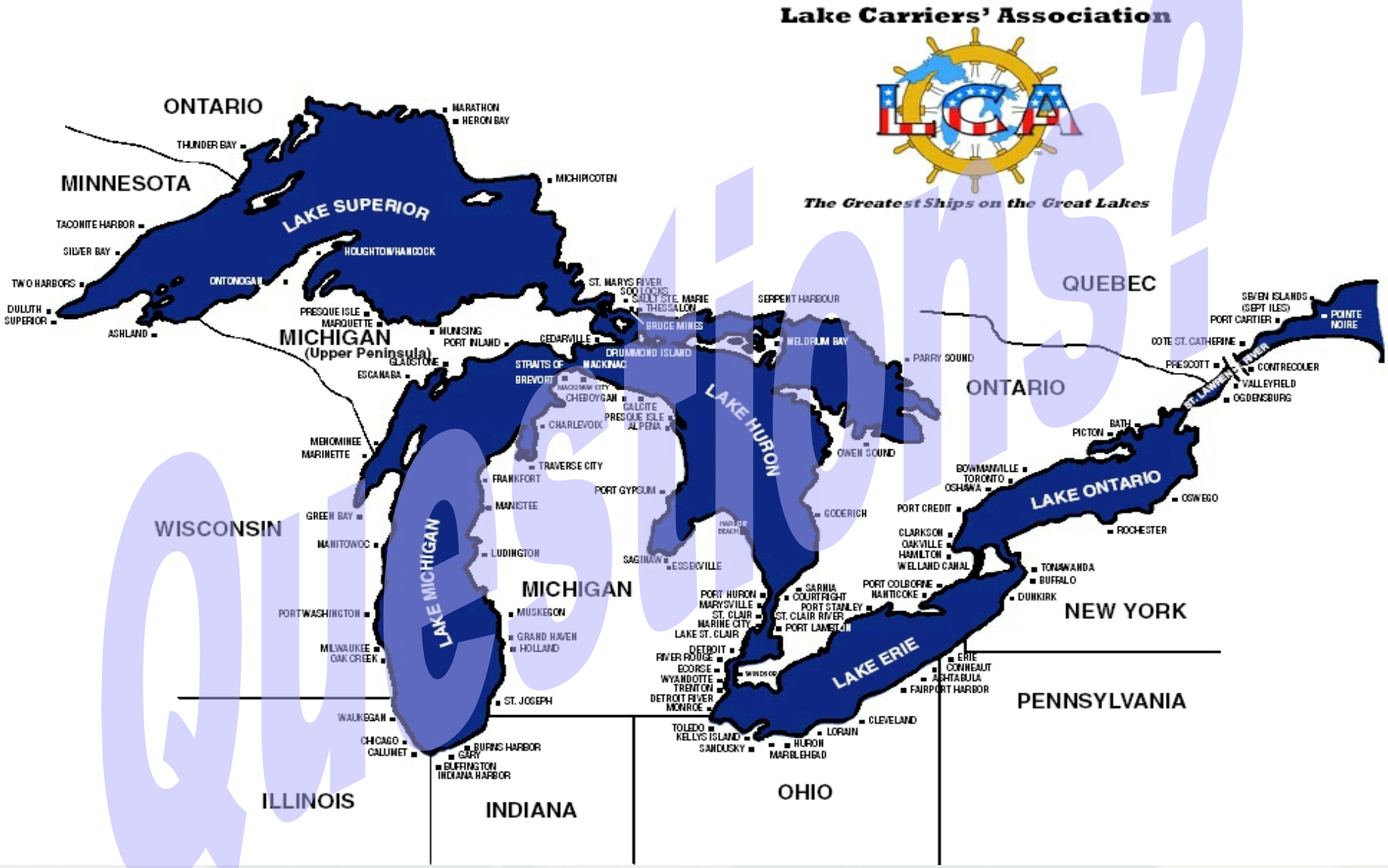
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ONTARIO
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OWEN SOUND
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PORT CARTIER
POINTE NOIRE
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Questions?

Other Sources Of Data

- Greenwoods Guide To Great Lakes Shipping-Ship characteristics
- Waterborne Commerce Statistics Center- Individual Vessel Movements
- Waterborne Commerce Of the U.S. Part 3- Summary Tonnage data
- Navigation Data Center Home Page (iwr.usace.army.mil)
- United States Coast Pilot 6- Data on Docks-depths
- Project Maps- COE-Authorized depths, dimensions
- Port Series-U.S. Army Corps Of Engineers-Port Dock Data
- Lake Carriers Association-Great Lakes Fleet
- Canadian Ship-owners Association
- United States Coast Guard Maritime Information Exchange
- Great Lakes Commission - Dredged Material (www.glc.org/rsm)
- Web Site: WWW.Boat Nerd.com-Vessel Data- ship photos