The Navigation Economic Technologies Program

October 2006

NETS

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Analysis of Towboat Operating Areas

Addendum Presenting Findings from Waterborne Commerce Statistics Center Data

US Army Corps of Engineers®

IWR Report 06-NETS-R-09

Navigation Economic Technologies

The purpose of the Navigation Economic Technologies (NETS) research program is to develop a standardized and defensible suite of economic tools for navigation improvement evaluation. NETS addresses specific navigation economic evaluation and modeling issues that have been raised inside and outside the Corps and is responsive to our commitment to develop and use peer-reviewed tools, techniques and procedures as expressed in the Civil Works strategic plan. The new tools and techniques developed by the NETS research program are to be based on 1) reviews of economic theory, 2) current practices across the Corps (and elsewhere), 3) data needs and availability, and 4) peer recommendations.

The NETS research program has two focus points: expansion of the body of knowledge about the economics underlying uses of the waterways; and creation of a toolbox of practical planning models, methods and techniques that can be applied to a variety of situations.

Expanding the Body of Knowledge

NETS will strive to expand the available body of knowledge about core concepts underlying navigation economic models through the development of scientific papers and reports. For example, NETS will explore how the economic benefits of building new navigation projects are affected by market conditions and/or changes in shipper behaviors, particularly decisions to switch to non-water modes of transportation. The results of such studies will help Corps planners determine whether their economic models are based on realistic premises.

Creating a Planning Toolbox

The NETS research program will develop a series of practical tools and techniques that can be used by Corps navigation planners. The centerpiece of these efforts will be a suite of simulation models. The suite will include models for forecasting international and domestic traffic flows and how they may change with project improvements. It will also include a regional traffic routing model that identifies the annual quantities from each origin and the routes used to satisfy the forecasted demand at each destination. Finally, the suite will include a microscopic event model that generates and routes individual shipments through a system from commodity origin to destination to evaluate non-structural and reliability based measures.

This suite of economic models will enable Corps planners across the country to develop consistent, accurate, useful and comparable analyses regarding the likely impact of changes to navigation infrastructure or systems.

NETS research has been accomplished by a team of academicians, contractors and Corps employees in consultation with other Federal agencies, including the US DOT and USDA; and the Corps Planning Centers of Expertise for Inland and Deep Draft Navigation.

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The NETS program was overseen by Mr. Robert Pietrowsky, Director of the Institute for Water Resources.

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PURPOSE

The Conclusions section of the NETS sponsored *Analysis of Towboat Operating Areas* report [1.] (Main Report) notes that the results presented rely solely on observed lockage information, and suggests future studies using Waterborne Commerce Statistics Center (WCSC) data. The intent of the suggestion was that additional movements may be identified if the data set is not limited to the lockage data contained in the Lock Performance Monitoring System (LPMS).

ANALYTIC APPROACH

This addendum first analyzes the movements of the same 203 unique towboats identified as the 90% group in the Main Report. The data set is then expanded to include all towboats. This addendum uses the same "peak" and "off-peak" periods in the main report, April through November and January through February respectively, and the same 5 year period of analysis (2000-2004). This addendum differs from the main report in that it uses WCSC data instead of LPMS data. The data source change results in a view of the data from a "days-used" and "miles-traveled" perspective instead of the "number of lockages" perspective taken with LPMS in the main report.

In simple terms, WCSC data contains information about;

- what is moving
- where it's moving
- when it's moving, and
- how much is moving

For this analysis, we are not interested in the types commodities moved. In addition, although WCSC provides tonnage and timing of commodity movements, the structure of WCSC does not allow us to tie together commodity movements with towboat movements. Therefore, we cannot tie the 90% group towboats to the commodities they are carrying. As a result, we cannot use tonnage as a measure for determining usage of the 90% group.

Fortunately, WCSC contains origin-destination and shipping-receiving date information for every towboat movement. This means we can determine distance traveled by time of the year as well as the amount of time each towboat is in transit.

DAYS-USED

Shipping and receiving dates in the WCSC "light" file were used to determine the amount of time a towboat was busy. If we assume the tow is "busy" the entire time between each reported ship-receive pair, it is a simple matter to sum up the days each towboat is busy and to do this by peak and off-peak periods. Table A-1 provides a summary of the "days-used" measure for each of the 203 towboats in the 90% group.

Table A-1
Towboat Days in Use
Peak and Off-Peak Periods

Towboat Rank	Days Used Peak	Days Used Off-Peak	Towboat Rank	Days Used Peak	Days Used Off-Peak	Towboat Rank	Days Used Peak	Days Used Off-Peak	Towboat Rank	Days Used Peak	Days Used Off-Peak
1	290		52	205	45	103	160	34	154	188	46
2	373		53	191	46	104	395	21	155	141	44
3	212	0	54	1086	176	105	202		156	241	55
4	206	99	55	923	87	106	123	43	157		
5	966	293	56	1345	324	107	72		158	241	61
6	873	249	57	215	48	108	239	30	159	5	
7	989	251	58	232	54	109	93	18	160	158	35
8			59	194	46	110	181	33	161	83	33
9	963	299	60	819	70	111	123	2	162	183	
10	229	50	61	1311	445	112			163	7	4
11	194	56	62	119	35	113			164		
12			63	144	44	114	169	32	165	92	20
13			64	227	123	115	101	29	166	65	11
14	231	53	65	195	50	116	76	18	167	123	24
15	747	151	66	764	116	117	186	38	168	155	31
16	229	56	67	188	39	118	225	29	169	203	52
17	210	49	68	202	39	119	14		170	86	12
18	231	52	69	228	56	120	188	38	171	165	38
19	1015	147	70	22	8	121	79	31	172	40	5
20	177	8	71	1016	181	122	178	39	173	58	17
21	220	128	72	272	41	123	159	25	174	809	177
22	1089	227	73	1543	255	124	153	33	175	1077	258
23	219	42	74	178	23	125	177	44	176	112	24
24	232	55	75	149	27	126	201	33	177	121	15
25	225	59	76	186	46	127			178	74	19
26	896	329	77	259	50	128	484	76	179	241	36
27	235	49	78	190	38	129	284		180	207	51
28	233	55	79	241	52	130	186	44	181	167	48
29	216	44	80	84		131	10	4	182	111	26
30	930	271	81	202	40	132	1423	326	183	94	28
31	180	31	82			133	527	247	184	657	83
32	201	37	83	1058	244	134	202	36	185	121	12
33	241	51	84	163	32	135	5	0	186	185	40
34	217	56	85	177	48	136	71	25	187	416	26
35	173	2	86	107	26	137	178	37	188	904	310
36	189	46	87	239	57	138	146	35	189	152	28
37	194	43	88	2		139			190	1450	427
38	212	45	89	175	41	140	197	35	191	184	168
39	202	43	90	144	34	141	47	13	192	240	55
40	196	48	91	76	34	142	195	35	193	20	4
41	203	31	92	403	11	143	168	22	194	171	34
42	199	42	93			144	143	11	195	144	46
43	181	34	94	229	18	145	205	52	196	1	0
44	295	50	95	1710	373	146	0		197		
45	845	201	96	242	55	147	7	1	198	542	126
46	236	135	97			148	880	136	199	947	201
47	206	124	98	182	39	149			200	209	40
48	1806	339	99	465	141	150	7	0	201	108	27
49	208	51	100	206	50	151	644		202	467	142
50	1013	175	101	472	39	152			203	64	12
51	894	142	102	169	33	153	78				

A quick review of the data above reveals a problem. Some towboats show over 1200 days of use, others show less than 250. While it is possible that a towboat sits idle for 100 days a year, it is impossible for a towboat to operate 1200 days a year.

A review of individual WCSC records identified the problem. This analysis uses the equation:

Days-used = Receiving Date - Shipping Date

Many of the low usage days can be explained by records where the shipping and receiving date are the same. Whenever this occurs, days-used will be zero for that movement. Some towboats show four individual movements all on the same day. In this case, the days-used will still be zero, even though the towboat made four movements. We could adjust the equation to make days-used equal to the receiving date minus the shipping date plus one, but then the towboat making four movements in one day will be counted as four days-used. A more sophisticated calculation could be attempted to determine days-used for this situation, but assumptions would have to be made. Inevitably, the assumptions would be incorrect in some cases.

On the other hand, the excessively large days-used values can be explained by the way some companies report their data. Some companies report all shipping dates as the first of the month and all receiving dates as the last day of the month. If a towboat moves between more than one origin-destination pair in a month, days-used can add up to more than the number of days in the month.

Based on a cursory review of the data, it is apparent days-used values are fairly good indicators of towboat usage for some towboats and very poor indicators for others. We would have to do a record-by-record review of the data in order to draw conclusions using the days-used statistic. It should be noted that the shipping-receiving dates are probably good indicators of the month in which a movement was made.

MILES-TRAVELED

The other measure of usage provided by WCSC data is “miles-traveled”. WCSC contains a field which shows the miles from origin to destination for every movement. This allows us to easily calculate miles-traveled. If we use this field in concert with the shipping-receiving date fields, we can estimate miles-traveled in each month, or during the Peak and Off-Peak periods. Table A-2 shows the average monthly miles-traveled by each of the 203 towboats in the 90% group for the peak and off-peak periods.

Table A-2
Average Monthly Miles-Traveled
Peak and Off-Peak Periods

Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak	Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak	Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak	Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak
1	351		52	1840	1480	103	1631	1606	154	1982	2084
2	205		53	1674	1739	104	2129	1221	155	1664	2109
3	2514	13	54	1729	771	105	67		156	3573	3117
4	1710	1135	55	1940	379	106	1505	1280	157		
5	1958	1417	56	2447	1524	107	187		158	2771	2928
6	1965	1525	57	2363	2418	108	1915	1385	159	81	
7	2079	1346	58	2221	2157	109	891	585	160	1773	1434
8			59	1866	1789	110	1880	1450	161	1067	1391
9	1952	1540	60	1777	328	111	25	2	162	1969	
10	3170	4229	61	2514	2076	112			163	645	463
11	1640	967	62	1588	663	113			164		
12			63	1300	1544	114	1860	1324	165	668	615
13			64	2410	2384	115	1487	1492	166	1828	2307
14	2966	3999	65	1853	1854	116	544	389	167	1464	1250
15	1887	1503	66	1685	1484	117	1988	1870	168	1895	1864
16	2990	4142	67	1748	1448	118	1720	1128	169	2316	1490
17	1920	1571	68	1925	1512	119	117		170	2047	2436
18	3415	4086	69	2332	2733	120	1445	1734	171	2011	1596
19	2048	1131	70	258	355	121	776	876	172	1558	965
20	1520	295	71	2612	1747	122	2975	3056	173	812	834
21	1953	1870	72	1167	1272	123	1124	498	174	2664	2561
22	2346	2209	73	2354	1707	124	1722	1579	175	1973	2169
23	2049	2107	74	1664	1032	125	1957	1671	176	1308	1180
24	3141	3584	75	1324	1023	126	1652	1223	177	1464	921
25	2761	2916	76	1793	1811	127			178	725	981
26	1783	1321	77	2986	2333	128	713	739	179	2128	1660
27	3026	3502	78	1712	1274	129	801		180	1999	1717
28	2848	2671	79	2760	2762	130	2954	2955	181	1857	2206
29	2003	1512	80	2		131	77	85	182	17	6
30	2303	2840	81	1943	1672	132	2773	2794	183	1213	1037
31	1540	775	82			133	751	1048	184	1724	846
32	1791	1438	83	3000	2540	134	2103	1675	185	1603	2028
33	3620	3132	84	1513	975	135	214	85	186	2465	1710
34	2515	3503	85	1793	1647	136	1046	1197	187	1323	929
35	1600	41	86	958	721	137	2898	2731	188	1832	2520
36	1649	1344	87	2822	3063	138	1887	1735	189	2222	1862
37	1718	1409	88	25		139			190	2643	1681
38	2015	1445	89	1840	1434	140	2109	1657	191	35	119
39	1806	1473	90	1286	1674	141	43	43	192	2070	1954
40	1695	1695	91	814	913	142	2031	1702	193	112	41
41	1638	779	92	45	3	143	1279	580	194	2455	2088
42	1769	1829	93			144	1275	410	195	1848	2166
43	1554	1283	94	95	51	145	2897	2384	196	4	2
44	2329	2087	95	1991	1876	146	4		197		
45	2205	2134	96	4424	3253	147	359	114	198	1018	1081
46	2063	1632	97			148	2918	1801	199	3119	2785
47	2095	2657	98	1897	1739	149			200	1367	1041
48	1910	1413	99	1934	1476	150	396	8	201	1414	1473
49	2720	3936	100	2295	2414	151	121		202	1730	1129
50	2296	2131	101	2301	2343	152			203	9	4
51	1407	531	102	1229	937	153	332				

Before comparing peak and off-peak mileage, let us first determine whether the mileage data, like the days-used data, is skewed or biased. To do this, we estimate the maximum number of miles a towboat can travel in a month, and then look for values greater than the reasonable maximum. If we assume a towboat travels about 6 miles an hour, 24 hours a day, 7 days a week, the reasonable maximum is about 4,400 miles per month. Review of the data in Table A-2 reveals only one towboat with average monthly mileage greater than 4,400. Towboat Order Number 96 reportedly traveled 4,424 miles per month during the peak period. Only three other towboats show monthly averages greater than 4,000 miles per month. Based on this cursory reiew, we can reasonably assume that reported mileages are not excessively high.

On the other hand, we can visually inspect the data and see there are some towboats that report no mileage at all. Comparison with Table A-1 shows these same towboats report zero days-used. We can only attribute this to a failure-to-report by the towboat's owner, or misreporting of the towboat number. There are also some towboats that show very small mileages traveled, such as numbers 80, 88, 92, 94, etc. Again, we have no choice but to assume these towboat's movements are not being properly reported to WCSC.

Towboats 1 and 2 are special cases. Detailed analysis of their data indicates these towboats operate exclusively on the far upper end of the Mississippi River in the Minneapolis-St Paul area. Although they create a lot of lockages, they do not travel very far.

In order to remove the bias of non-reporting and under-reporting towboats, we will ignore those towboats that report less than 100 miles per month in either the peak or off-peak periods. Table A-3 shows the 175 towboats that meet this criterion.

Table A-3
Average Monthly Miles-traveled
Peak and Off-Peak Periods – Selected Towboats

Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak	Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak	Order Number	Monthly Miles Traveled Peak	Monthly Miles Traveled Off-Peak
1	351		63	1300	1544	134	2103	1675
2	205		64	2410	2384	135	214	85
3	2514	13	65	1853	1854	136	1046	1197
4	1710	1135	66	1685	1484	137	2898	2731
5	1958	1417	67	1748	1448	138	1887	1735
6	1965	1525	68	1925	1512	140	2109	1657
7	2079	1346	69	2332	2733	142	2031	1702
9	1952	1540	70	258	355	143	1279	580
10	3170	4229	71	2612	1747	144	1275	410
11	1640	967	72	1167	1272	145	2897	2384
14	2966	3999	73	2354	1707	147	359	114
15	1887	1503	74	1664	1032	148	2918	1801
16	2990	4142	75	1324	1023	150	396	8
17	1920	1571	76	1793	1811	151	121	
18	3415	4086	77	2986	2333	153	332	
19	2048	1131	78	1712	1274	154	1982	2084
20	1520	295	79	2760	2762	155	1664	2109
21	1953	1870	81	1943	1672	156	3573	3117
22	2346	2209	83	3000	2540	158	2771	2928
23	2049	2107	84	1513	975	160	1773	1434
24	3141	3584	85	1793	1647	161	1067	1391
25	2761	2916	86	958	721	162	1969	
26	1783	1321	87	2822	3063	163	645	463
27	3026	3502	89	1840	1434	165	668	615
28	2848	2671	90	1286	1674	166	1828	2307
29	2003	1512	91	814	913	167	1464	1250
30	2303	2840	95	1991	1876	168	1895	1864
31	1540	775	96	4424	3253	169	2316	1490
32	1791	1438	98	1897	1739	170	2047	2436
33	3620	3132	99	1934	1476	171	2011	1596
34	2515	3503	100	2295	2414	172	1558	965
35	1600	41	101	2301	2343	173	812	834
36	1649	1344	102	1229	937	174	2664	2561
37	1718	1409	103	1631	1606	175	1973	2169
38	2015	1445	104	2129	1221	176	1308	1180
39	1806	1473	106	1505	1280	177	1464	921
40	1695	1695	107	187		178	725	981
41	1638	779	108	1915	1385	179	2128	1660
42	1769	1829	109	891	585	180	1999	1717
43	1554	1283	110	1880	1450	181	1857	2206
44	2329	2087	114	1860	1324	183	1213	1037
45	2205	2134	115	1487	1492	184	1724	846
46	2063	1632	116	544	389	185	1603	2028
47	2095	2657	117	1988	1870	186	2465	1710
48	1910	1413	118	1720	1128	187	1323	929
49	2720	3936	119	117		188	1832	2520
50	2296	2131	120	1445	1734	189	2222	1862
51	1407	531	121	776	876	190	2643	1681
52	1840	1480	122	2975	3056	191	35	119
53	1674	1739	123	1124	498	192	2070	1954
54	1729	771	124	1722	1579	193	112	41
55	1940	379	125	1957	1671	194	2455	2088
56	2447	1524	126	1652	1223	195	1848	2166
57	2363	2418	128	713	739	198	1018	1081
58	2221	2157	129	801		199	3119	2785
59	1866	1789	130	2954	2955	200	1367	1041
60	1777	328	132	2773	2794	201	1414	1473
61	2514	2076	133	751	1048	202	1730	1129
62	1588	663						

The table above shows 175 of the 203 towboats report traveling more than 100 miles per month in either the peak or off-peak periods. Of these 175 towboats, 57 (33%) traveled less than 75% as many miles during off-peak as they did during peak. Only 30% traveled more miles during the off-peak period. Overall, the average monthly miles-traveled during the peak period is 1829 miles and the average monthly miles-traveled during the off-peak is 1586 miles. This means for the group as a whole, off-peak miles-traveled is 87% of peak miles-traveled. Regarding the effect on individual towboats, only 13 (7%) towboats essentially quit operating. This includes the two on the extreme upper Mississippi.

ORIGIN-DESTINATION ANALYSIS

The Main Report and information provided thus far in this Addendum clearly indicate:

- Based on number of lockages shown in the Main Report, commercial navigation on the Upper Mississippi decreases significantly during the off-peak period, essentially ceasing above L&D 25.
- Based on miles-traveled shown thus far in this Addendum, a few of the boats essentially quit operating during the off-peak period, about a third travel significantly less during the off-peak period and another third travel as much or more during the off-peak period

This information begs the question, “Since the vast majority of boats continue to operate at some level during the off-peak, and they are not operating on the Upper Mississippi above L&D 25, where do they go?”

We seek to answer this question by tabulating and analyzing the mileage traveled by the 90% group between docks on various waterways during the peak and off-peak periods. This analysis shows us whether the 90% group tends to concentrate on certain routes or whether they disperse throughout the system.

O-D Analysis Procedure

The WCSC “light” file contains data that lists the origin and destination waterways for all towboat movements. In order to keep this analysis manageable, we first had to group the WCSC waterways into a small number of geographic waterway segments. The 2,800+ waterways listed in WCSC were consolidated into the 12 waterway segments shown below:

1. Upper Mississippi River above the mouth of the Missouri River
2. Upper Mississippi River from the Missouri to the Ohio River
3. Lower Mississippi River from the Ohio River to Baton Rouge
4. Lower Mississippi River from Baton Rouge to New Orleans
5. Lower Mississippi River from New Orleans to the Head of Passes
6. Gulf Coast East of the Mississippi River
7. Gulf Coast West of the Mississippi River

8. Illinois River
9. Ohio River and Tributaries
10. Missouri River
11. Tennessee-Tombigbee Waterway and tributaries
12. Other Areas

A few clarifications are offered here to help the reader understand how the waterway segments were created.

All rivers tributary to the main segment are included in the main segment except for those tributaries specifically listed. For example, the "Upper Mississippi above the mouth of the Missouri River" includes rivers such as the Minnesota and St Croix, but does not include the Illinois River. The "Upper Mississippi River from the Missouri to the Ohio River" includes the Kaskaskia River but not the Missouri.

The "Gulf Coast West of the Mississippi River" includes all waterways flowing directly into the gulf west of the Mississippi River all the way to Brownsville Texas. However, the "Gulf Coast East of the Mississippi River" segment ends at St Mark's Florida. Gulf ports east of St Mark's, including Tampa and Fort Myers, are included in the Other Areas group.

The Other Areas group includes all waterways on the east and west coasts, Alaska, Hawaii, and the Great Lakes.

O-D Mileages, 90% Group

Table A-4 shows the mileages traveled by the 90% group between various origin-destination waterways during the peak period. It shows that about one-half of the miles-traveled by the 90% group during the peak period originated or were destined for areas on the Upper Mississippi above the Ohio River. Other heavily traveled areas include the Lower Mississippi between the Ohio River and New Orleans, and the Illinois River. This information is not surprising since the 90% group was specifically selected because they account for 90% of the lockages on the canalized section of the Upper Mississippi River. The heavy usage of the Lower Mississippi River can be explained by the fact that the Lower Mississippi is the destination for the large grain movements out of the Upper Mississippi river basin. One surprising finding is that the 90% group travels extensively in the Ohio River Basin.

Table A-4
Average Monthly Miles-traveled
Between O-D Waterways, 90% Group, Peak Period

Origin Waterway Segment	Destination Waterway Segment: Upper Miss Above Missouri R	Upper Miss Missouri R to Ohio R	Lower Miss R Ohio R to Baton Rouge	Lower Miss Baton Rouge to New Orleans	Lower Miss New Orleans to Head of Passes	Gulf Coast West of Miss R	Gulf Coast East of Miss R	Illinois R	Ohio River & Tribs	Missouri R	Tenn-Tom Black Warrior	Other Areas	Totals
Upper Miss Above Missouri R	29158	41130	7369	6227	3681	574	31	2323	4942	607	76	9	96127
Upper Miss Missouri R to Ohio R	43192	2105	3658	10239	1842	381	26	10228	2992	431	65	110	75269
Lower Miss R Ohio R to Baton Rouge	3358	3711	4087	3401	1646	802	161	931	4733		248	28	23106
Lower Miss Baton Rouge to New Orleans	4113	10403	3667	372	219	959	55	2844	7801	32	76		30541
Lower Miss New Orleans to Head of Passes	527	1812	3219	246	24	194	9	472	1732		15	35	8285
Gulf Coast West of Miss R	416	257	543	932	196	1084	51	707	502	142			4830
Gulf Coast East of Miss R			63	109	41	30	43		23		89		398
Illinois R	1978	10617	1277	3551	363	441	38	5631	2360	26	14	32	26328
Ohio River & Tribs	3535	1955	4490	7441	2735	568	134	2281	30191	19	27	46	53422
Missouri R	501	463		82	36			26	31	722			1861
Tenn-Tom Black Warrior	59	11	49	54	58		57		16		63		367
Other Areas		109	48	35	35	82		48	31			191	579
Totals	86837	72573	28470	32689	10876	5115	605	25491	55354	1979	673	451	321113

Table A-5 shows the difference between the peak and off-peak miles-traveled by the 90% group. Numbers shown in (red parenthesis) mean fewer miles were traveled during the off-peak; those in black without parenthesis mean off-peak mileage is greater.

The table shows a precipitous drop in mileage for trips with an origin or destination on the Upper Miss above the Missouri. Lockage data from the Main Report indicates navigation essentially ceases above L&D 25. Therefore, we know the little remaining traffic is coming and going from points in the immediate St Louis area above the confluence of the Missouri. Traffic to and from points between the Missouri and Ohio rivers also declines, but the decrease is less dramatic.

On the other hand, we see that the 90% group increases mileage to and from points in the Ohio River Basin. It is interesting to compare intra-Ohio River basin mileage with intra-Upper Miss above the Missouri mileage. In a simplistic sense, one could say the Upper Miss's loss is the Ohio's gain. Of course, it isn't that simple, but it is interesting to consider the offsetting nature of these mileages. The Ohio River basin also realizes an increase in traffic due to increased shipments to points on the Lower Miss. The Illinois River sees a significant increase in traffic due to increased mileage to and from the Mississippi between the Missouri and Ohio.

Table A-5
Difference in Average Monthly Miles-traveled Between O-D Waterways, 90% Group

Destination Waterway Segment

Origin Waterway Segment	Upper Miss Above Missouri R	Upper Miss Missouri R to Ohio R	Lower Miss R Ohio R to Baton Rouge	Lower Miss Baton Rouge to New Orleans	Lower Miss New Orleans to Head of Passes	Gulf Coast West of Miss R	Gulf Coast East of Miss R	Illinois R	Ohio River & Tribs	Missouri R	Tenn-Tom Black Warrior	Other Areas	Totals	% Change
Upper Miss Above Missouri R	(28900)	(39726)	(5206)	(4192)	(2607)	(324)	338	(289)	(2931)	(604)	91	(9)	(84359)	-88%
Upper Miss Missouri R to Ohio R	(41327)	646	2757	3965	(82)	(237)	(26)	7788	2006	(431)	(65)	(35)	(25041)	-33%
Lower Miss R Ohio R to Baton Rouge	(1852)	1861	239	3776	923	145	170	123	1381	0	(248)	(28)	6490	28%
Lower Miss Baton Rouge to New Orleans	(2266)	2803	2045	367	102	543	225	1753	3272	(32)	(76)	0	8736	29%
Lower Miss New Orleans to Head of Passes	(317)	(400)	1257	47	(4)	174	(6)	(206)	(174)	0	(15)	(35)	321	4%
Gulf Coast West of Miss R	(28)	(50)	197	542	(72)	1208	59	(195)	920	(142)	0	0	2439	50%
Gulf Coast East of Miss R	247	121	(32)	141	4	(30)	5	0	(23)	0	211	0	644	162%
Illinois R	190	7732	690	1181	(223)	(441)	(38)	143	649	(26)	(14)	(15)	9828	37%
Ohio River & Tribs	(2197)	992	4630	2325	2350	112	(134)	(59)	31952	(19)	(12)	(46)	39894	75%
Missouri R	(498)	(463)	0	(82)	(36)	0	0	(26)	(31)	(721)	0	0	(1857)	-100%
Tenn-Tom Black Warrior	(13)	(11)	(49)	(54)	(2)	0	122	0	(16)	0	(54)	0	(77)	-21%
Other Areas	0	(27)	(48)	(35)	(35)	(82)	0	(48)	(31)	0	0	(166)	(472)	-82%
Totals	(76961)	(26522)	6480	7981	318	1068	715	8984	36974	(1975)	(182)	(334)	(43454)	-14%
% Change	-89%	-37%	23%	24%	3%	21%	118%	35%	67%	-100%	-27%	-74%	-14%	

O-D Mileages, All Towboats

The analysis thus far indicates the Ohio River basin and Illinois River see significant increases by the 90% group during the off-peak period. However, Figure 5 in the Main Report shows the number of lockages is steady on the Illinois River and actually decreases slightly on the Ohio. If the 90% group increases its use of these waterways during the off-peak period, but overall waterway use remains steady or declines slightly, what happens to those vessels that use these waterways during the peak period? Do they operate somewhere else, or are they idled?

We attempt to shed light on this question by performing the same type of O-D mileage analysis for all towboats, not just the 90% group. Table A-6 shows the mileage traveled between O-D's during the peak period, Table A-7 shows mileages during the off-peak, and Tables A-8 and A-9 show the differences.

Table A-6
Average Monthly Miles-traveled
Between O-D Waterways, All Towboats, Peak Period

Origin Waterway Segment \ Destination Waterway Segment	Upper Miss Above Missouri R	Upper Miss Missouri R to Ohio R	Lower Miss R Ohio R to Baton Rouge	Lower Miss Baton Rouge to New Orleans	Lower Miss New Orleans to Head of Passes	Gulf Coast West of Miss R	Gulf Coast East of Miss R	Illinois R	Ohio River & Tribs	Missouri R	Tenn-Tom Black Warrior	Other Areas	Totals
Upper Miss Above Missouri R	30889	43301	10514	11976	5388	3165	156	4978	8559	2412	275	27	121640
Upper Miss Missouri R to Ohio R	45533	6845	29603	55270	7411	3096	283	14596	9258	1590	126	191	173802
Lower Miss R Ohio R to Baton Rouge	6771	29243	59198	37297	11601	27050	1161	3743	35868	77	981	410	213400
Lower Miss Baton Rouge to New Orleans	8861	52776	36458	20736	14487	51458	9618	11465	38519	130	1056	13450	259014
Lower Miss New Orleans to Head of Passes	1754	6595	13275	13523	4376	17629	4614	2271	22239	35	373	20519	107203
Gulf Coast West of Miss R	3944	3605	28740	48608	17478	309533	17255	4973	16037	240	484	51060	501957
Gulf Coast East of Miss R	31	291	1092	9146	7720	18251	32991	303	10893		18979	8208	107905
Illinois R	4535	14801	4043	12018	2984	4636	260	16300	7152	91	14	1362	68196
Ohio River & Tribs	6561	7830	33719	34037	23498	16338	11620	6907	472055	82	7148	424	620219
Missouri R	1890	1578	182	194	71	199		70	50	3715			7949
Tenn-Tom Black Warrior	227	86	442	1010	263	454	18770		7660	23	12429		41364
Other Areas	17	318	407	15204	9292	36202	12421	1307	285		31	819989	895473
Totals	111013	167269	217673	259019	104569	488011	109149	66913	628575	8395	41896	915640	3118122

Table A-7
Average Monthly Miles-traveled
Between O-D Waterways, All Towboats, Off-Peak Period

Origin Waterway Segment	Destination Waterway Segment: Upper Miss Above Missouri R	Upper Miss Missouri R to Ohio R	Lower Miss R Ohio R to Baton Rouge	Lower Miss Baton Rouge to New Orleans	Lower Miss New Orleans to Head of Passes	Gulf Coast West of Miss R	Gulf Coast East of Miss R	Illinois R	Ohio River & Tribs	Missouri R	Tenn-Tom Black Warrior	Other Areas	Totals
Upper Miss Above Missouri R	307	1892	3936	5481	2245	1762	735	3540	4561	4	681	74	25218
Upper Miss Missouri R to Ohio R	2447	8002	28457	49361	6247	1729	231	21945	10341	79	125	75	129039
Lower Miss R Ohio R to Baton Rouge	3677	26896	58875	42643	11069	25496	1655	4211	36119		983	65	211689
Lower Miss Baton Rouge to New Orleans	5366	45430	39920	25801	14429	53159	8787	9851	42836		614	18303	264496
Lower Miss New Orleans to Head of Passes	807	5221	13930	13324	5723	18149	4674	1613	24667		283	16918	105309
Gulf Coast West of Miss R	2467	2209	25963	52769	16941	324542	16751	5243	16619		635	51162	515301
Gulf Coast East of Miss R	602	908	664	8986	7996	17143	32829	153	9949		18617	9704	107551
Illinois R	3542	22537	4886	11395	1327	1821	1053	11330	5799			901	64591
Ohio River & Tribs	3735	7496	35797	38697	26654	16027	11465	5525	460944		5853	568	612761
Missouri R	4	28		464						95			591
Tenn-Tom Black Warrior	276		227	955	294	650	18755		7322		12106	70	40655
Other Areas		82	137	16777	6864	38307	13174	878	529		114	647214	724076
Totals	23230	120701	212792	266653	99789	498785	110109	64289	619686	178	40011	745054	2801277

Table A-8
Average Monthly Miles-traveled
Between O-D Waterways, All Towboats, Difference

Origin Waterway Segment	Destination Waterway Segment: Upper Miss Above Missouri R	Upper Miss Missouri R to Ohio R	Lower Miss R Ohio R to Baton Rouge	Lower Miss Baton Rouge to New Orleans	Lower Miss New Orleans to Head of Passes	Gulf Coast West of Miss R	Gulf Coast East of Miss R	Illinois R	Ohio River & Tribs	Missouri R	Tenn-Tom Black Warrior	Other Areas	Totals
Upper Miss Above Missouri R	(30582)	(41409)	(6578)	(6495)	(3143)	(1403)	579	(1438)	(3998)	(2408)	406	47	(96422)
Upper Miss Missouri R to Ohio R	(43086)	1157	(1146)	(5909)	(1164)	(1367)	(52)	7349	1083	(1511)	(1)	(116)	(44763)
Lower Miss R Ohio R to Baton Rouge	(3094)	(2347)	(323)	5346	(532)	(1554)	494	468	251	(77)	2	(345)	(1711)
Lower Miss Baton Rouge to New Orleans	(3495)	(7346)	3462	5065	(58)	1701	(831)	(1614)	4317	(130)	(442)	4853	5482
Lower Miss New Orleans to Head of Passes	(947)	(1374)	655	(199)	1347	520	60	(658)	2428	(35)	(90)	(3601)	(1894)
Gulf Coast West of Miss R	(1477)	(1396)	(2777)	4161	(537)	15009	(504)	270	582	(240)	151	102	13344
Gulf Coast East of Miss R	571	617	(428)	(160)	276	(1108)	(162)	(150)	(944)	0	(362)	1496	(354)
Illinois R	(993)	7736	843	(623)	(1657)	(2815)	793	(4970)	(1353)	(91)	(14)	(461)	(3605)
Ohio River & Tribs	(2826)	(334)	2078	4660	3156	(311)	(155)	(1382)	(11111)	(82)	(1295)	144	(7458)
Missouri R	(1886)	(1550)	(182)	270	(71)	(199)	0	(70)	(50)	(3620)	0	0	(7358)
Tenn-Tom Black Warrior	49	(86)	(215)	(55)	31	196	(15)	0	(338)	(23)	(323)	70	(709)
Other Areas	(17)	(236)	(270)	1573	(2428)	2105	753	(429)	244	0	83	(172775)	(171397)
Totals	(87783)	(46568)	(4881)	7634	(4780)	10774	960	(2624)	(8889)	(8217)	(1885)	(170586)	(316845)

Table A-9
Average Monthly Miles-traveled
Between O-D Waterways, All Towboats, Percent Difference

Origin Waterway Segment	Destination Waterway Segment: Upper Miss Above Missouri R	Upper Miss Missouri R to Ohio R	Lower Miss R Ohio R to Baton Rouge	Lower Miss Baton Rouge to New Orleans	Lower Miss New Orleans to Head of Passes	Gulf Coast West of Miss R	Gulf Coast East of Miss R	Illinois R	Ohio River & Tribs	Missouri R	Tenn-Tom Black Warrior	Other Areas	Totals
Upper Miss Above Missouri R	-99%	-96%	-63%	-54%	-58%	-44%	371%	-29%	-47%	-100%	148%	174%	-79%
Upper Miss Missouri R to Ohio R	-95%	17%	-4%	-11%	-16%	-44%	-18%	50%	12%	-95%	-1%	-61%	-26%
Lower Miss R Ohio R to Baton Rouge	-46%	-8%	-1%	14%	-5%	-6%	43%	13%	1%	-100%	0%	-84%	-1%
Lower Miss Baton Rouge to New Orleans	-39%	-14%	9%	24%	0%	3%	-9%	-14%	11%	-100%	-42%	36%	2%
Lower Miss New Orleans to Head of Passes	-54%	-21%	5%	-1%	31%	3%	1%	-29%	11%	-100%	-24%	-18%	-2%
Gulf Coast West of Miss R	-37%	-39%	-10%	9%	-3%	5%	-3%	5%	4%	-100%	31%	0%	3%
Gulf Coast East of Miss R	1842%	212%	-39%	-2%	4%	-6%	0%	-50%	-9%		-2%	18%	0%
Illinois R	-22%	52%	21%	-5%	-56%	-61%	305%	-30%	-19%	-100%	-100%	-34%	-5%
Ohio River & Tribs	-43%	-4%	6%	14%	13%	-2%	-1%	-20%	-2%	-100%	-18%	34%	-1%
Missouri R	-100%	-98%	-100%	139%	-100%	-100%		-100%	-100%	-97%			-93%
Tenn-Tom Black Warrior	22%	-100%	-49%	-5%	12%	43%	0%		-4%	-100%	-3%		-2%
Other Areas	-100%	-74%	-66%	10%	-26%	6%	6%	-33%	86%		268%	-21%	-19%
Totals	-79%	-28%	-2%	3%	-5%	2%	1%	-4%	-1%	-98%	-4%	-19%	-10%

While all four tables have their own story to tell, Table A-8 is probably most relevant to this analysis. The only O-D pairs that stand out as substantial gainers are the Gulf Coast West to Gulf Coast West O-D pairs, Upper Miss between the Missouri and Ohio and the Illinois River movements, and those movements whose destinations are on the Lower Miss between Baton Rouge and New Orleans. These increases however, are greatly overshadowed by the overall decline in mileage traveled during the off-peak. If we exclude the Other Areas to Other Areas travel, average monthly miles-traveled by all towboats is about 6% less during off-peak than during the peak period.

CONCLUSIONS

This addendum first analyzes the movements of 203 towboats labeled as the 90% group in the main report, and then expands the analysis to include all towboats. The movement of these towboats was analyzed using Waterborne Commerce Statistics Center data for the years 2000-2004. The analysis found the WCSC data structure precludes analysis of tonnage moved by the towboats, but days-used and miles-traveled can be analyzed. The analysis found that days-used is an unreliable statistic. This is primarily due to the way some companies report their movements, and partially due to very short trips which take less than one day. The analysis found that miles-traveled is generally a valid statistic. Although some towboats are not reported or under-reported, most towboats appear to have valid mileage statistics in WCSC.

Of the 175 towboats in the 90% group that appear to have valid mileage statistics only 30% traveled as many or more miles during the off-peak period as they did during the peak period. Conversely, about 1/3 traveled less than 75% of peak period mileage during the off-peak. Taken as a group, the 175 towboats traveled about 87% of peak period mileage during the off-peak. Only 13 tows essentially quit operating in winter.

Analysis of all towboats shows a decline in miles-traveled on nearly all waterway segments. The only segments that realize an increase in travel during the off-peak period are the extreme Lower Mississippi River and Gulf Inter-Coastal Waterway. The increases on these segments pale in comparison to the decreases seen on other segments. Overall, off-peak travel by all towboats on the Gulf Coast and Mississippi River Basin is about 6% less than peak travel. The analysis found that some towboats that normally operate on the Upper Miss move to the Ohio River or Illinois River systems. However, overall miles-traveled during the off-peak period declines on both systems.

This analysis clearly shows that some towboats cease to operate during January and February. It shows that the decrease in miles-traveled on the far Upper Mississippi is not off-set by increases in miles-traveled elsewhere.

REFERENCES

1. Kang, M. W., Schonfeld, P., "Analysis of Towboat Operating Areas", Final Report Prepared for the Institute of Water Resources (IWR), 2006.

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The NETS research program is developing a series of practical tools and techniques that can be used by Corps navigation planners across the country to develop consistent, accurate, useful and comparable information regarding the likely impact of proposed changes to navigation infrastructure or systems.

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