

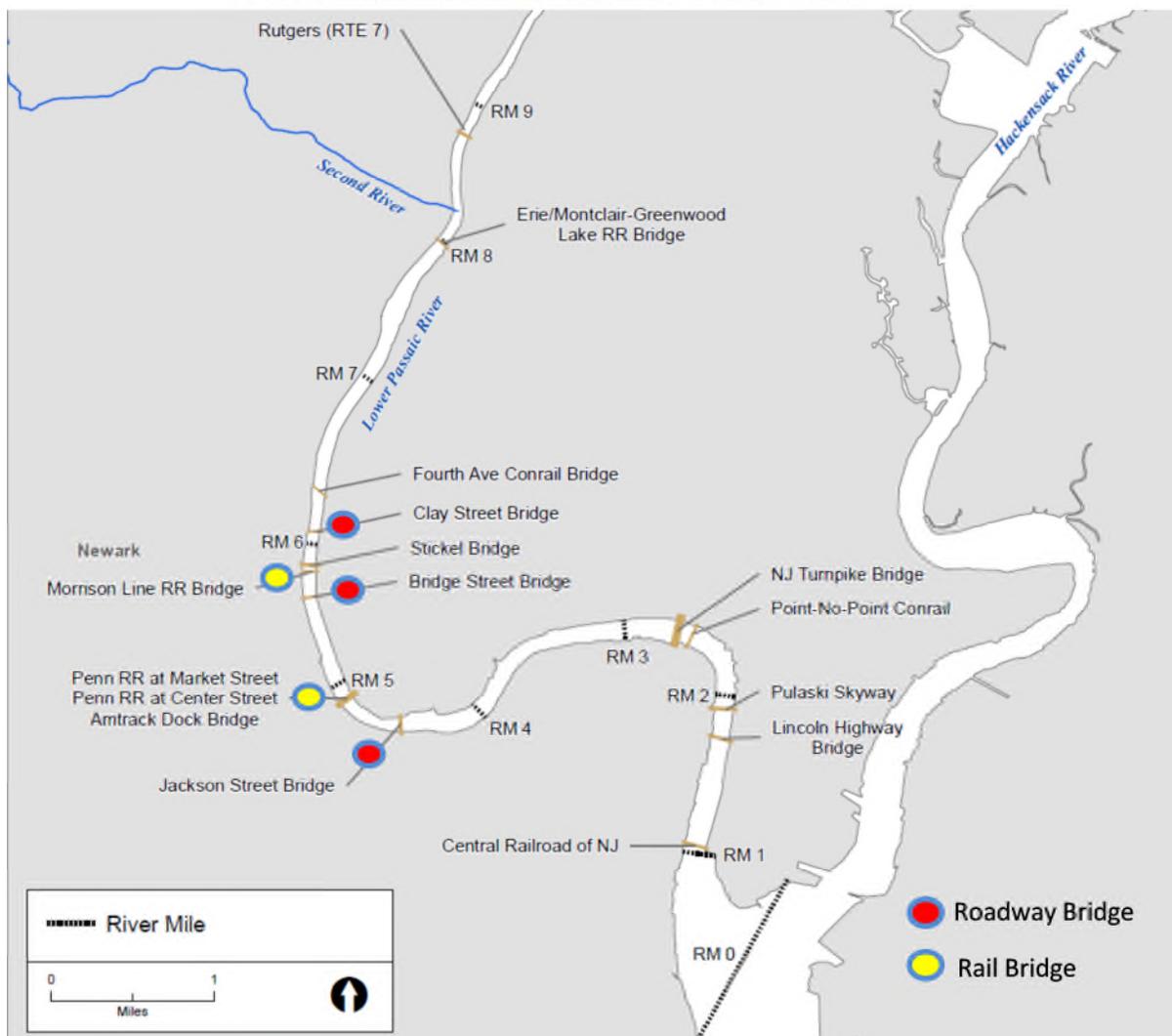
ATTACHMENT E.2
MONETARY VALUE OF THE INCREASED TRAVEL TIME AND DELAY

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OVERVIEW

A previous AECOM memo, *Initial Estimates of Traffic and Rail Transit Delays from Bridge Openings in the Lower Passaic River* (July 17, 2014), estimated the likely range of increases in travel time and delay due to the opening of various roadway and passenger rail bridges along the Lower Passaic River for barges to pass. The bridges involved in these studies are shown in Figure 1 below. The purpose of this memo is to assign a monetary value to the added travel delays that riders in vehicles or passengers in trains would face each time these roadway and passenger rail bridges were opened. The magnitude and schedule of USEPA's proposed remedial alternative would require frequent bridge openings to allow the volume of needed barge traffic to pass. This memo looks at a range of potential openings per day that could be required, and estimates the associated delay to travelers and an approximate monetary value for that delay based on widely used USDOT guidelines for such valuations.

**Figure 1: Location of Roadway and Passenger Rail Bridges
in the Analyzed Section of the Lower Passaic River**



The roadway bridges involved are the Jackson, Bridge, and Clay Street Bridges, while the passenger rail bridges are the NJ TRANSIT Newark-Harrison (Morristown Line) Bridge and the Amtrak/PATH Dock Bridges. The memo reported the approximate range of delays that drivers on these roadway bridges would experience when the bridge opened for a barge to pass, with delays estimated for various times of the day (AM and PM peaks and Midday and Evening off-peak periods). Similarly, the number of rail passengers that would be delayed due to barge-related openings of the three rail passenger bridges was estimated.

METHODOLOGY FOR DETERMINING MONETARY VALUE FOR TRAVEL DELAY

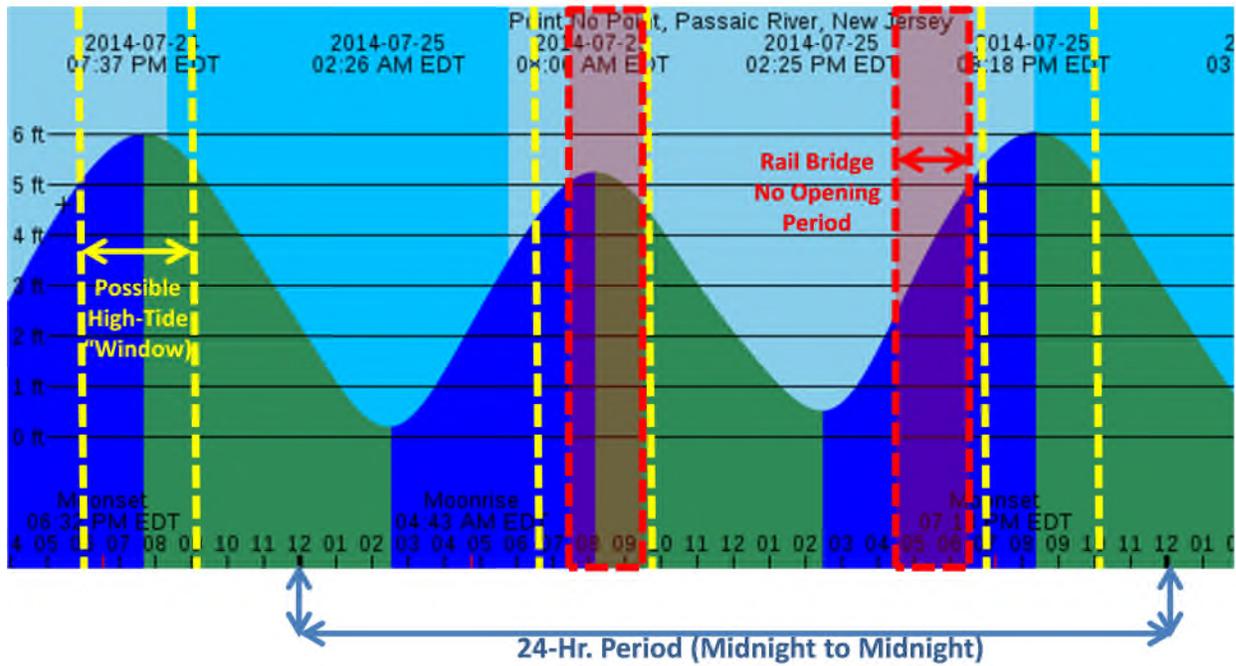
The following assumptions were made to provide the elements necessary to generate reasonable results at the preliminary study phase:

- **Location of Remediation:** The remediation work area within and along the river would be sufficiently far north (e.g., in the Kearny or Arlington Reaches) so that barges heading between these work areas and Newark Bay would require the opening of each of these roadway and rail bridges.
- **Time Restrictions on Barge Movements:** The analyses did not assume that the barges in question could only travel through these sections of the Lower Passaic River at or near high tide. Data from the recent openings of these bridges in connection with RM 10.9 in the months of December 2013 and May 2014 showed:
 - only 1-2 barges passing these bridges in both directions combined in any 24-hr. period,
 - all passages were within a high-tide window and outside of the no-opening period in the AM and PM peak periods for the rail passenger bridges, and
 - barges took approximately 25 minutes to pass in either direction from Clay Street Bridge to the north and Jackson Street Bridge to the south.

Figure 2 shows, for a given day (example is for July 25, 2014) the interaction of (1) the two 3-hour high-tide “windows” during a 24-hour period, and (2) the no-opening periods for rail bridges (the Coast Guard established 2-hour exclusion periods for the Newark-Harrison Dock Bridge carrying Amtrak, NJ TRANSIT and PATH trains is shown).

These restrictions and the data from RM 10.9 indicate that a remediation program with five or more barge passages per day would not be possible if barge movements were limited to two high-tide windows, especially with the added factor of at least four hours when rail passenger bridges cannot be opened.

Figure 2: Interaction of Potential High-Tide Restrictions for Barge Traffic and No-Opening Periods on Rail Bridges[1]



[1] Tidal data at Point-No-Point Bridge, July 24-25, 2014 (<http://www.findu.com/cgi-bin/tide.cgi?tide=2319>). Assumes barge traffic permitted within a 3 hr. period centered on high tide. No opening for rail bridges shown is for Dock Bridge as per USCG Regulations (33 CFR 117.739 - Passaic River).

- Temporal Distribution of Barge Movements:** The previous memo on roadway bridge delays and extensive data collected as part of those studies showed a wide range in delays throughout the day. A single barge movement opening all three roadway bridges would cause between 20 and 300 hours of passenger delay; e.g.:
 - 20-hours of delay if opening occurred in the low-volume late night period, and
 - 300-hours of delay if the opening occurred during the highest-volume PM peak hour.

Given these many factors, no effort was made to establish the exact number of barge movements in a given day or their distribution through a 24-hour period. Instead, the 24 hour period was divided into five time periods:

Time Periods	Early AM	AM Peak	Midday	PM Peak	Evening	Night
Range of Hours	5AM-7AM	7AM-10AM	10AM-4PM	4PM-7PM	7PM-10PM	10PM-5AM
Probability of Opening in Period	11%	0%	33%	0%	17%	39%

A very aggressive program would potentially require 5 to 10 openings per bridge per day during periods of the project and hundreds of barges a month. Under such conditions, estimating the probability of a bridge opening occurring within each of these time periods assumed the following:

- (1) no specific time constraints associated with high tide conditions, as this volume of barge movements would not be possible with those constraints,
- (2) 3-hour AM and PM Peak restrictions on the opening of rail bridges – these are normally 2-hour restrictions but are assumed to be somewhat longer to limit openings during “shoulder peak” periods when train volumes are still high, and
- (3) Probability percentages that reflect the total available hours in each time period as a percentage of the total available hours in a day (e.g., the 5AM-7AM period, with 2 available hours, has an 11% probability of any opening, as $2\text{hrs}/18\text{ available hrs.} = 11\%$), while the rail bridge prohibition periods (e.g., 7AM – 10AM) have 0%.

In terms of the calculation of travel delay, this approach is very conservative (low), as it assumes that openings during or near commuter peak periods, and the associated high travel delays, would never occur.

- **Monetary Value of Travel Time Delay:** Establishing an approximate monetary value of increases or decreases in travel delay due to a proposed action plays a major role in establishing the need for transportation projects and measuring the benefits of a project relative to the required investment (“benefit-cost analysis”). The US Department of Transportation (USDOT) has established guidelines for assigning monetary values for travel time delays.¹ These guidelines assign values for different types of travel (journey to work, business trips, recreation), intercity vs. local, high-speed modes [air, high-speed rail], and passenger vs. freight movement), using demographic data on income, wage rates, etc. to help assign values in a given situation. Making reasonable assumptions for this application, an approximate average value of \$15.90 per hour of passenger travel delay was calculated (in 2014 \$).

¹ USDOT, Office of the Secretary, Asst. Sect. for Transportation Policy, *Revised Department Guidance on Valuation of Travel Time in Economic Analysis*. September 2011.

PROJECTED DELAY COSTS – ROADWAY BRIDGES

Table 1 presents the increase in delays on the three analyzed roadway bridges affected under this barge movement scenario – the Clay, Bridge and Jackson Street Bridges.

Table 1: Impact of Bridge Openings by Time of Day (Weekday) on Roadway Bridges [1]

	Early AM (5AM-7AM)	AM Peak (7AM-10AM)	Midday (10AM-4PM)	PM Peak (4PM-7PM)	Evening (7PM-10PM)	Night (10PM-5AM)
Additional Delay Per Opening of Three Bridges [1]:						
Vehicle Hrs. of Delay	140	240	200	280	160	20
Passenger Hrs. of Delay	150	270	220	300	180	20
Probability of an Opening Occuring (%):						
	11%	0%	33%	0%	17%	39%
Average Daily Delay Per Opening of Three Bridges[1]:						
Vehicle Hrs. of Delay	120					
Passenger Hrs. of Delay	130					
Value of Passenger Delay	\$2,070					

Total Additional Daily Delay (Vehicles & Passengers) and Value of Delay[2]:

Openings Per Day	Vehicle Hours of Delay	Passenger Hours of Delay	Value of Passenger Delay
2	240	260	\$4,130
5	600	660	\$10,490
10	1,200	1,320	\$20,990

[1] Clay, Bridge and Jackson Street Bridges

[2] Value of travel time per passenger hour: \$15.90

Source: Based on Federal transportation sector guidelines, USDOT, Office of the Secretary, Asst. Sect. for Transportation Policy, *Revised Department Guidance on Valuation of Travel Time in Economic Analysis*. September 2011.

Based on the assumed weighted distribution of trips discussed above, the average vehicle and passenger delay due to a single barge passage and opening of all three bridges was calculated. The associated delay values under two, five and ten passages per day were then estimated to cover the possible range of bridge openings that might be required. As indicated, the passage delay per day would range from approximately \$2,000 per day (one barge passage) to \$20,000 (10 barge passages). Assuming operations for six days each week and approximately 4.3 weeks per month, the approximate values for total travel delays per month for travelers on these three bridges would be:

Barges/Day	Monthly Delay Costs
1	\$53,400
2	\$106,600
5	\$270,600
10	\$541,500

These cost estimates only include a monetary value for the increase in delay for travelers going over these bridges. They account for delays for truck drivers, as an average of 5% of traffic volumes are assumed to be trucks based on field counts. However, they do not take the following into account:

- the costs of the delays to truck drivers' businesses or to customers awaiting services or deliveries,
- other travelers also in the local roadway network delayed by the long queues of vehicles waiting to cross the bridge,
- delay costs for other autos and trucks unable to get to residences and businesses within the affected areas, and
- the complex traffic network adjustments that would occur if 5 to 10 bridge openings a day were to be required, with disruptions in personal and business trip-making decisions.

A more comprehensive traffic simulation study would be needed to capture these additional delays, which would clearly increase the overall delay values shown above.

PROJECTED DELAY COSTS – PASSENGER RAIL BRIDGES

A previous AECOM memo, *Initial Estimates of Traffic and Rail Transit Delays from Bridge Openings In The Lower Passaic River* (July 17, 2014), provided initial estimates of the trains and passengers delayed by a 15-minute opening of three Lower Passaic passenger rail bridges, as shown in Figure 1. Rail service volumes on these crossings are as follows:

- **the NJ TRANSIT Morristown Line Bridge**, with peak hour passenger service on weekdays across the bridge (combined traffic in both directions) of approximately 20 trains per hour. Off-peak passenger service levels are approximately 4 trains per hour. The bridge is also used in off-peak periods (primarily in the evening) for occasional freight movements. There are generally no movements across the bridge between approximately 1:30 and 4:30 AM.
- **Amtrak Dock Bridge** (Amtrak Northeast Corridor (NEC) to/from NY Penn Station, NJ TRANSIT NEC, NJ TRANSIT Coast Line and Raritan Valley Lines) – located immediately east of Newark Penn Station, actually consists of two independent structures – a north structure that accommodates Northeast Corridor (NEC) Tracks 2, 3 and 4, and a south structure that accommodates NEC Track 1. Together these bridges carry approximately 40 trains per hour in the weekday peak hours, the majority of which are NJ TRANSIT trains. The bridge is not used for freight. Off-peak service levels are approximately 12 trains per hour. The bridge is used continuously day and night, with some service gaps of an hour between approximately 1:30 AM and 4:30 AM.
- **PATH Dock Bridge** (Newark-Journal Square-WTC service), a sub-structure of the southern Amtrak Dock Bridge, carries PATH service between Newark and World Trade Center and is not used for freight. Peak hour service on weekdays is approximately 28 trains per hour, with approximately 8 trains of off-peak service across the bridge, which is used continuously day and night. During overnight hours (12:00 AM to 5:30 AM), there are slightly less than 4 trains per hour in both directions combined.

METHODOLOGY FOR DETERMINING MONETARY VALUE FOR RAIL PASSENGER TRAVEL DELAY

The procedures for assigning a monetary value to the delay that rail passenger travelers would face are essentially the same as those used above for traveler delays on roadway bridges. The assumed monetary value for travel time delay is also the same. While more detailed planning studies would likely establish somewhat different values for both rail passengers and roadway drivers and passengers, the estimated value represents a reasonable initial estimate at this planning stage.

PROJECTED DELAY COSTS – RAIL PASSENGER BRIDGES

Table 2 presents the increased delays for passengers on trains delayed by openings of the three LPR rail passenger bridges – the NJ TRANSIT Morristown, Amtrak Dock and PATH Dock Bridges.

Table 2: Impact per Bridge Opening by Time of Day (Weekday) on Passenger Rail Bridges [1]

	Time Periods [2]			
	Peak Hours	Shoulder Peak Hrs.	Off-Peak Hours	Late Night Hours
Probability of Opening Occurring in Time Period	0%	11%	50%	39%

Average Daily Delay Per Opening of Three Bridges [1]:

Delayed Passengers	2,940
Passenger Hrs. of Delay	740
Value of Passenger Delay [3]	\$12,000

Total Additional Daily Delay (Passengers) and Value of Delay[3]:

Openings Per day	Passengers Delayed	Passenger Hrs. of Delay	Value of Delay	
			Day	Month
1	2,940	740	\$12,000	\$310,000
2	5,880	1,480	\$24,000	\$619,000
5	14,700	3,700	\$59,000	\$1,522,000
10	29,400	7,400	\$118,000	\$3,044,000

[1] NJ TRANSIT Morristown, Amtrak Dock and PATH Dock Bridges

[2] Peak = 7-9AM, 5-7 PM; Shoulder: 6-7AM & 9-10AM, 4-5PM & 7-8PM; Off-Peak: 10AM-4PM, 8-10PM, 5-6AM; Late Night: 10PM-5AM

[3] Value of travel time per passenger hour: \$15.90

Source: Based on Federal transportation sector guidelines, USDOT, Office of the Secretary, Asst. Sect. for Transportation Policy, *Revised Department Guidance on Valuation of Travel Time in Economic Analysis*. September 2011.

The four time periods shown in Table 2 were used to better reflect the temporal distribution of rail service and ridership. The assumed hourly distribution of bridge openings throughout the day and night was the same for both roadway and rail bridges.

As shown in Table 2, the monetary value of the delays to approximately 3,000 rail passengers for one bridge opening a day would be \$12,000 per day or \$310,000 per month (6 days/week, 4.3 weeks per month). A remediation program that required 10 openings per day would result in approximately \$3

million in monthly delays. These figures do not include delays to other trains and passengers in the three passenger rail networks (NJ TRANSIT, Amtrak and PATH) that would be delayed in stations or elsewhere as these systems adjusted to this perturbation. These types of secondary rail network effects would increase dramatically if large number of such bridge openings occurred. Other issues that would need extensive review if any frequent-opening program were being considered would include:

- **Potential for Bridge Failure** - Rail bridges, especially ones as old as the Dock Bridges, would require further maintenance and careful attention to their condition, as the likelihood of serious failure would increase substantially under this type of schedule. If frequent Dock Bridge openings were proposed, the poor condition of this crossing and its ability to withstand repeated openings would have to be seriously considered given its critical role in the rail network and the significant effects of any extended outages.
- **Impact on Service Reliability** – a key element in the quality of rail service is its reliability, especially in this type of location, within:
 - the nation’s busiest passenger rail corridor, and
 - Amtrak’s most important and busiest corridor (the NEC), with trains going to and from its busiest station (NY Penn).

The impact on service reliability would involve impacts to:

- the trains directly affected in terms of how long they would take to get back into regular operation, deliver passengers to the station, etc., and
- trains and passengers at the stations on both sides of the opened bridges, which lack the track and station space for a timely and reliable return to normal operations.
- **Effective Reduction in Capacity** – these types of system disruptions can end up reducing the rail operators’ ability to deliver the same number of trains per hour if these openings frequently occur throughout the day, especially at any time near the peak periods.
- **All Rail Passenger Connections Simultaneously Affected** – with all three bridges effectively opened at the same time – the vast majority of all trans-Hudson rail services from New Jersey into New York City would be stopped at the same time, substantially limiting re-rerouting options and putting strains on other possible options (driving, ferries).

SUMMARY

Table 3 summarizes the passenger delays for users of the three roadway bridges and passengers on trains using the three passenger rail bridges, and the approximate monetary value of those delays. As shown, the combined single-day delay value for the roadway and rail passenger bridges would range from approximately \$14,000 for one daily opening of all six bridges to approximately \$139,000 for 10 openings per day. On a monthly basis (6 days/week, 4.3 weeks/month) this range translates to roughly \$360,000 to \$3.6 million. These initial estimates are conservatively low, as:

- many other travelers in the affected roadway and passenger rail networks would also be delayed by the disruption caused by bridge openings, especially when very frequent (5-10 per day) openings are considered, and
- the average delays for roadway and rail travelers will likely be longer than the 15-minute average delay assumed in these initial studies.

Similar opening of Conrail’s Point-No-Point Bridge farther south on the Lower Passaic River could result in important disruptions to the region’s rail freight network and services. This issue would require careful assessment when considering multiple barge-related openings of that crossing.

Table 3: Summary of Passenger Hours & Value of Delays due to Bridge Openings

Delay at Three Roadway Crossings			
Openings Per Day	Passenger Hrs. of Delay	Value of Delay	
		Per Day	Per Month
1	130	\$2,070	\$53,400
2	260	\$4,130	\$106,600
5	660	\$10,490	\$270,600
10	1,320	\$20,990	\$541,500

Delay at Three Passenger Rail Crossings			
Openings Per Day	Passenger Hrs. of Delay	Value of Delay	
		Per Day	Per Month
1	740	\$12,000	\$310,000
2	1,480	\$24,000	\$619,000
5	3,700	\$59,000	\$1,522,000
10	7,400	\$118,000	\$3,044,000

Combined Delays: Six Bridge Crossings			
Openings Per Day	Passenger Hrs. of Delay	Value of Delay	
		Per Day	Per Month
1	870	\$14,070	\$363,400
2	1,740	\$28,130	\$725,600
5	4,360	\$69,490	\$1,792,600
10	8,720	\$138,990	\$3,585,500