HUDSON COUNTY FERRY SERVICE EXPANSION STUDY

TECHNICAL MEMORANDUM #3

JUNE 30, 2021

NJTPA
NORTH JERSEY TRANSPORTATION PLANNING AUTHORITY

TECHNICAL MEMORANDUM

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INTRODUCTION

This Memorandum reports on the results of Task 3 *Data Assessment, Analysis, and Mapping* for the Hudson County Ferry Service Expansion Study.

In Technical Memorandum #2, the Consultant Team and County collected data on six potential sites for expanded ferry service in Hudson County and analyzed the feasibility and potential benefits of new service at each location. In addition, Case Studies of comparable national ferry service systems were reviewed. The report concluded that further analysis of ferry service in the Newark Bay area would provide the most benefit of study resources.

Technical Memorandum #3 takes the data collected for the previous report, performs a fatal flaw analysis of six potential sites to confirm the conclusion in the previous memorandum, and then continues with a more detailed analysis of the four locations along the western waterfront of Hudson County; south Harrison, South Kearny, Jersey City's Bayfront Redevelopment Area, and Bayonne's Newark Bay coastline. Estimates for ridership demand are generated through a customized approach using modeling and supplemental data, and a price elasticity of demand analysis identifies the sensitivity of ridership levels to changes in fares. Additionally, the requirements necessary to implement a ferry service are outlined.

This report is organized into the following sections:

1. Fatal Flaw Analysis
2. Origin and Destination Analysis
3. Demand Assessment
4. Proposed Ferry Service Requirements

FATAL FLAW ANALYSIS

As part of this task, the Consultant Team reviewed physical constraints, demands, and competitive disadvantages of each site to prioritize the value and viability of each site.

Ferry services offer several distinct advantages over conventional mass transit systems and road-based travel options. These include minimal infrastructure investment and minimal property needed due to the public nature of the waterways. Similarly, ferries have relatively low per seat hourly operating costs and, as in the Hudson County model where private operations are the norm and fares are not artificially constrained, result in a much higher fare box return.

Yet even with these advantageous attributes, ferry services struggle with competitive disadvantages and, if not subsidized, must rely on market share, like any other business. The disadvantages generally include highly subsidized public transit competition, the lack of landside intermodal connections and the availability of valuable waterfront land for parking and support facilities. The latter is particularly important where convenient waterfront transit connections are unavailable.

Physical Constraints

Ferry services offer several distinct advantages over conventional mass transit systems and road-based travel options. The obvious is the ability to connect two or more waterfront locations without massive infrastructure spending, long planning and construction lead times and the concomitant environmental issues associated with bridges or tunnels. Ferries do not require fixed right of ways and most waterways in and around New York Harbor and Newark Bay are not congested. Ferries can easily modify their routes and schedules to accommodate changes in market demand and capacity utilization. Vessel and terminal investments, with proper planning, are manageable and relatively low when compared to other high volume passenger systems.

When considering a new ferry service, there are key physical traits of a route that would preclude its success. As a part of this study, site data of the six proposed landing locations as well as possible navigational routes from each location were collected and reviewed for any fatal flaws that would prevent the feasibility of the services under consideration.

Water Depth

A review of the design parameters for potential ferry vessels operating the proposed routes determined a minimum water depth of 10 feet will be required for safe operation and, while dredging is an option, it is costly and for the purposes of this study the requirement of dredging is considered a fatal flaw.

Locations requiring dredging:

- **West New York**: The shoreline depths are too shallow to allow for vessels and the length of pier required to reach required depths would made a landing at this location would prove cost prohibitive.

Locations with potential depth concerns:

- **South Harrison**: The area with adequate depth may be too close to the channel and may interfere with the channel side slope. In addition, depths of Passaic River may need to be evaluated, however there is an ongoing Lower Passaic River Restoration

Project (LPRRP), spearheaded by the US Environmental Protection Agency, to remove contaminated sediment from the river and cap it. If a site in South Harrison is considered, it would be beneficial to coordinate the construction with the restoration of the Passaic River to ensure adequate depths and minimize impact on the remediation project.

Navigation Hindrances

On August 19, 2020, the project team presented the potential sites and routes being examined in this study to the Harbor Safety, Navigation, and Operations Committee of the Port of NY/NJ. One purpose of this discussion was to identify any concerns of existing stakeholders, operators and governing bodies that could lead to the elimination of any of the sites or routes.

A primary concern of the project team was vessel traffic for some of the identified routes. It was concluded that Hudson River and Newark Bay navigation would not be impacted by vessel traffic, but travel through the Kill Van Kull will most likely have an impact on schedules and speed. Due to the barge and cargo vessel traffic to the Port of Elizabeth and Newark, the Kill Van Kull can have speed restrictions and temporary closures to accommodate these ships which have the overriding right-of-way. A route through the Kill Van Kull would impact speed and reliability, which are two of the primary traits of ferry service that results in their success. Due to this challenge a route connecting the west side of Hudson County to locations along the Hudson River does not prove competitive against other transportation modes in Hudson County at this time. However, it was noted that future ferry routes from locations including Carteret and Staten Island may pass through the Kill Van Kull. Further exploration, and possible coordination with these services, may be reconsidered and could potentially provide a benefit to Hudson County residents at a later time.

Other physical hindrances were accounted for during the initial selection of the six sites, including low clearance bridges. As such, no locations in this study would require coordination with bridge openings to travel to proposed destinations.

Physical constraints were considered a fatal flaw for West New York. Routes traversing the Kill Van Kull are recognized as long term possibilities.

Competitive Disadvantage

When examining the six alternative ferry terminal locations, there are certain factors that can result in a competitive disadvantage to other transportation modes. These factors may include lack of a residential or business population, no transit connections or redundancy, limited available parking, poor or no time savings compared to other modes of travel, and a competing ferry service. It was identified that each of these six sites has its own disadvantages. These competitive disadvantages are examined and summarized below.

Harrison

The potential Harrison site is approximately 3½ miles up the Passaic River from Newark Bay. Navigation in the river is not as efficient as navigation through the Bay due to several turns and a narrow channel, resulting in longer trip lengths and increased fuel usage. Travel time along the Passaic River to the other Newark Bay locations is reasonable but prohibitive for a competitive service to Manhattan. Presently, prior to anticipated future redevelopment in south Harrison, there is not a large supporting residential or office population within ½ mile of the identified landing site and while the population increases with distance from the site, many of those residents have access to other modes of public transportation. Mass transit connections are limited and generally less convenient to the waterfront, but the PATH, and Newark Light Rail, and bus are alternatives in the area. The NJ TRANSIT 40 bus between the Jersey Gardens shopping center in Elizabeth and Kearny via Newark, which stops at the corner of Frank E. Rodgers Boulevard and Cape May Street, does offer potential as a connection to the concept ferry site.

South Kearny

Like many areas of Hudson County, South Kearny is undergoing land use changes and redevelopment. The Kearny Point redevelopment as a modern mixed-use commercial complex illustrates just such a change. Located at the mouth of the Hackensack and Passaic Rivers and adjacent to Jersey City's West Side, this site, and the entire area, are accessible by ferry. In fact, the developers' plans presently show a concept ferry landing. Transportation options at this site are currently limited, and developers are intently seeking expanded transportation alternatives to access the area, including ferries. As the Kearny Point development and adjacent sites continue to grow and additional facilities are constructed, the additional employee population will further increase demand for transportation options, including a ferry. Unlike the other sites in this study, there is not a residential population in the vicinity of the site. Connections to the Jersey City Bayfront area would be relatively quick by ferry and certainly faster than other forms of transit, while travel time from South Kearny to Lower Manhattan by ferry is also estimated to be competitive with alternative transit modes if a consistent cruise speed can be maintained. Travel time through the Kill Van Kull is unpredictable and may impact the ferry's competitive travel times. Any new service from South Kearny to New York will have to compete with the existing Hudson River ferry services.

Jersey City Bayfront

The west side of Jersey City, particularly at the junction of the Hackensack River and Newark Bay, is seeing significant redevelopment. Of note is the former Honeywell site now referred to as Bayfront Redevelopment Project (BRD). This particular project is one of the largest in New Jersey and fronts immediately on the water. At present, prior to future development of the site, there is not a large supporting residential or office population at the location, with the established neighborhoods of Jersey City's west side across Route 440. The redevelopment plan renderings indicate a potential ferry/water taxi terminal but no obvious adjacent commuter parking is shown. Currently the area is not well served by mass transit though this will change as the Hudson-Bergen Light Rail Route 440 Extension Project comes to fruition. Travel time from the proposed Bayfront location to Lower Manhattan by ferry is estimated to be competitive with alternative transit

modes, provided a consistent cruise speed can be maintained. Travel time through the Kill Van Kull is unpredictable and may impact the ferry's competitive travel times. Any new service will from Bayfront to New York will have to compete with the existing Hudson River ferry services.

West Bayonne

There are multiple Bayonne Newark Bay locations potentially suitable for access by a ferry vessel. Presently, and prior to future anticipated redevelopments in the area, there is not a large dense supporting residential or office population on the identified sites. There are limited opportunities for parking and automobile access; however, the approaches are through neighborhood streets which may raise local traffic concerns. While the existing NJ TRANSIT bus numbers 10 and 120 travel along John F. Kennedy Boulevard parallel to the waterfront, they do not directly serve any waterfront locations. The closest they come to the water's edge is one quarter mile, roughly a 10-minute walk. Travel time from West Bayonne to Lower Manhattan by ferry is estimated to be competitive with alternative transit modes, provided a consistent cruise speed can be maintained. Travel time through the Kill Van Kull is unpredictable and may impact the ferry's competitive travel times. Any new service will from West Bayonne will have to complete with the planned service to the east from the Bayonne Peninsula.

Hoboken

This Hudson River location is presently served by two ferry terminals offering service on four distinct routes to midtown and lower Manhattan. These privately owned and operated ferries compete directly with NJ TRANSIT bus, rail and PATH service. It is unlikely a new service would be able to compete with these well-established, high volume and frequently departing operations. It may be worth considering a new route to alternative destinations; however, current access points in Manhattan are limited at this time.

West New York

This Hudson River location appears to be a logical and potentially successful site for a new operation upon initial inspection. However, while it does benefit from a large and dense residential population, the service would compete directly with the nearby large NY Waterway Port Imperial ferry operation in Weehawken. This multimodal operation, which is less than 1,000 feet from the West New York border, is serviced by bus, rail and private automobile. It has 1,500 commuter parking spaces, a direct connection to the Hudson-Bergen Light Rail, and is serviced by several NJ TRANSIT and privately owned bus routes. The vessels operate from a large publicly owned state of the art 25,000 square foot ferry terminal seven days a week and sixteen hours per day. It is unlikely that a redundant operation from West New York without the same attributes would successfully draw sufficient ridership to compete with such a large and nearby competitor. The only option may be a new route to an alternative destination; however, current access points in Manhattan are limited and they are all presently served by the Port Imperial operation.

Competitive disadvantages were considered fatal flaws for West New York and Hoboken ferry service to the other proposed sites and existing Manhattan destinations. This study recommends future coordination with Hoboken and existing locations in New Jersey, such as Bergen and Monmouth Counties, Brooklyn, and future destinations planned along the lower Hudson River, which are beyond the scope of this study.

Demand Constraints

An important consideration in the ferry feasibility fatal flaw analysis is the overall level of transportation demand. The primary data used to make a determination of the sufficiency of demand are the 2018 volume estimates produced by the North Jersey Regional Transportation Model – Enhanced (NJRTM-E) which estimates total demand. **Table 1** shows the estimated total daily travel demand between potential ferry site catchment areas. Catchment areas around a location serve as the primary market for these potential ferry terminal sites. The catchment areas used in this initial analysis are preliminary and will be refined as part of the more detailed modeling taking place later in the study. The catchment areas used in this analysis will not limit the detailed modeling from including ridership outside of these initial areas. Catchment areas were generally determined by selecting a 10-15-minute drive time radius around the proposed ferry terminal locations and excluded areas that had competing modes of transportation with easier access.

The data produced by the model are estimates and therefore were compared to third-party cell phone data and Census commutation data to confirm its reasonableness. This was done by comparing the distribution of trips from origins to destinations from all origins and destinations in the NJRTM-E model and the third-party cell phone data. As the NJTPA model data is based on historical information it is useful to compare trip distributions to more recent data. The analysis showed that the trip distributions were similar which allowed the team to have confidence that the estimated trip data in the NJTPA model is reasonable even though it is based on historical information. Following this estimation, the ferry catchment sites were grouped into likely pairs to compare potential demand at a level that

Table 1: Total Daily Travel Demand between Potential Ferry Catchment Areas

	South Harrison	South Kearny	Bayfront	West Bayonne	Hoboken	West New York
South Harrison	-	8,150	1,086	530	1,472	851
South Kearny	10,419	-	316	94	330	118
Bayfront	3,497	1,592	-	6,716	3,826	1,075
West Bayonne	1,885	786	15,043	-	2,193	762
Hoboken	2,298	648	2,173	1,102	-	4,371
West New York	1,671	284	752	624	7,100	-

Source: Steer Analysis of Travel Demand estimates from NJTPA NJRTM-E Model

Table 2: Total Daily Travel Demand by Site Groups

Site Grouping	Total Daily Travel Demand between Sites
Intra- Hudson County Sites	50,114
Hudson River Sites	11,471

Source: Steer Analysis of Travel Demand estimates from NJTPA NJRTM-E Model

approximates routes. For this purpose, the sites on the Hudson River: Hoboken and West New York, were grouped together while the remaining sites along Newark Bay were considered a second grouping. It was assumed that service from the Hudson River sites would travel to a New York landing, while routes from the other sites on the Newark Bay would primarily serve an intra-Hudson County demand. While there is nothing physically stopping the Hudson River sites from being connected with the Newarl Bay sites, these trips would be significantly longer via ferry than existing transit options and were therefore not included in this study analysis. These groupings and their total daily travel demand are shown in **Table 2**.

The Intra-Hudson County sites (south Harrison, South Kearny, Bayfront and west Bayonne) together have significantly more daily demand than the Hudson River sites but currently have less population and employment within walking distance of the ferry so could be expected to have lower capture rates. The Hudson River sites, while exhibiting a lower level of intra-site demand, have higher density near the landings and have the potential to capture additional travel demand between the sites and New York if the sites are included in a route that stops in NYC. As a result of both groupings' levels of overall travel demand, advantages and disadvantages, there was no travel demand basis for removing either grouping consideration. Within the intra-Hudson grouping, the sites themselves have similar levels of travel demand so again, travel demand was not an appropriate basis for eliminating one of the considered sites.

Demand was not the basis for removing a site from consideration. There was no clear site to eliminate based off low demand. As a result, priority was given to sites that did not have other fatal flaws and that best met the County's objectives and goals to consider service to underserved areas for ferry and other transportation service.

Conclusion

The intention of the fatal flaw analysis was to refine the study focus by reducing the sites to the most promising sites for more in-depth assessment and analysis. Fatal flaws removed Hoboken and West New York from the study consideration. Routes which would travel through the Kill Van Kull would require further planning and coordination, and are not as feasible for shorter-term implementation. The study team concluded that an analysis of an independent route connecting a combination of the remaining four sites, south Harrison, South Kearney, Jersey City – Bayfront, and west Bayonne, would be the best next step for this study

ORIGIN AND DESTINATION DATA

A Site Profiles Memo was developed for the Technical Memorandum #2. In the Memo, a summary of the review of the NJTPA's North Jersey Regional Transportation Model-Enhanced in relation to the overall regional transportation demand was provided, along with travel patterns for use in determining transportation routes throughout the study area.

Travel Time by Transportation Mode

The dominant mode of transportation in the ferry landing catchment areas is automobile. To be competitive in terms of travel time, the proposed ferry route must compete with the drive times, and associated costs to and from the key destinations. **Table 3** shows the average travel time by auto and by ferry between the proposed terminal sites. On average, driving is 30 minutes faster than the proposed ferry when comparing total trip time including access, egress, and wait times. The ferry is most competitive with driving between South Kearny and Bayfront.

Diversion from other modes

As with any transportation system, ferry routes have the potential to remove motor vehicles from the road network, increase transit use, as well as increase the number of trips taken by active modes. Removing motor vehicle trips from the road network has external environmental and health benefits. Additionally, if a sufficient number of vehicle trips are removed from the network, the remaining road users experience improved travel times on congested roadways. Ferries routes do not often result in improved road travel times because they generally move small number of riders at a time and they capture users from other transit services in addition to drivers For example,

Table 3: Average Travel Time by Auto and Ferry between Ferry Catchment Zones

Origin WF Zone	Destination WF Zone	Average Peak Auto Travel time (minutes)	Average off-peak Auto Travel time (minutes)	Average Peak Total Ferry Travel Time (minutes)	Average Off Peak Total Ferry Travel Time (minutes)
South Harrison	**South Kearny**	20.7	15.5	42.8	45.6
South Harrison	**Bayfront**	26.7	20.3	48.8	52.5
South Harrison	**Bayonne**	32.7	27.3	64.0	67.7
South Kearny	**South Harrison**	19.6	15.1	42.6	45.3
South Kearny	**Bayfront**	17.4	11.9	30.6	34.4
South Kearny	**Bayonne**	25.1	20.2	45.8	49.5
Bayfront	**South Harrison**	24	19.2	49.1	52.8
Bayfront	**South Kearny**	17.1	12.6	31.1	34.8
Bayfront	**Bayonne**	16.9	13.0	39.7	43.3
Bayonne	**South Harrison**	30.8	26.3	61.9	65.7
Bayonne	**South Kearny**	24.6	20.8	43.9	47.7
Bayonne	**Bayfront**	17.1	13.1	37.4	38.8

Source: Steer Analysis of Travel Demand estimates from NJTPA NJRTM-E Model

based on data collected by PANYNJ in May 2019, a ferry capturing 500 daily auto trips previous made using the Holland Tunnel would have reduced the daily trips through the tunnel by approximately 1%. Such a change in volume would not be expected to significantly impact travel times. Ferries can also divert passengers from other overcrowded transit modes. For example, the Hoboken North terminal diverts about 1,000 bus passengers from the NJ TRANSIT 126 bus during the peak AM hours, which is about 17 buses, and this reduces demand at the Port Authority Bus Terminal and traffic at the Lincoln Tunnel.

While ferries often do not alleviate regional congestion, they can have significant localized impacts. Ferries may increase transit in the area around landings as riders can utilize transit to access the ferry service. Additionally, ferries tend to increase walking and cycling immediately around landings if they are sufficiently walkable/ accessible.

Market Demand Analysis

To estimate the potential ridership that the proposed ferry would capture, a regional travel demand model was used to estimate the number of trips that can be captured given the existing network, land use, and demographic conditions. This model estimates the daily weekday trips that would use the ferry route under existing conditions. A bespoke approach is then used to layer on the growth in ridership that can be expected from planned developments. Finally, the observed ratio between weekday and weekend ridership on similar ferry systems were used to estimate weekend trips. Observed monthly seasonality on other ferry routes will be applied to generate annualized estimates in the financial model.

Regional Model

The North Jersey Transportation Planning Authority (NJTPA) is the metropolitan planning organization for 13 counties in Northern New Jersey. NJTPA has developed and maintains the North Jersey Regional Transportation Model – Enhanced (NJRTM-E) to understand and plan for the region's multimodal transportation needs.

Regional travel demand models are not always best suited for corridor level studies, but they can be very helpful for feasibility studies. We found that the NJRTM-E was well-suited for our feasibility study estimating high-level ferry ridership in Hudson County. The model is an established, well-calibrated traditional 4-step regional travel demand model that estimates travel demand volume and mode choices made by travelers. The mode choice models within the NJRTM-E estimate travelers' modal choices based on the characteristics of the mode (travel times, cost, access/egress time, etc.) as well as travelers' observed preferences and behaviors and traveler survey data. The models are calibrated to replicate regional auto traffic and transit ridership. The model replicates regional travel volumes and choices well and is a good tool for estimating demand in feasibility level studies. In more detailed studies it may be appropriate to adjust the calibration within the regional model to better replicate travel in specific corridors. Alternatively, more detailed studies may require the development of new forecasting models requiring new data collection and surveys. Given the feasibility level of this study, the time and resources needed to develop new models or improve the calibration of an existing model, it was determined that the existing NJRTM-E model was the best suited for this feasibility level study.

The NJRTM-E was used to estimate the base ridership of three potential ferry routes in Newark Bay by coding in the network the routes and their level of service characteristics such as travel time, headways, walking distance, park and drive distance, connections etc. These are discussed in the section Modifications to the Model.

The three routes analyzed were:

1. Base Route: South Harrison – South Kearny – Bayfront – West Bayonne
2. 'Three Stops Only': South Kearny – Bayfront – West Bayonne
3. Newark Route: Newark – South Kearny – Bayfront – West Bayonne

Modifications to the Model

Travel Time

The travel time and headways were calculated based on ferry speed, which can vary based on

the geography of the waterway. The estimated average cruising speeds used for the calculations vary between landings. These estimated speeds include the reduced speeds required as the ferry approaches and departs from landings and a dwell time of five minutes at each landing. **Table 4** shows the travel time between the different landings for each route not including dwell time. The table also shows the total one-way trip and roundtrip travel times, including dwell times.

Headways

The ridership was estimated assuming two ferries operating on the route in the peak (6AM – 9AM) and 1 boat in the off peak (10AM – 2PM). The allowable headways are calculated based on the roundtrip travel time for each route. **Table 5** shows the peak and off-peak headways for the different routes.

Walk and Park and Ride Access

The allowable walking distance was set to 1.25 miles walk-radius of each landing. The park and ride (PNR) distance refers to the maximum distance that a traveler can access the ferry terminal via car, either parking at the terminal or being dropped off, and then taking the ferry. This distance represents the maximum distance a traveler is likely to drive to access the ferry and this distance was used to estimate the PNR catchment area. The NJRTM-E considers the site-specific parking costs at each landing when estimating ridership. Generally, the PNR catchment area was made to approximate a 10-minute drive access with care given to avoid users traveling too far in the reverse direction from their destination. This is notably different for the Newark landing where the PNR catchment area more closely resembles the Newark-Penn Station PNR catchment area which extends beyond a 10-minute drive time.

Table 4: Travel Time for Each Segment of The Different Ferry Routes

	Base Route	'Three Stops Only'	Newark Route
South Harrison - South Kearny	18 minutes	-	-
Newark - South Kearny	-	-	18 minutes
South Kearny - Bayfront	6 minutes	6 minutes	6 minutes
Bayfront - West Bayonne	11 minutes	11 minutes	11 minutes
South Harrison - West Bayonne (including dwell times)	50 minutes	27 minutes	50 minutes
Round trip (including dwell times)	1 hour 40 minutes	54 minutes	1 hour 40 minutes

Source: Team member GGES

Table 5: Headways for The Different Ferry Routes

	Base Route	'Three Stops Only'	Newark Route
Peak - 2 Boats	30 minutes	15 minutes	30 minutes
Offpeak - 1 Boat	60 minutes	30 minutes	60 minutes

Source: Steer analysis

Figure 1: Ferry and Parking Lot

Connections

Transfers were allowed in the model between the ferry landings and transit services stopping nearby. Allowing transfer between other modes allows for the incorporation of feeder services and the capture of longer distance trips. **Table 6** shows the modal connections at each ferry terminal.

Fares

A range of fares between $2.75 and $12 were considered for the fare analysis. The base fare shown for all the routes modeled is $7 USD (2020 USD) as this is roughly the midpoint of the range. The sensitivity to fares is discussed in more detail in the Price Elasticity of Demand section.

Off Model Analysis – Future Developments

After estimating the base ridership through the data values included in the model, a bespoke

Table 6: Connections to Different Transit Modes by Ferry Terminal

	PATH	Bus	NJT Rail	Newark Light Rail
South Harrison	X	X		X
Newark	X	X	X	X
South Kearny		X		
Bayfront		X		
West Bayonne		X		

Source: Steer Analysis

spreadsheet model was used to layer on growth from planned future developments identified within the catchment areas. The spreadsheet model was used to estimate the ridership impacts resulting from the planned developments as it allows for a very localized view on development instead of the regional or county level estimates from the regional model. An analysis of the planned developments provided by Hudson County Planning was conducted to determine the locations of the planned developments and the number of residential units and commercial square footage for each development. Assumptions of the number of trips generated or attracted to each type of development were then applied. The assumptions were based on information acquired from the Institute of Transportation Engineers (ITE) Trip Generation Manual 9th Edition. These trips were then distributed based on the travel patterns in the NJRTM-E. Finally, the study area ferry capture rates estimated by the NJRTM-E were applied to each origin-destination pair to estimate the resulting ferry ridership. **Table 7** shows the planned developments considered for each landing.

Ridership Estimation Results

Table 8 shows the ridership by route from the base NJRTM-E model and from planned developments for each of the three routes analyzed. The Base route has the highest base demand, which highlights the lack of competing transit alternatives. The 'Three Stops Only' route has 25% fewer riders. While removing the south Harrison stop increases the frequency of the service, it does not make up for riders lost from the south Harrison zones ferry riders in the Base route. The Newark route has similar ridership to the 'Three Stops Only' route. The decline compared to the Base route is likely due to the presence of multiple competitive alternate transit modes at Newark Penn Station such as bus, PATH, and NJ TRANSIT Rail which may provide a more appealing option for some trips.

The majority of the trips from planned developments are driven by the Bayfront Redevelopment Plan. The Bayfront redevelopment is expected to add 8,000 residential units and 790,000 sq. ft of commercial development by its estimated completion in 2066. While the development completion date is almost 50 years in the future, as phases are completed, the associated demand will increase over time.

The majority of the remaining trips captured from planned developments are due to developments in south Harrison's catchment area. These developments have a different impact on the Base route and Newark route despite being in both catchment areas. This difference is due to the developments being closer to the south Harrison landing and therefore having a higher capture rate for the Base route.

While the developments impacting ridership are the same for the Base route and the 'Three Stops Only' route, the higher ferry capture rate in the latter, due to shorter wait times, results in a larger number of trips from the planned developments.

Table 9 shows the base demand broken out by landing and **Table 10** shows the demand including estimates from planned developments.

Based on the significant impact the future developments have on projected ridership, it is highly recommended that the developers are brought into the discussion of potential ferry service near their properties. Engaging property developers allows for them to learn the potential benefits to a ferry service (i.e. increased property values and rentals), in turn benefiting the future service (i.e. attract residents that would use ferries and possible cost partnership with developers).

Table 7: List of Planned Developments in The Ferry Catchment Areas

Development Name	Closest Ferry Terminal
8 Story Building along Rt 440	Bayfront
Bayfront I Redevelopment	
West Side Park and Ride Mixed-use Complex	
Bayview Redevelopment Plan project for Bayonne A&P Store site	Bayonne
Redevelopment of former Texaco Plant site	
New Amazon Facility opening on Bayonne's Avenue A	
120 unit mixed use development proposed across from Newark Riverfront Park	Newark
155 Washington Street Urban renewal LLC (24-26 Warren Pl, 141-149 Washington St., 157-159 Washington St)	
30 James Street	
Amended Site Plan William St. Lofts (CPB17-64) (45-53 William St; 43 William St)	
CPB17-54 (194 Market Street)	
CPB19-37 (892, 894-900 Broad St)	
CPB19-50 (303-309 Washington)	
Halsey Street Lofts (36-38 Williams Street)	
McWhorter Bruen Commons (CPB18-51) (59-65 McWhorter St/50-56 Bruen St.)	
Mulberry Commons (54-64 East Kinney Street/321- 323 Mulberry St.)	
Newark Downtown Core District Redevelopment Plan and Amendment to the Newark Plaza Urban Renewal Plan (2004)	
Newark Master Plan (2012)	
Newark Tower Plaza (see also CPB18-38) (769-781 McCarter Hwy.)	
Pos. Health Care (Res Judicata Consideration) (395-399 University Ave.)	
The Vibe (See CPB18- 12) (16-24 William St aka 32-34 William St & 28 William St)	
Two 3-Story Buildings (223-225 Washington Street)	
2nd Phase of Harrison Yards Complex	South Harrison
Amended Harrison Waterfront Redevelopment	
Mixed use development (Hartz Industrial Site - Retail)	
Riverfront Development	
Westin Hotel	
Westin Hotel (Hotel)	
Kearny Point Redevelopment (Commercial + Industrial)	South Kearny
Amazon Delivery Station	
Proposed Truck Facility	

Source: Hudson County

Based on the Consultant Team's experience analyzing existing ferry routes, specifically fare-based operations in the region, a threshold for successful operation was determined. For the purposes of this study, it is assumed a ferry route in the Hudson County area would need a daily ridership of approximately 1,000 passengers at a fare rate of approximately $7 USD to operate

Table 8: Average Weekday Ridership by Route

	Base Route	'Three Stops Only'	Newark Route
Base Demand	187	141	142
Planned Developments (estimated completion between 2021-2066)	529	544	497
Total Ridership	717	685	639

Source: Steer Analysis

Table 9: Average Weekday Ridership by Landing (Base)

	Base Route	'Three Stops Only'	Newark Route
Newark	-	-	5
South Harrison	18	-	
South Kearny	17	2	4
Bayfront	75	69	65
Bayonne	78	70	68
Total Route Ridership	**187**	**141**	**142**

Source: Steer Analysis

Table 10: Average Weekday Ridership by Landing (including estimates from planned developments)

	Base Route	'Three Stops Only'	Newark Route
Newark	-	-	6
South Harrison	53	-	-
South Kearny	29	14	16
Bayfront	552	596	544
Bayonne	83	75	73
Total Route Ridership	**717**	**685**	**639**

Source: Steer Analysis

successfully without subsidies. The proposed developments in the area get the ridership numbers significantly closer to this threshold. Early engagement of developers would most likely increase these numbers expected from the proposed developments, as well as attract new developments to the area, which could create the demand for a successful ferry service.

Seasonality

If service levels and demand vary by month, as is often the case for ferry systems, it is important to take seasonality into account. This is done by applying monthly seasonality factors to determine the average daily ridership in a given month. These factors were calculated from 2019 trans-Hudson ferry ridership, which is driven primarily by commuters. As can be seen in **Table 11**, commuter driven services do not vary much from the average throughout the year.

Ferry services with significant recreational/tourist attractions or seasonal service levels tend to have a wider range of seasonality factors. This can be seen in **Figure 2** which compares the seasonality factors for trans-Hudson ferry ridership and the Rockaway route of NYC Ferry. The Rockaway route, which has a significant volume of beachgoers, has increased service levels during the summer and reduced interest during the colder months.

Table 11: Seasonality Factors by Month

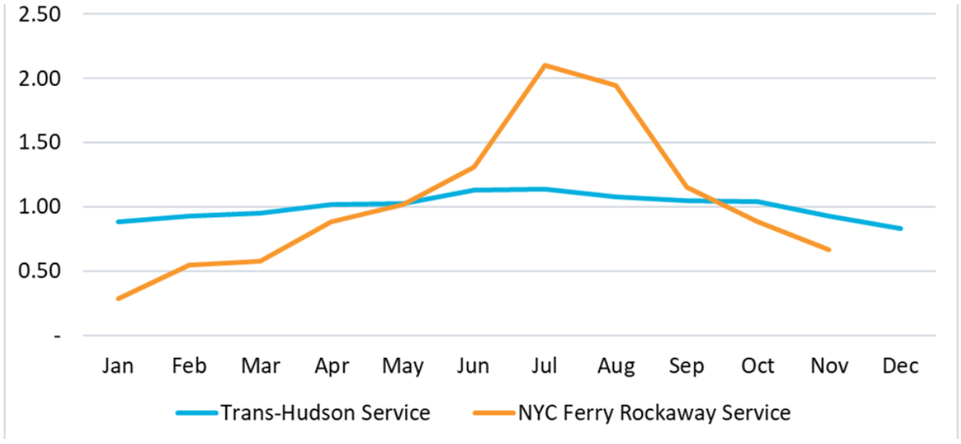
Month	Average Weekday Ridership Factor
Jan	0.88
Feb	0.93
Mar	0.95
Apr	1.02
May	1.02
Jun	1.13
Jul	1.14
Aug	1.08
Sep	1.05
Oct	1.04
Nov	0.93
Dec	0.83

Source: Steer analysis of PANYNJ ferry ridership data

Price Elasticity of Demand Analysis

Price elasticity of demand is a measure of how responsive ridership is to a change in fare. It is defined as the percent change in ridership due

Figure 2: Monthly Seasonality Factors



Source: Port Authority of New York and New Jersey (PANYNJ) ferry ridership data

Table 12: Price Elasticities by Fare Change

Fare	Price Elasticity	Interpretation
$2.75 - $5.00	-0.22	A 10% increase or decrease in fare reduces or increases ridership by 2.2% respectively
$5.00 - $7.00	-0.32	A 10% increase or decrease in fare reduces or increases ridership by 3.2% respectively
$7.00 - $10.00	-0.45	A 10% increase or decrease in fare reduces or increases ridership by 4.5% respectively
$10.00 - $12.00	-0.60	A 10% increase or decrease in fare reduces or increases ridership by 6.0% respectively

Source: Steer Analysis of Travel Demand estimates from NJTPA NJRTM-E Model

to a 1% increase in fares. For example, a price elasticity of -0.3 means, increasing fares by 1% will reduce ridership by 30%.

Models Tested

The elasticity is calculated based on the estimated ridership at different fare levels for the Base Route. For this purpose, ridership was estimated for 5 different fare levels as shown below. All fares are in 2020 USD.

1. Flat fare system of $2.75
2. Flat fare system of $5.00
3. Flat fare system of $7.00
4. Flat fare system of $10.00
5. Flat fare system of $12.00

Elasticity Results

Table 12 shows the price point elasticities for the different fare levels.

This points to elasticities ranging from -0.2 to -0.6 in the $2 to $10 fare range. Values well below 1.00 in absolute value are deemed inelastic: the ferry demand is not very sensitive to fare. Our results also indicate a lower responsiveness to fares at lower fare levels and higher as the fare increases as would be expected. The overall elasticity is within accepted range for ferry transit fares.

The elasticities will be applied to financial analysis model to help determine the optimal service and fare level.

Proposed Ferry Service Requirements

Many factors must be considered when assessing the potential of a ferry system. As reiterated throughout this study, there are many different approaches to creating a new ferry service and what makes a service “successful” is not consistent among ferry operations. The logistics of the operation, infrastructure, and equipment of a ferry service are interconnected and must be considered comprehensively when designing a new ferry service.

Routes

For the purpose of this study, the analysis concentrated on Hudson County ferry service, primarily, routes including south Harrison, South Kearny, Bayfront Jersey City, and west Bayonne. When considering future ferry service, these locations could benefit from connections to Elizabeth, Newark, Staten Island, and the proposed Carteret ferry location.

The existing and proposed ferry service from the east side of Hudson County could consider adding additional markets, both existing, such as Bergen County, Monmouth County, Staten Island, and Brooklyn, as well as proposed locations along the east side of the Hudson River.

Operations

Following the completion of the initial market assessment, development of the base ridership forecast, and determination of fare elasticities, the next step in determining a service’s feasibility is to evaluate its financial feasibility and determine required operating levels. To this end, the next steps for the study were development of the capital and operating costs, as well as a financial model to identify the operating surplus (profit) or deficiency (subsidy needs) under various operational scenarios. The completion of these next steps will allow for the identification of frequency and fare levels needed to deliver the most financially viable service. The financial analysis and concept financial plan for the study are included in the study final report.

Infrastructure

One of the benefits of a ferry service is limited infrastructure required for operation. Unlike most other modes of transportation, infrastructure is only required at the destinations, allowing for unique flexibility of service, increased speed of implementation, and limited impact during construction. The required infrastructure does need to be customized to meet the service needs, including the proposed vessels, service frequency, and any upland upgrades including parking and amenities. However, the increased property values associated with proximity to ferry service encourages collaboration with developers when designing and funding any required infrastructure and upgrades, which in turn provides an increase in potential ridership. Collaboration with the current developments underway in South Kearny and Bayfront would benefit ferry service to those areas.

In addition to infrastructure for the ferry departure locations, infrastructure is also necessary to dock, clean and refuel the boats. This additional infrastructure is dependent on the types of vessels and operator chosen for the service. Due to this dependence, the additional needs of a ferry service can be examined later in the development process, especially with multiple companies and vessel types currently operating in the area.

Equipment

There are several types of vessels appropriate for the ferry services under consideration as part of this study. Ultimately it is the proposed ferry route and service characteristics (passenger capacity, trip time, departure frequency and costs) that will determine which is most appropriate on a particular route. In general, there are two types of vessels employed in service in the operating area under consideration, aluminum constructed catamarans and monohulls.

Almost all ferry operations in the United States use diesel fuel to power their vessels, including those currently operating in the vicinity of Hudson County. However, due to the emissions regulations that continue to grow more stringent, many are exploring alternative fuel. There are a host of reasons why alternative fuel and propulsion systems should be explored including emissions, fuel savings, and overall operating expense. Alternative fuels for marine transport can play a crucial role in carbon reduction and ultimately contribute towards climate change goals. Market penetration by alternative fuels have already begun with ship builders, engine manufacturers and classification bodies introducing guidelines for greener vessels running on cleaner fuels.

While there are a myriad of alternative fuels and accompanying propulsion systems the challenge with implementing a change of this nature does not just lie with the vessel construction and operation. Switching to a new technology for passenger vessels requires United States Coast Guard approval and accompanying regulations.

From the operator's perspective there needs to an accompanying commitment for the landside infrastructure and general availability of the product.

There is a promising alternative being explored in New York Harbor: diesel electric and battery hybrid propulsion technology (battery-hybrid). A battery-hybrid propulsion system is particularly well suited for the short to moderate length runs with varying speeds and periods of idling that are under consideration through this study. Passenger class ferries operating primarily in New York Harbor commuter service typically make several short runs at cruising speed, broken up by loading periods during which the vessel's propulsion system is used to temporarily moor the vessel in a bow loading arrangement. It is during this phase of a ferry trip that the emissions benefits are most realized landside and in nearby neighborhoods. Another advantage of this approach is that these propulsion systems can be retrofitted into existing vessels or employed during a new build.

Emergency Evacuation Considerations

While not explicitly included in the financial analysis, it may be appropriate to consider the emergency use potential of ferry infrastructure as well as other public policy benefits such as climate change resiliency and system redundancy. These other benefits of ferry service have proven to be critical during several recent situations including, the implementation of temporary routes following Hurricane Sandy as well as providing emergency assistance during the terrorist attacks of September 11, 2001, the Northeast blackout of August 14, 2003 and the emergency Hudson River landing of US Airways Flight 1549 January 15, 2009.

CONCLUSION

The goal of this portion of the Study was to use the data collected and analyzed to refine the study focus by reducing the sites to the most promising ferry landing locations, allowing for a more detailed analysis moving forward with the Study. Grouping the locations into Hudson River sites and Newark Bay sites, the team came to the following conclusions.

There is existing ferry service along the Hudson River, providing access from New Jersey to Manhattan. The catchment areas identified for Hoboken and West New York are currently well served by public transportation, including existing ferry service. It was concluded that new service from these locations to existing Manhattan locations would only serve to compete with the existing ferries instead of providing service to an underserved population. The feasibility of new routes between existing landings, schedule alterations, and pricing are being continually evaluated by existing operators. As these locations are being addressed, it was determined that the Newark Bay locations, which have not been previously considered, should be the focus of the additional analysis during this Study.

Focusing the study on the west side of Hudson County, including south Harrison, South Kearny, Jersey City – Bayfront, and west Bayonne, the study was also able to concentrate efforts on providing transportation options for environmental justice populations in Hudson County, as well as the potential intra-New Jersey ferry service, which has not been analyzed before. Initial analysis did not show ferry service from the west side of Hudson County to New York being competitive against the other transportation options available due to the travel time of going around the peninsula. While the intra-county data did not show heavy ridership, it was a route with potential that was less likely to be studied in depth by operators. With funding sources available to assist with the construction of infrastructure for a service and the benefits that this service could provide to the county and its residents, the intra-county route was deemed the best use of study resources. In addition, due to the flexibility of ferry routes once infrastructure is in place, this study area would allow for future connections to New York if desired.