Jersey City Mobility Hub Feasibility Study

GRADUATE PLANNING STUDIO II
RUTGERS UNIVERSITY, BLOUSTEIN SCHOOL OF PLANNING & PUBLIC POLICY
SPRING 2023

RUTGERS
Edward J. Bloustein School
of Planning and Public Policy

Table of Contents

Introduction

Authors

The work in this report was done as a part of a collaboration of 16 graduate students in the Bloustein School of Planning & Public Policy. See the Team Testimony for a detailed overview of the students' background. The following individuals co-authored this document:

[Image A) Studio participants with the Jersey City Department of Transportation.

Jared Aisenberg
Sanjana Arunachalam
Owen C. Calvert
Marziya Farooq
Theint Thandar Ko
Paul J. Flanagan
Tianrun Jiang
Monika Pal
Min-Jae Park
Jackson D. Pierce
Bhumika Raj
Colin J. Roche
Max Toth
Ngawang Tshomo
Nilay Vinchhi
Jeffrey Young

Acknowledgements

We would like to express our sincere gratitude to the network of individuals who helped guide us through the process for our studio work and final report. We

would like to thank Dr. Clinton Andrews and Dr. Hannah Younes for spearheading the project and supporting our work throughout the semester. They have provided us opportunities to utilize our greatest strengths and explore our curiosity in academically enriching ways. We would also like to take this time to thank our client, the City of Jersey City's Transportation Planning Department, for advancing our academic research with their participation. Transportation Director Michael Manzella and his team gave us a foundation from which to explore our subject matter and propose research-backed recommendations for improving mobility throughout the city. Throughout the semester, Bloustein staff members including Leigh Ann Von Hagen and Dr. Robert Noland have provided us with professional feedback and ideas which shaped our research. We would also like to thank Rylan Seifert, Planning Analyst with the Department of Mobility and Infrastructure at the City of Pittsburgh for offering his insights on their pilot program and process. Our work would not have been possible without the support of these individuals.

Executive Summary

With a population of 292,449 (U.S. Census, 2020), Jersey City is the second-largest municipality in New Jersey. The 14.74 square-mile city has multimodal transportation options to serve its residents, workers, and visitors. These include NJ TRANSIT buses, the Hudson-Bergen Light Rail, PATH train service connecting Newark and New York City, ferries connecting Jersey City to New York City, several additional private bus operators, Via microtransit, and Citi Bikes. A complex roadway network is present, including the New Jersey Turnpike Newark Bay Extension (I-78), U.S. Route 1-9, and State Route 440. Jersey City has a robust, multimodal transportation system that supports on-demand car sharing, public transit, walking, and bicycling—all components of a mobility hub infrastructure. However, the network is largely set up to direct users to and from its primary east-west axis, which is intended to feed eastward into Lower Manhattan. There is an evident need for expansion of micromobility and on-demand services as local, crosstown travel is difficult and has less developed infrastructure.

"Mobility hubs are physical locations where shared mobility services – like public transit, ride-hailing, and bike- and scooter-share – converge in a centralized location, a place where people can seamlessly connect…in a safe, comfortable, and accessible environment'

- Shared-Use Mobility Center (SUMC), 2019

With the city's existing transportation conditions in mind and a goal of providing last-mile connections and facilitating otherwise difficult crosstown travel, this graduate planning studio class aims to support the City of Jersey City Department of Transportation's efforts to get people where they want to go by translating the concept of Mobility Hubs from theory to practice.

Mobility hubs play a significant role in addressing equity issues in transportation by providing more affordable and accessible transportation options for underserved communities. In Jersey City, mobility hubs can offer a variety of transportation options, including low-cost or free bike and e-scooter sharing programs, public transit and microtransit services (such as Via). These transportation options reduce the burden on underserved communities. In this report we advance recommendations and considerations to promote the effectiveness of any Mobility Hub implementation undertaken by Jersey City through an academic literature review, current plans and reports of cities with mobility hubs, and site-level studies.

The team conducted a thorough literature review for micromobility hubs, including academic literature and case studies of micromobility hubs. Topics reviewed included technology for micromobility, Mobility as a Service (MaaS), guides for detailed site analyses, and transportation equity. After the literature review, the team conducted a broad overview of eight mobility hub sites proposed in *JC on the Move* as well as at the Port Liberté Ferry Terminal. These nine sites include: Journal Square Transportation Center, Newport PATH Station, Garfield Avenue HBLR Station, Danforth Avenue HBLR Station, JFK Boulevard (between Communipaw Avenue and Grant Avenue), West Side Avenue at Lincoln Park, Bergen Avenue (between Belmont Avenue and Fairview Avenue), Central Avenue (between Thorne Avenue and Congress Street), and Port Liberté Ferry Terminal.

Initial sites were assessed qualitatively through in-person site visits, and information was gathered on the transportation, land use, economics, and demographics for each location. After a detailed analysis of these nine sites, we selected sites for more in-depth review and recommendation development. Our site selection criteria based on the premise that sites substantially differ by site conditions and existing transit options to provide a cross-section of Jersey City. Three were selected: Central Avenue (Ninth & Congress HBLR Station), Journal Square, and JFK Boulevard. The Ninth & Congress HBLR site was selected due to its proximity to the Heights neighborhood and its position as a major Central Avenue corridor and minor transit hub (at HBLR station). JFK Boulevard was chosen due to its high-traffic arterial and centralized location between West Side Avenue HBLR station, Citi Bike stations on Bergen Avenue, Greenville neighborhood, and New Jersey City

University. Journal Square was chosen as it provides accessibility to a major transit hub and is in a centralized location amidst commercial and retail development. After a detailed examination of each site, we propose mobility hubs for each site, complete with site plans and 3D models.

Journal Square

Journal Square is a high-density, mixed-use neighborhood with a wide range of housing options and a high concentration of commercial and office space. A transit-rich neighborhood, with the PATH station acting as its heart, Journal Square features over a dozen NJ TRANSIT bus routes, multiple Citi Bike stations, Via microtransit service, protected bike lanes, and an Oonee personal bike storage facility.

Journal Square is one of two high-priority places for establishing a mobility hub, according to the *JC on the Move* report. The existing Citi Bike station between Bergen Avenue and Sip Avenue is our primary suggestion for a micromobility hub close to the Journal Square transportation hub. The location we recommend is on the city-owned property next to the Citi Bike station, which had the second-highest number of rides (1,688) in the city in March 2023. Our proposal calls for designating a small portion of the pedestrian zone for shared scooters while enhancing the remainder of the parklet with more permanent landscaping and bollards.

JFK Boulevard at Grant Avenue

The JFK Boulevard site provides several valuable takeaways regarding implementation of mobility hubs in primarily residential neighborhoods that would mainly serve as a bus connection point. The proposed hub site is situated at the northern end of the Greenville neighborhood, a historically-disadvantaged location with a highly diverse population.

We recommend a new mobility hub at the southwest corner of the JFK Boulevard/Grant Avenue intersection. Wide sidewalk space provides the opportunity to establish an amenity-rich mobility hub. Should Citi Bike choose to locate a docking station at this site, hub users would benefit from access to bike and/or E-bike rental. To make the JFK hub an attractive and welcoming space for all users, we recommend the installation of an electronic wayfinding/information display similar to the CityPost units installed in downtown Jersey City.

Ninth Street/Congress Street

The Heights, a densely-populated, diverse neighborhood, is identified as a hub priority area in the city's 2022 *Alternative Transportation Modes Assessment.* More than 50% of the neighborhood identifies as non-white.

We propose two mobility hubs in the Heights: one at Congress and Ninth Street Light Rail station and another within a parking lot located in Washington Park. The mobility hub at Congress and Ninth Street Light Rail station covers 1,500 square feet around the light rail station on the Jersey City municipal border, owned by NJ TRANSIT. This site provides connectivity to multimodal transportation services, including the Hudson-Bergen Light Rail station, NJ TRANSIT buses, and a Citi Bike station. Due to the proximity to different modes of transit, the site has enormous potential to attract more users, contingent on a small investment to provide the facilities. Additionally we propose an alternative site for a mobility hub in the parking space of Washington Park. The lot is owned and maintained by Hudson County and is a shared recreational space between Union City and Jersey City. Both of our proposed sites require securing the agreement and collaboration of third parties. However, we include them as prototypes for hub integration in parking lots or recreation facilities. Overall, mobility hubs in the Heights will enhance connectivity and accessibility for the residents of the Heights by providing access to various modes of transportation. Our recommendation for mobility hub elements include: charging docking stations for e-bikes and e-scooters, bike racks, sitting areas, ticket vending machines, interactive information boards, and advanced lighting.

For all three mobility hubs, we recommend incorporation of innovative technology. Integrating advanced and emerging technologies such as digital displays, smart kiosks, helmet vending machines, and smart streetlight corridors will help provide users with the best trip experience. Some of these innovations hold potential to improve affordability and environmental impact.

Drawing from practices highlights during the literature review and case study analysis, our studio makes the following general recommendations for developing mobility hubs in Jersey City:

1. Develop a high quantity of micromobility access points as a network before focusing on higher amenity hubs to maximize ridership;
2. Concentrate the network in currently underserved neighborhoods early to build a strong user base that represents a full cross-section of Jersey City;

3. Implement a combination of docked and dockless scooters to complement the docked Citi Bike system for greater access to crosstown and last-mile travel;
4. Integrate payment options into seamless contactless, accessible methods; work jointly with PATH and NJ TRANSIT toward a full MaaS package with Lyft, Via, or the Transit app;
5. Thoughtfully consider technology applications that further user utility and efficiency, such as photovoltaic solar panels or digital wayfinding displays.

Team Testimony

About the team:

Sixteen second year graduate students in the Master of City and Regional Planning (MCRP) Program at the Bloustein School of Planning and Public Policy at Rutgers University joined the *Jersey City Micromobility* Graduate Planning Studio course to get practical, hands-on experience in the planning profession during the Spring 2023 semester. Students responsible for this final report stem from various planning specializations within the program including transportation planning and policy, community development and housing, environmental planning, and urban design. Additionally, some students are enrolled in dual-degree course of studies including the Master of Public Informatics program. These combined backgrounds provided the studio members with a diverse array of ideas, experiences, and management skills to construct and propose micromobility enhancements to the City of Jersey City.

The team hopes that the findings outlined in the report are beneficial, provide diverse perspectives and supply useful recommendations to the City of Jersey City as they move toward implementation and operation of mobility hubs.

Goals and Objectives

The goals of our studio and this report are to support the City of Jersey City Department of Transportation's efforts to get people where they're going by translating the concept of Mobility Hubs from theory to practice.

Through examination of academic literature, reports of cities with mobility hub experience, and site-level investigation, this report aims to provide recommendations and considerations to advance the success of any Mobility Hub implementation taken on by Jersey City.

Starting with Jersey City's 2022 *Alternative Transportation Modes Assessment*—entitled *JC on the Move*—priority areas for feasibility, micromobility demand, mode choice availability, and challenges and opportunities were analyzed. As hub utilization and safety are influenced by surface conditions we examined the extent of surface improvements needed at representative hubs for micromobility riders to be able to use nearby streets and sidewalks. Current redevelopment plans were reviewed to suggest updates to incorporate or facilitate micromobility. Information and communications infrastructure with potential to facilitate Mobility Hub utilization were assessed, as well as potential considerations for implementation.

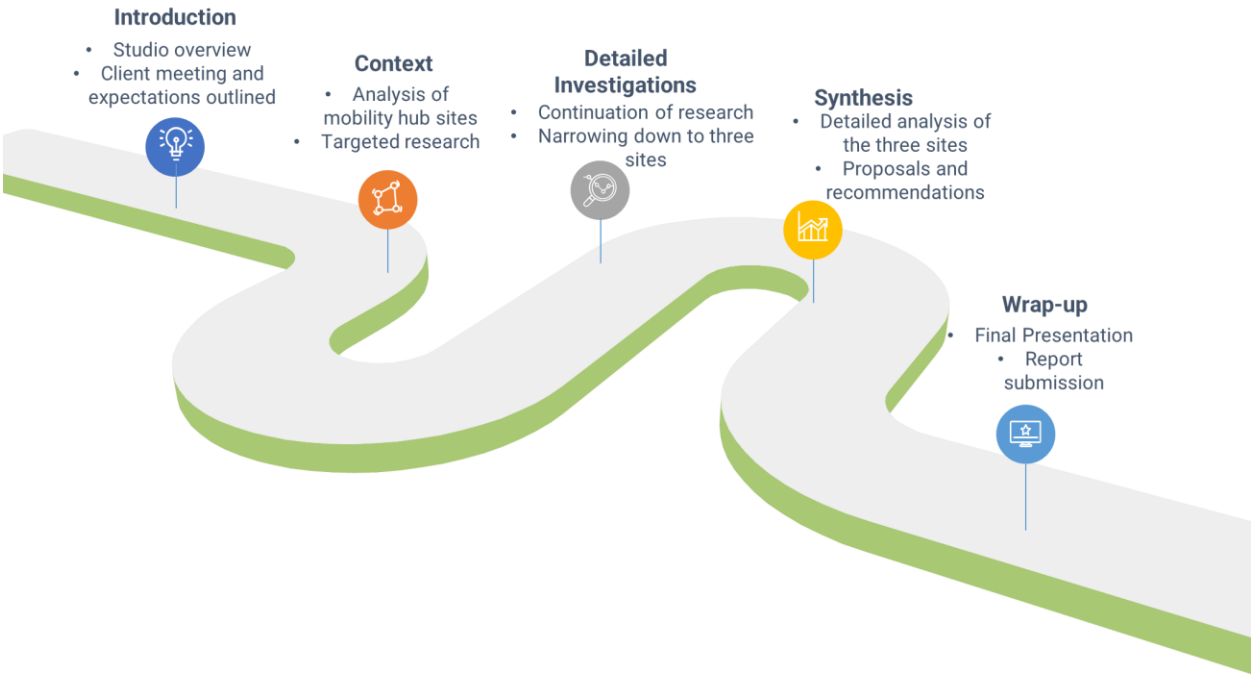
The Transportation Planning team at the Jersey City Department of Transportation offered their priority focus areas for this report both during our initial site visit and during the studio, which include:

- Sites for specific investigation: The Heights, Greenville, and Port Liberté;
- The potential for Mobility Hubs to facilitate east-west travel;
- Foster greater connections between neighborhoods;
- Review and recommendation of best practices in micromobility and scooter adoption both from academic literature and from cities with existing micromobility;
- Recommendations for particular micromodes;
- Specific recommendations for select illustrative sites.

We hope that this report succeeds in advancing Jersey City's Transportation Planning efforts to improve connectivity, mobility, and access through innovative and iterative approaches, ultimately benefiting residents and visitors through improved access to transit and increased transportation equity in Jersey City.

Methodology

The studio began with a high-level overview of Jersey City and introduction to the studio project. Each member was required to thoroughly study Jersey City's 2022 *Alternative Transportation Modes Assessment.* To realize the goals and objectives of the studio, we adopted a broad methodology as shown in Figure 1. The studio team and the coordinators met with the Jersey City Department of Transportation during which the first reconnaissance site visit was also conducted. The meeting enabled the team to understand the expectations and deliverables based on which the team developed a scope of work to guide the entire course of the studio.



[Figure 1] Methodology adopted for the studio.

The team reviewed literature for micromobility hubs, including academic literature and case studies of micromobility hubs. Topics reviewed included technology for micromobility, mobility as a service (MaaS), guides for detailed site analysis, and transportation equity.

Members reviewed the proposed mobility hubs identified in Jersey City's 2022 *Alternative Transportation Modes Assessment* in-depth as small groups. The *Assessment* identified eight candidate sites, some at existing transit hubs and others in under-served neighborhoods. Additionally, Port Liberté was included in the eight candidate sites. Small groups investigated their sites and presented findings. Due to limitations of time and resources, we decided that developing design proposals for each of the candidate sites would be beyond scope of this studio.

We arrived at criteria to narrow the sites to three mobility hub sites, with the goal of selecting diverse sites intended to represent a cross-section of conditions found in Jersey City. The results from detailed investigations were deliberated in the studio in the weekly meetings. Three sites: Journal Square, JFK Boulevard, and Congress Heights (9th Street at Congress Street) were selected. Members of the studio also arranged and conducted interviews with staff responsible for

micromobility hub site planning at Move PGH and another mid-Atlantic Department of Transportation. Interviewees provided their experience and practices for integration into our proposals and recommendations.

To develop proposals for each of the three chosen mobility hub locations, we formed site-based research teams. Site-based teams conducted further site visits to deepen understanding of the site and its neighborhood conditions. Site teams developed site-specific suitable mobility hub and amenity recommendations. Preliminary key findings were presented to the Jersey City Department of Transportation during which clarifications were sought from the team and feedback was received. At this point our studio designed and presented a research poster for Bloustein Research Day 2023. We continued to improve the proposals and illustrative design recommendations for each site, deliberating weekly until presentation of the final draft to faculty and students of Bloustein School. After further refinements from feedback of the draft presentation, we presented the final proposals and recommendations to the Jersey City Department of Transportation on April 25, 2023.

Limitations

Studio participants were required to develop a framework approach, produce research analyses, and construct both a final presentation and final written report within a standard 15-week semester during the academic year. The following report reflects the hard work and dedication of the team during this limited timespan. Mistakes and omissions in the report are the responsibility of studio participants, and we have done our best within constraints to provide as accurate and complete a set of considerations as possible. Much of the work is rooted in key findings from Jersey City official documents such as *JC on the Move*, communicating with the Department of Transportation and responding to their inquiries, providing case study examples of mobility hubs, and recommending three intentionally different locations to begin the foundation for a future, integrated mobility network.

Mobility Hubs & Micromobility

Definitions

What are Mobility Hubs?

"Mobility hubs are physical locations where shared mobility services – like public transit, ride hailing, and bike- and scooter-share – converge in a centralized location, 'a place where people can seamlessly connect…in a safe, comfortable, and accessible environment' (Shared-Use Mobility Center (SUMC), 2019)." (Arseneault, 2022)

Ranging from transit stops with a nearby bikeshare dock to destinations offering access to a diverse array of modes, mobility hubs can serve as access points for travel as well as social gathering places depending upon their design.

Mobility hubs differ according to the amenities that they offer. The hubs reflect the need of the neighborhood they are serving and the ground realities of the existing built environment. The Mobility Hub Guide by the Los Angeles department of Transportation talk about the three general tiers of Mobility Hubs: Neighborhood, Central, and Regional. The tiers are differentiated by their scale, amenities, and context (*Mobility Hubs Readers Guide*).

- The neighborhood mobility hubs are found in lower density areas. They mostly offer micromobility options essential to every transit area such as bike share, bike parking and/or e-scooters. They usually also have benches nearby it. Some examples of this include Bagley/Venice bus stops.
- Central mobility hubs are located in more urban areas where population density is higher and they usually contain multi modes of transport such as car-share/bike share, bus stops, bus shelter and information boards. These are the most common types of mobility hubs.
- Regional Mobility hubs are the largest scale mobility hubs- usually in the densest areas of cities "or end of line stations where they connect to other regional transit providers" (*Mobility Hubs Readers Guide*). Examples of this are the North Hollywood Station and Harbor Gateway Transit Center.

What is Micromobility?

"Micromobility is an innovative urban transport solution aimed at providing short-distance travel options including first and last kilometer trips. The

appeal of micromobility is that it provides flexible, sustainable, cost-effective and on-demand transport alternatives (Shaheen et al., 2020) and reduces reliance on using private vehicles for short-distance travel (Clewlow, 2018, Tiwari, 2019)." (Abduljabbar, 2021).

Inclusive of a range of devices and lightweight vehicles that operate at speeds typically under 28 mph, micromobility can refer to bicycles, scooters, skateboards, segways and hover-boards both manual and electric, shared or privately owned (Dia, 2019). Cities looking to shift towards low carbon and sustainable modes of transport find micromobility a valuable solution toward reducing private car trips for short-distance travel (Abduljabbar, 2021).

Literature Review

Implementation of effective mobility hubs appropriate to the diverse, large population of Jersey City requires that we understand multiple aspects involved in hub success, such as transportation planning, urban design, sustainability, and technology. Here we provide a comprehensive overview of the current literature on mobility hubs, highlighting key topics and best practices for creating successful mobility hubs in communities of all sizes.

Shared Micromobility

Shared micromobility programs offer riders short term access to vehicles—such as bikes or scooters—usually in return for a small fee. These options offer a promising potential in terms of integration with public transit systems, particularly by providing enhanced last-mile access to and from stations. Data on shared E-scooter trips indicate that trips made by this mode are often substitutes for car, rideshare, taxi, or walking trips. They may actually increase transit ridership due to enhanced last-mile connectivity (Yan et al., 2023). Research on emerging micromobility connections in the San Francisco Bay Area indicates that several transit station components play a major role in determining support for micromobility connections. These include the provision of adequate parking and storage options (such as scooter corrals), clear signage for micromobility users, and supportive infrastructure near stations (Ferguson and Sanguinetti, 2021). An additional approach to improving transit/micromobility connectivity involves integrating fare payment methods between public transit and shared micromobility options. This also has the added benefit of making micromobility more accessible to disadvantaged users (Beale et al., 2023).

On-Demand Transit

On-demand transit typically involves the use of smaller vehicles to provide more flexible schedules that are better suited to passenger demands (Zhang et al., 2022). These types of services are perhaps best suited to areas or times of day with lower demand for transit trips, where conventional fixed route buses would generally be too expensive to operate (Wang and Shen, 2022). Microtransit is a very similar concept, which is often used interchangeably with on-demand transit. The US Department of Transportation defines microtransit as, "...a privately owned and operated shared transportation system that can offer fixed routes and schedules, as well as flexible routes and on-demand scheduling" (Westervelt et al., 2018). Fixed schedules and routes are ones set by the operator, whereas flexible/on-demand schedules and routes can be adjusted in real-time to match demand (Westervelt et al., 2018).

There are significant mobility-related benefits that have been associated with microtransit systems and pilots. For instance, a study on a Via on-demand transit trial in Seattle, WA found that the new service significantly increased accessibility to transit stops in lower-density areas, especially those with disadvantaged populations (Wang and Shen, 2022). Another pilot project in a smaller Canadian city found that an on-demand system implemented in lower-density areas increased the number of off-peak transit trips. This included increased non-work-related trips, something that produced a number of social benefits according to survey data (Zhang et al., 2022). On-demand transit options have also been associated with improved access to employment opportunities. A study of an on-demand microtransit service in Dallas, TX found that when compared to conventional buses, the new service improved connectivity between transit stations and centers of employment; something that was especially advantageous for lower income workers (Kang and Hamidi, 2019).

There are potential challenges with microtransit that need to be considered as well. As microtransit can sometimes provide a more attractive alternative to regular buses, trip substitution may occur, potentially decreasing local bus ridership (Wang and Shen, 2022). This means that it is important for transit operators to coordinate their services with any microtransit providers. A similar effect was observed in a Finnish on-demand transit trial, where the new service was sometimes used to substitute for walking, cycling, or local transit trips (Haglund et al., 2019). There are also accessibility concerns associated with micro- and on-demand transit. The use of online or app-based payment systems to pay for rides may not be a feasible option for certain populations, such as seniors and lower income individuals — these are the potential users who could benefit the most from on-demand services (Miah et al., 2020). Flexible microtransit routes may

also pose an accessibility challenge, as "virtual" stops may not always be as accessible as conventional bus stops (Miah et al., 2020).

Car Share

Car sharing systems allow their users to rent automobiles on a short-term basis. There are generally two different forms of carsharing services: fixed (or station-based) systems, and free-floating systems. In a station-based system, vehicles must be picked up from and returned to designated locations, an aspect that has been found to limit their flexibility (Kopp et al., 2015). By contrast, free-floating systems allow users to rent a vehicle, usually through phone-based options, and leave it at any location within a designated area when finished using it (Sprei et al., 2019). Carsharing services have existed in both Europe and the United States for some time, although there is generally much more academic literature available on European case studies with this technology. However, it is worth noting that car sharing services such as Zipcar and Car2Go have seen moderate success in certain U.S. cities like New York (Kim, 2015).

The most significant advantage of carsharing is that it can both reduce the need to own multiple vehicles and reduce overall dependence on private vehicles. Studies from the Netherlands, Austria, and Italy have all indicated that carshare users feel less of a necessity to own multiple cars, sometimes avoiding private vehicle ownership altogether (Sprei et al., 2019). Research on trip purposes suggests that carsharing trips can be particularly useful for certain types of travel, such as leisure or shopping, and that individuals who use carsharing services tend to make more multimodal trip choices in general (Kopp et al., 2015). There are certain issues to be considered with carsharing services though, such as equity and trip substitution. Carshare demand is often more significant amongst individuals with higher incomes, and prohibitive rental costs can be a deterrent for potential lower-income users (Kim, 2015). Carshare systems can potentially reduce active transportation and public transit trips, although this effect has not been uniformly observed (Sprei et al., 2019).

E-Mopeds

E-mopeds are small, electrically-powered moped scooters that can be rented over apps similar to those used by private e-scooter and bikeshare providers (Aguilera-Garcia et al., 2021). E-moped rental is a relatively recent development in North America. Most US cities that have adopted E-mopeds require operators to possess a valid driver's license, and operators are also typically required to wear a helmet that is provided with the vehicle while operating it. This technology

has been deployed in Spain for somewhat longer than it has in the United States, so it is possible to draw some conclusions regarding its impacts on urban mobility. A study by Aguilera-García et al. found that some of the most common purposes for E-moped trips were either for leisure or to avoid downtown congestion. However, there are also certain barriers associated with this option, such as the learning curve associated with moped operation, and the difficulties associated with the app payments required to use these systems (Aguilera-Garcia et al., 2020).

Docked and Dockless Micromobility

Shared mobility networks can be deployed in a docked or dockless configuration, which refers to the parking and storage of shared vehicles while not in use.

Docked networks - sometimes known as *station-based* networks – require riders to collect and park vehicles at physical stations, which lock the vehicles in place until riders pay for access. If the network includes electric-powered vehicles, stations may also recharge them between rides. Since docked networks require vehicles to be stored in designated stations, destinations are limited as riders must only travel between docking stations. Additionally, since stations have limited parking capacity, riders run the risk of arriving at a location that doesn't have any parking available.

Ma et al. (2020) compiled comprehensive demographic characteristics for bikeshare riders in Hangzhou, China to discern if docked and dockless vehicles were—statistically speaking—used by different people. They found the average docked bikeshare rider was:

- More likely to be used by people with lower incomes;
- More likely to be used by the elderly;
- More likely to be used by car owners;
- Commuter-oriented, with higher usage on weekdays during peak commute hours;
- Riding on average between one and five kilometers, and for approximately 30 minutes;
- Using the service related to public transit stations or dense employment areas.

Dockless networks—sometimes called free-floating networks—do not require vehicles to be left at a station, though some geofencing restrictions may apply. Dockless vehicles typically have self-locking wheels that can be unlocked by

riders who pay for access through a mobile application. One advantage of dockless networks is the lack of limitations on parking when riders reach their destination. Additionally, dockless networks don't require the upfront cost to build and maintain docking stations, making them an attractive choice for cities looking to introduce micro-mobility while minimizing financial commitments. However, dockless networks have a higher risk of misuse. For example, riders may leave vehicles parked in inconvenient locations that block sidewalks or curb cuts. Even when dockless vehicles aren't actively blocking paths, they have been reported to create visual clutter due to disorderly storage. Dockless vehicles have also been subject to higher rates of vandalism and destruction.

Ma et al. (2020)'s analysis of bikesharing in Hangzhou compiled the following characteristics of a conventional dockless network bikeshare rider:

- Riders were more likely to be young professionals, highly educated, male, middle income, single, and have proficient use of the internet;
- Weekend use was steady and didn't experience noticeable peak demands, indicating a variety of trip purposes;
- 44% of trips were for leisure purposes (followed by 36% for commuting);
- The average ride distance was less than three kilometers and the average ride time was less than 20 minutes;
- Riders were less sensitive to weather changes.

There is a growing amount of evidence suggesting that dockless micromobility systems can be beneficial from an equity standpoint. A study comparing newer dockless bike and E-scooter options to the conventional, docked bikeshare system in Washington, D.C found that adoption rates for dockless options were higher amongst disadvantaged populations. This was especially true for predominantly Black users in the eastern part of the city, who have adopted dockless modes at a rate 2.6 times higher than the existing Capital Bikeshare system (Clewlow et al., 2018). A major factor thought to be driving this increased usage was the shortened average distance to a vehicle that dockless modes offer potential users (Clewlow et al., 2018). Another US-based study, using data from Tempe, Arizona, identified a somewhat similar effect. Minority residents were more willing to try dockless E-scooters than other forms of micromobility, in part because of their lack of satisfaction with existing transportation options (Sanders et al., 2020).

Transport and Equity

Transportation equity is critical to consider when implementing mobility hubs. Transportation equity refers to the idea that everyone should have access to safe, affordable, and reliable transportation options, regardless of their income, race, or physical ability. Unfortunately, many cities struggle to achieve transport equity, as low-income neighborhoods and communities of color often lack access to high-quality public transportation and other mobility services. Micromobility can help to address this problem by providing a low-cost, flexible, and convenient transportation option for people who may not have access to cars or traditional public transit. By using micromobility, people can travel quickly and easily to work, school, or other destinations, without having to rely on expensive or unreliable modes of transportation.

Is it important to ask who is served by new micromobility options. Even when new transport facilities emerge, there are issues of equitable distribution. Thus, in the absence of better public transport facilities, many immigrant communities turn to informal modes of transportation to reach destinations. Thus, mobility hubs – or any policy that focuses on improving access to mobility – need to account for existing informal modes of transit. New transit networks have to include them for success. Research conducted by Eric Goldwyn and David King looks to understand why regulation of jitney services have been historically unsuccessful in the United States. Using different case studies in Miami, Los Angeles and New York City, they saw that jitneys generally had high ridership amongst immigrant and minority communities (2014). Formal attempts to integrate jitneys into the public transit system were considered unsuccessful due to competition with subsidized public transit. The article studies the importance of jitneys in New York where the growth of commuter vans was triggered by deficiencies in city-operated transit service; they remained illegal until 1983. Attempts to regulate them failed due to lack of subsidy, a two-month gap between the cessation of bus service and the start of Group ride vehicle (jitney) service, poorly branded service, and uncertainty about jitneys serving a broad transit market and lack of unawareness (King & Goldwyn, 2014). Anne Brown's research on mobility as a service and its impacts on transport equity found that ride hail services in Los Angeles provided, "...reliable car access to neighborhood marginalized by [the] taxi industry" (2018), particularly the neighborhoods where the percentage of people owning cars is low. However, racial biases, price surges, and discrimination meant that it was used for occasional rather than regular travel need.

Transportation practitioners, including planners, engineers, and policymakers, recognize that access to transportation is essential for social and economic participation and that some groups are more vulnerable to transportation barriers

than others. Cantilla, et al. (2021) researched how practitioners addressed equity in their work, including how experience-based strategies and research-developed equity metrics contribute to supporting the achievement of transportation equity goals (2021). Fifty-nine participants from four sectors of the transportation industry were surveyed and interviewed about different transport equity methods. "Scarcity of data or data analysis tools" was cited as a main barrier to addressing equity, followed by funding and "lack of legislative support" (Cantilla, et al., 2021) as well as policy implementation and community engagement.

City Case Studies

To explore insights from cities who have piloted or adopted micromobility and mobility hub models, our team reviewed plans, ordinances, regulations, reports, academic literature, and news articles for several relevant cities. Among these were Hoboken, Minneapolis, Pittsburgh, Washington, D.C., and Denver, as well as international cities of Singapore, and Bremen, Germany. We conducted follow-up interviews formally with Pittsburgh, and informally with another mid-sized eastern US city. Arsenault's 2022 capstone thesis, *Mobility Hubs: Lessons Learned from Early Adopters,* comparing Columbus, Ohio; Hamburg, Germany; Minneapolis and San Diego County, California was particularly helpful to our review, as well as APA's Zoning Practice on Mobility Hubs (Crozier & Nisenson, 2022). Among these cities, we identified approaches to regulating and enforcing equity goals for micromobility with vendors.

Emerging Themes from City Plans and Reports

Plans we reviewed, including *JC on the Move*, underscored Arsenault's topline mobility-related finding: agencies adopting mobility hubs, "...share common goals and design principles. Shared goals included transit and shared mobility use; alignment of transportation, public health, sustainability, and equity goals; technological advancements; and building partnerships with private mobility providers." Additionally, "...the most consistent goal is to increase ridership on transit and other shared mobility options in order to reduce neighborhood congestion and dependence on personal automobiles (Columbus, 2021; Lesch, interview, March 14, 2022; Rasp et al, 2020; SANDAG & ICTC, 2017a)." (Arsenault, 2022).

Themes that arose from plans and conversations included the following:

- ***Good bicycle and pedestrian infrastructure supports other micromodes.*** From Pittsburgh's Mid-Pilot Evaluation, "Making it easier for residents and visitors to choose shared mobility also includes making those options safer...We see a strong correlation between high usage scooter routes and our bike(+) infrastructure." (DOMI, 2022)
    - "All three U.S. agencies highlighted the need for additional bicycle infrastructure, including protected bicycle lanes, in their project documentation (Columbus, 2019, 2021; Rasp et al, 2020; SANDAG & ICTC, 2017a, 2017b). Hamburg staff noted that bicycling infrastructure is necessary for any multimodal system, and that all hubs are already connected to safe bicycle paths, primarily dedicated lanes (Lesch, interview, March 15, 2022)." (Arsenault, 2022, p26)
    - Pittsburgh: "Particularly in dense areas, like Downtown and Oakland, bike lanes offer a safe lane for more vulnerable road users." (DOMI, 2022)
- ***Hub quantity matters:*** Increasing frequency of hubs was a city priority, both for parking management and to address availability. Location and site challenges were more about public acceptance of additional hubs at any given section of sidewalk than about maximizing proximity to specific features.
- ***Lower-barrier micromodes will be more popular.*** For inexperienced riders, scooters are much easier to learn quickly relative to bikes. Trip counts for cities with bikeshare and scooter share systems consistently reported substantially higher trip counts for scooters versus bicycles.
    - Metrics from Pittsburgh's Mid-Pilot Report reveal seven scooter trips for every bike trip (DOMI, 2022), but a reduction in bikeshare availability during the study period means this ratio is likely an upper bound.
    - Washington, D.C. published an interactive trip data dashboard in January 2023 (Brady, 2023) that shows a ratio of 3.6 scooter trips per e-bike trip in Q1 2023 (DDOT, n.d.). Capital Bikeshare is the longest-running urban bikeshare program in the country, so this would likely be closer to average in a city with an ongoing bikeshare program.
    - Consistently higher trip counts for scooters suggest that bike trips will not be predictive of scooter trips.

- ***Topography matters.*** Cities with large slopes 'drain' docked bikes or scooters to lower elevation areas, creating dock parking congestion in low-lying areas and a rebalancing burden throughout the day.
    - Pittsburgh: "The most popular neighborhoods for scooter trips are primarily in the east end and in other relatively flat areas of the city. However, hilly areas such as Mount Washington and the Hill District see high rates of scooter usage as well." (DOMI, 2022)
    - Washington, DC's experience is reflected in the Capital Bikeshare Master Plan update of 2020 (Capital Bikeshare, 2020), which highlights the 'drainage basin' challenge. Planners in DC must account for this when siting bikeshare docking stations, as bike parking congestion requires a higher than 1:1 ratio at lower elevations. "Trip imbalances reflect the topography of the District as riders are more likely to travel from uphill neighborhoods like Woodley Park and Columbia Heights to downhill neighborhoods like Dupont or Logan Circle than the reverse. The introduction of electric assist bicycles could lessen this imbalance by making uphill trips easier on riders." (Capital Bikeshare, 2020)
- ***Easier micromodes will be more popular, especially uphill.*** E-bikes and electric scooters require less physical effort by riders, especially when faced with uphill rides. Both Pittsburgh and DC are looking to expand their shared bike fleets to include more e-Bikes in response to ridership and surveys.
- ***Micromode use changes with the weather.*** Weather quickly impacts ridership of bikes and scooters, shifting would-be riders to buses and potentially creating congestion for rideshare, buses, and rail.
- ***Dockless bikes and scooters have wider geographic ranges.*** The convenience and lack of parking congestion can present an advantage to areas that are more geographically dispersed or to fill directional gaps.
    - Greenville may be a great candidate for dockless to fill the east-west gap along well-served north-south corridors.
- ***Electricity issues.*** Rylan Seifert of Pittsburgh's Department of Mobility & Infrastructure (DOMI) noted the challenges Pittsburgh has encountered when locating electric grid tie-ins for bike and scooter docking stations. In Pittsburgh, some streetlights are owned directly by the city and tended to be more modern. However, many streetlights are owned by Pittsburgh's electric distribution utility. Utility-owned streetlights were in poorer conditions and more frequently found in equity emphasis areas. Their utility was resistant to hub grid tie-ins through their streetlights. Pittsburgh is not alone:

in 2020 an article in *Cities Today* notes, "...a growing trend of US municipalities buying back streetlights," driven by cost savings potential, interest in advancing smart streetlights, and a recognition of the critical nature of streetlights as infrastructure (Wray, 2020).

  - Electricity requirements for docking hubs without scooter or bike charging – strictly payment processing and unlocking – are much less, and can be offset during daylight hours by smaller, attached solar panels. However, electricity demand increases with larger LED screens for digital advertisements, or transit information displays.
  - Hubs that recharge scooters or bikes will have much greater electricity demand. This will likely require greater coordination with PSE&G in Jersey City to identify areas with sufficient "hosting capacity."
  - Seifert recommends piggybacking on other electrical upgrades underway in the streetscape to site higher-demand charging hubs. These upgrades can include EV charging installation or streetlight upgrade efforts.

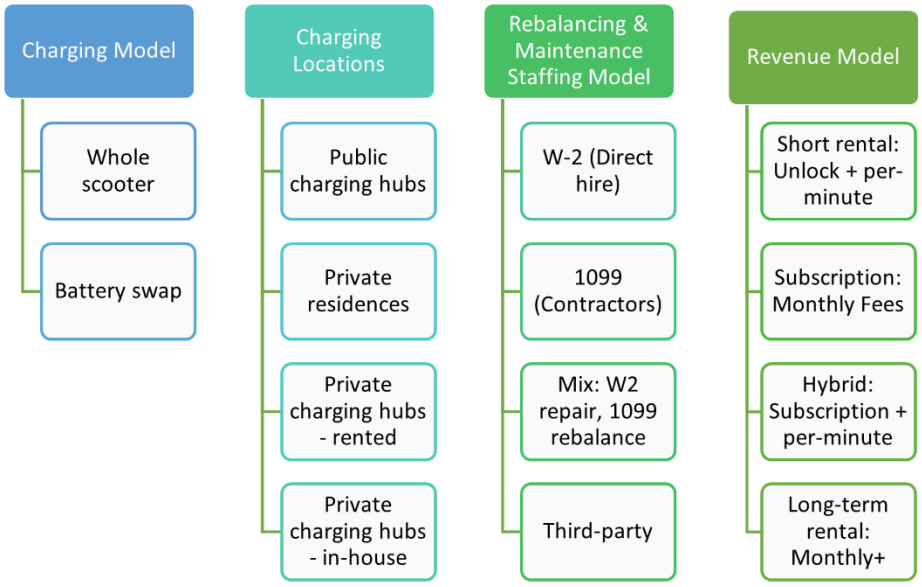
- ***Having fewer vendors per mode improves odds of successful collaboration.*** Two scooter vendors left markets citing the challenges of competition from a multiplicity of providers but also a lack of clear regulation from host cities. In the maturation phase of scooter share, vendors seek to partner with cities in an environment of fewer competitors and tighter coordination with city administrators.
  - Arsenault: "Program managers stressed that partnerships with mobility providers are the determining factor of whether hubs are successful." But also: "Trip data sharing is a conflict point between public agencies and private mobility providers."
  - Pittsburgh credits their decision to select a single vendor per mode as a major factor of success in establishing their scooter share pilot.
  - Washington, D.C. has reduced the number of permits issued as fewer vendors met the requirements of their revised ordinance.
  - One city found that the exit of any given scooter vendor in an otherwise crowded market did not impact overall volume of scooter trips so long as scooter availability was maintained (e.g., the gap left by the exit was filled by competitors).

Key Considerations for Jersey City

The plan review and interviews raised questions that may be useful for Jersey City transportation planners to consider when approaching addition of micromode services and with the placement of hubs:

- Which elements of micromobility service will be owned by the city and which will be managed through private operators? Some operational factors to consider include whether or not Jersey City will:
    - Manage micromode service providers on the market through permits and licensing.
    - Cap the number of vendors per mode, or permit as many as fulfill vendor requirements.
    - Directly own equipment or work with vendors who supply equipment.
- Are stations for scooter docking primarily intended to manage shared device parking, or are they central to recharging devices?
    - Scooter docks which allow scooter battery recharging increases scooter availability to potential riders, but increases the electrical capacity requirements of the site, potentially restricting site selection criteria.
        - It is helpful to identify the recharging strategy of prospective scooter vendors in advance, to determine the frequency and necessity of docked charging hubs;
        - The scooter models chosen by a vendor determine the recharging strategy employed – e.g., battery swap or whole-scooter recharging. See Figure 2 for an illustration of scooter business model elements relevant to recharging and rebalancing strategies employed by vendors;
        - Vendors of electrified scooter docking hubs include Swiftmile, Charge, and Kuhmute. Pittsburgh has worked with Swiftmile for their docking stations, a relationship that began with Spin but is now independently managed by DOMI.
    - What share of hub sites may require electricity? Will these be combined with corrals which do not require electricity?
    - Do hub sites currently have sufficient electric grid capacity and sites for tie-in?

        - The EV Hosting Capacity map provided by PSE&G can provide a useful heuristic for electrical capacity available at the transformer level for prospective hub locations: https://nj.myaccount.pseg.com/myservicepublic/hosting_capacity_map
        - Engaging with PSE&G early on locations for hubs which may require larger-capacity electrical requirements is recommended.
- Service levels: How frequent and at what distances can riders of micromodes expect to encounter hubs or parking corrals?
- For areas of redevelopment: Would hubs open prior to or after new residents are expected to populate an area?
    - Exploring partnerships for siting hubs near new developments, especially hubs with larger electrical capacity requirements may be useful.



[Figure 2] Scooter Vendor Business Model Elements

Plans and Case Studies Brief

Pittsburgh, Pennsylvania

Pittsburgh's Department of Mobility & Infrastructure (DOMI) launched Move PGH in July 2021 as a two-year pilot of Mobility as a Service (MaaS). Working with

existing providers and bringing new mobility operators into the space, their goal was to "...create a more affordable, accessible, and equitable mobility ecosystem." Outside of Move PGH, Pennsylvania has a commonwealth-wide ban on electric scooters, so the results of the policy are likely to influence electric scooter policy statewide. To analyze their program for potential insights, we reviewed their Mid-Pilot Report, their Bike+ plan, a proposed hub siting presentation for a neighborhood, city-level regulations for scooters enacted for the pilot and conducted an interview with Rylan Seifert, Policy Analyst at DOMI. As of this report, DOMI's final report on the pilot was not yet available but will be available in the near term.

The primary source of tension in city micromobility programs tends to be scooter parking. To reduce conflict potential, Pittsburgh banned scooter parking on sidewalks outside of designated hubs or corrals entirely. This was a unique approach requiring a complementary accelerated installation of hubs and corrals. As of the Mid-Point Pilot, the city had 150 hubs installed, with more slated for installation. DOMI requires use of geofencing to enforce no-parking, no-riding, and low-speed (less than 15 mph) zones throughout the city, as well as to enforce equity deployments, described in the Equity section below. (City of Pittsburgh, 2022).

DOMI also made the strategic decision to select one vendor per mode, rather than licensing multiple vendors per mode. Seifert credits this decision with a close working relationship with their selected vendors, and key to the success of the program. Some changes occurred during the pilot with the cast of vendors. For instance, the eMoped provider Scoobi, a local startup, went bankrupt during the pilot, removing a mode from the network. Spin, the scooter vendor, made a nationwide decision to cease managing hubs during the pilot as well, instead narrowing their scope to scooter provision. Spin had been working with another vendor – Swiftmile – for hub management, so DOMI has since established a direct relationship with Swiftmile for hub installation and management (Seifert interview, 2023).

Hub Siting Priorities and Grid Difficulties

DOMI hub sites were prioritized along two major themes: proximity to existing transportation mode networks (bus, train, bikeshare) and service level requirements in equity areas. In siting hubs, they encountered unexpected challenges locating appropriate electricity grid tie-in points. Swiftmile hubs can tie into electrical at the site of city streetlight posts, but in Deployment Zones, the streetlights were owned by the electrical utility rather than the city, and lacked sufficient amperage to supply the hubs.

Electricity requirements for POGOH bike share hubs were relatively low, as the two electricity-dependent functions are payment processing and unlock rather than charging vehicles. This level of demand can be met by solar power during the day, but a grid tie-in would still be required for reliable service at night.

Scooter charging is a much larger draw, particularly depending on the number of scooters and their state of charge, as well as the charge management infrastructure within the hub. DOMI is considering non-electrified stations in areas which lack sufficient or city-controlled electricity near ideal hub locations. Where Swiftmile hubs are installed, their recharging capacity supports greater scooter availability, but Spin nonetheless has employees who perform recharging and battery-swap operations to keep scooters running throughout the city (Seifert, 2023).

Scooter Commuters

DOMI's analysis of trip data found that scooter and bike trips vary seasonally and demand for these modes shifts quickly due to weather. Weekdays saw scooter use increase during peak rush hours, and survey responses from scooter riders confirmed the use of scooters as last-mile or first-mile modes used for commuting. Bike and scooter lane infrastructure supports increased use of these modes. Scooters were being used in areas of low-transit connectivity to provide last/first mile transport as part of commutes – 40% of trips were for commuting (Seifert, 2023).

"Doing It Right" Is Worth It

Seifert emphasized that while the effort to iron out policy is essential, making frequent assessments, surveying riders and adapting, tracking service levels and equity goals can have a higher cost both in terms of budget and political capital. However, it is worth the effort to attain the goals sought by the program. Their data showed that 35% of car trips were replaced by scooters – the outcomes being sought will follow if the effort is made.

Pittsburgh's Mid-Pilot Report and our interview with Rylan Seifert, Policy Analyst with the City's Department of Mobility and Infrastructure (DOMI) emphasized DOMI's decision to select a single vendor per mode for their pilot program as key to success of their pilot. This reinforces Arseneult's fourth finding, that mobility provider partnerships are crucial. Seifert credits the single-vendor decision with fostering a productive and responsive relationship with Spin. Both the city and Spin worked collaboratively on program roll-out and improvements to accountability metrics such as scooter availability requirements in equity areas. However, this

strategy did leave a mode gap when their eMoped vendor, Scoobi, closed its doors.

Denver, Colorado

Denver implemented a dockless mobility permit program in July 2018 to regulate commercial e-scooters and e-bikes on the city's public right-of-way. The pilot program issued permits to five scooter operators and two bicycle and e-bike operators, with quarterly fleet size adjustments permitted. The city urged operators to deploy their vehicles near transit stops each morning to enhance dockless vehicle integration with the existing transportation system (Denver Public Works, 2019). During the two-and-a-half-year dockless pilot program, which saw over 6.4 million miles of rides, the city observed the potential of dockless vehicles to advance its sustainable mobility goals, as well as issues such as pedestrian safety concerns and appropriate vehicle parking. (Denver Public Works, 2021)

Furthermore, the City of Denver realized that having fewer operators handling more vehicles is more efficient for the city; it is also important to have more than one operator to maintain the competitiveness of price and service. As a result, the city switched to a more stringent longer-term non-financial license program in 2021, where chosen operators must provide both electric scooters and bicycles/e-bicycles, along with comprehensive user education and management procedures. (Sachs, 2021) The five-year license program provides consistency of operations for both the city and operators, as well as the opportunity for operators to increase their investments in shared micromobility infrastructure. The program mandates that a minimum of 30% of all vehicles must be deployed in "Opportunity Areas" at the start of each day. The operators must offer discounts to low-income customers and cash payment options to unbanked customers.

In June 2022, ridership in Denver micromobility rose to 604,000 trips, with a 76% increase compared to the same quarter in 2021, largely due to convenience, incentives, high gas prices, and events in downtown. The City and County of Denver has launched e-bike and e-cargo bike rebate program in April 2022, with $300 for a standard rebate, $1,200 for income-qualified rebate, and $1,400 for adaptive rebate. The rebate vouchers are available every other month and a total of 5,060 e-bike vouchers have been redeemed as of March 2023. (City and County of Denver, n.d.)

Bremen, Germany

The mobility hub in the City of Bremen is worth highlighting because Jersey City similarly wants to reduce the number of single-occupancy vehicle trips across the city. Bremen has been at the forefront of recognizing the potential of using mobility hubs to promote multimodal transportation options, thereby decreasing cars on the roads, and improving street space. In 2003, Bremen established its first mobility hub with a car-sharing program, which has since expanded (Glotz-Richter, 2016).

The city has two types of mobility hubs, each differing in size and location. The larger ones, called Mobil.Punktes, have four-to-12 car-sharing vehicles and are integrated with public transportation, cycling, pedestrian access, taxi stands, and other facilities in the neighborhood. The smaller ones, called Mobil.Punktes, have two-to-three car-sharing vehicles and are located within residential neighborhoods. Approximately one-third of the total car-sharing stations in Bremen are constituted by Mobil.Punktes.

As of October 2022, there are over 130 mobility hubs throughout the city offering more than 400 car-sharing vehicles and 100 free-floating vehicles as part of a combined system. Over 23,000 users have utilized this program, with many choosing car-sharing as an alternative to car ownership. Through the program, Bremen has successfully removed 7,000 private cars from public streets using car-sharing, which has reduced traffic and saved money on building new parking garages. The city's goal is to establish 100 mobility hubs, with a hub in every 300 meters.

Given its extensive experience in developing and implementing mobility hubs, Bremen has shared valuable insights and lessons learned with the Shared Use Mobility Center (SUMC) in the United States. SUMC identifies seven key aspects of mobility hubs, including their connectivity to transit, targeting areas with high parking pressure, proximity to users, utilization of mobile technology, promotion of multimodal living rather than just trips, visibility of hubs, and effective marketing.

Singapore

The Land Transportation Authority (LTA) in Singapore aimed to create a total of 100 new bicycle parking spots in their Central Business District (CBD). The implementation of micromobility hubs in the CBD intended to resolve the issue of improperly parked bicycles around that area while offering convenient access to the city center. The cost-effective option of repurposing roadside carparking

spaces was opted for five locations in the central business district due to the lack of space to build new infrastructure. (Yufeng, 2022)

Although the issue of improperly parked bicycles was resolved, the lack of influx of additional customers was a point of concern to the nearby eateries. As a solution, the co-founder of Love Cycling SG suggested that the authorities work with local businesses to give perks to cyclists or create social media campaigns around cycling in the CBD.

Singapore invested in a $3.5 million secure automated underground bicycle parking system, which was a part of the Kampung Admiralty Integrated Development, which was a substantial micromobility failure. Although the micromobility hub had the capacity to house more than 500 bicycles, only five monthly passes were purchased. Lack of demand for the underground parking service stemmed from its extreme proximity to the nearest Mass Rapid Transit station, where ample free surface-level bicycle parking slots were available. Moreover, the bikes had to be carried up stairs to be deposited into the kiosks. As a result, the hub was shut down after two years of operation due to low demand. This example emphasizes the importance of choosing the right location, design, and giving utmost priority to rider convenience while selecting a mobility hub site.

Equity Implementation Approaches

JC On the Move already identified locations where additional mode share would serve the goal of equitable access to transit. Cities are broadly aligned on prioritizing equity in micromobility, as seen in individual city plans, Arsenault's paper and the North American Bikeshare & Scootershare Association (NABSA)'s 2021 annual report. City approaches include identification of equity-priority locations and goals embedded in regulatory frameworks.

Approaches employed by cities included the following, for consideration:

- Requirements for minimum device threshold in specific modeled equity locations;
- Location-based reduced trip costs in equity locations;
- Ridership demographic targets with vendor data collection requirements for demographics of ridership;
- Automatically qualifying households receiving federal, state or local means-tested aid for mobility discounts.

Washington, D.C.

Washington, D.C.'s most recent final rules update for Shared Fleet Devices (DDOT, 2023) provides their approach. A substantial financial incentive is offered to permitted vendors who meet equity device availability criteria. DC reserves the right to reduce or cancel the $10 per-device monthly fee for shared micromobility vendors who meet equity thresholds. For example, a vendor supplying 1,000 vehicles in DC would face $10,000 per month or $120,000 annually for these fees, a substantial sum to be relieved in exchange for conforming to the equity provisions.

Pittsburgh

In Pittsburgh, Spin and DOMI launched 'Access Zones' in Oct 2021. DOMI established an equity score to identify 21 distinct areas facing outsized barriers to transportation, called "Deployment Zones". Inputs to the score included race, ethnicity, average household income, car-ownership rates, and "other demographic factors." DOMI requires Spin to deploy at least 33% of their fleet to these zones, with minimum percentage requirements set by zone. Should Spin fail to comply, DOMI issues fines to the vendor which are earmarked toward establishing additional hubs. Additionally, riders who start their trip within an Access Zone receive a 25% discount from the total trip fee.

Denver

Denver's Department of Transportation and Infrastructure (DOTI) requires vendors to deploy 30% of vehicles in Opportunity Areas daily based on their equity index, which includes variables such as minority populations, poverty rate, education level, traffic safety, and more. Additionally, pedal bike distribution to need-based organizations and the on-demand delivery of adaptive seated scooters are provided to ensure all individuals have equal access to micromobility options.

Lime provides a rate of up to $1.00 for a 30-minute bike or e-bike ride and a discounted rate of $1.00 to unlock and $0.15 per minute for any scooter ride beginning in any opportunity area. In addition, it also provides "pay-near-me" and cash programs to enable access for unbanked and non-smartphone users.

Lyft offers a membership program called Lyft Community Pass, which provides discounted e-bike rides at $0.05 per minute with no unlocking fee for qualifying residents of Denver who are currently enrolled in state or federal assistance programs such as Medicaid, SNAP, RTD LiVE, or a discounted utility bill. The membership costs $3 per month.

Minneapolis

Minneapolis launched a multi-site mobility hub pilot in 2019. "Designed with equity as a central goal, Minneapolis' program offers insight into siting and engagement in mobility-disadvantaged areas" (Arsenault, 2022). Partnering with nonprofits and business improvement districts to staff mobility hubs, Minneapolis, "...used hubs to 'create a platform for interactive community engagement,' including pop-up tabling with provider partners, surveys, and an ambassador program in partnership with civic and business associations" (Arsenault, 2022). Rather than fielding surveys, feedback about users' interactions with the hubs was available from the observations of the ambassadors.

About Jersey City

History

Among the early permanent colonial settlements in North America, Jersey City ranks alongside Jamestown, Plymouth and New Amsterdam (New Jersey City University, n.d.) and hence has a rich history. In order to understand how the existing conditions of Jersey City were influenced by what happened in the past, we looked into the history of Jersey City. The history of Jersey City summarized for this studio has mostly been adopted from the website of New Jersey City University's digital project titled "Jersey City: Past and Present," unless cited otherwise.

European Contact and Settlement

The inception of Jersey City began when Henry Hudson sailed and anchored in the upper bay, almost opposite old Communipaw (New Jersey Institute of Technology, 2004). As early as 1621, the Dutch West India Company was formed to oversee this new territory, and New Netherland was founded in 1623 with its headquarters in New Amsterdam, which today is the southern tip of Manhattan Island. In 1630, Michael Reyniersz Pauw received a land grant as patron on the condition that he would establish a settlement of at least 50 persons within four years. He chose the west bank of the North River, commonly known today as the Hudson River, and took the land from the Lenape people residing there. Jan Evertsen Bout became a superintendent of the area and built the first house in Communipaw Area. Followed by another construction in Harsimus Cove by Cornelius Van Vorst. (Wikipedia, "Jersey City", 2023)

During the mid-to-late 1600s, multiple sources quote war and unrest between Dutch Colonists and the Lenape. Throughout these tensions, Jersey City began evolving into villages in the Bergen Square area. By 1660, the land of Paulus Hook had been permanently settled by Europeans and established nearly 20 years after Henry Hudson's visit to the region in 1630.

The Revolutionary War Era

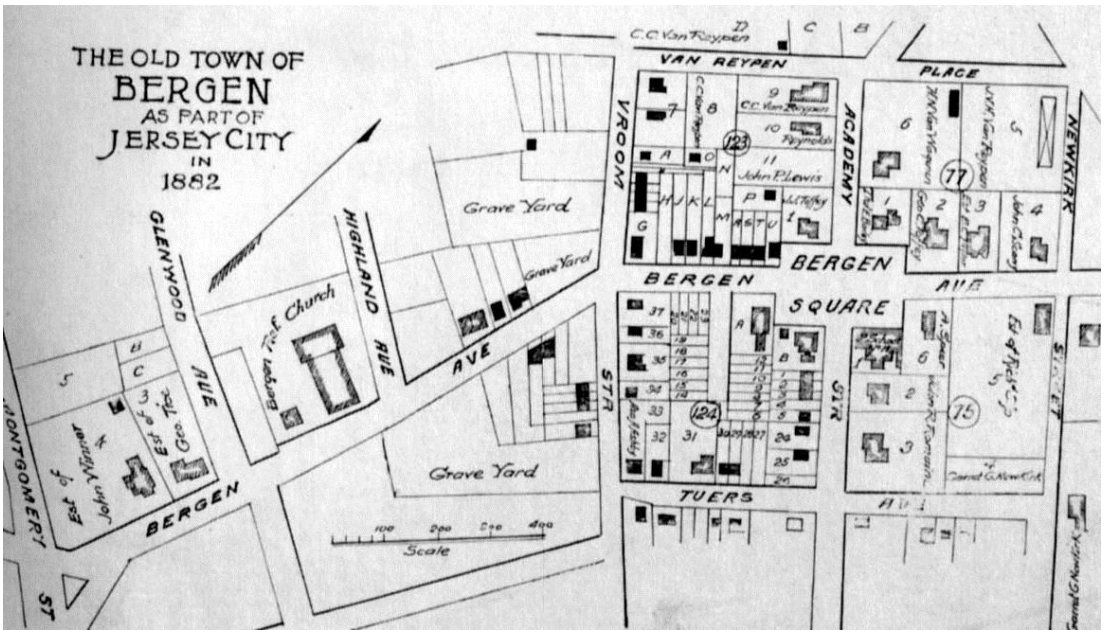
In 1764, ferry service was established between Paulus Hook and New York City as part of a stage coach route to Philadelphia. The Paulus Hook area of Jersey City became a notable site for military activity during the Revolutionary War. In 1776, General George Washington ordered the fortification of Paulus Hook, but it was taken by the British which caused the patriots to abandon Paulus Hook and retreat to Bergen Township. After the war, what is known today as the historic downtown area was established. (Shalhoub and Karnoutsos, n.d.)

From Townships to City

In 1804, the property of Cornelius Van Vorst was sold to the Associates of the Jersey Company who began the development of present-day Jersey City. They also privately developed the waterfront and laid the groundwork for Jersey City's transportation and manufacturing hub. Subsequently Robert Fulton purchased the land for a dry dock to run his steamboats to and from Manhattan in 1812. In 1820, Paulus Hook was incorporated as the City of Jersey in the County of Bergen by the New Jersey Legislature (January 28); five freeholders were chosen annually to constitute the Board of Selectmen of Jersey City. A decade later, the second charter of incorporation under the name "Jersey City" was written with the treaty between New York and New Jersey being established to settle the riparian rights to the Hudson River. (Shalhoub and Karnoutsos, n.d.)

[Figure 3] Jersey City in 1854. Source: New York Public Library.

In 1837, the third charter of incorporation of Jersey City and separated from Bergen Township was established, granting Jersey City its own mayor and city council. Three years later, the southern portion of Bergen County (Van Vorst Township/Harsimus) separated from northern Bergen County to become Hudson County. This was followed by the separation of the Township of Van Vorst (former Harsimus) from Bergen Township and received a charter to be an independent municipality. This eventually became most of downtown Jersey City, excluding Paulus Hook. Ten years later, it joined Jersey City (Figures 3 and 4). The following years saw a number of new constructions, the relocations of industries to Jersey City, and ultimately led to Jersey City, City of Bergen, and Hudson City merged into one municipality called Jersey City in 1870.

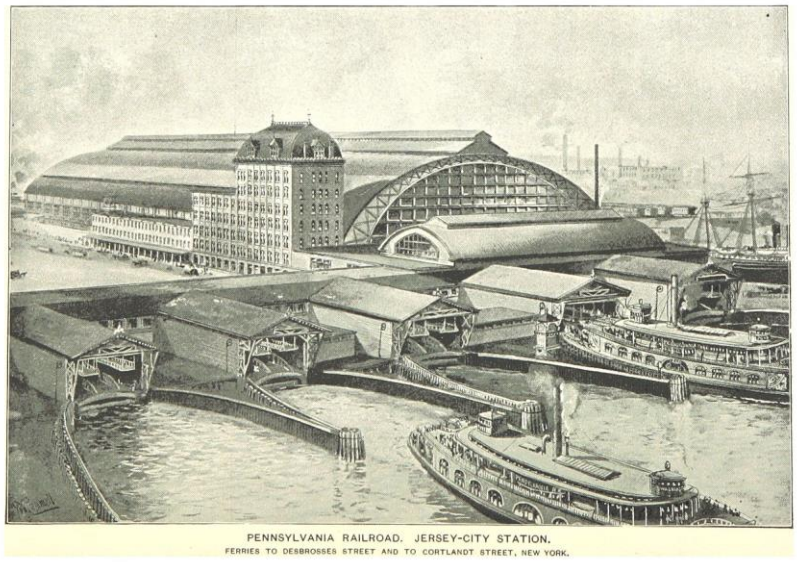


[Figure 4] Map of old Town of Bergen as part of Jersey City, 1882. Source: Jersey City Free Public Library.

New Industries and New Immigrants

In 1871, the Pennsylvania Railroad began operations at Exchange Place and Harsimus Cove, making Jersey City its eastern terminus. Two years later, Greenville merged with the municipality of Jersey City completing the boundaries for Jersey City. Through the 1880s, rail service greatly expanded to Jersey City owing to its prime location near New York City (Shalhoub and Karnoutsos, n.d.). These rail lines included marine freight terminals and three passenger terminals. A new welcome place for immigrants from Ellis Island, Pavonia Terminal, Exchange Place, and Communipaw were located near the Hudson River (Solis, 2022). As a result of the

work opportunities and chances of creating a better life for themselves and their families, many immigrants decided to make their way to Jersey City. A prominent part of Jersey City's history during the 20th century was its political organization, dominated for over 30 years by Frank Hague ("Jersey City: America's Golden Door," n.d.). Figures 5 and 6 illustrate the railroad and city's development.



[Figure 5] Pennsylvania Railroad Station, 1893. Source: British Library, Flickr.

[Figure 6] Jersey City and Manhattan Skyline, 1939. Source: Dave, Shorpy.

Years before the first World War, Jersey City had transformed into an industrial powerhouse, with much of its coastline consumed by railyards, ports, warehouses, and factories. A number of factors changed Jersey City following World War II, including the lure of the suburbs and the collapse of independent railroad lines ("Jersey City: America's Golden Door," n.d.). As a post-industrial city in the 1970s and 1980s, Jersey City was perceived as a sad and neglected place with rusted piers, vacant buildings, litter-filled streets, and abandoned railroad yards. The manufacturing employment base in Jersey City lost 38% between 1982 and 1990, significantly more than the state's 22% loss (Office of Community Planning and Development, 1995).

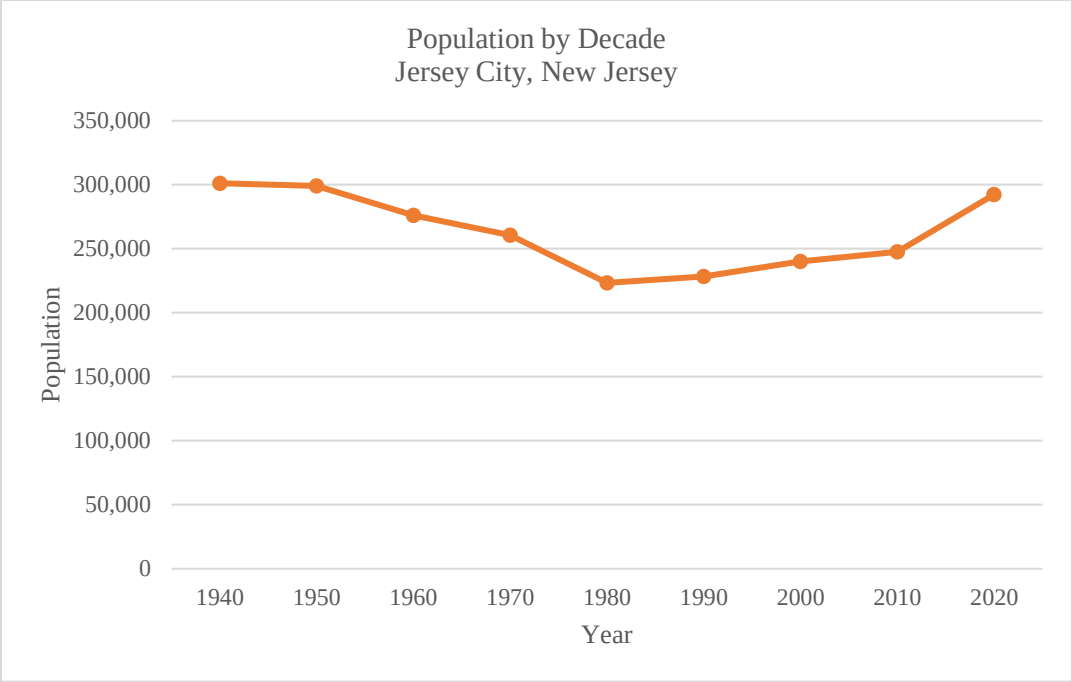
However, Jersey City rose up once again in the late 1980s when the developers saw potential in its low-cost property. As new development, residents, businesses, and jobs came to the waterfront, Jersey City became the proverbial Gold Coast ("Jersey City: America's Golden Door," n.d.). Businesses fled New York City's high rent and other exorbitant costs during this time, turning Jersey City into a "back office" site of New York ("Jersey City," n.d.).

Growth and Development

During the 1980s and early 1990s, planners and government officials realized that alternative transportation systems were required to relieve increasing congestion along the Hudson River waterfront. The Hudson-Bergen Light Rail began operating between Bayonne and Jersey City in April 2000. To this day, the city remains one of the most diverse areas in all of New Jersey: a true convergence of culture, ethnicities and communities.

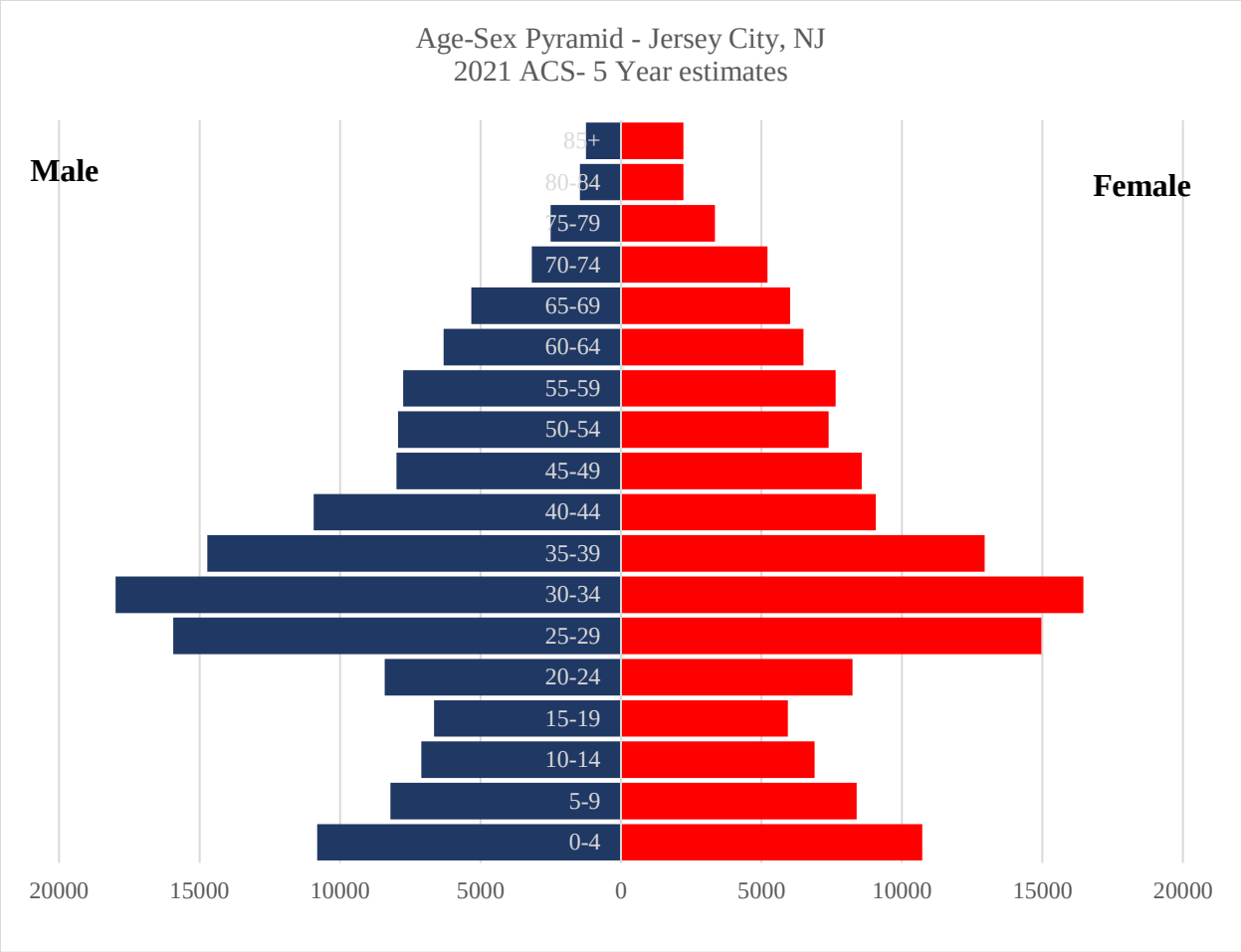
Demographics

Jersey City encompasses a land area of 14.74 square miles and has a population of 292,449 according to the U.S. 2020 Census. Jersey City has experienced an 18.1% growth from the 2010 census (247,591) and is the second-largest city in New Jersey. Since 1940, Jersey City has not seen drastic changes in terms of the population except for a brief decay in 1980, after which the population started growing again. See Figure 7.



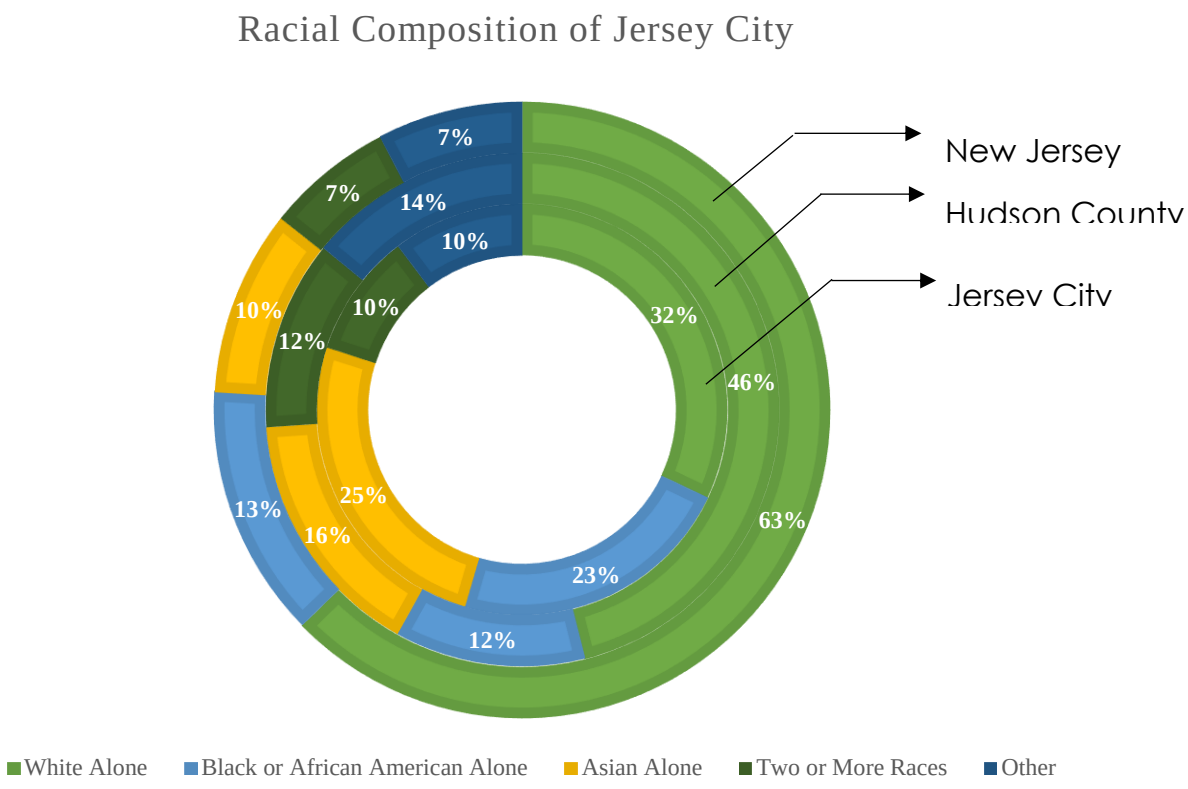
[Figure 7] Population by decade for Jersey City. Source: U.S. Census Bureau

According to the US Census Bureau 2021 American Community Survey (ACS) five-year estimates, the median age in Jersey City is 34.5 years old, which is lower than Middlesex County (35.6) and the statewide average (40.0). Figure 8 demonstrates the distribution of population in Jersey City by age and sex. The major working age group that is persons aged 18 to 64 are estimated to be about 70% of the total population.



[Figure 8] Age-Sex Pyramid for Jersey City, NJ, 2021.
Source: U.S. Census Bureau 2021 ACS 5-year estimates

According to the US Census Bureau 2021 ACS five-year estimates, White represents the largest racial group (32%), followed by Asian (25%) and Black/African American (23%) as shown in Figure 9, however the difference between each is not large. Compared to the state, Hudson County has a larger "other" race population (14%) and a smaller White population (46%), while New Jersey overall has a larger Black population (13%). The smaller share of White population in Jersey City as compared to Hudson County and New Jersey indicates the diversity within the city. Additionally, 27.5% of the total population in Jersey City are Hispanic or Latino.



[Figure 9] Racial Composition of Jersey City. Source: U.S. Census Bureau 2021 ACS 5-year estimates

The median household income of Jersey City is $81,390. This is higher than that of Hudson County ($79,795), but lower than that of the state ($89,703) per the US Census Bureau 2021 ACS five-year estimates. However, certain parts of Jersey City have much lower median household incomes whereas other areas are drastically higher than the figure stated. In Jersey City, about 16.1% of the population live below the poverty level, which is 2% higher than that of the county and 7% higher than that of the state.

With regard to health, the US Census Bureau 2021 ACS five-year estimates states that 5.3% of Jersey City residents have a disability under the age of 65 years, which is lower than both the county (5.6%) and the state (6.6%).

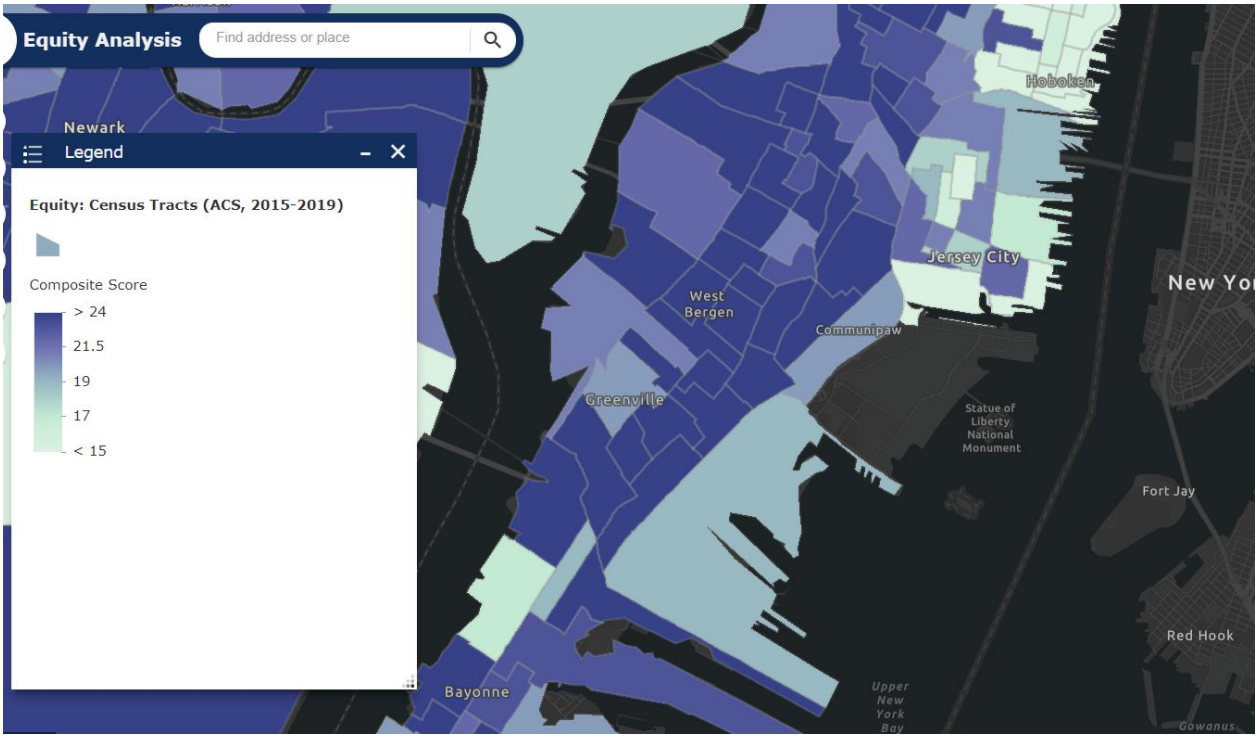
Equity

Mobility hubs play a significant role in addressing equity issues in transportation by providing a more affordable and accessible transportation option for underserved communities. In Jersey City, mobility hubs can offer a variety of transportation options, including low-cost or free options like bike and e-scooter sharing programs, public transportation, and car-sharing services (such as VIA). These transportation options reduce the burden on underserved communities.

Recommending mobility hubs in the areas where these will address the equity issues for underserved communities should be priority. To identify the location of mobility hubs, we reviewed the reports and tools available for an equity analysis of Jersey City. We also reviewed how equity is currently incorporated in transportation planning for Jersey City.

NJTPA Equity Analysis Tool

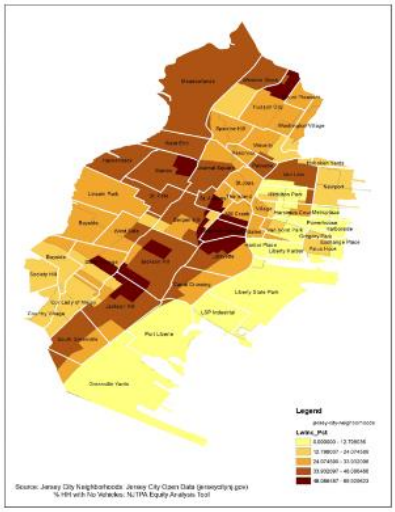
To map underserved communities, the North Jersey Transportation Planning Authority (NJTPA) publishes an Equity Analysis Tool focusing on ten factors: minority population, low-income residents, limited English proficiency, disability, age cohorts (youth, adolescents, and elderly populations), foreign-born individuals, female population, zero-vehicle households, and educational attainment. A high composite score represents a larger underserved population with a maximum score of 44. As shown in Figure 10, most of Jersey City comes under a composite score of greater than 24.



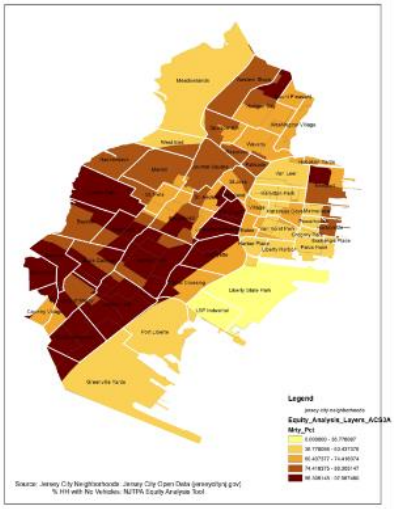
[Figure 10] Equity Analysis of Jersey City. Source NJTPA. Equity Resources. Retrieved on February 25, 2023. Link: https://equity-resources-njtpa.hub.arcgis.com/

To disaggregate factors used in the map's equity analysis, the team analyzed maps for each individual factor for Jersey City (Figure 11). By looking at each individual factor, we obtained a clear picture of characteristics of different neighborhoods in Jersey City.

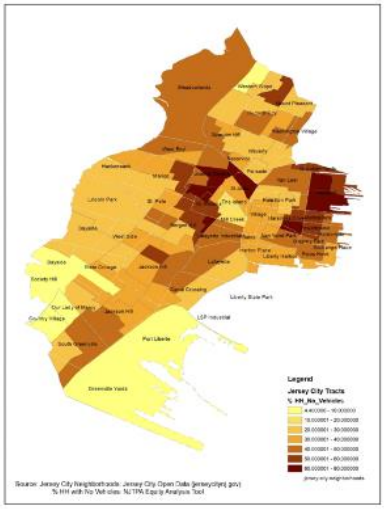
Greenville was once considered a desirable neighborhood for its quality of life and prosperity, but now is ranked lower in the list of prime neighborhoods in Jersey City. As observed from Figure 10, the neighborhood has more than 40% of households without vehicles and more than 85% of minority households. This neighborhood, with a higher need for transit and active transportation options, has significantly less transit, walking and bicycling options.



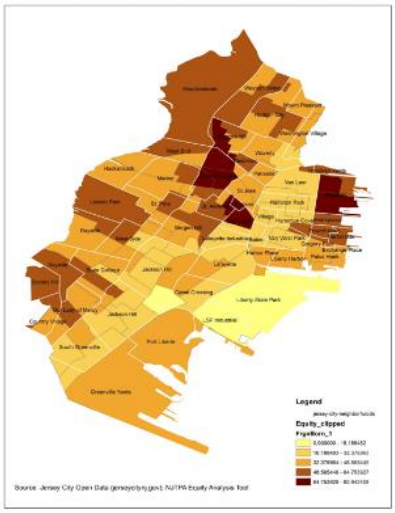
% Low-Income Popn



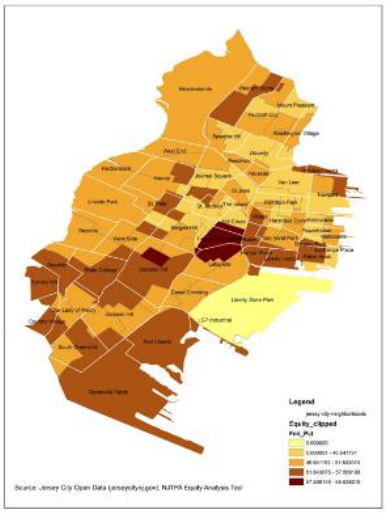
% Minority Popn



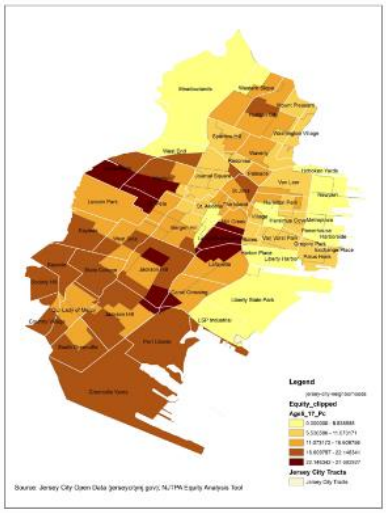
% HHs with no vehicles



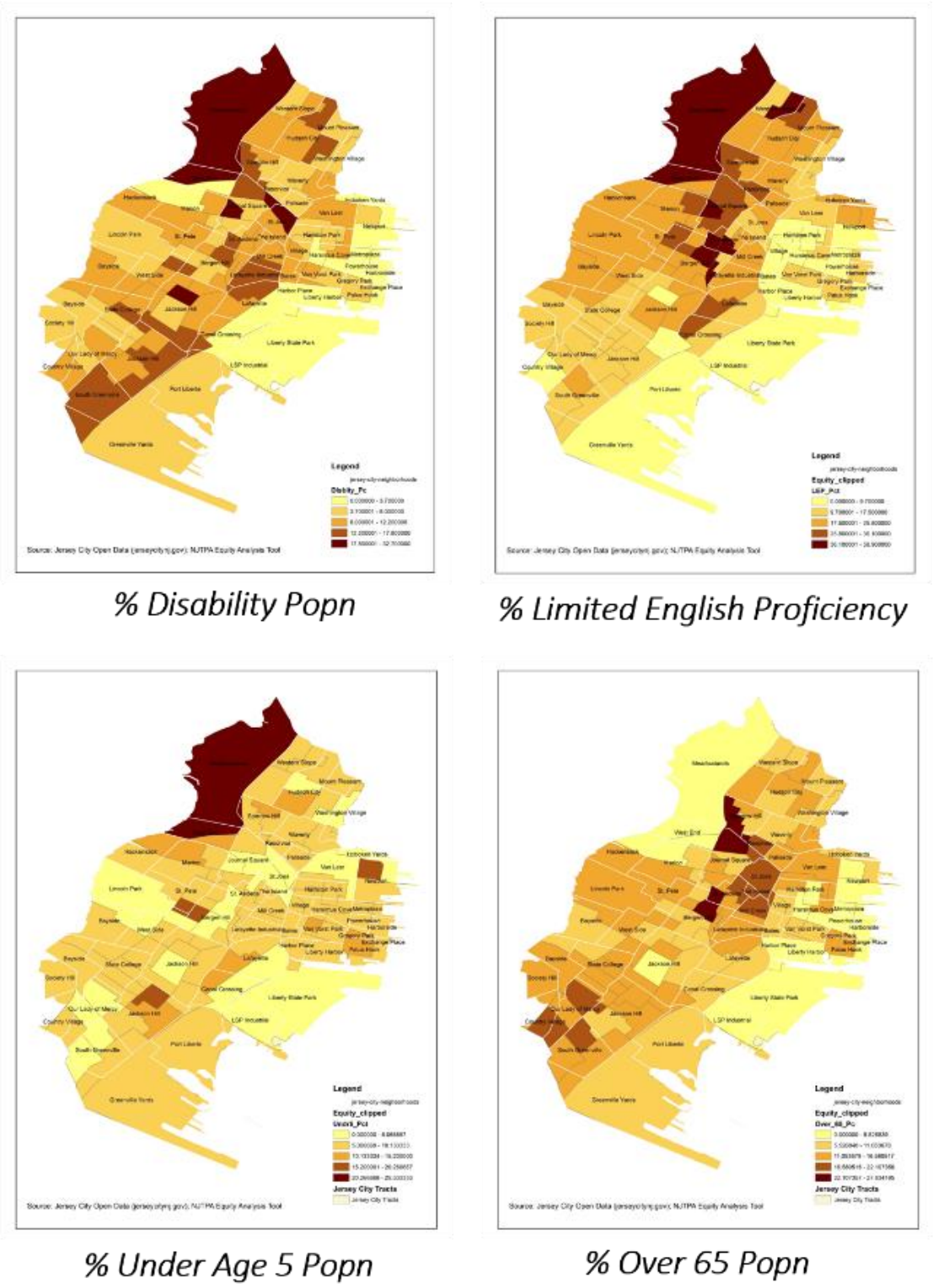
% Foreign-Born



% Female



% Age 5-17 Popn



[Figure 11] Map of each individual factor used in NJTPA Equity Analysis for Jersey City. Source NJTPA. Equity Resources. Retrieved on February 25, 2023. Link: https://equity-resources-njtpa.hub.arcgis.com/

The NJTPA Equity Analysis Tool helped us to identify underserved populations that need more attention when it comes to transportation planning. Mobility hubs in Jersey City are a means to address equity issues, as these hubs will provide affordable and accessible transportation options for underserved communities. To integrate equity in transportation planning, we need to look at options to improve transit access and transportation infrastructure in the areas that are underserved and in higher need of accessible and affordable transportation infrastructure.

Equity and *JC on the Move*

Jersey City's 2022 *Alternative Transportation Modes Assessment* highlighted equity as one of the foundational components of the study. Consequently, the report's recommendations were created around three core objectives: equity creation, multimodal systemization, and improving safety and efficiency. The report also highlighted that a mobility hub program can be utilized to further equity goals. The report noted comprehensive equity and transit access analyses. The results from these were a major input in determining the priority locations for additional or alternative transportation mode recommendations. The following analyses were conducted:

Equity Analysis

The equity analysis evaluated the impact of transportation services on disadvantaged populations in Jersey City, including minorities, low-income individuals, and those with disabilities or limited English proficiency. The goal is to use this information to ensure that these populations are included in the planning process and recommend innovative modes and technologies to meet their needs.

Title VI Analysis

The Title VI analysis examined minority and foreign-born populations in Jersey City and identifies areas of need based on their share compared to citywide and regional averages. The analysis shows that Jersey City has a diverse population, with 78% minorities and 40% foreign-born, mostly from Asia and Latin America. 13% of the population has limited English proficiency, and some neighborhoods have concentrations of underrepresented communities. The map developed from the analysis highlights these neighborhoods and shows the extent to which they are served by NJ TRANSIT buses and PATH trains.

Environmental Justice Analysis

The Environmental Justice Analysis is legally required for agencies receiving federal funding to ensure equitable distribution of transportation benefits and burdens. The analysis helps identify the transportation needs of minority and low-income populations and removes barriers to public participation. In Jersey City, 33% of the population qualifies as low-income, with high concentrations in neighborhoods on the east side and central Jersey City. The analysis culminates in a map showing clusters of environmental justice (EJ) populations in neighborhoods such as Bergen Square, Hilltop, The Island, and Marion, which are served by multiple NJTRANSIT bus routes, two PATH lines, and the Hudson-Bergen Light Rail.

Other Equity Factors

In addition to Title VI and EJ assessments, other equity factors were examined, such as populations with disabilities, female-headed households, older and younger populations, households without access to a vehicle, and those with a GED or less as the highest educational attainment. The aim of this analysis is to ensure the inclusion of these populations in the planning process, limit negative impacts on them, and focus transportation investments to increase access and mobility equitably.

Transit Desert Analysis

The transit desert analysis by *JC on the Move* aims to identify areas with service gaps and the need for additional or alternative transit services in Jersey City. The transit propensity index, based on indicators such as minority population, low-income population, and zero vehicle households, is used to measure transit needs. While Jersey City has a comprehensive transit network, not all neighborhoods are served equally, particularly in terms of access to frequent transit service.

The key findings of the Transit Desert Analysis are:

- Transit service is oriented around peak periods;
- Some communities that are more reliant on transit have relatively poor access to transit;
- The community does not always feel involved that their voice is adequately heard;
- Travelling between certain locations in Jersey City can take significantly longer by transit;

- In certain parts of the city, a significant share of car trips are less than two miles;
- Neighborhoods with significant levels of biking lack safe infrastructure and/or access to Citi Bike;
- Paying for multiple transportation options is a burden for low-income families.

Let's Ride JC

In our effort to explore how equity has been incorporated into Jersey City transportation, we also studied *Let's Ride JC*. The *Let's Ride JC - Bicycle Master Plan* is the first step in making Jersey City a safe and accessible city for cycling. The city commissioned the plan and provides recommendations for improved network connectivity, policies, and programs. The plan also recognizes that Jersey City is part of a dynamic metropolitan region and aims to enhance connectivity with adjacent municipalities. In addition to enhancing cycling, the plan also aims to provide convenient access to transit, green infrastructure, and public spaces, with the ultimate goal of delivering safer streets for everyone. The plan builds on past and ongoing planning efforts and looks to position Jersey City as a regional transportation leader.

The bicycle master plan for Jersey City prioritizes equity and outlines five equity goals that must be achieved for the plan to be successful. These goals include institutionalizing equity in all city plans, programs, policies, and processes, ensuring the full and fair participation of marginalized populations, increasing bicycling rates among marginalized groups, reducing bicycle-related fatalities and injuries in those groups, and prioritizing bike infrastructure investments in vulnerable communities. Equity has been identified as one of the five areas that needs to be promoted beyond infrastructure for Jersey City to reach its goals. The plan had clearly defined equity action plan with success metrics as well.

Equity Personas

After conducting thorough research on current equity issues in Jersey City, we prepared seven personas to show different groups of people (Figure 12). The personas are based on the comments received through community engagement programming during the planning process of the *JC on the Move* report. To ensure equitable engagement and outreach throughout the planning process, the study team of *JC on the Move* report conducted several discussions with different groups of people. These personas helped us better understand the issues, frustrations, and the expectations of different communities residing in

Jersey City. For example, a persona for a senior citizen living in the Heights faces difficulty going to downtown and the outskirts of Jersey City as there is limited public transit options. His expectations from a mobility hub include an appealing and sustainable public transportation system for people of all ages and economic backgrounds. Another persona of a non-white woman in Greenville put emphasis on bike lanes for her kids and safe and affordable transportation for her neighborhood. Please see the full profile of seven personas below:

Persona #1 : Journal Square

Profile

Asian Male, 33 years
Works in NYC
Unmarried

Other Details

Job: Software Engineer
Income: $90,000
No Vehicle ownership
Enjoys cycling on weekends

Issues/Frustrations

- Bikes on sidewalks create conflict with pedestrians
- Heavy traffic flow making walking unsafe

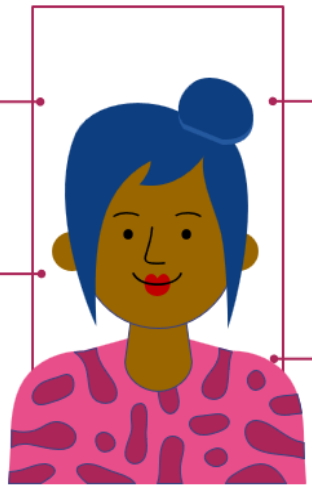
Expectations from Hub

- Tap-&-go pay option like OMNY
- Dedicated protected bike lanes in the neighborhood
- Improved bike and light rail infrastructure

Persona #2: Greenville

Profile
Black Woman, 42 years
Married with 3 Kids

Issues/Frustrations
- Challenging to get to this location via public transit. You need a car to move around this area
- Traveling with kids without car is impossible
- Wait time for VIA is a concern



Other Details
Job: Teacher
Income: $80,000
Vehicle: 1 car

Expectations from Hub
- Better transit connectivity
- Bike lanes for kids
- Safe streets
- Affordable transportation options in the neighborhood.
- Having designated stops or at bus stops would be great for pickups for VIA

Persona #3: Heights

Issues/Frustrations
- Difficult to go to Downtown Jersey City because public transportation is nonexistent.
- Because that area of JC is so spread out there should be a better means of public transportation.

White Male, 68 years
Retired
Owns 1 car

Expectations from Hub
- Public transportation for everyone (not just economically challenged people)
- We need to make public transportation more appealing to all people and save our planet!

Interests
Going for morning and evening walk

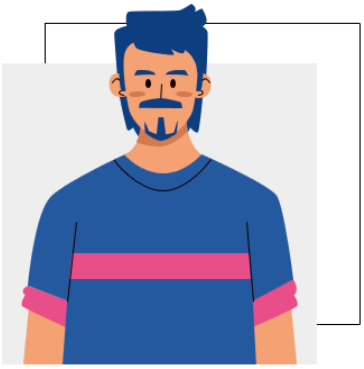
Persona #4: Communipaw

Profile

Asian Male, 27 years
Unmarried

Issues/Frustrations

- Eliminate the double parking on JFK between Sip and Bergen. I have witnessed at least 2 pedestrian incidents.
- The traffic build up due to inability for cars to move along this section of JFK is a hazard to pedestrians and other drivers.



Other Details

Job: Student/Part-Time worker
Income: $40,000
Vehicle: 1 bike

Expectations from Hub

- A network of bike lanes and docking station for safely parking bikes
- Smart cards for access to multiple modes
- Safe transportation options at night

Interests Loves to hang-out with friends after work (involved night-time mobility)

Persona #5: West Side

Profile

White Female, 19 years
Student

Expectations from Hub

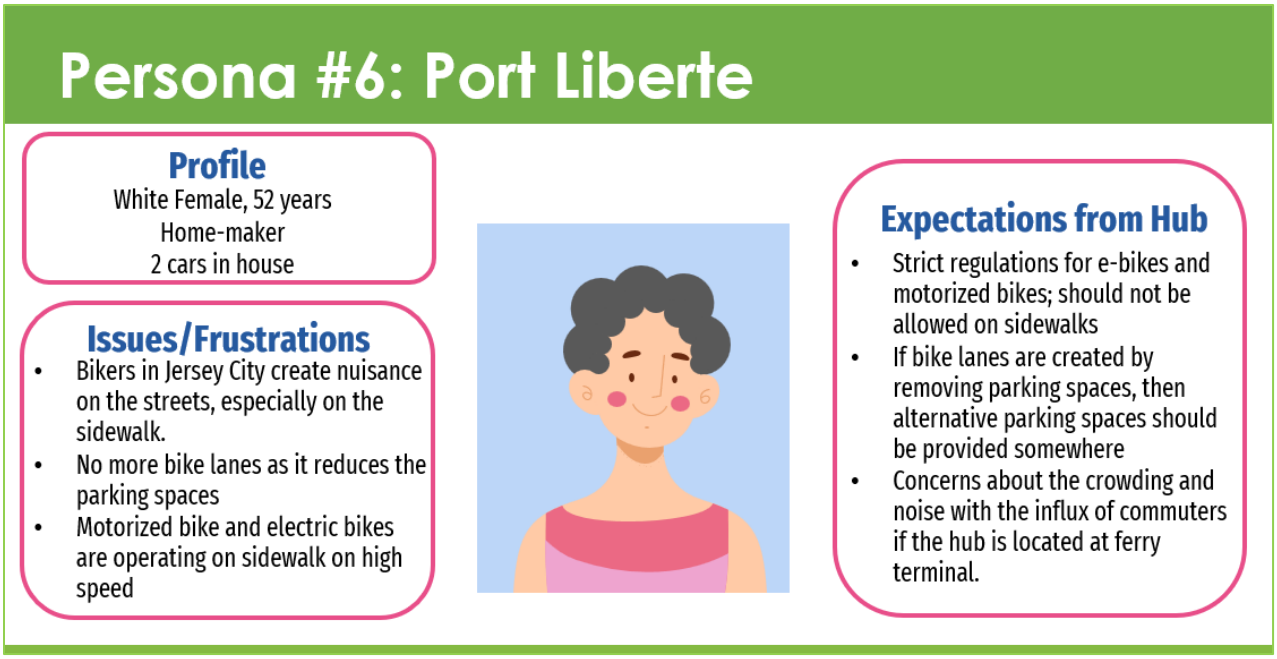
- Need safer streets for women: include better lighting, security cameras, wide sidewalks

Interests

Loves painting so taking painting classes

Issues/Frustrations

- Buses are not on time and are usually crowded.
- Buses should have a dedicated lane because when buses, cars, trucks, schools buses at the West Side Avenue, it gets really congested.
- Some streets have no stop lights which makes it little unsafe for pedestrians especially kids.



[Figure 12] Personas of fictional characters in Jersey City neighborhoods. (Credits: Authors)

Takeaways

Mobility hubs should meet the needs of all populations regardless of age, gender, race, income, or ability. Mobility hubs need to be planned in a way that addresses the equity issues of less privileged populations. In the above section, we looked at different equity analysis tools and reports. While the *JC on the Move* report

conducted Title VI and environmental justice analyses, the NJTPA Equity Analysis tool provides a composite equity index based on ten factors. Some of the takeaways from our research on equity analysis for Jersey City include:

- A clear vision and goals for equity with mobility hubs is needed;
- Methods and metrics for how plans will be measured over time to achieve success is just as important as defining and developing goals;
- Developing equity performance metrics should be explored, seeking to incorporate and build upon existing action plans;
- A focus on equity beyond mobility hubs is necessary, using the framework of transportation as a form of equity.

Current Transportation Characteristics

Jersey City currently features a robust, multimodal transportation network that accommodates walking, bicycling, public transit, and on-demand ride share—all elements of mobility hub infrastructure. However, the network is broadly laid out to funnel users to and from its central east-west axis, which in turn is designed to feed eastward into Lower Manhattan. Local, crosstown travel is more cumbersome and features less extensive infrastructure, bringing a clearly defined purpose for micromobility and on-demand infrastructure. With the city's existing transportation conditions in mind, a goal of providing last-mile connections and facilitating otherwise difficult crosstown travel is an impetus behind the development of mobility hubs.

Let's Ride JC

In addition to *JC On the Move*, we reviewed the *Let's Ride JC* Bicycle Master Plan, published in 2019. The goals of that plan are well-aligned with a vision of providing safer streets for multiple modes; elements of the plan reinforce points from *JC on the Move* and Vision Zero plans, such as a need to focus on reducing the High Injury Network and to solve gaps left by the removal of Ward 8 Citi Bike stations in 2018. Similarly, challenges identified will require thoughtful design consideration directly applicable to mobility hubs, emphasizing micromobility. Bus stops can become bus-bike conflict zones for example, while areas with grade-separated highways remain a challenge for bikes or scooters to traverse.

The safety concerns sought to be addressed through expansion of bike lanes and particularly protected bike lanes in High Injury Areas will additionally support safer transportation on micromodes such as e-scooters, should the city opt to offer

additional shared mode programs alongside mobility hubs. The plan's goal to expand bike lanes to 50% of the street network has already been advanced in areas of the city where we observed roadway conditions. As of 2020, the city provides a useful map displaying planned and completed bike lanes, as well as available bike parking and other infrastructure. It does not reflect progress the city has made since 2020 such as the Oonee pod installations (Jersey City Bike Facilities, n.d.). Updating the map to include planned micromobility hubs, as well as representing more recently developed bike lanes, would be valuable to potential users.

Considering 37% of Jersey City households do not own a car, and 47% take mass transit to work, there exists a strong need for a strong bike and micromode transportation network. This would allow greater access to existing transit systems serving regional needs, but also allow for local circulation by filling transportation gaps later identified in *JC On the Move*.

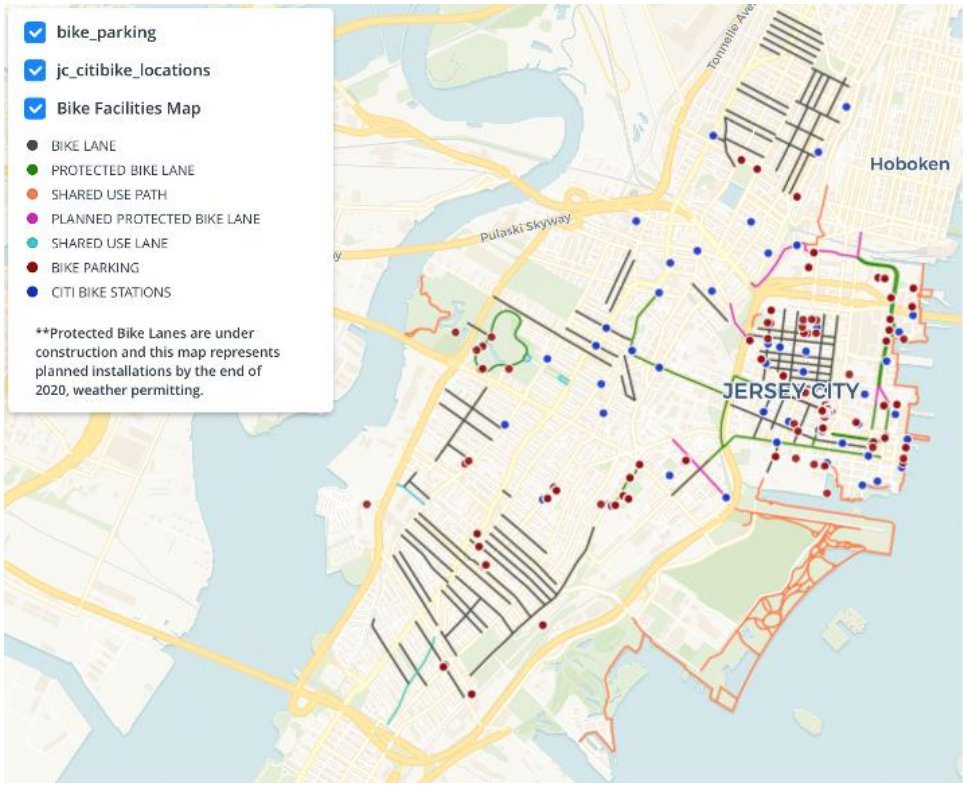
Walking and Micromobility

Jersey City is largely walkable, with most of its streets featuring sidewalks and a development pattern that historically favors the dense residential and commercial activity conducive to pedestrian travel. Despite a geographic inclination toward walkability, many of the city's sidewalks are in poor condition and several outlying arterial roads (such as US 1-9 Truck/NJ Route 440 on the west side of the city) lack sidewalk access entirely, forcing pedestrians to use adjacent overgrown dirt paths.

The city is also developing a network of bike infrastructure, highlighted by 6.7 completed miles and 2.7 additional planned miles of protected bike lanes (City of Jersey City, 2023). These protected lanes are supported by growing grids of unprotected lanes along residential streets primarily concentrated in Wards A (Greenville), D (Heights), and E (downtown/Hamilton Park). These grids are incomplete, with lanes occurring in the east–west direction only in Ward A for example, and feature minimal infrastructure aside from paint. Altogether, these unprotected lanes cover less than half of the city's neighborhood area. Additional dedicated bike infrastructure exists as multi-use paths along the Hudson River Waterfront and within Liberty State Park. In the near-term there are no plans to extend such infrastructure inland to the city's neighborhoods; in the long term a proposed East Coast Greenway extension may provide a multi-use trail connection to the west side of the city via the abandoned Bergen rail line right-of-way ("Essex-Hudson...", 2021).

In 2015, New York City's Citi Bike program, an electronic docked bikeshare system, expanded into Jersey City. Although Jersey City has 51 bikeshare stations, most of these are concentrated in its central east-west axis, especially near the waterfront. Consequently, the city's northern and southern reaches (i.e., the Heights and Greenville neighborhoods) lack connections by Citi Bike to central neighborhoods and other regional connections as illustrated by Figure 13. In 2022, Jersey City and Hoboken saw 895,485 total Citi Bike trips (roughly 2,500 per day) ("System Data", 2022).

The city adopted Vision Zero—a goal and policy framework for eliminating pedestrian fatalities—in 2018 and achieved the milestone in 2022. Vision Zero was realized through the implementation of quick-build traffic calming infrastructure, and the implementation of a "slow streets" program as a result of the Covid-19 pandemic. Notably, the Vision Zero achievement only concerns streets maintained by the city; county- and state-maintained routes are not included in the pedestrian fatality total (Surico, 2022).



[Figure 13] Online map of Jersey City bike infrastructure.
Courtesy City of Jersey City.

Fixed-Route Mass Transit

Jersey City is served by a variety of mass transit modes and providers (see Figure 14).

The Port Authority Trans-Hudson (PATH) system, a rapid transit railroad, is a regional lifeline for Jersey City, connecting it eastward to Manhattan and westward to Newark and the Northeast Corridor rail lines. PATH has characteristics of both local rapid transit and regional express transit: it features dense stop spacing within Jersey City and very frequent service on weekday peak hours, and runs express to Harrison and Newark west of Jersey City. The PATH stations within Jersey City (at Journal Square, Grove Street, Newport and Exchange Place) are essential nodes for local transportation access and have become centers of dense construction and redevelopment activity. Approximately 4.5 miles of the 13.8-mile network is in Jersey City.

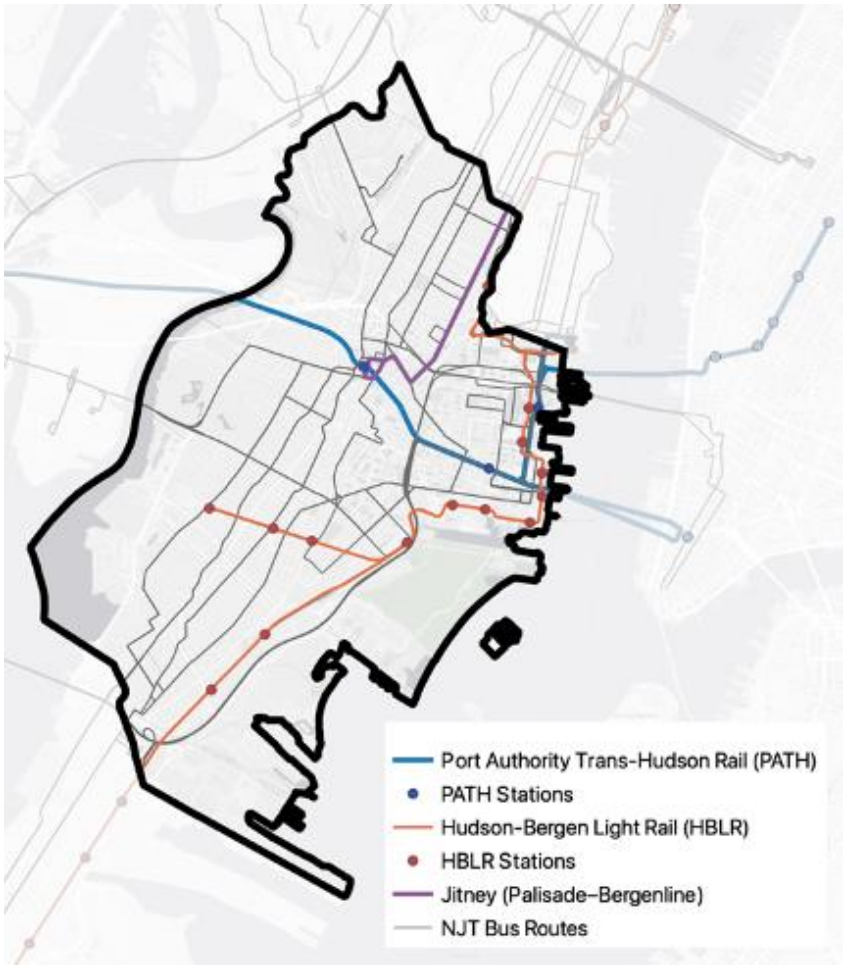
PATH is supplemented by local fixed route public transit through NJ TRANSIT's Hudson-Bergen Light Rail (HBLR) and local bus routes. Having first opened in 2000, the 17-mile HBLR is a higher-capacity, north-south complement to PATH's primarily east-west orientation. HBLR's stop spacing, with stations less than a mile apart, is oriented toward local trips, but the system connects Jersey City with neighboring cities to the north and south. NJ TRANSIT's bus routes in the city have a similar general north-south orientation, with some routes designed for local service to hubs like PATH stations and others extending to New York via Hoboken or the Holland Tunnel. Several local routes are operated by the private A&C bus corporation.

Moreover, Jersey City has a unique abundance of informal public transportation options in its jitney system. Post-pandemic, jitneys in Jersey City generally run north from Journal Square along Palisade Avenue. These cash-only fixed-route van services provide useful increased service (in addition to NJ TRANSIT routes) along the dense Bergenline Avenue corridor connecting to Bergen County and New York via the George Washington Bridge.

The New York Waterway, a private ferry company, provides service to Manhattan via the Hudson River. Currently regular service departs from Paulus Hook and Harborside with half-hourly service additionally serving Liberty Harbor. The entire New York Waterway system—also serving Hoboken, Weehawken, and Edgewater in New Jersey—saw approximately 4.7 million riders in 2022, averaging to about 13,000 daily riders ("Private Ferry Monthly Passenger Counts", 2022)

Despite the robust transit options, limitations in coverage and service span result in city neighborhoods considered as underserved "transit deserts." The

neighborhoods are largely consistent with those lacking Citi Bike service, particularly on the south side of the city in the Greenville neighborhood. Notably, the HBLR through Bayonne skirts these neighborhoods to the east using a former freight right-of-way.



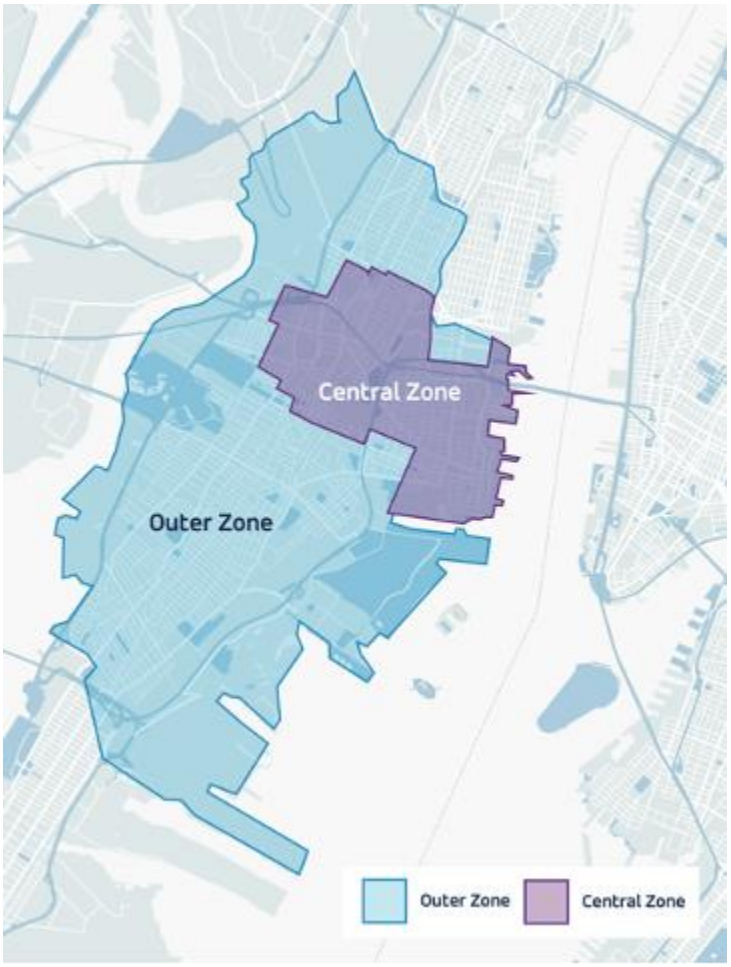
[Figure 14] Fixed-route transit in Jersey City.
Data courtesy NJ TRANSIT, JC Open Data, Axel Hellman (jerseyjitneys.info).

On-Demand Transit Service

In 2020, Jersey City partnered with Via, a transportation technology company, to provide on-demand rideshare service within the city limits, providing a supplement to the described fixed-route transit. The service directs riders to request a shared ride with a mobile app (or phone call) and wait at designated street corners for the ride to arrive. Operating on a two-zone system (Figure 15), the service is subsidized by the city and features fixed fares; the last-mile utility of the service has proven valuable to the low-income, transit dependent users that

comprise most of its riders. Via Jersey City surpassed 1 million total rides in August 2022 ("Jersey City's on-demand...", 2022).

Via still faces significant limitations; it requires users to have a bank account and for wheelchair-bound users to request a specific vehicle. Currently, Via is only available from Monday–Friday from 10am–6pm, omitting days and times Via may be relatively valuable to Jersey City residents. Additionally, the current fleet of 15 vehicles restricts the speed at which service demands can be met, and at busy periods wait times for rides can heavily fluctuate and lead to waits of 30 minutes or longer.



[Figure 15] Jersey City Via coverage by service zone.
Courtesy City of Jersey City, Via.

Micromobility Regulations

In May 2019, New Jersey state law (N.J. Stat. § 39:4-14.16) has designated e-scooters as "low-speed electric scooters" and permitted their use on roadways with a maximum speed limit of 19 miles per hour. E-scooters, like low-speed electric bicycles, are subject to traffic laws for traditional bicycles and they can be parked on the sidewalk if they do not obstruct pedestrian access. The law authorizes local governments and municipalities to decide whether e-scooters can be ridden on sidewalks and trails. For safety reasons, individuals under the age of 17 are required to wear a proper helmet when riding bicycles, skates, roller blades, roller skates, or similar devices.

In Jersey City, Article VI of Chapter 242: Peace and Good Order outlines the rules and guidelines for the use of micromobility devices in Jersey City. All micromobility devices including scooters, e-scooters, skateboards, motorized wheelchairs, and bicycles with trailers are not allowed to be ridden on public sidewalks, trails, and walkways within city parks, but they are all allowed on designated bicycle lanes. Bicycles are required to have proper lamps, brakes, and audible signals. Commercial bicycles are not permitted to use any publicly owned parking rack for more than two hours.

Most micromobility vendors forbid people under the age of 18 to use shared e-scooters. New Jersey law allows e-scooter users to be under age 18 as long as they wear a helmet. E-scooter users are required to dismount from the vehicle and walk alongside it when traveling on the sidewalk. Additionally, riders must keep their hands and feet on the scooters while riding, and only one person is allowed on a scooter at a time. The maximum speed limit for e-scooters is 15 miles per hour in general and eight miles per hour in high-pedestrian areas with heavy foot traffic. E-scooters shall not be operated between 11:00 pm to 6:00 am in the city. E-scooters must always yield to bicycles and pedestrians and obey all traffic control signs. The operator of an electric scooter must proceed in the same direction as vehicular traffic, on the same side of the road, and as close to the right side of the road as possible.

E-scooters must be parked in an upright position in designated areas, such as docking stations, specially marked corrals, furniture zones of sidewalks, adjacent to bicycle racks, and other designated e-scooter parking areas. They must not be parked in commercial loading areas, ADA-compliant parking spots, transit zones, curb ramps, driveways, and entryways, within ten feet of fire hydrants, on vegetation, or anywhere that obstructs bus stops, pedestrian or wheelchair access to buildings, benches, parking pay stations, crosswalk buttons, wheelchair

ramps, handrails, areas of refuge, and detectable warning strips. It is illegal to obtain a shared e-scooter rental system without city's approval, and the person riding or operating the shared electric scooter must be the same person who made the rental reservation.

Technology

Mobility as a Service (MaaS)

Mobility as a service (MaaS) is a concept that originated in Scandinavia and has gained currency over the last decade. It refers to a transportation services model in which multiple modes of shared transportation are brought together on a single digital platform that centralizes payment for users. The platform typically includes multimodal route planning and optimization, as well as the option to purchase service bundles or subscription plans. For example, a user might pay a monthly subscription to the service, which would give them access to a certain number of minutes of use or miles traveled per mode each month. Mobility as a service is referred to in *JC on the Move* as "...the digital version of a mobility hub" and described as a potentially reinforcing strategy for a mobility hubs program in Jersey City.

Figure 16 shows a representation of the City of Pittsburgh's implementation of a mobility as a service platform as part of their MOVE PGH program, which also included implementation of mobility hubs and was highlighted in *JC on the Move*. MOVE PGH's MaaS platform is built off the Transit app, and as shown in the image below includes access to public transit, bike share, car share, scooter share, and ride share, among other services.

[Figure 16] Diagram showing Mobility as a Service, as implemented by MOVE PGH. Courtesy of https://engage.pittsburghpa.gov/move-pgh

As a mobility solution that is still emerging, a key question regarding mobility as a service is what elements must be in place before it can be piloted in a given locale. A journal article by Li and Voege (2017) provided a helpful decision rubric, which we have adapted as Table 1 below. We find that all five questions in the rubric can be answered in the affirmative for Jersey City, which indicates the city is ready for a pilot implementation of MaaS.

MaaS Required Conditions	Conditions met in Jersey City?
Adequate public transport system?	Yes
E-tickets for public transport?	Yes, on NJ Transit and Via, OMNY-like system coming to PATH this year
Will other shared transport (taxi, carshare, bikeshare) open data?	Yes, for Citi Bike
Is the format and quality of that data usable?	Yes, it is in General Bikeshare Feed Specification format

Do these shared transport services accept e-payment?	Yes

[Table 1] Required Conditions for Mobility as a Service

MaaS Insights from an Academic Literature Review

As mobility as a service has moved from theoretical concept to implementation, the academic community has responded with an increasing number of scholarly articles on the topic, most of them published in Europe. An academic literature review by Benjamin Maas (2022) identified 127 scholarly articles published as of June 2021 that focused on Mobility as a Service. Maas found that only five of the 127 articles had been published in the US and only three in Canada, 100 articles (nearly 80%) had been published in Europe, and the rest in Australia or Asia. Reflecting growing interest in MaaS, 97 of the 127 articles had been written in 2018 or later.

The academic literature surveyed by Maas (2022) has many insights regarding what mobility as a service is and what it can be. Below, we highlight the findings that may be most beneficial to Jersey City transportation planners seeking best practices for MaaS implementation.

The role of the public sector as discussed in the surveyed literature includes creating a long-term framework for mobility as a service by allocating liabilities, protecting consumers, and creating minimum service standards. While it appears that public-private partnerships have the greatest chance of success in pulling off a successful implementation of MaaS, the private partners involved are primarily driven by revenue maximization, including the potential to increase sales, expand market share, and access high-quality demand data. This means that the public sector must take an active role in shaping the service to ensure that social benefits accrue to the community.

To further guarantee that the MaaS service will meet the community's needs, the public sector should actively involve potential users in the development of the service, both in the interest of equity and to make sure the service that is developed will be used. Meanwhile, although incorporation of public transit services on the platform is often crucial to the success of MaaS, transit authorities are less likely to be innovators given the quasi-monopolies they hold over transit service. To counter their inherent conservatism, the public sector should create an innovation-friendly environment.

Who uses MaaS and how much are they willing to pay? The user base for mobility as a service, at least according to evidence so far, consists of people who are younger or middle-aged, do not have a family, regularly use car share, have a higher education, have a regular income, have an ecological attitude, want to reduce car use, or have already used multimodal platforms. The greatest potential for MaaS uptake appears to be among regular transit and private vehicle users.

Studies generally show a low willingness to pay for MaaS and supplying a MaaS platform to the public does not automatically generate demand. However, users who are shown the financial, environmental, or other benefits of MaaS will likely use it. One study found that bikes, e-bikes, and taxis were associated with a negative willingness to pay when included in MaaS service bundles (Tsouros, et al., 2021). On the other hand, car sharing, park and ride services, and public transit were associated with a higher willingness to pay.

What is the effect of MaaS on the transport ecosystem? Although MaaS advocates typically suggest that adoption of MaaS will help reduce traffic volumes and greenhouse gas emissions and increase transit use, the literature suggests that MaaS only has the potential to positively impact these factors. Some literature suggests that rather than replacing an individual or household's private car use entirely, MaaS may more likely play the role of replacing a second car. Car sharing, therefore, can be a strong catalyst for the use of MaaS. The literature also notes that depending on how MaaS is implemented, car sharing and bike sharing services may either compete with or complement each other. In addition, a MaaS app could be used to incentivize walking or disincentivize certain trips altogether.

Technical considerations in developing MaaS include dealing with significant concerns about data disclosure. This must be carefully considered when negotiating with the MaaS platform developer, who may see the ability to access high quality data for personalized marketing or targeted advertising as a primary incentive to join the partnership. In addition, the compatibility of the data type made available by various partners, including providers of shared mobility, could be an important selection criterion in procurement.

Mobility as a Service vs. Mobility on Demand

At about the same time that Mobility as a service was developing in Europe, the related concept of mobility on demand (MOD) was taking form in the US. Shaheen and Cohen (2020) compare the concepts in the following way:

> "Although MOD and MaaS share a number of similarities, MaaS primarily emphasizes passenger mobility allowing travelers to seamlessly plan, book, and pay for a multimodal trip on a pay-as-you-go and/or subscription basis, whereas MOD emphasizes the commodification of passenger mobility, goods delivery, and transportation systems management. A key similarity between MOD and MaaS is their emphasis on physical, fare, and digital multimodal integration…As the public and private sectors increasingly emphasize concepts of integrated mobility, there could be a convergence between MOD and MaaS."

Given this potential convergence, we believe that in considering development of a MaaS platform, especially in the US context, it would also be worthwhile for Jersey City to consider case studies involving MOD projects. A prime example are the 11 projects across the country that were funded as part of the Federal Transit Administration's (FTA) Mobility on Demand Sandbox Program in 2016.

Patel, et al., (2022) analyzed the Mobility on Demand Sandbox projects, which took many forms. As an example of potential lessons with applicability to MaaS that can be derived from this type of MOD case study, we summarize their analysis of the GoLink Project carried out by Dallas Area Rapid Transit (DART) in Plano, Texas, in 2017-2018.

The version of GoLink rolled out as part of the MOD Sandbox projects was akin to Jersey City's Via program, but it was run directly by the transit agency, and it relied on Uber vans to provide backup service. The first goal of DART's MOD Sandbox project was to upgrade their app for GoLink with multimodal travel info, unified payment systems, and a single, integrated trip booking system, and their second goal was to offer solutions "accessible to disabled, unbanked, low-income, and smartphone-challenged customers." To accomplish this second goal, they employed the PayNearMe service, which allows cash loading at stores, while also maintaining the option of reserving the service by phone.

Lessons learned from the project include, first, that having reliable software is crucial, but so is making sure the driver's device is charged and can support the software used on the vans. Second, dispatchers and reservationists should occasionally accompany drivers to understand the problems they face. Third, walk-ons and pre-scheduled rides in addition to on-demand service was offered as part of the service for reasons of equity, but as a side effect, service efficiency was compromised. Finally, it was useful to entice hesitant users to the service by offering both discounts and in-person support representatives.

The following list of FTA mobility programs may provide a useful source of additional case studies:

Mobility on Demand Sandbox Program (2016)
https://www.transit.dot.gov/research-innovation/mobility-demand-mod-sandbox-program

Integrated Mobility Innovation (2019)
https://www.transit.dot.gov/research-innovation/integrated-mobility-innovation-imi-fiscal-year-2019-selected-projects

Accelerated Innovative Mobility (2020)
https://www.transit.dot.gov/AIM

Enhancing Mobility Innovation (2022)
https://www.transit.dot.gov/research-innovation/enhancing-mobility-innovation

MaaS Examples and Comparative Table

APP/ PROGRAM	**Location**	**Funding**	**Services/ Catchment**	**Payment Interface**	**Equity Model**
CAPMETRO	Single Location Scalability, Austin	City - 1 percent sales tax levied by members of its service area	All services (UT Shuttle for students) except car rentals	CapMetro card, or CapMetro App	Affordable Reduced Fare, Metro access fare, ADA accessible, CART, late night services
TRANSIT/MOVE PGH	Single Location Scalability (so far), Pittsburgh	City - Grant funding from the RK Mellon Foundation - Public Private Partnership	All services including Zipcar (Car rentals)	Transit App, ConnectCard for transit, universal basic mobility pilot	Affordable Reduced Fare, Metro access fare, ADA accessible
WHIM	Good scalability Finland, some parts of Europe and Asia	Venture Capital/ Equity	All services provided, except university shuttle	Whim App	Service (zone based), taxi rides, car discount, Bike share access, bike rentals, subscription-based model

UMO	Good scalability, 10 states and 3 countries.	Venture Capital/ Equity	All services, except university shuttle	UMO App	Pricing based, Discounts, loyalty rewards, points, subscription based model
In Context of Jersey City	Does city require an app which has scalability or choose one with single scalability	Federal funds State funds City funds Private/Others	Integrate all services	Single Method Having both public and private services EG. Lyft, uber, Citi Bike - private NJ Transit/ Path - public	Pricing, Service, Payment-type, Subscription-based model can be used

[Table 2] Comparative Table

Recommendations on Implementing MaaS

Mobility as a Service needs a solid transit agency partner, so we recommend securing NJ TRANSIT and/or PATH as key stakeholders first. Identifing a public-private partner with whom to work is also key. Transit app, Lyft, and Via are primary vendors. Considerations for vendor suitability include desired scalability, fundamentals of the company, and each company's willingness to be responsive to the public sector. Academic literature indicates the importance of bringing the community/user base into the conversation early in the process. From the perspective of MaaS as a virtual mobility hub, it is important to ensure that MaaS and mobility hub equity strategies are mutually reinforced.

Jersey City & Other Modern Technology

Incorporating modern and innovative technology into the Jersey City mobility hubs provides residents with information they need to understand and navigate their transportation options easily at each location. Advanced and emerging technologies such as digital displays, smart kiosks, helmet vending machines, and smart streetlight corridors will help provide users with the best trip experience. Some of these innovations hold potential to improve affordability and environmental impact.

To ensure the best use out of recommended technology, Jersey City should consider three important factors, including (Zhang & Kamargianni, 2022):

- Technology that provides transit information should be at the forefront of a robust micromobility network, which includes alerts about potential unpleasant travel experiences;
- Technology that incorporates the latest safety features available in tech will provide for a heightened level of comfort, especially in high-congestion areas;
- Technology that looks at green initiatives to decrease carbon footprints and other environmental issues that come from current pollutions including from light and air.

Digital Displays

Digital displays, such as the CityPost kiosks which Jersey City has adopted in 50 locations (Kofsky, 2018), enhance time travel estimates, wayfinding, and additional information important to help people navigate the city. Similarly, SmartLink kiosks found across neighboring New York City provide important amenities at mobility hubs including free Wi-Fi, calling features, transit service information, and destination recommendations for locals and visitors. In New York City, the contract to install 10,000 of these machines was roughly $200 million. This translates to around $200 per kiosk. At the microlevel, installing kiosks like SmartLink at just three mobility hubs would be around $600 (Wiggers, 2018).

Art & Design

Mobility hubs can include smart infrastructure to provide access to a better user experience for hub users. In San Francisco, the San Francisco Municipal Transportation Agency (SFMTA) invested in a $26 million traffic improvement project within the last five years. Part of this improvement project was the investment in reimagined bus stops for SFMTA bus services. The bus stops provided a new and improved experience for passengers with energy efficient lighting, Wi-Fi capabilities, and LCD next bus displays. It also gave the opportunity for the city to incorporate art into the design of the shelters to make them visibly pop and represent the culture of the city. Jersey City can follow suit with their own versions of this technologically-advanced bus stop design, improving the experience for those at designated mobility hubs that have a connection to bus services (Leahy, 2022).

Sharing Safety

One of the most recognizable forms of micromobility is bike sharing, such as with the Citi Bike program that has rapidly expanded across Jersey City. The ability to provide enhanced safety technology features at the recommended hubs could encourage broader usage of these services. This includes the prospects of introducing helmet vending machines at the given mobility hubs. In Boston, HelmetHub provides cyclists with the ability to purchase or rent and return helmets at bike sharing stations. It currently costs users $20 to buy a helmet, or $2 to rent and return. The company that provides this service is also active on Twitter; an important part of the customer experience in the age of technology (Borchers, 2014).

Smart Streetlights

Smart infrastructure can also include the integration of Smart Streetlight Corridors. Smart streetlights are an emerging technology that not only help with energy savings, but help to increase corridor safety and wayfinding. The Smart City Expo found that smart streetlights have the ability to reduce energy consumption a city uses by up to 50 percent. There are also ways to incorporate advanced lighting such as color control to create a guided, lit path for cyclists to most safely take when going between mobility hubs. The streetlights can include surveillance cameras and gunshot detection systems to increase safety measures along the corridor, too. Beyond these concrete changes to the dynamic of mobility hubs and their corridors, these smart streetlights can include the ability to charge electric vehicles, provide a steady broadband for those who are using their phones for directions or streaming music, and performance monitoring to ensure the system is being maintained properly (Intelilight, 2022).

Alternatives & Takeaways

With the advancement of technology also come the prospects of providing cheaper and greener alternatives to these proposals. Newer, more advanced products can come with a steeper price. There are also cheaper initiatives being provided across the world that look to incorporate these technological advancements for transportation while still being economically viable for the municipality to upkeep. Jersey City can look at cities in Poland that are introducing digital bus stop and sign displays that use a cheaper, low-cost dot-matrix display to convey important service information. These E-Paper displays use a standard black and white screen and also reduce the costs of editing and printing for these local cities and agencies (Bicket, 2020).

One of the biggest challenges to incorporating technology into Jersey City mobility hubs is ensuring all transportation modes, agencies, and initiatives are on the same page when it comes to sharing data and information for hub users to have access to. Jersey City, in conjunction with companies providing the technology, must work together to ensure that agencies such as NJ TRANSIT, Port Authority, Citi Bike, and car rideshare groups provide accurate and up-to-date information so there is no miscommunication to mobility hub users. Another challenge includes the potential for seamless fare payment options between modes operated by different agencies. Payment systems should be equitable and accessible.

Hub Sites

Site Evaluation and Selection

This study involved both a broad overview of the eight mobility hub sites proposed in *JC on the Move* and a deeper dive into three of these sites that the team felt accurately represented a cross-section of Jersey City. The initial sites were qualitatively assessed through in-person site visits and compared to one another based on their adherence to these principles. In addition, measurable data points that represented these principles in a simplified form were used to group the sites into similar typologies. These typologies represent unique characteristics for the areas surrounding each hub and ensure a wide cross-section of the city is represented and receives relevant recommendations through an analysis.

The guiding principles for successful mobility hub function, as determined by the study team, are as follows—a successful mobility hub:

- Attracts users;
- Is technically feasible to construct and operate;
- Is spatially feasible;
- Promotes safety and security for all users;
- Is a viable transportation alternative in the case of transit shutdowns;
- Supports future growth;
- Supports amenities (e.g., vehicles, water, lighting, restrooms, electricity, landscaping);
- Implements universal (barrier-free) design frameworks.

Site Evaluation

The initial site reconnaissance was performed by small teams, covering the eight potential sites for mobility hubs as described by *JC on the Move,* as well as the Port Liberté Ferry Terminal. The latter was added at the request of the Jersey City DOT, expressing interest in reintroducing ferry service on the south side of the city's Hudson River waterfront.

The sites are:

- Journal Square Transportation Center
- Newport PATH Station
- Garfield Avenue HBLR Station
- Danforth Avenue HBLR Station
- JFK Boulevard, between Communipaw Avenue and Grant Avenue
- West Side Avenue at Lincoln Park
- Bergen Avenue, between Belmont Avenue and Fairview Avenue
- Central Avenue, between Thorne Avenue and Congress Street
- Port Liberté Ferry Terminal

[Figure 18] Proposed Mobility Hub Locations.

In this reconnaissance, teams photographed sites, identified early possible locations for micromobility siting through aerial imagery, and gathered information on the transportation, land use, economics, and demographics for each site. New Jersey's Transit Friendly Data Application (New Jersey Transit Friendly Data Application, n.d.), an online tool produced by NJ TRANSIT, provides information at quarter- and half-mile radii which was particularly useful in

providing much of this information. The team assembled a spreadsheet as a repository that documents the qualitative responses to the guiding principles, to begin the process of characterizing each site and identifying patterns.

To provide additional insight, another systematic approach to characterizing the sites based on quantitative data points was also taken. This process began by simplifying the guiding principles into measurable metrics. The team, chiefly interested in the transportation characteristics of the sites, incorporated the walk, bike, and transit scores (as determined by Redfin's Walk Score algorithm) for approximate locations as described in *JC on the Move*. Most of these sites were defined at specific points, whereas others followed corridors—for the purposes of this analysis, a central point on the corridor was used to calculate these metrics (These points are highlighted in Figure 18). Median household income and population density were also measured for each site; these metrics were developed by averaging the median household income for all census tracts intersecting a half-mile radius of the points and dividing the total population of each tract by their total land area. All census data is collected from the 2021 American Community Survey 5-Year Estimate.

Location	Walk Score	Transit Score	Bike Score	Med. Household Income	Area (Sq Mi)	Pop. Density (ppsm)
Journal Square	99	80	48	$ 70,179	3.08	13,611
Newport PATH	93	87	59	$ 169,947	0.96	33,209
Garfield Ave HBLR	70	70	62	$ 48,439	1.30	22,429
Danforth Ave HBLR	65	68	58	$ 71,079	2.54	8,121
JFK Blvd	78	72	56	$ 60,199	1.60	25,536
West Side Ave (Lincoln Park)	90	58	61	$ 64,354	1.64	25,095
Bergen Ave	95	64	65	$ 62,389	2.04	24,523
Central Ave	95	70	74	$ 77,606	1.38	37,490
Port Liberté Ferry Terminal	20	42	29	$ 221,597	1.85	1,022

[Table 3] Mobility Hub Characteristics

The study team does not recommend moving forward with Port Liberté as a mobility hub in early implementation phases. The team believes that a strong user base should be first established in dense areas of the city currently underserved by public transit. Port Liberté has, by far, the lowest surrounding population density and highest median household income in the census tracts within a half-mile of the proposed hub site. These figures indicate that the site's ridership would be highly volatile. Additionally, ferries are not nearly as capacious or efficient (or connected to the region's existing transportation) as frequent bus and train service is, so the team recommends the city uses their resources to develop further means of access to the latter modes.

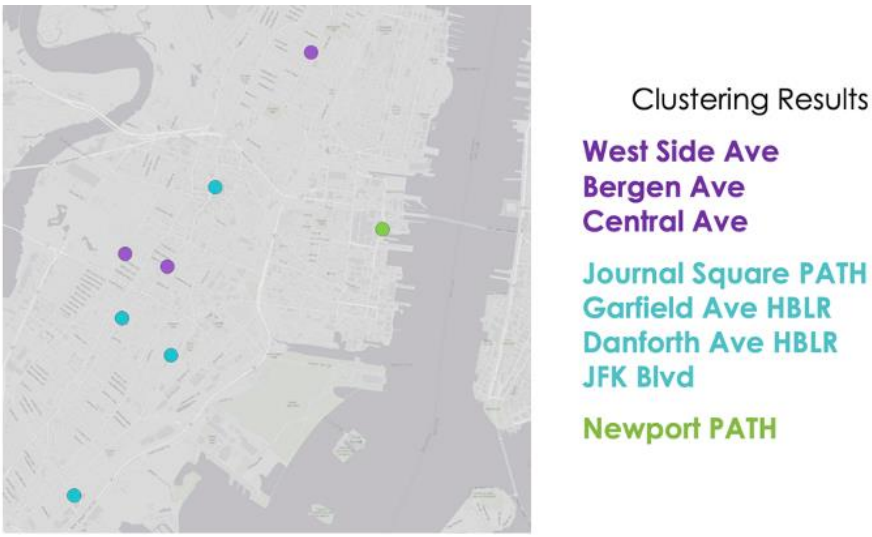
Site Selection

Of the mentioned sites, the study team selected three for further analysis. The selection of these sites considered both the qualitative and quantitative observations recorded in the previous section, as well as the values of the research team that prioritize equitable implementation, benefiting underserved communities as a solidified user base.

The site selection process began with the grouping of sites with other similar sites based on their quantitative metrics. This process used K-Means Clustering, a machine learning algorithm that clusters data records into binned groups based on similarities in their recorded attributes. In this case, the sites were clustered based on a number (K) of classifications that matched the number of exemplar sites to be studied in detail. Because the algorithm is unsupervised, its output is not directly interpretable (i.e., a given cluster of sites cannot explicitly be defined as having certain characteristics), though because the number of observations and number of observed attributes are both low, patterns can still be identified.

Iterations of the model were performed that specified two clusters and three clusters excluding Port Liberté, as well as three clusters and four clusters including Port Liberté. For both iterations that included Port Liberté, that site's uniquely low transportation scores and population density, coupled by its uniquely high median household income resulted in it being grouped independently. Ultimately, the output identifying three clusters excluding Port Liberté was selected to identify possible groups from which three detailed exemplar sites could be selected. This output is displayed and mapped below (Figure 19).

Note: each color represents an automatically-generated cluster of sites with similar characteristics.



[Figure 19] Proposed mobility hub locations, with clusters of hubs with similar characteristics organized by color. Port Liberté omitted.

While this process gave valuable insight, the study team ultimately deviated from these groupings in selecting three sites for further analysis. Figure 20 below illustrates the location of the ultimately selected sites.

[Figure 20] Map from Figure 19, annotated with sites selected for further study.

The Central Avenue site was selected from the first cluster (in purple) because of its location in the Heights neighborhood, unique from the other sites. It has the greatest surrounding population density of all sites, is located along the busy Central Avenue bus corridor, is near the Palisade Avenue jitney corridor, and near the Ninth and Congress HBLR station. Given the latter consideration, the team decided to study a site at the HBLR entrance along Paterson Plank Road. Considering the density of the site and the predominant micromobility focus of

the mobility hub concept, a hub sited at the Ninth and Congress station would greatly expand the neighborhood's access to rail and destinations such as Hoboken and the Palisades. This location thus satisfies a potential use case for mobility hubs at the site of minor transit hubs—in this case, an outlying HBLR station.

The southern JFK Boulevard segment in the second cluster (in blue) was selected because it is the only site in its cluster not located at a transit station, although similarly to Central Avenue, is along a major bus corridor. For this reason, the site is a possible exemplar of a neighborhood hub—it is not immediately adjacent to a single neighborhood amenity, but it is within fewer than 10 minutes' walk to New Jersey City University, the West Side Avenue HBLR station, and existing Citi Bike docks and bus service along Bergen Avenue to the east. The site is accessible from the northern part of the traditionally underrepresented Greenville neighborhood, but has a much higher surrounding population density than the proposed Danforth Avenue site further south. The development of a hub along JFK Boulevard consequently could enable southward expansion upon inducing a reliable ridership base.

Finally, rather than Newport—which was clustered independently in the K-Means model likely because of its high population density (second to Central Avenue/the Heights) and its high household income measure (over $90k higher than the second-highest site, excluding Port Liberté)—the study team instead elected to pursue a concept at Journal Square. Like Newport, Journal Square is a major transportation hub featuring the PATH station and extensive bus service. Journal Square was preferred for two reasons: it features a more socioeconomically and demographically diverse population than Newport, supporting the study team's equity goals, and is in between the other two selected locations, forming a north-south axis that could induce crosstown travel between the mobility hubs and strengthen a nascent network.

Site Analysis

Journal Square

History

Journal Square is one of the longest continuously inhabited neighborhoods by European colonists in the United States. Its first colonial settlers trace back to the mid-1600s, when the area was part of a peer settlement to New Netherlands.

In 1912, the Hudson and Manhattan Railroad (the predecessor of the PATH train) constructed a station at Summit Avenue, transforming the neighborhood into a

transit-oriented, mixed-use district. Around this time, a newspaper company named the *Jersey Journal* constructed their headquarters in the square, which was then named in its honor.

For much of the 20th Century, Journal Square was the cultural and entertainment center of Hudson County, home to several historic theaters.

Today, Journal Square continues to grow as a pivotal economic, cultural, and residential hub for Hudson County. The historic Stanley and Loews theaters still stand and have been renovated for future use. Hudson County Community College is located on the southern end of the square and St. Peter's University is situated just a few blocks south. Additionally, the county courthouse, administrative building, and other county offices are in the northeast section of the area, in the "Five Corners" neighborhood.

Neighborhood Characteristics

Land Use

Journal Square is a high-density, mixed-use neighborhood with a wide range of housing options, from two-family detached buildings with yards to forty-story residential towers. The neighborhood also has a high concentration of commercial and office space.

Activity Generators

Major activity generators include the PATH station, Hudson County Community College, multiple public schools, Hudson County Administrative Campus and Courthouse, and multiple cultural centers and places of worship.

Parks/Green Space

Green space is notably lacking in the district, with objective number three in the Journal Square 2060 plan highlighting a "need to integrate a network of parks and open space" into the area.

Street Grid

JFK Boulevard is a county-maintained, multi-lane, urban arterial that travels north/south through much of Hudson County. The main entrance to the Journal Square PATH station is situated on JFK Boulevard. Additionally, State Route 139 wraps around—and makes up much of—the northern borders of the neighborhood. State Route 139 is a major urban arterial that may be intimidating to cross for pedestrians or cyclists. A topographic change limits Journal Square's east/west connectivity to downtown Jersey City and the Newport neighborhood. Newark Avenue is the only non-county- or state-owned road that connects Journal Square to downtown.

Transportation

Journal Square is a transit-rich neighborhood, with the PATH station acting as its gravitational center. In addition to PATH service, Journal Square features over a dozen different NJ TRANSIT bus routes, multiple Citi Bike stations, Via microtransit service, protected bike lanes, and an Oonee personal bike storage facility.

Transit Gateway

The Journal Square Transportation hub is the "Grand Central" of Jersey City. Those who use public transit to commute into and out of Jersey City go through this location to reach destinations in the city. PATH users from Newark, Hoboken, and New York meet here to then board other transit services to take them further into Jersey City. NJ TRANSIT provides an extensive network of buses and light rail to Bayonne and other points in North Jersey. Additionally, long-haul NJ TRANSIT routes to Central Jersey, Atlantic City, and other Jersey Shore points originate here. This creates a gateway network that Journal Square acts as for the entirety of Jersey City.

Planning Background

The *JC on the Move* report classifies Journal Square as one of two high priority locations to implement a mobility hub. This recommendation was made based on the results of an equity and transit access analysis that identified Journal Square as a neighborhood with a "very high concentration of under-represented people." This assessment was based on demographic data conventionally associated with burdened populations such as low-income, migrant status, low English proficiency and other characteristics.

Journal Square has a neighborhood-specific redevelopment plan (Journal Square 2060) that identifies the neighborhood as an important transit village and economic center for the city. Some of the most important goals of this plan include "emphasizing sustainability" in all future development and "making biking and walking an easy, safe, and desirable mode choice" for local transportation.

Zoning Information

The current zoning of Journal Square consists of a special improvement district detailed in the Journal Square 2060 Redevelopment Plan. The plan was adopted in June 2010 to redevelop the area around the Journal Square transportation hub and elevate this important business district through transit-oriented development. The plan covers over nine million square feet of land in and around the hub, including the floor area of all residential, educational, and business buildings within it.

The special improvement area is divided into different zone districts that indicate how the city wants each part of Journal Square to develop. Our recommended

location for the mobility hub on Bergen Avenue at the corner of Sip Avenue, at the southwest corner of the "Journal Square" megablock, is part of Zone District 3: Commercial Center. The Jersey City Redevelopment document states that the purpose of Zone District 3 is, "to provide for an active and intensive use of parcels surrounding the Journal Square Transportation Center." This is key to understanding the purpose of this zone, and how it benefits the proposed mobility hub.

After reviewing the special improvement district zoning and its guidelines, we feel it is safe to conclude that there is no direct effect to the proposed mobility hub on Bergen Avenue at Sip Avenue. Rather, building a hub at this location would help support continued business activities along Bergen Avenue and in Journal Square, as the commercial zoning designation envisions.

Roadway Conditions

The condition of the roads in and surrounding the proposed site location are mixed in their upkeep. Some portions of the roadway in the northern portion of Journal Square are in moderate-to-poor conditions. There are cracks, holes, and other safety hazards on some of these streets that would require rehabilitation before implementing a mobility hub site.

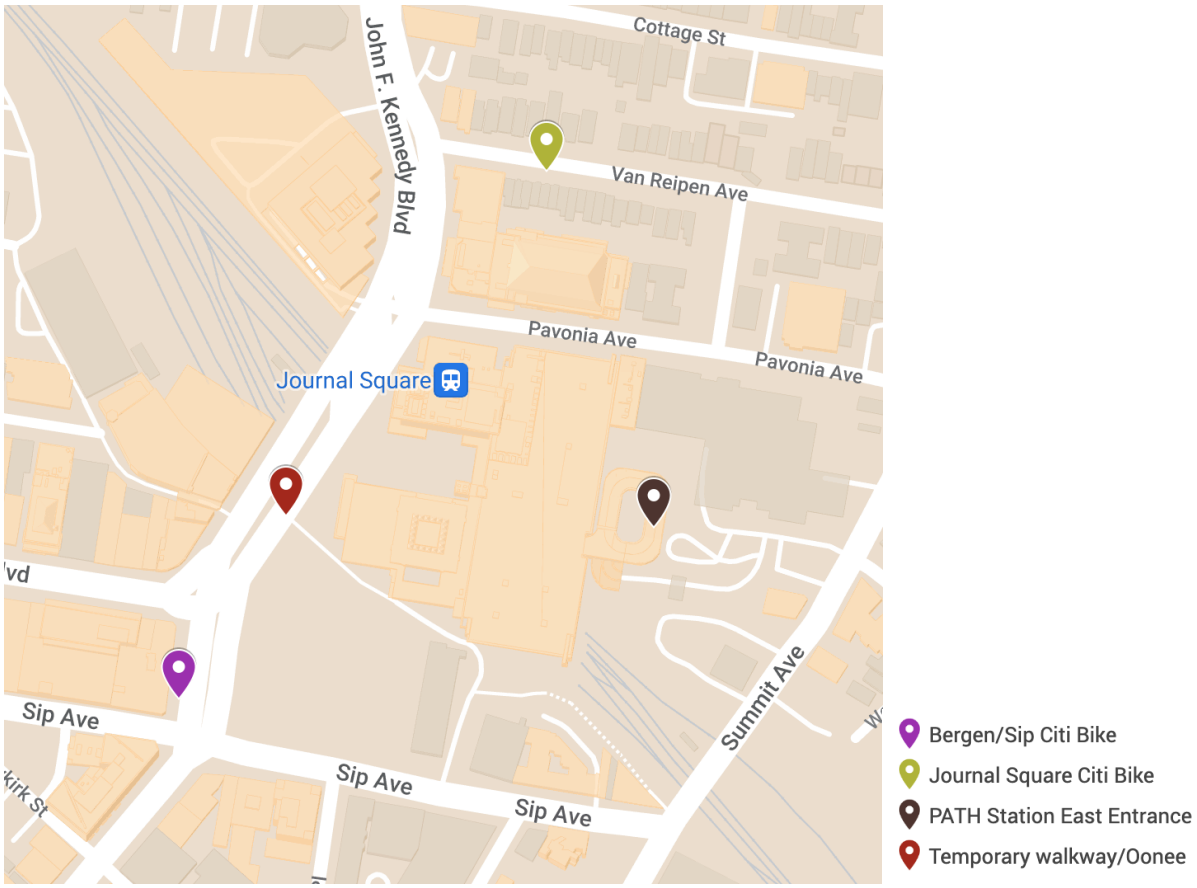
[Figure 21] Bergen Avenue Citi Bike station approaching Sip Avenue.

However, most of the roads immediately adjacent to the recommended site including Sip Avenue and Bergen Avenue are in preferred conditions. This means these streets possess little to no potholes, cracks, or other safety issues that may

be of a concern in other areas of Journal Square that may prohibit a comfortable experience using the mobility hub.

Site Selection and Recommendation

We identified four possible sites for a mobility hub in the vicinity of Journal Square, shown in Figure 22. Below, we discuss advantages and disadvantages of each site option.



[Figure 22] Journal Square hub sites considered.

Our main recommendation for a micromobility hub near the Journal Square transportation center is based around the existing Citi Bike station at Bergen Avenue and Sip Avenue. This site has the advantage of being on city-owned right-of-way near the Citi Bike station with the second highest number of rides in the entire city in March 2023 (1,688 rides) according to https://ctbk.dev/; only the Grove Street PATH Station Citi Bike station had a greater number of rides that month (3,193). The sidewalk at this location is wide and well-maintained, discounting some small-scale construction work currently taking place on the corner. The site is well-lit, with pedestrian-scale lampposts (as opposed to the highway-style lampposts around the corner), trash receptacles, and boxes for local newspapers. It is adjacent to a section of the street that previously

functioned as a right turn lane, which has been claimed with temporary bollards and green road paint as the site of a small pedestrian mall and weekly farmers' market.

Our proposal envisions setting aside a small portion of the pedestrian area for shared scooters, while improving the rest of the parklet with more permanent landscaping and bollards. Since the site currently lacks a place to sit and could benefit from improved wayfinding, we have recommended including a solar shelter, which combines all of these elements. In addition, although a protected bike lane enters Journal Square from the south on Bergen Avenue and is in easy reach of the site, the lane stops on the opposite side of the intersection. We recommend constructing a formal connection to the bike network with the hub via a redesign of the intersection.

The second site we considered for a hub was centered around the Citi Bike station at Van Reipen Avenue and JFK Boulevard, which is designated by name as the Journal Square station. Despite the name, this hub is located on a side street out of view of the Journal Square PATH plaza. There is also no existing bike lane nearby. These two factors may explain in part why the hub has lower ridership numbers than the Bergen/Sip Citi Bike station (645 rides in March 2023). Further, the narrower sidewalk on Van Reipen gives little room to expand without taking away additional parking spaces. Therefore, even though the site is in easy reach of both the PATH station and nearby India Square (an Indian cultural district), we feel that the Bergen and Sip Avenue station represents a more promising starting point for expanding micromobility offerings in the area.

The third site we considered for a hub was located at the east entrance of the PATH and bus terminal. There is a large plaza at this location with a significant existing bike rack and access to the terminal via both stairs and a ramp. Compared to the west entrance to the station, what many might consider the main entrance, it is much easier to gain access to the station from this side without using any stairs. Furthermore, since the existing bike racks are near a large, at-grade open area, it would be simple to place an additional bike or scooter share facility here from which one could easily ride away on a direct route to the street. However, we suspect there may be issues with ridership at this less known entrance to the station, and crucially, as on the main PATH plaza itself, we are unsure what steps might be necessary in order for the city to gain permission to install a facility here.

The fourth and final site we considered would occupy what is currently a temporary pedestrian path just south of the Oonee bicycle storage pod, adjacent to a large construction site. We observed that this pedestrian path had replaced a lane of traffic without leading to significant congestion, at least at the time we visited. This site is even closer to the main entrance of the station than the Bergen and Sip Avenue station, and the nearby Oonee pod provides an existing

micromobility resource to associate with. However, given its location on JFK Boulevard, a county-owned road, it is uncertain how much discretion Jersey City might have in maintaining the lane removal after the end of the construction period. It is also unclear how the forthcoming high-rise and plaza taking shape in the construction site might affect the outlook for this location. Given these risks, we recommend sticking with a site where control by the city is undisputed.

Proposed Micromobility Hub: Aligning with the City's Smart Growth Strategies

The Jersey City Master Plan Circulation Element, Jersey City Mobility 2050, which has been lauded for its innovative approach, suggests the implementation of sustainable smart development strategies. These strategies seek to direct future development towards areas with convenient access to public transportation, while reducing parking requirements to minimize traffic congestion and its negative effects on air quality. In order to discourage the use of automobiles and encourage the adoption of alternative modes of transportation, the plan also mandates the provision of bicycle parking and wider footpaths. In light of this, it is crucial to implement a micromobility hub in the Journal Square location to reflect the priorities of the city's master plan.

[Figure 23] Proposed site using 3D modeling.

The Journal Square Redevelopment plan envisions the establishment of a narrow-gauge streetcar line that would run from the intersection of JFK Boulevard and State Route 139 to Bergen Avenue at McGinley Square. In addition, the plan recommends the construction of a dedicated bus lane, complete with permanent bus stops, along the streetcar right-of-way. It is worth noting that the proposed site for the micromobility hub will prove beneficial to streetcar users if the city opts for the opposite side of Bergen Avenue as the streetcar line. Another promising aspect of the proposed hub is that it will serve a larger number of people, given that the entire length of Sip Avenue, between Garrison Avenue and the Journal Square Transportation Center, is expected to feature bus priority lanes in order to prevent delays to Bus Rapid Transit (BRT) services caused by regular traffic. The inclusion of bus priority lanes on Sip Avenue can not only

reduce traffic congestion but also make the streets safer for cyclists and pedestrians, further supporting the use of the micromobility hub.

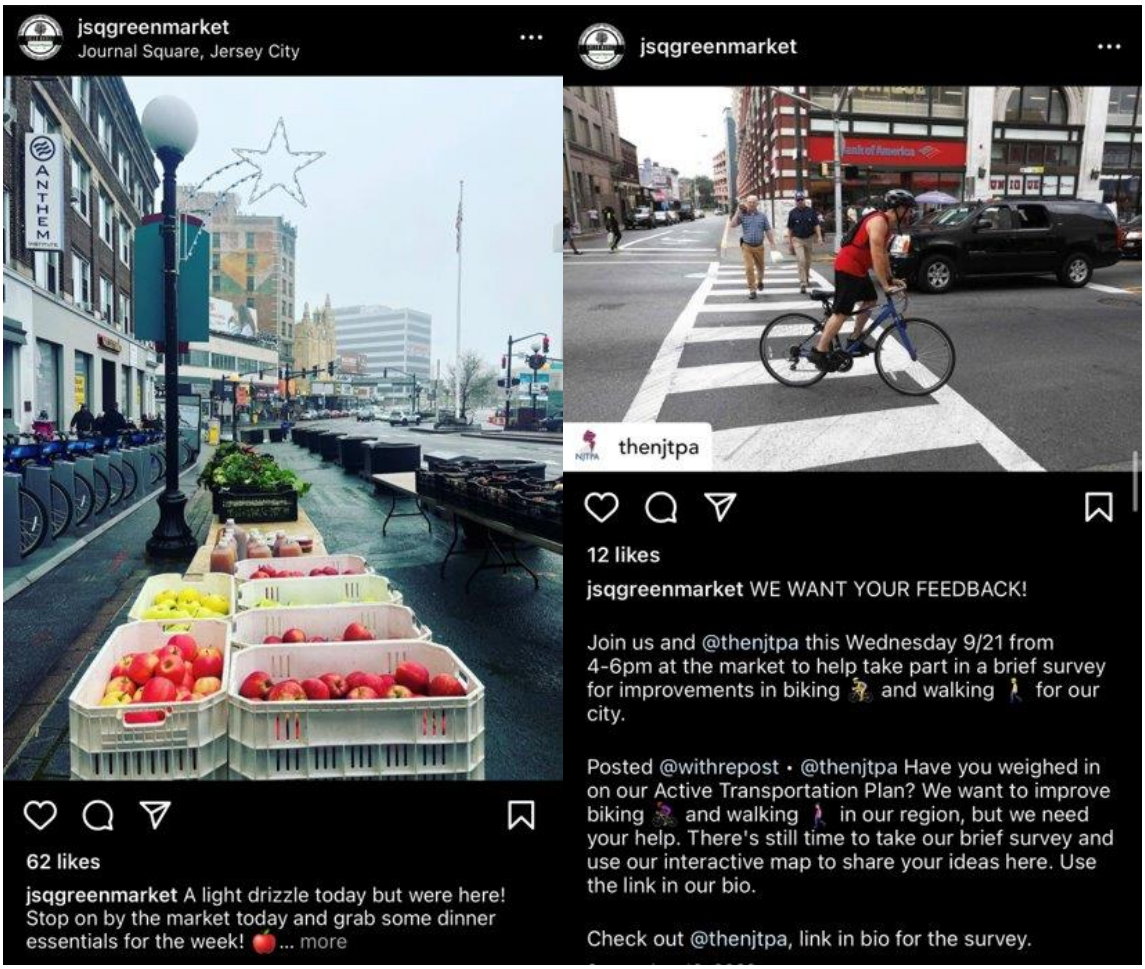
The proximity of a micromobility hub to a streetcar route and a road with bus priority lanes promotes the integration of different modes of transportation and establishes a seamless connection between the streetcar, bus, and micromobility systems, thereby facilitating the movement of city residents. It also prioritizes public transportation and micromobility modes over private vehicles, consequently decreasing travel time and congestion and improving the overall efficiency of the Journal Square area's transportation system.

Designing an Equitable and Sustainable Mobility Hub

According to the Journal Square Redevelopment Plan, the proposed micromobility hub is in Zone 3: Commercial Center, where the required sidewalk width along Bergen Avenue and Sip Avenue is minimum 20 feet. With this consideration, the micromobility hub borrows space from the adjacent farmers' market lane running parallel to the sidewalk with the existing Citi Bike station on one end, to allocate spaces for additional e-scooter sharing (See Figure 23). Moreover, as feasible to the city, space is designated for a smart solar shelter with wayfinding information beside the fire hydrant on the other end of the sidewalk. As the site for the micromobility hub is conveniently proposed at a commercial center, the city should pay due heed to the ongoing trend of cargo bikes and consider implementing electric cargo-bike share programs between small businesses and their clients, from business to business, or from suppliers to business. Finally, Jersey City should pioneer efforts to incorporate adaptive scooters into its existing city-wide bike share program to create an equitable future for all.

Working with Local Partners

The Journal Square Green Market is an active user of the space within the recommended mobility hub location. The group hosts a farmers' market on the corner of Sip Avenue and Bergen Avenue seasonally. The Journal Square Green Market has had an active stance on perusing better transit alternatives for community members in and around Jersey City. The Market has publicly addressed its interests in active transportation on social media as illustrated in Figure 24 (New Journal Square, n.d.), and working with them would be a major opportunity to collaborate and promote the mobility hub. Not only would this benefit justifying the location further, but potentially increase traffic to the farmers' market when it operates.



[Figure 24] Screenshots from Journal Square Green Market Instagram.

Takeaways: Siting Hubs in Dense, Transit-Rich Locations

- Finding sites where the city has jurisdiction may be the biggest challenge;
- The site is already a magnet for transit users, so adding more facilities such as sheltered bus stops may not be necessary;
    - Adding additional amenities to sites like Journal Square is an added benefit, but it is not necessary to successful implementation.
- A site within view of an important location may see more use than one that is closer but out of view, as with the Bergen/Sip Citi Bike station vs. Journal Square Citi Bike station;
- If a choice must be made, we recommend prioritizing proximity to bike lanes over immediate adjacency to transit assets for new micromobility facilities;
- This site's size may be contingent on municipal codes regarding fire safety. The area the mobility hub covers may be limited by emergency utilities that

cannot be moved from the block or corner, such as a fire hydrant, on the north end of the block;

- This site is located within an area that is seasonally occupied by a farmers' market that has expressed interest in micromobility on their social media platforms. A local partner at this site may encourage greater usage;
- Journal Square uniquely acts as a gateway mobility hub into and out of the city. This can encourage those who do not have a car who want to access the city to do so by using the mobility hub at this site.

JFK Boulevard

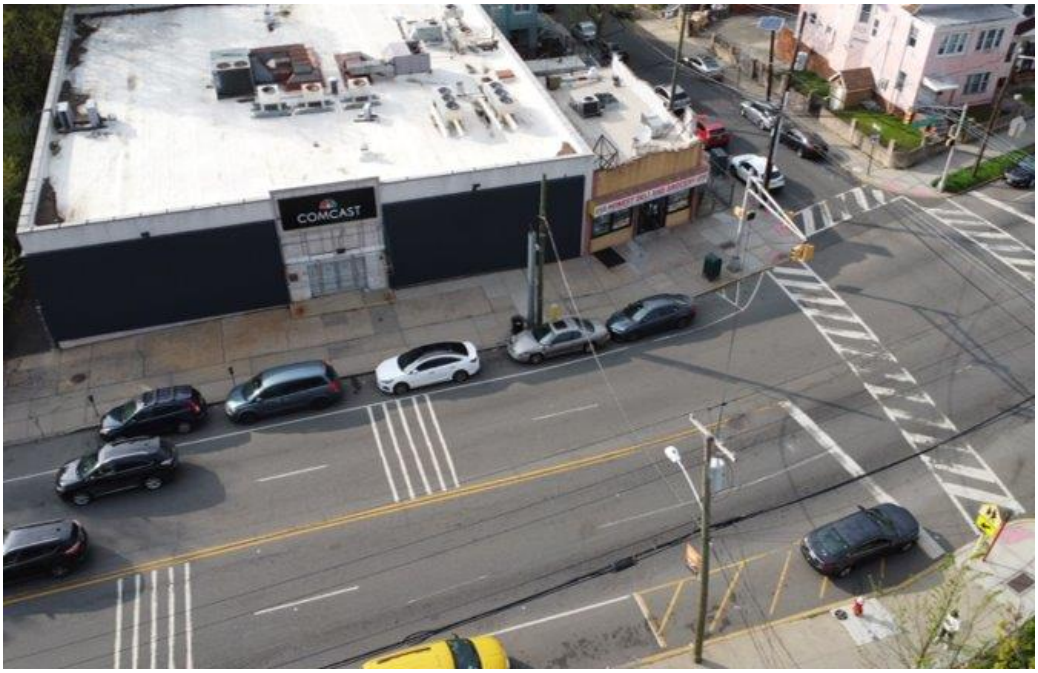
Background

JC on the Move identified a broad study corridor rather than a specific location or intersection for the proposed Greenville/South Jersey City mobility hub location. This corridor follows a roughly 11-block section of JFK Boulevard between Communipaw Avenue and Grant Avenue. The site we selected for analysis is situated at the southwest corner of the JFK Boulevard/Grant Avenue intersection.

The JFK Boulevard site can provide a number of useful takeaways regarding the implementation of mobility hubs in primarily residential neighborhoods on the outskirts of Jersey City. It is also an example of a mobility hub that would only offer bus transit connections. The proposed hub site is situated at the northern end of the Greenville neighborhood, which is a historically disadvantaged location with a highly diverse population.

Site Characteristics

The potential hub location identified for this corridor is on the west side of JFK Boulevard, just south of Grant Avenue (see Figure 25). There is a wide sidewalk area outside the corner store and former Comcast building, which should offer enough surface area to facilitate a mobility hub while still maintaining an ADA-compliant sidewalk segment. The Comcast building next to the site is not being used at present, although property records indicate that it is still owned by Comcast. The sidewalk area includes parking meters for paid parking along JFK Boulevard, but these might have to be shifted in order to provide space for future hub amenities.



[Figure 25] Location of the JFK Boulevard site and the southbound NJ TRANSIT bus stop.

Neighborhood Characteristics

Land Use

Land use in the immediate vicinity of the proposed hub site is largely residential. JFK Boulevard is lined with a mixture of single-family dwellings and mid-rise apartment buildings. The neighborhood streets that intersect JFK Boulevard in this area are almost entirely lined by detached, single-family dwellings. There are several commercial uses along JFK Boulevard as well, including a number of small convenience stores. Institutional uses in the site vicinity include Henry Snyder High School (located directly across the street from the proposed site), and the New Jersey City University (NJCU) campus, located one block to the south.

Major activity generators

Activity generators around the proposed site include the aforementioned academic institutions, and the large number of residential dwellings in close proximity to the site. This section of JFK Boulevard also hosts several bus routes that provide connections to Journal Square, Bayonne, and New York City.

Parks/Greenspace

The proposed hub site is on the same block as the Lt. Robert P. Grover Memorial Park, a small, city-owned greenspace. Audubon Park lies several blocks to the south along JFK Boulevard. This is a slightly larger facility that offers additional amenities, such as basketball courts and a playground.

Street Grid

The proposed hub will be located along JFK Boulevard, a major north-south roadway linking Bayonne with areas to the north in Hudson and Bergen Counties. In the vicinity of the proposed hub site, JFK Boulevard has four lanes of traffic, in addition to a parking lane on each side. Traffic speeds along JFK Boulevard are relatively high, and our observations of the radar speed signs along the road seem to indicate that many drivers are exceeding the posted 25 mph limit. Many of the residential cross streets in this area are one-way, and allow on-street parking on both sides. Some of these streets include limited traffic calming features, such as speed humps.

Current transportation options

Currently, NJ TRANSIT bus routes 10 (Journal Square-Bayonne) and 119 (New York City-Bayonne) provide service near the proposed hub location. An additional transit option is the NJ TRANSIT Hudson-Bergen Light Rail stop at Westside Ave., which is within a 10-minute walking distance of the proposed hub location. In terms of shared mobility, JFK Boulevard is somewhat close to several existing Citi Bike locations, including two along Martin Luther King Drive, and one near West Side Avenue. When it comes to nearby bike infrastructure, some of the east-west streets in the vicinity of the potential hub site feature painted bike lanes. However, there does appear to be a lack of north-south bike connections in the surrounding area, which could pose a challenge with regards to increased micromobility usage.

Planning Background

The *JC on the Move* report identifies the area between Communipaw Avenue and Grant Avenue along JFK Boulevard as one of the main priority areas where

a mobility hub can significantly benefit a current transit desert location within Jersey City. This report also determined that JFK Boulevard could be a suitable location for future Bus Rapid Transit (BRT) services, to provide a "faster and more reliable service than traditional local bus service." A BRT feasibility study was carried out in 2013 for Jersey City, and JFK is one of the routes mentioned for future BRT service. Among other items, the study recommended adding enhanced amenities at all bus stops served by a future BRT service. Mobility hubs could play a substantial role in bringing about such improvements at bus stop locations.

Zoning Information

According to Jersey City's online zoning map, the portion of JFK Boulevard in the study area is almost entirely zoned for R-3 (multi-family mid-rise housing), although there are obviously variances allowing smaller businesses to operate. Certain areas to the south, such as the NJCU campus, are zoned for institutional uses. It is also worth noting that some of the areas east of the site fall within the designated Green Villa Redevelopment Plan zone.

Recommendations

Our primary recommendation is to construct a new mobility hub at the southwest corner of the JFK Boulevard/Grant Avenue intersection (see Figure 26). Given the wide sidewalk space available at this location, it should be feasible to establish a mobility hub that provides a number of amenities within the existing sidewalk area. A Citi Bike station should also be installed, to provide hub users with the ability to rent bikes and/or E-bikes. If the city contracts with an E-scooter vendor, we would also recommend adding scooter corrals to the hub, to provide a convenient pick-up/drop-off spot. Because of the more dispersed nature of this site's surroundings, a dockless system would likely prove more effective at facilitating last-mile connections between the hub and final destinations, especially those to the south.

[Figure 26] Proposed JFK hub using 3D modeling.

To make the JFK hub an attractive and welcoming space for all users, an electronic wayfinding/information display similar to the CityPost units installed in downtown Jersey City should be added. Pedestrian-scale lighting fixtures should also be installed, to complement the existing street lighting, and to increase user safety and comfort at all times of day. The concrete sidewalk on which the hub would be situated would ideally be rebuilt prior to adding hub features, to better accommodate all necessary modifications (including any electrical supply needed), and to give the hub a better overall appearance. Sidewalk and street repairs should also be made on the blocks closest to the hub in order to improve the quality of infrastructure available for potential users. Additionally, the city should seek to integrate future bike infrastructure upgrades with the hub, by connecting new bike lanes to nearby streets.

If this hub location proves to be successful, several expansion strategies could be considered. The proposed hub site is just beyond an existing NJ TRANSIT bus stop, which currently has a combined bus stop/right turn lane that buses can pull into. Many of the buses observed during our site visit stopped at least several feet out from the curb, which makes boarding and alighting much more difficult (especially for riders with disabilities). To remedy this issue, we recommend adding enhancements to the existing bus stop area, such as a shelter and improved boarding area. This could prove especially useful if future BRT plans are implemented along JFK Boulevard. A curbside boarding area could also benefit users of on-demand Via micro transit vehicles, in addition other rideshare options. Ideally, some sort of pavement markings could be added in the parking lane to demarcate the loading zone and bus stop.

An expanded hub implementation scenario in this particular location might also address some additional needs present along the JFK Boulevard corridor. Because of its high traffic volumes and speeds, JFK Boulevard has gained a dangerous reputation from a safety standpoint. Most cyclists observed during our site visits were riding on the sidewalk to avoid traffic. Although the road is county-owned, it would be ideal to explore the implementation of some form of traffic calming features as a means of mitigating for the hazards posed by speeding cars. For instance, improved pavement markings could be installed along the blocks closest to the hub, in order to draw the attention of motorists. It may also be necessary to provide additional micromobility options (especial additional capacity for parking and docking solutions) in closer proximity to the New Jersey City University campus in the future, should demand grow.

As part of hub implementation in this location, it is critical to ensure that there is enough local electrical capacity to facilitate electronically-operated features, such as night lighting, electronic displays, and charging options for E-scooters and

E-bikes. Currently, PSE&G's website shows that remaining electric capacity is either very limited or unknown in the areas along JFK Boulevard closest to the proposed hub site. It will therefore be important to gauge exactly how much capacity is available prior to implementing the hub design, and to work with PSE&G to facilitate any potential modifications if necessary.

Takeaways: Siting Hubs Along Bus Corridors

- A JFK Boulevard hub site would have to be located along the county-owned right of way, which would potentially limit the amount of site alterations (especially on-street changes) that could be made to accommodate the hub. For this reason, it is ideal to start out with hub designs that can be fit entirely within the bounds of existing sidewalks.
- Along bus-only corridors, it would be ideal to integrate existing bus stops with nearby mobility hubs. This would be facilitated by enhanced curbside bus stop areas, which would provide new sheltered waiting areas, and more accessible boarding provisions. Integration with bus stops would also be especially useful for the purpose of facilitating last-mile connections to/from transit via micromobility.
- It is important to ensure that local bike lane infrastructure is in place in the areas surrounding hub sites. Ideally, hub sites along bus corridors should offer a connection to at least one north-south bike lane. In the case of JFK Boulevard, it is especially important to provide safe connections with areas to the south.
- Dockless E-scooter options could prove to be more useful in an outer location like Greenville, where users may have more dispersed trip destinations. Literature on micromobility suggests that dockless solutions may be more beneficial form an equity standpoint and given the more diverse set of demographics present around this particular site (combined with its geography), we feel that it would be an ideal case for dockless scooter implementation in Jersey City.

Ninth & Congress

History and Background

One of the hub priority locations earmarked in Jersey City's 2022 *Alternative Transportation Modes Assessment* is located in the Heights in Jersey City. At the top of the Palisades, the Heights is bordered by Paterson Plank Road (see Figure 27) and Union City to the north; the City of Hoboken borders the east; and State

Route 139 borders the west. municipality called Hudson City and became a suburban-like community for middle-class families (New Jersey City University, n.d.). Slowly, Irish-immigrant railroad workers and German merchants and their families also settled here. In response to Hudson City's increasing population, its civic interests became more aligned with those of its neighboring towns. Residents of Hudson City voted in 1870 to give up their independent political status, under the name "Jersey City," in order to consolidate with Bergen and Jersey City. Between 1886 and 1949, there was an elevated railroad for trolley car service between Hoboken Terminal and Jersey City.

[Figure 27] View of Paterson Plank Road taken from postcards. Source: Riverview Neighborhood Association.

Today, the Heights area is known for its historic sites, such as Washington Park and the 1742 Van Vorst House built during Dutch settlement. Due to the relative affordability of housing and the diversity of transportation options available in the Heights, parts of the neighborhood are experiencing gentrification (Central Ave Special Improvement District Management Corporation, n.d.)

The two illustrative hub locations explored in the Heights are located in at Washington Park and at the Ninth and Congress light rail station. The Ninth and Congress station, located between the ends of Eighth and Ninth Streets in Hoboken along the private right of way adjacent to Jackson Street, has an elevator and pedestrian bridge up the "Palisade" to the foot of Congress Street, Jersey City, at its intersection with Paterson Plank Road. This station opened on September 7, 2004. Washington Park is a 100-year-old, 22-acre park in Hudson County between Union City and Jersey City (Washington Park Association of Hudson County, n.d.).

The Heights has been identified in the Jersey City's 2022 *Alternative Transportation Modes Assessment* as a neighborhood that relies more on transit, but has relatively poor access to transit, creating a transit desert. The report also stated a significant

number of commuters travelling within the Heights and need to improve microtransit services.

Neighborhood Characteristics

Located in Ward D, the Heights is one of the more densely populated neighborhoods in Jersey City. With a total population of 55,624 people (U.S. Census Bureau) and a population density of 33,580 people/sq mile, it is denser than the Jersey City average. Thus, it's a smart location for a mobility hub as it can serve a huge proportion of the city's population. It is also an incredibly diverse neighborhood with more than more 50% of the neighborhood identifying as non-white. Residents most commonly identify their ethnicity as Hispanic (45%) or Asian (24.6%). This neighborhood also boasts a high immigrant population and thus the estimated percentage of all people aged five and older who were non-English speaking, between 2017-2021 is approximately 20%.

Economically, the Heights is comprised mostly of two- and three-family houses and remains generally middle-class. The average median household income is approximately $67,000 though it varies in different census tract from approximately $35,000 to $80,000.

Land Use/Land Cover

Using New Jersey Land Use/Land Cover data, we can see that the neighborhood around the two mobility hubs is mainly a high-density, residential area with a wide range of housing options from single family homes to mid-high condominiums or multiple dwelling. The neighborhood also has a high concentration of commercial and office space. The Heights is also a very green neighborhood, home to various parks. One of the main one is Washington Park, which is shared by Union City and Jersey City, and is an ideal location for leisure and recreational enjoyment. It contains green, passive areas with its shady and winding walkways. The other park is the Riverview Fisk Park located on Palisade Avenue, only a short walk from the Ninth and Congress Light Rail Station. This park is a major spot for community gathering and has multiple amenities that are valuable to mobility hubs such as EV charging stations, a community garden, library, and Citi Bike docking station.

Activity Generators

The neighborhood offers several community and economic hubs that contribute to its vitality and appeal. Just within the neighborhood, there are more than ten non-profit locations. Institutions include the Hudson City Branch Library, multiple public schools, and the Eastern International College. In addition, the

neighborhood contains numerous religious and cultural sites. There are a few hospitals located in the neighborhood, the largest one being the Christ Hospital which is one of the area's largest employers. It offers a variety of medical services, including emergency care, surgery, and rehabilitation. Central Avenue, near both locations of the proposed mobility hubs is a bustling commercial corridor with more than 240 businesses serving the area. There are also different community centers in the Heights such as the Heights Vietnam Veterans Memorial Community Center.

Microtransit Services

In terms of Microtransit, Via is a popular option. There are two zones which Via serves: The Central Zone and the Outer Zone. Table 4 below lists the number of rides in each ward, with Ward D representing Ninth and Congress. Via pick-ups and drop-offs are the lower for Ward D compared to all other wards, indicating Via services should be improved near the hub which is located in the Outer Zone. Considering that Ward D has a lower median household income compared to the other wards, it's beneficial to provide microtransit services for the community which have cheaper fares.

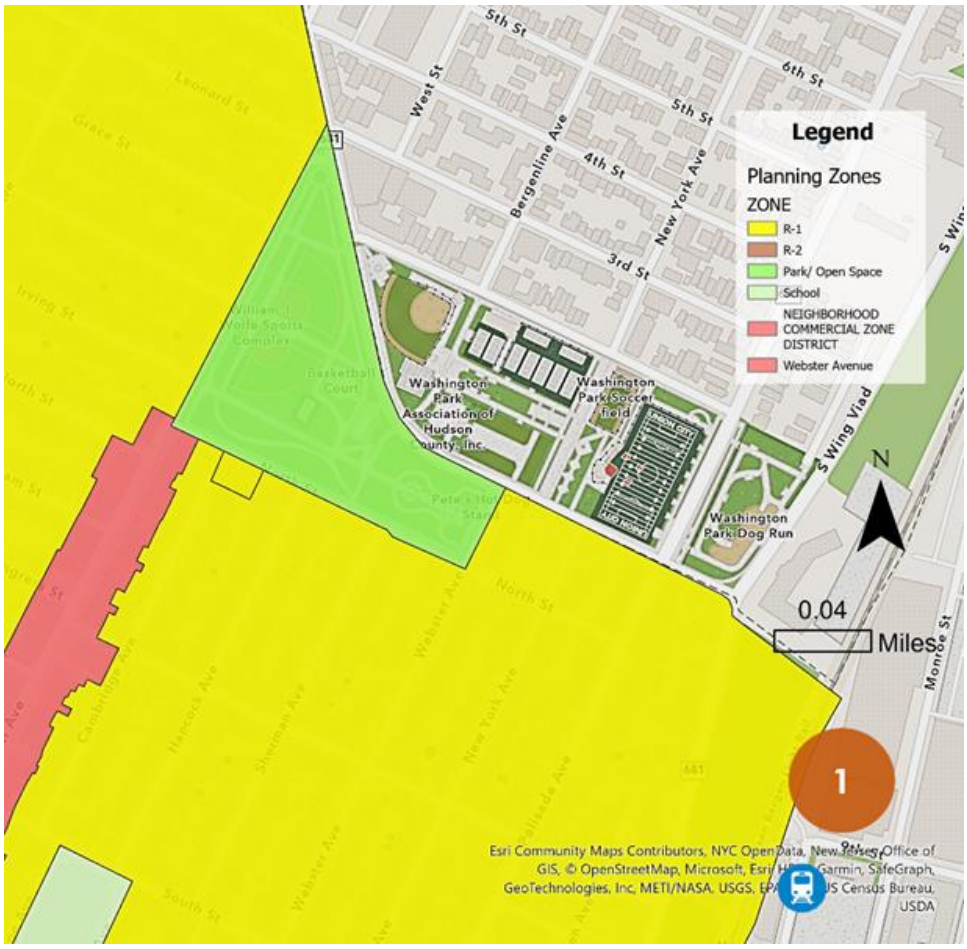
	Ward A	Ward B	Ward C	Ward D	Ward E	Ward F
Pick-ups	17,293	21,796	22,967	16,585	23,714	23,563
Drop-offs	15,453	17,222	26,358	15,172	31,758	19,955

[Table 4] Ward microtransit usage by the numbers.

Navigating the Neighborhood

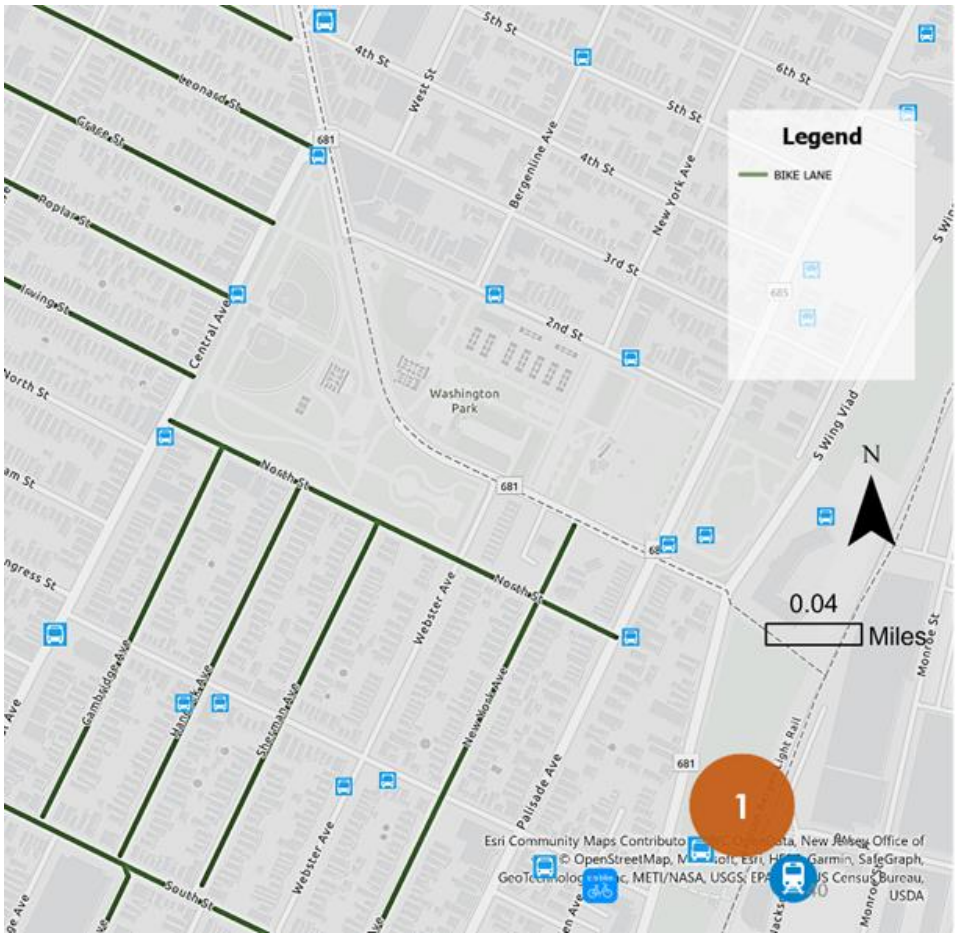
The study area for this report is centered around the Ninth and Congress Station in Jersey City, along with its surrounding neighborhood. Figure 28 presents a zonal map, which highlights the different zones in the area. The majority of the land near the train station is designated as R-1 zone, while a commercial zone is situated along Central Avenue. Additionally, the Christa McAuliffe Elementary School is

located in this area. Two parks: Washington Square Park and Riverview-Fisk Park, are also situated in the neighborhood.



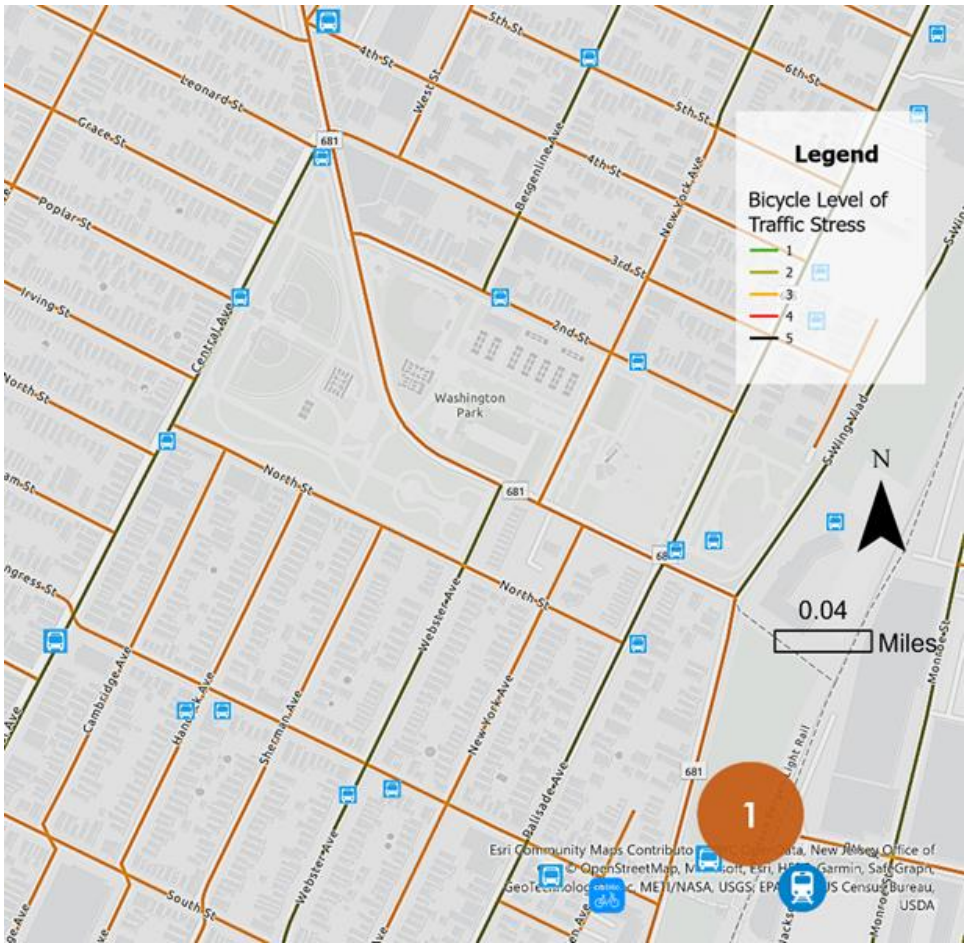
[Figure 28] Zoning map of Ninth Street Light Rail Station neighborhood.

Figure 29 displays existing bike lanes in the area. Several streets, including North Street, New York Avenue, Sherman Avenue, Hancock Avenue, Cambridge Avenue, Irving Street, Popular Street, Grace Street, and Leonard Street, have designated bike lanes that connect well to Washington Square Park. This map provides important information for cyclists in the area, as it highlights the best routes to take to reach the park safely.



[Figure 29] Bike lane map of Ninth Street Light Rail Station neighborhood.

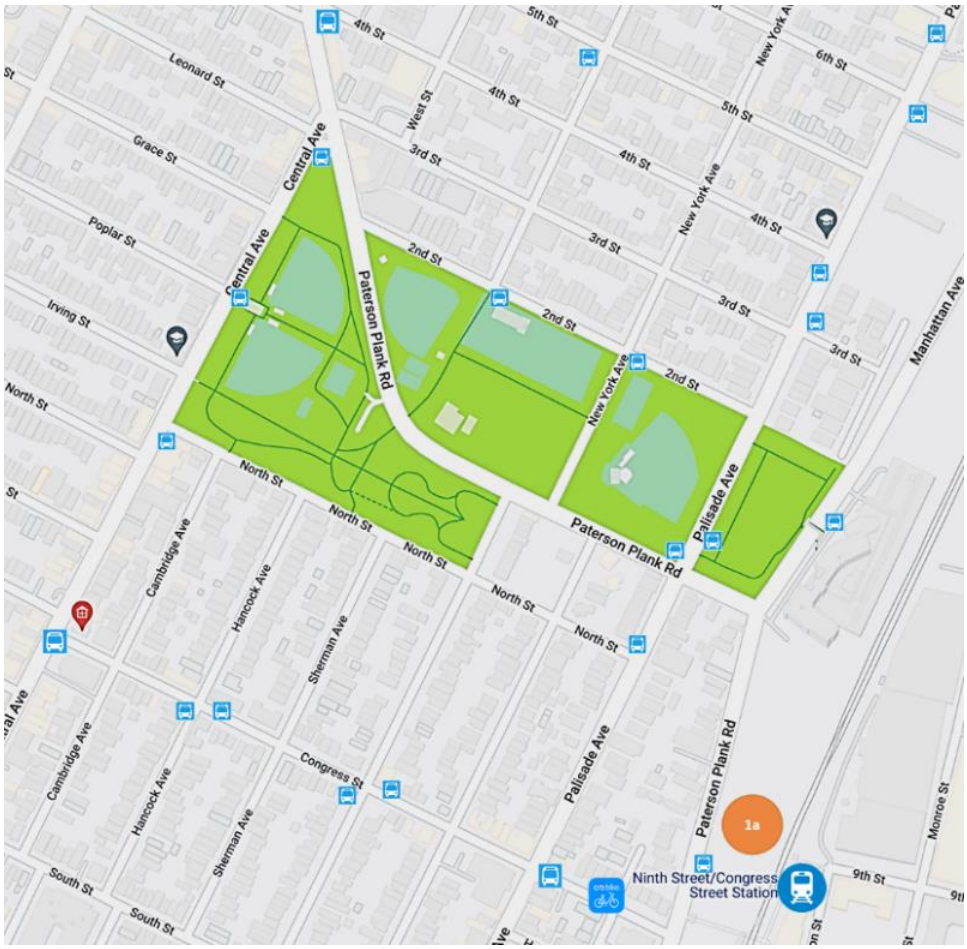
Figure 30 is a bicycle traffic stress level map, which represents the different roadways in the area based on their level of stress for cyclists. The study for this map was conducted by the NJTPA in January 2023. Each roadway is assigned an level of bicycle compatibility (LBC) score ranging from 1 to 5. Roads with an LBC of 1 are more likely to be used by all cyclists, while those with an LBC of 4 are only likely to be used by the most experienced cyclists. Upon observation of the map, it is noted that the streets with designated bike lanes typically have a LBC of 3, while the commercial street, Central Ave, has an LBC of 5. This information provides insight into the level of difficulty for biking in the area, making it moderate for cyclists.



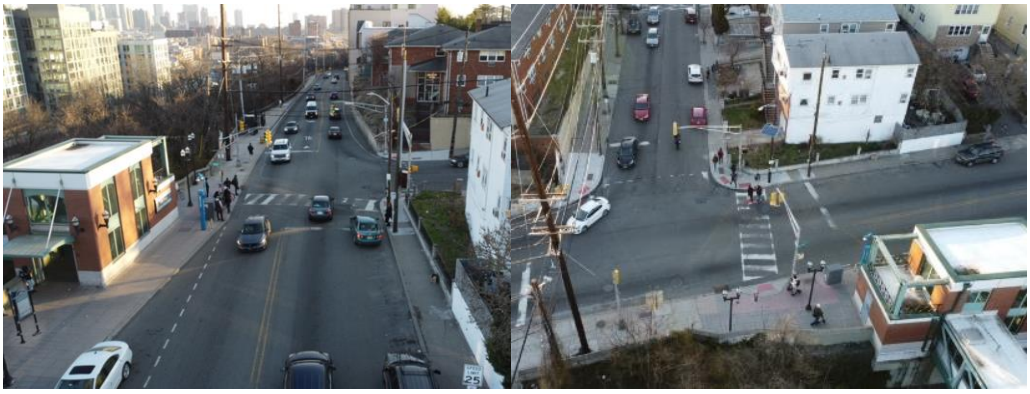
[Figure 30] Bicycle Level of Traffic Stress of Ninth Street Light Rail Station neighborhood.

Primary Site: Ninth Street Light Rail Station

The first site we propose for the mobility hub is at the Ninth and Congress Light Rail station as shown in Figures 31 and 32.



[Figure 31] Location of proposed mobility hub site at Ninth and Congress Light Rail Station.

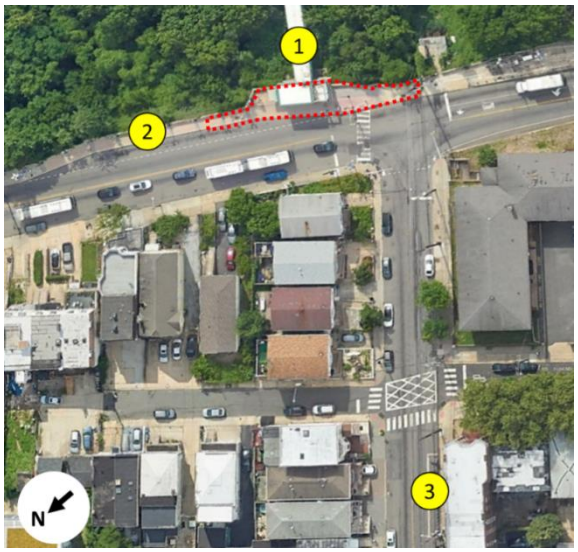


[Figure 32] Potential mobility hub site at the Light Rail Station (left) and Congress Street at Paterson Plank Road (right).

Site Evaluation

The mobility hub at Ninth and Congress covers an area of 1,500 square feet around the light rail station on the Jersey City municipal border. As shown in Figure 33, the mobility hub site is well connected to multi-modal transportation services, including Hudson-Bergen Light Rail station (1), NJ Transit bus (2), and Citi Bike station (3). The Citi Bike station with 18 bike docks is 275 feet from the proposed site. The site also has existing bike racks and information boards.

Figure 34 illustrates existing site characteristics. There are no benches or shelters available at the site. There are also no bollards to protect the area from oncoming vehicular traffic. The mobility hub will be located on the sidewalk around the light rail station, thus easily accessible by a sidewalk. The width of the sidewalk immediately leading to the site is 8 ft. to 9.5 ft., and the condition is good. Some sections of the sidewalk need improvement as there is an obstruction on the sidewalk, hindering the movement of wheelchair users. ADA curb ramps are at the nearest intersection (Congress Street at Paterson Plank Road) but need improvement. The condition of the pavement near the mobility hub is fair. There is high vehicular traffic during weekday rush hours and weekend evenings. There are sufficient pedestrian crossing points at the nearest intersection, but the paint has worn away. There are no bike lanes on Paterson Plank Road or Congress Street that provide direct access to the mobility hub. However, there are bike lanes present in the neighborhood. During the reconnaissance survey of the site, many users were observed to confidently use bikes and e-scooters in the vicinity. However, the users were riding on the sidewalk.



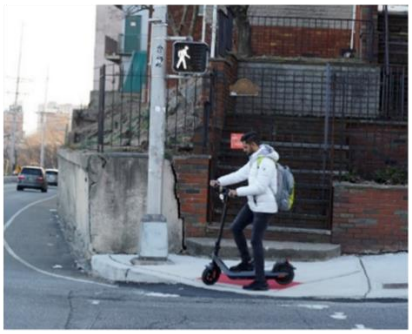
[Figure 33] Location of proposed mobility hub and nearby transportation facilities.

(1) Potential Location for Hub

(2) Potential Location for Hub (Existing Bike Rack)

(3) CITI Bike station

(4) CITI Bike User



(5) People riding on sidewalk

(6) Sidewalk in Poor Condition (for some stretches)

(7) Unmaintained Curb Ramps

(8) Obstacles on Sidewalks

[Figure 34] Existing site characteristics of the mobility hub site.

SWOC Analysis

We conducted a SWOC (Strengths, Weaknesses, Opportunities, and Challenges) analysis to identify the site's strengths and weaknesses and to assess the external opportunities and challenges that may impact the implementation of this mobility hub.

Strengths

- Proximity to existing transit facilities: The site is located close to different modes of transportation, such as the NJ TRANSIT bus stop, Hudson-Bergen Light Rail station, and CITI Bike station. It makes it convenient for users to transfer between modes during their journey.
- Low investment and high potential site: Due to proximity to different modes of transportation, the site has enormous potential to attract more users, and it will only involve a small investment to provide the facilities.
- Improved user experience: It will enhance the overall user experience by providing amenities such as real-time transit information, comfortable waiting areas, docking stations for bikes, and charging stations for electric vehicles, making travel more convenient and pleasant for users.
- Improved connectivity and access: This mobility hub will enhance connectivity and accessibility for the residents of Heights, creating a seamless and integrated transportation network that can improve the overall efficiency and effectiveness of the transportation network in the Heights.

Weaknesses

- Limited land for development: The site is proposed around the existing light rail station, thus, has limited land for development.

Opportunities:

- Multi-modal integration: This mobility hub brings together different modes of transportation, including light rail, buses, rental bikes, and e-scooters. Incorporation of innovative tech: The mobility hub will include innovative technologies such as smart devices, interactive information boards with Wi-Fi, advanced lighting, and safety enhancements.
- Immediate implementation: The hub can be implemented immediately due to limited infrastructure investment and proximity to different transportation modes.

- Community engagement: The hub will provide a focal point for community engagement and participation, involving local stakeholders in the planning, design, and operation of mobility hubs and addressing their needs and concerns.

Challenges

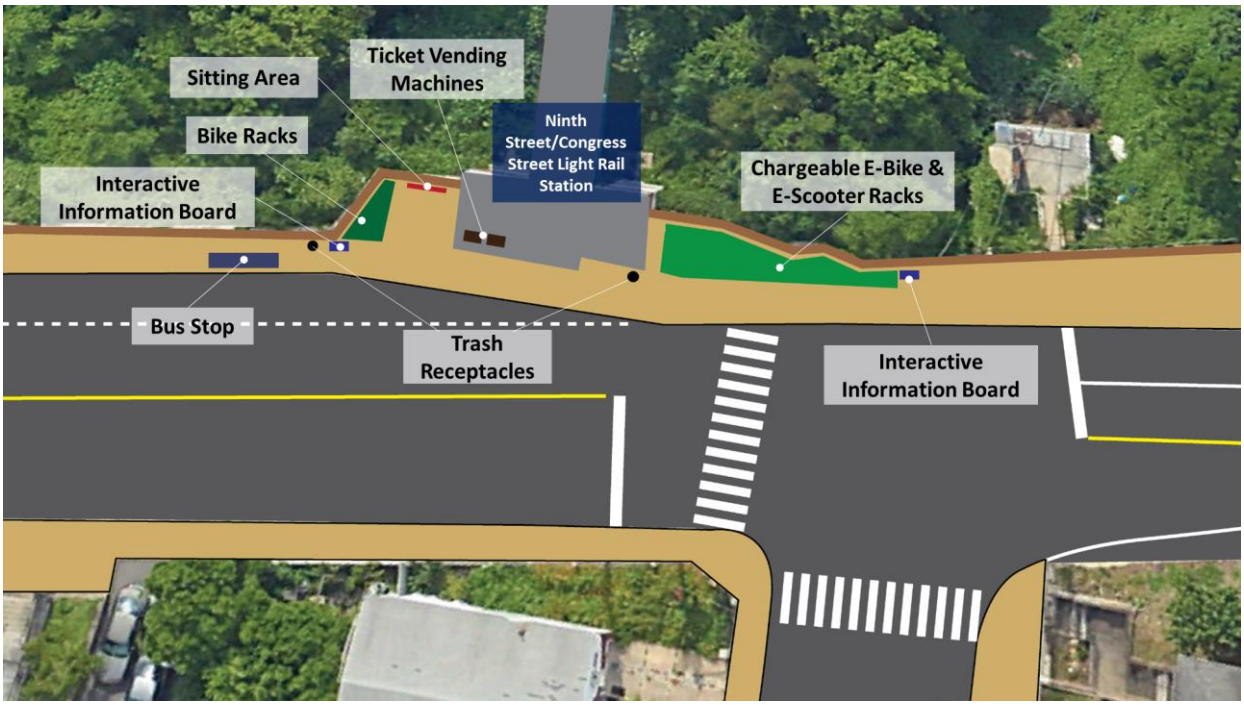
- Coordination and Governance: The mobility hub will require coordination and collaboration between various stakeholders, such as transportation agencies, local government, and private companies, which can be complex and challenging.
- Infrastructure Requirements: The mobility hub require significant infrastructure investments, such as providing interactive information boards with Wi-Fi and charging facilities, improvement in sidewalks and crosswalks, providing docking stations for bikes, etc. Providing these facilities may pose financial and logistical challenges.

Site Plan

The proposed mobility hub would include the following amenities:

- Docking station for bikes: Designated areas with bike racks where people can securely park their bikes.
- Chargeable electric bike and scooter docking station: This designated area is similar to a bike docking station, but it would be specifically for electric bikes and scooters as it will allow users to charge their electric bikes and scooters.
- Interactive information boards: Digital displays that will provide real-time information about different transportation options, such as the NJ TRANSIT bus schedules, Light Rail schedules, etc. The boards would also provide access to free Wi-Fi and charging spots for people to charge their phones or other devices.
- Sitting areas: Benches would be included in the mobility hub design where people can sit and wait for the bus or light rail.
- Ticket vending machines: Ticket vending machines for the for the light rail station and bus shall be provided inside the light rail station building.
- Trash receptacles: To keep the mobility hub clean, trash receptacles will be provided on either side of the light rail station.

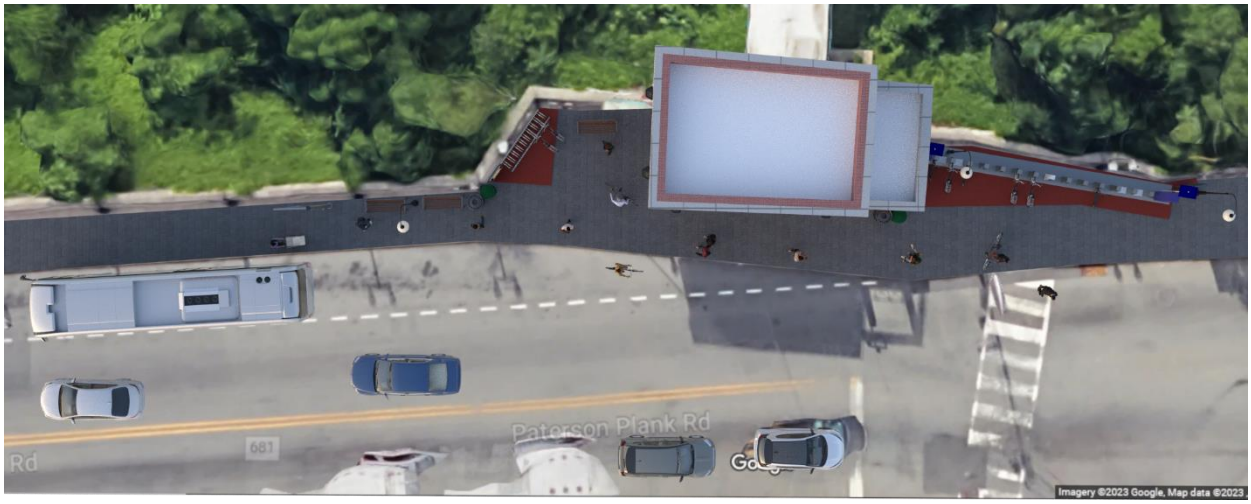
The site plan of the proposed mobility hub is provided below in Figure 35:

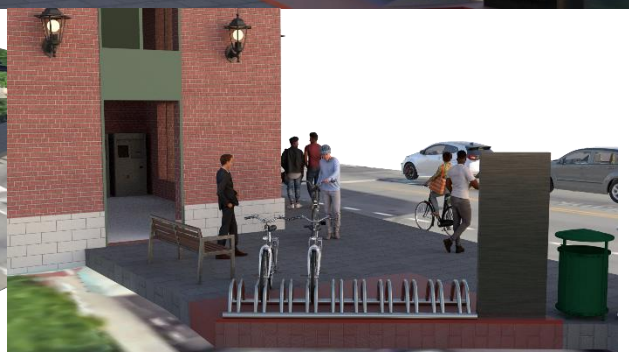


[Figure 35] Site Plan of the proposed mobility hub at Congress and 9th Street Light Rail Station

3-D Rhino Model of the Mobility Hub

Figure 36 below shows a 3-D model of the proposed mobility hub prepared in Rhino software.


Paterson Plank Rd
687
Imagery ©2023 Google, Map data ©2023



[Figure 36] Proposed hub at Congress and 9th Street Light Rail Station using 3D modeling.

Additional Recommendations

The mobility hubs in the Heights will enhance the connectivity and accessibility for the residents. The mobility hubs will provide access to multi-modal transportation. They will include innovative technology such as interactive information boards, advanced lighting, and charging docking stations for e-bikes and e-scooter. Other than these facilities, the mobility hubs in Heights will address the following considerations:

- Focus on Equity: Adding micromobility options will improve last-mile access for residents in the Heights neighborhood.
- Adequate Infrastructure and well-kept streets and sidewalks are essential for successful mobility hubs.
- A collaborative effort involving multiple stakeholders, including public agencies, transportation providers, and private developers, would ensure that the needs of all parties are met.
- A sustainable and Environment-Friendly Hub using solar panels would offload the Environmental impact of the hub.
- Create Traffic Garden for better community engagement.
- Partner with local businesses and organizations to offer discounts and promotions to visitors who use the mobility hub.
- Implement a data collection system to track visitor transportation patterns and preferences, allowing for informed decision-making and future mobility initiatives.

Alternative Site: Washington Park

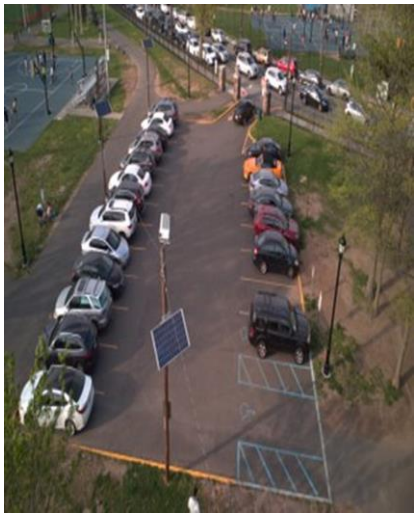
We have also proposed an alternative site for a mobility hub, located in the parking space of Washington Park. Because the park is owned and maintained by the Hudson County and is a shared recreational space between Union City

and Jersey City, we are aware that there might be administrative issues and thus it may not be the easiest place to propose a mobility hub. That being said, the aim of this place was to showcase how parking lots and parks can become a pivotal space for community engagement and also increase mobility options if utilized correctly.

[Figure 37] Washington Park in Jersey City, Courtesy of Google Photos.

Washington Park is a 100-year-old, 22-acre park in Hudson County (shown in Figure 37). It is maintained by Hudson County and has a rich history of providing an ideal location for leisure and recreational enjoyment. It is home to a variety of activities and sports and makes a great place for a mobility hub due to its location nearby major transit hubs and rail lines. The park is generally well maintained by the Washington Park Authority and contains basic necessities such as restrooms, drinking fountains and benches.

Evaluation of Alternative Site



[Figure 38] Exact location of the potential mobility hub site at the Washington Park.

The 6,715 square foot parking lot is an ideal size for a medium size mobility hub (Figure 38). Due to its size, it can offer more amenities beyond micro-mobility options. The M hub site is well connected to multi-modal transportation services. It is a seven-minute walk from the Ninth Street light Rail Station and can be accessed via four NJ TRANSIT buses: the 30, 84, 85 and 86. It is also a 7-minute walk from a Citi Bike station.

The park contains many recreational facilities and basic amenities such as restrooms, drinking stations and benches that makes it an ideal site for a mobility hub. The parking currently incorporates solar panels, making it a more sustainable option. However, some of the sidewalks outside the park, especially along North Street and Central Avenue are narrow and broken and need to be repaired for better transport and mobility. They also need to be widened to make it ADA-compliant. There is high vehicular traffic during weekday rush hours and weekend evenings. There are no bike lanes on Paterson Plank Road, North Street and Central Avenue that provide direct access to the mobility hub as well. During our site evaluation, we observed many people using bikes and e-scooters outside the park to get around. Some children were using scooters inside the park as a recreational activity.

[Figure 39] Existing site characteristics of the mobility hub site.

SWOC Analysis of Alternative Site

Strengths

- The mobility hub site is at a central location in a historical and popular park with high foot traffic and access to public transportation
- The park contains many recreational facilities and basic amenities such as restrooms, drinking stations, and benches.
- Opportunity to enhance the overall visitor experience by providing convenient access to park amenities and information.
- The mobility hub can help reduce traffic congestion and improve air quality in the area.
- Safe walking, biking, and scootering areas with secure parking options.

Weakness

- Currently there are no protected bike lanes in the site vicinity which makes mobility inaccessible and unsafe for pedestrians and cyclists.
- There can be potential safety concerns associated with increased pedestrian and cyclist traffic in the park.
- Limited space in the park may make it challenging to accommodate a large mobility hub with a variety of transportation options.
- Implementation of a design principles require support from other jurisdictions, which is a regulatory barrier.

Opportunities

- The mobility hub will give us an opportunity to introducing Via pick-up / drop-off locations in Ward D (where the park is located) which currently is outside of Via's ridership location. It can be a mutually beneficial partnership with Via.
- It can provide a range of sustainable transportation options, such as ridesharing and electric vehicle charging.
- It can increase transit ridership for residents, employees near the mobility hub.
- It is large enough to offer EV charging.

Challenges

- There will be regulatory challenges associated with implementing a new transportation service in Washington Park as it is owned by Hudson County and is a shared space with Union City.
- Infrastructure Requirements: The mobility hub site requires significant infrastructure investments, such as the repair and maintenance of sidewalks, adding EV charging hubs, and providing interactive information boards with Wi-Fi.
- The sidewalks around the park vary regarding width. Some of the sidewalks such as on North Street is not wide and a has a lot of obstacles in the way which makes into not ADA-compliant.

Street Analysis

Site visits were conducted for each proposed micromobility hub site. These site visits consisted of analyzing the existing sidewalk conditions, roadway conditions, and existing bicycle infrastructure. The sidewalk segments were graded on a scale of good, moderate, and bad. A green line illustrates the segment as having good conditions, yellow is moderate, and red is bad. It is very important to analyze the surrounding conditions of the sidewalks and roadway conditions before implementing a mobility hub to ensure the area is safe for pedestrians to access the site and use the micromobility options safely. Maps displaying the sidewalk conditions within close proximity to each proposed micromobility site can be found in Figure 40, Figure 18, and Figure 20. For this study we used the Paser Concrete Roads Manual as a guide for creating our own criteria to rank the existing sidewalk conditions. (Donald, Walker. (2015) Paser Manual Concrete Roads). Additionally, we used the Paser Asphalt Roads Manual to identify

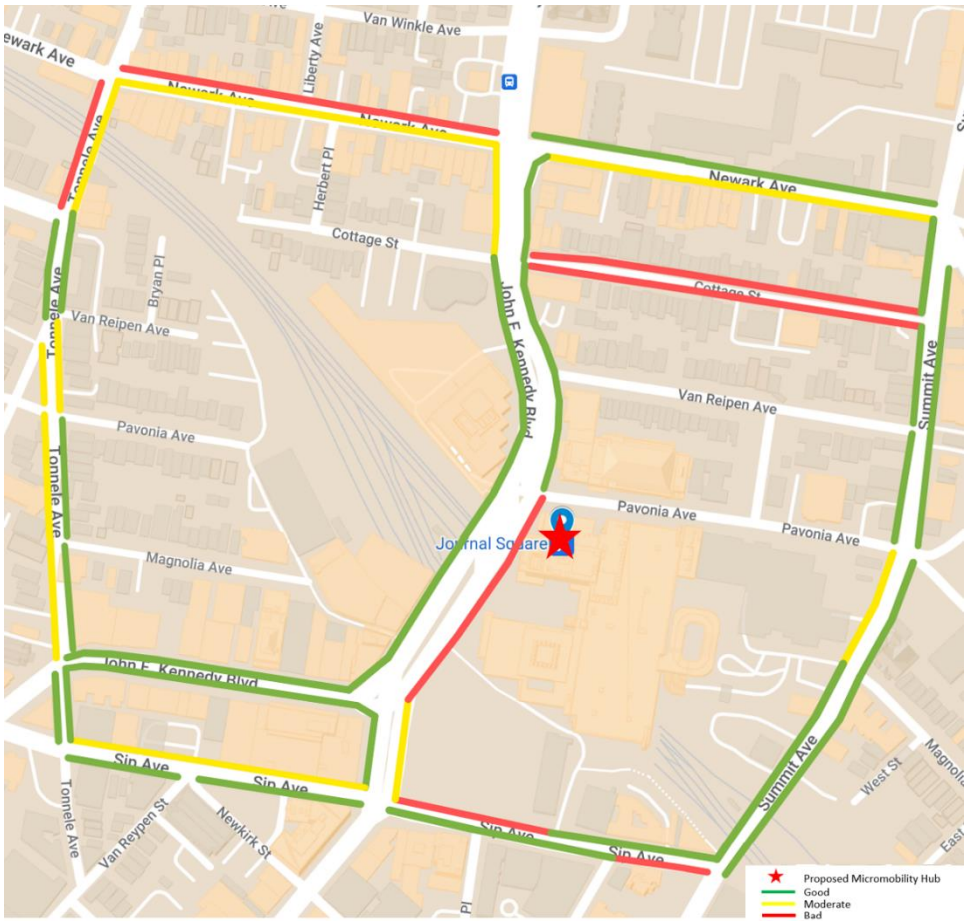
potential roadway issues around the proposed sites. (Donald, Walker. (2002) Paser Manual Asphalt Roads).

Journal Square

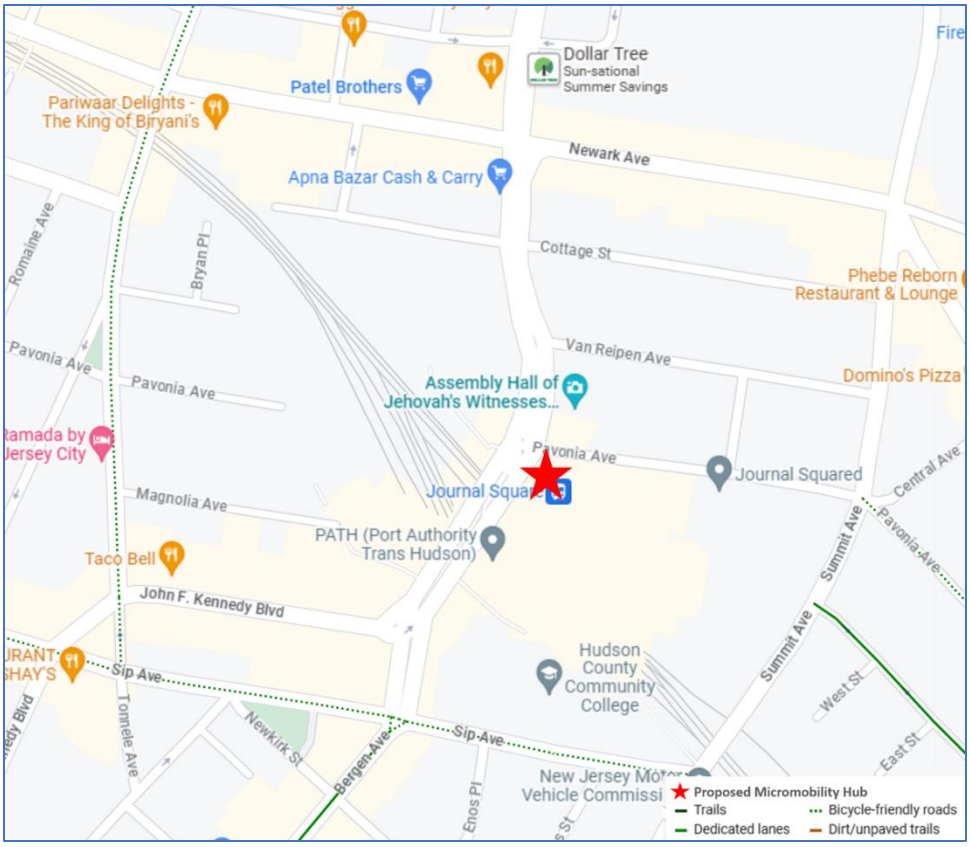
Sidewalk and roadway conditions around Journal Square are either good (green) or moderate (yellow). For the sidewalk conditions, many sidewalk sections south and east of Pavonia Ave (namely JFK Boulevard, Summit Avenue, and sections of Sip Avenue) are in relatively good conditions. However, there are multiple ongoing real-estate developments in this part of the neighborhood, resulting in temporary replacement or removal of the existing sidewalks. Particularly, the three red-colored sidewalk sections on Sip Avenue are due to very low visibility (from sections away), unsatisfied conditions (low width, lack of ADA accessibility, inconvenience), or lack of existing sidewalk. Since our proposed hub location at Journal Square is in the corner of Bergen Avenue and Sip Avenue, the sidewalk conditions in the surrounding streets should be highlighted so that pedestrians can have easy access to the hub. In terms of the streets north of Pavonia Avenue (Van Reipen Avenue and Cottage Street), the overall sidewalk conditions are less pleasing. The sidewalks along streets that mainly hold local traffic are less adequately maintained, leading to more cracks or unevenness. Because buildings on both sides of these streets are residential, there are also other obstacles on sidewalks including cars in driveways or bulky trash bags waiting for collection, which can also be seen on sections along Tonnele Ave. Lastly, Newark Avenue and the north tip of the evaluated part of JFK Boulevard has a lot of small businesses and a large pedestrian volume so the sidewalk can become overcrowded, which means any deduction of the current sidewalk can exacerbates the pedestrian flow. However, it was observed that, besides unevenness, cracks, or different pavement materials, many businesses in this area are utilizing the sidewalk to sell or stock products, hence some of the sidewalks are inaccessible to the pedestrian.

The bicycle layer of Google Maps (Figure 41) shows that the current biking and scootering environment around Journal Square can be greatly improved. Among the inspected sections, there are no dedicated bike lanes. Tonnele Avenue and Sip Avenue are the only two roads in the corridor that are "bicycle friendly." As a result, it poses a great challenge to get around the area on a non-motorized, two-wheel vehicle. To implement the micromobility hub on the corner of Bergen Avenue and Sip Avenue, it is strongly suggested that the adjacent streets be redesigned to be micromobility-friendly with dedicated lanes and other facilities. It would also be beneficial if JFK Boulevard, as the county road, can be modified to be inclusive of bike and scooter travels. See Figure 18 which shows the existing Dedicated Bicycle Lanes and Bicycle Friendly Roads.

The roadway conditions around Journal Square are generally good. There are no notable cracks or bumps on most of the driving lanes and many of the sidewalk sections, but the street markings are faded; repainting should be considered. One potential rehabilitation is to make is to improve the unevenness at the edge of some of the streets. For example, the street sides along Tonnele Avenue are sloped down. The slope not only creates challenges for a micromobility-rider to keep the direction, it can also create standing water between the street edge and the curb after precipitations, which may lead to unpleasant experience for micromobility users. Thus, the streets should be leveled or have better permeability to avoid such an issue. It is to note the site visit was conducted during the daytime when sunlight was sufficient. Before introducing micromobility to this part of the city, additional evaluations should be done during different hours to inspect the street conditions in other contexts.



[Figure 40] Google My Maps View Displaying Sidewalk Conditions Near Proposed Mobility Hub. April 26, 2023, Google Imagery, https://www.google.com/maps/place/Jersey+City,+NJ



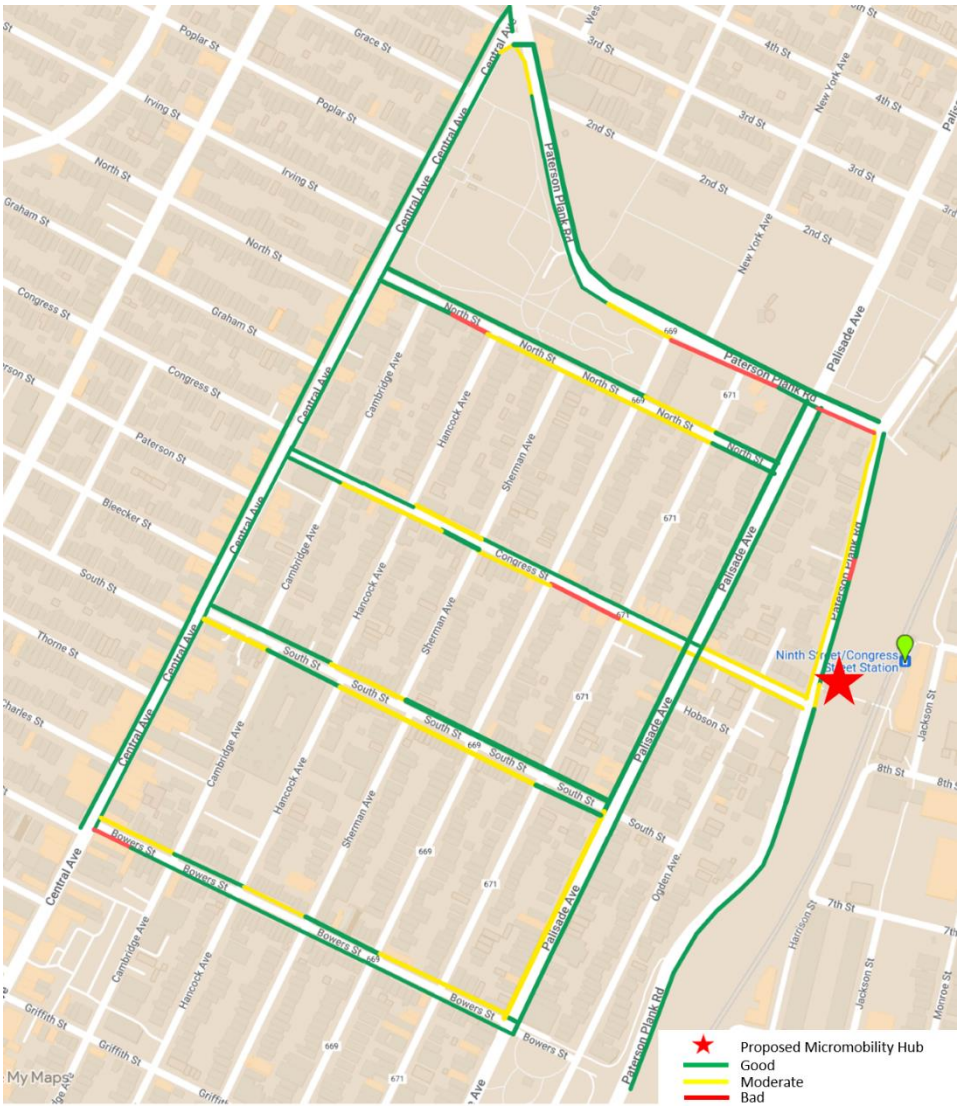
[Figure 41] Google Maps View Displaying Proposed Mobility Hub Location and Surrounding Area Bicycle Infrastructure. April 26, 2023, Google Imagery, https://www.google.com/maps/place/Jersey+City,+NJ

Ninth & Congress

The majority of sidewalk and roadway conditions on the main roads near the Ninth and Congress Light Rail Station are in good condition (green) or moderate condition (yellow) (Figure 42). For the sidewalk conditions, a few areas present bad conditions (red), which means it is dangerous for pedestrians and micromobility users. The bad conditions reflect highly damaged sidewalks, unsafe gaps between sidewalk sections, and/or a section of the sidewalk not being ADA accessible in width. It is highly recommended that action is put towards repairing the sidewalk segments that are listed as bad (red) in the map shown in Figure 42. These sections create safety concerns for pedestrians and ADA accessibility. Moderate conditions (yellow) should be monitored and repaired as needed. Most of these segments are showing extended signs of cracking, minor gaps between segments, and material changes. These segments will likely need to be repaired in the near future and should be re-evaluated prior to a micromobility hub being implemented. The good conditions (green) display areas that were recently repaired or are brand new, and/or have minor cracking.

According to the Google Maps bicycle layer, the area around Ninth and Congress Light Rail Station has many streets going east to west labeled as having dedicated bike lanes. Two of the main roads: Central Avenue and Palisades Avenue are labeled as bicycle-friendly roads. It would be beneficial for Jersey City to add dedicated bicycle lanes on Paterson Plank Road if a micromobility hub is implemented at the Ninth and Congress location. This will help increase the safety of bicycle users and continue to create better connectivity throughout this area of Jersey City. See Figure 43 which displays the existing Dedicated Bicycle Lanes and Bicycle Friendly Roads.

From the site visit, the roadway conditions of this area appeared to be in overall good condition. A few areas presented pot holes or a poor repair job. One of the main roads which presented concerns is the roadway on Paterson Plank Road at the corner of Congress Street. This intersection has a stormwater grate in the ground where asphalt has begun to chip away. This resulted in a bump in the road connecting the asphalt to the stormwater grate which poses a safety hazard for pedestrians and micromobility users. Additionally, along Palisade Avenue between North Street and Congress Street utility work had been done which required part of the asphalt to be ripped up and repaired. The repair job was poor and left a large portion of Palisade Avenue unsafe for micromobility users to ride on the right of way of Palisade Avenue going north to south. The repaving work done is uneven to the prior paving which resulted in additional cracks and uneven pavement. This area should be further evaluated to see if repaving should be done to ensure the safety of micromobility users.



[Figure 42] Google My Maps View Displaying Sidewalk Conditions Near Proposed Mobility Hub. April 26, 2023, Google Imagery, https://www.google.com/maps/place/Jersey+City,+NJ

[Figure 43] Google Maps View Displaying Proposed Mobility Hub Location and Surrounding Area Bicycle Infrastructure. April 26, 2023, Google Imagery, https://www.google.com/maps/place/Jersey+City,+NJ

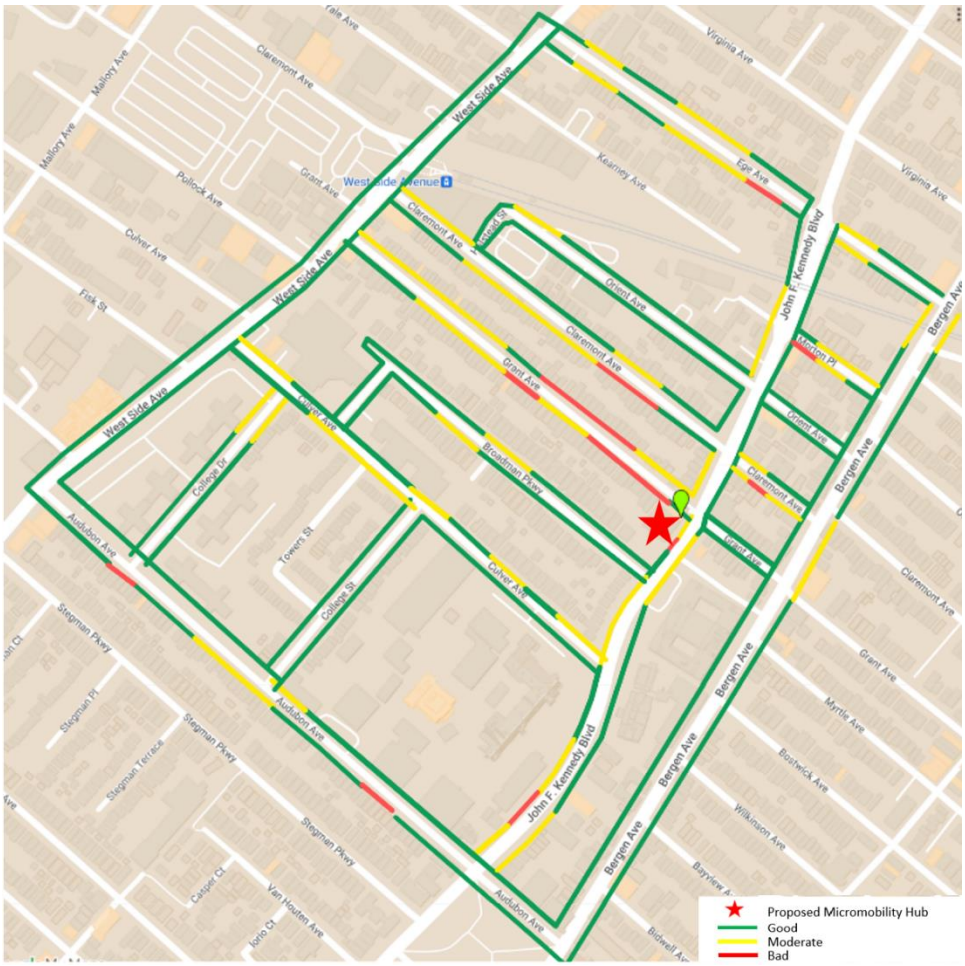
JFK Boulevard

The sidewalk and roadway conditions near the site are in poor condition. Specifically, outside of the vacant Comcast building where the mobility hub is proposed to be located and on adjacent Grant Avenue between John F. Kennedy (JFK) Boulevard and West Side Avenue. On that portion of Grant Avenue, most of the sidewalk segments are moderate (yellow) or poor (red). The conditions here present a mix of uneven segments, dangerous cracks, and areas of the sidewalk, not ADA-accessible in width. With a large amount of area presenting moderate to bad conditions, it is recommended that the sidewalks are repaired to create a safe atmosphere for pedestrians and micromobility users. The main priority here is the area where the hub is proposed to be located, along Grant Avenue, and the areas on JFK Boulevard that have moderate and bad existing conditions. During the site visit, it was found that the sidewalks on JFK

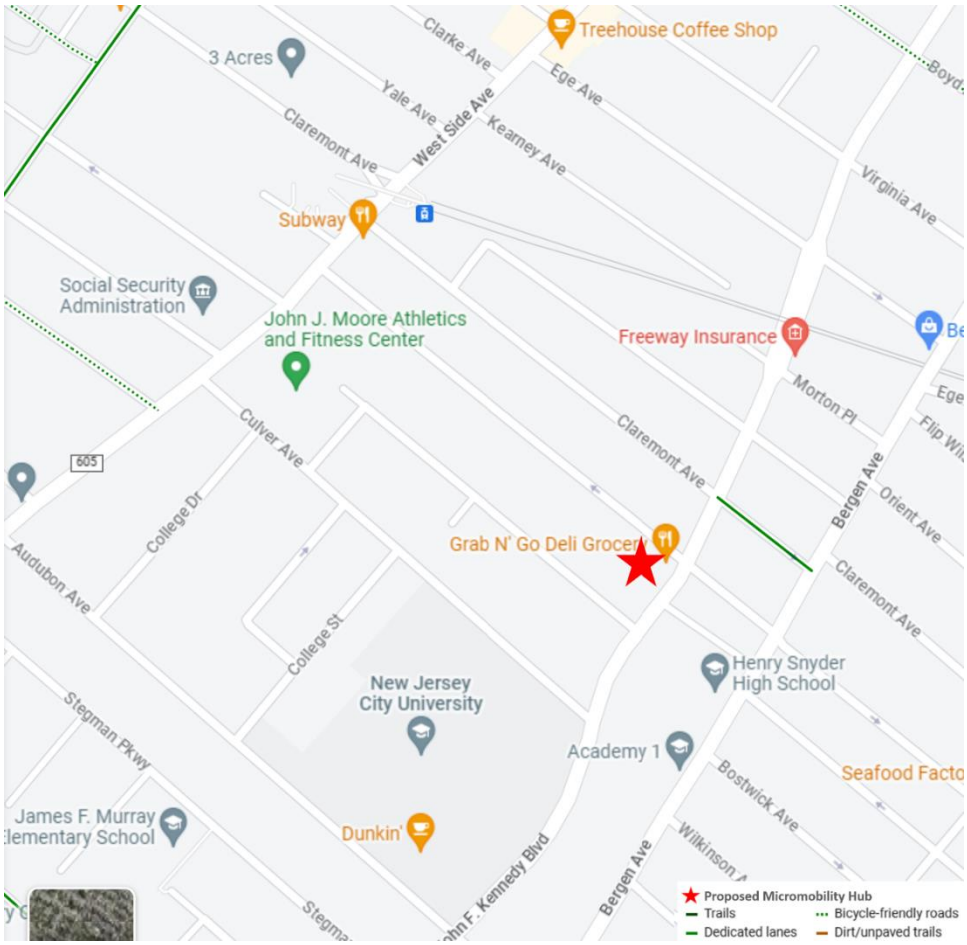
Boulevard presented a large amount of litter. This is also something that can impact the user experience and should be addressed by increasing the number of garbage cans along the corridor. West Side Avenue and Bergen Boulevard both scored high in this analysis, presenting overall good conditions in a majority of the sections of those streets that were analyzed. Figure 44 displays the sidewalk conditions on a map view for the area that was surveyed.

According to the Google Maps bicycle layer, there is only one dedicated bike lane and no bicycle-friendly road within the study area. A dedicated bike lane is located on Claremont Avenue between JFK Boulevard and Bergen Avenue. This area needs to be updated to include additional bike lanes around the surrounding streets to increase safety for the users. JFK Boulevard is not pedestrian friendly due to the four lanes of traffic, the high rates of speed the vehicles travel, and no existing safety infrastructure implemented. JFK Boulevard is a county-maintained road which creates hurdles to making roadway improvements due to Hudson County approval requirements. It is strongly encouraged that dedicated micromobility lanes be implemented throughout JFK Boulevard and the surrounding area where the mobility hub is proposed. Figure 45 shows existing Dedicated Bicycle Lanes and Bicycle Friendly Roads.

From the site visit the roadway conditions of this area appeared to be in overall good condition. The crosswalk crossing JFK Boulevard at the corner of JFK Boulevard and Broadman Parkway has cracking and repaired potholes. This section is not level either as it presents a downslope at a small section here which can create potential safety concerns. It is important to note that JFK Boulevard is sloped and this can create some discomfort for micromobility users. Additionally, the streets near the site going east to west are at a high incline. This can make it difficult for micromobility users if the bikes/scooter are not electric. The geographic orientation of this area does prove some hurdles and further enhances the need for both quality roadway conditions and sidewalk conditions to ensure safety. Lastly, any of the streets going east to west have speed bumps on the roads and proper signage needs to be ensured that it is placed at every speed bump to ensure the safety of micromobility users. Prior to the installation of a micromobility hub, further investigation should be done to ensure the sidewalks and roadways are in a good and safe condition for pedestrians.



[Figure 44] Google My Maps View Displaying Sidewalk Conditions Near Proposed Mobility Hub. April 26, 2023, Google Imagery, https://www.google.com/maps/place/Jersey+City,+NJ



[Figure 45] Google Maps View Displaying Proposed Mobility Hub Location and Surrounding Area Bicycle Infrastructure. April 26, 2023, Google Imagery, https://www.google.com/maps/place/Jersey+City,+NJ

Limitations – County Roads

County ownership of certain streets is a significant limitation that must be addressed when planning for mobility hubs. Some roadways in Jersey City, such as JFK Boulevard, are owned by Hudson County. Any changes made within the county-owned portion of these rights-of-ways would require the county's approval. The nature of the approval process could vary, depending on the proposed alterations, although more significant changes could potentially require the involvement of the Hudson County Board of Commissioners.

Next Steps

Recommendations

General Recommendations

Throughout this report we have highlighted relevant findings and recommendations from our review of literature, plans and reports. The following general recommendations will support micromobility hubs and access for Jersey City residents city-wide. Following these are site-specific recommendations particular to conditions found at prototypical sites throughout Jersey City but which pertain to their respective prototypes. These recommendations are also intended to reflect goals found in JC On the Move, prioritizing equity, reducing transit gaps, and supporting greater cross-neighborhood connectivity.

1. Develop a high quantity of micromobility access points as a network before focusing on higher amenity hubs, to maximize ridership. Plans and reports from cities with established rideshare programs appear to prioritize the density of hubs rather than finding locations with ideal site conditions.
2. Concentrate early nodes of the network in neighborhoods currently underserved by transit to build a strong user base that represents a full cross section of Jersey City.
3. Implement a combination of docked and dockless scooters to complement docked Citi Bike system for greater access to crosstown/last-mile travel.
    a. Consider the city's approach to vendors of e-Scooters, the approach to regulatory frameworks for vendor relations, and device charging requirements in advance. The section of this report, Key Considerations for Jersey City on page 24, is intended to support the City of Jersey City with this process.
4. Integrate payment options into seamless contactless, accessible, methods; work jointly with PATH and NJT toward full MaaS package with Lyft, Via, or the Transit app.
5. Thoughtfully consider technology applications that further user utility and efficiency, such as digital wayfinding screens and smart street lighting.
    a. Many advanced technical applications are likely to depend on electricity and may require partnership and engagement with PSE&G.

Site-Specific Highlights

Major Transit Hub (Journal Square)

This site prototype provides opportunities to enhance transit-rich neighborhood by adding multimodal options to improve cross-neighborhood, north-south and/or local last-mile connectivity. Density and competing jurisdictions create challenges for sites on city land near transit and bike lanes. Local partners can be important allies.

Local Transit Hub (9th and Congress)

This site prototype provides opportunities to improve transit user experience and last-mile access for residents by adding multimodal options. Siting hubs as close as possible to transit sites is ideal, but limited land and/or non-city land ownership near transit can pose a challenge, as well as electrical infrastructure constraints. Thers is potential for high community engagement around these key local assets.

Neighborhood Hub (JFK Blvd)

This site prototype provides opportunities to enhance connectivity to neighborhoods, filling transit gaps and deserts in equity emphasis areas, and serve demand centers such as schools and parks. Infrastructure, including access to safe bike lanes and electricity, can be challenges. Strategies for these hubs can include bus stop and urban design enhancements.

Phase Implementation

The success of a mobility hub initiative will be driven by thoughtful phased implementation.

Establish robust city-wide micromobility network

Before constructing higher-end mobility hubs with rich amenities, a comprehensive coverage of the city with shared bicycle and scooter options should be established. This goal should be achieved using both expansions of Citi Bike stations and through implementations of additional electric scooter options. Additionally, more Via vans should be purchased to make the service more reliable for those not traveling on fixed routes. Without providing useful mobility service to most users not within the immediate catchment of a mobility hub, hubs will be underused. Concurrently, payment for these services should be refined in tandem with the development of electronic payment options on PATH and NJ TRANSIT so seamless MaaS can be in operation before higher-end mobility hubs are introduced.

Introduce Mobility Hub Pilots

When the previous phase is achieved, Jersey City will be ready for the implementation of a mobility hub pilot program. For this phase, we recommend the city choose to develop proposed sites close to one another, to facilitate hub-to-hub trips. The detailed sites in this report are a strong set because they generally follow a north-south corridor. With an expanded micromobility system, neighborhood travelers can feed into mobility hubs with transit access, and nearby hubs form a network with one another. The mobility hubs should be introduced with fully-developed technology and a consistent wayfinding scheme that can be easily expanded alongside the further construction of mobility hubs across the city.

Continued Expansion

After the launch of pilot hubs, their use should be studied over the course of at least one year to determine best practices, opportunities for improvement, and potential desirable characteristics of new locations. Once the mobility hubs have been firmly institutionalized as nodes of a greater multimodal network, new locations that extend the amenities of the pilot hubs should be considered and constructed.

Stakeholders

In order to maintain and sustain the mobility hub network throughout Jersey City, key players in the community must be involved in its continuous process. The Department of Transportation for Jersey City should continue to work with other local agencies including Hudson County's transportation department, the Port Authority of New York and New Jersey, NJ TRANSIT, and other private rideshare service companies that assist in the movement of Jersey City residents. Additional stakeholders that should be considered include members of the community who rely on the micromobility hub as a part of their everyday travel, and political figures who actively are engaged in ensuring the mobility hubs are properly maintained and funded for the future. PSE&G should also be included in ensuring that the electric grid for Jersey City is powerful enough to provide additional energy needed to operate the mobility hubs in their entirety and will not fail.

Bibliography

Aguilera-García, Á., Gomez, J., & Sobrino, N. (2020). Exploring the adoption of moped scooter-sharing systems in Spanish urban areas. *Cities*, 96. https://doi.org/10.1016/j.cities.2019.102424

Aguilera-García, Á., Gomez, J., Sobrino, N., & Vinagre Díaz, J. J. (2021). Moped scooter sharing: Citizens' perceptions, users' behavior, and implications for Urban mobility. *Sustainability*, *13*(12), 1-26. https://doi.org/10.3390/su13126886

Arseneault, D. (2022). Mobility Hubs: Lessons Learned from Early Adopters. *UCLA: Institute of Transportation Studies.* http://dx.doi.org/10.17610/T6N31C Retrieved from https://escholarship.org/uc/item/0np6b5sn

Beale, K., Kapatsila, B., & Grisé, E. (2023). Integrating public transit and shared micromobility payments to improve transportation equity in Seattle, WA. *Transportation Research Record: Journal of the Transportation Research Board*, *2677*(1), 968–980. https://doi.org/10.1177/03611981221103233

Bicket, R. (2020, September 21). *The first multifunction e-paper bus stop display goes on trial in Poland*. Papercast. Retrieved April 20, 2023, from https://www.papercast.com/partners/the-first-multifunction-e-paper-bus-stop-display-goes-on-trial-in-poland/

Borchers, C. (2014, June 15). *HelmetHub helps bicycle riders protect their heads*. Boston Globe. Retrieved from https://www.bostonglobe.com/business/2014/06/14/helmethub-kiosks-add-safety-boston-bike-rentals/vLGtNuMOUC4ZMpYxOoWHsN/story.html

Brady, M. (2023, January 30). DC launches public shared micromobility dashboard. *Smart Cities Dive*. Retrieved April 26, 2023, from https://www.smartcitiesdive.com/news/dc-public-shared-micromobility-dashboard-veoride/641519/

Cantilina, K., Daly, S. R., Reed, M. P., & Hampshire, R. C. (2021). Approaches and barriers to addressing equity in transportation: Experiences of transportation practitioners. *Transportation Research Record: Journal of the Transportation Research Board*, *2675*(10), 972–985. https://doi.org/10.1177/03611981211014533

Capital Bikeshare Development Plan. (2020, May). *Capital Bikeshare*. Retrieved April 4, 2023, from http://ride.capitalbikeshare.com/blog/capital-bikeshare-development-plan

Central Ave Special Improvement District Management Corporation. (n.d.). *About the Heights. Central Ave Special Improvement District Management Corporation*. Retreived from https://jcheights.com/our-neighborhood/about-the-heights/

Chen, M., Wang, D., Sun, Y. et al. A comparison of users' characteristics between station-based bikesharing system and free-floating bikesharing system: case study in Hangzhou, China. Transportation 47, 689–704 (2020). https://doi.org/10.1007/s11116-018-9910-7

City of Pittsburgh Department of Mobility and Infrastructure (DOMI). (2022, Oct. 13). *City of Pittsburgh Announces Mid-Pilot Report for the Move PGH Initiative*. Retrieved March 7, 2023, from http://pittsburghpa.gov/press-releases/press-releases/5889

City of Pittsburgh Department of Mobility and Infrastructure (DOMI). (n.d.). Order No: 21-0001. Retrieved from: https://apps.pittsburghpa.gov/redtail/images/15515_LOW_SPEED_ESCOOTER_POLICY_AND_OPERATIONS_FINAL_7.12.pdf

Clewlow, R., Foti, F., & Shepard-Ohta, T. (2018). (rep.). *Measuring Equitable Access to New Mobility: A Case Study of Shared Bikes and Electric Scooters* (pp. 1–9). San Francisco, CA: Populus.

Crozier, A. and Nisenson, L. (2022 Mar). Planning and Zoning for Mobility Hubs. *APA Zoning Practice*. Vol. 39, No. 3.

DC Department of Transportation. *Shared Fleet Device Program.*(n.d.). Retrieved April 25, 2023, from https://ddot.dc.gov/page/shared-fleet-device-program

Denver Public Works. (2019, Feb). *Denver Dockless Mobility Program Pilot Interim Report.* Retrieved from https://www.denvergov.org/files/assets/public/doti/documents/programsservices/dockless-mobility/denver-dockless-mobility-pilot-update-feb2019.pdf

Denver Public Works. (2021, Mar). *Denver Dockless Mobility Program Pilot Final Report.* Retrieved from https://www.denvergov.org/files/assets/public/doti/documents/programsservices/dockless-mobility/dockless-mobility-pilot-final-report.pdf

Denver's Scooter and Bike Share Program. (n.d.). City and County of Denver. Retrieved April 24, 2023, from https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Department-of-Transportation-and-Infrastructure/Programs-Services/Transit/Micromobility-Program

Essex-Hudson a "game-changer" for East Coast Greenway. (n.d.). Retrieved April 11, 2023, from https://www.greenway.org/stories/essex-hudson-a-game-changer-for-east-coast-greenway

Ferguson, B., & Sanguinetti, A. (2021). Facilitating micromobility for first and last mile connection with public transit through environmental design: A case study of California Bay Area Rapid Transit stations. *Proceedings of the Design Society*, *1*, 1577–1586. https://doi.org/10.1017/pds.2021.419

Glotz-Richter, M. (2016). Reclaim Street Space! – Exploit the European Potential of Car Sharing. *Transportation Research Procedia*, *14*, 1296–1304. https://doi.org/10.1016/j.trpro.2016.05.202

Haglund, N., Mladenović, M. N., Kujala, R., Weckström, C., & Saramäki, J. (2019). Where did Kutsuplus drive us? Ex post evaluation of on-demand micro-transit pilot in the Helsinki Capital Region. *Research in Transportation Business & Management*, *32*. https://doi.org/10.1016/j.rtbm.2019.100390

Homewood—Move PGH | Move PGH. (n.d.). *Engage Pittsburgh.* Retrieved March 7, 2023, from https://engage.pittsburghpa.gov/move-pgh/homewood-move-PGH

Intelilght. (2022, November 29). *InteliLIGHT Streetlight Control Shines in Barcelona, at Smart City Expo World Congress*. InteliLIGHT. Retrieved April 20, 2023, from https://intelilight.eu/intelilight-streetlight-control-shines-in-barcelona-at-smart-city-expo-world-congress/

Jersey City. (n.d.). *Jersey City Bike Facilities*. CARTO. Retrieved April 26, 2023, from https://jerseycity-enterprise.carto.com/u/jerseycity/builder/5805dc28-e0ab-4196-bd87-e8395917e71c/embed?state=%7B%22map%22%3A%7B%22ne%22%3A%5B40.67389434714914%2C-74.14068603306079%5D%2C%22sw%22%3A%5B40.76782768980019%2C-74.00335693149829%5D%2C%22center%22%3A%5B40.72087758146514%2C-74.07202148227952%5D%2C%22zoom%22%3A13%7D%7D

Jersey City. (n.d.). What-When-How. http://what-when-how.com/cities-of-the-united-states/jersey-city/

Jersey City: America's Golden Door. (n.d.). Jersey City Online. http://www.jerseycityonline.com/history/jc_history.htm

Jersey City Code of Ordinances. Chapter 242: Article VI. Retrieved from https://library.municode.com/nj/jersey_city/codes/code_of_ordinances?nod

eId=CH242PEGOOR_ARTVIROSKNESKSKBIELSC_S242-9.1DEBIRISUTRRERIBIBUDIPUSIPRRIBIPUSIAROUBUDIPREXMIAGNIUNUSBILAPUBIPARARESACY

Jersey City's on-demand, affordable public transit service Via surpasses 1 million rides (2022). Via. https://ridewithvia.com/news/jersey-citys-on-demand-affordable-public-transit-service-via-surpasses-1-million-rides

Kang, S., & Hamidi, S. (2019). (rep.). *On-Demand Microtransit for Better Transit Station and Job Accessibility*. Arlington, TX: USDOT University Transportation Center.

Kim, K. (2015). Can carsharing meet the mobility needs for the low-income neighborhoods? lessons from carsharing usage patterns in New York City. *Transportation Research Part A: Policy and Practice*, *77*, 249–260. https://doi.org/10.1016/j.tra.2015.04.020

King, David & Goldwyn, Eric. (2014). Why do regulated jitney services often fail? Evidence from the New York City group ride vehicle project. Transport Policy. 35. 186–192. https://doi.org/10.1016/j.tranpol.2014.05.011

Kofsky, J. (2018, August 20). *CityPost Information Kiosks Coming to Jersey City's Streets*. Jersey Digs. Retrieved April 20, 2023, from https://jerseydigs.com/citypost-information-kiosks-coming-jersey-city/

Kopp, J., Gerike, R., & Axhausen, K. W. (2015). Do sharing people behave differently? an empirical evaluation of the distinctive mobility patterns of free-floating car-sharing members. *Transportation, 42*(3), 449-469. doi: https://doi.org/10.1007/s11116-015-9606-1

Leahy, G. (2022, October 18). *SF Muni Upgrades Will Change City Streets With 1500 New Signs*. The San Francisco Standard. Retrieved April 20, 2023, from https://sfstandard.com/transportation/sf-muni-upgrades-will-change-city-streets-with-1500-new-digital-signs-boost-wi-fi/

Li, Y. and Voege, T. (2017) Mobility as a Service (MaaS): Challenges of Implementation and Policy Required. Journal of Transportation Technologies, 7, 95-106. https://doi.org/10.4236/jtts.2017.72007

Maas, B. Literature Review of Mobility as a Service. Sustainability 2022,14,8962. https://doi.org/10.3390/su14148962

Maciel Costa da Silva, L. (2020). Smart Cities and Mobility Stations: Lessons learned from the Smarter Together in Vienna and Munich.

Miah, M., Naz, F., Hyun, K., Mattingly, S., Cronley, C., Fields, N. (2020). Barriers and opportunities for paratransit users to adopt on-demand micro transit. *Research in Transportation Economics*, 84, 1-10.

Mobility Hubs Readers Guide. (n.d.). LADOT. Retrieved May 18, 2023, from https://ladot.lacity.org/docs/mobility-hubs-readers-guide

New Jersey Transit Friendly Data Application. (n.d.). Retrieved May 18, 2023, from https://njlutrans.org/

New Jersey City University. (n.d.). Explore Jersey City's History. Jersey City Past and Present. https://www.njcu.edu/community/jersey-city-past-and-present

New Jersey City University. (n.d.). Hudson City. Jersey City Past and Present. https://njcu.libguides.com/hudsoncity

New Jersey Institute of Technology. (2004). A Short History of Jersey City. https://web.njit.edu/~elliot/Proteasa/background/background.html

New Journal Square, The. (n.d.). *News.* Retrieved May 24, 2023, from https://thenewjournalsquare.com/news/

Office of Community Planning and Development. (1995). Consolidated Plan for 1995—Jersey City, NJ [Executive Summary]. U.S Department of Housing and Urban Development.

Patel, R. K., Etminani-Ghasrodashti, R., Kermanshachi, S., Rosenberger, J. M., & Foss, A. (2022). Mobility-on-demand (MOD) Projects: A study of the best practices adopted in United States. Transportation Research Interdisciplinary Perspectives, 14, 100601. https://doi.org/10.1016/j.trip.2022.100601

"Private Ferry Monthly Passenger Counts" (2022). NYC Open Data. Retrieved April 24, 2023 from https://data.cityofnewyork.us/Transportation/Private-Ferry-Monthly-Passenger-Counts/hn6c-5qkb

Pfertner, M. (2017, May 16). Evaluation of Mobility Stations in Würzburg - perceptions, awareness, and effects on travel behavior, car ownership, and CO2 emissions. Retrieved from: https://mediatum.ub.tum.de/doc/1446936/1446936.pdf

Regional Transportation District (RTD). *Mobility Hub Guidelines.* Retrieved from: https://www.rtd-denver.com/sites/default/files/files/2019-12/RTD-mobility-hub-guidelines-final.pdf

Sachs, D. (2021, May 10). "Will Denver let Lime and Lyft run the city's shared bike bike and scooter system?" *Denverite*. Retrieved April 24, 2023, from https://denverite.com/2021/05/10/denver-officials-will-decide-monday-whether-to-let-lime-and-lyft-run-the-citys-shared-bike-and-scooter-system/

Sanders, R. L., Branion-Calles, M., & Nelson, T. A. (2020). To scoot or not to scoot: Findings from a recent survey about the benefits and barriers of using e-scooters for riders and non-riders. *Transportation Research Part A: Policy and Practice*, *139*, 217–227. https://doi.org/10.1016/j.tra.2020.07.009

Shaheen, S. (2021). What's the Big Deal with Shared Micromobility? Evolution, Curb Policy, and Potential Developments in North America. Transportation Sustainability Research Center, Volume 47(Issue 4), 499-514.

Shaheen, S., & Cohen, A. (2020). Similarities and differences of mobility on demand (MOD) and mobility as a service (MaaS). Institute of Transportation Engineers. ITE Journal, (6), 29-35.

Shalhoub, P. and Karnoutsos, C. (n.d.). *Jersey City: Past and Present*

Website Project. New Jersey City University. Retrieved from https://njcu.libguides.com/c.php?g=1050832&p=7628014

Shared Micromobility. (2021, January 22). DRCOG. https://drcog.org/planning-great-region/transportation-planning/advanced-mobility/shared-micromobility

Solis, B. (2022, February 14). A Glimpse Into The History Of Jersey City. New Jersey Digest. https://thedigestonline.com/nj/jersey-city-history/

Sprei, F., Habibi, S., Englund, C., Pettersson, S., Voronov, A., & Wedlin, J. (2019). Free-floating car-sharing electrification and mode displacement: Travel time and usage patterns from 12 cities in Europe and the United States. *Transportation Research Part D: Transport and Environment*, *71*, 127–140. https://doi.org/10.1016/j.trd.2018.12.018

Surico, J. (2022). "How Jersey City Got to Zero Traffic Deaths on Its Streets." *Bloomberg Citylab*. Retrieved April 11, 2023 from https://www.bloomberg.com/news/features/2022-12-28/it-s-been-a-deadly-year-on-us-roads-except-in-this-city

System Data (2022). Citi Bike NYC. Retrieved https://citibikenyc.com/system-data

Tiwari, A., 2019. Micro-mobility: the next wave of urban transportation in India [WWW Document]. URL https://yourstory.com/journal/micro-mobility-edc6x8f1y1 (accessed 7.10.20).

Tsouros, I., Tsirimpa, A., Pagoni, I., & Polydoropoulou, A. (2021). MaaS users: Who they are and how much they are willing-to-pay. *Transportation Research Part A: Policy and Practice*, *148*, 470–480. https://doi.org/10.1016/j.tra.2021.04.016

Walker, Donald. (2002) *Paser Manual Asphalt Roads*, Retrieved April 26, 2023 from: https://www.canton-mi.org/DocumentCenter/View/7459/PASER-Manual-Concrete-Roads

Walker, Donald. (2015) *Paser Manual Concrete Roads*, Retrieved April 26, 2023 from: https://www.apa-mi.org/docs/Asphalt-PASERManual.pdf

Wang, Y., & Shen, Q. (2022). A latent class analysis to understand riders' adoption of on-demand mobility services as a complement to transit. *Transportation,* 1-19. doi:https://doi.org/10.1007/s11116-022-10351-3

Washington, DC District Department of Transportation (DDOT). *Ride Report: Micromobility Dashboard*. (n.d.). Retrieved April 26, 2023, from https://public.ridereport.com/dc

Washington Park Association of Hudson County. (n.d.). *About the WPA. Washington Park Association of Hudson County*. Retrieved from http://www.wpanj.org/

https://northernvirginiamag.com/family/family-features/2022/12/28/traffic-gardens-northern-virginia-dc/

Westervelt, M., Huang, E., Schank, J., Borgman, N., Fuhrer, T., Peppard, C., & Narula-Woods, R. (n.d.). *Uprooted: Exploring Microtransit in the United States*. Eno Center for Transportation. Retrieved March 7, 2023, from https://www.enotrans.org/wp-content/uploads/2018/01/UpRouted-18.pdf

Wikipedia contributors. (2023, May 24). Jersey City, New Jersey. In *Wikipedia, The Free Encyclopedia*. Retrieved April 24, 2023, from https://en.wikipedia.org/w/index.php?title=Jersey_City,_New_Jersey&oldid=1156687898

Wiggers, K. (2018, September 29). *LinkNYC's 5 million users make 500000 phone calls each month*. VentureBeat. Retrieved April 20, 2023, from https://venturebeat.com/business/linknycs-gigabit-kiosks-hit-1-billion-sessions-and-5-million-users/

Wray, S. (2020, May 17). US$8 billion to be invested in streetlights over next decade, says US market report. *Cities Today*. https://cities-today.com/us6-billion-to-be-invested-in-streetlights-over-next-decade-says-us-market-report/

Ma, X., Ji, Y., Yuan, Y., Van Oort, N., Jin, Y., & Hoogendoorn, S. (2020). A comparison in travel patterns and determinants of user demand between docked and dockless bike-sharing systems using multi-sourced data. *Transportation Research Part A: Policy and Practice,* 139, 148–173. https://doi.org/10.1016/j.tra.2020.06.022

Yan, X., Zhao, X., Broaddus, A., Johnson, J., & Srinivasan, S. (2023). Evaluating shared e-scooters' potential to enhance public transit and reduce driving. *Transportation Research Part D: Transport and Environment*, *117*. https://doi.org/10.1016/j.trd.2023.103640

Yufeng, Kok. (2022, July 11). *More roadside carpark spaces in the CBD to be converted into bicycle parking facilities*. The New Paper. https://www.tnp.sg/news/singapore/more-roadside-carpark-spaces-cbd-be-converted-bicycle-parking-facilities

Zhang, Y., Farber, S., & Young, M. (2022). Eliminating barriers to nighttime activity participation: The case of on-demand transit in Belleville, Canada. *Transportation, 49*(5), 1385-1408. doi:https://doi.org/10.1007/s11116-021-10215-2

Zhang, Y., & Kamargianni, M. (2022, July 29). *A review on the factors influencing the adoption of new mobility technologies and services: autonomous vehicle, drone, micromobility and mobility as a service*. Transportation Reviews. Retrieved April 20, 2023, from https://www.tandfonline.com/doi/full/10.1080/01441647.2022.2119297

Appendices

Appendix A: Survey Instruments

A.1 Sidewalk Survey

Good Condition	Moderate Condition	Poor Condition
		
		
		
		

Sidewalk Condition Grading Example, Graduate Planning Studio, April 26, 2023.

A.2 Detailed Site Evaluation Criteria

Site (~30 ft radius) – select best spot to site the mobility hub (or best spots; if so, complete for each)

1. How large is the workable area of the site that can be used as a mobility hub? *(number in sq ft)*
2. Does the site have existing lighting? *(y/n)*
    a. If yes, please describe the quality of the light, if visible.
    b. Is the site adjacent to other visible electrical/power sources? (y/n)
3. Does the site have existing mobility infrastructure? (If not, how far is the nearest amenity?)
    a. Are there bike racks? *(y/n)*
        i. Is there a Citi Bike station? *(y/n)*
    b. Is the site at a bus/jitney stop? *(y/n)*
        i. Is the bus/jitney stop location clearly marked and signed? *(y/n)*
    c. Does the site have space for a dedicated rideshare (Via) pickup/drop-off? *(y/n)*
        i. If not, would creating such a space be practical? *(y/n)*
4. Does the site have benches? *(y/n)*
5. Does the site have a shelter? *(y/n)*
6. Is the site protected from oncoming vehicular traffic (e.g. by a curb or bollards)? *(y/n)*
7. Is the site accessible by a sidewalk? *(y/n)*
8. How wide are the sidewalks immediately leading to the site? *(number in ft)*
9. Is there any litter at the site? *(yes–a lot, yes–a little, no)*
    a. Are trash receptacles available, and if so, what kind?
10. Is there evidence of hostile design at the site? (e.g. middle bench arms to prevent sleeping on benches, spikes on places where people could otherwise sit, etc.) If so, what?
11. What existing infrastructure would the hub displace? *(sidewalk space, parking spot, etc.)*

12. Is there significant construction taking place at the site that makes it hard to determine future conditions? *(y/n)*
13. Please provide any qualitative thoughts about site condition not covered above, including the condition of any site amenities.

Site vicinity (~500 ft radius, about a block on average around each site)

1. What is the condition of the pavement in the area? *(excellent, good, fair, poor)*
    a. Is the pavement asphalt, concrete, or other material?
    b. Are there cracks in the pavement? *(yes–major, yes–minor, no)*
    c. Are there deformations such as bumps in the pavement? *(yes–major, yes–minor, no)*
    d. Are there potholes in the pavement? *(y/n)*
    e. Are there patches in the pavement where there may have been cracks or potholes in the past? *(y/n)*
    f. Please provide any subjective thoughts on overall pavement quality in the area.
2. What is the condition of the sidewalks in the area vicinity? *(excellent, good, fair, poor)*
    a. Mark down significant issue points on a Google My Maps file or on a printed map to digitize later. *(items such as large cracks, narrow gaps, overgrowth…)*
3. Is the area around the site ADA accessible? *(y/n)*
    a. If not, what needs to be done to make it accessible? *(list)*
4. Are the street crossings in the vicinity safe? *(y/n)*
    a. Do the streets in the area exhibit high vehicular traffic? *(y/n)*
    b. Do vehicles on these streets travel at high speeds? *(y/n)*
    c. Are there sufficient pedestrian crossing points? *(y/n)*
    d. Are the pedestrian crossing points sufficiently visible? *(y/n - e.g. is the paint worn away)*

e. Do the signaled crosswalks allow enough time to safely cross the street? *(y/n)*

5. Are the streets in the vicinity comfortable to bike/scooter? *(y/n)*
    a. Do the high-speed, high-traffic streets have bike infrastructure? *(y/n)*
        i. If so, what sort of bike infrastructure? (*protected lanes, unprotected lanes, sharrows)*
        ii. What is the condition of the bike infrastructure? (*excellent, good, fair, poor)*
    b. During in-person observation, were there any cyclists/scooter users on the streets?
    (*yes–a lot, yes–a little, no)*
        i. Was there a dominant micromobility type? *(bike, ebike, scooter, other)*
        ii. Did most (if not all) users appear to be quick/confident? *(y/n)*
        iii. Please add any other observations about micromobility use, including damaged devices noted in the area and whether people rode on the street or sidewalk.
6. Is there clear wayfinding for pedestrians near the site? *(y/n)*
    a. What destinations were listed? *(list)*
7. Were enforcement personnel such as city police, transit police, or crossing guards observed in the area? (*y/n, list if y)*
8. Are there commercial establishments within the site vicinity? (e.g. stores, restaurants) *(y/n)*
    a. If so—what are they? *(list – clarify if your list is thorough or representative)*
9. Are there public facilities within the site vicinity? (e.g. civic buildings, libraries, police/fire stations, shelters/labor centers, parks, public restrooms) *(y/n)*
    a. If so—what are they? *(list – clarify if your list is thorough or representative)*

Site neighborhood (~1320 ft, or ¼ mi radius, or 5-min walk)
(we already know a good amount about the neighborhoods from our overview research)

1. What are the major transit connections within or in reach of the greater hub neighborhood (i.e. rail stations or bus transit center facilities) *(list)*
2. If the site vicinity has bike infrastructure, is that bike infrastructure connected to a greater network of infrastructure in the site neighborhood and beyond? *(y/n)*
3. Is there a police station within the neighborhood? *(y/n)*
4. Is there a fire station within the neighborhood? *(y/n)*

Appendix B: Augmented Reality

Introduction

Augmented reality (AR) is a rapidly developing technology that has the potential to transform community engagement in various fields, including urban planning, public health, education, and cultural heritage. AR enables the integration of digital content into the user's physical environment, creating a mixed-reality experience that combines the real world with virtual elements. This immersive experience allows for a more interactive and personalized approach to community engagement, leading to more meaningful and inclusive participation. In this section, we will discuss the use of augmented reality for community engagement, specifically how we used it to present a proposed micro-mobility hub station in Jersey City.

Augmented Reality and Community Engagement

One of the key advantages of AR in community engagement is its ability to visualize proposed projects in a more realistic and dynamic way. This technology enables stakeholders to view and interact with 3D models of proposed developments, infrastructure, or public spaces, which can help them better understand the potential impact of these projects. By experiencing a virtual representation of the project, community members can provide more informed feedback and make more informed decisions. This can lead to better project outcomes, increased community satisfaction, and reduced conflicts.

AR can also facilitate collaboration and co-creation between community members and decision-makers. Through AR-based workshops and interactive installations, participants can work together to generate ideas, test different

scenarios, and co-design solutions. This collaborative approach can promote a sense of ownership and involvement in the planning process, as well as foster social cohesion and trust between different stakeholders. Moreover, AR can provide access to information and educational resources that are not available through traditional communication channels.

However, the adoption of AR in community engagement is not without challenges. One of the main concerns is the potential for digital divide, where certain groups may not have access to the necessary technology or skills to participate in AR-based activities. This issue can be addressed through targeted outreach and training programs that ensure equitable access to AR-based resources. Another challenge is the need for appropriate data privacy and security measures to protect the personal information of community members.

Methods

In this section, we will discuss the methods employed to create an augmented reality model of the proposed micromobility hub station. The goal of this endeavor was to create a realistic and immersive representation of the station, which could be utilized in community engagement efforts. To achieve this goal, we utilized a combination of software programs that were specifically designed for creating 3D models and augmented reality experiences. Firstly, we designed the 3D model of the station using Rhino 3D, a multidisciplinary 3D modeling software program.

Once the initial model was designed, we exported it to Adobe Aero, which is a software program specifically designed for creating augmented reality experiences. In Adobe Aero, we scaled the model to fit the real-world dimensions of the proposed site. This was a critical step, as it ensured that the model accurately reflected the size and scale of the proposed station. To further enhance the model, we utilized the features available in Adobe Aero, including the ability to add textures, colors, and other visual elements. This allowed us to add a level of detail that helped to bring the proposed station to life in an augmented reality environment. Finally, we tested the model on iOS devices, ensuring that it was fully functional and compatible with the devices we intended to use for community engagement. This step was essential, as it allowed us to identify any issues with the model before it was presented to the community.

Limitations

One of the primary limitations of the proposed approach is its platform-specific compatibility. Specifically, our approach currently only supports iOS devices, which significantly limits the potential audience for engagement with the augmented reality model. This limitation may result in an underrepresentation of

stakeholders who lack access to iOS devices, which can lead to a skewed perception of the model's effectiveness and value. In addition, this limitation could also hinder the adoption of the model in real-world settings, as stakeholders who cannot engage with the model due to device incompatibility may be less likely to embrace its use and potential benefits.

Future research in this area should focus on addressing this limitation by developing approaches that are compatible with a wider range of devices, such as Android or web-based platforms. This would allow for broader stakeholder engagement and more equitable representation across different user groups. Additionally, efforts should be made to ensure that the user experience and functionality of the model are maintained across different devices and platforms, which may require adapting the design and implementation of the model to suit different technological environments.

Moreover, other limitations may exist beyond the scope of device compatibility. For instance, the accuracy and reliability of the augmented reality model may be affected by external factors such as lighting conditions, camera quality, and object recognition capabilities. Furthermore, the model's effectiveness and user acceptance may depend on the nature of the application and the specific context in which it is used. Therefore, future research should also explore these potential limitations and identify strategies to mitigate their impact on the model's performance and user experience.

Conclusion

In conclusion, our study highlights the potential of AR technology in enhancing community engagement. The use of AR can facilitate a more immersive and interactive design communication process, allowing stakeholders to better understand and provide feedback on proposed designs. However, the effectiveness of AR may be limited by factors such as compatibility with different devices and the technical skills of stakeholders. Further research is needed to explore the full potential of AR in community engagement and to develop strategies for addressing these limitations. Ultimately, we believe that AR has the potential to transform the way we engage with communities in the design process and to promote a more inclusive and collaborative approach to urban planning.

[Appendix C] QR code to access the augmented reality model of the proposed micro-mobility hub station at 9th St & Congress St.