Market Assessment
Development Patterns Matter

Transit service, ridership, and performance are overwhelmingly governed by the pattern of urban development. When designing for high ridership, transit agencies will naturally focus service on places where urban development patterns are favorable.

Figure 57 offers a simple distillation of the key ways that the built environment governs transit ridership. Four facts about the environment are critical:

- **Density**: how large is the market for transit within a given distance of each stop? This is the first-order measure of ridership potential. The more residents, services, or jobs located in the fixed area around a stop, the larger transit’s potential market.

- **Walkability**: how easy is it for people near each stop to actually reach it? If there are physical barriers to this access, including poorly connected streets or difficulties crossing a major street, the number of people who can reach a stop is smaller.

- **Linearity**: can transit serve destinations by straight, efficient paths, or are time-consuming deviations required? Wherever a destination is set far back from the street, or accessed only from circuitous roadways, it is harder to combine its market with other markets to build useful and durable transit lines.

- **Proximity**: are there long gaps between destinations that transit must traverse? For example, linking the Torresdale neighborhood in Northeast Philadelphia to Center City is less productive than it would be if the neighborhood was closer, since the distance determines the cost of providing the service.

In some cases, the diversity of land uses can also matter. This helps to determine whether demand is evenly distributed in both directions and throughout the day, which leads to higher productivity. Mixtures of housing, retail and jobs are generally much better on this score than large areas that are all residential or all employment.

These factors determine both the costs of providing transit in a particular place and how many people are likely to find the service useful. Density and walkability tell us about the overall potential of the market: are there a lot of people around, and can they get to the place where the product is available? Linearity and proximity tell us about cost: are we going to be able to serve the market with short, fast, direct line or will our costs be higher as we must design service that uses indirect or longer paths?

Transit agencies can influence the level of ridership their services generate, and the efficiency at which they do so, by targeting these sorts of favorable land uses appropriately. However, they cannot directly control the urban form of the places they serve. That form is controlled by zoning and planning authorities, usually city governments.

Without dense, walkable places along linear street patterns, where density is continuous along efficient transit paths, transit service alone is unlikely to support a high ridership outcome. Only local governments have the ability to directly affect these characteristics of urban form. Transit agencies can seek to provide a level of service that can be useful and competitive with other modes, but ultimately without a development context that produces transit-oriented places of all types, the ceiling for transit ridership is constrained.

**Figure 57: The Ridership Recipe—four geographic elements for achieving high ridership**

- **Density**: How many people, jobs, and activities are near each transit stop?
  - Many people and jobs are within walking distance of transit.
  - Fewer people and jobs are within walking distance of transit.

- **Walkability**: Can people walk to and from the stop?
  - The dot at the center of these circles is a transit stop, while the circle is a 1/4 mile radius.
  - The whole area is within 1/4 mile, but only the black-shaded streets are within a 1/4 mile walk.

- **Linearity**: Can transit run in reasonably straight lines?
  - A direct path between any two destinations makes transit appealing.
  - Destinations located off the straight path force transit to deviate, discouraging people who want to ride through, and increasing cost.

- **Proximity**: Does transit have to traverse long gaps?
  - Short distances between many destinations are faster and cheaper to serve.
  - Long distances between destinations mean a higher cost per passenger.
Density and walkability often go hand in hand. The aerial imagery shown here contrasts two areas at the high and low end of the spectrum for both.

**Higher density and walkability:** Much of South Philadelphia, like this area near the Italian Market, features a mix of rowhouses, apartment buildings, as well as small commercial and large institutional uses (see Figure 58). The area is connected by a dense network of streets and alleys with a few larger streets (like Washington) that make it easy to walk to bus stops from any point.

- Many people are likely to be present near any bus stop, and it is a relatively short distance from any point to the nearest bus stop.

**Lower density and walkability:** The area near the Andorra Shopping Center in Northwest Philadelphia has much lower density, with a single-use, auto-oriented shopping center at the main intersection and mostly single-family detached residential buildings in the surrounding area (see Figure 59). The blocks are long, with relatively few street intersections, and the street network is disconnected and more curvilinear. Thus, walking distance to a bus stop is longer and less direct. And with wider streets, crossing the street to access a bus stop is likely to feel less safe.

- Far fewer people are likely to be near any bus stop, and walks from any point to the nearest bus stop are longer and more circuitous.
Residents

While not all trips start or end at home, nearly everybody makes at least one trip starting or ending at home on most days. Furthermore, places with many households are also destinations for other people, whether for visiting, worship, caring for family, or home-based work.

Figure 60 to the right shows the density of residents in the City of Philadelphia and the adjacent parts of surrounding counties.

Residential density across large parts of the city exceeds 24,000 people per square mile, which is quite high compared to most North American cities. The historic Philadelphia pattern of narrow, two to three story rowhouses intermixed with apartments and other medium to high density housing is found across much of the city and provides a strong transit market. This pattern is consistent across much of South Philadelphia and North Philadelphia west of Broad Street toward the Schuylkill River. High residential density is also prevalent across much of West Philadelphia, particularly between Lancaster Avenue and Baltimore Avenue.

Residential density remains quite high through much of North Philadelphia, though it is broken up by industrial areas around Juniata Park, Feltonville, and Lawncrest. In Northeast Philadelphia, residential density drops off significantly north of Cottman Avenue. In Northwest Philadelphia, density remains relatively high along and east of Ogontz Avenue all the way to the city line, and then drops abruptly on the other side of Cheltenham Avenue in Montgomery County. West of Germantown Avenue, and particularly west of Wissahickon Valley Park, residential density is relatively low in Northwest Philadelphia.

Note how high the residential density in Philadelphia is compared to the density just across the city line in surrounding counties. In many cases, the density drops of quite significantly at the city line.

Figure 60: Residential density is high across many areas of Philadelphia and is high by the standards of North American cities.
Jobs

Job density is an even better predictor of transit ridership than residential density. It shows us not only where people go for work, but also where they go for services, shopping, community, health care, and more.

Figure 61 to the right shows the density of jobs (and of other important destinations) in the City of Philadelphia and surrounding counties.

Key observations from this map include the fact that Center City is an extremely dense job center, as is University City just across the Schuylkill River. Medium-density job centers are scattered up and down the Broad Street Line. Also of note is the industrial job center near Feltonville, where there is little residential density in the map in Figure 60 on page 54.
Activity

In Figure 62 at right, residential and job densities are combined into Activity Density. This allows us to see how the total density of activities, the mix of uses, their proximity and their linearity could affect transit ridership across Philadelphia. Shades of red indicate high density mixtures of jobs and housing. Shades of yellow indicate areas of higher jobs densities. Shades of blue indicate areas of higher housing densities.

This map of Activity Density gives us the full picture of how many people and jobs might be around any given transit stop in Philadelphia. In terms of ridership potential, we can observe that:

- The Market Street corridor from Center City to University City is the corridor with the highest activity in the entire city.
- The Broad Street corridor from Center City into South Philadelphia is also extremely dense with both jobs and people.
- Much of South Philadelphia, particularly east of Broad Street, is broadly dense with both housing and jobs and is ripe for high transit ridership.
- In general, there is high activity density across most of the areas of North Philadelphia.
- Activity density in Northeast Philadelphia drops dramatically beyond Cottman Avenue and particularly beyond Pennypack Park.
- Activity Density in Northwest Philadelphia drops off significantly beyond Wissahickon Creek, except that Manayunk maintains relatively high activity density compared to surrounding areas.

Though it is not one of the four major factors in the Ridership Recipe, the mix of land uses along a transit route also affects ridership on that route. Transit routes serving purely residential neighborhoods tend to be used in only one direction—away from the residential neighborhood, towards the center of jobs and services in the morning and the reverse in the afternoon. In residential areas that are far away from any jobs and services, transit routes tend to be used only for long commutes to and from work, and not at other times of day.

The "directionality" of ridership on a transit route limits how much ridership it can attract relative to its cost, because:

- If ridership is only high during the morning and evening rush hours, that means the transit provider must pay to run mostly-empty buses during the rest of the day (or must pay drivers extra for split shifts, or for a very long midday break).
- If ridership is only high in one direction during each peak, then the provider must pay to run mostly-empty buses back in the other direction.

Thus all-day and two-way demand, along an entire route, yields higher ridership relative to cost. All-day and two-way demand tends to arise on corridors that have continuous mixtures of housing, retail, services and jobs.

A mix of uses along a transit line also makes the service far more useful to riders. The time they must spend traveling to the next useful place is potentially much shorter. They are also more able meet multiple needs on their transit commute—hopping off halfway home to get groceries, or meet a friend, and then hopping back on again.

Figure 62: Map of activity (residential and job) density in Philadelphia and surrounding counties

Combined Activity Density

Legend:

- Residents / m²
- Jobs / m²

Combined Activity Density (population and employment density) indicates the total level of daily activity in an area, as must trips begin or end at a residence, workplace, commercial, or educational establishment.

Source: US American Community Survey 2015 and LEHD WAC 2014
Linearity

Because of differences in historic land use and road network decisions, some parts of Philadelphia are served (and servable) by much more linear bus services than others. The following examples illustrate this:

- **More Linear:** As shown in Figure 63, North Philadelphia, like much of the city, has a well-connected, gridded street-system and has long, straight north–south streets that can be served with frequent bus service running in straight lines. Crosstown service is possible on many streets. Large railroad corridors do break up the street grid in places, but most routes make relatively small deviations and then return to generally straight paths. This means it is possible to operate bus services that are both fast and direct and, as a result, are both convenient and cost-effective. In fact, the frequent SEPTA bus routes in this area have some of the highest ridership in the system.

- **Less Linearity:** As shown in Figure 64, the vicinity of Morrell Park is much more complicated to serve with bus service due to the geometric limitations of the road network and development pattern. It is impossible to go through this area, serve it well, and continue out the other side without a route that is unacceptably circuitous. As a result, everything existing routes do is somewhat unsatisfactory.
  - Route 84 is trying to serve the hospital at Knights and Red Lion on its way to Philadelphia Mills. Therefore it can only serve a small part of Morrell Park, and this is still an awkward deviation.
  - Route 20 attempts to cover the most of Morrell Park by splitting into two branches at Academy and Morrell Avenue. The southern branch deviates through the center of the neighborhood on Keswick and Chalfont before returning to Academy to continue to Philadelphia Mills. This makes Route 20 more confusing. Spacing of Route 20 buses east of here is uneven because the branches are of different lengths.
  - Any line that tries to provide coverage to areas with poor street linearity by entering the neighborhood must follow a slow and circuitous path, as Routes 20, 84 and 67 are today.

![Figure 63](image1.png) North Philadelphia—good linearity and clear grid pattern of routes.

![Figure 64](image2.png) Morrell Park in Northeast Philadelphia—poor linearity in the street network requires inefficient, circuitous routing.
The Pattern of Boardings

Figure 65 shows the pattern of bus and trolley boardings across the city during an average weekday. The size of each dot is proportional to the number of boardings that occur at that stop on an average weekday. This map shows immense transfer activity in Center City, at Fern Rock and Olney Transportation Centers on the BSL, and at the Frankford and Arrott Transportation Centers on the MFL.

Another key pattern that seems evident from the boardings map is the transfer activity between bus routes in the system. Larger dots at locations where frequent bus routes cross suggest that people are using the frequent bus network to make connections across the city.

Many major streets can be traced by following the pattern of dots. This means that many streets in Philadelphia have a continuous, linear pattern of development that is supportive of transit ridership that is ideal for transit.
Continuity

While many corridors in Philadelphia are continuously developed and generate demand throughout, others force public transit to traverse larger gaps of lower or non-existent demand. In these cases, transit must traverse longer distances, at higher costs, to connect people and destinations. The corridors in Figure 66 illustrate this:

- **More Continuity:** Frankford Avenue, the more southerly corridor highlighted in Figure 66, has a steady level of demand from Harbison Avenue to Knights Road. Few of the areas in this corridor have extremely high demand, but there is consistent and significant demand throughout.

- **Less Continuity:** On the other hand, the Roosevelt Boulevard corridor, the more northerly corridor highlighted in Figure 66, connects major shopping centers with high demand, but the local development pattern is more auto-oriented and disconnected. This means that bus lines traverse long stretches with weak demand in between. While this pattern of demand is a challenge for a typical local bus route, it is a demand pattern that is actually well suited to Bus Rapid Transit (BRT) style service with widely spaced stops (every 0.5–1 miles).

SEPTA and the City recently worked together to introduce DIRECT BUS service on Roosevelt Boulevard with the new Boulevard Direct line, shown in the route map in Figure 67. The DIRECT BUS is a branded service with features of Bus Rapid Transit, including wider stop spacing, enhanced stations with more amenities, consistent frequent service (at least 15 minute frequency from 6 am to 9 pm every day), and branded buses.
Income and Poverty

Figure 68 shows the median household income in Philadelphia and surrounding counties.

Median Income

The contrast between the median income levels in the city versus surrounding counties is vividly apparent in this map. This disparity, however, also helps explain why transit is so much more productive and walkable streets, the city has geometric features that lead to higher transit ridership. And with a population with a higher need, who are likely to find the value proposition of transit more useful, transit is serving a population that is more likely to use transit. Combined, these two factors significantly increase the potential transit ridership in the city.

While it is useful to compare the income levels across the city and region, this map only shows us the relative level of income or poverty. It does not tell us about the density or concentration of that poverty. So some zones in dark red, where median incomes are very low, may have very few people and very low population densities. And some zones in dark blue, where median incomes are very high, may have many people and very high population densities.
Low-income Density

Figure 69 shows the density of low-income residents in Philadelphia and surrounding counties.

Individuals with lower incomes tend to ride transit at higher rates than other people. Yet they also have a need for transit access that exists whether or not they ride in large numbers from any given place.

Transit is often tasked with providing affordable transportation for low-income residents, and this leads agencies toward the goal of covering people and areas, irrespective of ridership potential. Federal laws also protect those with low incomes from disparate transportation impacts, which can lead agencies to provide transit service in places where poverty is high even if this does not maximize ridership.

Understanding where there are large numbers of low income residents (and where else they travel) is thus important in terms of both trying to maximize ridership and in thinking about where transit is trying to provide service for reasons other than maximizing ridership, like lifeline access to low-income residents.

Some people think that transit, especially all-day transit, is only useful to people who cannot afford a car. This is a simplistic view of a complex matter. People with lower incomes do not automatically choose transit because it is the cheapest option. The service available to them must be useful and reliable for the kinds of trips they need to make, otherwise they will find other options, such as walking, cycling, taking a taxi or asking friends and family for rides.

What is certainly true is that people with fewer resources have an incentive to spend less on transportation. The more carefully a person must manage their money, the more attractive transit’s value proposition may be. In low-income and moderate-income families, not having to purchase, insure and maintain a car could free up enough money for school, college, or some other productive investment.

Figure 69: Density of low-income residents is highest in Center City and South Philadelphia.
The prevalence of zero-vehicle households is correlated with lower incomes. Figure 70 shows a plot of these two variables, which show a strong relationship between Census Block Groups with low median household incomes and low car ownership. The higher a dot is on the chart, the fewer households own cars in that Census Block Group. The farther to the left on the chart, the lower the median household income is in the Block Group.

There are some interesting outliers, however. There are a number of places with lower vehicle ownership near Center City. People in this area are likely to walk or bicycle as much or more than they use transit due to the very high density levels and short trip distances required to reach jobs, shopping, and other destinations in and around Center City.

The households in these higher-income, Center-City Block-Groups are likely to have more income to spend on transportation.

Figure 71: Broad swaths of Philadelphia have high densities of zero-vehicle households.

Zero Vehicle Households

Philadelphia has many zero-vehicle households, which is expected given the density and the relatively low incomes of households in the city. People with limited access to personal vehicles must find other ways of traveling, whether they carpool, cycle, walk, used a shared car or take transit. Which of these they choose has everything to do with availability and usefulness.

If transit is of limited use for the trips a person needs to make, they are less likely to use it, even if they do not have a car in their household. This person is not necessarily “transit-dependent” just because they do not own a car. However, they do have a greater inclination toward transit use than someone who has a car in their driveway, always ready to go.

Figure 69 shows the density of households with no vehicles. Neighborhoods where car-free households are numerous are great prospects for high-ridership transit.

The households in these higher-income, Center-City Block-Groups are also major targets for ride-hailing providers like Uber and Lyft, as these households have more income to spend on transportation.

Figure 70: Census block groups where median household incomes are low tend to be places with lower vehicle ownership.
Race and Ethnicity

Figure 72 shows where white, black, Hispanic and people of other races and ethnicities live in the city of Philadelphia and surrounding counties. Each dot represents 50 residents. Where many dots are very close together, the overall density of residents is higher. Where dots of a single color predominate, people of a particular race or ethnicity make up most of that area’s residents.

While information about people’s income tells us something about their potential interest in or need for transit, information about ethnicity or race alone does not tell us how likely someone is to use transit. However, this map is essential to helping planners to avoid placing disproportionate burdens on people of color through transportation decisions. Transit agency policies that protect people of color from negative impacts are one type of coverage goal. Such policies might state, for example, that service to high-minority neighborhoods should be prioritized even if such service would not maximize ridership.

In addition to local policies, federal civil rights law protects people from discrimination in the provision of transit service on the basis of their race or ethnicity. It is important to understand where large numbers of people of color live, so that service changes can be evaluated in light of possible civil rights impacts.

Since the end of World War II and in particular since the 1970s, the combination of rapid suburban development and de-industrialization has tended to shift many lower skill and lower paying jobs from cities to suburbs. SEPTA, as a regional agency, is better positioned to serve suburban jobs than other, more geographically constrained, transit agencies. According to a 2012 Brookings Institute study1 of city and suburban job access, SEPTA is about average among the 100 largest transit agencies in providing access to regional jobs. The fact that so many lower-skilled jobs have moved out of cities to suburbs makes them naturally harder to connect with transit to people who need access to those jobs.

This imbalance in the location of jobs and housing has had a disproportionate impact on low income and minority residents in cities. And it is important in this study that we acknowledge the role that race and discrimination have played in past decisions and the harm those decisions has caused to minority and low-income Philadelphia residents. SEPTA cannot solve this challenge on its own, but it must honestly grapple with the challenge and decide how best to react to it.

This study will not fix this problem. But a thorough reconsideration of the bus network within the City of Philadelphia may reveal opportunities to improve connections to suburban job centers or increase access to jobs and opportunities that are already within the city. And a continuing study of the rest of the SEPTA network across the suburbs will likely reveal additional opportunities to improve connections to serve people who want to ride to the suburbs for job opportunities.

In fact, building reverse commute ridership is a useful way to improve the productivity of suburban bus service that often serves primarily to bring workers from their suburban residences into the city. By combining that kind of traditional suburb to city commute service with service that is bringing workers from the city to the suburbs is a fruitful opportunity to increase ridership with minimal additional cost.

Density of Transit Commuters

Figure 73 shows the density of people who commute by transit based on their home location. This gives us an idea of the location of dense pockets of people who commute to work via transit. Commutes to work make up a large part of transit demand, but not the majority. Therefore, this map only tells us a part of the story of where transit riders live.

Although existing commuter behavior can be a good indicator, this data should not be construed as an absolute measurement of public transport use, for a variety of reasons:

- This map shows only the home end of work commute trips: the commuters captured by this data are all headed to work somewhere else, and will also generate demand there.
- The journey to work is only one of the average person’s daily trips, and not everyone takes this trip. Commute-related trips may be as few as 20% of total trips.
- Many people combine their commute with a variety of different purposes such as shopping, appointments, socializing, school, and many others. Transit can be useful for all of these.
- Many existing transit riders are people for whom the existing network works well. There may be others for whom it could work if the network were different.

2 The Census Bureau collects this data using annual surveys of a sample of the population over the five preceding years. Thus, this data represents an estimate of transit commuters from 2011 to 2015.
Density of Walk and Bike Commuters

Figure 74: Bike and walk commuter density is highest in Center City and University City.

Manhattan and San Francisco, some of the densest places in North America. At these densities, so many destinations are within such close proximity that walking or biking becomes more convenient than transit.

Figure 74 shows the typical transit demand curve relative to the density of development. From suburban to urban density the demand for transit increases exponentially, meaning that transit demand increases faster than the increase in density. But when density approaches the levels of Center City Philadelphia or Manhattan, transit demand increases at a rate slower than density, as biking and, in particular, walking become more convenient options for more trips.

Figure 75: At high density levels, a marginal increase in density has a smaller effect on transit demand because so many people walk or cycle.