Identifying Opportunities for Expanded Park-and-Ride Capacity in South Jersey

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DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

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Executive Summary

As travel patterns shift and demand for public transit services increases due to congestion, drive-to-transit access patterns, such as park-and-rides (PNR), will remain a primary means of transit access for many regional residents and workers to avoid the time and monetary cost of traveling by automobile. This project sought to identify locations where New Jersey Transit (NJT) bus and train PNR demand exceeds capacity, or is likely to do so in the future within the DVPRC region in South Jersey (the study area).

Table 1 and Figure 1 both identify locations recommended for future PNR consideration in the South Jersey study area. (Figure 1 also shows existing PNR facilities in the study area.) Some recommended locations are within a short distance of each other and even within the same municipality. This is not to suggest that in both locations a PNR should be implemented, but that in their current condition and ownership both parcels are sites fit for future PNR.

Through the course of the project the steering committee provided feedback focused on understanding future transit demand, and in developing criteria used to determine sites best suited for future PNR in the study area.

Current and projected demographics, land use, land cover, parcel, and transportation network data were analyzed through GIS and aerial imagery to reveal PNR locations that could improve travel patterns for NJT or other transit passenger use. New PNR opportunities were identified by narrowing all parcels in the study area, in a two-stage analysis, down to eight recommended locations for further research for PNR implementation.

The first stage of analysis removed parcels from the group that scored low in a raster analysis of 11 criteria, and the second stage used aerial imagery interpretation to narrow the group even further. Each location was then vetted by the steering committee, and some locations were added and removed based on feedback.

These proposed locations reflect the current capabilities of the region's transportation network to accommodate ridership. Thus, while PNR passenger rail locations were considered for expansion at locations that are at capacity, none are recommended because there are no plans to increase the capacity of the transit services there.

Prior to PNR design and build, an additional evaluation of the passenger demand at each specific location will be required. This report provides design amenities and examples that can be used as a resource at the time of PNR implementation.

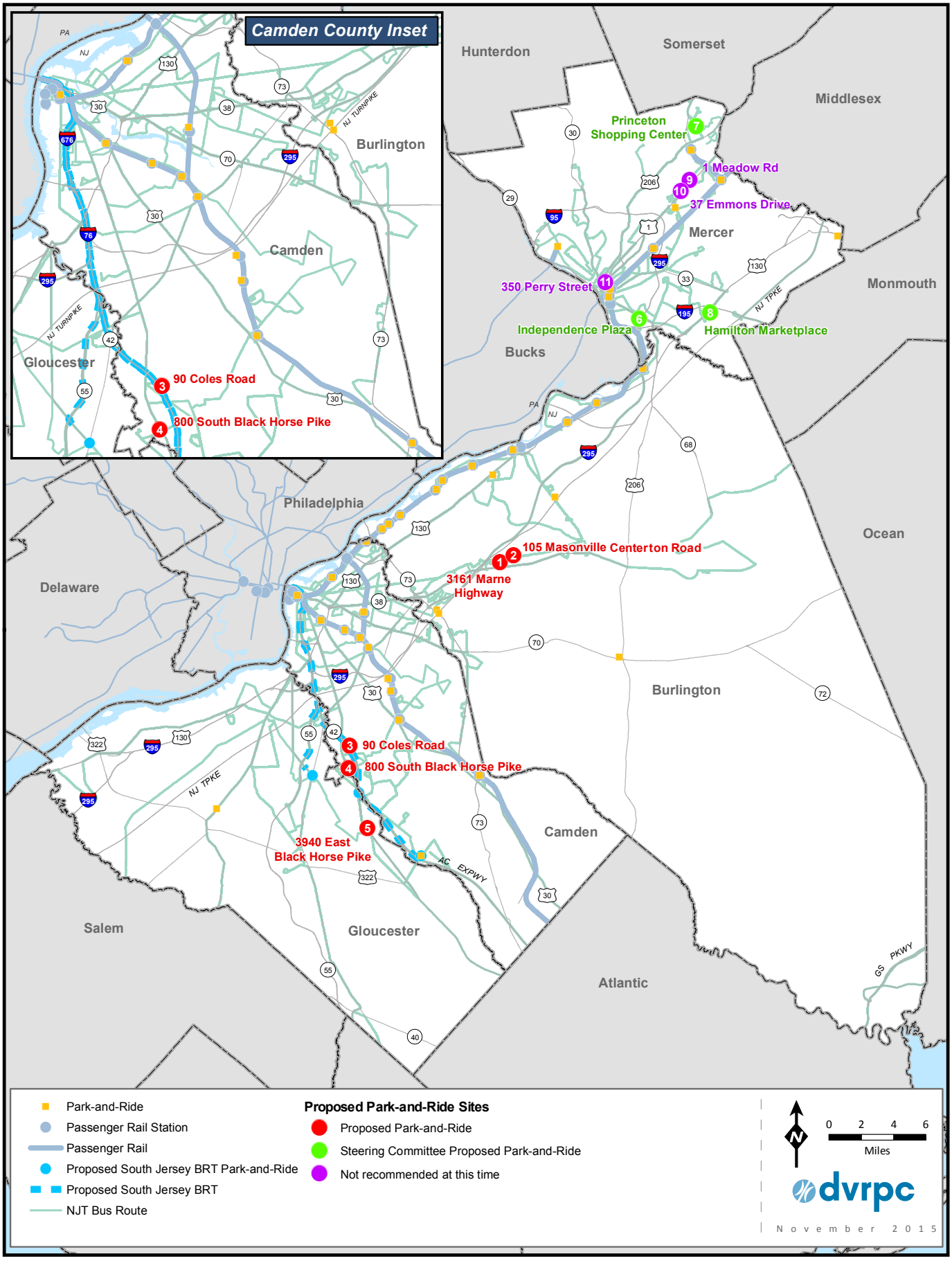
Table 1: Sites Discussed for Future PNR Implementation

#	County	Municipality	DVRPC Land Use (2010)	Zoning	Acres	Score
1	Burlington	Mount Laurel Township	Vacant	Planned Unit Development	9.76	41
2	Burlington	Mount Laurel Township	Vacant	Neighborhood Commercial	7.05	41
3	Camden	Gloucester Township	Parking: Commercial	General Industrial	1.73	42
4	Camden	Gloucester Township	Vacant	Neighborhood Commercial	8.70	43
5	Gloucester	Washington Township	Parking: Commercial	Highway Commercial, Commercial Industrial	2.56	42
6	Mercer	Hamilton Township	Parking: Commercial	Highway Commercial	17.2	45
7	Mercer	Princeton	Commercial	Shopping Center	6.18	N/A
8	Mercer	Hamilton Township	Parking: Commercial	Research Development with Commercial Development	22	N/A
9	Mercer	West Windsor Township	Vacant	Neighborhood Center Business	6.18	43
10	Mercer	West Windsor Township	Vacant	Neighborhood Center Business	2.19	43
11	Mercer	Trenton City	Parking: Commercial	Mixed Use	5.80	42

*N/A means the site was screened out of the DVRPC analysis at or prior to stage-2.

Sources: DVRPC, 2015; Muncipal Plans, 1987–2015

Figure 1: Sites Selected to Be Further Studied for PNR in South Jersey



Chapter 1: Introduction

As travel patterns shift and demand for public transit services increases due to congestion, drive-to-transit access patterns, such as park-and-rides (PNR), will remain a primary means of transit access for many regional residents and workers to avoid the time and monetary cost of traveling by automobile. This project sought to identify locations where New Jersey Transit (NJT) bus and passenger rail PNR demand exceeds capacity, or is likely to do so in the future in the South Jersey DVRPC region.

Through the course of the project the team used feedback from the steering committee and indicators of current and future transit demand to determine sites best suited for future PNR.

Study Goals

The purpose of this study was to identify potential opportunities for new PNR facilities in NJT's service area based on existing and anticipated passenger demand. The team also reviewed opportunities to expand parking inexpensively via strategies such as shared use.

Related Studies

There were three relevant resources the DVRPC team used to learn about existing and previously recommended PNR in South Jersey. Using the *Cross County Connection Park|Ride Guide*, existing PNR locations were identified. Other primary resources used to understand proposed PNR and public transit in the study area were the *CR 571 Park-and-Ride Study* and the *Route 55/42/676 Transit Alternatives Analysis*. The sites identified in the *CR 571 Park-and-Ride Study* and the *Routes 55 / 42 / 676 Bus Rapid Transit Locally Preferred Alternative* remain favorable PNR candidates; however, this study sought to focus efforts on identifying new PNR candidates throughout the South Jersey region.

Cross County Connection Park|Ride Guide (2007)

The *Cross County Connection Park|Ride Guide* was published in 2007, and it lists all New Jersey counties with their associated PNRs. This document was used as a resource to direct the DVRPC team to all existing PNR locations in the study area and supplement information in the DVRPC database.

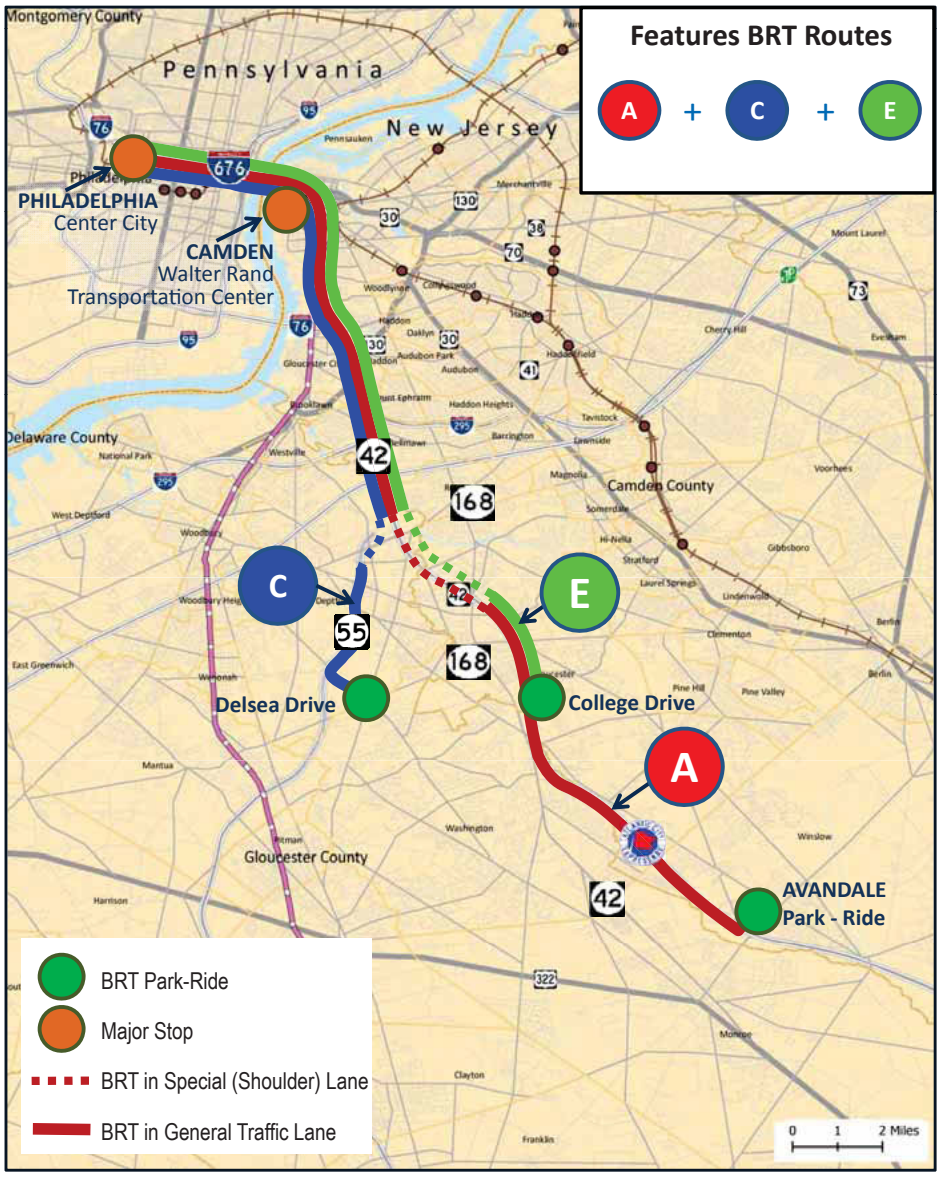
CR 571 Park-and-Ride Study (2012)

This *CR 571 Park-and-Ride Study* (DVRPC publication number 11017) was used as a guide to develop the criteria inputs for the analysis in the present study. The *CR 571 Park-and-Ride Study* examines what makes a successful PNR in general (nationally) and specifically for New Jersey. The criteria identified in the report was used to reveal the proposed PNR locations (A process similar to what was used in this report). The findings of the *CR 571 Park-and-Ride Study* suggest five sites for PNR advancement on CR 571 in Mercer County. Four sites would be new PNR designated facilities in existing locations and include: West Windsor Community Park, Southfield Shopping Center, Millstone Road, and East Windsor Village. The fifth site is recommended for PNR expansion at the Twin Rivers Shopping Center.

Routes 55 / 42 / 676 Bus Rapid Transit Locally Preferred Alternative (2012)

The *Routes 55 / 42 / 676 Bus Rapid Transit Locally Preferred Alternative* document was used to discern the preferred alternative for the proposed South Jersey BRT service. The analysis identifies BRT supportive infrastructure such as PNR locations. This information was helpful for this project to recognize PNR locations that could be pursued for implementation for proposed service. Twenty-two potential PNR facilities were identified and evaluated, and nine locations were determined feasible, with more study necessary to be formally recommended. The locally preferred alternative proposes adding 1,800+ parking spaces by expanding the Avandale Park-Ride and creating new PNR facilities at College Drive and Delsea Drive, illustrated in Figure 2.

Figure 2: South Jersey Bus Rapid Transit Locally Preferred Alternative



Source: Routes 55 / 42 / 676 Bus Rapid Transit Locally Preferred Alternative, 2012

The Benefits of PNR

PNRs are intermodal transfer points where individuals from dispersed origins can shift from a low-occupancy or non-motorized mode to a higher-occupancy vehicle such as public transit. PNRs tend to thrive when available transit services provide customers a reliable service with a high level of flexibility. This can be achieved by providing access to other modes of transportation as well as providing high-quality linkages that make walking and bicycling to the PNR possible. The benefits can be realized on an individual level (the cost of gas, car maintenance, tolls, greater work productivity) or on a societal level (possible reduction in congestion along a corridor).

Gas prices in the United States have fluctuated erratically in the past decade, at times putting personal vehicle travel out of reach for potential motorists commuting to their jobs. Effectively placed and designed PNR lots can benefit auto users by reducing the portion of commute completed by their personal vehicle, thus decreasing additional investment in their personal vehicles. This reduction in personal vehicle use is likely to reduce maintenance costs that are expected to be accrued with higher auto usage. PNR located ideally for commuters can also help them avert fees such as road and bridge tolls common to commuting into urban areas within the region.

If a passenger were to change modes, from their personal vehicle to transit, depending on the type of services offered on-board, there may be an opportunity for that passenger to shift work hours that may have previously been spent at an office to be completed while on transit.

PNR also offers a number of societal benefits. Reducing the number of personal vehicles commuting into CBDs, especially

those used by a single commuter, has the potential to reduce energy consumption, traffic congestion, parking demand in CBDs, and air pollution caused by vehicle emissions. The creation of PNR can also have positive effects for bus route operations, by increasing ridership.

PNR Location Types

PNRs can be categorized into two fundamental types: neighborhood and regional. As seen in Figure 3, neighborhood PNRs tend to have small to medium capacity, and they are placed at the junction of major collector arterials with the intention of collecting drivers from residential areas. Regional PNRs tend to have high-capacity lots located at the junction of a primary arterial and a radial freeway. Both types of lots are intended to intercept single-occupancy vehicles as a means of reducing recurring congestion along radial freeways headed to CBDs during peak traffic hours.

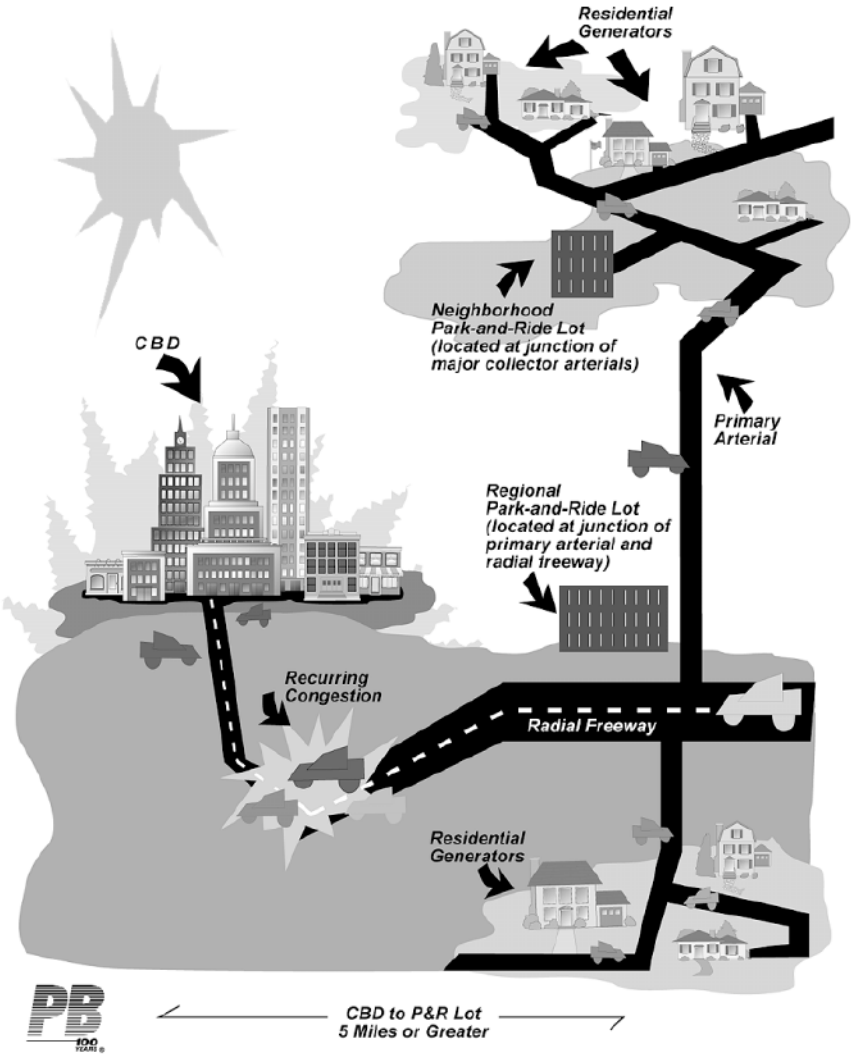
What Makes a Good PNR Location?

Through literature, related studies, and team and steering committee knowledge, specific characteristics were selected to determine what would make an ideal site for PNR. Model conditions considered were: adaptability for a site to be changed to a PNR facility, proximity to a roadway with high volumes, convenient site accessibility for all modes, visibility from a major roadway, safety for passengers and users, significant user demand, and the suitability of the land use context.

Adaptability

A site that already has elements of an ideal PNR site is desirable because of the potential for cost savings related to design and construction. Factors that are ideal for a site's potential reuse are appropriate lighting, sidewalks, ADA ramps, signage, parking and traffic striping, and dedicated ingress and egress. For undeveloped sites, it is important to consider whether the ground is level or wooded and whether the soil requires remediation before construction.

Figure 3: Siting a Park-and-Ride Lot



Source: Park-and-Ride Planning and Design Guidelines, 1997

Proximity

A site that is both near (in a straight line distance) and accessible (on network) to a major intersection or interchange that does not experience high levels of congestion during peak periods tends to be most convenient for potential PNR users.

Site Accessibility

A site that has existing or potential for ingresses or egresses that are convenient and safe for all vehicles and users is optimal. Examples of good ingress and egress elements include auxiliary lanes (which

provide an independent lane for vehicles turning into lots) and signalized turning movements for lots located adjacent to intersections. Site designs should also be studied to ensure that they do not exacerbate existing traffic problems. In some settings, sidewalk networks, bicycle infrastructure, and ADA ramps are features important in attracting non-auto users.

Visibility
The site is visible to potential users from a major intersection or interchange.

Safety
Existing features such as fencing, lighting, sidewalks, and shelters can contribute to the perceived safety of a location.

Demand
In order to be well patronized, a site should be located in an area with enough demand for PNR to substantiate its construction. The existing or constructed site should have a capacity that is proportional to its demand. Experts suggest that a 15 percent parking vacancy rate is ideal for PNR.

Context
A PNR location should be suitable to the general land use of the areas around it. Areas featuring industrial, commercial, and vacant uses are generally the best adjacent usages. Locating lots in entirely residential or environmentally vulnerable areas should be avoided.

Chapter 2: Existing Conditions

The total population and employment of the study area is summarized in Table 2, which also illustrates the number of municipalities and tracts by county to give some context for how information is displayed throughout this chapter. Data sources used to understand the study area include: demographics, existing PNR locations, PNR capacity and space utilization, and station shed inventories.

Since the purpose of this project is to predict where PNR could have the most impact, the team took some time to analyze the DVRPC-approved population and employment projections.

Figure 4 illustrates the study area, which includes all four New Jersey counties within the DVRPC region: Mercer, Burlington, Camden, and Gloucester. In addition, the figure shows a population projection from 2010 to 2040. There are major projected increases in localities in Gloucester and Camden counties of up to and over 4,000 residents. The proposed South Jersey BRT (detailed more in Chapter 1) would provide service in Camden and Gloucester counties in these same areas of growth. Further, in Figure 4, the yellow points identify bus-only PNR facilities, which coincide with areas of projected population growth.

Specifically, high growth is projected within the municipalities Harrison, Winslow/Monroe, and Mount Laurel for 2040.

Figure 5 demonstrates the employment projections for 2040. Figures 4 and 5 illustrate similar existing activity in 2010 and growth projections for 2040. However, Mercer County municipalities have a higher projected employment growth than population in suburban areas such as Hopewell, West Windsor, Hamilton, Ewing, and Lawrence.

Table 2: Population and Employment by County in the Study Area

County	*# of Municipalities*	*# of Tracts*	*Total Population*	*Total Employment*
Mercer	12	77	368,094	295,849
Burlington	40	114	449,964	360,254
Camden	37	127	513,512	403,893
Gloucester	24	63	289,098	228,136

Source: DVRPC, 2010

Figure 4: Population Projections for Study Area (2010-2040)

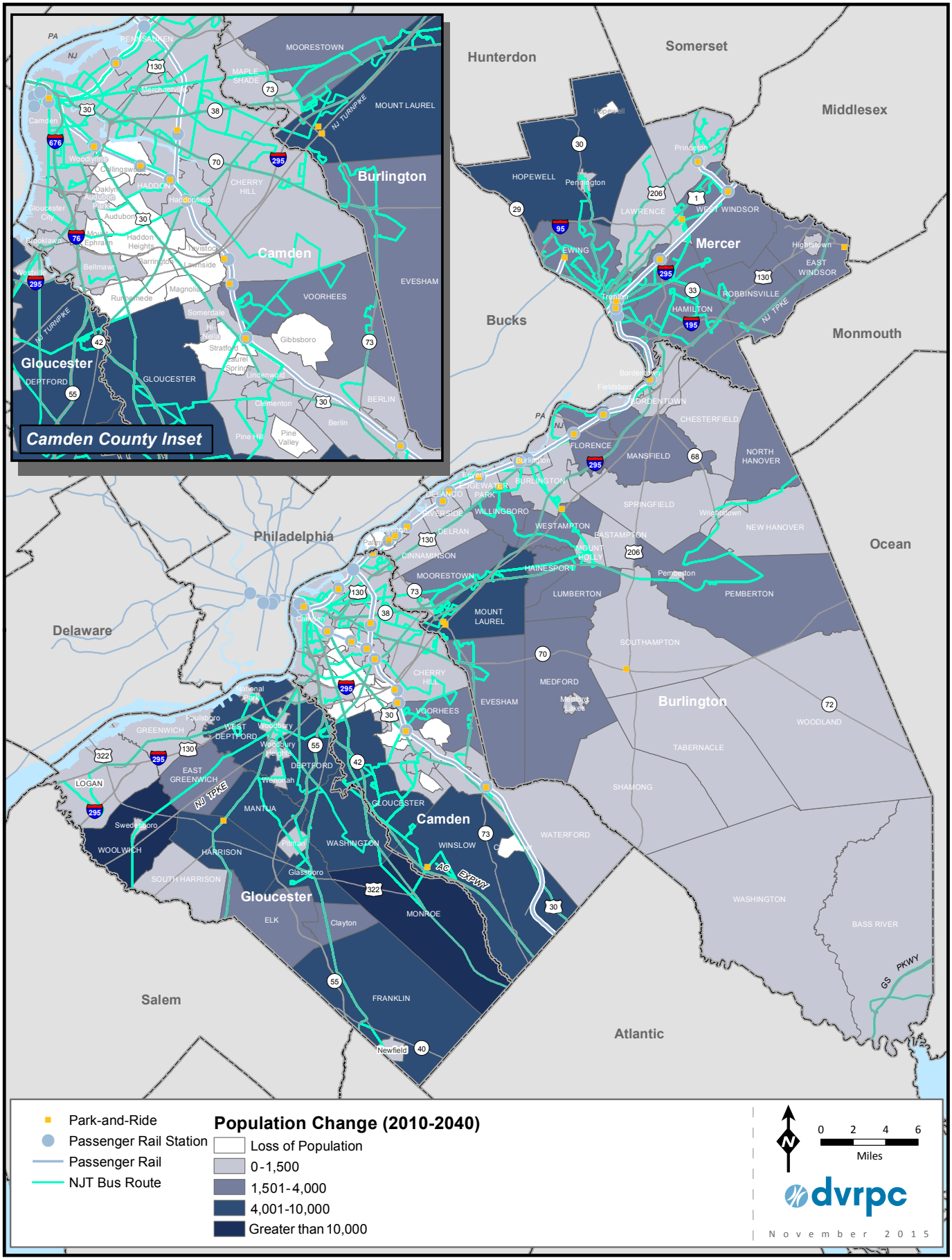
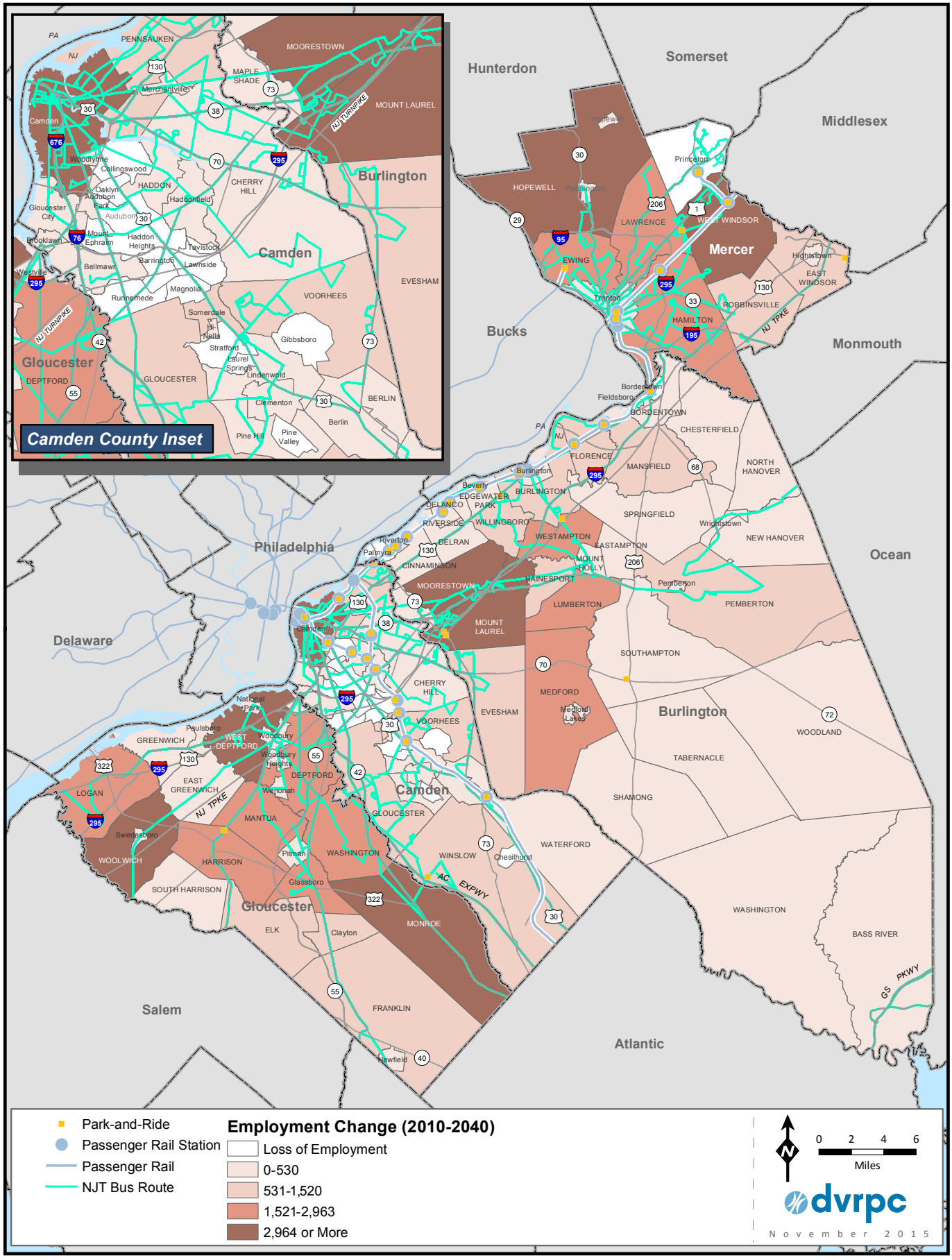


Figure 5: Employment Projections for Study Area (2010-2040)



Existing PNR in South Jersey

As outlined in the goals of this study (Chapter 1), there were two ways the team was asked to find potential locations for PNRs in South Jersey for NJ Transit: expansion and new development. The team looked more closely at the existing PNRs in the region to analyze any expansion that could be recommended. All known PNRs in South Jersey are shown in Figure 6.

PNR lots are a resource for commuters and travelers to decrease trip travel time and avoid additional fees that may arise if using their personal vehicle. Decreasing travel time can be based on the traveler's perception.

Table 3 lists the PNRs in the study area with high parking usage. The Northeast Corridor stops—Princeton Junction in particular (87 percent filled)— is a multimodal hub for three public transit services and has ample bicycle and pedestrian access for residents in Mercer County. This type of station and PNR facility is ideal because passengers can choose from many options on how to make their trip to and from their destination.

Figure 6: PNR in South Jersey

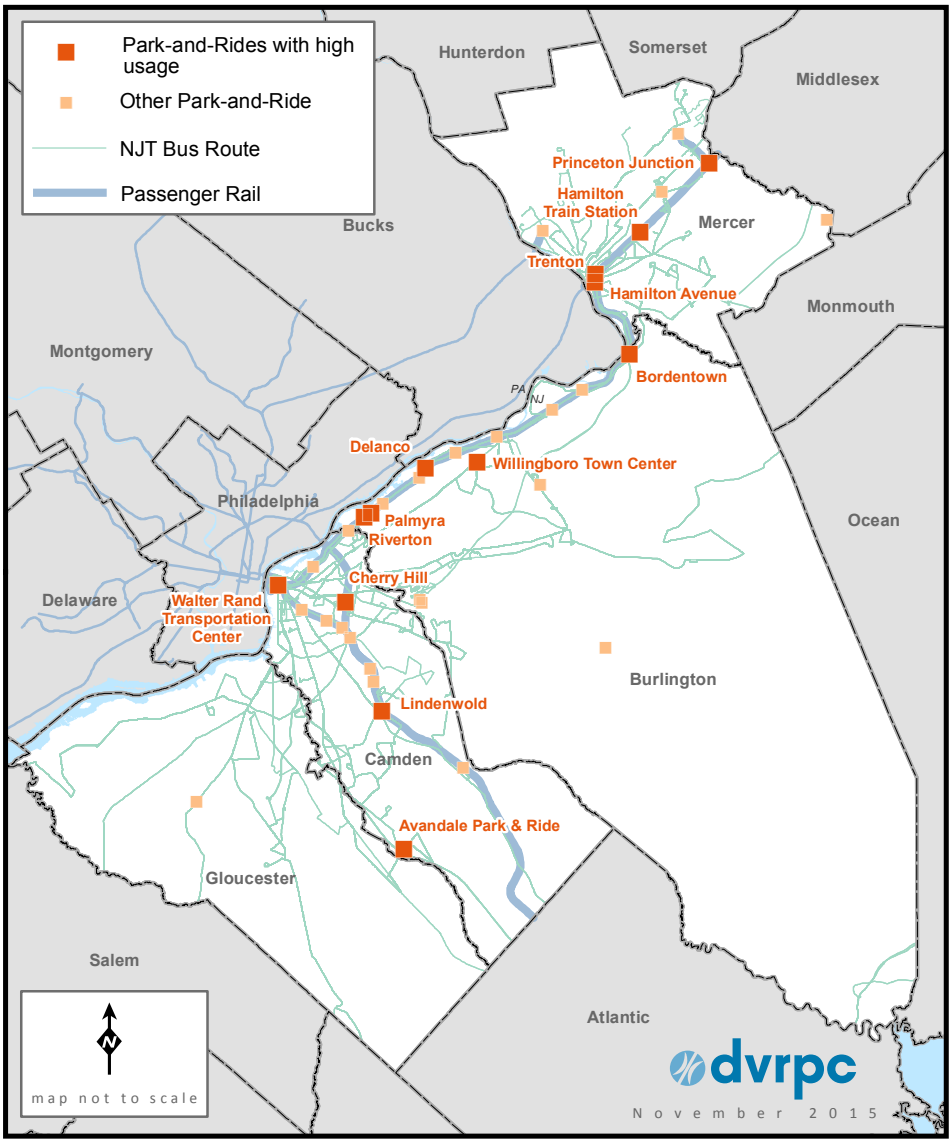


Table 3: Most Used NJT Affiliated PNRs Within the Study Area

Type	Service	County	Name	Transit Connections	Total Lots	Standard Usage	Standard Capacity	ADA Volume	ADA Capacity	Utilization Rate
Bus	Bus	Burlington	Willingboro	NJ Transit Bus: 409, 417, 418; Burlink B1, B2	1	88	150	0	3	58%
		Camden	Avandale	NJ Transit Bus: 400, 551, 463, 459	1	222	322	6	8	69%
Light Rail	River Line	Mercer	Trenton	Amtrak - Northeast Corridor, SEPTA - Trenton Line, NJ Transit Bus: 600, 601, 602, 606, 608, 609, 619	1	85	105	3	5	80%
		Mercer	Hamilton Ave	NJ Transit Bus: 409, 603, 613	1	16	22	1	1	74%
		Burlington	Bordentown	NJ Transit Bus: 409	1	142	183	0	6	75%
		Burlington	Delanco	None	2	71	103	1	2	69%
		Burlington	Riverton	NJ Transit Bus 419	3	62	64	2	3	96%
		Burlington	Palmyra	NJ Transit Bus 419; BurLink B9	2	20	35	1	2	57%
		Camden	Walter Rand Transportation Center	NJ Transit Bus: 313, 315 317, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 412, 413, 418, 419, 450, 451, 452, 453, 457, 551; PATCO, River Line	1	409	421	0	0	97%
Passenger Rail	AC Line	Camden	Lindenwold	NJ Transit Bus: 403, 459, 554; PATCO	5	2,647	3,217	62	62	83%
		Camden	Cherry Hill	NJ Transit Bus: 406, 450	1	201	350	12	12	59%
	NEC	Mercer	Princeton Junction	NJ Transit Bus: 600, 612, Amtrak, Princeton Shuttle	10	3,621	4,187	42	42	87%
		Mercer	Hamilton	NJ Transit Bus: 606, 610	1	2,987	3,580	32	32	84%
		Mercer	Trenton	SEPTA - Trenton Line, NJ Transit Bus: 600, 601, 602, 606, 608, 609, 619	4	2,428	3,465	48	64	70%

Source: NJT Parking Guide, 2013

A portion of the PNR facilities listed in Table 3 are close to capacity, and so are the NJT passenger rail services these passengers use. Since NJT does not have plans to expand passenger rail service in these areas, adding more parking, especially at high-volume stations, would bring a false perception that these transit modes could accommodate more riders. Therefore, the steering committee decided this project should focus on potential NJT PNRs that could provide a new resource for bus passengers.

Shed Analysis

In partnership with NJDOT and PennDOT, DVRPC has a longstanding program to assess transit station market areas. The assessment is conducted by surveying license plates of vehicles parked at each PNR (on a specific date) and mapping the addresses that are associated with those plates. By exploring the distribution of mapped records, we can visualize where a given station's highest concentrations of PNR customers reside, as well as typical drive-access distances. The mapped data illustrates the commuter shed or catchment area for that PNR.

Figures 7 and 8 illustrate passenger rail and bus PNR commuter sheds by transit line in the study area. This type of analysis identifies "hot spots" of passenger origins regardless of their linear distance from the PNR. The darker shades of each color indicate areas with the highest densities of PNR user travel origins.

One trend highlighted in Figure 7 is that the passenger rail lines with high PNR occupancy rates (see Table 3) also have a large catchment areas.

Figure 8 shows two PNR locations that are served by NJT bus service: Avandale and Willingboro. The catchment area of the Avandale Park-Ride is large (ranging from eight to ten miles) and shares a market with the PATCO commuter shed (in Figure 7 in pink). Avandale Park-Ride is likely attractive to passengers because there is express bus service into Philadelphia and free parking.

In comparing Figures 7 and 8 the southwest and southeast portions of the study area (Gloucester and Burlington counties) do not fall into any station shed. One assumption that can be made is that commuters are not using PNR with public transit to reach their destinations.

The proposed South Jersey BRT is highlighted with a blue dotted line in Figure 8. From this shed analysis data it looks as though the new service could provide transit to residents who are not currently using public transit PNR facilities.

Figure 7: Passenger Rail PNR Commuter Sheds in New Jersey

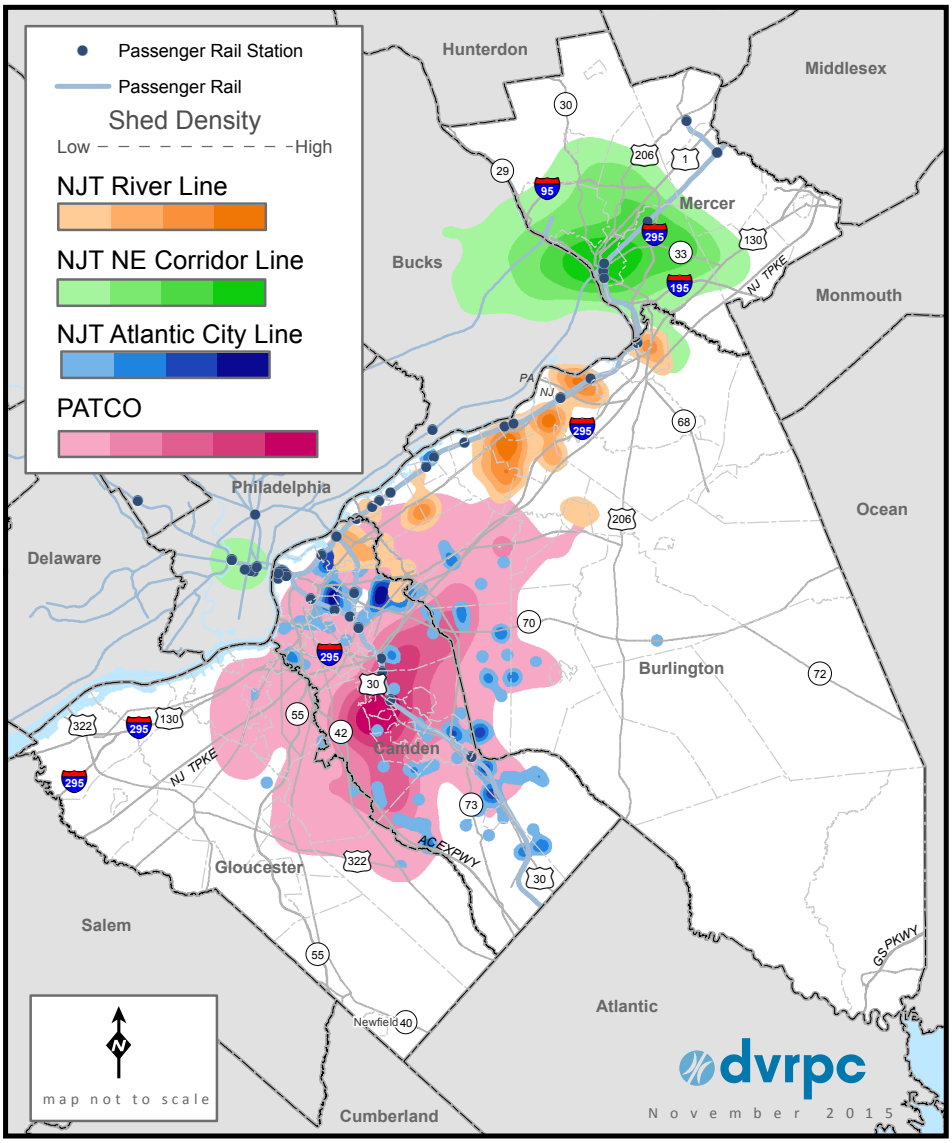
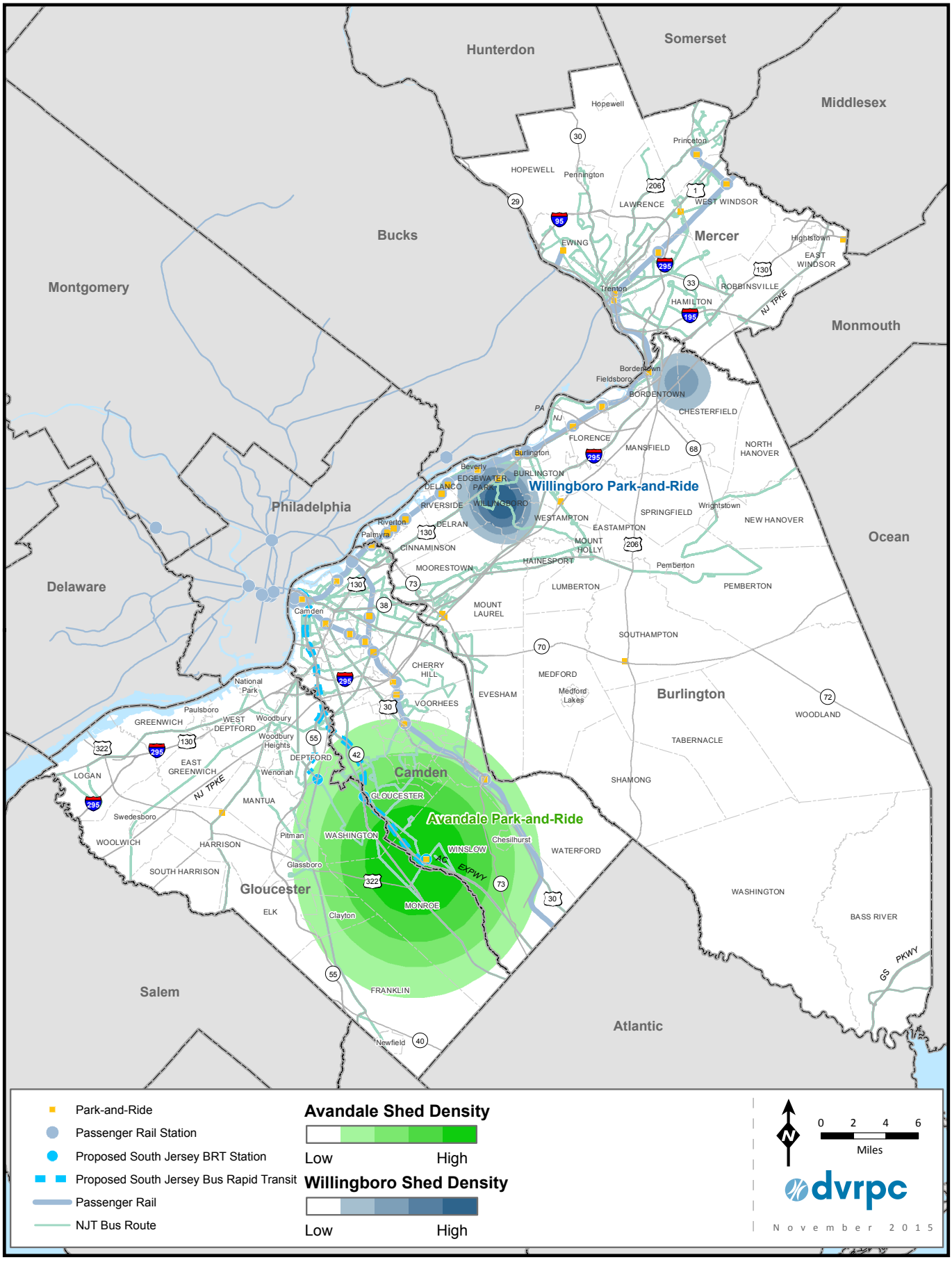


Figure 8: Avandale and Willingboro PNR Commuter Sheds



Chapter 3: Description of Site Selection Process

The team put together a two-stage analysis to determine the most suitable locations in the study area for future PNR implementation.

Stage 1: Raster Analysis and Criteria

The first stage of analysis was completed by using 11 criteria inputs (Table 4) from existing datasets to reveal the highest-potential parcels for PNR in Burlington, Camden, Gloucester, and Mercer counties.

Each data set had a score that was normalized on a scale of 1 to 5 (scoring treatment) based on the distribution of data (also in Table 4). The criteria and weighting was determined with feedback from the steering committee.

When developing criteria for finding parcels with potential for PNR, NJT mentioned that commercial retail and, specifically, shopping centers have previously proven difficult when attempting to develop or negotiate space for a PNR. Final criteria, developed in part by this recommendation, screened the aforementioned land uses, and the outcome is reflected in the parcels recommended by the DVRPC two-stage analysis.

Table 4 is organized into four categories that the team and steering committee deemed influential for successfully locating a PNR facility: location, traffic, transit, and demographics. The importance of each category and criteria are explained in detail over the next few pages. These categories build on the description of important site selection factors for PNR in Chapter 1.

Table 4: Criteria Selected as Inputs for GIS Analysis (Stage 1)

	Criterion	Data Source	Scoring Treatment	Weight
Access	Distance to Major Highway	DVRPC GIS	Low = 5, High = 1	2
	Distance to Existing Park-and-Ride Facilities	DVRPC GIS	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	1
	Total Weight for Access			**3**
Traffic	Annual Average Daily Traffic (AADT)	DVRPC TIM 2.0 Network	Low = 1, Med = 3, High =5	1
	Volume-to-Capacity (V/C) Ratio	DVRPC TIM 2.0 Network	Low = 3, Med = 5, High =1	.5
	Total Weight for Traffic			**1.5**
Transit	Transit Passenger Volumes	New Jersey Transit	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	1
	Transit Vehicle Volumes	DVRPC TIM 2.0 Network	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	2
	Transit Score	DVRPC GIS	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	.5
	Total Weight for Transit			**3.5**
Demographics	2040 Population Projections	DVRPC GIS	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	.75
	2040 Employment Projections	DVRPC GIS	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	.5
	Journey to Work Data (Census Transportation Planning Products)	US Census	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	1
	Journey to Work Data (Mean Travel Time)	US Census	Low = 1, Low-Med =2, Med = 3, Med-High = 4, High = 5	1
	Total Weight for Demographics			**3.25**
Total Weight				**11.25**

Source: DVRPC, 2015

Location

The location of parcels ideal for PNR are those that are convenient for vehicle access, but are far enough from existing PNR facilities to avoid competition between them. This category has two criteria and has a weight of 3.

Distance to Major Highways – Ease of access from main arterials is thought to play a role in the connection of individuals commuting by car to public transit. Finding locations closer to highways allows for travelers to minimize their auto trip; therefore, a higher score is more valuable in this treatment and is also the highest possible weight for a single criterion (2.0).

Distance to Existing Park-and-Ride Facilities – PNR facilities should be located about four to five miles apart. Those potential sites that are furthest from an active PNR are given the highest scoring treatment. The weight for this criterion is 1.0.

Traffic

When considering parcels, optimal PNR locations are along arterials that have consistent volumes, but are not experiencing regular, heavy congestion, which could deter potential use. This category has two criteria and has a total weight of 1.5.

Annual Average Daily Traffic (AADT) – AADT indicates the number of travelers using a road on an average basis. A segment with higher AADTs received a higher score due to the potential to capture users along a single corridor. The criterion received a weight of 1.0.

Volume-to-Capacity (V/C) Ratio – Placing PNRs in locations with traffic congestion could provide relief to corridors by removing autos from the roadway. However, adding a new PNR to an arterial with gridlock conditions could potentially add more vehicles to the same roadway and increase travel times for both autos and transit. This criterion is broken into three bins: <.75, 0.75 to 1.25, and >1.25, and scored, with the middle category that represents congestion (but not gridlock) receiving the highest score. V/C ratio tends to be created based on inferred capacity, and therefore was given a weight of 0.5 to reflect this relative uncertainty.

Transit

PNR is thought to function best in places where public transportation exists with higher vehicle volumes (auto and transit) so there is potential for users to shift to transit. This category has three criteria and has a total weight of 3.5.

Transit Passenger Volumes by Route – Passenger volumes or ridership is important because it demonstrates how well used transit is along an arterial. Transit lines with larger passenger volumes received higher scores. This criterion has a weight of 1.0.

Transit Vehicle Volumes – The number of transit vehicles running daily along a corridor is an indicator of transit frequency. PNRs have a higher success rate based on high transit frequencies, and therefore higher vehicle volumes were awarded a higher score and the highest weight of 2.0.

Transit Score – Using population, employment, and zero-car household density figures, Transit Score provides a composite estimate of how transit supportive a place is. Areas with a higher scores are more likely to experience greater transit demand, and thus higher values receive higher scores. Because Transit Score relies on criteria that tend to favor dense urban places over suburban settings, the criterion received a weight of 0.5 for this particular analysis.

Demographics

Fitting parcels for future PNR should be located in areas where population and employment and growth are expected. To identify key locations, the group thought it was also meaningful to capture, by tract, the highest number of trips to a central location and the longest commute time. This category has four criteria and a total weight of 2.25.

2040 Population Projections – Projections of future growth can highlight transportation trends and needs related to capacity and demand. Therefore, areas that are projected to grow received a higher score. This criterion was given a 0.75 weight because it is a forecast, and conditions are subject to change.

2040 Employment Projections – Projections of job growth provide insight into transit demand in a corridor, and PNR locations should be built where there is potentially a need. Therefore, higher growth received a higher score. PNR users will likely want to use a lot that is closer to their home rather than their work, and so this was given a lower weight of 0.5 than the population projection criterion.

Journey to Work Data – Travel flows between home and work going to the central locations of Camden, Philadelphia, and Trenton (dense-transit accessible employment centers) were measured by tract for all modes using the Census Transportation Planning Products (CTPP). Those tracts with a higher number of people traveling to one of these three cities were awarded a higher score, indicating commuting patterns that could benefit from PNR facilities. This category received a weight of 1.0.

Journey to Work Data – Using the American Community Survey's Five-year Journey to Work data, mean travel time for individuals

16 years and older was parsed by census tract and mode for areas along major arterials. PNRs are likely to attract potential users with longer travel times; therefore, these tracts were awarded higher scores. This data was given a weight of 1.0 because it provides insight into travel patterns in South Jersey.

Stage 1 Analysis Results: PNR Location Suitability Score

Once all the criteria were agreed upon, scored, and weighted, the line features were buffered in GIS at a distance of a half-mile; in some instances the buffers overlapped one another. In those cases the higher of the scores was assigned to the overlapping area.

The scored datasets were then converted into a raster in GIS in preparation for spatial analysis. The raster calculator was used in conjunction with the scoring weights developed to create a PNR location suitability score. The sites with PNR location suitability scores of 40 (the highest score a site received was 43) or higher were then separated into a new shapefile for further analysis.

The land uses included in this analysis were designated as parking (commercial, transportation, light manufacturing, and heavy manufacturing) or vacant (non-wooded or preserved lands) properties. The outcome of the Stage 1 analysis narrowed the total number of potential parcels for PNR to about 600.

Stage 2: Aerial Imagery Interpretation

The Stage 2 analysis began with pre-screening GIS analysis and then a series of iterative aerial imagery interpretation analyses using GIS and online mapping programs, described in greater detail in Table 5.

In the pre-screening process, the number of sites that could possibly be proposed was reduced first by removing those that were less than one acre from the group. Next, by using the DVRPC Environmental Screening Tool (Figure 9 describes the tool), additional sites were eliminated. This tool was used to ensure that no sites were recommended on environmentally vulnerable land such as those that are wooded, preserved, or historic. The remaining 529 sites were evaluated using aerial imagery in GIS and online mapping programs. The following four criteria were assigned a score of 0 or 1 to further narrow the number of sites.

Visibility – Visibility from a major arterial is important for way-finding and marketing of transit services, and also contributes to a higher perception of safety for riders and their property. For the purposes of scoring, a parcel is either visible or not from the arterial. For example, if a candidate location was directly visible from the major arterial, i.e., if a passing vehicle could see a bus dwelling there, it was assigned a score of one point. If not, no points were given.

Ease of Entry - The degree of difficulty involved in accessing PNR lots has the potential to affect the number of users they attract. This was captured partially in the Stage 1 analysis, in the distance to the arterial; however, distance on network varies from the straight line distance. Using aerial imagery, each site's ease of ingress and egress, and presence of auxiliary lanes, was studied and evaluated. If the parcel was a half-mile by roadway network from a major arterial, it received one point; if it was not, it received no points.

Activity and Employment Centers - Activity and employment centers represent an opportunity to improve transit visibility in more

Table 5: Criteria Selected as Inputs for Stage 2 Analysis

Criterion	Data Source	Pre-Screening
DVRPC Environmental Screening Tool	DVRPC GIS	Yes or No
> 1 Acre	DVRPC GIS	Yes or No
Criterion	**Data Source**	**Scoring Treatment**
Visibility from Arterial	Aerial Imagery/ DVRPC GIS	No= 0 Yes =1
Ease of Entry/ Exit	Aerial Imagery	No= 0 Yes =1
Activity / Employment Centers	DVRPC GIS	No= 0 Yes =1
Connectivity (Sidewalks/Bike lanes)	Aerial Imagery/ DVRPC GIS	No= 0 Yes =1

Source: DVRPC, 2015

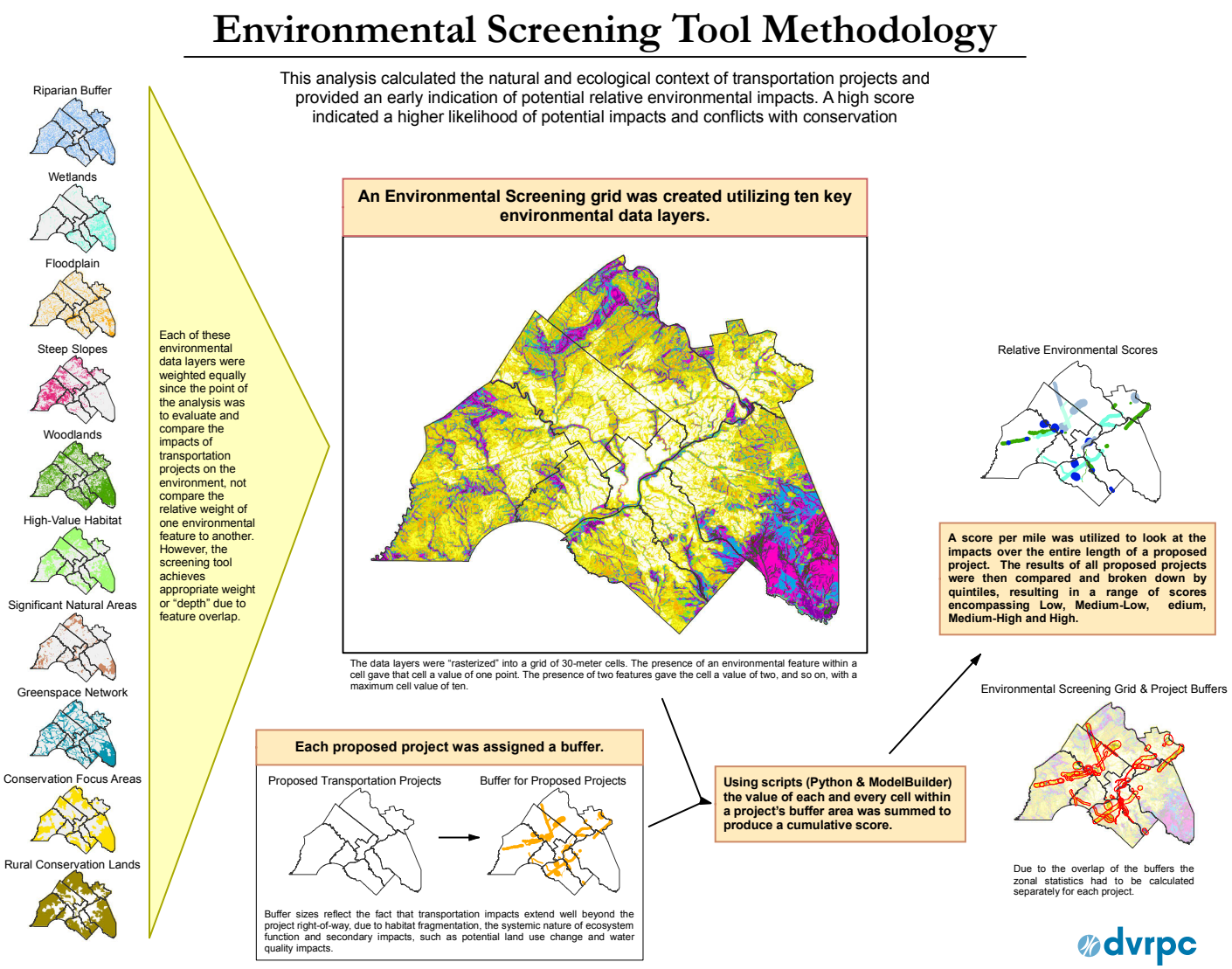
congested areas and bring more users, as well as reduce auto use by allowing for combined trips when centered close to places such as shopping centers. If a parcel was 500 feet from an activity center, it received one point; if it was not, it received no points.

Connectivity (Sidewalks/Bike lanes) - PNR lots generally serve as a pick-up point for transit riders. The ability to walk and cycle to a lot has the potential to attract more users and allows for more transportation options, making it multimodal. This category could receive up to three points in the scoring. First, the parcel could be assigned one point for connecting to a sidewalk network and one point for connecting to a bicycle network.

Additionally, if the parcel was within a quarter of a mile (on network) of a train station, it received a third bonus point. The higher point was given because passengers would have the capability to directly access or easily transfer from the PNR to a train station.

This secondary scoring system was used as a starting place for a final visual inspection of the sites; following this, parcels were checked for details of concern such as current use, site geometry, zoning, and specific proximity to an arterial on the roadway network. The team narrowed the number of sites to ten and asked for feedback from the steering committee.

Figure 9: Environmental Screening Tool Methodology



Chapter 4: Site Evaluation and Analysis

After completing both stages of analysis the team found ten sites and proposed these to the steering committee. There were at least two sites selected for discussion from each of the four counties. The committee provided the DVRPC team with thoughtful feedback.

Any recommendations listed will require further study prior to implementation. Convenience of accessibility, adaptability, visibility, frequency of service, and cost savings for the implementing party and the potential user are important to review when evaluating and proposing a site for PNR implementation.

Information about all the sites is outlined in Table 6 and detailed in the following pages.

Significant Criteria

After the sites were determined and confirmed with the steering committee, the team mapped three criteria that highly influenced the site selection and are thought to help define travel patterns affecting PNR. Figure 10 identifies the average daily ridership for NJT bus routes. Figures 11 and 12 illustrate mean travel time to work by all modes and car trips to major local cities from each census tract in the study area. All three maps show each criterion's data in the study area in the context of existing PNR and sites recommended for future PNR implementation.

Figure 10 depicts all NJT bus routes in the study area. The highest average weekday ridership routes (shown by the thickest and darkest brown lines) are routes 400 and 608.Route 400 serves Philadelphia to Sicklerville along Black Horse Pike, stopping at the Avandale PNR. The Route 608 travels from West Trenton to Hamilton Township mostly along State Street, serving employment centers in and around Trenton. High passenger volumes demonstrate how well used transit is along an arterial. High volumes indicate parcel locations that may be more ideal for NJT or another entity to invest in a PNR because of the ability to capture current riders.

Nearly half of the sites recommended for future PNR are within a five-mile (specifically in Gloucester and Washington townships in Camden County) distance of communities with 406–1,246 total trips per day to Philadelphia, Camden, or Trenton. This is represented and mapped in Figure 11. This indicates commuting patterns that could benefit from PNR facilities. In

Table 6: Sites Discussed for Future PNR Implementation

#	County	Municipality	DVRPC Land Use (2010)	Zoning	Acres	Score
1	Burlington	Mount Laurel Township	Vacant	Planned Unit Development	9.76	41
2	Burlington	Mount Laurel Township	Vacant	Neighborhood Commercial	7.05	41
3	Camden	Gloucester Township	Parking: Commercial	General Industrial	1.73	42
4	Camden	Gloucester Township	Vacant	Neighborhood Commercial	8.70	43
5	Gloucester	Washington Township	Parking: Commercial	Highway Commercial, Commercial Industrial	2.56	42
6	Mercer	Hamilton Township	Parking: Commercial	Highway Commercial	17.2	45
7	Mercer	Princeton	Commercial	Shopping Center	6.18	N/A
8	Mercer	Hamilton Township	Parking: Commercial	Research Development with Commercial Development	22	N/A
9	Mercer	West Windsor Township	Vacant	Neighborhood Center Business	6.18	43
10	Mercer	West Windsor Township	Vacant	Neighborhood Center Business	2.19	43
11	Mercer	Trenton City	Parking: Commercial	Mixed Use	5.80	42

*N/A means the site was screened out of the DVRPC analysis at or prior to stage-2.

Sources: DVRPC, 2015; Municipal Plans, 1987–2015

comparison, in the areas surrounding Princeton, which already have a high number of PNR, there are a lower number of total car trips.

As previously mentioned, PNRs are likely to attract potential users with long auto travel times. Figure 12 demonstrates that a significant number of the recommended sites for future PNR (represented as red, green, and purple numbered circles) are in or adjacent to census tracts with the highest range of commute time to work (36-45 minutes) in the study area. Therefore, implementing PNR in these locations may be beneficial to residents in these communities.

Site Evaluation

Each site has a profile that includes pictures (aerial and street view) and details about zoning, land use, adjacent arterials, and vehicle volumes on those arterials. In addition, the team has listed the advantages, disadvantages, and other commentary from the steering committee regarding implementation of each recommended PNR facility or parcel.

Figures 13 through 15 illustrate geographically the same sites in Table 6. These figures and sites are separated into three categories that explain the type of follow-up research that will be needed prior to implementing PNR at each location. Descriptions of each category are listed below.

a. Sites output from the criteria-based tool, and supported to be studied further for transit demand and purchase. The first five locations are within this category.

b. Sites recommended by Mercer County, which require further research into transit demand, and journey to work trips. There are three locations in this category.

c. Sites output from the criteria- based tool but not recommended due to current congestion conditions. There are three locations in this category.

Figure 10: New Jersey Transit Average Weekday Ridership by Route

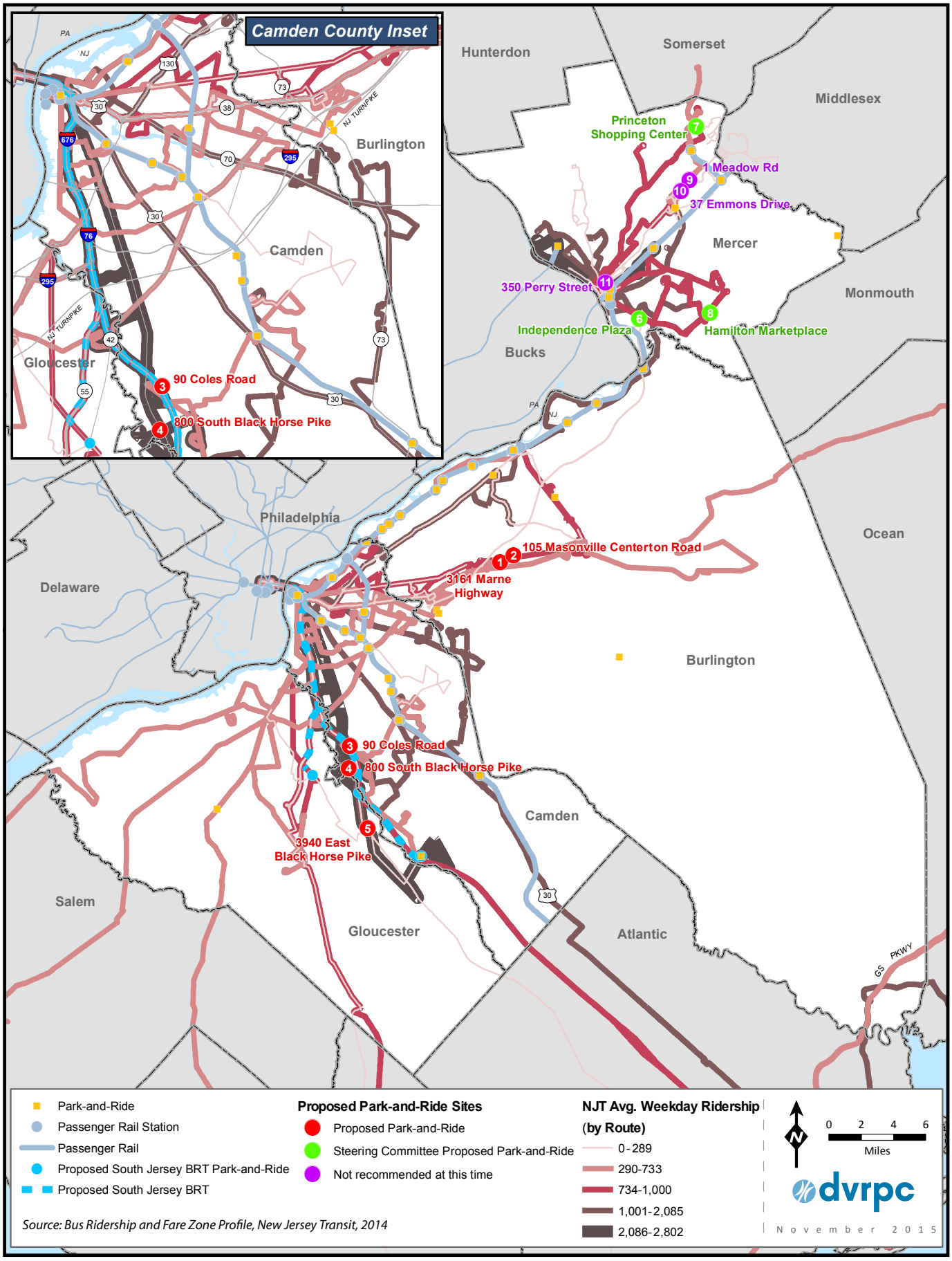


Figure 11: Total Car Trips by Census Tract to Philadelphia, Camden, and Trenton

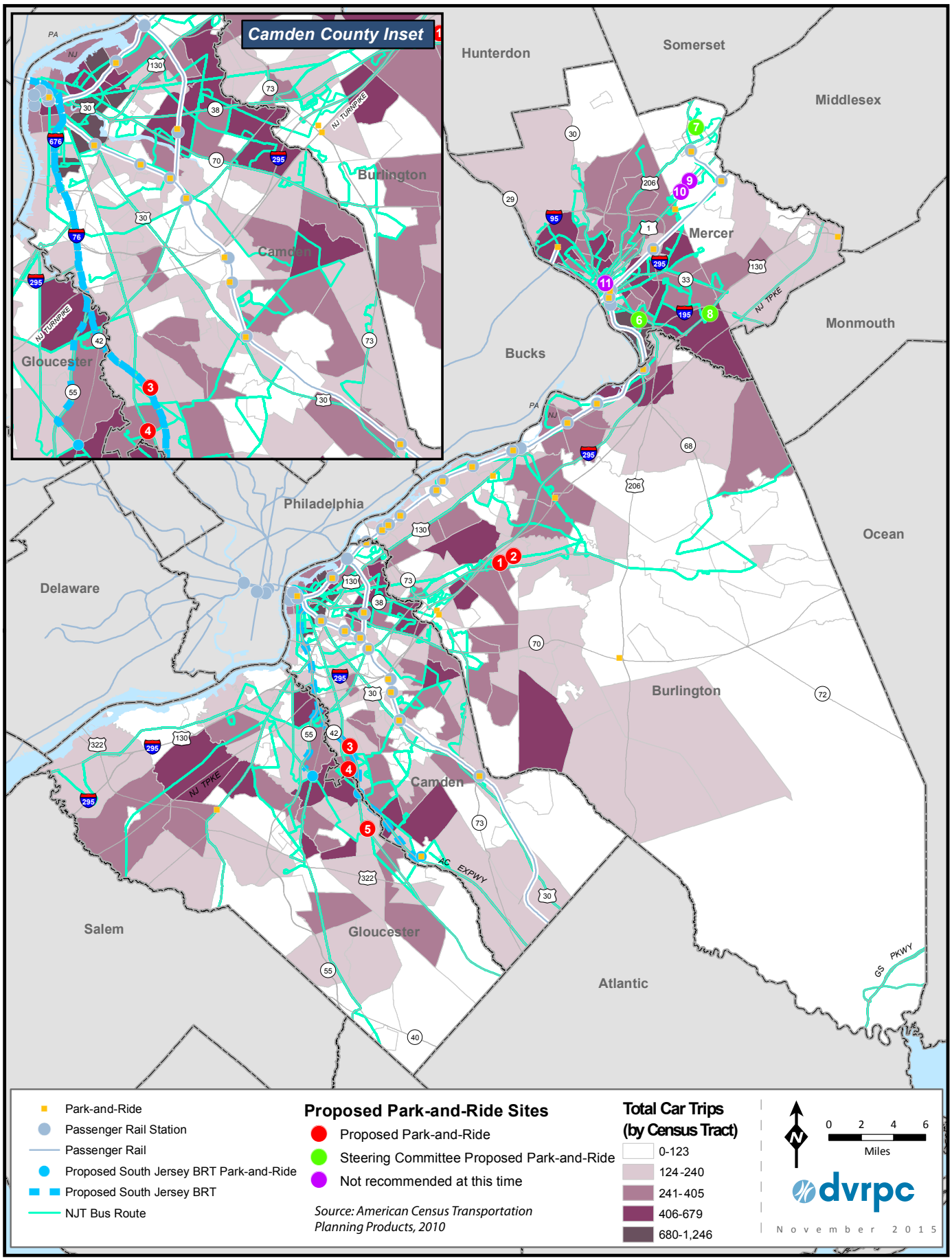
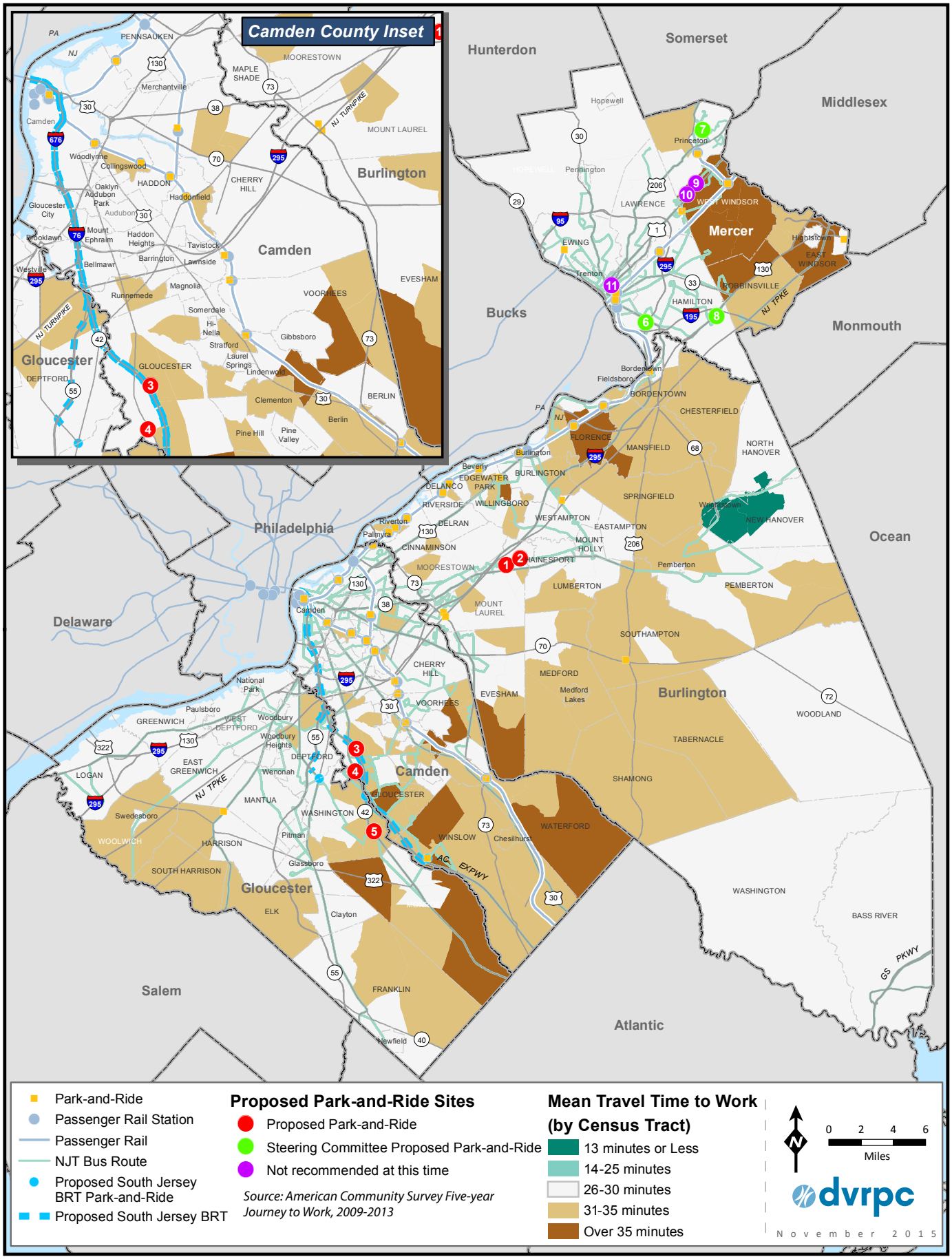


Figure 12: Journey to Work (Mean Travel Time in Minutes) by Census Tract

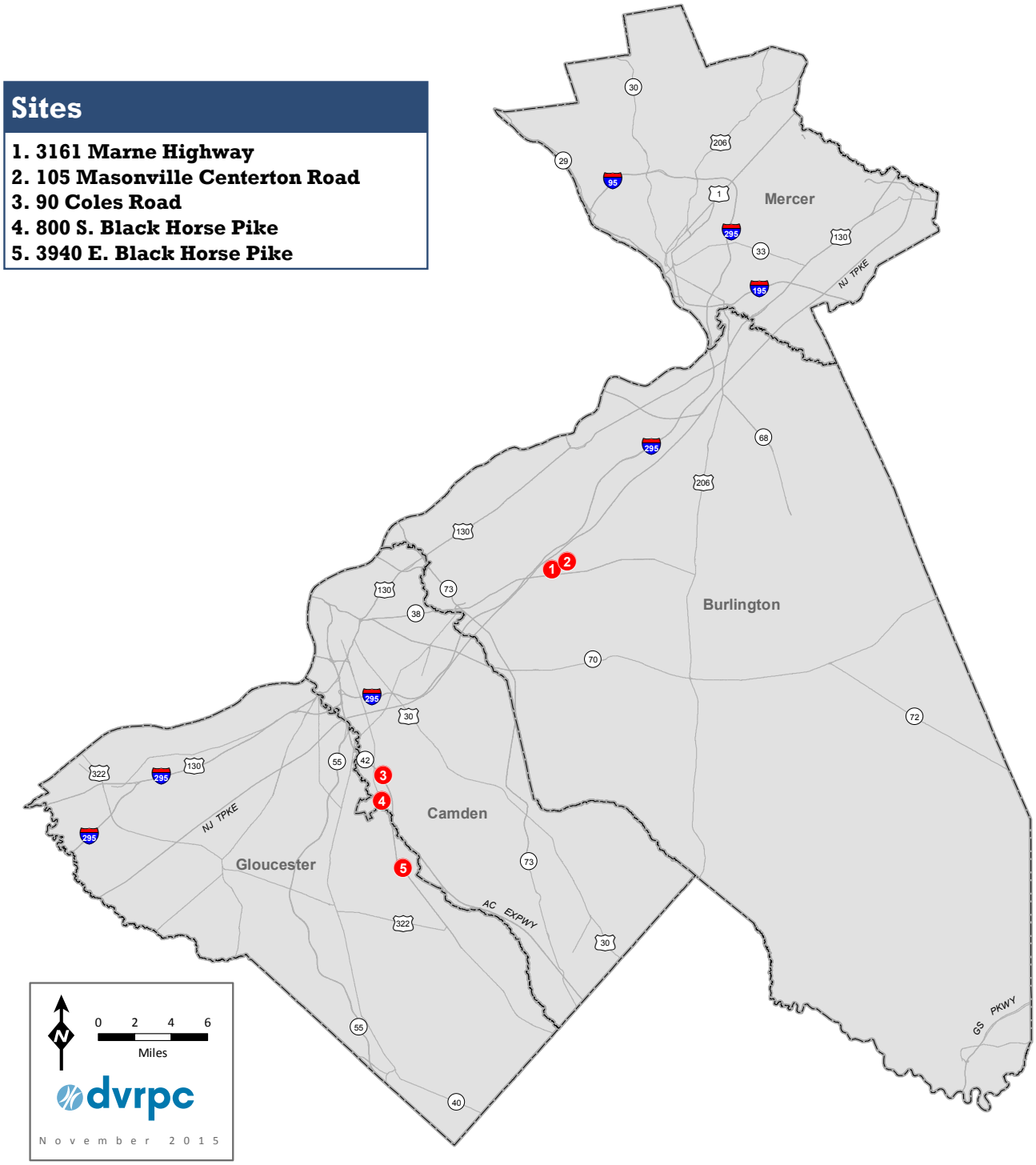


The sites within this chapter are separated into three categories explaining the follow-up that will be needed if the sites are to be proposed for PNR implementation and built. More than one site may be highlighted within a municipality. In this, we are not suggesting that in both locations a PNR be implemented, but that the parcels both may be sites fit for future PNRs in their current condition and ownership.

Location Suitability Score Recommended Sites

Figure 13 shows sites output from the criteria-based tool. Those that are included are recommended to be studied further for transit demand, purchase, and feasibility. The first five locations are within this category.

Figure 13: Map of PNR Sites Recommended for Future Implementation



Site 1: 3161 Marne Highway

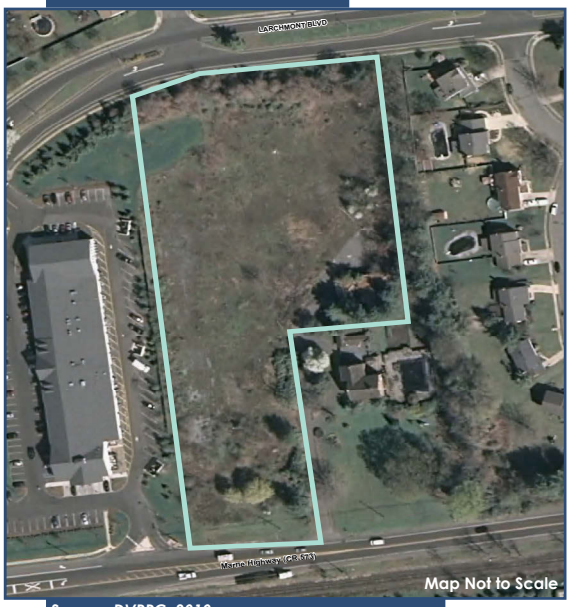
Site Description: The site is next to a small shopping center, has service from NJ Transit Route 413, and is within five miles of I-295, NJ Turnpike, and NJ Route 38.

Advantages: There are access points on both the north and south sides, and the site has ample space for parking and bus ingress and egress.

Disadvantages: This parcel is large and predominately wooded. Existing transit service to the site terminates in Camden rather Philadelphia, limiting some job access. Improved pedestrian and waiting areas would be required if this site were to become a PNR.

Other Commentary: There are limits on demand for PNR due to the current transit service frequency.

Aerial View of Site 1



Source: DVRPC, 2010

Street View of Site 1

Source: Google Maps, 2011

Summary Statistics for the Area around Site 1

Township:	**Mount Laurel Township**
County:	**Burlington**
Acres:	**9.76**
Score:	**41**
Adjacent Arterial:	**Marne Highway (CR 573)**
Volume on Marne Highway:	**Btw. Hartford and Larchmont: 5.25k (EB) & 4.58k (WB) Collected 4/2005**
Owner:	**Township of Mount Laurel**
Lot View Number:	**Block-202.05 & Lot-45**
Land Use:	**Vacant**
Zoning:	**Planned Unit Development**

Sources: Mount Laurel Township Zoning Map, 2009; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 2: 105 Masonville Centerton Road

Site Description: This site abuts both Masonville Centerton Road and Marne Highway or CR 537. There is bus service from NJT Route 413 at this site.

Advantages: The parcel is publicly owned, currently undeveloped, and has ample access to connect users from both the east and south.

Disadvantages: There is a lack of pedestrian infrastructure, weather-protected shelters, and street furniture for passengers.

Other Commentary: There are limits on demand for PNR due to the current transit service frequency.

Aerial View of Site 2

Source: DVRPC, 2010

Street View of Site 2

Source: Google Maps, 2011

Summary Statistics for the Area around Site 1

Township:	**Mount Laurel Township**
County:	**Burlington**
Acres:	**7.05**
Score:	**41**
Adjacent Arterial:	**Marne Highway (CR 573)**
Volume on Marne Highway:	**Btw. Hartford and Larchmont: 5.25k (EB) & 4.58k (WB) Collected 4/2005**
Owner:	**Masonville Fire Company**
Lot View Number:	**Block-202.05 & Lot-48**
Land Use:	**Vacant**
Zoning:	**Neighborhood Commercial**

Sources: Mount Laurel Township Zoning Map, 2009; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 3: 90 Coles Road

Site Description: The parcel is part of a developed but idle property currently for sale.

Advantages: This site is already paved, has delineated parking spaces, dedicated ingress and egress, and lighting.

Disadvantages: To access the site, autos heading northbound cannot exit at Coles Road, and would have to turn around and come back south on NJ Route 42 or take the local roads.

Other Commentary: If built, this PNR has the potential to be a regional PNR due to its location. Existing bus routes in the area could be rerouted to serve this site, and it could also be used by SJ BRT passengers when that service is implemented.

Aerial View of Site 3

Source: DVRPC, 2010

Street View of Site 3

Source: Google Maps, 2011

Summary Statistics for the Area around Site 3

Township:	**Gloucester Township**
County:	**Camden**
Acres:	**1.73**
Score:	**42**
Adjacent Arterial:	**North/South Freeway (New Jersey Route 42)**
Volume on N/S Freeway:	**Btw. Coles and Erial roads: 58.3k (EB) & 57.2k (WB) Collected 8/2013**
Owner:	**Montgomery Commons I. LLC**
Lot View Number:	**Block-11001 & Lot-49**
Land Use:	**Commercial Parking**
Zoning:	**General Industrial**

Sources: Gloucester Township Zoning Map, Last Revised 2010; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 4: 800 South Black Horse Pike

Site Description: This parcel is undeveloped, cleared, and flat.

Advantages: Black Horse Pike has a satisfactory sidewalk network in this area. There is service from NJT Route 400 on both Black Horse Pike and Lakeland Road, both adjacent to this parcel.

Disadvantages: There is a lack of pedestrian infrastructure and weather-protected shelters or furniture for passengers adjacent to the site.

Other Commentary: This location should be evaluated for current and future demand in service to identify if a bus stop upgrade (such as shelters) is warranted at this location. To implement bus stop enhancements, capital funds and a local sponsor to maintain the shelter must be identified.

Aerial View of Site 4

Source: DVRPC, 2010

Street View of Site 4

Source: Google Maps, 2011

Summary Statistics for the Area around Site 4

Township:	**Gloucester Township**
County:	**Camden**
Acres:	**8.70**
Score:	**43**
Adjacent Arterial:	**South Black Horse Pike**
Volume on Black Horse Pike:	**Btw. Davidson Rd. & College Dr.: 5.2k (NB) & 7.6k (SB) Collected 1/2012**
Owner:	**Black Horse Properties and Marin Orabona**
Lot View Number:	**Block-11001 & Lot-30; Block-12402 & Lot-14**
Land Use:	**Vacant**
Zoning:	**Neighborhood Commercial**

Sources: Gloucester Township Zoning Map, Last Revised 2010; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 5: 3940 East Black Horse Pike

Site Description: This semi-developed and vacant parcel has direct access to East Black Horse Pike, a bustling commercial corridor with many popular restaurants and stores. NJT Bus Routes 315, 400, and 403 provide service close to this location.

Advantages: The site is at an intersection that has pedestrian treatments, including crosswalks and signals. In addition, there are a few parking spaces at the western portion of the lot on East Black Horse Pike.

Disadvantages: Bus stops and treatments may need to be relocated and upgraded if a PNR is pursued at this location.

Other Commentary: According to NJT, this location has been vacant for many years. A small pilot PNR could be implemented with signage in the existing parking spaces.

Aerial View of Site 5

Source: DVRPC, 2010

Street View of Site 5

Source: Google Maps, 2011

Summary Statistics for the Area around Site 5

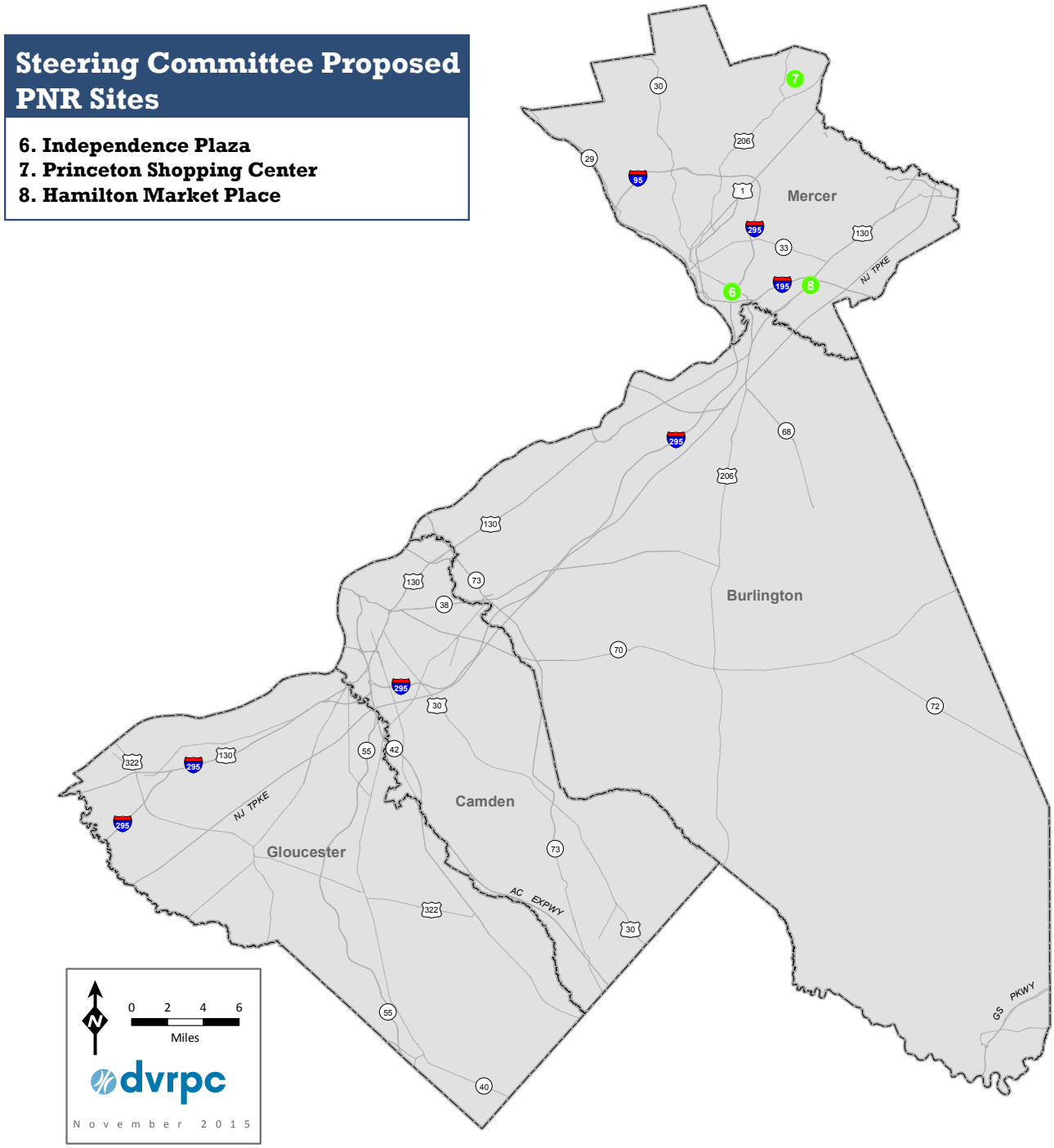
Township:	**Washington Township**
County:	**Gloucester**
Acres:	**2.56**
Score:	**42**
Adjacent Arterial:	**East Black Horse Pike (New Jersey Route 42)**
Volume on Black Horse Pike:	**Btw. Madison Ave. & Stagecoach Rd.: 12.9k (NB) & 14k (SB) Collected 5/2015**
Owner:	**EML Holdings L.L.C. and Linda Lustgarden**
Lot View Number:	**Block-112.01 & Lot-12**
Land Use:	**Commercial Parking**
Zoning:	**Highway Commercial, Commercial Industrial**

Sources: Zoning Map Township of Washington, 2009; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Steering Committee Recommended Locations

The three locations in this category are sites that were recommended by Mercer County Planning Commission staff (shown in Figure 14). They were not evaluated using the PNR location suitability score (see Chapter 3 for details). All three were commented on by the steering committee and those comments are incorporated into each profile. Two additional locations were also suggested by Mercer County Planning Commission staff: Montgomery Shopping Center and Princeton Airport. However, these two locations are outside the study area and were not further researched for viability as potential PNR.

Figure 14: Additional Steering Committee Recommended PNR Sites



Site 6: Independence Plaza

Site Description: This is a shopping center located near the intersection of I-295, I-95, and US 206 (Broad Street). Four NJT bus routes (409, 603, 607, 613) serve this shopping center; three stop on Broad Street, where there is a bench for passengers.

Advantages: Route 607 serves and terminates within the shopping center, and there is space allocated for these buses to layover and turn around.

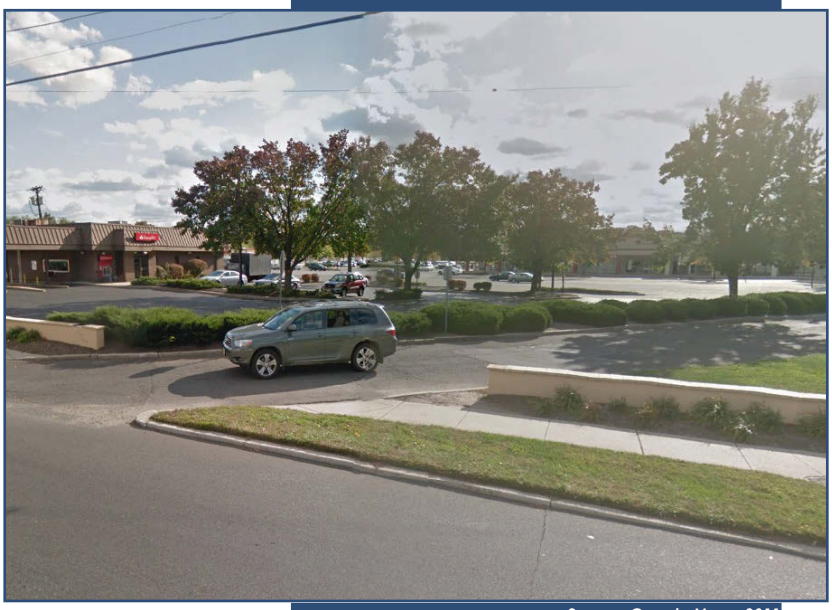
Disadvantages: Although this shopping center is close to the intersection of three major arterials, it is only visible and easily accessible from Broad Street.

Other Commentary: NJT has noted that implementing a PNR location at an active commercial location may require more difficult negotiations than other potential locations. This parcel did receive a score in the stage-1 output analysis; however it was eliminated due to its proximity to an active commercial location.

Aerial View of Site 6

Source: DVRPC, 2010

Street View of Site 6



Source: Google Maps, 2011

Summary Statistics for the Area around Site 6

Township:	**Hamilton**
County:	**Mercer**
Acres:	**17.2**
Score:	**45**
Adjacent Arterial:	**I-295 and SR 206**
Volume on US 206 (Broad):	**Btw Hobson and Park: 8,805 (NB) & 10,008 (SB) Collected 4/2011**
Owner:	**Cobalt RLTY, LLC C/O Onyx Equities**
Lot View Number:	**Block 2389 & Lot 3**
Land Use:	**Commercial, Parking: Commercial**
Zoning:	**Highway Commercial**

Sources: Hamilton Township Municipal Zoning Map, Revised 2013; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 7: Princeton Shopping Center

Site Description: This shopping center is south of State Route 206. NJT bus routes 605 and 606 serve this shopping center.

Advantages: The lot is large and is adjacent to N. Harrison Street at the southern end of the parcel. The shopping center is within a residential neighborhood and could potentially serve individuals traveling by bicycle or foot.

Disadvantages: The lot is not visible from US 206, which could make it difficult to advertise to potential riders.

Other Commentary: Existing levels of transit frequency indicate limited parking demand at this time; however, a modest amount of parking would support existing operations.

Aerial View of Site 7

Source: DVRPC, 2010

Street View of Site 7

Source: Google Maps, 2011

Summary Statistics for the Area around Site 7

Township:	**Princeton Township**
County:	**Mercer**
Acres:	**6.18**
Score:	**-**
Adjacent Arterial:	**N. Harrison St., SR 27, SR 206**
Volume on N. Harrison St.:	**Btw Hamilton Ave. and Valley Rd.: 14911 Both Directions (Collected 3/2010)**
Owner:	**Princeton (Edens) LLC**
Lot View Number:	**Block 7401 & Lot - 1**
Land Use:	**Commercial**
Zoning:	**Shopping Center**

Sources: Princeton Township Zoning Map, Adopted 2011; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 8: Hamilton Marketplace

Site Description: This shopping center sits at the junction of US Route 130 and I-195. The shopping center is served by NJT routes 601, 603, 606, 613, Greater Mercer TMA's ZLine, and the Route 130 shuttle connection.

Advantages: The lot is part of a large and well-kept shopping center that features ample parking and access to two major arterials. Existing bus infrastructure (bus stops with shelters) is present.

Disadvantages: The parking lots within Hamilton Marketplace are private and have multiple corporate owners, which could make it difficult to develop a PNR. Additional pedestrian pathways may need to be installed to make this site safer for NJT passengers to use.

Other Commentary: NJT concurs that this is potentially a good location for a PNR.

Aerial View of Site 8

Source: DVRPC, 2010

Street View of Site 8

Source: Google Maps, 2011

Summary Statistics for the Area around Site 8

Township:	**Hamilton**
County:	**Mercer**
Acres:	**22**
Score:	**-**
Adjacent Arterial:	**US Route 130**
Volume on US 130:	**Btw Crosswicks Hamilton Square Rd. and I-95 NB 17,529**
	& SB 13,705 (Collected 1/2015)
Owner:	**National Retail Property, LP C/O BJ's**
Lot View Number:	**Block - 2613 & Lot - 107 and 37**
Land Use:	**Commercial, Parking: Commercial**
Zoning:	**Research Development with Commercial Development Overlay**

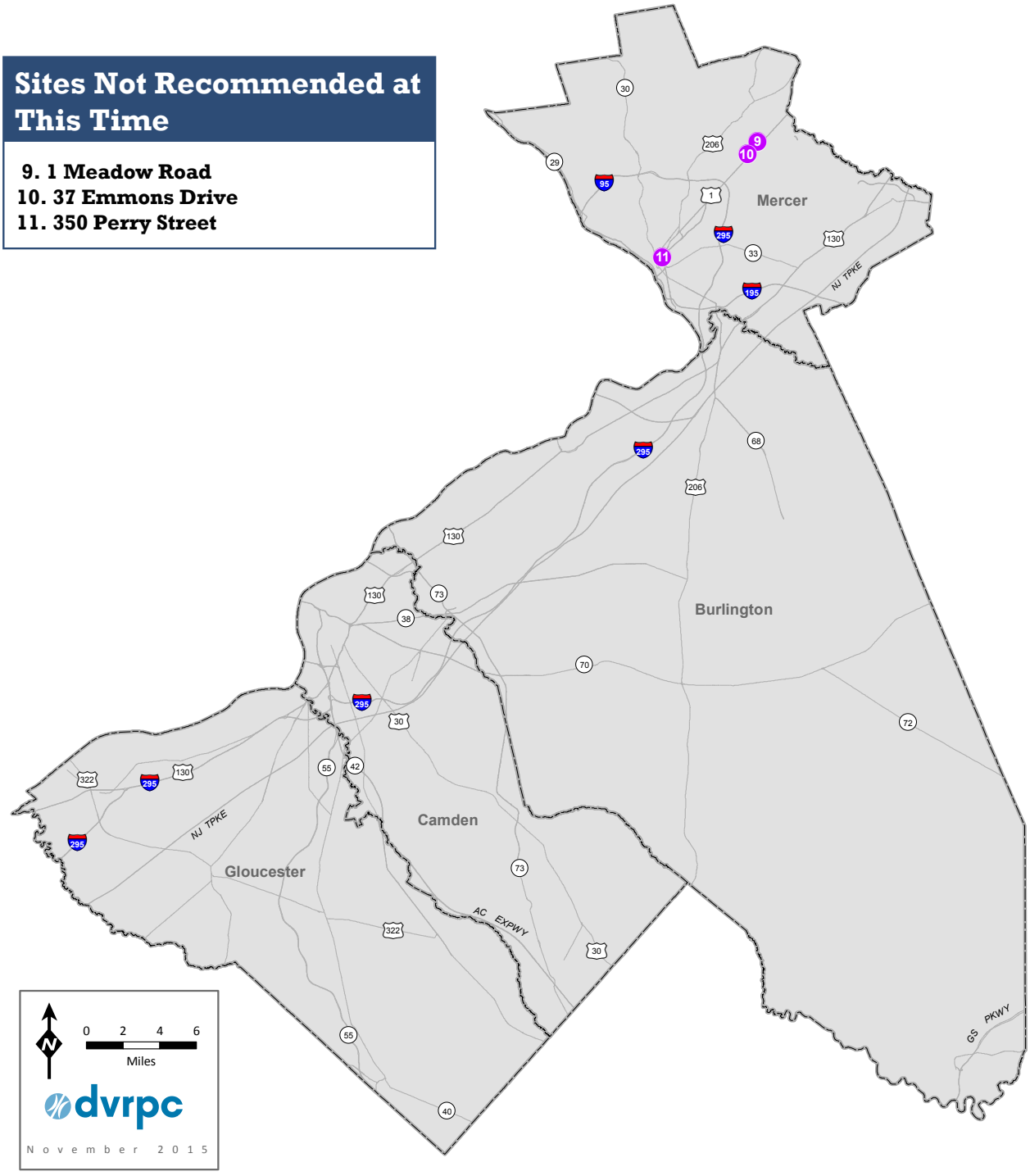
Sources: Hamilton Township Municipal Zoning Map, Revised 2013; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Sites Not Recommended at This Time

There are three sites output from the PNR location suitability score and the aerial imagery interpretation analysis that are not recommended at this time due to current constraints (shown in Figure 15).

These locations were identified by Mercer County Planning Commission and other steering committee members as too congested to accommodate PNR locations currently.

Figure 15: Sites Output from DVRPC Tool, but Not Recommended due to Congestion



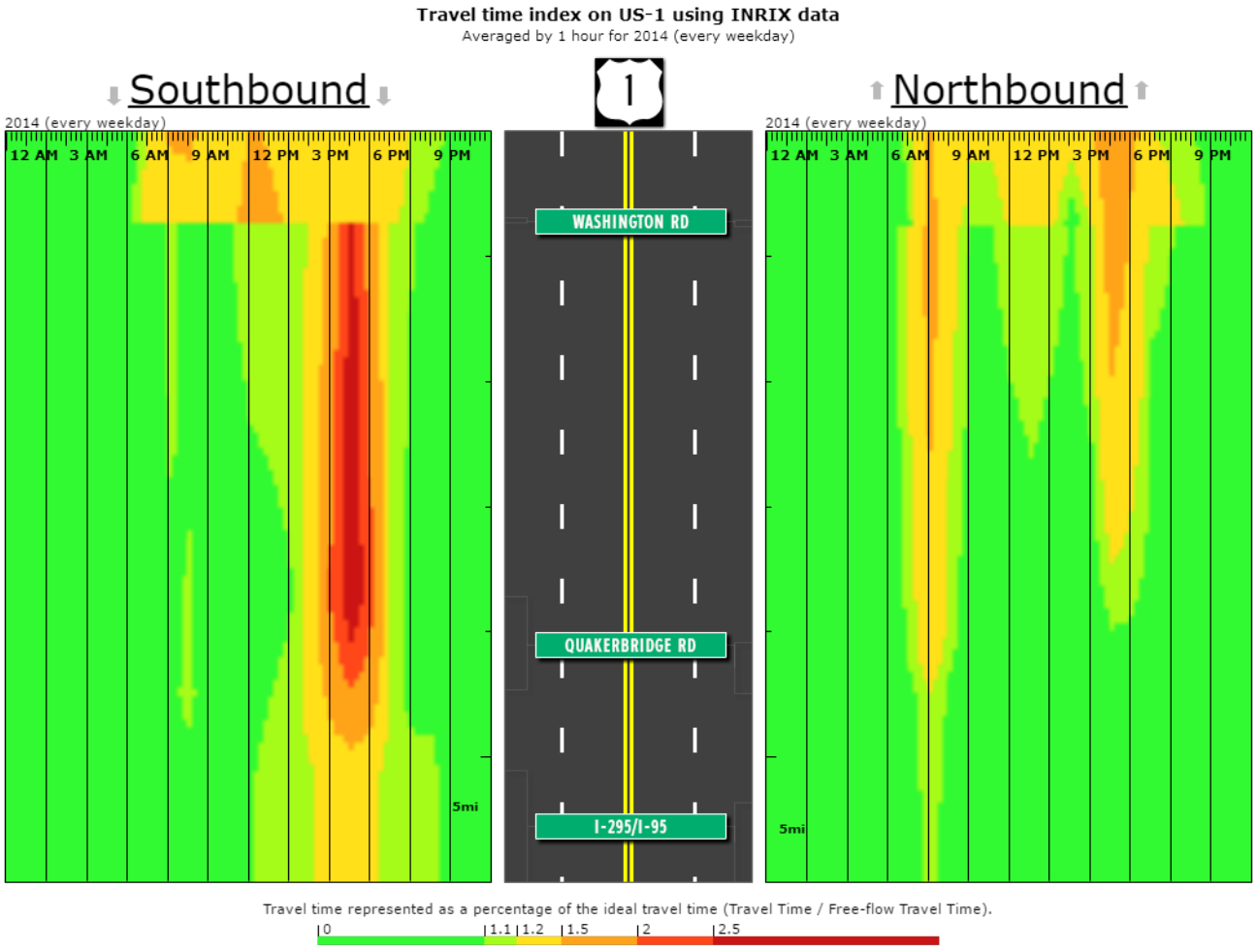
Congestion around Mercer County

Sites 9 and 10 in Mercer County are both located along US 1 (Brunswick Pike) in West Windsor Township. Figure 17 illustrates the congestion travel time index from I-295 to Washington Road; these two sites are between Quakerbridge Road and Washington Road. The travel time index measures the percentage of additional time it takes an auto to travel in that area at that time of day versus free-flow conditions.

For example, it could take a vehicle traveling southbound at 3 p.m. in this section of US 1, up to two times longer than it would during free-flow conditions.

Although these two sites do satisfy the criteria established during this project, these acute congestion constraints make them unsuitable for PNR implementation at this time.

Figure 16: Congestion Scan Along US 1 (Brunswick Pike) in Mercer County



Source: VPP Suite, 2015

Site 9: 1 Meadow Road

Site Description: This undeveloped parcel is north of Brunswick Pike.

Advantages: The lot is flat and cleared, and within a quarter mile (walking distance) of Princeton Market Fair shopping center and two residential neighborhoods to the north. There is service from NJT routes 600 and 605.

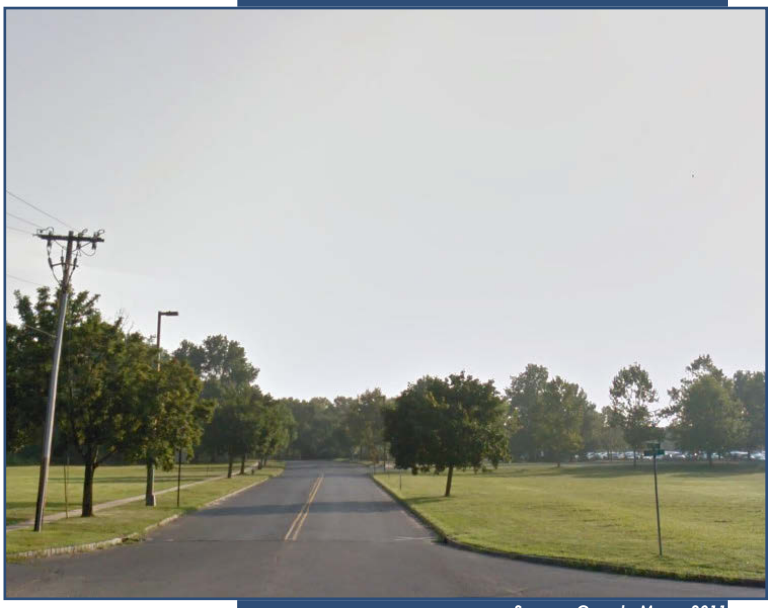
Disadvantages: Due to the large parcel size, existing transit demand will need to be identified and evaluated to determine if the entire site should be used for a PNR.

Other Commentary: Various steering committee members were not interested in devoting funds to this site for PNR implementation in the short term due to the congestion in the area.

Aerial View of Site 9

Source: DVRPC, 2010

Street View of Site 9



Source: Google Maps, 2011

Summary Statistics for the Area around Site 9

Township:	**West Windsor Township**
County:	**Mercer**
Acres:	**6.18**
Score:	**43**
Adjacent Arterial:	**Brunswick Pike**
Volume on Brunswick Pike:	**Btw Quakerbridge Rd. & Emmons Dr.: 53.6k (NB) & 52.0k (SB); Colctd 1/2013**
Owner:	**Princeton Theological Seminary**
Lot View Number:	**Block-86 & Lot-58.02**
Land Use:	**Vacant**
Zoning:	**Neighborhood Center Business**

Sources: Township of West Windsor, 2009; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 10: 37 Emmons Drive

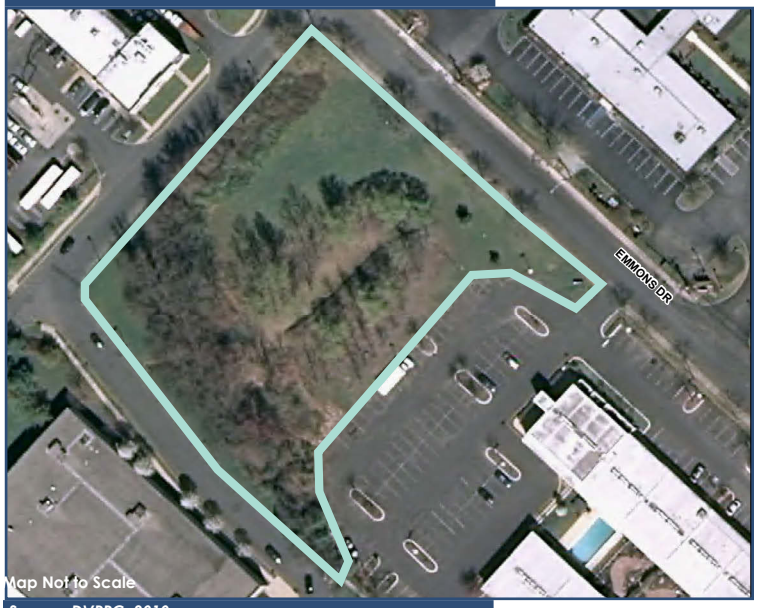
Site Description: This site is northwest of Brunswick Pike, undeveloped, and primarily wooded. NJT Bus Routes 600 and 605 serve the arterial adjacent to this site, Brunswick Pike.

Advantages: This parcel is adjacent to the Windsor Green Shopping Center but is not attached. Therefore, ingress and egress would conflict with shopping center traffic.

Disadvantages: This parcel is tree-covered and likely not visible from the arterial from all directions because of shopping center buildings. In addition, there is no direct access to the arterial.

Other Commentary: Individual steering committee members were not interested in devoting funds to this site for PNR implementation in the near term.

Aerial View of Site 10



Source: DVRPC, 2010

Street View of Site 10

Source: Google Maps, 2011

Summary Statistics for the Area around Site 10

Township:	**West Windsor Township**
County:	**Mercer**
Acres:	**2.19**
Score:	**43**
Adjacent Arterial:	**Brunswick Pike**
Volume on Brunswick Pike:	**Btw Quakerbridge Rd. & Emmons Dr.: 53.6k (NB) & 52.0k (SB); Colctd 1/2013**
Owner:	**West Windsor Lodging L.L.C.**
Lot View Number:	**Block-7 & Lot-59**
Land Use:	**Vacant**
Zoning:	**Neighborhood Center Business**

Sources: Township of West Windsor, 2009; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Site 11: 350 Perry Street

Site Description: This parcel is a state-owned parking lot currently in use, with a bus stop for NJT Route 611.

Advantages: This parcel is already functionally a PNR due to the existing paved and striped parking lot, private ingress and egress, and bus shelters. In addition, the parcel is located in a neighborhood with a sidewalk network.

Disadvantages: This parcel is slightly under a mile in distance from the Trenton Transit Center, which already has ample parking for NJT users.

Other Commentary: Various steering committee members were not interested in devoting funds to this site for PNR in the near term. However, with permission from the state and some additional signage, the site could be put into use as a PNR for NJT passengers.

Aerial View of Site 11

Source: DVRPC, 2010

Street View of Site 11

Source: Google Maps, 2011

Summary Statistics for the Area around Site 11

Township:	**Trenton**
County:	**Mercer**
Acres:	**5.80**
Score:	**42**
Adjacent Arterial:	**US Route 1 in New Jersey (Trenton Freeway)**
Volume on US Highway 1:	**Btw. Market and Perry Streets: 29.9k (NB) & 34.8k (SB) Collected 8/2010**
Owner:	**State of NJ Department of Treasury**
Lot View Number:	**Block-7301 & Lot-5**
Land Use:	**Commercial Parking**
Zoning:	**Mixed Use**

Sources: City of Trenton Zoning Map, Adopted 1989; DVRPC Land Use Layer, 2010; Mod IV Open Public Records website, retrieved 2015

Chapter 5: PNR Design Considerations

The composition of a PNR tends to be highly contextual due to the number of variables involved in its design (setting, ingress and egress, capacity). Despite this variation, successful PNRs have many commonalities in terms of the approaches used to design them. The following chapter provides an overview of design principles for PNRs. Additionally, there is design guidance, cost, and descriptions of common amenities found within the parking, waiting, and loading areas of a PNR, as well as the vehicle and pedestrian approaches. The design guidance is based in part on three documents: The Environmental Protection Agency's *Park-and-Ride / Fringe Parking* (1992) report, Robert Spillar's *Park-and-Ride Planning and Design Guidelines* (1997), and the UNC Highway Safety Research Center's *Costs for Pedestrian and Bicyclist Infrastructure Improvements* (2013). The average cost of amenities is provided when applicable.

Also, designing for how the transit vehicle will operate in the PNR is of great importance. This chapter discusses the navigation, access, parking, and space designated for a transit vehicle in a PNR.

Designing a PNR for the Transit Passenger

Universal Design

An overarching principle common in successful PNRs is the use of universal design. Universal design encourages the design of products and environments that are functional and usable for all people. Amenities that are essential to create a safe and successful environment in a PNR include: security, lighting, connectivity, and signage.

Universal design in the context of PNR can be interpreted to mean that all areas or amenities within the site should be easily usable by anyone, including those with disabilities, but also by users who are temporarily encumbered, such as commuters carrying a large load of groceries, a person traveling with children, or someone provisionally using crutches. When creating a space using universal design principles, special attention is given to the path pedestrians walk on to the bus stop, the loading area clearances, and the design of furnishings that are part of a bus stop.

North Carolina State University's Center for Universal Design developed seven primary principles that should be considered when designing a facility for the public.

- *Equitable use* considers that the design be useful and marketable to people with diverse abilities.

- *Flexibility in use* recognizes that the design should accommodate a wide range of individual preferences and abilities.

- Use of the design is *simple and intuitive*, easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

- The design communicates necessary *perceptible information* effectively to the user, regardless of ambient conditions or the user's sensory abilities.

- *Tolerance for error* minimizes hazards and the adverse consequences of accidental or unintended actions in a design.

- The design can be used efficiently and comfortably and with a minimum of fatigue or *low physical effort*.

- *Appropriate size and space* should be provided for each user. All passengers should be able to approach, reach, manipulate, and use each element in the area regardless of user's body size, posture, or mobility.

Security
Developing a feeling of safety and security is central to the success of a PNR. Key to this success is providing visibility throughout the lot. This can be achieved by keeping the PNR free of unnecessary obstructions, so that a majority of the PNR can be seen from the central waiting area. Other means of enhancing security in a PNR are providing emergency phones, consistent graffiti and trash cleanup, security cameras, and requesting regular police presence.

Lighting
Lighting should be present throughout a PNR (Figure 17) to assure safe passage to and from parked vehicles and waiting and loading areas. Dispersed lighting makes passengers feel secure and more visible to drivers.

Connectivity
PNRs should be designed to be pedestrian friendly, allowing users to safely and efficiently gain access to all parts of the lot as well as the local bicycle and pedestrian networks (if present). Further discussion of the amenities associated with connectivity will be discussed later in this chapter. Figure 18 illustrates connected sidewalks and crosswalks throughout a suburban parking lot.

Signage
The use of clear and concise signage is integral to all parts of a PNR. Figure 19 shows the approach to the Avandale Park-Ride, where signage provides advertisement and wayfinding to the lot. In the parking area, signage can be used to direct traffic, mark parking aisles, and post regulations. In the waiting and loading area, signage can assist passengers with travel information, provide important security information, and provide wayfinding to the appropriate transit vehicle.

Figure 17: Lighting at a PNR

Source: synergylightingusa.com/, 2015

Figure 18: Pedestrian Connectivity Within a Parking Lot

Source: DVRPC, 2015

Figure 19: Signage at the Avandale Park-Ride

Source: DVRPC, 2014

Parking Area

The parking area encompasses the majority of a PNR lot, and typically comprises delineated parking spaces, space for lay-by buses, vehicle travel lanes, landscaping, pedestrian pathways, bicycle parking, and kiss-and-ride. In order to support PNR as an alternative to driving, parking areas must reinforce that PNR is convenient and easy to navigate both in a car and on foot, which can be achieved by following the techniques and implementation strategies in this section.

Delineated Parking Spaces

Aligning parking spaces in a PNR perpendicular to the transit platform can allow for pedestrian movement up aisles, improving efficiency and safety. Figure 20 illustrates a 90-degree parking configuration, which is generally the least complicated pattern for drivers to interpret. Additionally, it is typically the most efficient because it allows for two-way traffic flow between aisles for ease of access.

Vehicle Travel Lanes

Travel lanes should provide enough space for vehicles (Figure 20) to move through the aisles and easily maneuver into and out of parking spaces. One-way lanes should be indicated using appropriate ground markings.

Landscaping

The importance of street trees, perimeter screening, and interior landscaping can be used to provide additional shade for users, collect storm water, and provide a sound buffer for adjacent properties.

Pedestrian Pathways

Sidewalks or raised walkways (Figure 20) provide safe and direct access from the loading area throughout a PNR. The UNC Highway Safety Research Center cites the average cost of concrete is $32 per linear foot, assuming a sidewalk 5 feet in width (other material costs may vary).

Figure 20: PNR Configuration in Swansea, United Kingdom

Source: SuDS Wales, 2010

Figure 21: Signage and Configuration at Pennsauken T.C.

Source: DVRPC, 2013

Bicycle Parking

Parking for bicycles should be provided to accommodate commuters who use a bicycle to access transit but prefer not to use on-board bike racks. Bicycle racks are typically metal objects fixed to the ground that multiple bikes can be locked to, while a bike locker is an enclosed space for one bike. Supplying bicycle parking, either a rack or a bike locker, in a well-lit, secure area will help to deter theft. Average cost of a bicycle rack is $660, and each bicycle locker costs approximately $2,090.

Kiss-and-Ride

Passenger facilitates for picking up or dropping off passengers are important for circulation at a PNR (Figure 21). Kiss-and-ride should be located in areas within direct sight of the loading area, maximize parking turnover, and avoid traffic conflict.

Waiting Area

The waiting area is a space that can include a shelter, rest areas, and information to PNR users waiting for the arrival of transit vehicles. A waiting area should be sized to reflect expected passenger volumes and at a minimum, be wide enough at the curb line to provide a safe place for passengers to wait outside of the loading area. In locations where both pedestrian volumes and the number of transit passengers expected to use a stop are relatively low, the waiting area may overlap with the pedestrian path. Where pedestrian and passenger volumes are higher, care should be given to separate the waiting area and pedestrian path. Important amenities to consider when designing a waiting area are: focal points, stop area furnishings, transit information, and transit shelters. These are exhibited in Figures 22 and 23.

Focal Points

The use of art and sculpture within a PNR creates a more welcoming environment for users that reflects the unique qualities of the surrounding community. Additionally, setting aside a designated space for mobile vendors such as book-mobiles and food trucks can encourage activity within the lot throughout the day, providing an enhanced sense of place.

Stop Area Furniture

Stop furniture should be durable and resistant to vandalism and weather exposure to avoid additional cleaning and maintenance costs. The chosen furniture should be ADA compliant, a minimum of 6.5 feet long (3 seats), and contain arms to help assist passengers to stand. Options of stop furniture to enhance passenger comfort while waiting for transit include benches, leaning rails, and low-masonry walls.

Figure 22: SEPTA Bus Shelter at 23rd and Venango Loop

Source: DVRPC, 2015

Figure 23: SEPTA Bus Waiting Area at 33rd and Dauphin Loop

Source: DVRPC, 2015

Transit Information

A transit information component, typically part of a shelter, is a location where route and general network information can be displayed for passengers.

Transit Shelters

Shelters provide protection for passengers from weather conditions. The following should be taken into consideration when designing a transit shelter at a PNR.

- The shelter should be built with durable and architecturally sound construction materials to withstand heavy use and continual exposure to the elements. The shelter should be oriented and enclosed to protect against exposure from sun, rain, and snow. A site-specific design for the protective sides or solar shading material may be necessary depending on local weather conditions.

- A roof that is enclosed on at least two sides to provide shelter from weather.

- A clear view of the approaching bus and bus loading pad is necessary and can be accomplished using tempered, clear glass panels. The shelter opening should be oriented toward the path that leads to the bus loading pad.

Loading Area

The loading area is the location within a PNR where passengers board and alight from transit vehicles. When designing a loading zone, it is important to provide a level and slip-proof area, with enough space to receive and discharge passengers through both sets of doors. Additionally, it is mandatory that the loading area provides space for the deployment of an ADA ramp and maneuverability within that space for a wheelchair-bound passenger. Important amenities to consider when designing a loading area are detectable edges and landing and bus pads.

Detectable Edge

A detectable edge is a surface of distinguishing color used on a curb line at a bus stop to help define the stop location. This is shown in Figure 24.

Landing Pad

A landing pad is where passengers board and alight transit vehicles. It is essential that landing pads be level, slip resistant, clear of obstructions, and large enough for a vehicle to deploy a lift ramp for customers to maneuver on and off the lift. This is shown in Figure 25.

Figure 24: Detectable Edge at SEPTA Bus Loop

Source: DVRPC, 2015

Figure 25: Landing Pad at SEPTA Bus Loop

Source: DVRPC, 2015

Approaches

The approach to a PNR encompasses design features that help passengers gain access to a lot. Amenities that should be considered when designing PNR approaches include: ingresses and egresses, signage, crosswalks, refuge islands, pedestrian countdown timers, and curb ramps.

Ingress and Egress

Access to PNRs should be provided to a collector street or access road. These entrances should be wide enough for simultaneous entry and exit by personal and transit vehicles. When applicable, the use of auxiliary or turn lanes can be used to lessen traffic impacts for vehicles entering or exiting PNR. If transit vehicles enter the lot, creating separate bus and vehicle access should be considered to reduce conflict between the two modes (shown in Figure 26).

Signage for PNR

Providing advertisement of a PNR along nearby arterials and wayfinding to the site helps to educate commuters and can attract in new users.

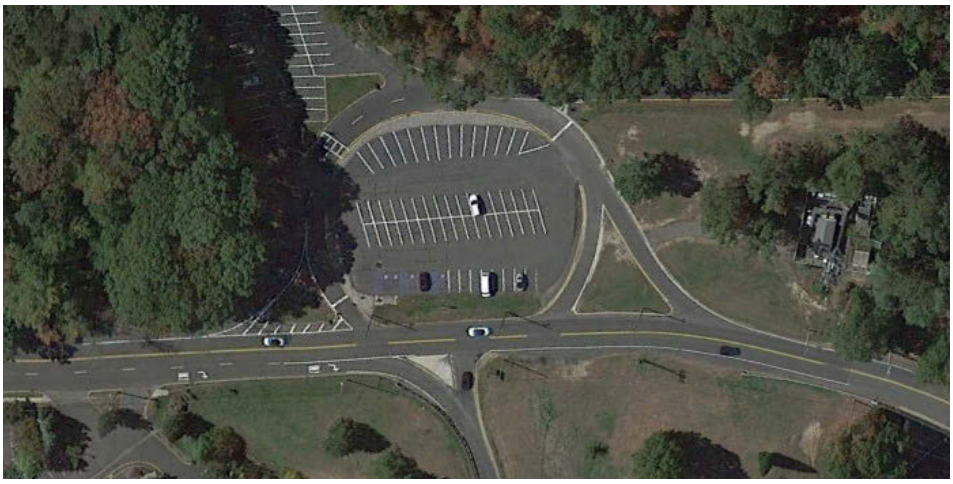
Crosswalks

Marked crosswalks help pedestrians identify preferred locations at which to cross the street. Crosswalks may be installed at intersections or midblock locations and indicate to motorists where pedestrians have priority and where to yield. Crosswalks should be highly visible to pedestrians and drivers (Figure 27). Research has shown that continental (also known as ladder striping) is more visible to motorists than standard parallel markings. The average cost of a standard crosswalk is about $7.50 per square foot, and a continental crosswalk is approximately $8.50 per square foot.

Refuge Islands

Refuge islands create a protected space for pedestrians in the middle of a street and allow them to focus on crossing one direction of traffic at a time. Refuge islands are particularly useful at wide intersections and unsignalized midblock locations. The average cost of a refuge island is $13,520.

Figure 26: Garden State Parkway Bus PNR with Superior Ingress and Egress



Source: Google, 2015

Figure 27: Crosswalks and Sidewalks within a Transit PNR

Source: DVRPC, 2015

Pedestrian Countdown Timers

Timers allow pedestrians to gauge the amount of time they have to cross the street before the traffic signal will change. These timers can be combined with pedestrian push buttons. Push buttons can be effective on arterial and congested streets because they can allot more time to pedestrians only when they are present, thereby reducing the delay for vehicles. However, push button actuation should not be required to trigger a walk phase in areas where pedestrians are common. The average cost for countdown timer modules is approximately $740.

Curb Ramps

Curb ramps are required by ADA, and they provide access between the sidewalk and roadway for people using wheelchairs, walkers, and strollers as well as people with difficulty stepping up and down high curbs. The average cost is approximately $810.

Designing for the Transit Vehicle in a PNR

Designing a PNR to be suitable for the primary user or passenger is essential; however, it is also important to consider how the transit vehicle will navigate, access, and park within a PNR facility, if applicable.

Navigation and Access of a Transit Vehicle in a PNR

Understanding the size and maneuverability of the transit vehicle using the PNR is important when considering how it will function. Things to consider when designing for maneuverability and access are the following:

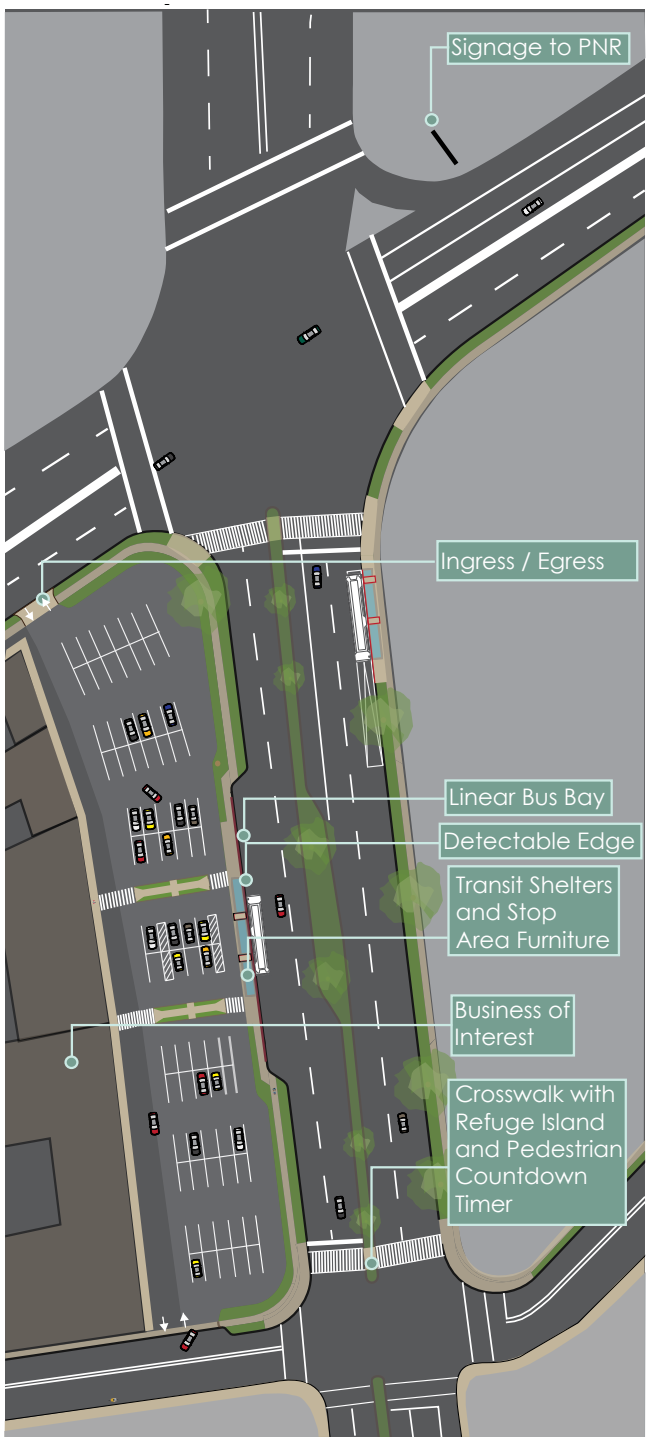
- Turning radii of the vehicle;
- Grade of the parking area or parcel and what grade the vehicle can maneuver; and
- Ingress and egress without any obstruction (vegetation, shelters, etc.).

Bus Bays within a PNR

A bus bay is the area where transit vehicles park while loading and unloading passengers. Bus bays should not be used if there is not sufficient space; bays that are too short can lead to significant time delay for transit. As mentioned in Chapter 1, PNRs are built in context or location for a specific type of user.

Figures 28 and 29 illustrate neighborhood PNRs that use small-to-medium capacity shared-use parking lots of strip retail and malls located near arterials to collect single-occupancy vehicles from residential areas. Figure 30 illustrates a single-use regional PNR, which are located at the junction of a major arterial and a radial highway. Regional PNRs collect single-occupancy vehicles as well, but tend to function as a greater intermodal transfer point, with larger parking capacities and ridership sheds.

Figure 28: Example of Linear Bus Bay Design with Shared Use Parking



Source: DVRPC, 2015

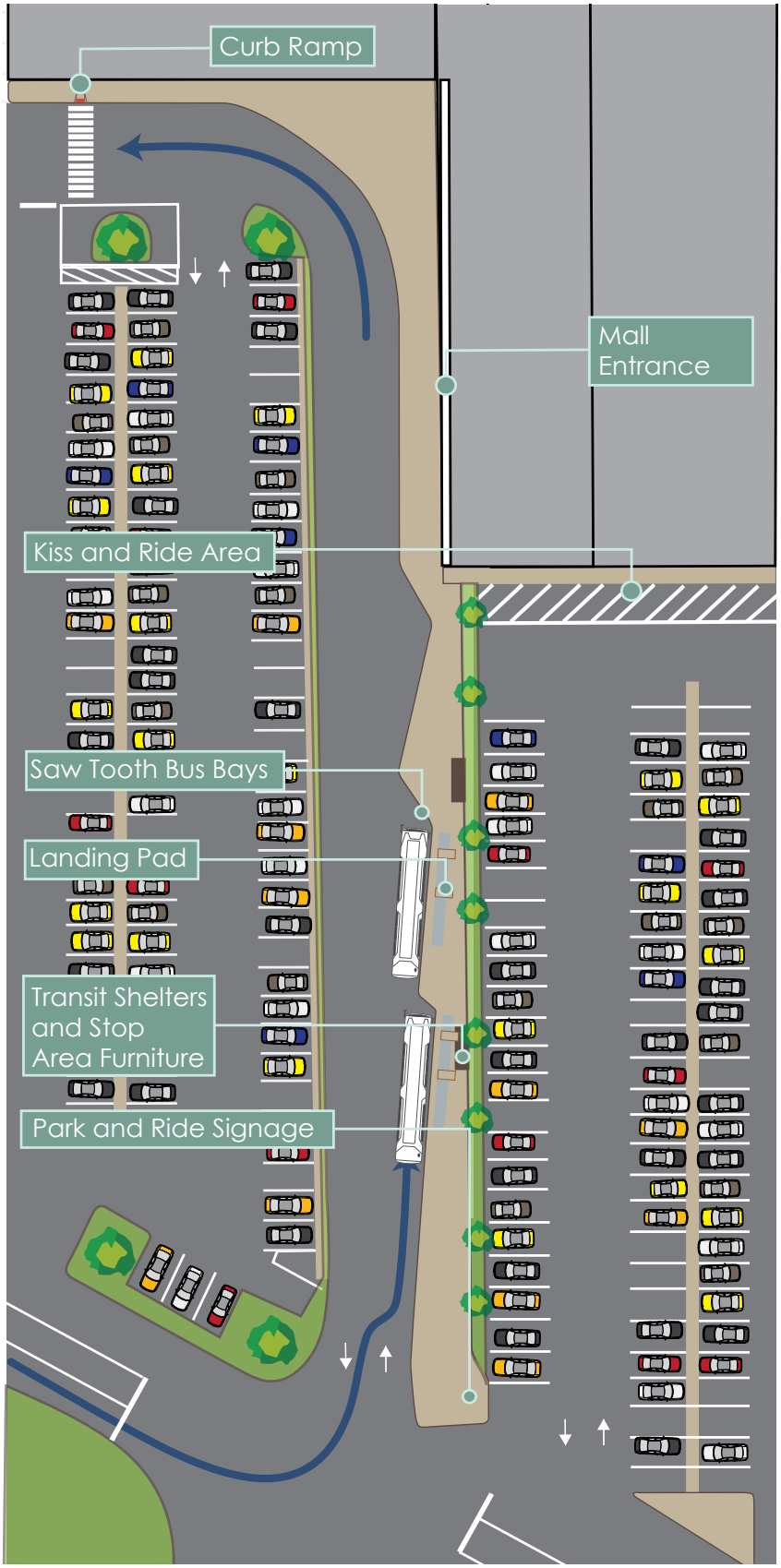
Bus Bay with Shared Use Parking

Linear bus bays (shown in Figure 28) are insets that allow buses to pull directly out of traffic into a protected space; this helps traffic to freely flow around the bus while passengers are discharged. Sufficient space for acceleration and deceleration allows the bus to leave and re-enter the traffic flow smoothly. Linear bays are appropriate for PNRs in settings where dwell times are likely to be higher, such as a supermarket.

Bus Bay with Shared-Use PNR Design

Saw tooth bus bays are often recommended for PNRs because of their efficient use of curb space. Saw tooth bus bays use a series of angled curb lines in zigzag formation to create space for multiple buses in areas with high demand but too little space for a linear bus bay. Saw tooth bays tend to be wider than a linear bus bay, but require a shorter curbside clearance and can work alongside curved lanes and facilities.

Figure 29: Example of Saw Tooth Bus Bay Design at a Shared-Use PNR



Source: DVRPC, 2015

Large and Single-Use Bus PNR

A delineated bus bay can use either a saw tooth or linear curb condition, but it is physically separated from through traffic and only allows transit vehicles to enter. This type of bay is often used in high capacity PNR lots to provide additional protection from traffic.

Transit Vehicle Space within a PNR

Two additional elements to consider when designing for a space for the transit vehicle in a PNR are the bus layover space and bus pads.

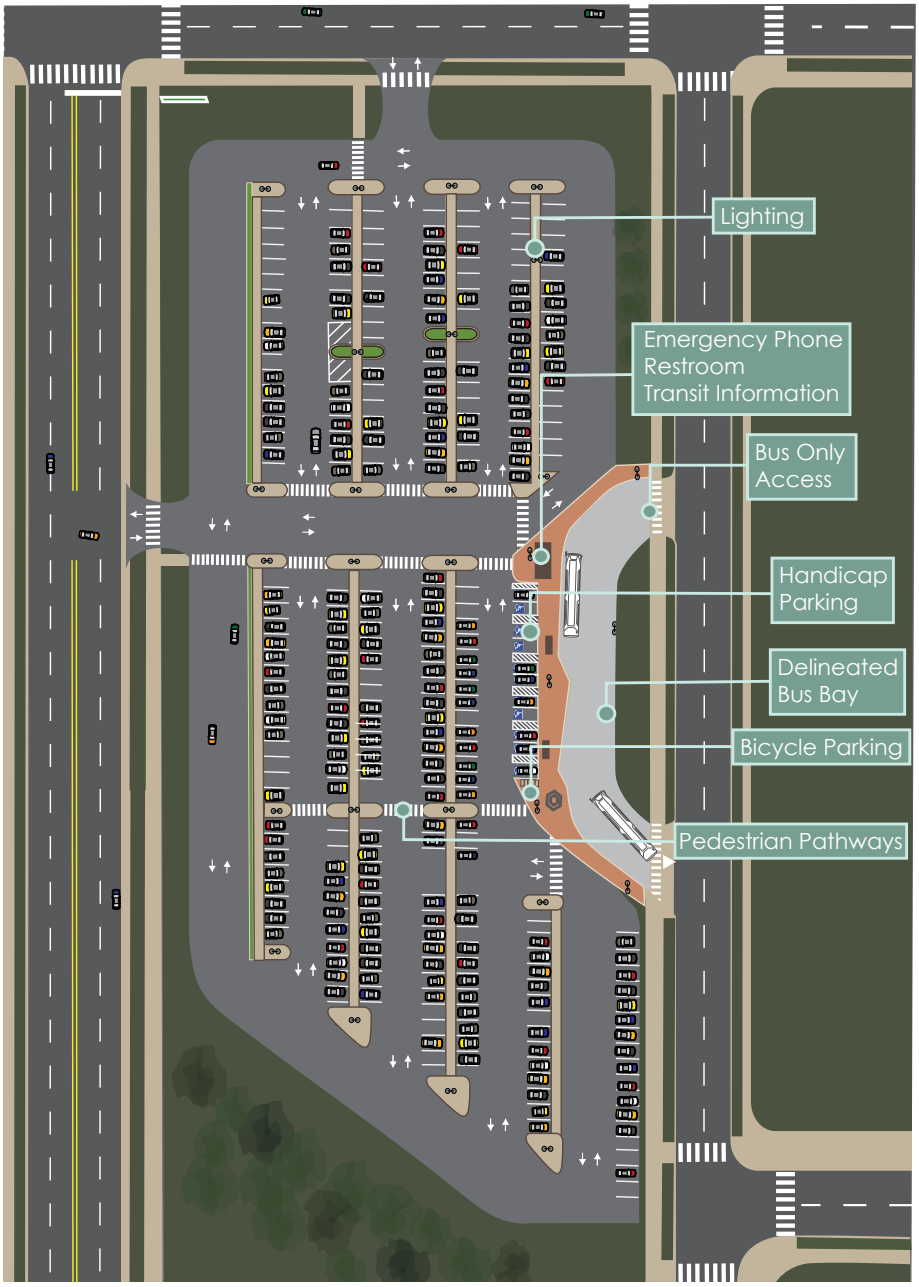
Bus Layover Space

In many cases, a PNR may be the end of a route for a bus. In this scenario, the creation of lay-by space using striping or signage should be made to designate a bus-only parking area. This area should be located away from vehicular parking so that traffic conflicts can be avoided.

Bus Pad

Bus pads are concrete slabs located at bus stops or along a corridor with many bus stops, and within the bus right-of-way. The material of the pad is intended to absorb the impact of daily transit vehicle use and provide a more reflective surface to distinguish bus stops at nighttime. As shown in Figure 31, bus pads are used curbside on East Market Street in Philadelphia for NJT and SEPTA buses.

Figure 30: Example of a Large, Single-Use Bus PNR



Source: DVRPC, 2015

Figure 31: Bus Pad on Market Street in Philadelphia

Source: DVRPC, 2015

Chapter 6: Conclusions

Strategically located PNRs can enhance and extend the transportation network, particularly the public transit network in a region. Within the DVRPC region PNRs provide an important means for NJT customers to access public transit.

All sites that are recommended for future PNR consideration and implementation were selected either through the DVRPC PNR location suitability score and aerial analysis or suggested by Mercer County. The selection process is explained thoroughly in Chapter 3.

Within this report the DVRPC team has listed sites where PNRs could be implemented in the future. The proposed and documented sites will need to be evaluated by NJT in terms of overall capital investment priorities for the agency and available resources prior to consideration of implementation. In addition, there is the potential for municipalities or counties to directly develop PNRs as resource for their local region. The following need to be identified for NJT PNR project development and implementation.

a. detailed evaluation of capital investment (needed property acquisition and improvements);

b. operating costs (insurance, maintenance, security);

c. potential revenue from parking fees to offset some portion of the costs;

d. additional site screening for land use compatibility; and

e. environmental constraints, and general coordination with the local municipalities.

Funding

Funding opportunities for traffic, pedestrian and transit planning, design, and implementation can be found in the following locations:

a. the Central Jersey Transportation Forum Transit Action Team website: www.dvrpc.org/LongRangePlan/CentralJerseyForum/ActionTeams.htm; and

b. on the DVRPC website: www.dvrpc.org/Funding/.

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Publication Number:	15015
Date Published:	February 2016
Geographic Area Covered:	Burlington County, Camden County, Gloucester County, Mercer County,

Key Words: New Jersey Transit (NJT), Park-and-Ride (PNR), bus, bus stop, park-and-ride design

Abstract: As travel patterns shift and demand for public transit services increases due to congestion, drive-to-transit access patterns, such as park-and-rides (PNR), will remain a primary means of transit access for many regional residents and workers to avoid the monetary and time costs of traveling by automobile. This project sought to assess locations where New Jersey Transit (NJT) bus and train PNR demand exceeds capacity, or is likely to do so in the future within the DVPRC region in South Jersey (the study area), and develop candidate locations for PNR investment.

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