Freight Performance Analysis Technical Memo

SJTPO Regional Freight Plan Data Collection and Analysis

June 28, 2022

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1 Introduction

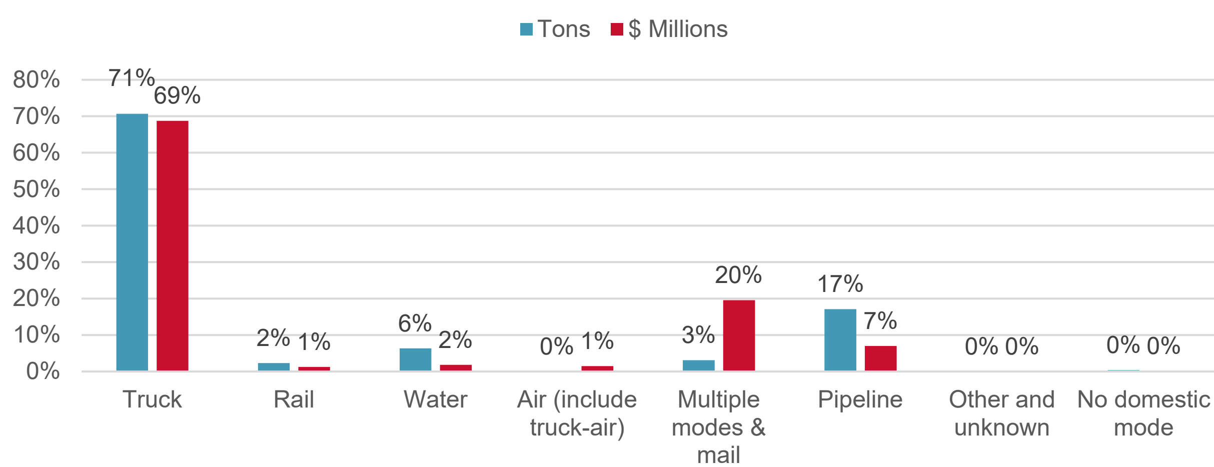
The South Jersey Transportation Planning Organization (SJTPO) is conducting this Regional Freight Plan Data Collection and Analysis project to better understand the movement of freight goods in southern New Jersey and to better integrate freight into its transportation planning process. SJTPO's overarching goal is to develop an optimal multimodal transportation network contributing to the region's economic development and its residents' wellbeing. This study will also help SJTPO to better represent the region's issues and needs in the New Jersey State Freight Plan.

This document summarizes the results of the second phase of the study, evaluating available freight data to assess performance measures for truck movements and other freight modes in the region, including congestion, bottlenecks, and safety issues.

2 Truck Performance Measures

This first section of this document focuses on the evaluation of truck freight flows. A greater emphasis is placed on truck freight movements relative to other modes due to the fact that truck freight makes up approximately 70 percent of the freight tonnage and value shipped into, out of, and within the region (Figure 2-1). SJTPO and other local freight partners such as counties, cities, and townships also have much greater jurisdictional authority over the roadway system compared to other freight modes.

Figure 2-1. Southern New Jersey Inbound/Outbound Freight Flow Proportions



Source: FAF5 Data Tabulation Tool, Philadelphia PA-NJ-DE-MD (NJ Part). Includes counties outside of SJTPO area.

2.1 Congestion

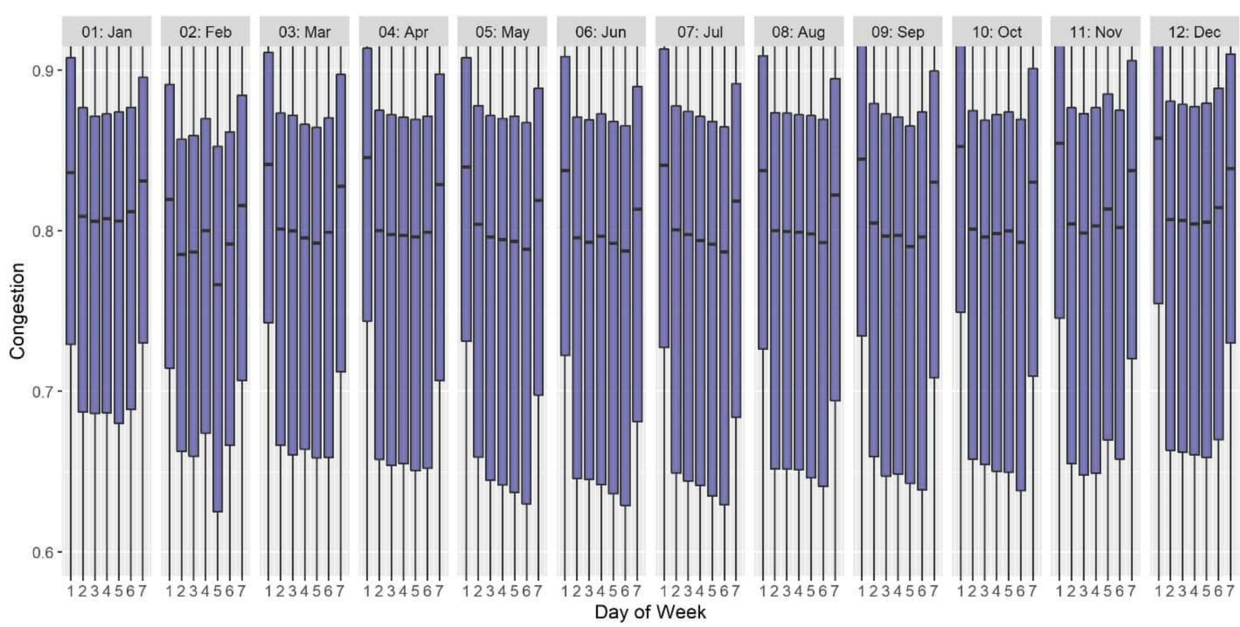
Data for this evaluation of roadway congestion in the SJTPO region was collected from the Regional Integrated Transportation Information System (RITIS) Probe Data Analytics (PDA) Suite Massive Data Downloader. This tool allows for the collection of data from INRIX and the National Performance Management Research Data Set (NPMRDS). Important distinctions between these two data sets are discussed in further detail below.

National Performance Management Research Data Set (NPMRDS)

The NPMRDS is a national dataset made available by the FHWA to state and local transportation agencies for the purpose of monitoring and reporting on various transportation performance measures. The data sources include vehicle probe data from INRIX, TomTom, and HERE. A useful feature of this data is that truck vehicles can be analyzed separately from other vehicles. However, one key limitation of the data is that it is only available on National Highway System (NHS) roadways. For this analysis, truck probe data was collected for the full calendar year of 2021.

One known feature of traffic in the SJTPO area is the seasonal impacts of tourists and summer-focused events. This aspect of local travel patterns is highlighted in Figure 2-2 below. In this context, the measure of congestion is calculated as the average speed divided by the 99th percentile speed for each segment. The 99th percentile speed is assumed to be equal to the free flow speed for each segment and was used in place of the reference speed provided by the NPMRDS after a detailed review found the reference speed to be substantially different from what would be expected on many roadway segments. The results are shown as a box plot where the median value for all segments for each hour is shown with a horizontal black bar. The blue area represents the interquartile range (25th percentile to 75th percentile) within each time period. The figure shows that the summer months in the SJTPO region exhibit a greater likelihood for congestion levels less than 70 percent of free flow speed. This is most noticeable during the months of May through July. Notably, there are many instances of high congestion during the month of February. This is a direct result the record snowfall events which occurred in February 2021. For the purposes of further evaluating the impacts of seasonal traffic on truck travel, this analysis will define May through July as the "Peak Season" and the months of November through January as the "Off-Peak Season". Note that these peak and off-peak seasons are specific to truck behavior and may not fully represent the peak congestion for all vehicles.

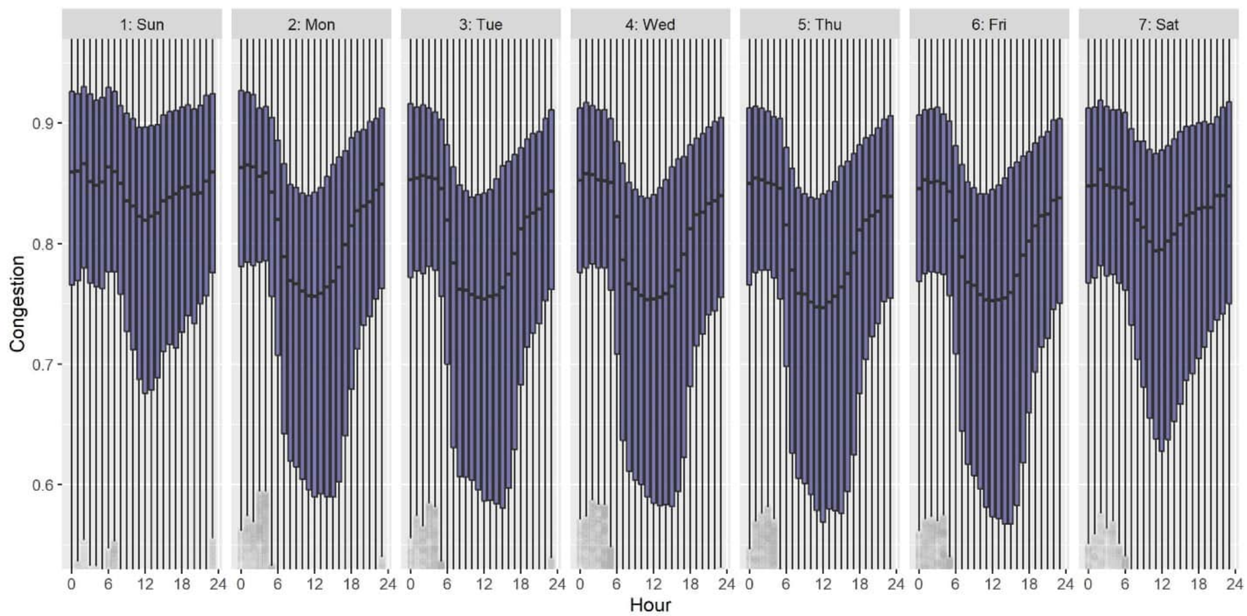
Figure 2-2. Congestion by Month and Day of Week (NHS Roads in SJTPO)



Source: NPMRDS Data, Jan-Dec 2021

Additional results from the NPMRDS data are shown in Figure 2-3. This figure shows the truck congestion levels by hour and day of week in the boxplot format. Peak truck congestion in SJTPO occurs between approximately between 10 A.M. and 4 P.M. on weekdays. Truck congestion levels are much less on Saturdays and Sundays with peak congestion occurring at approximately noon.

Figure 2-3. Congestion by Day and Hour (NHS Roads in SJTPO)



Source: NPMRDS Data, Jan-Dec 2021

The extents of this data on SJTPO roads are shown in Figure 2-4. This figure shows the peak hour congestion levels for trucks on NHS roadways in the region during the peak season months described in the previous section. The peak hour values shown on this map represent the peak hour for the individual segment. Roadway segments in red indicate that the truck travel speeds on these segments are less than half of the free flow speed.

Segments of heavy congestion are primarily located in and near more heavily populated areas of Atlantic City, Cape May, and the near the interchange of the New Jersey Turnpike and I-295. Similar information for the off-peak season is shown in Figure 2-5. While there is much overlap between the locations of the highest congestion, the overall congestion levels for trucks in the off-peak season are slightly lower than the congestion levels during the peak season. However, the peak hour congestion levels on Highway 55 near Vineland are higher during the off-peak season.

Figure 2-4. Peak Season Peak Hour Congestion (Trucks Only, NPMRDS)

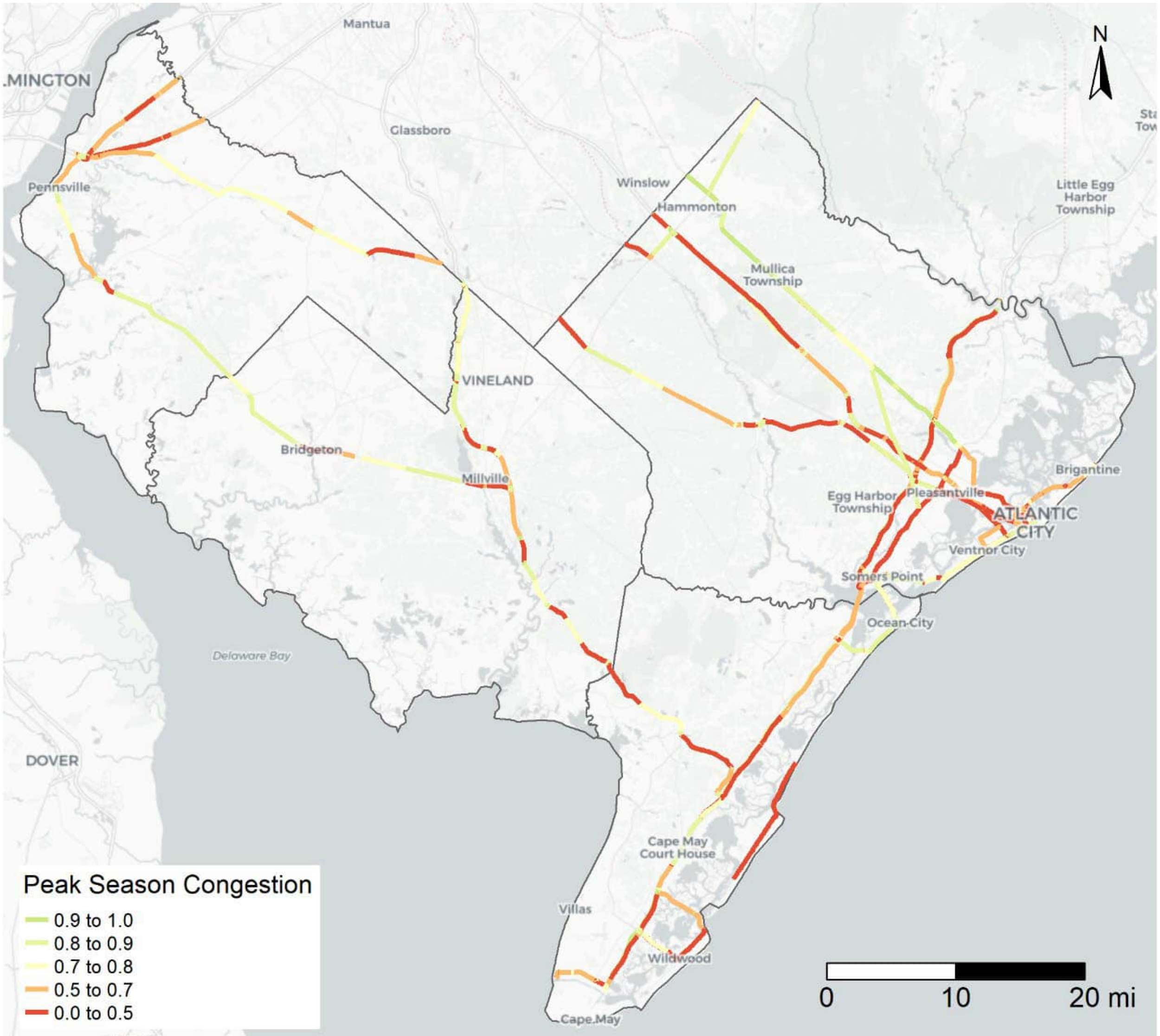
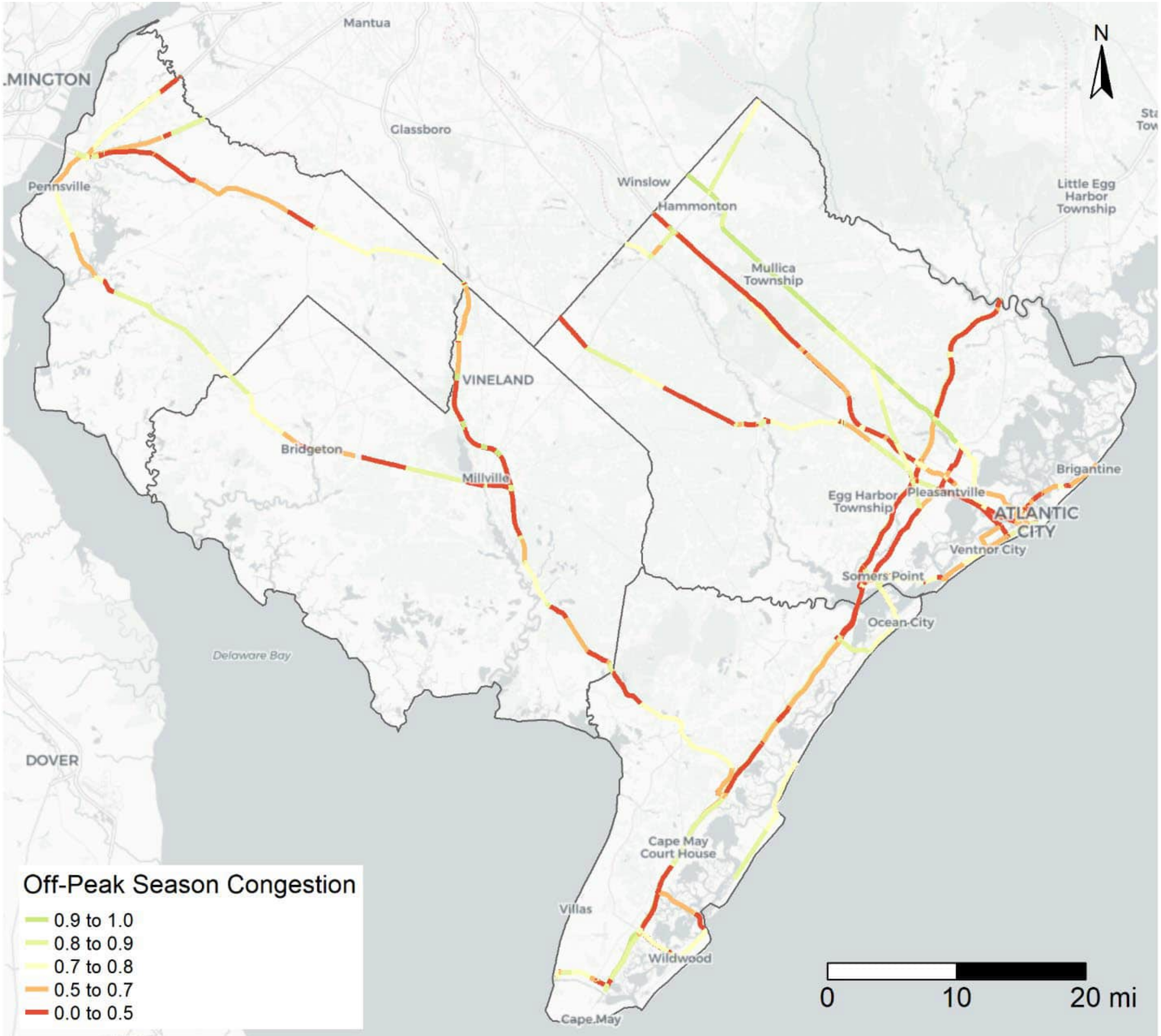


Figure 2-5. Off-Peak Season Peak Hour Congestion (Trucks Only, NPMRDS)



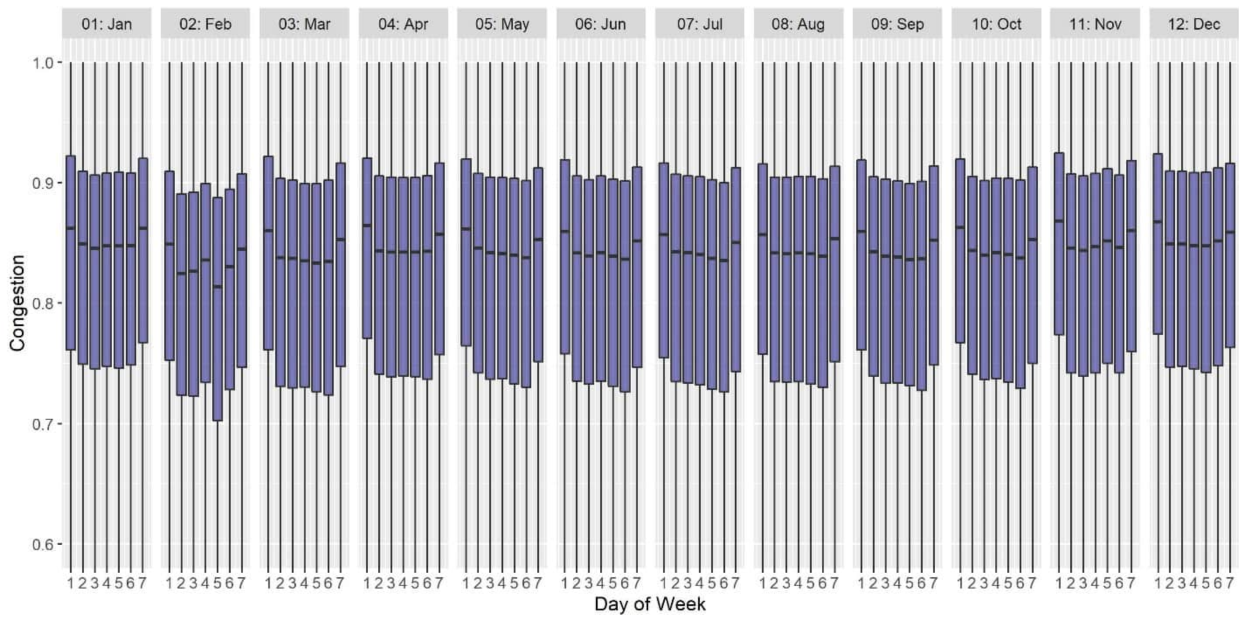
INRIX

INRIX vehicle probe data is another data source made available through the RITIS PDA Suite. This data is provided for a broader coverage area beyond the NHS roadway segments included in the NPMRDS data. However, a major limitation of this data sources is that it is only made available for all vehicles, unlike the NPMRDS data which can be disaggregated to include only trucks.

INRIX data for SJTPO roadway segments is shown in the figures below for congestion by month and day of week (Figure 2-6) and congestion by day and hour (Figure 2-7). The first figure shows that the majority of roadway segments remain between 70 percent and 90 percent of free flow speed throughout the course of the day. This is both higher than the range of congestion for trucks and shows less variability from month to month. This indicates that truck trips may be more heavily impacted by seasonal traffic congestion than all vehicles combined. While the INRIX data includes additional roadway segments beyond the NHS system covered by the NPMRDS, a direct comparison between only the NHS roadway segments showed similar findings.

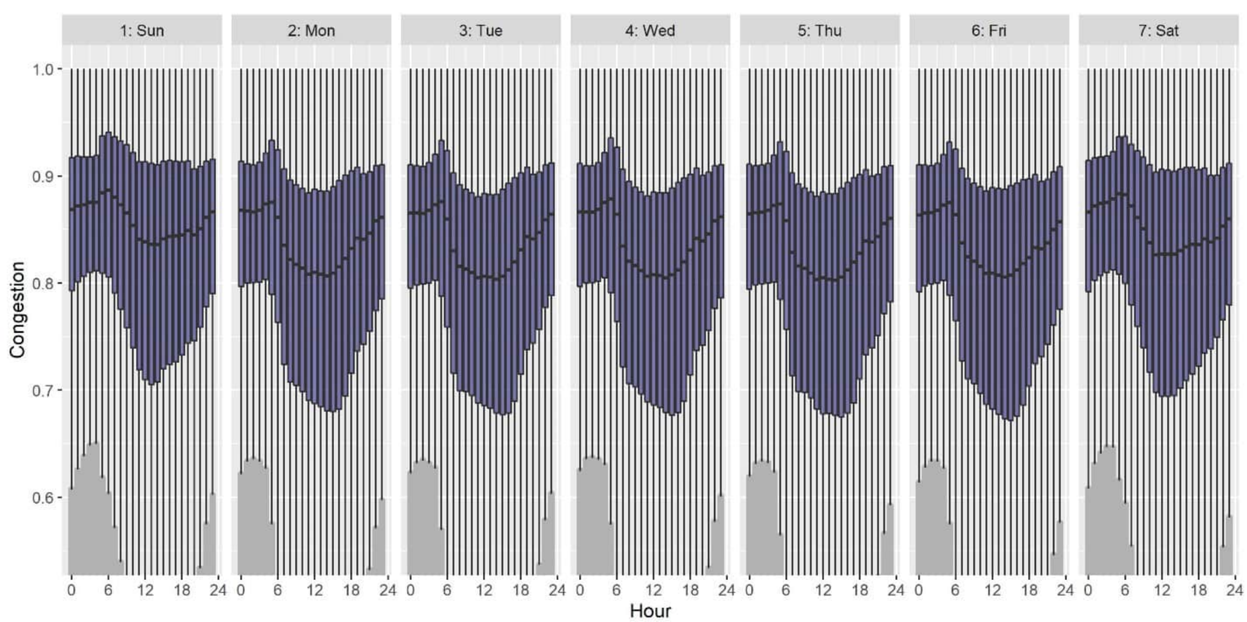
Similar results are found for the second figure showing the congestion by day and hour. Congestion levels for all vehicles are less severe throughout the course of the week than they are for truck vehicles specifically. There is also less of a difference between weekday and weekend congestion levels for all vehicles.

Figure 2-6. Congestion by Month and Day of Week (All Vehicles)



Source: INRIX Data, Jan-Dec 2021

Figure 2-7. Congestion by Day and Hour (All Vehicles)

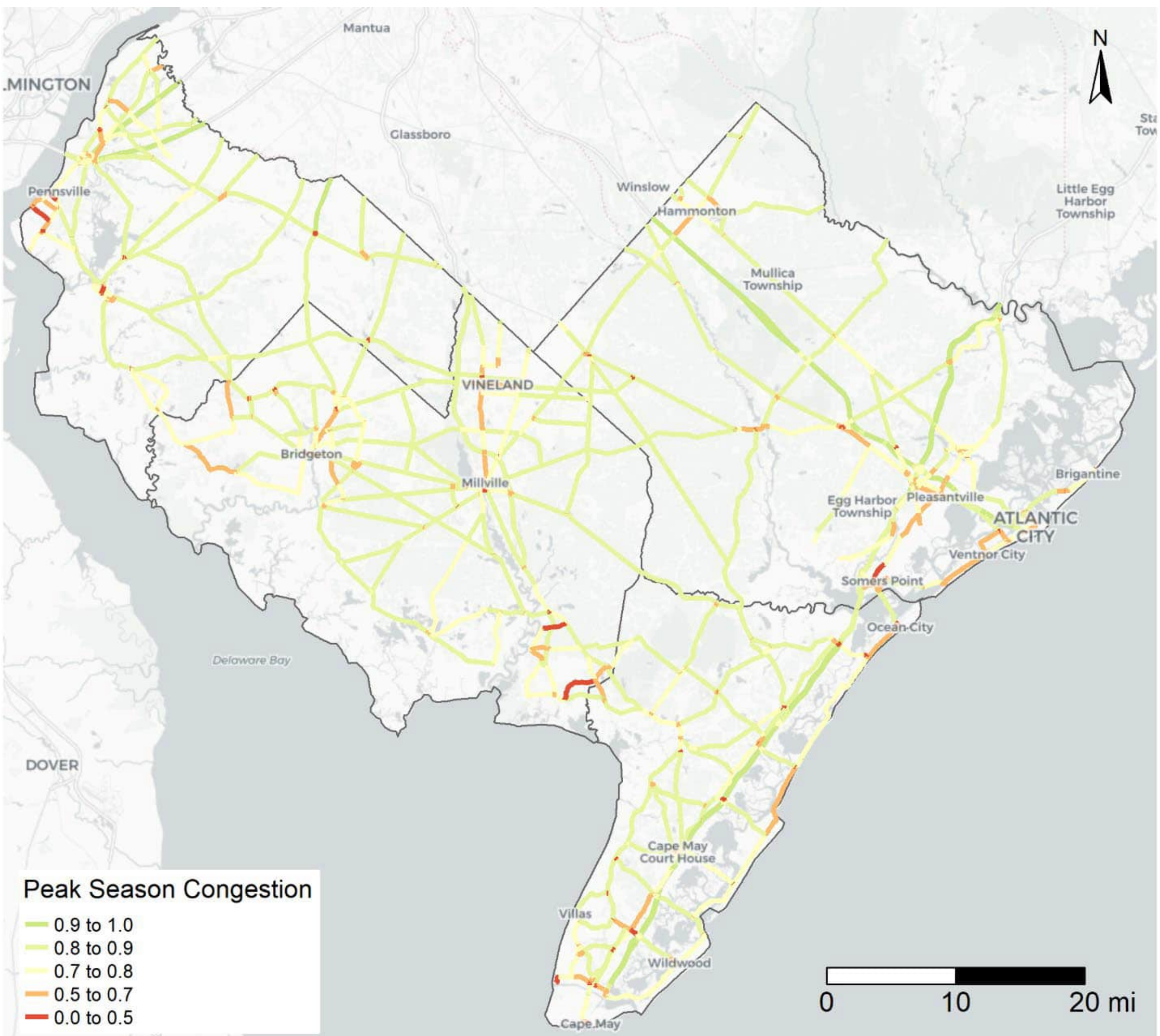


Source: INRIX Data, Jan-Dec 2021

As with the NPMRDS data, the INRIX data was summarized for the peak and off-peak seasons to highlight differences in travel patterns. Figure 2-8 shows the peak hour congestion levels for all vehicles during the peak season while Figure 2-9 shows the peak hour congestion levels for all vehicles during the off-peak season.

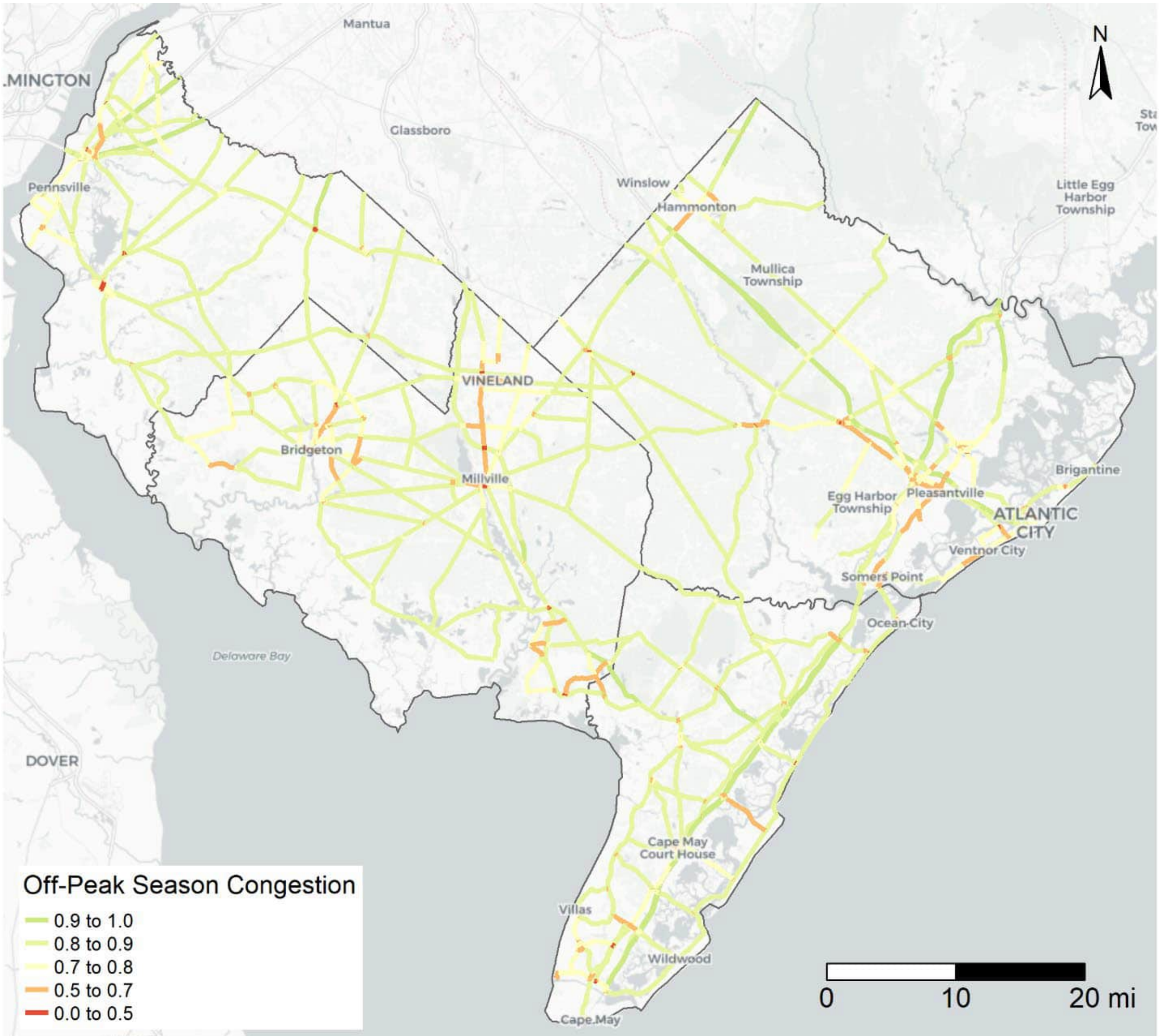
Notably, these maps show that the congestion levels for all vehicles do not vary as widely as those for trucks only. Where many segments on the NPMRDS network showed average speeds at less than half of the free flow speed, there are very few roadway segments within the INRIX data that have congestion that severe. Part of this difference between the two data sources is likely due to the differing performance of trucks compared to passenger vehicles. Trucks take longer to accelerate and decelerate along segments, and in many cases do not travel at speeds as high as passenger vehicles. Comparing matching segments between the two data sources shows that truck travel as speeds six percent slower than passenger vehicles on average.

Figure 2-8. Peak Season Peak Hour Congestion (All Vehicles, INRIX)



Source: INRIX Data, Jan-Dec 2021

Figure 2-9. Off-Peak Season Peak Hour Congestion (All Vehicles, INRIX)



Source: INRIX Data, Jan-Dec 2021

Table 2-1 summarizes the roadways in SJTPO that have a peak hour congestion level of 0.50 or less for either the peak season or the off-peak season and which are at least one quarter mile in length. Roadway segments shorter than this are likely to include highway interchange on and off ramps and other short segments that are more susceptible to variations in speed due to the proximity of signalized intersections. The roadway descriptions are based on INRIX Traffic Message Channel (TMC) roadway features made available through the NJDOT license with RITIS. Note that the Intersecting Roadway column indicates one terminal end of the segment. The Direction and Miles columns indicate the direction and distance to the other terminal end of the roadway, but this does not necessarily correlate to traffic direction.

Table 2-1. Summary of Congested Roadways

Was	Road Name	Intersecting Roadway	Dir.	Miles	County	Peak Cong.: Peak	Peak Cong. Hour	Peak Cong.: Off-	Peak Cong. Hour
103-10244	E 9TH ST	CR-619/Central Ave	SB	0.27	CAPE MAY	0.49	12	-	-
103+10245	E 9TH ST	CR-656/Bay Ave	NB	0.27	CAPE MAY	0.45	16	-	-
103-05692	E MAIN ST	RT-47/2nd St	EB	0.27	CUMBERLAND	0.43	16	0.50	15
103+11455	E MAIN ST	RT-47/2nd St	NB	0.27	CUMBERLAND	0.43	16	0.50	15
103-17256	FERRY RD	Cape May-Lewes Fry	SB	0.36	CAPE MAY	0.44	5	0.49	Multiple
103+17257	FERRY RD	US-9/Lincoln Blvd	NB	0.36	CAPE MAY	0.42	8	-	-
103-15492	FIRE RD	Garden State Pky	SB	0.27	ATLANTIC	0.49	16	0.49	16
103-11642	FORT MOTT RD	CR-632/Lighthouse Rd/Lehigh Rd	SB	0.65	SALEM	0.46	6	-	-
103+51956	HANDS MILL RD	CR-679/Mosslander Rd	NB	2.42	CUMBERLAND	0.34	7	-	-
103+10261	HAWKS BRIDGE RD	US-130/Shell Rd	NB	0.29	SALEM	-	-	0.46	3
103-51935	HIGH ST	CR-739/High St	SB	0.98	CUMBERLAND	-	-	0.48	11
103+12856	HIGHLAND AVE	Riviera Dr	WB	0.66	SALEM	0.48	6	-	-
103+51952	HUNTERS MILL RD	RT-47/Delsea Dr	EB	0.58	CUMBERLAND	0.29	6	-	-
103+51953	HUNTERS MILL RD	RT-347/New Stage Rd	EB	0.83	CUMBERLAND	0.42	6	-	-
103-12924	INDUSTRIAL RD	CR-630/Fort Mott Rd	SB	1.25	SALEM	0.35	6	-	-
103+12925	INDUSTRIAL RD	Riviera Dr	NB	1.25	SALEM	0.45	6	-	-
103-05773	NEW RD	RT-52/MacArthur Blvd/W Laurel Dr	SB	1.26	ATLANTIC	0.49	12	-	-
103+05774	NEW RD	CR-559-ALT/W Ocean Heights Ave	NB	1.26	ATLANTIC	0.50	13	-	-
103+09581	RT-47	US-9	NB	0.51	CAPE MAY	0.38	16	-	-
103-51942	STATION RD	CR-616/High St	WB	0.89	CUMBERLAND	0.13	6	0.16	6
103-52083	SWAINTON GOSHEN RD	CR-615/Goshen Rd	WB	1.64	CAPE MAY	0.43	6	-	-
103-52084	SWAINTON GOSHEN RD	CR-657/Court House South Dennis Rd	WB	1.61	CAPE MAY	0.27	5	-	-
103-51834	WALNUT ST	Grieves Pkwy	SB	0.42	SALEM	0.40	9	0.46	9
103+51835	WALNUT ST	RT-49/E Broadway	NB	0.42	SALEM	0.32	8	0.36	8
103-51846	WEST RD	CR-647/Marlboro Rd	WB	1.14	CUMBERLAND	0.46	5	-	-

Source: HDR Analysis of 2021 INRIX Data from RITIS Massive Data Downloader. (Peak Congestion ≤ 0.50, Roadway Segment > 0.25 Miles)

2.2 Travel Time Reliability Index

An alternative measure of truck mobility is the Travel Time Reliability Index (TTRI). This federal performance measure is defined as the ratio between the 95th percentile travel time (representing traffic when it is slow and congested) and the 50th percentile time (representing average traffic conditions). A higher TTRI value indicates more variability in travel time, and therefore less reliability. A TTRI of 1.0 indicates a roadway segment that never varies in travel time (very reliable) while a TTRI of 2.0 indicates a roadway segment where the travel times during the slowest conditions are twice as slow as on average (less reliable). The federal measure requires that the TTRI value be calculated for a range of days and times as follows:

- Weekday AM Peak (6 A.M. - 10 A.M.)
- Weekday Midday (10 A.M. - 4 P.M.)
- Weekday PM Peak (4 P.M. - 8 P.M.)
- Weekend All Day (6 A.M. - 8 P.M.)
- All Days Overnight (8 P.M. - 6 A.M.)

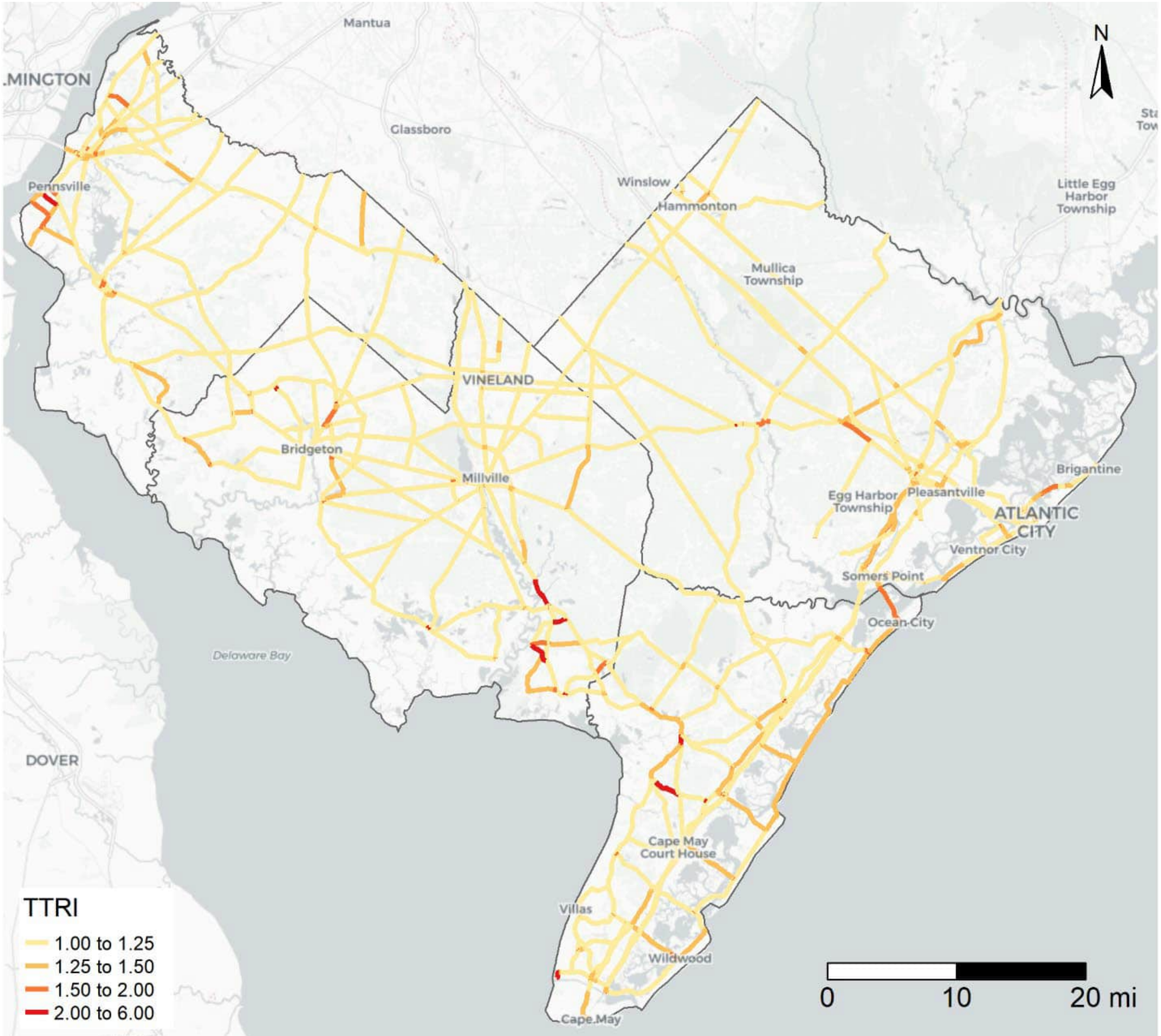
The overall road segment TTRI measure is determined by the highest TTRI calculated among this grouping of five distinct time periods. However, TTRI on individual time periods can also be used as a useful performance measure. For this analysis, the full 2021 data set was used.

Travel time reliability is an especially important performance measure for commercial truck trips, in some cases being more important than overall travel speeds. If a truck travels on a roadway segment that is not reliable, this often means the trucking company will have to choose between leaving “on-time” and risking a late delivery or leaving early and potentially wasting potentially productive time while they wait for their destination location to open for business.

The TTRI measures on SJTPO roadways are shown in Figure 2-10 below. The majority of roadway segments in SJTPO exhibit a TTRI level between 1.00 and 1.25, indicating relatively reliable travel speeds under most circumstances. Some areas that exhibit more unreliable travel speeds are roads in Pennsville Township, portions of Highway 55 south of Millville, and multiple segments along Ocean Drive southwest of Atlantic City.

Note that the information provided in the figure represents the data for all vehicles from the INRIX dataset. Comparing this data between all roadway segments and roadway segments more heavily traveled by trucks shows no substantial difference in TTRI. The weighted average TTRI for all roadway segments in SJTPO is 1.18. The weighted average TTRI for roadway segments in SJTPO with an estimated 200 or more trucks per day is 1.17.

Figure 2-10. Travel Time Reliability Index (All Vehicles, INRIX)



Source: INRIX Data, Jan-Dec 2021

2.3 Bridges

Bridges provide key links in the freight transportation system but can also pose potential impediments if they are not built to sufficient load limits, have low vertical underclearance, or have not been maintained in sufficient condition. For this analysis, the National Bridge Inventory (NBI) maintained by the FHWA was used as the primary data source. States report information on bridge characteristics and conditions to this central database.

One limitation of this data source is that railroad-over-highway bridges are not included. Importantly, it is this specific bridge configuration which is most often associated with lower vertical underclearances and other freight impediment issues. Additional data was collected from the Federal Railroad Administration's crossing inventory to identify these bridge types. This data includes the locations of grade separated rail crossings.

Information on vertical underclearance for the railroad-over-highway briges was collected through a manual assessment of Google Street View imagery. Information is not available regarding bridge condition and inventory rating.

In total, the NBI data includes 493 highway bridges within the SJTPO area. The FRA data review identified an additional six rail-over-highway bridges, primarily located in Pleasantville and Absecon.

Vertical Underclearance

Vertical underclearance is defined as the distance between the lowest point of a bridge span and the roadway or other surface underneath that span. For the purposes of this freight data collection effort, the primary interest is in vertical underclearance when a highway is running under the bridge. Using this criteria, there are 147 bridges in SJTPO with a highway-over-highway configuration and an additional six bridges with a railroad-over-highway configuration.

Currently, New Jersey uses 13’-6” as the maximum vehicle height allowable without an oversize/overweight permit. To identify bridges that potentially function as impediments to truck freight traffic this study uses the following thresholds to categorize the bridge vertical underclearance:

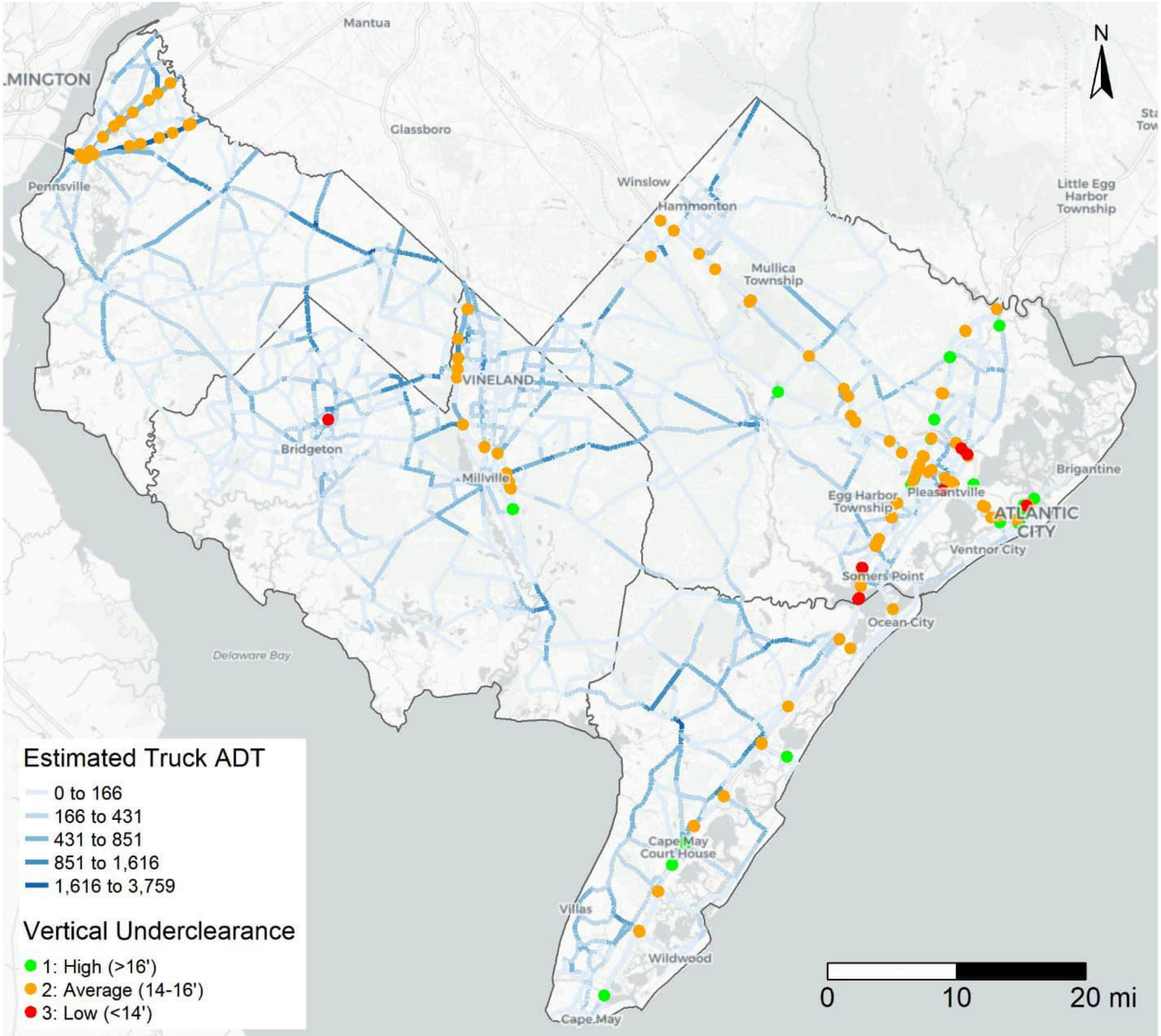
- High: > 16’-0”
- Average: 14’-0” – 16’-0”
- Low[1]: < 14’-0”

Of the 148 bridges over highways in SJTPO, 29 are categorized as high, 110 are categorized as average, and 9 are categorized as low. The locations of bridges over highways in SJTPO is shown in Figure 2-11. This figure also shows the distribution of estimated truck volumes based on the analysis completed for Tech Memo 1. Of these nine low bridges, four are railroad-over-highway configuration.

It should be emphasized that the minimum vertical underclearances for highway over highway bridges described in this data should not be expected to correspond directly with posted bridge clearance signs. Posted clearance signs will typically be between three and six inches lower than the minimum vertical underclearance to provide a minimum clearance space between vehicles and the bridge structure.

[1] Note that per the NJDOT Design Manual for Bridges and Structures, the minimum vertical underclearance for bridges are defined as 16’-0” for interstates, freeways, expressways, and arterials and 14’-6” for local and collector roads.

Figure 2-11. Bridge Vertical Underclearance



Source: 2021 National Bridge Inventory, FRA

Table 2-2 provides a summary of these nine low bridges. The table includes the NBI bridge identification number in the case of highway bridges and the FRA crossing inventory number in the case of grade separated rail crossings. The table also includes a description of the bridge, the vertical underclearance, and a high-level summary of the potential impacts to truck freight movements due to the placement of this bridge on the freight highway network.

Table 2-2. Summary of Bridges with Low Vertical Underclearance

Bridge ID / FRA ID	Description	Vertical Under-clearance	Impacts to Truck Freight
360280N	Garden State Parkway NB over Harbor Road	9'-10"	Minimal: Harbor Road serves only residential areas to the east of the Parkway.
370280S	Garden State Parkway SB over Harbor Road	12'-10"	Minimal: Harbor Road serves only residential areas to the east of the Parkway.
360300N	West Laurel Drive off-ramp over Garden State Parkway NB	13'-11"	Some potential impact: Some truck traffic on the Garden State Parkway may be required to detour to alternate routes. However, the clearance is only 1" shorter than the ideal minimum clearance.
360300S	West Laurel Drive off-ramp over Garden State Parkway SB	13'-11"	Some potential impact: Some truck traffic on the Garden State Parkway may be required to detour to alternate routes. However, the clearance is only 1" shorter than the ideal minimum clearance.
586137N (FRA)	Railroad over Black Horse Pike (US 40/US322)	13'-10" (Posted)	Some potential impact: Through and local truck trips make be impacted by this bridge, but alternate routes are readily available. The posted clearance also exceeds the maximum standard truck height.
586109K (FRA)	Railroad over South New Road	13'-10" (Posted)	Potential impact: South Mill Road to the west is currently used more heavily by north-south truck travel, but South New Road might provide a more direct route for some trips. The posted clearance also exceeds the maximum standard truck height.
586110E (FRA)	Railroad over Station Avenue	12'-6" (Posted)	Minimal: This route does not provide through access for north-south trips and alternate routes are available to the east and west. The posted clearance is equal to the maximum standard truck height.
Unknown (FRA)	Railroad over Shore Road	13'-11" (Posted)	Potential impact: South Mill Road to the west is currently used more heavily by north-south truck travel, but Shore Road might provide a more direct route for some trips. The posted clearance also exceeds the maximum standard truck height.
4200004	Borgata Casino Parking Ramp Access Crossover	10'-4"	Minimal: Route used for passenger vehicle access to casino parking ramp.
172187W (FRA)	Railroad over NJ 77	13'-7" (Posted)	Potential impact: NJ 77 is heavily used by trucks. However, the posted clearance exceeds the maximum standard truck height.

Note that the FRA vertical underclearance values in this table are based on the posted height restriction while the vertical underclearance for non-railroad bridges is based on the actual height from the NBI.

Inventory Rating

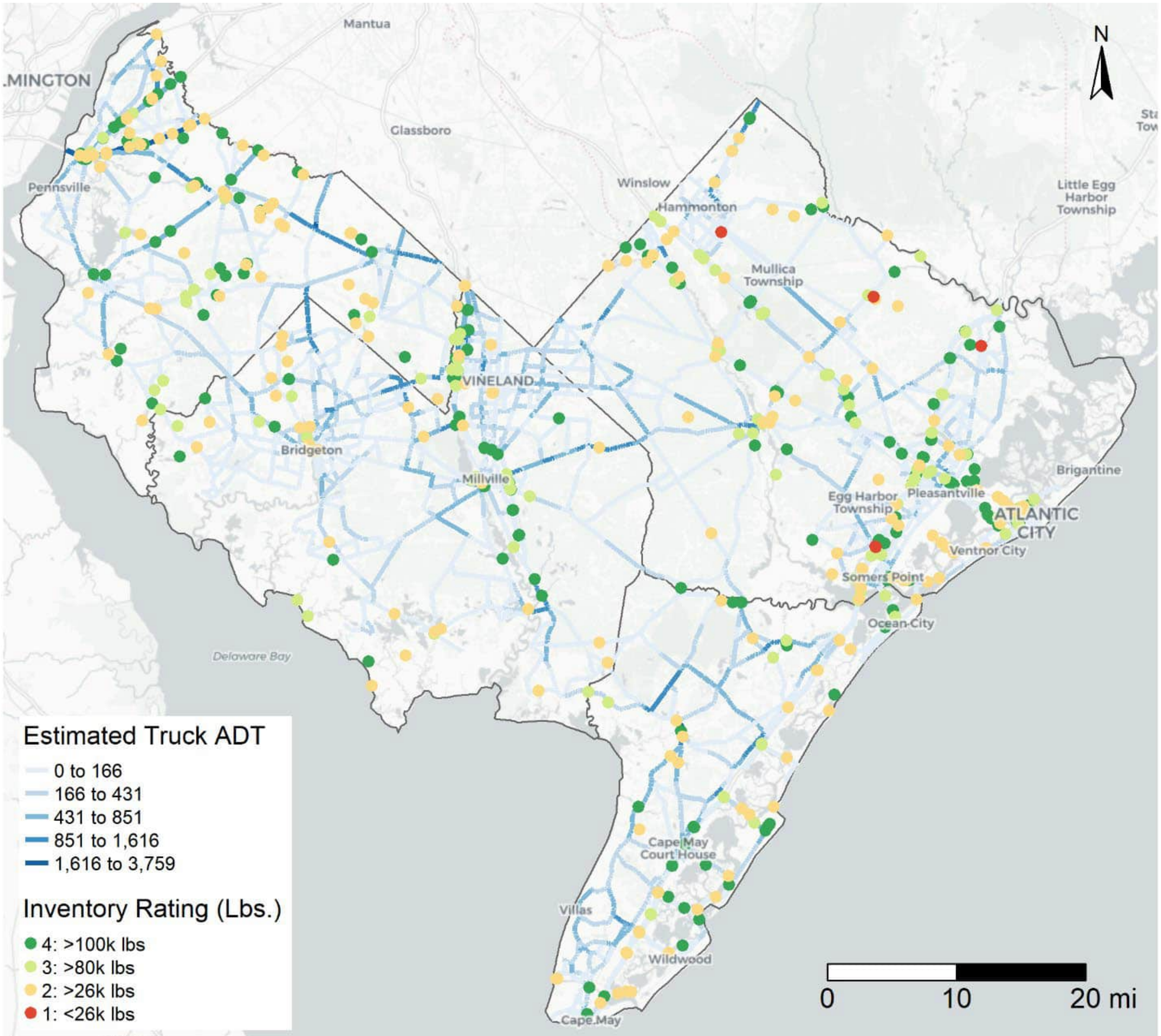
The measure of Inventory Rating used in the NBI dataset refers to the maximum vehicle load that can safely utilize a bridge structure for an indefinite period of time. This rating is distinct from—and less than—the operating rating, which refers to the absolute maximum vehicle weight that can safely utilize the bridge structure. For this study, the inventory ratings for bridges in SJTPO were divided into the following categories:

- **>100k lbs. (176 in SJTPO):** These bridges are built to an exceptionally high inventory rating and are able to handle all standard truck vehicles[2] as well as many overweight vehicle loads requiring a permit.
- **>80k lbs. (114 in SJTPO):** These bridges are able to handle all standard truck vehicles and have the potential to handle some overweight vehicle loads.
- **>26k lbs. (197 in SJTPO):** These bridges can handle all Class 6 medium duty trucks and some Class 7 and 8 heavy duty trucks. These bridges may impact the routes taken by heavy duty trucks in some instances.
- **<26k lbs. (6 in SJTPO):** These bridges pose a potential impediment to nearly all truck freight vehicles and should be evaluated further to identify these potential impacts.

Figure 2-12 shows the distribution of bridges in SJTPO based on these categories of inventory load rating. The five bridges with an inventory rating below 26,000 lbs. are predominantly located in Atlantic County. Further review and details of these bridges are summarized in Table 2-3.

[2] The maximum gross vehicle weight limit in New Jersey 80,000 lbs.

Figure 2-12. Bridge Inventory Rating



Source: 2021 National Bridge Inventory

Table 2-3. Summary of Bridges with Low Inventory Rating (<26k lbs.)

Bridge ID	Description	Inventory Rating (lbs.)	Impacts to Truck Freight
0162150	Weymouth Road (CR 640) over Atlantic City Line	24,000	Potential impact: Improved weight limits on this bridge would provide a more direct route for truck freight movements between Hammonton and points to the south. Further study would be required to compare the benefits and costs of this improvement.
01EHC39	Indian Cabin Road 0.4 miles east of CR 563	22,000	Minimal: This road does not directly connect to any major freight generators or roadways with high truck volumes.
01PR007	Old New York Road 0.28 miles south of Main Street	18,000	Minimal: This road does not appear to offer a useful alternative to existing truck movements.
360316N	Garden State Parkway NB over Ocean Heights Avenue	20,000	Some potential impact: While the Garden State Parkway is not heavily used by truck freight, improving the load capacity of this bridge could provide additional options for some freight haulers.
360316S	Garden State Parkway SB over Ocean Heights Avenue	21,000	Some potential impact: While the Garden State Parkway is not heavily used by truck freight, improving the load capacity of this bridge could provide additional options for some freight haulers.

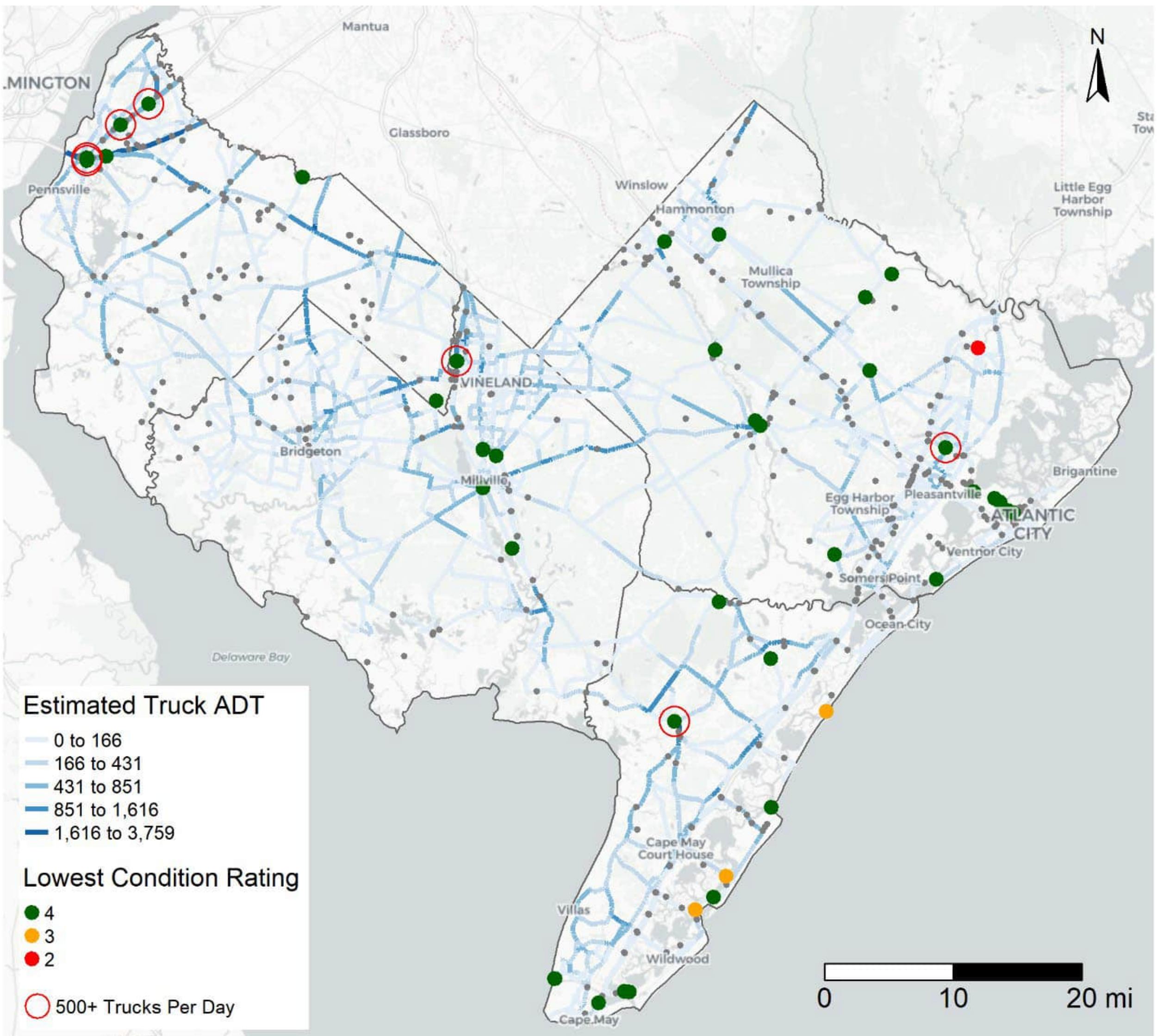
Bridge Condition

The NBI records conditions for three components of each bridge, the bridge deck, the superstructure, and the substructure. Each component is ranked on a scale of 0 through 9 based on the condition of the bridge at the time of inspection. The guidelines for this rating system are as follows:

- **9: Excellent Condition**
- **8: Very Good Condition** – No problems noted.
- **7: Good Condition** – Some minor problems.
- **6: Satisfactory Condition** – Structural elements show some minor deterioration.
- **5: Fair Condition** – All primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
- **4: Poor condition** – Advanced section loss, deterioration, spalling or scour.
- **3: Serious Condition** – Deterioration has seriously affected primary structural components. Local failures possible.
- **2: Critical Condition** – Advance deterioration of primary structural elements. May be necessary to close bridge.
- **1: Imminent Failure Condition** – Major deterioration or section loss present in critical structural components. Bridge closed to traffic.
- **0: Failed Condition** – Bridge is out of service

For this evaluation, each bridge was evaluated based on the lowest condition score within each of the three bridge components. Of the 493 highway bridges in SJTPO, 91 percent have a condition rating of 5 or higher. No bridges are rated at 0 or 1. Only one bridge has a condition rating of 2, and three bridges have a condition rating of 3. Another 40 bridges have a rating of 4. The distribution of bridges in SJTPO based on the lowest condition rating is shown in Figure 2-13. Bridges with a condition score of 5 or higher are shown as gray dots. Bridges on or over roadway segments with estimated daily truck volumes of 500 or more are circled in red. These bridges represent locations that could have potentially substantial impacts to truck freight movements if they were to deteriorate to a point that trucks could no longer traverse them. Additional details for these bridges are provided in Table 2-4.

Figure 2-13. Bridge Condition Rating



Source: 2021 National Bridge Inventory

Table 2-4. Summary of Bridges with Low Condition Rating and High Truck Volume

Bridge ID	Description	Deck Condition Rating	Superstructure Condition Rating	Substructure Condition Rating
1711156	I-295 SB Ramp to CR 551	6	6	4
1711150	I-295 NB Ramp over Salem Canal	4	7	6
1712153	NJ 48 over I-295	4	7	6
1712157	Perkintown Road over I-295	4	6	6
0610163	NJ 55 over West Oak Road (CR 681)	4	7	5
01A0004	Mill Road (CR 651) 0.52 Miles south of US 30	5	4	5
0508151	NJ 47 0.93 Miles north of NJ 83	4	4	6

Source: 2021 National Bridge Inventory

Note that for the Perkintown Road bridge (Bridge 1712157), the high truck volumes are almost entirely from I-295 rather than Perkintown Road itself and Perkintown Road is not an interchange location. Therefore, a closure of this bridge would not have as much impact as the other bridges on this list, which have high truck volumes on the road carried by the bridge.

2.4 Highway-Rail Grade Crossings

Similar to bridges, highway-rail grade crossings are key components of the freight transportation system that can sometimes pose impediments to truck freight movement. This review of highway-rail grade crossings in the SJTPO area is based on data collected from the FRA's Grade Crossing Inventory System (GCIS), commonly known as the crossing inventory. Data in this inventory is compiled through a combination of state DOT, railroad, and FRA input. The inventory includes up-to-date information on roadway and crossing characteristics such signal systems, signage, lane configuration, train volumes, and other relevant information

SJTPO has a total of 329 highway-rail grade crossings. Of these 258 are under public jurisdiction with the remaining 71 being privately owned crossings typically providing access to private residences or businesses. A total of seven grade crossings are classified as pathway grade crossings which include pedestrian or bicycle pathways distinct from other vehicular crossings. Sidewalks and pathways adjacent to typical roadway grade crossings are not considered to be pathway grade crossings. For the purposes of this study, the primary interest is in evaluating public highway crossings which have the greatest potential impact on truck freight movements.

Table 2-5. Summary of SJTPO Highway-Rail Grade Crossings

Crossing Type	Highway	Pathway	Total
Public	251	7	**258**
Private	71	0	**71**
Total	**322**	**7**	**329**

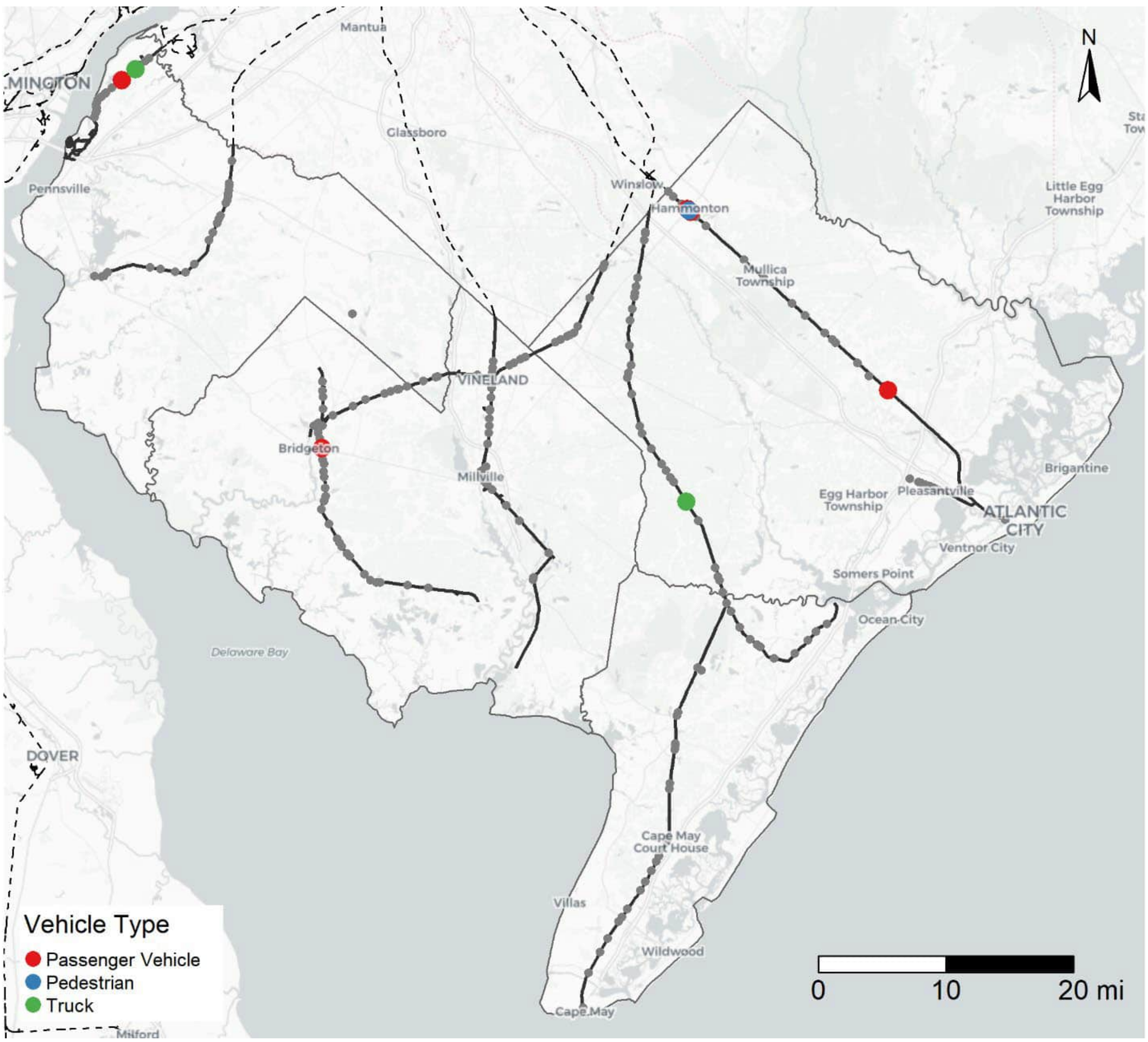
Highway-Rail Grade Crossing Crashes

This study reviewed the past 10 years of highway-rail crash data. Data was collected from the FRA's Accident/Incident Report database and includes data for all crossings in SJTPO for years 2012 through 2021. Over this time period, nine highway-rail grade crossing crashes have been recorded in SJTPO. The locations of these crashes are shown in Figure 2-14.

Of these crashes, three resulted in fatal outcomes. All three fatal crashes occurred in Hammonton and include two instances of vehicles driving around crossing gates and one instance of a train striking a trespassing pedestrian.

Two of the nine crashes involved trucks. These crashes occurred at the Cumberland Avenue crossing near the intersection with Tuckahoe Road and at the Pennsgrove Pedricktown Road crossing in Oldmans. Both incidents involved a truck proceeding across the tracks without stopping for the oncoming train.

Figure 2-14. Highway-Rail Grade Crossing Crashes



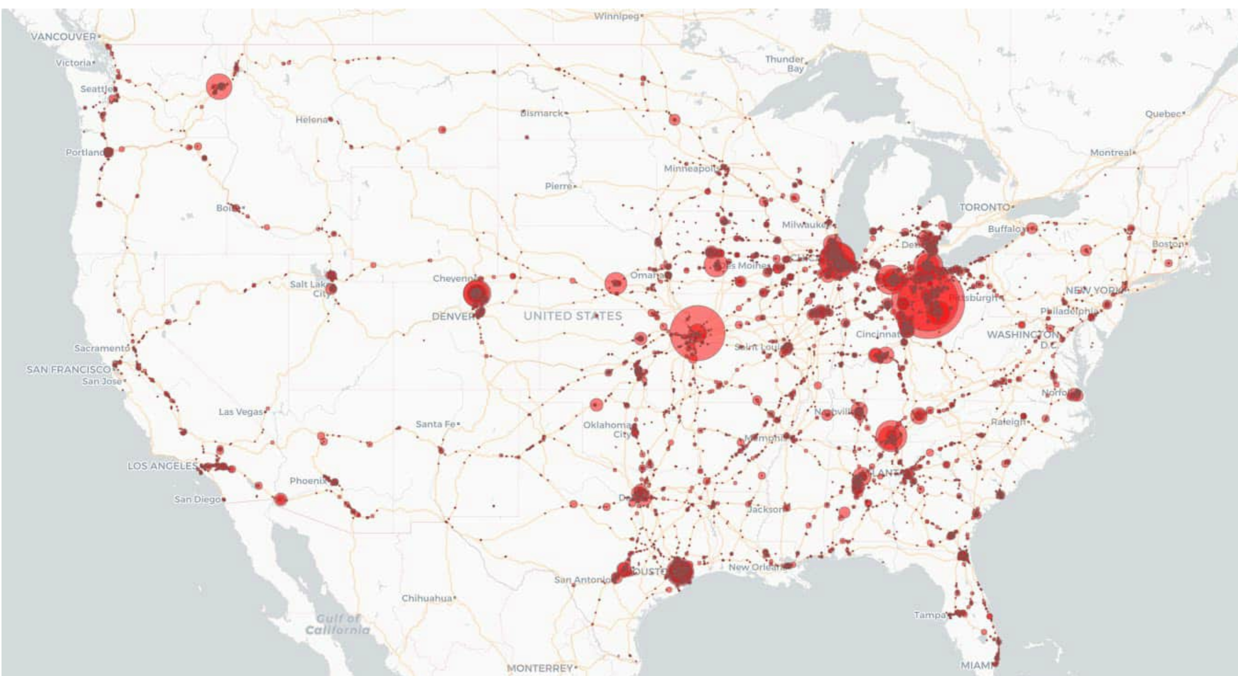
Source: FRA Grade Crossing Inventory System

Blocked Highway-Rail Grade Crossing Delays

Complaints and issues with delays due to blocked grade crossings have increased substantially in recent years across the country. The FRA defines a blocked crossing as a situation where "stopped trains impede the flow of motor vehicle or pedestrian traffic at railroad tracks for extended periods of time."[3] This trend has been exacerbated by increasing train volumes and the use of longer trains in many parts of the country. The FRA recently established a blocked crossing portal which allows for law enforcement and members of the public to record complaints about blocked crossings. The online form records information detailing the reason for the blocked crossing, the time and duration of the blockage, and the effect of the blockage on emergency responders or pedestrians. The locations of these complaints in the continental US are shown in Figure 2-15. To date, no complaints of blocked crossings have been recorded in SJTPO.

Upon further review of the data, it is not surprising to find relatively little impact of blocked crossings. The average number of total daily trains at public crossings in SJTPO is only 7, with the highest volumes occurring along the Atlantic City Line in Atlantic County. Further analysis shows that there are only 14 grade crossings that have at least five trains per day and also have at least 100 estimated truck trips per day (Figure 2-16). These are located almost exclusively along the Atlantic City Line with additional crossings at Chestnut Avenue and Burns Avenue in Vineland.

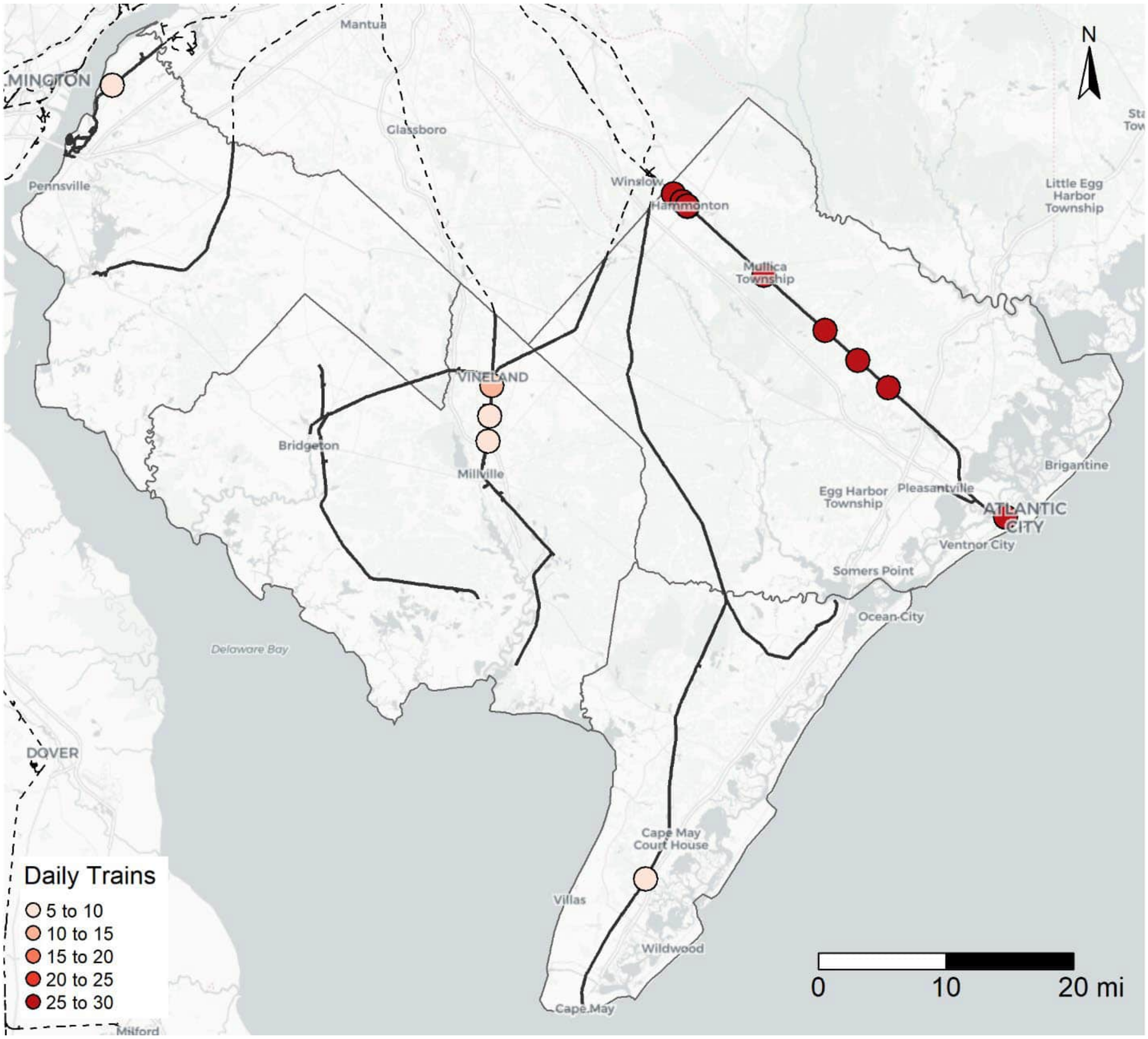
Figure 2-15. FRA Blocked Crossing Reports



Source: FRA Blocked Crossing Portal (https://www.fra.dot.gov/blockedcrossings/)

3 https://railroads.dot.gov/newsroom/press-releases/federal-railroad-administration-launches-web-portal-public-report-blocked-0

Figure 2-16. Highway-Rail Grade Crossings with 5+ Daily Trains and 100+ Trucks Per Day



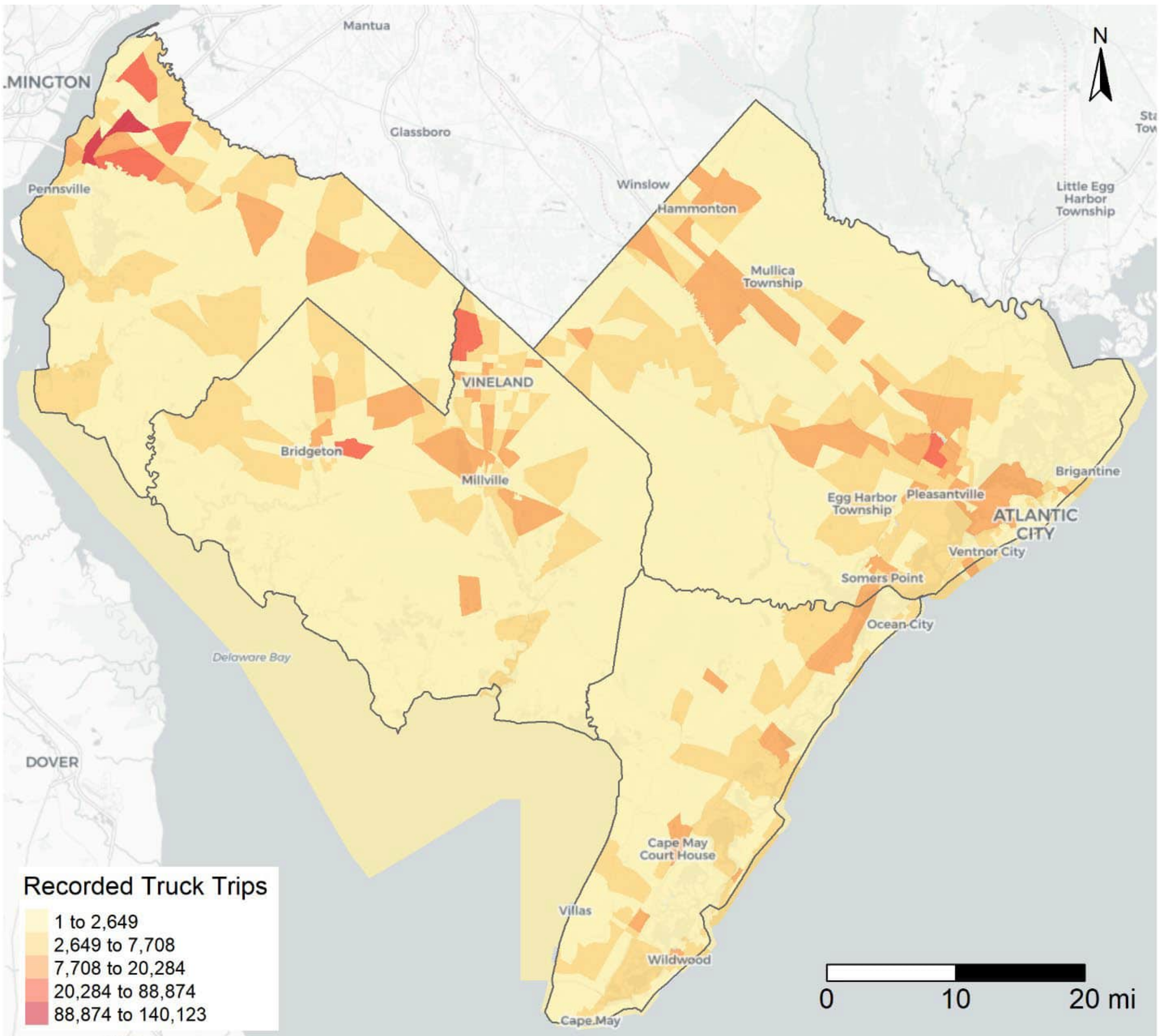
Source: FRA Grade Crossing Inventory

2.5 Origin-Destination Information

Data for truck trip origins and destinations was made available through the RITIS Trip Analytics platform. Data was available for April 2019, April 2020, and April through September 2021 and included truck probe sample data for medium duty trucks (14,000 – 26,000 lbs.) and heavy duty trucks (26,000+ lbs.). In total, this dataset includes records for nearly three million distinct truck trips either starting or ending a trip within a Traffic Analysis Zone (TAZ) in the SJTPO region. Note that the RITIS Trip Analytics Platform utilizes the 2010 Census TAZ delineations. These TAZ areas do not necessarily correlate with other local or regional delineation of TAZ areas.

The SJTPO TAZ with the highest level of recorded activity is located near the Hawks bridge road interchange in the northwestern portion of Salem County. This single TAZ accounts for nearly five percent of all truck trips into or out of SJTPO. The explanation for this high activity is the presence of multiple truck parking facilities near the interchange including both a Pilot and a Flying J. The location of these facilities just east of the Delaware Memorial Bridge make them an ideal stopping point for trucks just entering New Jersey or just about the depart for Delaware. Other hotspots of truck probe activity include the Vineland Industrial Park, areas of Bridgeton and Millville, and multiple areas in and around Atlantic City and Pleasantville.

Figure 2-17. RITIS Truck Probe Trips by TAZ Origin/Destination



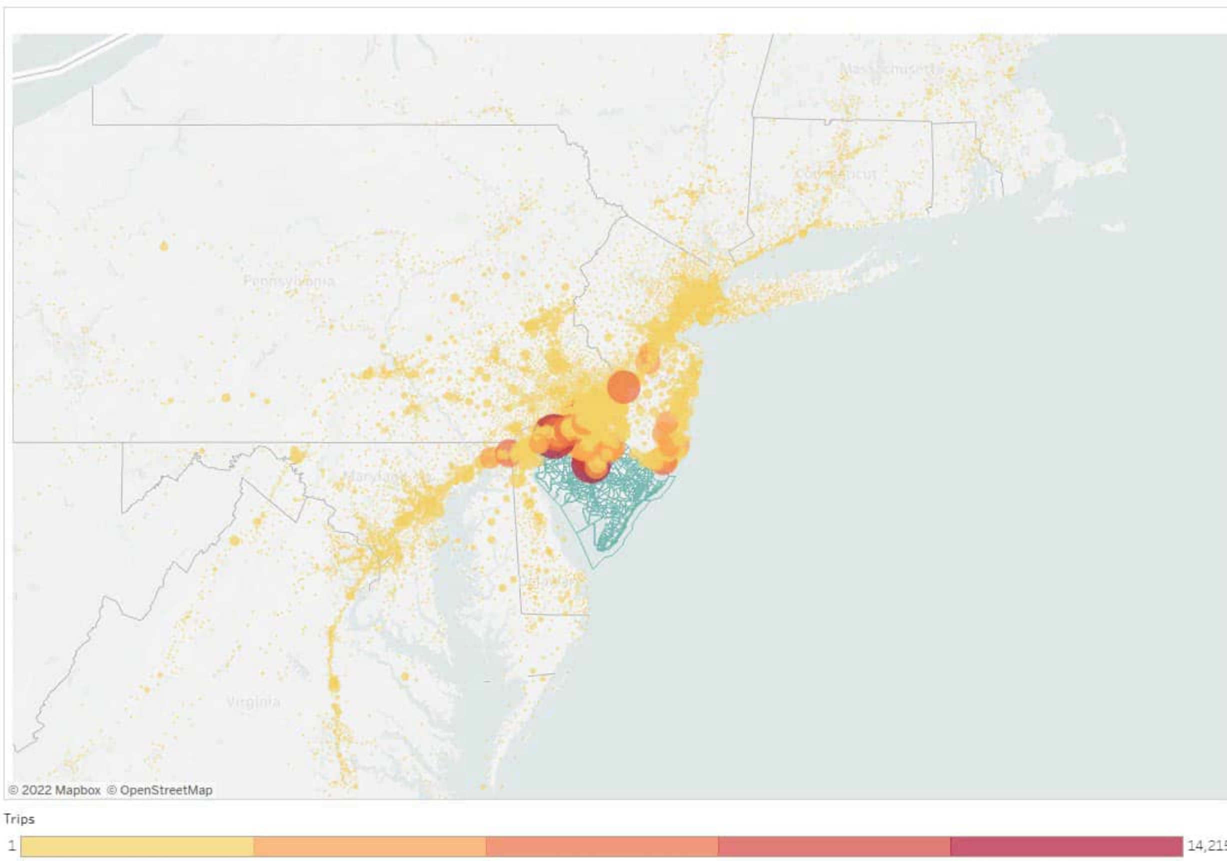
Source: RITIS Trip Analytics Origin-Destination Data

Origin-Destination Interactive Tool

The origin-destination data collected from the RITIS Trip Analytics platform was used to develop an interactive online tool to facilitate the summary of truck travel patterns in the broader region. Figure 2-18 displays results showing the magnitude of truck trips connecting to TAZs outside of the SJTPO. Each connecting TAZ is represented by a single point and is color- and size-coded to correspond to the number of trips connecting to it. The figure shows two major connecting TAZs just outside of the SJTPO boundary which appear to correspond to the locations of truck parking facilities discussed later in this document. Beyond these key destinations, the figure highlights the importance of the I-295 and New Jersey Turnpike as key corridors for freight entering and leaving SJTPO. The figure also highlights key connecting regions including Philadelphia, New York City, and multiple destination along the shore.

A more detailed description of the use of this interactive tool will be provided in the study Final Report.

Figure 2-18. Origins and Destinations for Trips Starting or Ending in SJTPO



Source: RITIS Trip Analytics Origin-Destination Data

2.6 Truck Crash Rates

Crash data for the SJTPO region was collected from the NJDOT Safety Voyager platform. The following criteria were used in the collection of the data for this study:

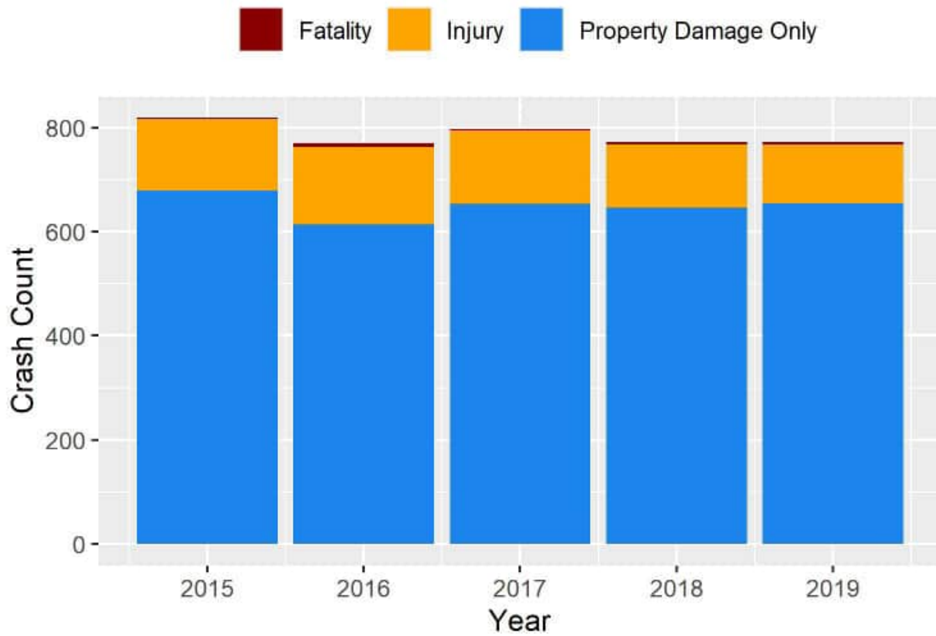
- Included only crashes that included the following commercial and truck vehicle types:
  - Single Unit (2-axle)
  - Single Unit (3-axle+)
  - Single Unit Truck w/ Trailer
  - Other Truck
  - Light Truck w/ Trailer
  - Truck Tractor (Bobtail)
  - Tractor Semi-Trailer
  - Tractor Double
  - Tractor Triple
- Included years 2015 through 2019, inclusive

In total, 3,927 crashes matched these criteria. The data provided through Safety Voyager also included attributes for latitude and longitude for the majority of crashes. However, 437 crash records (11.1 percent) did not include this information, making it impossible to pinpoint the exact location of the incident. These missing records were distributed across all four counties in the SJTPO area with 234 missing lat/long records for Atlantic County, 19 missing records for Cape May County, 168 missing records for Cumberland Count, and 16 missing records for Salem County. Upon review of the data, it appears that the cause of this discrepancy is likely inconsistent reporting of crashes between law enforcement jurisdictions. There are many areas, particularly around Salem and Cape May, where no crash records exist due to this lack of information. For the purposes of this study, crash summaries will include all of the crashes, but crash maps and segment-level crash rates will show only those with lat/long information.

Crash Type Summary

The following tables summarize key aspects of the crash data to identify common themes or issues. Figure 2-19 shows the annual count of truck-related crashes in SJTPO by severity. The total number of crashes has held relatively stable at approximately 800 per year with a high of 818 in 2015 and a tie for lowest of 771 in 2018 and 2019. Fatal crashes make up only 0.5 percent of all truck-related crashes while Injury crashes make up 16.8 percent. The remaining 82.6 percent of truck-related crashes are Property Damage Only.

Figure 2-19. Annual Truck Crashes by Severity



Source: NJDOT Safety Voyager

Table 2-6 summarizes the top ten municipalities based on the total number of truck-related crashes. At the top of the list is Vineland City with 674 crashes following by Atlantic City at 482 crashes and Egg Harbor Township at 401 crashes. Combined, these three municipalities account for 40 percent of all SJTPO truck crashes. Vineland City also has the highest number fatal and injury truck crashes with a total of 4 and 119 over this time period, respectively.

Table 2-6. Top 10 Municipalities for Truck Crashes

Rank	Municipality	Fatal	Injury	PDO	Total
1	VINELAND CITY	4	119	551	674
2	ATLANTIC CITY	0	63	419	482
3	EGG HARBOR TWP	1	74	326	401
4	HAMILTON TWP	2	49	208	259
5	MILLVILLE CITY	1	37	216	254
6	GALLOWAY TWP	2	27	163	192
7	HAMMONTON TOWN	2	41	143	186
8	UPPER DEERFIELD TWP	1	24	108	133
9	PLEASANTVILLE CITY	1	15	102	118
10	OCEAN CITY	0	4	106	110

Source: NJDOT Safety Voyager

Crash Heat Map

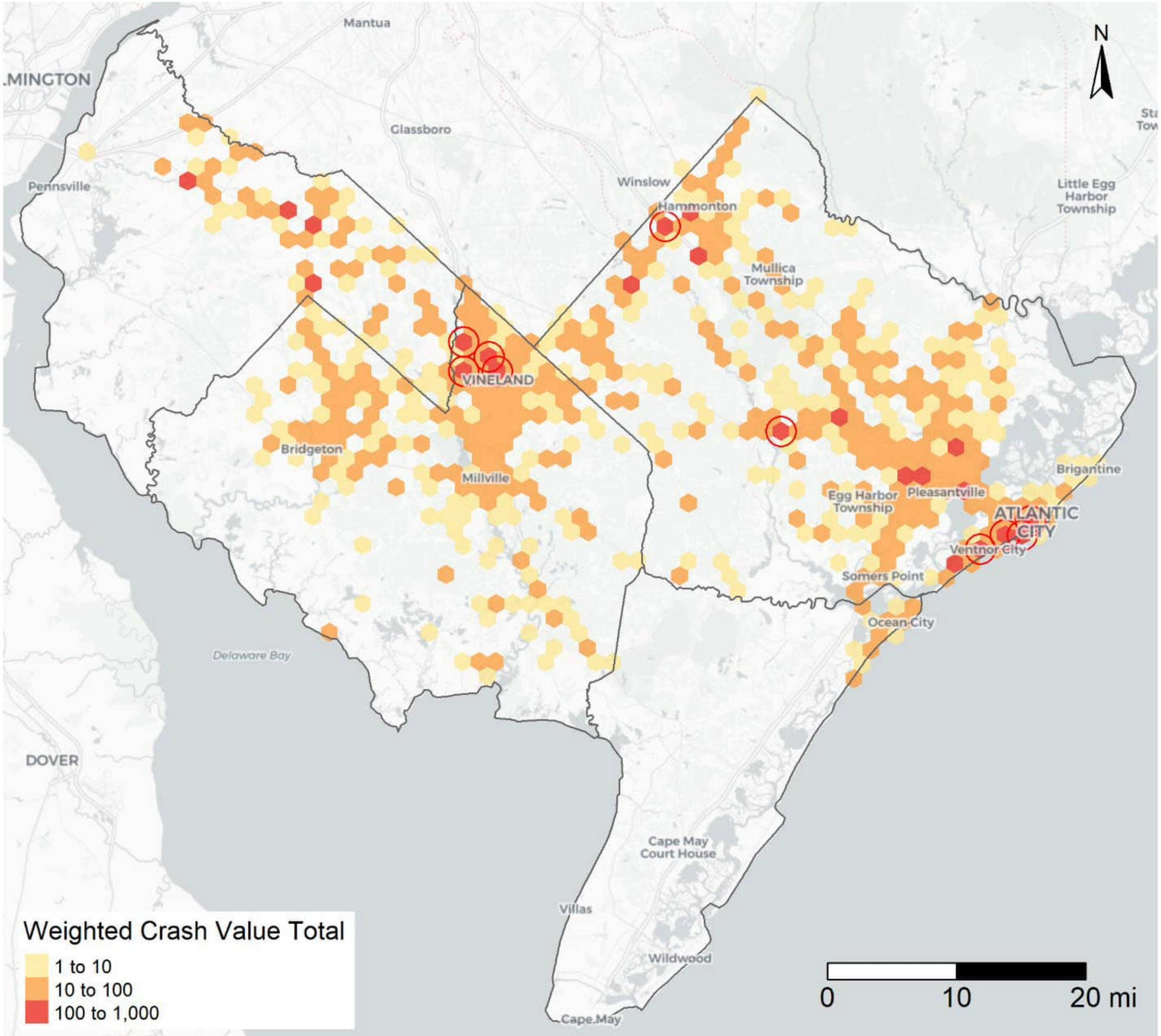
A crash heat map was developed to identify specific locations with higher relative crash rates compared to other areas within the region. The following process was used to develop the heat map:

1. Calculate adjusted crash weights using the methodology summarized in the New Jersey Highway Safety Improvement Manual[4]. This analysis used updated weighting values based on 2022 crash costs provided by the NJDOT Bureau of Safety, Bicycle, and Pedestrian Programs. The following weighting factors were used. The bracketed text indicates the matching terminology used in the NJDOT crash data:
    a. Fatal [Fatal Injury] = 57.7133
    b. Disabling Injury [Suspected Serious Injury] = 57.7133
    c. Evident Injury [Suspected Minor Injury] = 17.4169
    d. Possible Injury [Possible Injury] = 10.9735
    e. PDO [No Apparent Injury] = 1.0
2. Create a ½-mile hexagonal grid covering the SJTPO area
3. Calculate the total adjusted crash weights within each hexagon

The results of this heat map approach are shown in Figure 2-20. The locations of the top 10 hexagons based on this weighted crash rate value are circled in red. These locations are concentrated in Vineland, Atlantic City, Hammonton, and Egg Harbor Township.

[4] New Jersey HSIP: https://www.state.nj.us/transportation/about/safety/pdf/2016hsipmanual.pdf

Figure 2-20. Crash Heat Map



2.7 Truck Parking

Truck parking facilities are a critical feature of the truck freight network. Truck drivers are required to abide by the hours of service regulations maintained by the Federal Motor Carrier Safety Administration (FMCSA). In general, drivers are not allowed to drive more than 8 hours without taking at least a 30-minute rest and are allowed no more than 11 hours of total driving time following a 10-hour rest. Additional details can be found at the FMCSA website.[5]

To help satisfy these rest requirements, truck parking facilities are provided by both the public and private sectors in the form of rest areas (public) and truck stops (private).

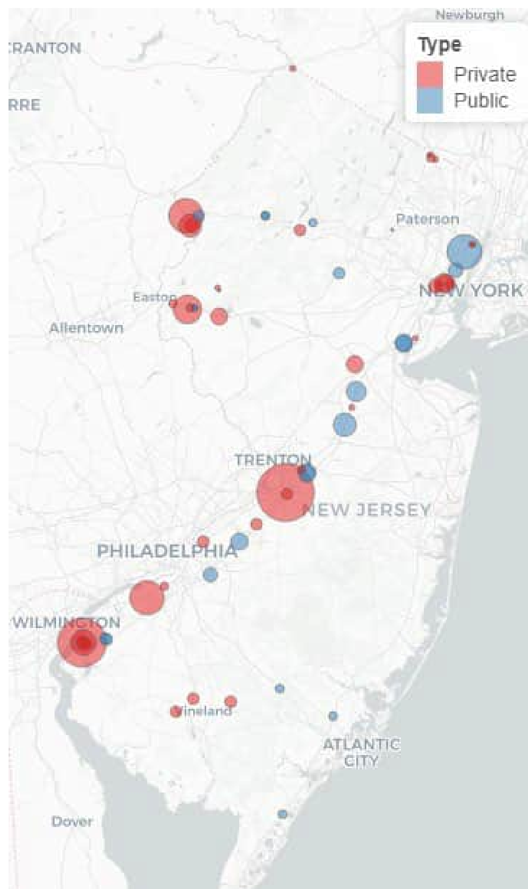
[5] FMCSA HOS Summary: https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations

Many of the public truck parking facilities in New Jersey—specifically those located on the New Jersey Turnpike, the Garden State Parkway, and the Atlantic City Expressway—represent a relatively unique case in which the public facilities include private accommodations such as fuel stations, restaurants, and other accommodations.

Information for public truck parking facilities was collected from the FHWA's 2019 Jason's Law Survey.[6] This national truck parking survey collects information from all 50 states to develop a comprehensive data source for truck parking facilities nationwide. However, the most recent iteration of this survey has not provided location-specific information for private truck parking facilities as of the date of this writing. Information for private truck parking facilities was gathered from DC Book Company, which maintains an online repository of truck stop locations, parking space counts, and other amenities for truck stops across the country.[7]

In total, the State of New Jersey has an estimated 2,797 truck parking spaces at 118 distinct locations. These facilities are largely concentrated along the New Jersey Turnpike (Figure 2-21). Of these, 735 (26 percent) are provided at public truck parking facilities. Nationally, approximately 12 percent of all truck parking spaces are provided at public facilities.

Figure 2-21. New Jersey Truck Parking Facilities



Source: Jason's Law Survey and truckstopsandservices.com

Within the SJTPO area there are a total of 627 truck parking spaces at 13 distinct locations (Figure 2-22). The majority of these spaces are located at private truck parking facilities near the interchange between the New Jersey Turnpike and I-295. This includes a Flying J Travel Center with an estimated 350 truck parking spaces, the second largest facility in the state. Combined with the other facilities at this location, there are a total of 515 truck parking spaces in this area. As a major entry and exit point for the state, this area is a natural location for trucks to rest to meet their hours of service requirements and as a location at which to stage prior to making deliveries at the final delivery location.

This study does not include an assessment of truck parking demand. However, per recent changes under BIL/IIJA, all

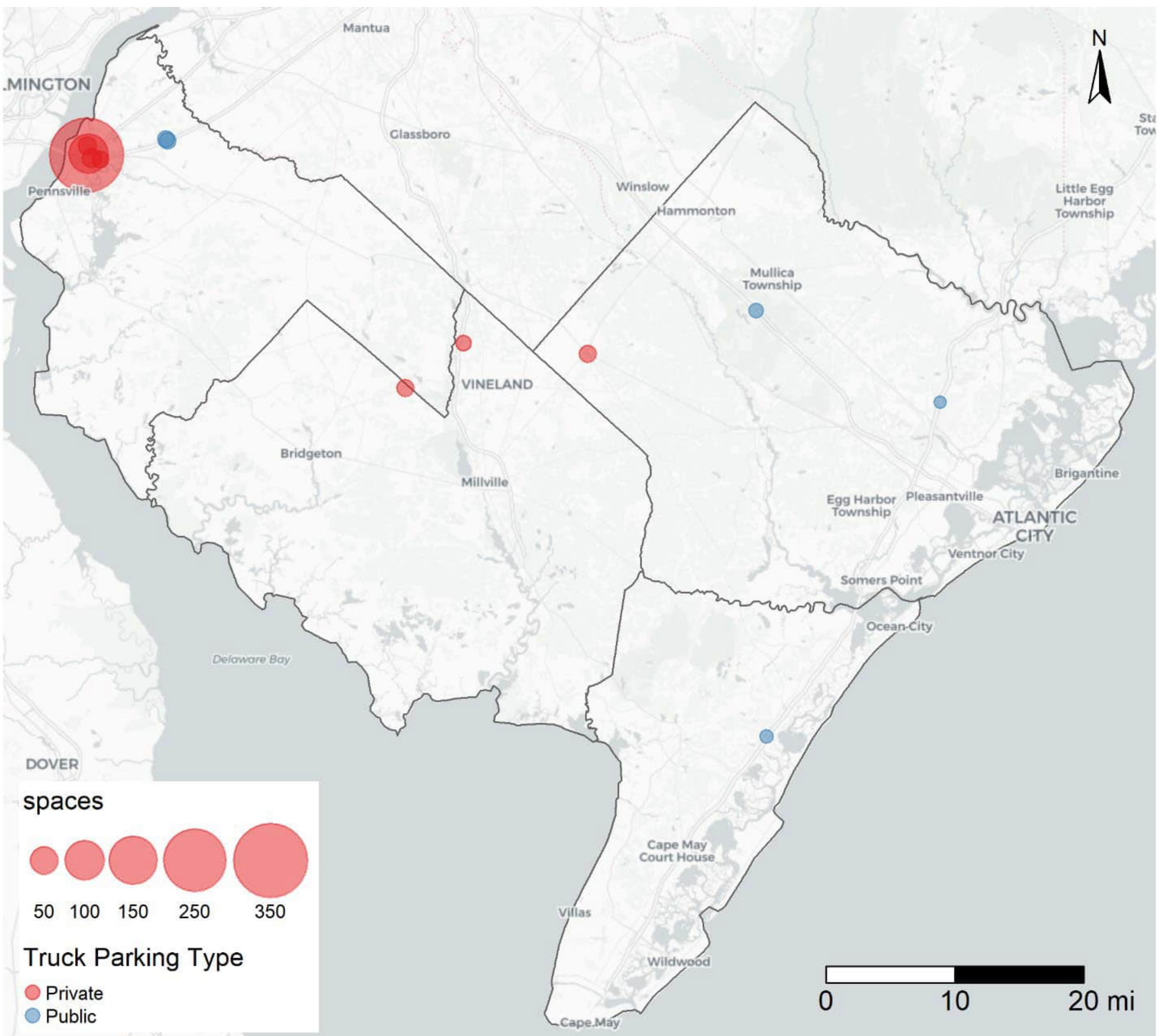
[6] FHWA Jason's Law Survey: https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/index.htm

[7] DC Book Company NJ Truck Stops: https://www.truckstopsandservices.com/listcatbusinesses.php?id=19&state=30

state freight plans will be required to provide an update on the most recent assessment of truck parking facilities that identifies areas of unmet demand. One comment received during stakeholder outreach was in regard to trucks frequently parking on North Mill Road near the Vineland Industrial Park. It is likely that these trucks are parking to stage for a delivery to a location that is not open yet. The current configuration of the roadway does not include a sufficiently wide shoulder for trucks to parking without impacting the flow of traffic. Potential solutions to this issue include:

- Reconstruction of the roadway with a wider shoulder lane to permit this parking activity
- Construction of a separate truck parking facility in the area
- Coordination with local facility owners to permit short duration parking while staged for delivery

Figure 2-22. SJTPO Truck Parking Facilities



3 Multimodal Performance Measures

This document has so far focused primarily on the evaluation of truck freight movements in SJTPO. This section supplements this analysis by reviewing additional data sources and results for other freight modes including rail, air cargo, maritime, and pipeline.

3.1 Rail

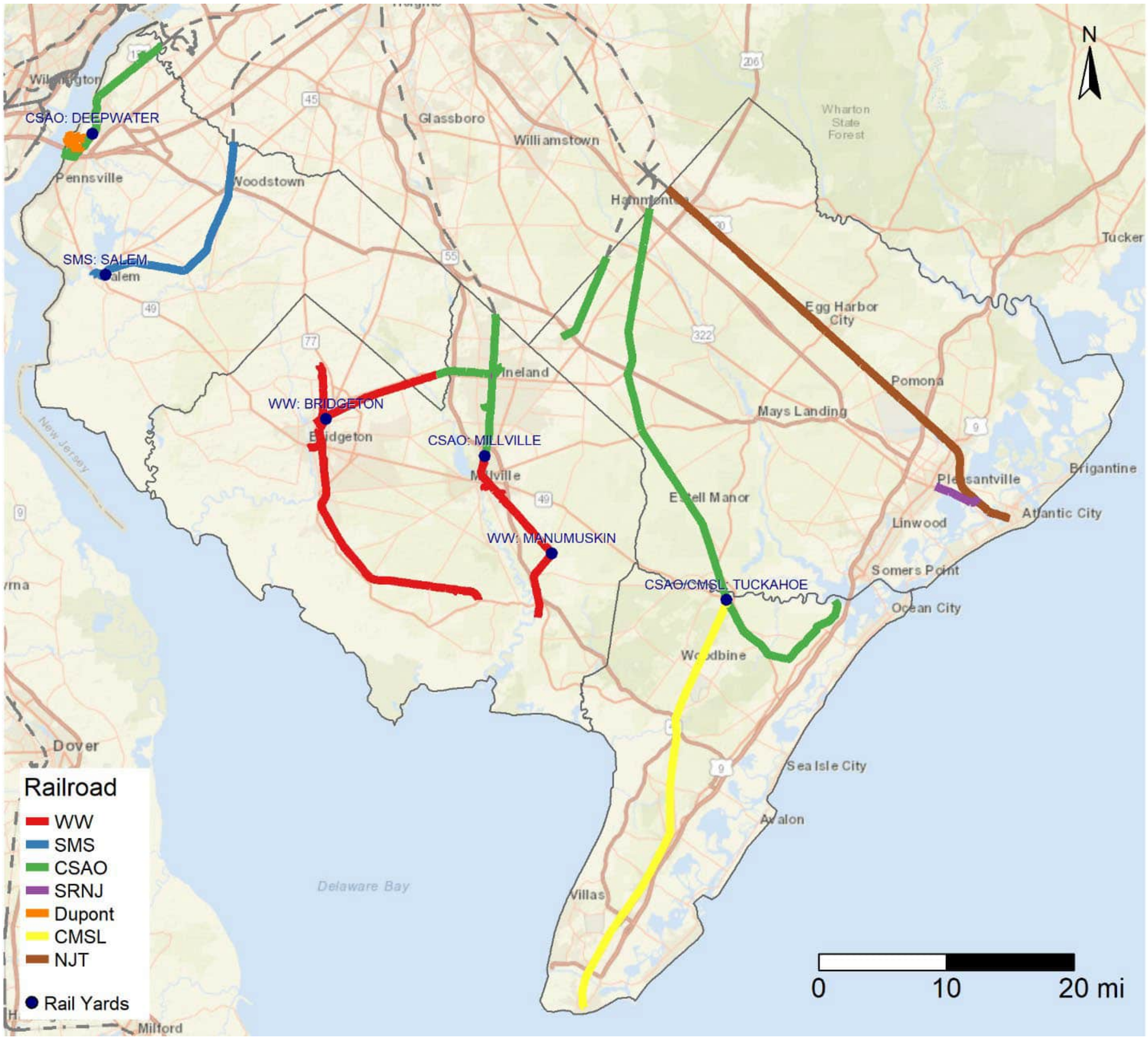
Rail service in SJTPO is provided through a combination of five distinct railroads. (Table 3-1. At roughly one-third of all track mileage in region, Conrail Shared Assets Operation makes up the largest share of railroad operations, followed by Winchester and Western. The remaining tracks are operated by New Jersey Transit which operates the Atlantic City Commuter Rail Line between Philadelphia and Atlantic City, the Southern Railroad of New Jersey, and Cape May Seashore Lines which operates both freight and passenger rail service. Additionally, approximately 18 miles of yard tracks are owned by Dupont as part of the Chemours Chambers Works facility in Deepwater.

Table 3-1. Approximate Track Mileage by Railroad

Railroad	Track Mileage
Conrail Shared Assets Operation (CSAO)	79.6
Winchester & Wester (WW)	52.5
New Jersey Transit (NJT)	30.2
Cape May Seashore Lines (CMSL)	28.3
Dupont (Yard Tracks)	17.6
SMS Rail Lines	15.4
Southern Railroad of New Jersey (SRNJ)	3.1
Total	**230**

The locations of these railroads are shown in Figure 3-1. This figure also shows the locations of the six named railyards in SJTO, including CSAO: Deepwater, SMS: Salem, WW: Bridgeton, CSAO: Millville, WW: Manumuskin, and CSAO/CMSL: Tuckahoe. These locations represent key staging locations for the classification and sorting of rail freight in the region.

Figure 3-1. Railroads and Rail Yards in SJTPO



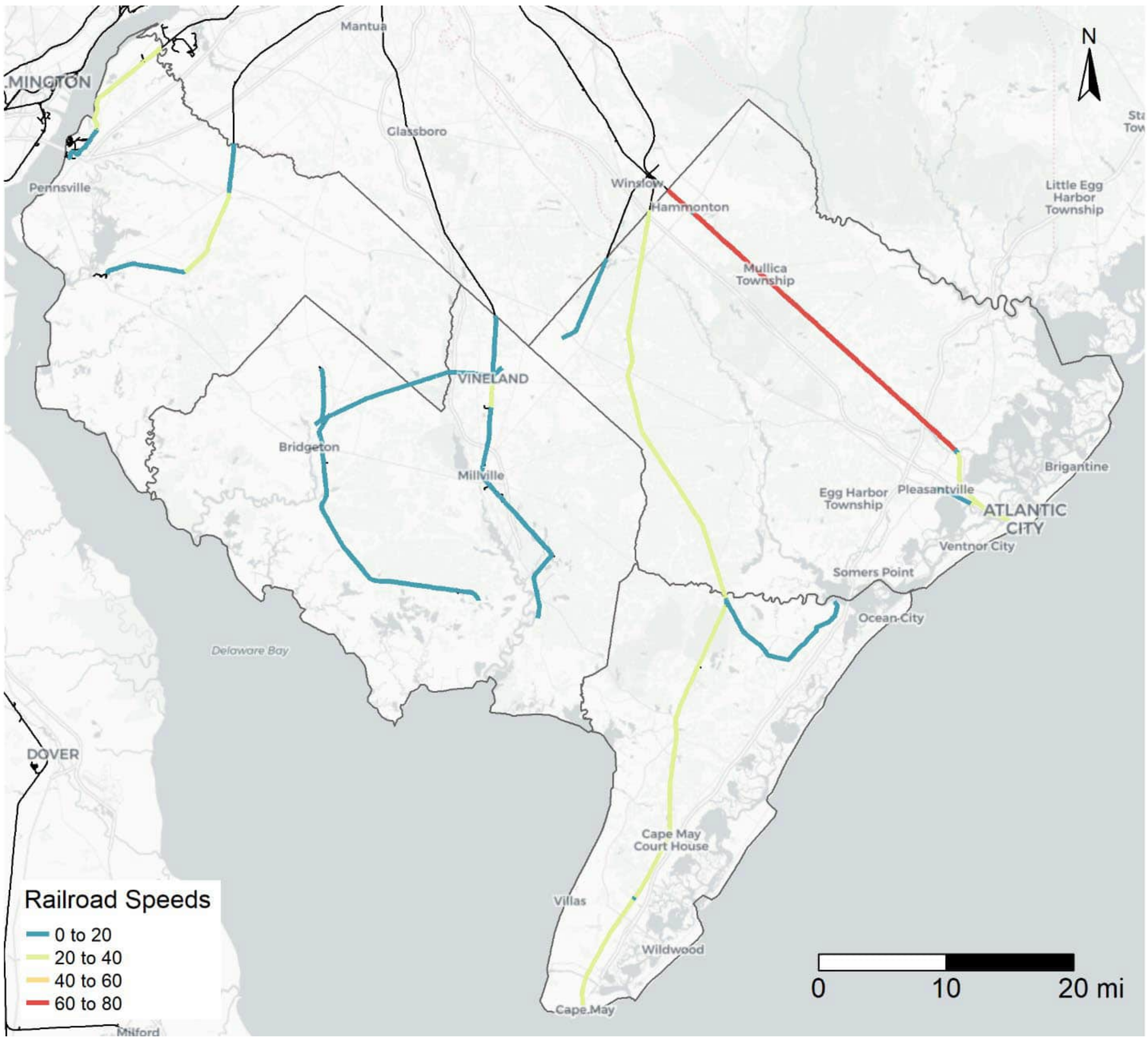
Source: BTS North American Rail Lines

Estimated Trains and Train Speeds

Daily train counts and maximum train speeds are important elements of train operations as well as key considerations for railroad safety evaluation. Limited public data is available to assess maximum train speeds. For this analysis, the FRA grade crossing inventory was used to geospatially join information to the Bureau of Transportation Statistics (BTS) North American Rail Line spatial file. The maximum timetable speed and combined Day Through Trains (6 A.M. – 6 P.M.) and Night Through Trains (6 P.M. – 6 A.M.) factors from the FRA grade crossing inventory database were used to estimate speed and daily train volumes in the region.

The results of this analysis are shown in Figure 3-2. At a maximum speed of 80 mph and an estimated daily train count of 26, the Atlantic City Line represents both the fastest and busiest rail line in the SJTPO area. The remaining rail lines range in speeds from 5 to 30 mph with an average speed of approximately 10 mph. Likewise, the range of estimated through train volumes on the other lines is also lower with four or fewer estimated trains per day. Multiple rail segments, particularly along the CMSL line and the WW line between Hammonton and Ocean City show an estimated train count of less than one per day.

Figure 3-2. Estimated Maximum Train Speeds



Source: BTS North American Rail Lines and FRA Grade Crossing Inventory

3.2 Air Cargo

The evaluation of air cargo freight movements was completed primarily using the BTS T-100 dataset. This data is recorded by U.S. and International carriers operating in the U.S. and includes detailed information regarding passengers, freight, and mail transported by planes between airports. Data was collected for 2019 through 2021.

While there are 51 airports located within SJTPO, only the Atlantic City International Airport (ACY) showed a measurable amount of freight shipments over this time period, recording a total of 16,000 lbs. of freight handled. The majority of this freight was handled in 2020 within negligible amounts of freight recorded in either 2019 or 2021.

However, the air cargo handled at ACY is dwarfed by the amount handled at Philadelphia International Airport (PHL), the nearest major air cargo airport. Over this same three-year time period, PHL has averaged approximately 1.2 Million lbs. per year of freight handled. Of the outgoing air cargo shipments, 14.9 percent departs to the Louisville Muhammad Ali International Airport (SDF) and another 11.5 percent departs to the Memphis International Airport (MEM). These two airports are major national hubs for UPS and FedEx, respectively. Inbound air freight to PHL arrives in similar proportions.

While it is likely that Philadelphia will remain the primary regional destination for inbound and outbound air cargo shipments for the foreseeable future, there is room for expansion of current services at the Atlantic City International Airport, particularly within the fast-freeze produce industry. The details of this potential development are discussed further in the study Final Report.

3.3 Maritime

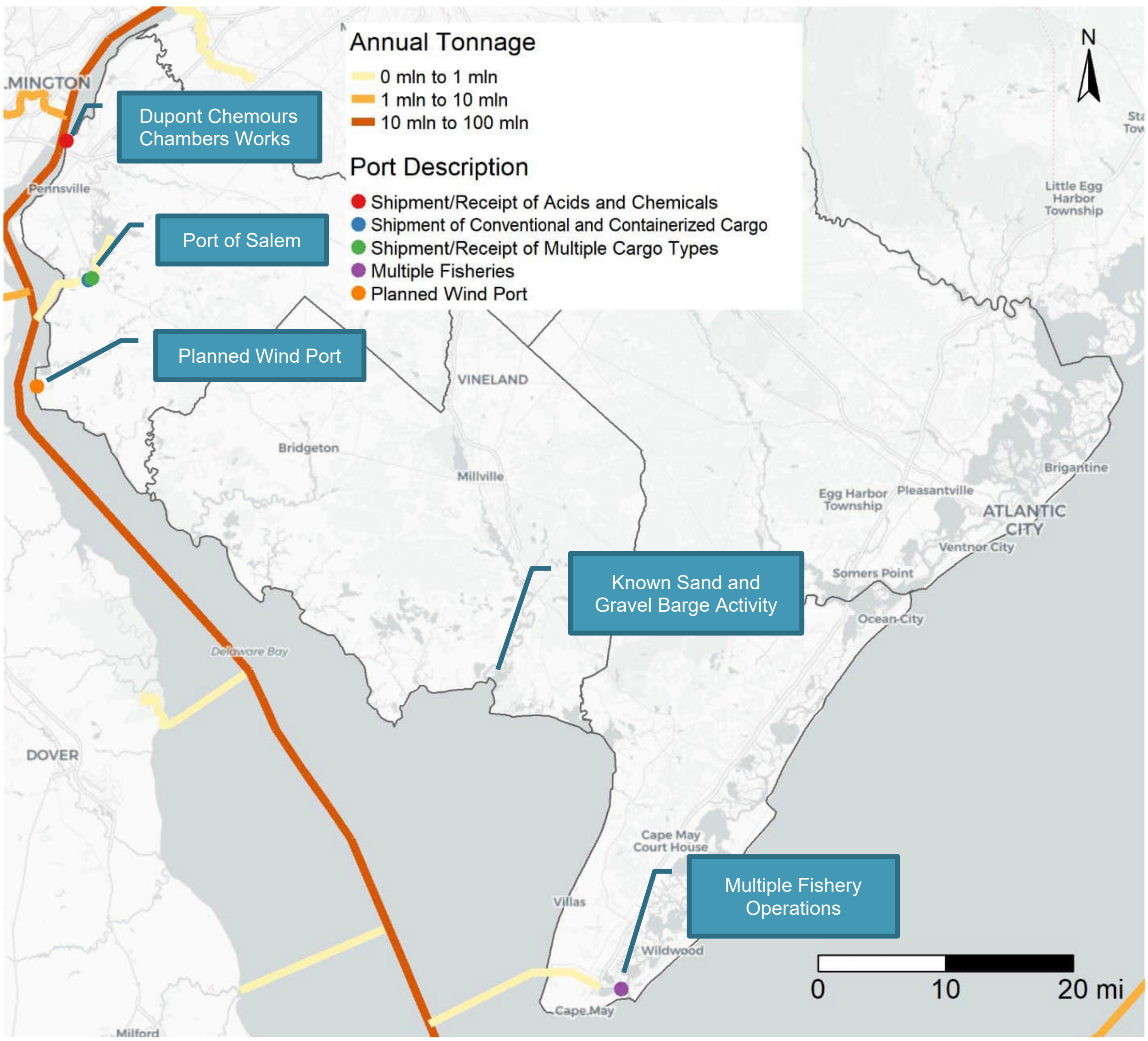
This review of maritime freight relies primarily on data provided by the U.S. Department of Transportation and the Army Corps of Engineering (USACE). Information on port locations, port purpose, and other key characteristics was collected from the BTS Ports dataset. The data includes multiple points that represent a maritime freight features such as docks, fleeting areas, repair stations, and other facility types. The data was filtered for this study to include facilities with the stated purposed of shipping, receiving, or otherwise handling material goods. Based on this definition, four maritime freight locations were identified in the SJTPO region. An additional fifth location was identified for a planned port development project. These locations are shown and further described in Figure 3-3. In addition to these known locations, local freight stakeholders also indicated the presence of barge activity near Port Norris and the Maurice River related to quarrying activity.

Commodities

Data on the types of commodities transported via maritime freight in the SJTPO area was collected from the USACE Waterborne Commerce Statistics Center. Information was collected for two waterways: Delaware River, Philadelphia to the Sea, and the Salem River.

- **Delaware River:** In 2020, this portion of the Delaware River handled approximately 62 Million tons of maritime freight. Crude petroleum made up half of the inbound shipments and nearly two-thirds of the intraport shipments. The primary outgoing shipment from this portion of the river was hydrocarbon and petrol gases, making up one third of outgoing shipments. At 14 percent, the largest commodity group passing through this portion of the river was bananas and plantains.
- **Salem River:** In 2020, ports in the Salem River handled approximately 23,000 tons of maritime freight. Nearly one quarter of the outgoing shipments from this river were classified as Unknown, with alcoholic beverages, food products, and animal feed making up a combined 23 percent of outgoing shipments. The largest incoming commodity group by far was manufactured products at 77 percent of all shipments. This was followed by sand and gravel at 11 percent and textile products at 3 percent.

Figure 3-3. Maritime Port Facilities



Source: USACE/BTS Ports Layer, USACE Link Tonnages 2019

3.4 Pipeline

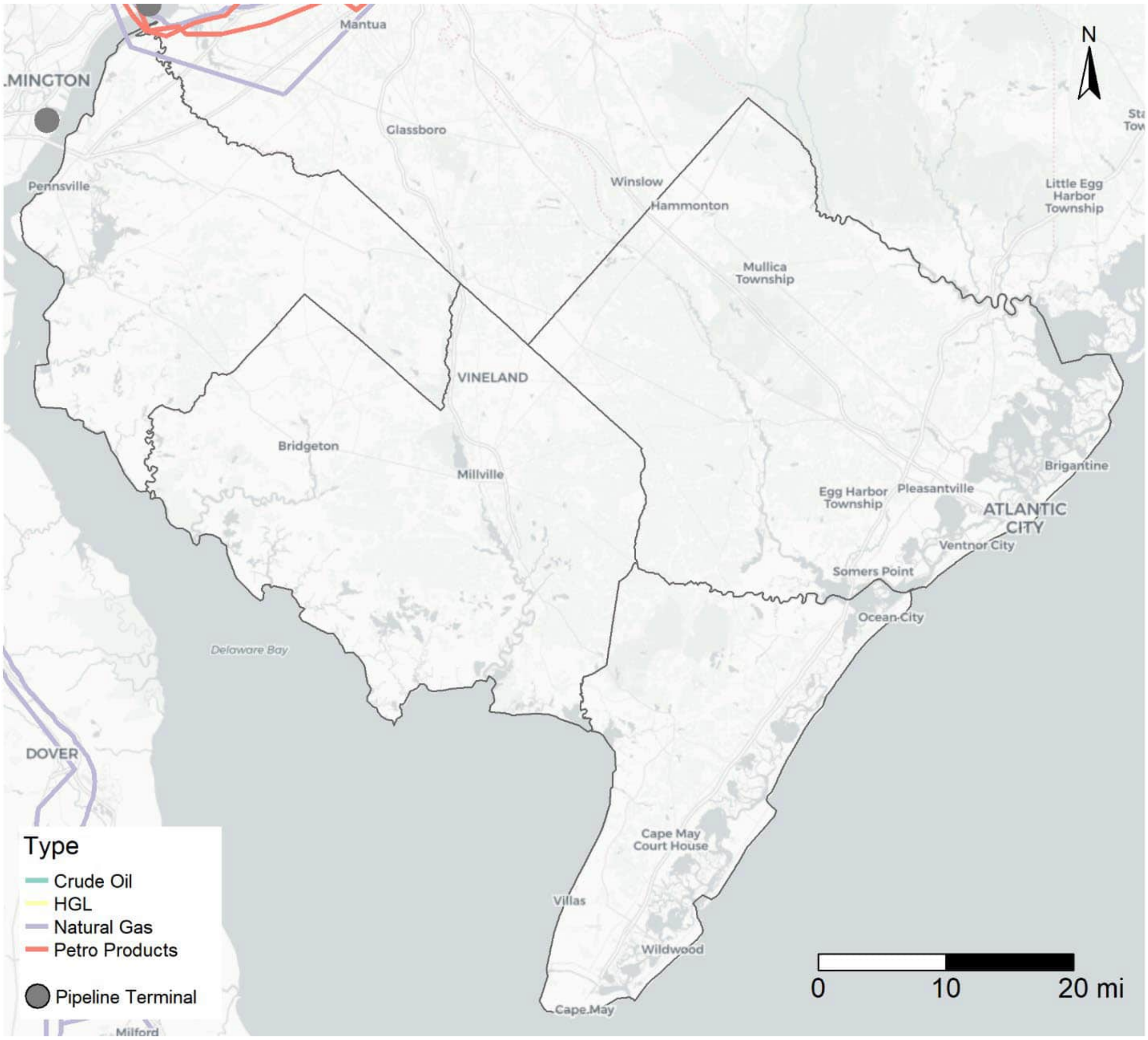
Despite the fact that the pipeline mode makes up 17 percent of freight tonnage and 6 percent of freight value shipped in the U.S.[8], the majority of freight planning efforts at the state and local level typically give little attention to pipelines as a freight mode. This is largely due to the fact that states, MPOs, and local roadway authorities generally have little to no jurisdiction over the development of pipeline infrastructure. In many cases, the most important consideration for pipeline freight is the impact it can potentially have on other freight modes. For example, expanded development and use of pipelines can shift crude oil shipments from rail to pipeline as a more cost-effective shipping option.

Figure 3-4 displays the locations of pipelines and pipeline terminals in the SJTPO region. This information is collected from the U.S. Energy Information Administration (EIA). However, the spatial information is purposefully kept at a relatively high level for security reasons. No pipeline terminals are located within SJTPO. The nearest terminals are located in Wilmington, Delaware and in Marcus Hook, Pennsylvania. Similarly, the figure shows that portions of natural gas and petroleum product pipelines travel through the northernmost corner of Salem County. However, the exact locations of these pipelines are unknown.

Overall, pipeline freight is not expected to have a substantial impact on the overall freight transportation system in SJTPO.

[8] BTS 2017 North American Freight Numbers: https://www.bts.gov/newsroom/2017-north-american-freight-numbers

Figure 3-4. Pipelines and Pipeline Terminals



Source: U.S. Energy Information Administration

3.5 Last-Mile Multimodal Highway Connections

An important consideration for all of the multimodal facilities discussed in this section is the local and regional roadways used to connect these facilities to the national highway freight system. To identify the roadways most critical for this purpose, this analysis first identified the locations to be used as the key multimodal connectors. These included the named rail yards, cargo airports, and maritime ports discussed in the previous sections located within SJTPO. The HERE Routing API was used to calculate routes between these origin locations and a series of destination points created outside the SJTPO boundary. The routes were then truncated to show only those portions of the routes between the starting locations and the first intersection with the National Highway System. Roadways identified through this process (Figure 3-5) should be considered to meet the NJDOT Local Freight Impact Fund eligibility criteria of demonstrating that a proposed project will provide access to key freight nodes.

Figure 3-5. Last-Mile Multimodal Highway Connections