Truck Wayfinding in the City of Chester

Balancing Community and Business Needs

JUNE 2018

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CHAPTER 1:

Introduction

Overview

This study recommends strategies to facilitate the efficient movement of heavy trucks between local businesses and the regional roadway network, while minimizing their negative impact on residents. The study area is the City of Chester in Delaware County, Pennsylvania, with a particular focus on the industrial waterfront and central business district. Major roads in municipalities adjacent to the City of Chester are also considered.

The core recommendation is the formal adoption of a designated truck route system, designed to deter trucks from residential streets with inadequate infrastructure. Further recommendations seek to encourage drivers to use the adopted system and include installation of a truck wayfinding system, communication with local businesses, and important updates to the signage on local Amtrak bridges. Lastly, strategies are provided to mitigate conflict between trucks, pedestrians, and bicyclists on designated truck routes. The actions recommended in this report aim to ameliorate the negative effects truck movement may have on public life and promote the efficient movement of goods.

Purpose and Need

Freight movement—by truck, train, and ship—is a driving force of the economy and the lifeblood of the City of Chester's industries. The City of Chester waterfront provides access to two Delaware Valley Regional Planning Commission (DVRPC)-designated Mega Freight Centers: Chester/Eddystone and Marcus Hook/Trainer. These centers encompass 125 establishments and provide 15,273 jobs to the region.[1] While these freight centers are also served by rail and ship, they depend heavily on trucks to move goods throughout the region and the country. Trucks departing from Delaware County carry over $21 billion in domestic exports annually.[2] Additionally, heavy trucks make essential deliveries to local businesses, such as grocery stores, retail, and distribution facilities throughout the City of Chester. Local business owners, employees, and consumers depend on these deliveries for their everyday needs, and they are critical in supporting equity and urban revitalization.

The study area is the City of Chester, located in Delaware County, Pennsylvania. Source: DVRPC, 2017

[1] Delaware Valley Freight Center Inventory, 2012.

[2] Philly Freight Finder, "Delaware County Domestic Trade Patterns," accessed 2017.

Heavy trucks are not only vital in the provision of goods and services, but also share the same infrastructure as many other modes of travel: the roadways. The resulting intersection of daily life and industry in these public spaces can lead to conflict, particularly in residential neighborhoods. Safety hazards, noise pollution, congestion, and air pollution produced by freight movement via truck can decrease the quality of life for residents. Heavy trucks can also have a negative impact on the lifespan of local roadways, sidewalks, and bridges. Therefore, truck movement requires planning so that communities such as the City of Chester can reap the economic benefits of industry while maintaining—or improving—local residents' quality of life.

Air Quality and Public Health

Delaware County does not meet the federal National Ambient Air Quality Standards (NAAQS) for two criteria air pollutants: ground-level ozone and fine particulate matter or $PM_{2.5}$.[3] Ozone is not directly emitted, but forms in the atmosphere when volatile organic compounds (VOCs) and nitrogen oxides (NO_x) react in the presence of sunlight. $PM_{2.5}$ can be directly emitted and NO_x emissions also contribute to $PM_{2.5}$ formation.

Exposure to ozone and $PM_{2.5}$ pollution is implicated in asthma and other respiratory illnesses, cardiovascular disease, and even premature death. Children and the elderly are especially susceptible to the effects of these pollutants. The effects of ambient air pollution can be further exacerbated by exposure to local sources of emissions, such as diesel engines and fuel combustion from energy generation and industry.

Ozone exposure has been implicated in premature death, chronic respiratory disease, and decreased lung development and function. Short-term exposure can aggravate respiratory conditions, promote lung infections, and result in increased hospitalization in response to respiratory distress.[4]

$PM_{2.5}$ pollution is a suspected carcinogen and has both long-term and short-term exposure implications that are aggravated by both the pollutant concentrations and duration of exposure to the pollutant. Fine particles get trapped deep in the lungs and can trigger respiratory distress, as well as cause premature death. Even short-term exposure has been linked to strokes, increased heart attacks, inflammation of lung tissue, and increased mortality in infants and young children. Groups that face the greatest risk of harm from particle pollution include infants, children, and teens; people over 65; people who work or are active outdoors; people with low incomes; and people with lung disease, heart disease, or diabetes. While diabetics face increased risk due to their higher risk for cardiovascular disease, some studies suggest that air pollution itself can be a risk factor for diabetes.[5]

According to DVRPC's health indicator project, asthma rates in the South Delaware County planning area (including the City of Chester) exceed regional averages for children, adults, and adults over the age of 60 (Table 1). The health impact of high asthma rates may be compounded by other notable health issues in the planning area, including high blood pressure and obesity.[6] Further, according to DVPRC's Indicators of Potential Disadvantage analysis, the City of Chester ranks "above average" to "well above average" for

[3] www.epa.gov/green-book. Delaware County received a clean data determination from EPA for PM2.5 in 2017 and is processing a request to be re-designated as a maintenance area for this pollutant.

[4] American Lung Association, *State of the Air* (2014).
[5] *Ibid.*
[6] www.dvrpc.org/Health/PASnapshot.

environmental justice and equity concerns compared to the region as a whole. Most census tracts in the city are characterized by populations that are often disproportionately affected by poor air quality and related concerns, particularly racial minorities, residents with disabilities, and low-income residents.[7]

The impact of ambient air pollution is amplified in environmental justice communities, such as the City of Chester, where exposure to local air pollution sources, lack of access to health care, balanced diet, and exercise, and even increased levels of daily stress, result in poorer health outcomes for the residents of those communities. The business community, including industrial facility operators and truck drivers, can help mitigate these impacts by employing the best available technology.

Table 1: Asthma Rates[8]

	Regional Average	South Delaware County Planning Area
Percentage of Children with Asthma	20%	23%
Percentage of Adults with Asthma	15%	18%
Percentage of Adults Over 60 Years of Age with Asthma	11%	13%

[7] www.dvrpc.org/webmaps/IPD.

[8] www.dvrpc.org/Health/PASnapshot.

CHAPTER 2:

Existing Conditions

Land Use

The City of Chester contains a mix of land uses, with some conflicting uses—such as industrial and residential—in close proximity (Figure 1). The portion of the city north of I-95 consists largely of residential and community uses; while the eastern portion bordered by I-95, Chester Creek, and PA 291 contains clusters of commercial and residential activity, as well as pockets of vacant land. The waterfront is characterized by industrial and recreational uses (i.e., Talen Energy Stadium and Harrah's Casino) interspersed with vacant parcels. A number of homes are located very close to the industrial waterfront, including several multifamily buildings and row homes located south of PA 291. The areas north of PA 291 and west of Chester Creek are dominated by residential and community/recreational uses, with commercial activity scattered throughout, and clusters of vacant lots along the Amtrak railway, PA 291, and Flower Street.

Focus Areas

Two areas of interest are addressed in this report: the industrial waterfront and the Central Business District (CBD). These areas were determined to have the highest potential need for truck access based on current economic activity, as well as revitalization efforts. Recommended truck routes were designed to streamline truck access to these areas while controlling truck movements as much as possible in predominantly residential areas.

Industrial Waterfront

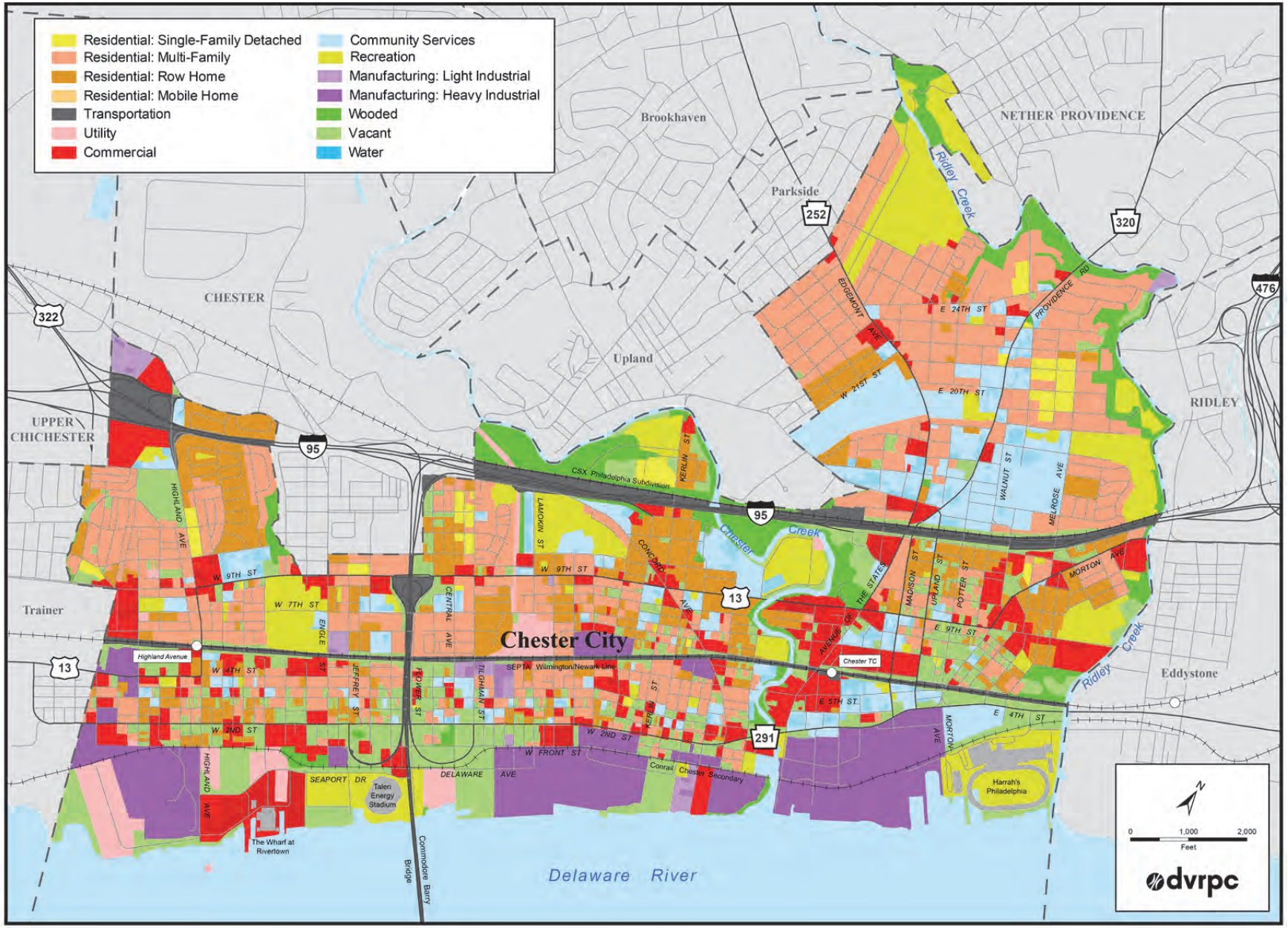
The City of Chester industrial waterfront is here defined as the area bordered by the Delaware River to the south, PA 291 to the north, Trainer Borough to the west, and Eddystone Borough to the east. Freight destinations along the City of Chester waterfront include Covanta, a processing facility for municipal and commercial waste;

A view of Kimberly-Clark from PA 291. Source: DVRPC, 2017

Riverbridge Industrial Complex, a light manufacturing and distribution area; and Kimberly-Clark, a manufacturer and distributor of Scott paper products (Figure 2). These businesses depend on connections to regional markets via the state and interstate highway system.

Industrial activity adjacent to the City of Chester also contributes to freight truck movement through the city. Northeast of the City of Chester waterfront, Penn Terminals, a major regional port facility in Eddystone Borough; Eddystone Industrial Center, a PECO facility; and a Boeing heavy manufacturing facility all have direct access to PA 291. Southwest of the City of Chester waterfront is the Trainer/Marcus Hook freight center, which includes a steel plant, rail yard, FedEx facility, and the Sunoco Marcus Hook Industrial Complex. West of the City of Chester, the Upper Chichester/Twin Oaks freight center includes a rail yard and automobile distribution center, several parks for light manufacturing, and an oil tank farm.

Figure 1: Land Use



Source: DVRPC, 2015

While industry as a freight destination is the primary focus of this report, other uses along the waterfront are important to consider when planning for truck movement. Current recreational facilities require truck deliveries, as well as waste removal. They simultaneously generate activities that may conflict with truck movement, such as heavy pedestrian traffic and higher parking demand during sporting events. In its Vision 2020 plan, the City of Chester emphasizes the need for mixed-use development along the waterfront, which would benefit the city but may increase the potential for truck-pedestrian conflicts. These issues are addressed in the Delaware County 2035 Transportation Plan and must be taken into consideration as the city continues to develop the recreational waterfront.

Central Business District

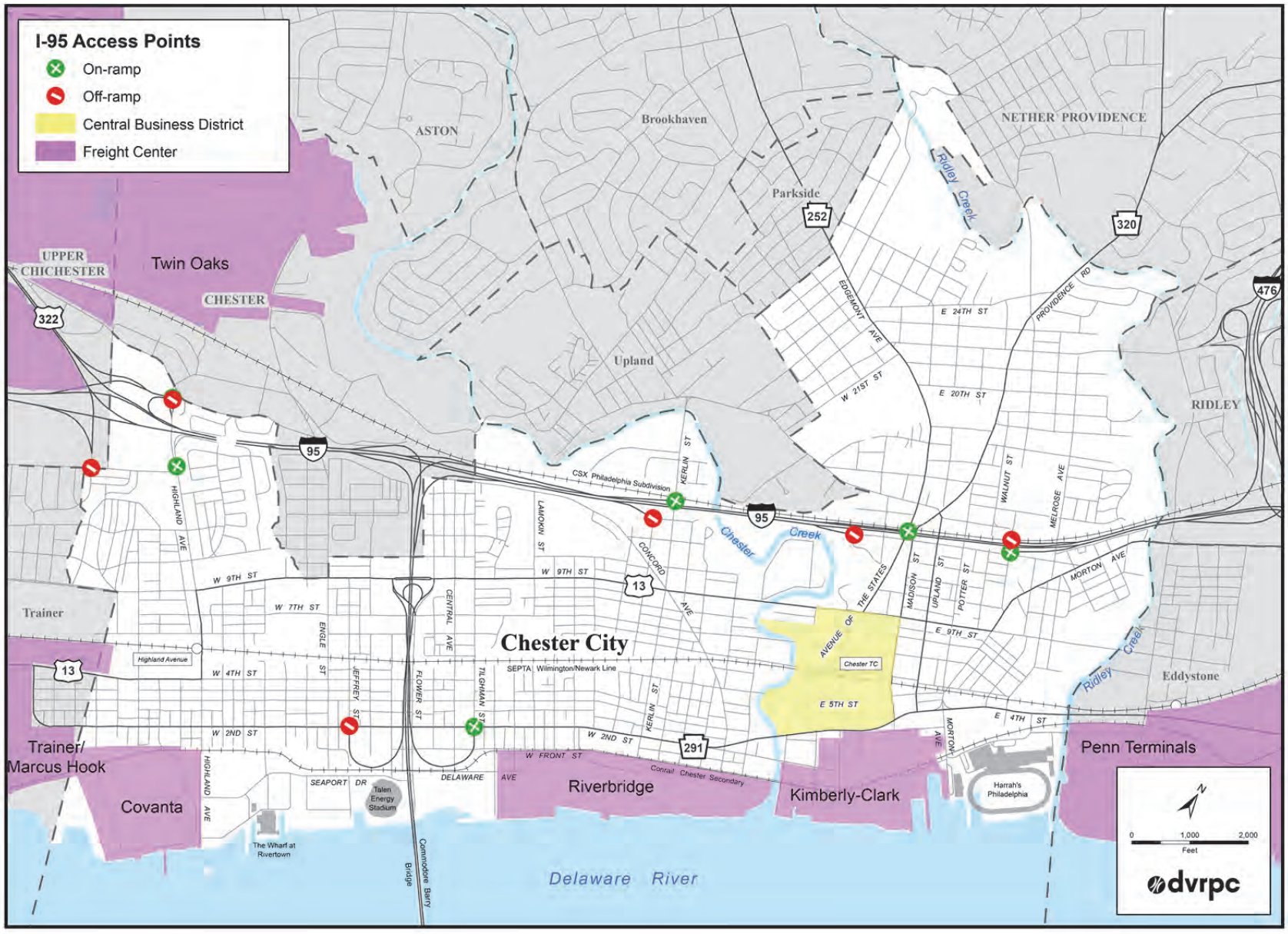
The CBD is bounded by Madison Street/PA 320 north to the east, Chester Creek to the west, 9th Street/US 13 to the north, and PA 291 to the south (Figure 2). Currently, the CBD contains a small cluster of shops and restaurants concentrated along Avenue of the States, which acts as a main street. There are also banks, parks, schools, social services, public buildings, and civic institutions in the CBD. The Chester Transportation Center provides Regional Rail service on the Wilmington/Newark line and connects several bus routes. The concentration of services in the area generates significant pedestrian activity that sometimes comes into conflict with vehicular traffic.

Vision 2020 highlights the CBD as a target area for revitalization, emphasizing the importance of transportation investment in drawing visitors from nearby institutions. Existing businesses require occasional deliveries, and planned economic growth in the area would increase the frequency of truck trips. At the same time, uncontrolled truck traffic could deter potential customers from visiting the CBD. Revitalizing the commercial core depends on balancing the needs of delivery trucks and pedestrians.

A recreational trail along the Chester waterfront. Source: DVRPC, 2017

A view of the CBD from 7th Avenue and Avenue of the States. Source: DVRPC, 2017

Figure 2: Freight Truck Destinations



Source: DVRPC, 2017

Roadway Network

Several major state and interstate roads carry vehicular traffic through the City of Chester (Figure 3). I-95 and PA 291 are parallel north-south roadways through the City of Chester. US 322 is an east-west route, and the US 322/ I-95 interchange in Upper Chichester Township is a crucial node in the area's highway system. I-95 has three southbound on-ramps, three southbound off-ramps, two northbound on-ramps, and two northbound off-ramps in the city. Of these ten ramps, eight connect to local roads, posing difficulties for truck drivers seeking connections to PA 291, as well as nearby residents. Alternatively, Exit 4 connects I-95 to US 322, with an exit and entrance ramp on PA 291. US 322 East is also accessible from US 13 at Flower Street.

US 13 is also a north-south route roughly parallel to I-95 and PA 291. In the City of Chester, US 13 is concurrent with 9th Street between Morton Avenue and Highland Avenue. Most of this segment of the route has two travel lanes with room for on-street parking. There are turning lanes, painted medians, and other design elements accommodating heavier traffic near Flower Street (access to US 322), Kerlin Street/Concord Avenue, and Edgmont Avenue, and a three-lane segment between Central Avenue and Lamokin Street. At Morton Avenue, US 13 has a wide turn that connects to Chester Pike in Eddystone. Chester Pike, which serves Penn Terminals and other industries along the Delaware County waterfront, is wider and better designed for heavier traffic. In the southbound direction, US 13 turns left onto Highland Avenue, then right onto 4th Street toward the freight Center at Trainer/Marcus Hook. These two turns have tight radii compared to the turn at Morton Avenue.

Pedestrians and a parked freight truck in the CBD. The newsstand at right generates pedestrian crossings within and outside of marked crosswalks. Source: DVRPC, 2017

A freight truck turning east onto 9th Street/US 13 from Engle Street. This route is not preferred for waterfront-bound and other through truck traffic, but may be necessary for some local deliveries.
Source: DVRPC, 2017

Figure 3: Roadway Network

Source: DVRPC, 2017

I-95 and US 322 ramps provide critical connections to the regional and national freight network, while PA 291 provides access to the industrial waterfront and its key freight destinations. Because PA 291 continues north to Philadelphia and connects to US 13 just south of the City of Chester in Trainer, it can serve as a route for heavy trucks particularly when I-95 is congested. US 13 is also utilized by trucks traveling through the City of Chester, as well as those making local deliveries. However, this route is not preferred due to the surrounding residential character of much of the route. Additionally, trucks have been observed departing US 13 for local residential streets that are not designed to safely accommodate them.

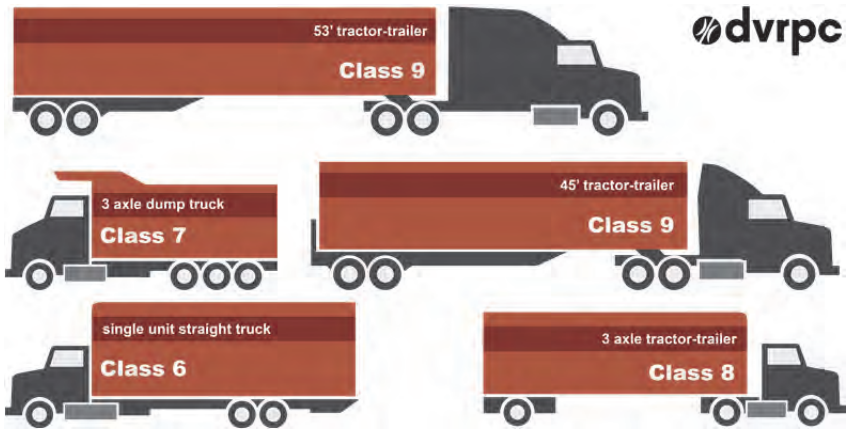
A damaged curb at Engle Street and 9th Street/US 13. Some intersections in the City of Chester were not designed to accommodate large trucks, which require wide turning radii. When trucks attempt these tight turns, they can overrun the curb, damaging the sidewalk and endangering pedestrians. Source: DVRPC, 2017

Heavy Truck Traffic

To better understand how trucks currently move through the City of Chester, average annual daily traffic (AADT) counts of trucks in Federal Highway Administration (FHWA) Class 6 or higher were analyzed. These include single unit straight trucks, 3 axle dump trucks, and tractor-trailers with three or more axles (Figure 4).

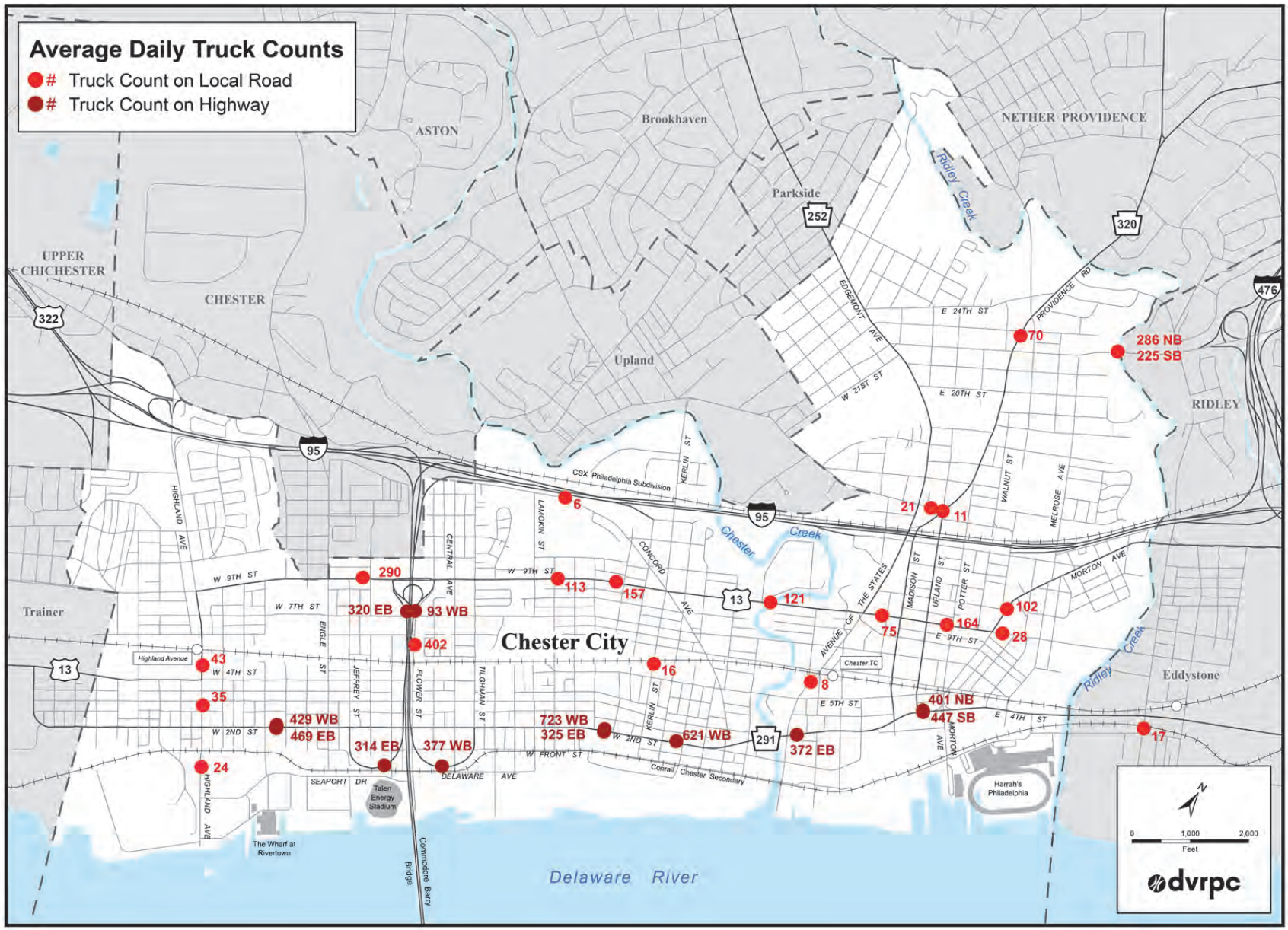
Daily volumes greater than 100 were found in several locations along 9th Street/US 13, indicating the road's likely use as a truck route (Figure 5). Particularly high volumes were measured on 9th Street/US 13 just south of the US 322 ramps on PA 291, and on Flower Street. High volumes on Flower Street suggest that it is being used as an east-west connector between PA 291 and US 13. Other roads such as southbound PA 320 and Highland Avenue, which connect to the industrial waterfront, have smaller but still substantial truck volumes.

Figure 4: Examples of trucks in FHWA Class 6 or higher.



Source: DVRPC, 2017

Figure 5: Weekday Truck Volumes (AADT)



Source: DVRPC Traffic Counts, 2012–2017

East Coast Greenway (ECG)

In addition to serving as a major route for heavy trucks and other vehicular traffic, portions of PA 291 are designated as part of the East Coast Greenway (ECG), an interstate bicycle and walking route connecting Maine to Florida. Improvements to City of Chester streets related to the ECG have been in discussion in Delaware County and include off-road multipurpose trails on the river side of PA 291 and along the waterfront. In addition, bicycle lanes have been considered on roads such as Morton Avenue and Welsh Street to connect the ECG to local businesses. As funding becomes available and the ECG is further developed, the potential for conflict between truck drivers and cyclists may increase. Street design changes implemented on local streets, particularly where truck routes and bicycle routes overlap, should support multimodal use.

Amtrak Bridge Clearance

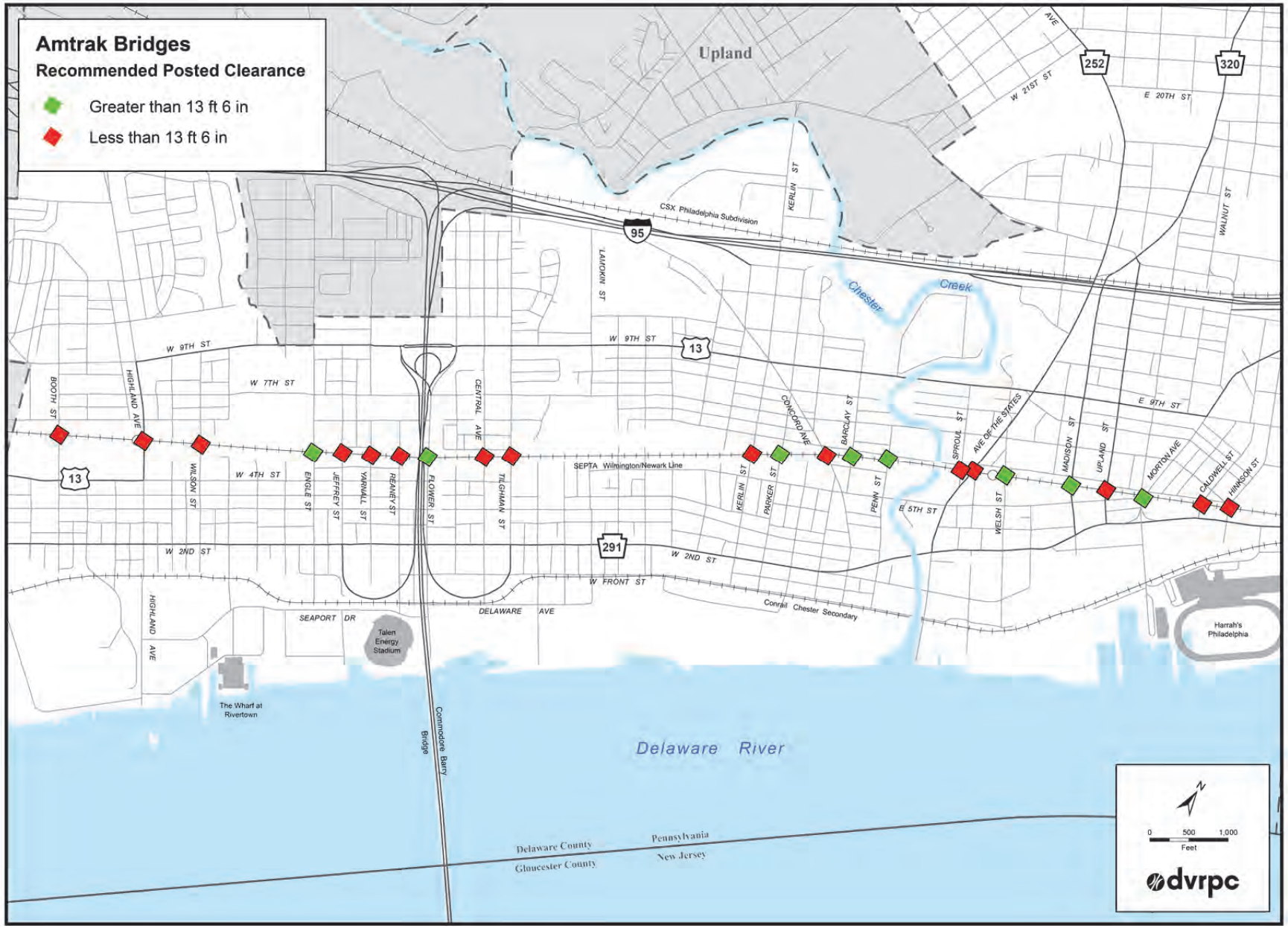
A major constraint for trucks traveling between I-95 and PA 291 is the elevated Amtrak railway that runs across the city. The railway includes 23 underpass bridges in the city, 22 of which require signage for low clearance because they have clearances below 14'6".[9] In some cases, posted clearances need to be updated due to changes such as weathering. For this reason, each bridge was measured and needed updates to posted clearance were identified in partnership with the Chester City Engineer and the Director of the Public Works Streets and Highway Department, based on guidelines prescribed in PennDOT Publication 238, Bridge Safety Inspection Manual.

Additionally, several bridges are missing clearance signs or advance warning signs, which could lead trucks to make difficult and dangerous maneuvers. Lastly, some existing clearance signs do not comply with current guidelines in PennDOT Publication 236, Handbook of Approved Signs, which are designed to maximize visibility and clarity for drivers. Recommended signage updates for Amtrak bridges are listed in Appendix A.

Left: At 6th Street and Kerlin Street, an advance warning sign is placed at the decision point for drivers. This best practice prevents truck drivers from following roads with inadequate clearance, eliminating the need for difficult turning movements closer to the bridge. Advance warning signs are recommended for bridges with clearance below 13'6". Source: DVRPC, 2017

[9] PennDOT Publication 238, Bridge Safety Inspection Manual.

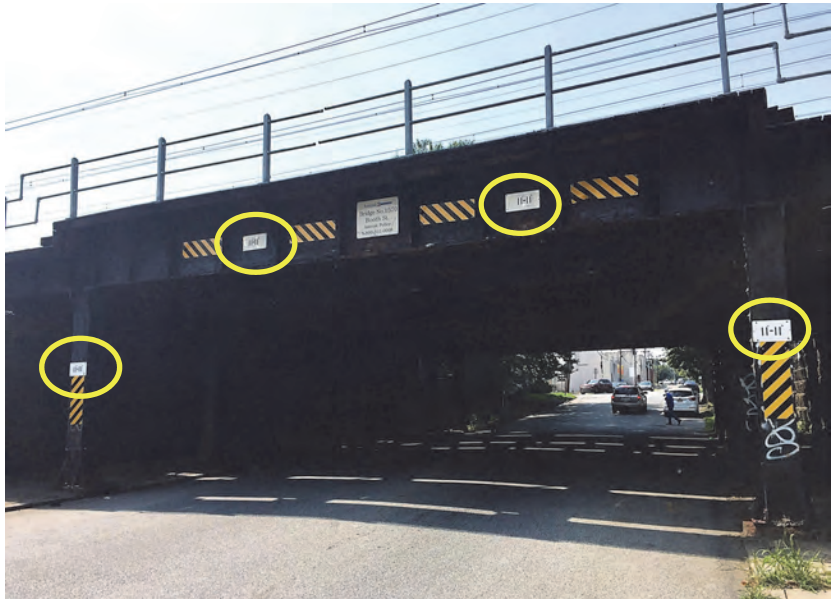
Figure 6: Amtrak Bridge Clearance



Source: DVRPC, 2018

Per Title 75, Section 49 (subsection 4922) of the Pennsylvania Consolidated Statutes, the maximum height of any vehicle using Pennsylvania roads is 13'6"; vehicles exceeding this height require a permit from the Pennsylvania Department of Transportation (PennDOT). Over-legal permitted loads travel on assigned routes with adequate clearance. Therefore, underpasses with a posted height of 13'6" or greater accommodate all legal trucks passing through Chester. Based on updated measurements, these include the bridges at Engle Street (14'0"), Flower Street (13'8"), Parker Street (13'6"), Barclay Street (13'10"), Penn Street (15'11"), Avenue of the States (13'9"), Welsh Road (13'9"), Madison Street (13'9") and Morton Avenue (13'9") (Figure 6). These streets could serve as truck routes based on clearance alone; the remaining streets, with clearances under 13'6", are only appropriate for smaller trucks making local deliveries.

To accommodate large trucks and other tall vehicles, urban arterials connecting to interstate highways should have posted bridge clearances no lower than 14 feet.[10] Based on updated measurements, only two Amtrak bridges in the City of Chester—at Penn Street (15'11") and Engle Street (14'3")—meet this standard. Unfortunately, neither Penn Street nor Engle Street connects directly to highway ramps, and both have features, such as tight turning radii and non-signalized intersections, that pose problems for heavy freight truck traffic.



Above: On-bridge clearance signs at Booth Street do not meet PennDOT Publication 236 design guidelines. Source: DVRPC, 2017

Right: A PennDOT Publication 236-compliant clearance sign (style W12-2) adjacent to the Amtrak bridge at Tilghman Street. Another option is to affix a clearance sign (style W12-2A) directly to the bridge; however, this would require cooperation from Amtrak. Source: DVRPC, 2017

[10] U.S. Department of Transportation, FHWA, *Mitigation Strategies for Design Exceptions* (July 2007).

CHAPTER 3:

Recommendations

Proposed Truck Network Facilities

The truck routes and corresponding network facilities recommended in this report were developed with community and economic goals in mind. Regional truck access to the waterfront and CBD was balanced with the city's desire to minimize the number of heavy trucks on local residential streets. Physical constraints, such as low bridge clearance and turning radii, were taken into account. Given these constraints, the road network was divided into primary and secondary facilities for heavy trucks. These routes are illustrated in Figure 7.

Primary Truck Network Facilities

Proposed primary truck facilities are roads that minimize the exposure of residents to heavy truck traffic while also posing the fewest obstacles to truck drivers. These include the major interstate highways (I-95, I-476), and US and PA routes (US 322, PA 352, PA 320, and PA 291).

For trucks exiting I-95 to reach the waterfront, the preferred exits are those that connect most directly to primary facilities, including:

- Exit 11 in Delaware (connection to US 13 via Naamans Road)
- Exit 4 in Pennsylvania (connecting to PA 291 via US 322)
- Exit 8 in Pennsylvania (connecting to PA 291 via Stewart Avenue)

Existing signs on I-95 direct traffic to use Exits 4 or 8 for the City of Chester waterfront. Signs cannot be installed advising truck drivers to take a preferred exit in the State of Delaware.

Secondary Truck Network Facilities

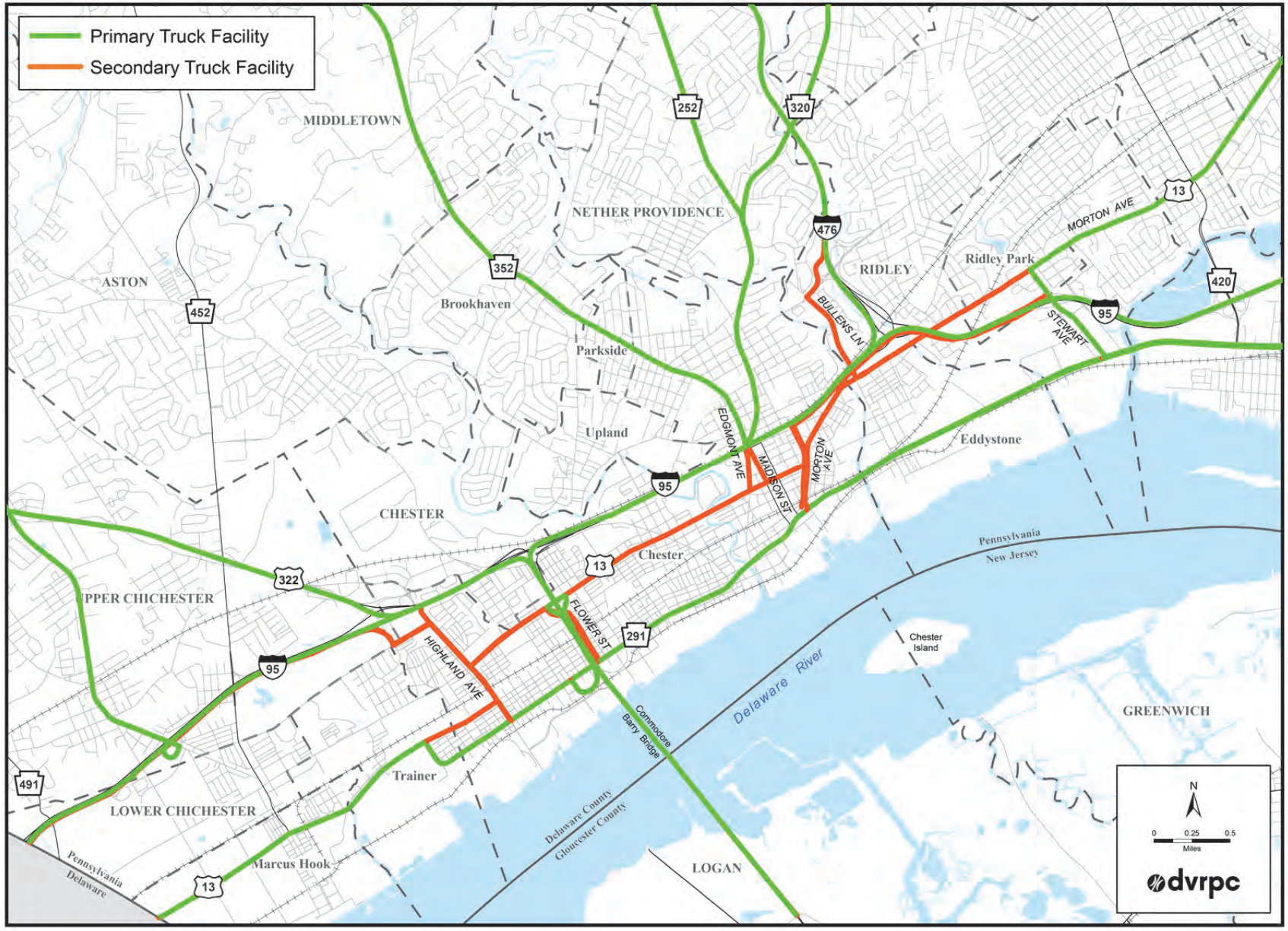
Secondary truck facilities are suggested to increase flexibility and allow drivers to respond to congestion and other disruptions on primary facilities. These facilities are less preferred routes due to certain physical constraints and greater proximity to residential areas.

For example, US 13 between Price Street and Morton Avenue is not a preferred truck facility for the City of Chester. This route follows both Highland Avenue and 9th Street, carrying trucks through residential areas. Because US 13 is a state road and designated truck route, it is not possible to restrict heavy trucks from using it. Nevertheless, the City of Chester can use wayfinding to encourage truck drivers to use primary facilities instead and ensure that truck drivers using US 13 reach their destinations safely and efficiently.

One source of heavy truck traffic on US 13 is congestion on I-95. To avoid congestion near the I-95/US 322 interchange, northbound truck drivers often take Exit 3 toward Highland Avenue, then turn onto US 13 to pass through the City of Chester before getting back on I-95. Similarly, southbound truck drivers take Exit 6 toward Chestnut Street and turn onto US 13 to pass through the city.

While this through movement on US 13 is not ideal, it is not possible to close Exits 3 and 6 to trucks because these exits provide important relief for drivers during peak congestion. An alternate strategy is to direct trucks using these exits toward PA 291 instead of US 13. Previously, this option was not feasible, as both Highland Avenue and Morton Avenue had 12'9" clearances under the Amtrak line, and the turning radius at Highland Avenue and Township Line Road was not adequate for large trucks to turn comfortably. The Highland Avenue and Township Line Road intersection was recently reconstructed with a wider turning radius, and construction to increase the Amtrak clearance to 13'9" on Morton Avenue will be completed in 2018.

Figure 7: Proposed Truck Network Facilities



Source: DVRPC, 2017

The clearance of the Amtrak bridge on Highland Avenue will remain 12’9” for the foreseeable future. The City of Chester should consider a long-term option to increase the bridge clearance on Highland Avenue to improve the direct connection to PA 291. More access routes to attractions along the waterfront would improve the efficiency of travel during special events. Such a project would require strong community engagement, as it would increase truck traffic past a number of homes on Highland Avenue between 9th Street and 2nd Street.

US 13 Business Route

To maximize the number of trucks using PA 291 instead of US 13 – particularly through trucks and trucks delivering to the waterfront – a US 13 Business Route should be established between Price Street and Morton Avenue, concurrent for most of its designation with PA 291 (Figure 8).

Northbound trucks traveling into the city on US 13 would turn right onto Price Street, follow PA 291, and turn left onto Morton Street to rejoin US 13. Conversely, southbound trucks traveling into the city on US 13/Chester Pike would continue along Morton Avenue rather than turning right onto 9th Street, then turn right onto PA 291 until Price Street. Trucks entering the city at other points, such as I-95 Exits 3 and 6, could also be directed toward US Business Route 13 rather than the main route, minimizing through traffic on US13/9th Street.

The formal process for assigning a business route is described in PennDOT Publication 46, *Traffic Engineering Manual–Change 1*. This process must be completed before installing related signage along the route.

Road Restrictions

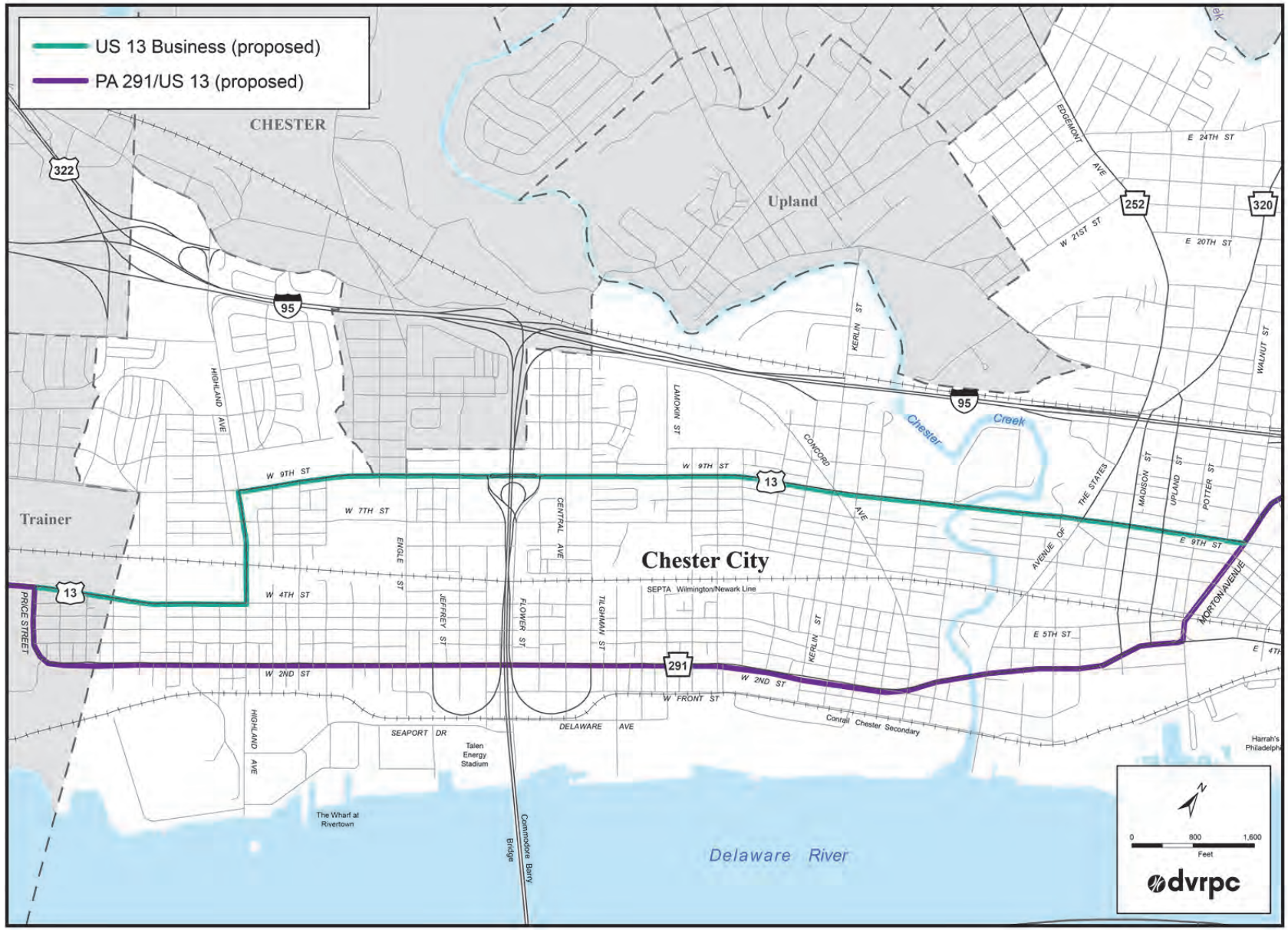
Roads with tight turning radii, low clearance, and other features not favorable to truck movements were avoided in the selection of primary and secondary facilities. Formal truck restrictions should be considered on roads where truck travel may cause severe damage to existing infrastructure or safety issues for drivers and other members of the community, including roads with insufficient clearance for non-permitted trucks.

Per PA Code Title 67, a municipality must demonstrate sound engineering judgment in establishing the need for truck restrictions and accompanying signage. An engineering study must be submitted to PennDOT demonstrating this need using one or more of the following:

- Crash Analysis
- Geometric Review
- Past Experience
- Pavement Analysis
- Speed Data
- Structural Analysis
- Traffic Volumes

For example, inadequate turning radii could be used to justify a truck restriction, but these must be documented. Given this evidence, the engineer must also consider whether all trucks should be restricted from the road segment or only trucks above a certain height, weight, or class, and whether exceptions such as local deliveries will be permitted.

Figure 8: Proposed US 13 Business Route



Source: DVRPC, 2017

Proposed Truck Access Routes

Waterfront Access

Detailed directions are provided for waterfront access routes in the inbound direction in Figures 9 and 10, and Tables 2 and 3. Waterfront routes can be reversed for outbound traffic.

Preferred Access Routes

The goal of preferred access routes is to maximize the use of primary truck network facilities and minimize heavy truck traffic on local streets. For this reason, preferred access routes consist largely of interstate highways and a few connecting roads with truck-friendly design elements, such as wide lanes, signalized intersections, adequate turning radii, and predominantly non-residential land uses. In favorable traffic conditions, these routes are highly preferred for truck traffic. As the waterfront continues to develop, a capacity analysis should be conducted at the intersection of US 322 and PA 291 to determine the ability of these roads to accommodate truck traffic in addition to event traffic.

All primary routes can accommodate all trucks that do not exceed the maximum vehicle height requirement of 13’6”. Preferred access routes to the waterfront are illustrated in Figure 9 and described in Table 2.

Alternate Access Routes

Due to high traffic volumes on the interstate highway, truck drivers may desire alternate routes to avoid severe congestion. These secondary routes utilize secondary truck network facilities and are not preferred for through truck traffic under normal conditions, due to less favorable design elements, lower bridge clearances, and residential land uses. However, their designation is necessary to relieve pressure on I-95 and provide flexibility for truck drivers. Routes 2A and 3A overlap with PennDOT detour routes for incidents on I-95 between Stewart Avenue and Naamans Road. Secondary waterfront routes are illustrated in Figure 10 and described in Table 3.

CBD Access

While US 13 is not the optimal route for large trucks delivering to the waterfront or passing through the city, it is an appropriate route for smaller trucks traveling to the CBD. From US 13, trucks should turn onto Sproul Street and left onto 7th Street (Figure 11). After making a delivery, trucks should continue on 7th Street toward Morton Avenue, where they can turn right for PA 291 or left for US 13. Some smaller trucks making deliveries on Sproul Street can reach the waterfront more directly by continuing on Sproul past the Amtrak underpass (clearance 12’4”).

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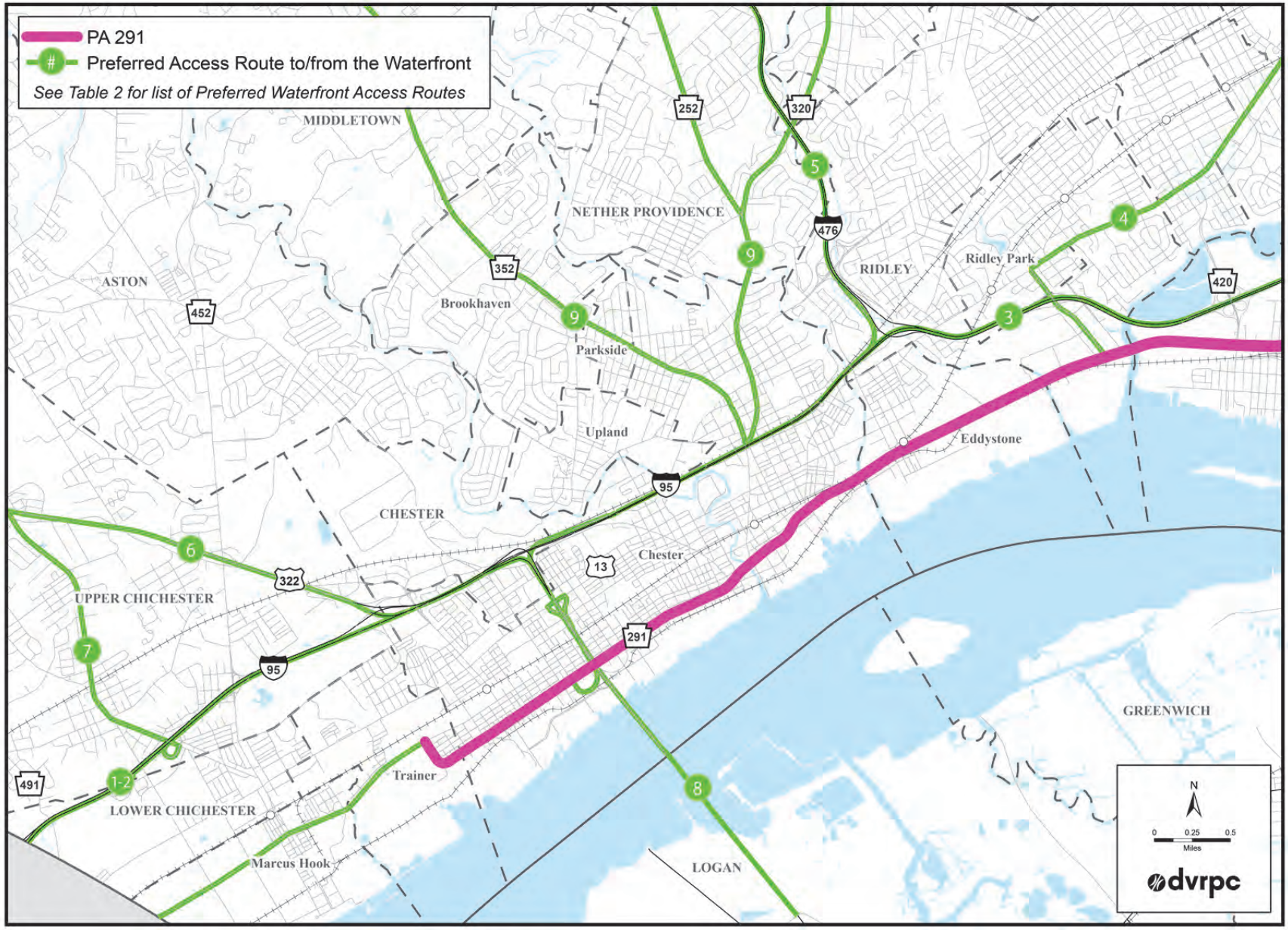
Figure 9: Preferred Waterfront Access Routes

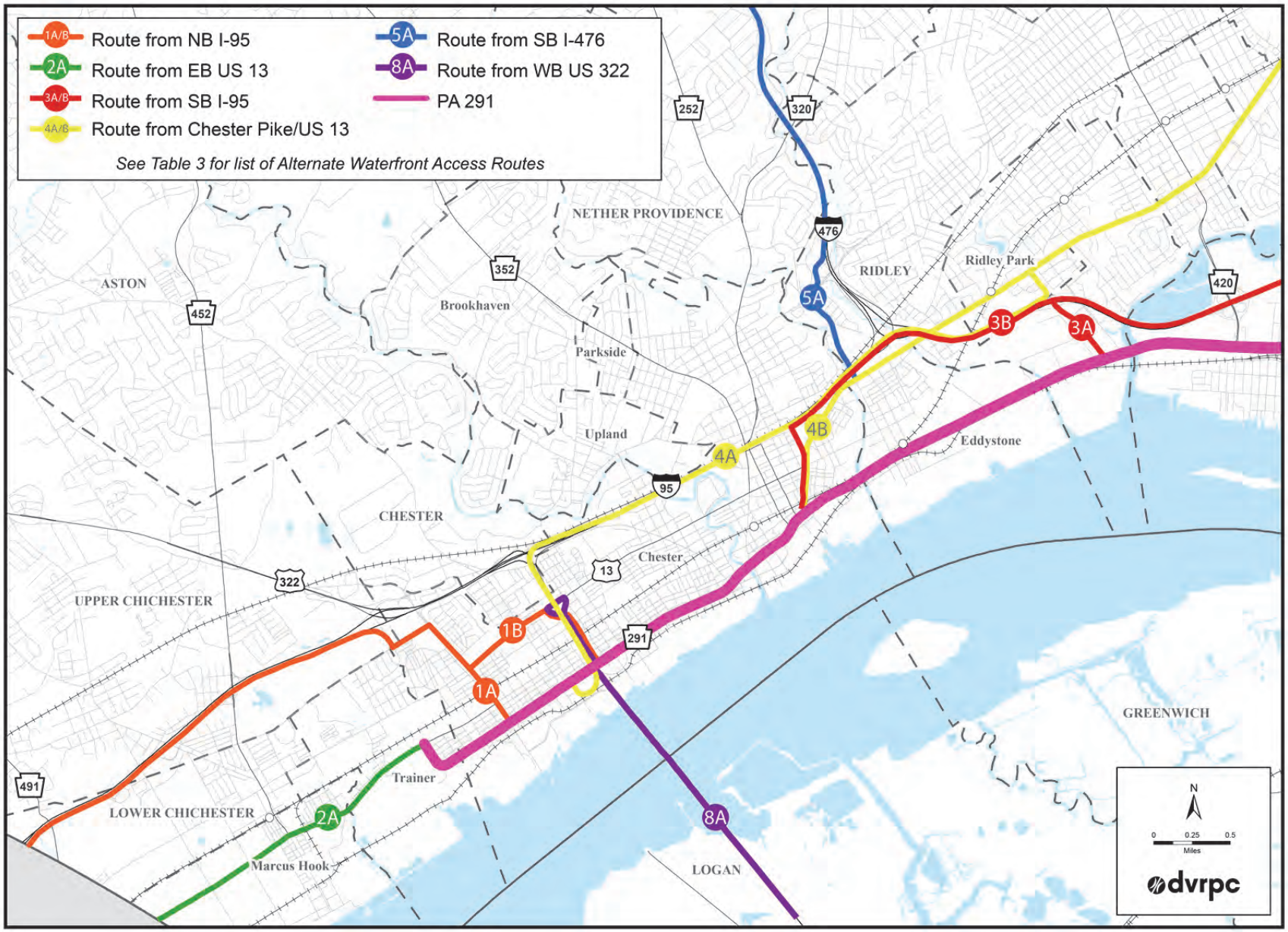


Source: DVRPC, 2017

Table 2: Preferred Waterfront Access Routes

Route Number	Description
1	Northbound trucks traveling from Wilmington on I-95 should take Exit 4 for the US 322 interchange, then take the last exit before the Commodore Barry Bridge for 291/City of Chester waterfront.
2	Northbound trucks traveling from Wilmington on I-495 should take the interchange to I-95 North to Exit 4.
3	Southbound trucks traveling from Philadelphia on I-95 should take Exit 4 for the US 322 interchange, then take the last exit before the Commodore Barry Bridge for 291/City of Chester waterfront.
4	Southbound trucks traveling from Philadelphia on US 13/Chester Pike should take Stewart Avenue to connect to PA 291.
5	Southbound trucks traveling from King of Prussia on I-476 should follow the I-95 South interchange just east of the City of Chester, then follow the routes recommended for I-95 southbound trucks.
6	Eastbound trucks traveling from Concordville on US 322 should continue on US 322 East (I-95), take Exit 4 for the US 322 interchange, then take the last exit before the Commodore Barry Bridge for 291/City of Chester waterfront.
7	Eastbound trucks traveling from Upper Chichester on Chichester Avenue should get on I-95 to access the City of Chester waterfront rather than continuing on Chichester Avenue/DE-452, which carries them through the downtown area of Marcus Hook.
8	Westbound trucks traveling from New Jersey on US 322 should take the exit for PA 291/US 13/Chester just after the Commodore Barry Bridge, stay left to take the Flower Street ramp, then follow Flower Street south to PA 291. This route accommodates trucks with a maximum clearance height of 13’-8”.
9	Southbound trucks traveling from Media or Lima on PA 252/320 or PA 352 should get on I-95 South at Edgmont Avenue, then take Exit 4 to connect to PA 291 via US 322.

Figure 10: Alternate Waterfront Access Routes

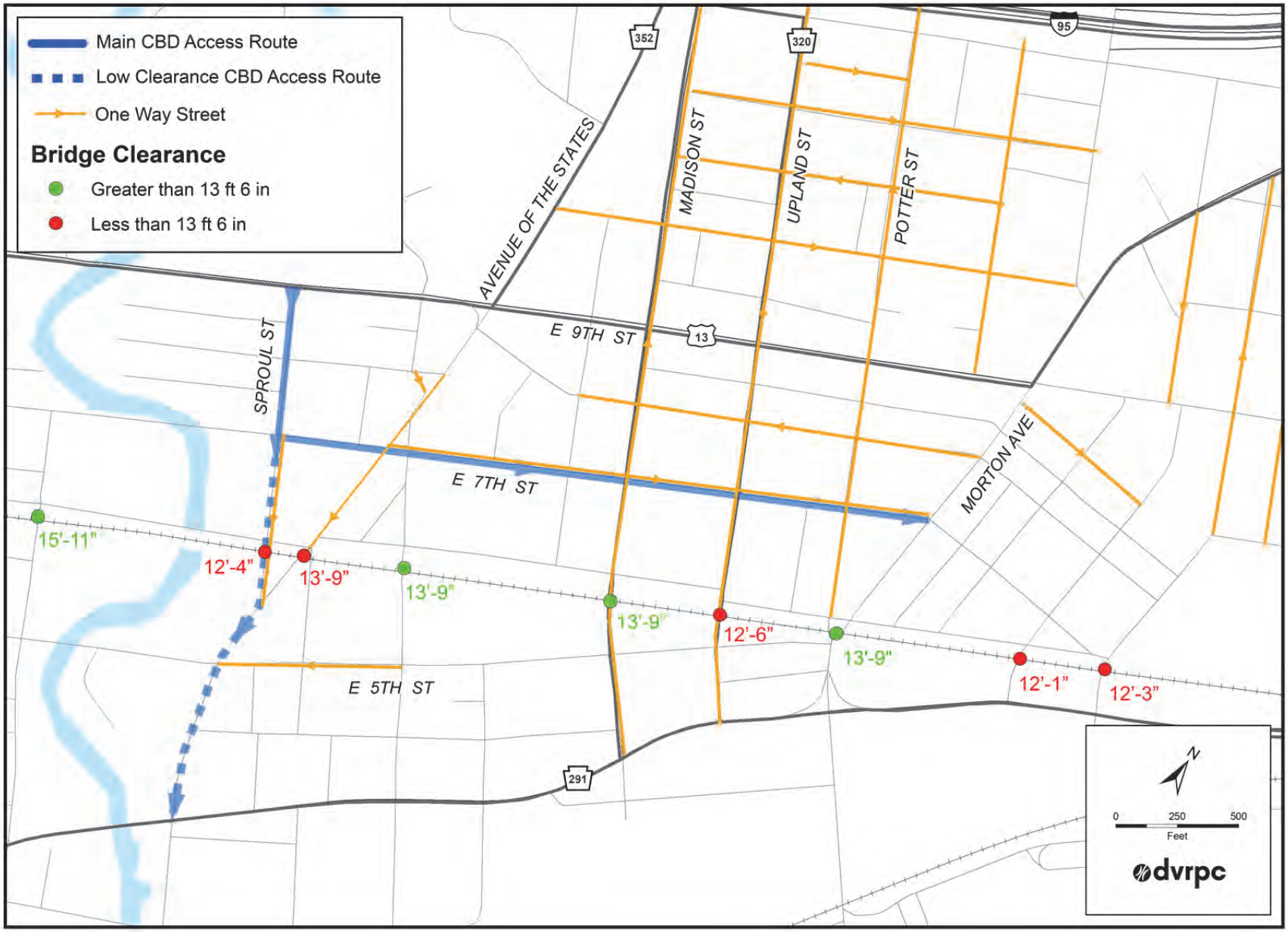


Source: DVRPC, 2017

Table 3: Alternate Waterfront Access Routes

Route Number	Description
1A	Northbound trucks traveling on I-95 can take Exit 3, turn left on Township Line Road and right onto Highland Avenue to access PA 291. This route accommodates trucks with a maximum clearance height of 12’9”.
1B	Northbound trucks traveling on I-95 can take Exit 3, turn left on Township Line Road and right onto Highland Avenue, turn left onto 9th Street, then turn right onto Flower Street to access PA 291. This route is an alternative to Route 1A for trucks with clearance height greater than 12’9”.
2A	Northbound trucks traveling from Wilmington on I-495 can take Exit 5 to US 13. All northbound trucks entering the City of Chester via US 13 should turn right on Price Street to access PA 291.
3A	Southbound trucks traveling from Philadelphia on I-95 can take Exit 8/Ridley Park, which is just east of Chester proper, and use Stewart Lane to connect to PA 291.
3B	Southbound trucks traveling on I-95 can also take Exit 6, turn left onto Chestnut Street, and right onto Morton Avenue, then follow Morton Avenue to PA 291.
4A	Southbound trucks traveling from Philadelphia on US 13/Chester Pike can get on I-95 at Stewart Avenue and use Exit 4 to connect to PA 291 via US 322.
4B	Southbound trucks traveling from Philadelphia on US 13/Chester Pike can also continue on US 13 to Morton Avenue to PA 291. This route accommodates trucks with a maximum clearance height of 13’-9”.
5A	Southbound trucks traveling from King of Prussia on I-476 can take Exit 1 for MacDade Boulevard West from I-476, turn left onto Bullens Lane, and turn right onto Morton Avenue to PA 291. This route accommodates trucks with a maximum clearance height of 13’-9”.
8A	Westbound trucks traveling from New Jersey on US 322 can exit US 322 at Flower Street toward 9th Street, turn left onto 9th Street, left again to take the on-ramp for US 322 East, then exit for PA 291. This route is an alternative to Route 8 for trucks with clearance height greater than 13’8”.

Figure 11: CBD Access Routes



Source: DVRPC, 2017

Truck Wayfinding

Communicating a network of preferred and alternate routes to truck drivers is an essential part of establishing designated truck routes. Existing signage restricts truck traffic on some residential streets, but the city lacks positive wayfinding to direct trucks to their destinations. Figure 12 and Table 4 detail a proposed truck wayfinding system that balances wayfinding and advance clearance warnings. Recommended PennDOT-approved signs are defined in Appendix B. A thorough field review of these recommendations should be conducted in partnership with PennDOT and necessary adjustments made prior to implementation.

Truck Route Signs

The proposed truck route signs aim to direct trucks to preferred routes and facilities. Signs 24-44 in Figure 12 and Table 4 direct trucks to the proposed US 13 Business Route, to the CBD, and to secondary truck facilities, such as Flower Street and Sproul Street.

Advance Warning Signs

When trucks turn onto local roads with insufficient clearance, they are forced to navigate the local street network to return to the main route or find a road with better clearance. This contributes to noise, air pollution, and road damage in local neighborhoods. To deter trucks from turning onto these local roads, advance warning signs should be placed at potential entry points such as PA 291 and US 13. Signs 1-23 in Figure 12 and Table 4 show potential locations for advance warning signs. Posted clearances for these signs should be verified before a signage plan is finalized.

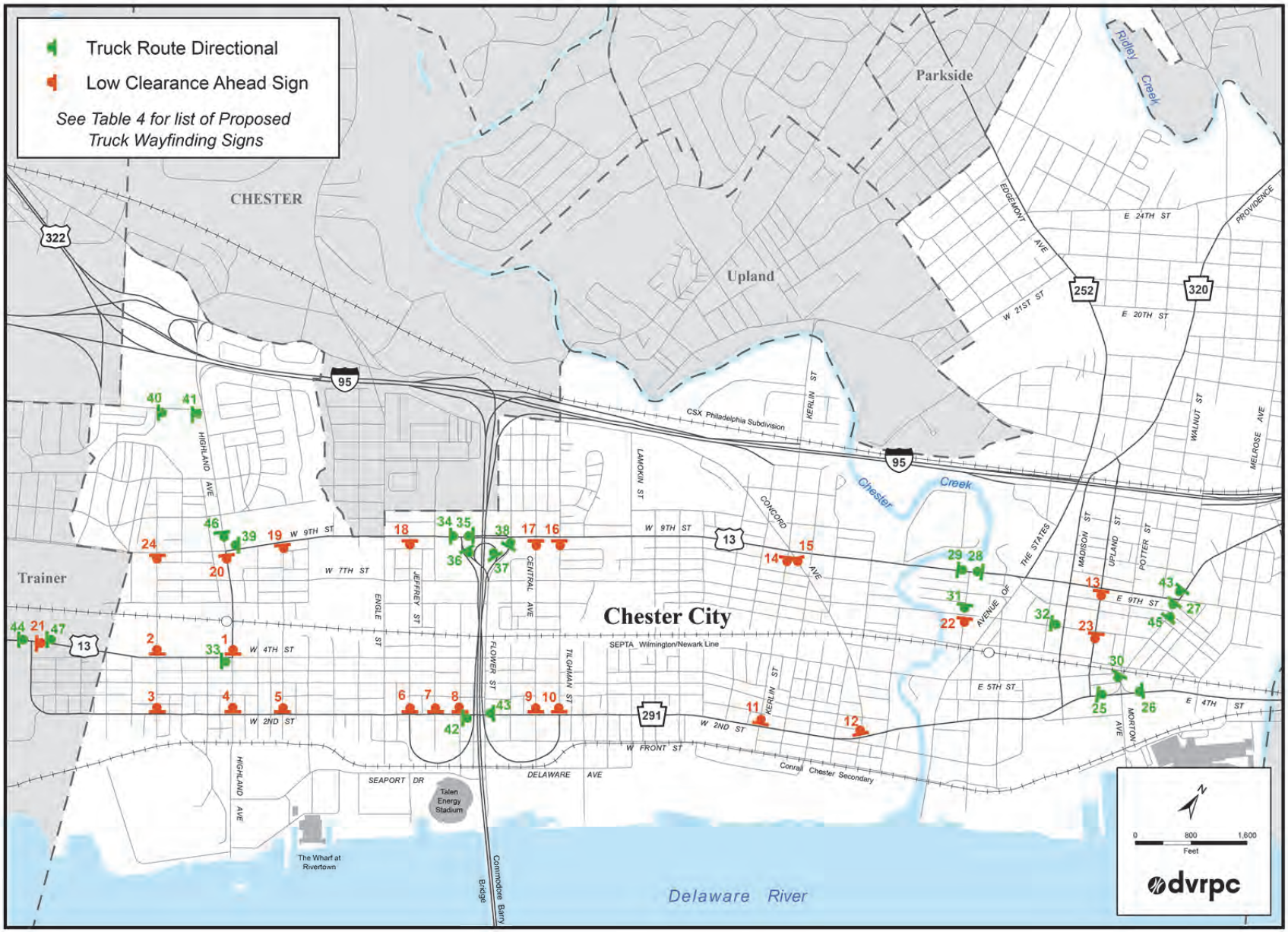
Truck Restriction Signs

Because engineering studies are required to formally restrict streets from heavy trucks, no specific truck restriction signs are recommended in this report. The City of Chester should evaluate which streets are most important to close to through truck movements based on street design, and submit a formal application to PennDOT before posting new restriction signs. If new roads are chosen for truck restrictions, Signs R5-2 (No Truck Sign), R5-2-3 (Except Local Deliveries Sign), and R5-2-4 (Truck Weight (Length) Restriction Panel) should be posted at intersections leading to restricted streets.

There are currently a number of truck restriction signs throughout the city. These signs should be evaluated for compliance and updated if necessary. Signs that are poorly placed should be taken down to prevent confusion and reduce visual clutter. Priority should be given to removing signs that directly conflict with proposed truck routes, such as signage near the Highland Avenue and 9th Street intersection.

Streets with proposed advance warning signs (1-23) in Figure 12 and Table 4 represent potential streets for truck restrictions. These must be studied in greater detail by the city engineer, but represent a starting point in determining future truck restrictions.

Figure 12: Proposed Truck Wayfinding Signs



Source: DVRPC, 2017

Table 4: Proposed Truck Wayfinding Signs

Number	Content	Sign Nomenclature(s)
1-24	(Clearance) Ahead	W12-2, W16-9P
25	Truck Route - to US13 (left arrow)	R14-1, M4-5, M1-4 (US13), left arrow
26	Truck Route - to Central Business District, right arrow	R14-1, M4-5, D1-1 (Central Business District), right arrow
27	Truck Route - to US13	R14-1, M4-5, M1-4 (US13)
28	Truck Route - to Central Business District (left arrow)	R14-1, M4-5, D1-1 (Central Business District), left arrow
29	Truck Route - to Central Business District (right arrow)	R14-1, M4-5, D1-1 (Central Business District), right arrow
30	Truck Route - to US13 (right)	R14-1, M4-5, M1-4 (US13), right arrow
31	Truck Route - to Central Business District (left arrow)	R14-1, M4-5, D1-1 (Central Business District), left arrow
32	Truck Route - to US13	R14-1, M4-5, M1-4 (US13)
33	Truck Route - to US13 (right arrow)	R14-1, M4-5, M1-4 (US13), right arrow
34	Truck Route - to US13 (right arrow)	R14-1, M4-5, M1-4 (US13), right arrow
35	Truck Route - to US13 (left arrow)	R14-1, M4-5, M1-4 (US13), left arrow
36	Truck Route - to US13	R14-1, M4-5, M1-4 (US13)
37	Truck Route - to US13	R14-1, M4-5, M1-4 (US13)
38	Truck Route - to Central Business District (right arrow)	R14-1, M4-5, D1-1 (Central Business District), right arrow
39	Truck Route - to US13 (left arrow)	R14-1, M4-5, M1-4 (US13), left arrow
40	Truck Route - to US13	R14-1, M4-5, M1-4 (US13)
41	Truck Route - to US13(right arrow)	R14-1, M4-5, M1-4 (US13), right arrow
42	Truck Route - to Central Business District (left arrow)	R14-1, M4-5, D1-1 (Central Business District), left arrow
43	To US13 Business (right arrow)	M4-5, M1-4 (US13), M4-3, right arrow
44	Truck Route - to US13 (right arrow)	R14-1, M4-5, M1-4 (US13), right arrow
45	To US13 Business (left arrow)	M4-5, M1-4 (US13), M4-3, left arrow
46	To US13 Business (left arrow)	M4-5, M1-4 (US13), M4-3, left arrow
47	US13 Business	(US13), M4-3

Truck Route Communication

Wayfinding can help truck drivers navigate the city correctly once they arrive, but a communication plan can help drivers plan ahead to avoid problematic routes. The first step in communicating the truck route network is to officially adopt the routes through a municipal ordinance. Route descriptions and maps can be incorporated into the zoning ordinance as an official reference for drivers, business owners, and residents.

Appendix C includes excerpts from the municipal codes of three Pennsylvania municipalities that restrict truck traffic on some or all municipality-controlled roads. These examples differ in types of trips restricted, types of vehicles restricted, and enforcement. The final language adopted by the City of Chester should reflect the city's priorities and desired degree of flexibility. Lastly, anti-idling regulations can be adopted and enforced to supplement the truck route language.

The next step is to communicate directly with business owners who rely on heavy trucks for deliveries. Many businesses can be persuaded to employ "freight as a good neighbor" strategies in order to maintain good relationships with surrounding communities. With this in mind, the City of Chester can request that businesses communicate the new truck routes to their drivers and encourage them to avoid traveling through the city in other, less preferred ways. The nearby Sunoco facility in Marcus Hook provides an example; truck scale personnel inform drivers of truck routes adopted by the Borough of Marcus Hook and PennDOT.

Another best practice in truck route communication comes from the South Jersey Port Corporation (SJPC). To protect residential neighborhoods from trucks going to and from the Paulsboro Marine Terminal, SJPC creates handouts for drivers highlighting preferred routes. Sharing a pre-made handout with clean, simple route visualizations could increase the likelihood that information is passed on and followed by drivers. An example flyer for the City of Chester is provided in Appendix D. This example could also be tailored to fit the needs of individual businesses, and translated into the appropriate languages to reach drivers.

Over the long term, it may be possible to incorporate preferred and restricted truck routes into commericial navigation systems for live, direct communication with drivers. DVRPC is working toward this public-private collaboration through its freight program.

Repowering and Replacing Heavy-Duty Diesel Engines

Diesel emissions are a major source of $PM_{2.5}$, NO_x, and VOCs. According to the most recent report from the U.S. Environmental Protection Agency (EPA) on air emissions trends, $PM_{2.5}$ emissions from all mobile sources are approximately 6 percent of the national total of direct $PM_{2.5}$ emissions, with 3 percent coming from on-road sources. NO_x emissions from mobile sources account for approximately 55 percent of the national total, with 34.5 percent coming from on-road sources.[11] Approximately one-third of on-road mobile emissions of $PM_{2.5}$ and one-quarter of the NO_x emissions are from Heavy-Duty Vehicles (HDVs).[12] These numbers represent a significant source of emissions whose health impacts are compounded for people living, working, and playing in proximity to the sources of these emissions.

[11] www.epa.gov/air-emissions-inventories/air-emissions-sources.
[12] EPA, *Plain English Guide to the Clean Air Act* (2015).

Although regulations for diesel vehicles were enacted as early as 1974, rules that significantly reduced NO_x and $PM_{2.5}$ emissions were not implemented until the mid-2000s. Model year (MY) 2010 and later, on-road diesel engines are expected to emit 90 percent less $PM_{2.5}$ and 95 percent less NO_x than pre-MY 2007 engines.[13] These improvements to emissions profiles indicate that significant improvements to air quality and public health can be accomplished by modernizing the fleet of HDVs, especially in communities that host ports or other industrial centers with heavy HDV traffic. However, fleet modernization poses a challenge due to the durability and reliability of diesel engines which, when properly maintained, can remain in service for decades.

Reliable and accessible funding sources, along with technical assistance from federal, state, and local agencies to help truck fleet operators access funding for diesel equipment repowers and retrofits, are critical components to addressing emissions from diesel engines. The other critical component is identifying industry partners. Since funding for diesel emission reduction projects is very limited, public–private partnerships geared toward mitigating diesel emissions in the region are necessary to raise awareness and create momentum to address this issue and improve air quality in the region's most vulnerable communities and in the region as a whole. In an attempt to encourage the replacement of pre-MY 2010 diesel engines, federal and state governments offer competitive funding and technical assistance programs. Possible funding sources include the Diesel Emissions Reduction Act (DERA), Congestion Mitigation and Air Quality (CMAQ), and Smartway, detailed in Chapter 4.

Updates to Amtrak Bridge Signage

Appendix A provides a complete list of recommendations for each Amtrak bridge in the City of Chester. These recommendations were developed based on guidelines from the FHWA, the Manual on Uniform Traffic Control Devices (MUTCD), and PennDOT publication 238, Bridge Safety Inspection manual. These guidelines include:

• All underpasses lower than 14'6" should have a W12-2 sign adjacent to the bridge, or a W12-2A sign affixed directly to the bridge.

• Where clearance is less than 13'6", advance warning signage (W12-2, W16-9) is recommended.

• The posted clearance should reflect the lowest measured point, subtracting three additional inches to account for the effect of freezing and thawing on the street level.

Recommendations are provided for all bridges where signs are missing, inaccurate, or do not meet PennDOT Publication 236 specifications. All clearance measurements were verified in partnership with the Chester City Engineer and the Director of Public Works Streets and Highway Department.

[13] www.dieselnet.com/standards/us/hd.php#y2007.

Improvements to Street Design

The waterfront and CBD areas, as well as many other areas in the City of Chester, are characterized by the close proximity of industry, commerce, recreation, and residences. Economic development efforts focus on bringing more recreational uses to the industrial waterfront and reviving the CBD as a destination for residents and visitors. Planning efforts for the ECG aim to connect communities and open up the waterfront to pedestrians and bicyclists.

When implemented, these plans will improve quality of life for City of Chester residents, but will also increase interactions between truck drivers, bicyclists, and pedestrians. Therefore, all street design changes should have a multimodal focus, and changes near adopted truck routes should account for truck turning movements, stopping distances, and other factors. For example, where a potential ECG off-road trail crosses a truck route, signs indicating the conflict should be clearly visible to truck drivers as well as trail users. Bicycle traffic signals, push-buttons for trail users, and clear markings guiding turning movements for drivers, cyclists, and pedestrians could also improve safety. The City of Chester should be involved in planning ECG design to ensure these steps are taken.

Right, above: In Philadelphia, the Delaware River Trail provides a safe option for bicyclists and pedestrians to enjoy the waterfront. The trail runs along and crosses the high-volume Delaware Avenue corridor and brings trail users into close proximity with vehicles, including heavy trucks. Source: DVRPC, 2017

Right, below: A key pedestrian link to the Delaware River Trail crosses an expressway on-ramp. High-visibility crosswalks, signage, and other design elements improve comfort and safety for all road and trail users. Source: DVRPC, 2017

The city should also consider changes to street design in the CBD as commercial redevelopment intensifies. The proposed CBD truck routes follow 7th Avenue in part because of the availability of on-street parking. If economic activity in the CBD grows, trucks may compete for on-street parking with residents and customers of local businesses, or they could cause congestion by double parking for deliveries. Loading zones, loading bays, or designated truck parking spaces may be appropriate if parking demand increases. The city could also work with businesses and landowners to develop vacant or underutilized parcels for truck loading. Other strategies and precedents for streamlining downtown deliveries can be found in DVRPC's Philadelphia Delivery Handbook.

In addition to infrastructure for truck loading and unloading, streets in the CBD should be pedestrian-friendly and safe for users of all ages. Visible crosswalks with sufficient crossing time, Americans with Disabilities Act (ADA)-compliant curb ramps and sidewalks, and traffic-calming measures to control vehicle speed can all contribute to a safer experience for pedestrians, as well as drivers. Recent pedestrian improvements on Welsh Street between 6th Street and 7th Street provide an excellent example and should be extended throughout the CBD. To better organize and advocate for street design changes in the CBD, the city should encourage the establishment of a City of Chester Business Improvement District in the area.

Trucks, transit, and bicyclists intersect in the CBD. Source: Delaware County Planning Department, 2017

Recent improvements to Welsh Street and 6th Street near the Chester Transportation Center include ADA-compliant curb ramps, sidewalk bump-outs, and highly visible crosswalks. Source: DVRPC, 2017

CHAPTER 4: Implementation

Timeframe

The recommendations in this report can be divided into short-, medium-, and long-term actions, summarized in Table 5. This study emphasized lower-cost, short- and medium-term solutions as much as possible to ease implementation efforts. Possible funding sources are provided for higher-cost elements of the plan.

Funding Sources

A variety of funding sources are available to support economic revitalization and transportation enhancements. The following programs could assist in funding some of the actions outlined above.

Transportation and Community Development Initiative (TCDI)

The City of Chester may decide to pursue other localized mobility plans as a result of this study. The TCDI is a potential funding source for such activities. In 2002, the City of Chester was awarded TCDI funding for its Downtown Improvement Strategy.

The TCDI is an opportunity for DVRPC to support growth in individual municipalities of the Delaware Valley through planning initiatives that implement the region's long-range plan. TCDI grants support early stage planning, design, and feasibility studies. Eligible projects reinforce and implement improvements in designated centers and improve the overall character and quality of life within the region. Among the eligible activities are wayfinding plans and mobility elements of master plans.

Act 89 Multimodal Transportation Fund (MTF)

The design recommendations in this report are multimodal in nature, making these improvements eligible for the Act 89 MTF program. The MTF provides grants to encourage economic development and ensure that a safe and reliable system of transportation is available to the residents of the commonwealth. The program is administered by PennDOT and the Department of Community and Economic Development (DCED) under the direction of the Commonwealth Financing Authority (CFA).

MTF–PennDOT

Eligible projects for PennDOT's MTF program include projects related to streetscape, bicycle and pedestrian facilities, improved signage, and improvements to an integrated transportation corridor in order to improve the productivity, efficiency, and security of goods movement to and from PA ports.

MTF–DCED/CFA

On behalf of the CFA, the DCED accepts applications every year between March 1 and July 31 for multimodal projects. Project eligibility for this funding source is similar to the PennDOT MTF.

CMAQ

The implementation of the strategies outlined in this plan has the potential to reduce the number of idling trucks. The DVRPC Competitive CMAQ Program funds transportation projects that will improve air quality and reduce traffic congestion in the DVRPC region. CMAQ-eligible projects demonstrably reduce air pollution emissions and help the region meet the federal health-based air quality standards. Congestion reduction and traffic flow improvement projects are eligible for CMAQ funding.

DCED Municipal Assistance Program (MAP)

One of the short-term goals outlined in this document is to update the City of Chester Zoning Ordinance to include local truck route designations and truck wayfinding signage guidelines. The city may also decide to include language that specifically addresses transportation infrastructure and truck movement in its next comprehensive plan update. A multimunicipal initiative to enforce truck

route consistency, particularly among Delaware County's waterfront municipalities, could broaden the positive impact on residents' quality of life.

The DCED MAP provides funding to assist local governments to plan for and efficiently implement a variety of services and improvements. Shared service activities and community planning are eligible for MAP funding. Community planning projects that could be funded through MAP include parts of comprehensive plans and land use ordinances.

DERA

In 2008, the EPA established the National Clean Diesel Campaign (NCDC). The NCDC is funded through DERA, which appropriated money to promote the reduction of diesel emissions throughout the country. Since that time, the program has funded nearly 60,000 pieces of clean diesel technology.

In 2017, the EPA awarded $34 million in a national competitive DERA program. The replacement or repowering of Class 5-8 heavy-duty, on-road vehicles were eligible under this program. The DERA solicitations are typically announced in the spring of each year.

States also get an allocation of DERA funds to hold statewide competitive funding rounds to replace or retrofit diesel equipment. In 2018, Pennsylvania is expected to announce the availability of over $600,000 for diesel mitigation projects. The Pennsylvania DERA program is typically announced in December or January.

SmartWay

The SmartWay Program is a public–private initiative between federal and state agencies, trucking companies, rail carriers, logistic companies, commercial manufacturers, and retailers that looks to improve fuel efficiency and reduce the environmental impact of the goods movement supply chains. SmartWay aims to accelerate the availability, adoption, and market penetration of advanced fuel-efficient technologies and operational practices in the freight supply chain, while helping companies save fuel, lower costs, and reduce adverse environmental impact. The EPA helps SmartWay Partners move more goods for more miles, with lower emissions and less energy through financing and technical assistance tools. More information is available at www.epa.gov/smartway.

Table 5: Action Plan

Action	Timeframe	Cost	Partners
Conduct a field review of proposed signage plan to confirm and adjust locations as needed.	Short-term	Low	PennDOT, DVRPC
Apply for US13 Business route designation.	Short-term	Low	PennDOT
Determine which streets should be restricted to trucks and conduct necessary engineering studies and applications.	Short-term	Low	N/A
Reach out to County and adjacent municipalities for coordination of truck route systems and signage plans.	Short-term	Low	Delaware County, adjacent municipalities including Trainer Borough, Marcus Hook Borough, Eddystone Borough
Adopt and enforce local anti-idling restrictions.	Short-term	Low	N/A
Codify approved truck restrictions in a municipal ordinance.	Medium-term	Low	N/A
Communicate truck routes to local businesses.	Medium-term	Low	Local businesses
Update Amtrak bridge clearance signs.	Medium-term	Medium	PennDOT, Amtrak
Install truck wayfinding signs.	Medium-term	Medium	PennDOT
Stay involved in the development of the ECG to support multimodal street improvements that accommodate trucks.	Medium-term	Low	Delaware County, East Coast Greenway Alliance

Encourage the establishment of a City of Chester Business Improvement District for the CBD.	Medium-term	Medium	Local Businesses, Delaware County, Transportation Management Association
Implement street design improvements to safeguard pedestrians.	Long-term	Medium to High	PennDOT
Incorporate truck routes into commercial GPS navigation systems.	Long-term	Low	DVRPC
Pursue a road-lowering project for Highland Avenue.	Long-term	High	PennDOT

Appendix A

Appendix A: Amtrak Bridge Measurements and Recommendations

Bridge Number and Street Name	Posted Clearance (current)	Updates to Posted Clearance[14]	Description	Recommended Signage Updates
15.70 Booth Street*	11'-11"	-	• Advance warnings one block away, visible from decision point at 6th and 4th Streets • No clearance signage on bridge in eastbound direction • Westbound on-bridge clearance signs not PennDOT Publication 236-compliant	• Add clearance sign (W12-2) adjacent to bridge in eastbound direction • Replace westbound on-bridge signage with PennDOT Publication 236-compliant signage adjacent to bridge
15.50 Highland Avenue	12'-9"	-	• Advance westbound warning , but sight line is poor • No eastbound advance warning signs • On-bridge clearance signs not PennDOT Publication 236-compliant	• Improve sight line to westbound advance warning sign • Add advance warning sign (W12-2) in eastbound direction • Replace on-bridge clearance signs with PennDOT Publication 236-compliant clearance signage (W12-2) adjacent to bridge
15.36 Wilson Street	12'-7"	-	• Advance warnings one block away, visible from decision points at 6th and 4th Streets • Existing signage in good condition • No clearance sign on bridge	• Add clearance signage (W12-2) adjacent to bridge in both directions
15.09 Engle Street*	14'-3"	-	• Advance warnings one block away, visible from decision points at 6th and 4th Streets • Existing signage in good condition • No clearance sign on bridge	• None

[14] Recommended changes to posted clearances are based on field measurements conducted in partnership with the Chester City Engineer and the Director of the Public Works Streets and Highway Department, based on guidelines prescribed in PennDOT Publication 238, Bridge Safety Inspection Manual. Vertical clearance measurements were taken at several critical points under each bridge and rounded down to the nearest inch. The lowest of these measurements was recorded as the actual vertical clearance, and three inches were subtracted to account for vehicle bounce, weathering, and other factors. Updates are recommended where the final value is more than one inch lower than the currently posted value.

* Clearance must be verified by the City Engineer.

Bridge Number and Street Name	Posted Clearance (current)	Updates to Posted Clearance[14]	Description	Recommended Signage Updates
15.02 Jeffrey Street	13’-1”	**Change to 12’-10”**	• Advance warnings one block away, visible from decision points at 6th and 4th Streets • No clearance sign on bridge	• Update posted clearance on existing signs • Add clearance signs (W12-2) adjacent to bridge in both directions
14.94 Yarnall Street*	12’-10”	-	• Advance warnings one block away, visible from decision points at 6th and 4th Streets • No clearance sign on bridge	• Add clearance signs (W12-2) adjacent to bridge in both directions
14.85 Reaney Street*	12’-6”	-	• Advance warnings one half block away • No clearance sign on bridge • Existing signage in fair condition but faded	• Add clearance signs (W12-2) adjacent to bridge in both directions
14.80 Flower Street	13’-8”	-	• No advance warnings • Clearance signage adjacent to bridge in both directions	• Add advance warning signs (W12-2) in both directions
14.67 Central Avenue	12’-9” EB 12’-3” WB	**Change to 12’-3” in both directions**	• No advance eastbound signage • Clearance signage adjacent to bridge in both directions • Advance westbound signage one block away, visible from decision point at 4th Street	• Update posted clearance on existing signs • Add advance warning sign (W12-2) in eastbound direction
14.60 Tilghman Street	12’-9” EB 12’-10” WB	-	• No advance warnings • Clearance signage directly adjacent to bridge in good condition	• Update posted clearance on existing signs • Add advance warning signs (W12-2) in both directions

Bridge Number and Street Name	Posted Clearance (current)	Updates to Posted Clearance[14]	Description	Recommended Signage Updates
14.02 Kerlin Street	12’-5”	**Change to 12’-3”**	• Advance warnings one block away, visible from decision points at 6th and 5th Streets • No clearance sign on bridge	• Update posted clearance on existing signs • Add clearance signs (W12-2) adjacent to bridge in both directions
13.96 Parker Street	13’-9”	**Change to 13’-6”**	• Advance warnings one block away, visible from decision points at 6th and 5th Streets • No clearance sign on bridge	• Update posted clearance on existing signs • Add clearance signs (W12-2) adjacent to bridge in both directions
13.83 Concord Avenue	13’-2” EB 12’-9” WB	**Change to 13’-2” in both directions**	• No advance warnings • Clearance signage directly adjacent to bridge	• Update posted clearance on existing signs • Add advance warning signs (W12-2) in both directions
13.79 Barclay Street*	13’-10”	-	• No advance eastbound warning • Eastbound clearance signage adjacent to bridge • Advance westbound signage visible from decision point at Patterson Street • No westbound clearance signage on/adjacent to bridge	• Add clearance sign (W12-2) adjacent to bridge in westbound direction • Add advance warning sign (W12-2) in eastbound direction
13.70 Penn Street	16’-1”	**Change to 15’-11”**	• No advance westbound signage • Westbound clearance signage adjacent to bridge • Advance eastbound signage before decision point at West 6th Street • Existing eastbound signage in good condition • Existing advance westbound sign is tilted	• Update posted clearance on existing signs • Add clearance signs (W12-2) adjacent to bridge in both directions • Add advance warning signs (W12-2) in both directions

Bridge Number and Street Name	Posted Clearance (current)	Updates to Posted Clearance[14]	Description	Recommended Signage Updates
13.51 Sproul Street	12’-8”	**Change to 12’-4”**	• One way eastbound street • Eastbound signage adjacent to bridge • Westbound sign on bridge obscured (“8” painted over), but not necessary because no westbound traffic allowed	• Update posted clearance on existing signs
13.49 Avenue of the States	13’-6” or 13’-9”	**Keep 13’-9” sign in place, remove 13’-6” sign**	• One-way eastbound street • Trucks prohibited • Eastbound signage adjacent to bridge and on bridge • Signage on and adjacent to bridge inconsistent (13’-6” on bridge)	• Add clearance sign (W12-2) adjacent to bridge in eastbound direction
13.42 Welsh Street	13’9”	-	• No westbound signage • No advance eastbound signage • Eastbound signage adjacent to bridge and on bridge • Eastbound sign on bridge obscured (“9” painted over), but not necessary because no eastbound traffic allowed	• Remove eastbound on-bridge clearance sign • Add clearance sign (W12-2) adjacent to bridge in westbound direction • Add advance warning sign (W12-2) in westbound direction
13.25 Madison Street	13’-9”	-	• One-way westbound street • Advance westbound signage one block away in good condition • No signage on/adjacent to bridge	• Add clearance sign (W12-2) adjacent to bridge in westbound direction
13.17 Upland Street	12’-6”	-	• One-way eastbound street • No advance eastbound signage • Eastbound signage adjacent to bridge	• Update posted clearance on existing signs • Add advance warning sign (W12-2) in eastbound direction

Bridge Number and Street Name	Posted Clearance (current)	Updates to Posted Clearance[14]	Description	Recommended Signage Updates
13.07 Morton Avenue	N/A	N/A	• Measurements and signage observations were not conducted, as Morton Avenue was under construction during this study • Anticipated clearance is 13’9” after the road is lowered	• N/A
12.92 Caldwell Street	12’-1”	-	• No advance signage • Signage adjacent to bridge in both directions, visible from decision points	• Add advance warning signs (W12-2) in both directions
12.85 Hinkson Street	12’-3”	-	• No advance signage • Signage adjacent to bridge in both directions, visible from decision points	• Add advance warning signs (W12-2) in both directions

Appendix B

Appendix B: Relevant Sign Types from PennDOT Publication 236, Handbook of Approved Signs

Nomenclature	Description
D 1-1	Single-Line Destination
D 1-1A	Single-Line Destination Mileage
D 1-2	Double-Line Destination
D 1-2A	Double-Line Destination Mileage
M1-4	US Route Marker
M1-6	Pennsylvania Route Marker
M4-5	To Marker
M4-3	Business Route Auxiliary
R5-2	No Truck Sign
R5-2-3	Except Local Deliveries Sign
R5-2-4	Truck Weight (Length) Restriction Panel
R14-1	Truck Route
W12-2	Low Clearance Sign
W12-2A	Low Clearance (Overhead)
W16-9P	Ahead Plaque

Source: Pennsylvania Department of Transportation, Handbook of Approved Signs: Publication 236 (2013)

Appendix C

Appendix C: Sample Ordinance Language

Example 1: Township of Middletown, Pennsylvania

Chapter 470. Vehicles and Traffic
Article III. Restrictions on Size, Weight and Type of Vehicle and Load
§ 470-304. Truck traffic restricted on certain streets.

A. It shall be unlawful for any person to drive a vehicle other than a passenger car on any of the following streets or parts of streets:

Street
All Township streets

B. Provided that nothing in this section shall prohibit any person from driving an emergency vehicle on any of those streets or parts of streets or from driving on any of those streets or parts of streets a truck or other commercial vehicle making local deliveries to or pickups from premises located along that street or part of a street.

C. Any person who violates any provision of this section shall, upon conviction, be sentenced to pay a fine of $25 and costs.

Example 2: Borough of Marcus Hook, Pennsylvania

Chapter 191. Vehicles and Traffic
Article VIII. Schedules
§ 191-76. Schedule XI: Closing of Certain Streets to Certain Vehicles; Prohibiting Trucks Except for Local Deliveries.
[Amended 7-11-2011 by Ord. No. O-11-3, approved 7-11-2011]

A. In accordance with the provisions of § 191-17, it shall be unlawful for any person to drive any vehicle, except a passenger vehicle (but not including any passenger vehicle drawing any trailer or towing any other vehicle), upon any of the streets or parts of streets described below:

Name of Street	Limits
Church Street	From Delaware Avenue to Fourth Street
Church Street	From Eighth Street to Tenth Street

<continued…>
B. In accordance with the provisions of § 191-17, trucks are prohibited from accessing the streets described below, except for local deliveries. Local deliveries are defined as deliveries or picking up materials or merchandise going to or from a residence, commercial/business establishment, or public property.

Name of Street	Limits
Church Street	From Tenth Street to Eighth Street
Green Street	From Tenth Street to Delaware Avenue

<continued…>

C. In accordance with the provisions of § 191-17, trucks are prohibited from accessing the streets described below, except for local residential deliveries. Local residential deliveries are defined as deliveries or picking up materials or merchandise going to or from a residence.
[Added 11-7-2016 by Ord. No. O-16-5, approved 11-7-2016]

Name of Street	Limits
Plaza Street	Entire length
Yates Avenue	From Tenth Street to Chestnut Street

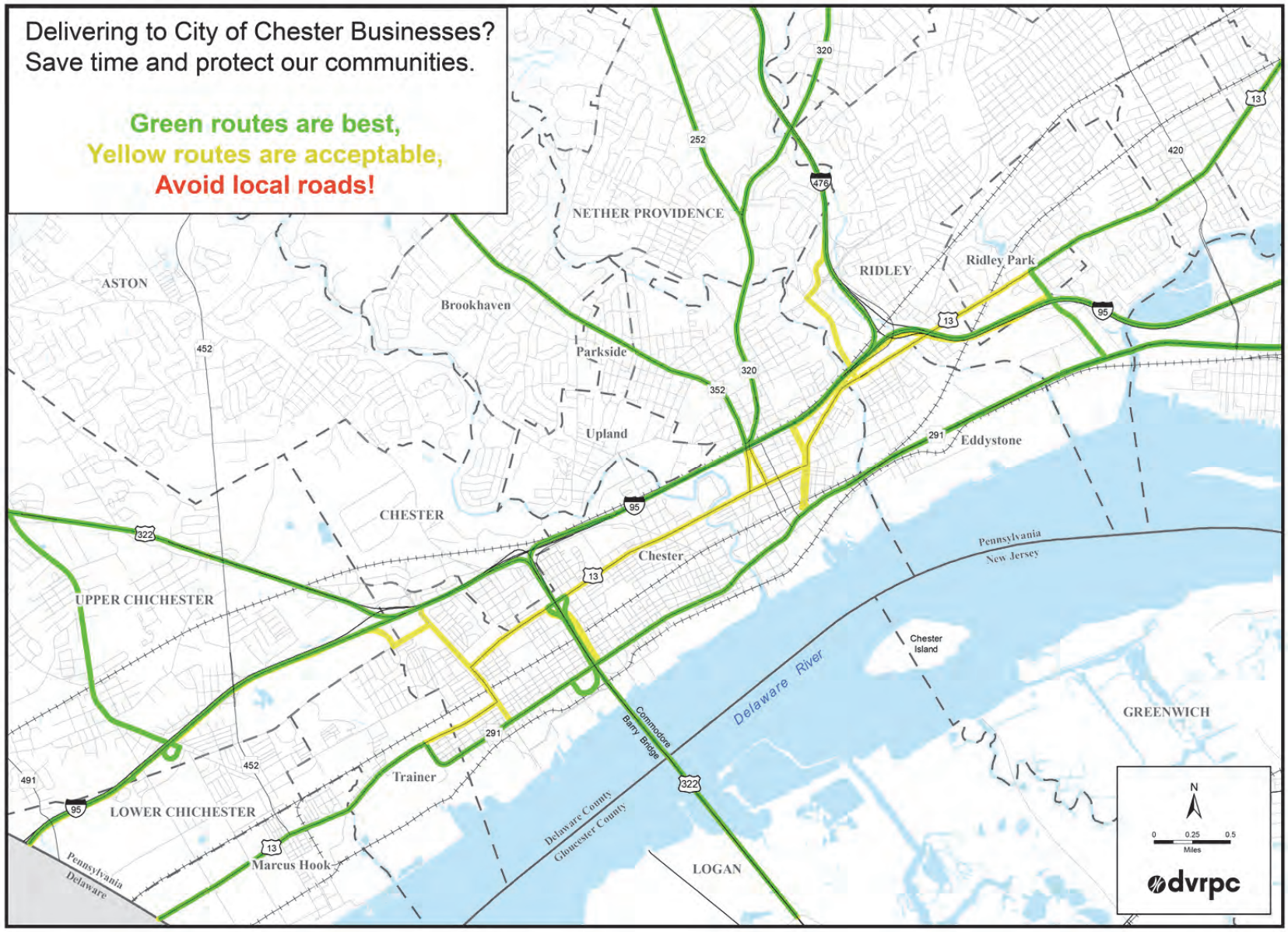
Example 3: City of Pittsburgh, Pennsylvania

§ 503.12 - TRUCK ROUTES.

No person shall operate a vehicle with a gross registered vehicle weight in excess of fourteen thousand (14,000) pounds except on a designated truck route unless the vehicle is moving from its point of origin to the nearest truck route, or from the nearest practical and safe street that can be used from the truck route to its destination.
(Ord. 1-1991, eff. 2-4-91)

Appendix D

Appendix D: Sample Flyer for Local Businesses



Truck Wayfinding in the City of Chester

Balancing Community and Business Needs

Publication Number: 18009

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Geographic Area Covered:
City of Chester, Pennsylvania

Key Words:
Truck Routes, Wayfinding, Heavy Vehicles, Pedestrian Safety, Air Quality, Economic Development, Waterfront, Industry, Central Business District, Deliveries, Bridge Clearance, Signage

Abstract:
The recommendations in this report were developed for the City of Chester to mitigate the effects of freight truck movement through the city, including compromised air quality in residential areas. Designated truck routes are proposed to facilitate the safe and efficient movement of goods to and from the city's industrial waterfront and central business district. Communication strategies and other methods are suggested to encourage use of the proposed routes to support truck drivers, local businesses, and residents.

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