

# Trucks and the Port of Virginia: Understanding Freight Patterns with Big Data

Presented to TRB Innovations in Freight Data Workshop  
Tuesday April 9, 1:00pm

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# Agenda

## I. Introduction

- Rob w/ HRTPO

## II. Using ATRI data via R

- Rob w/ HRTPO

## III. Big data resources and analytics for trucks

- Joannathan w/  
StreetLight Data

## IV. Using StreetLight Data

- Rob w/ HRTPO

## V. Q&A





# Data sources

- Initial: American Transportation Research Inst. (ATRI)  
Not-for-profit conducting **trucking** industry research
- Final: StreetLight Data

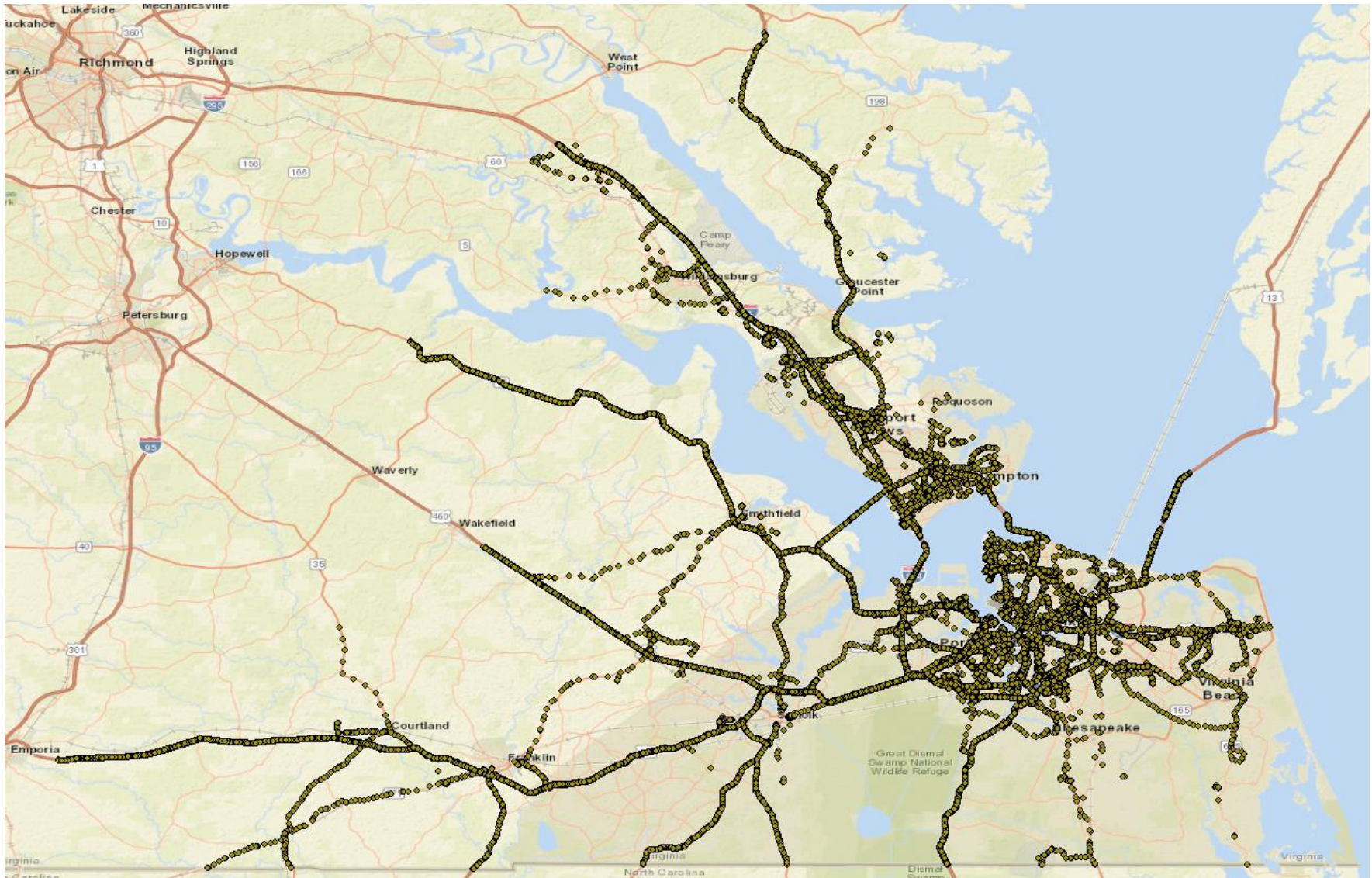
## II. Using ATRI data via R

# ATRI Data

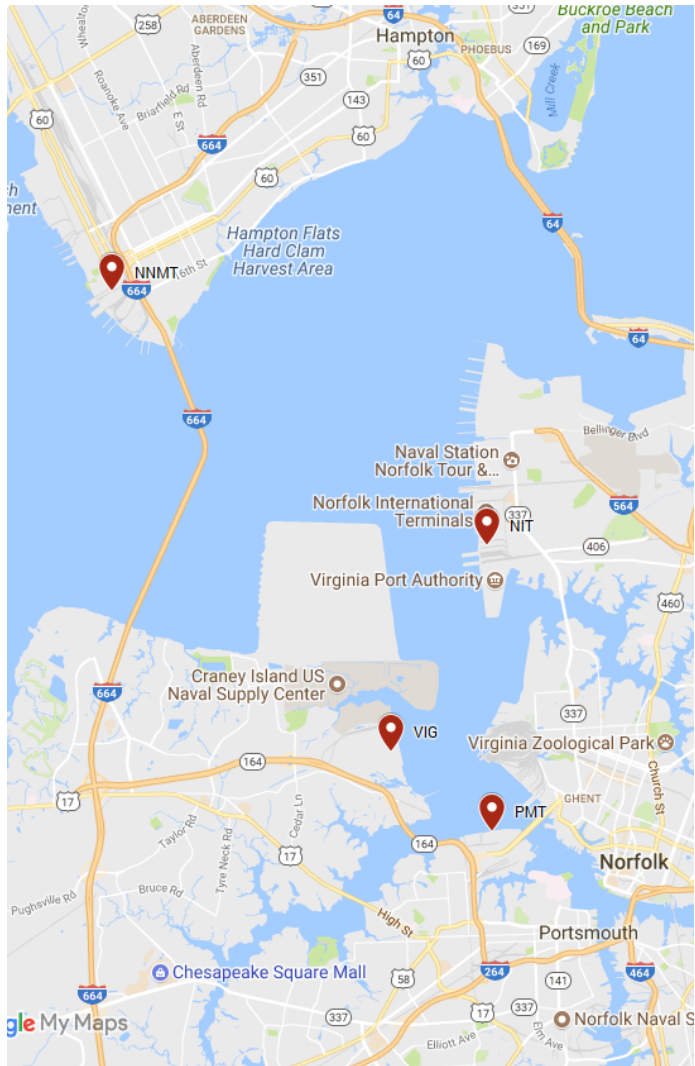
- Time period: Sep 2014
- Trucks: 23,291 unique trucks
- Location records: 7.5m pings
  - Typical ping rate: once per minute
- Processing:
  - Initial: Microsoft Access
  - Final: R (language)



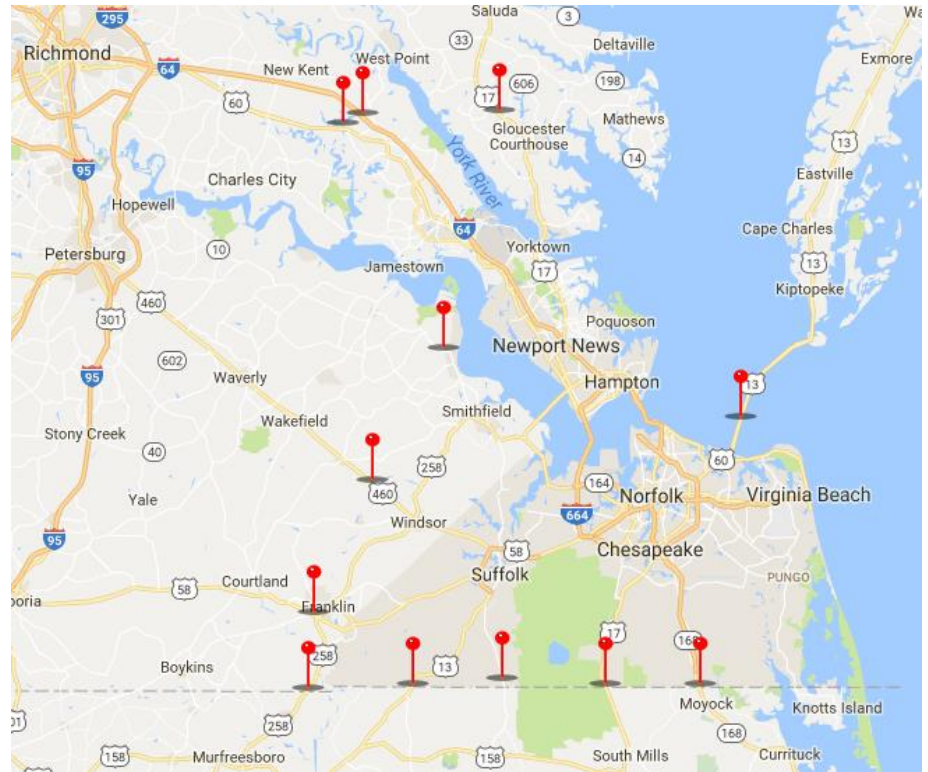
# Port Truck Pings, Sep 2014



# Ports



# Gateways

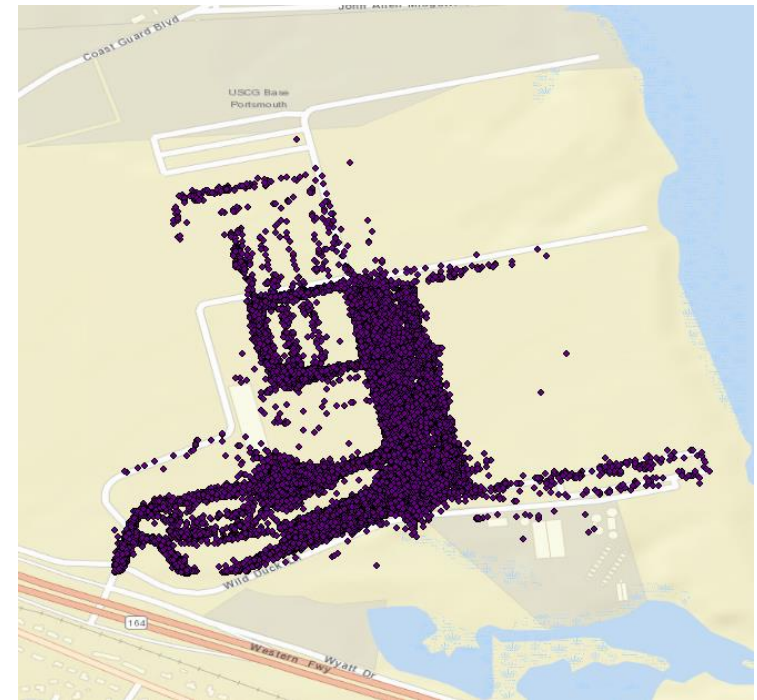




# Identifying Trucks Visiting a Port



Between latitudes 36.8695 and 36.8791,  
and between longitudes -76.3616 and -76.3475



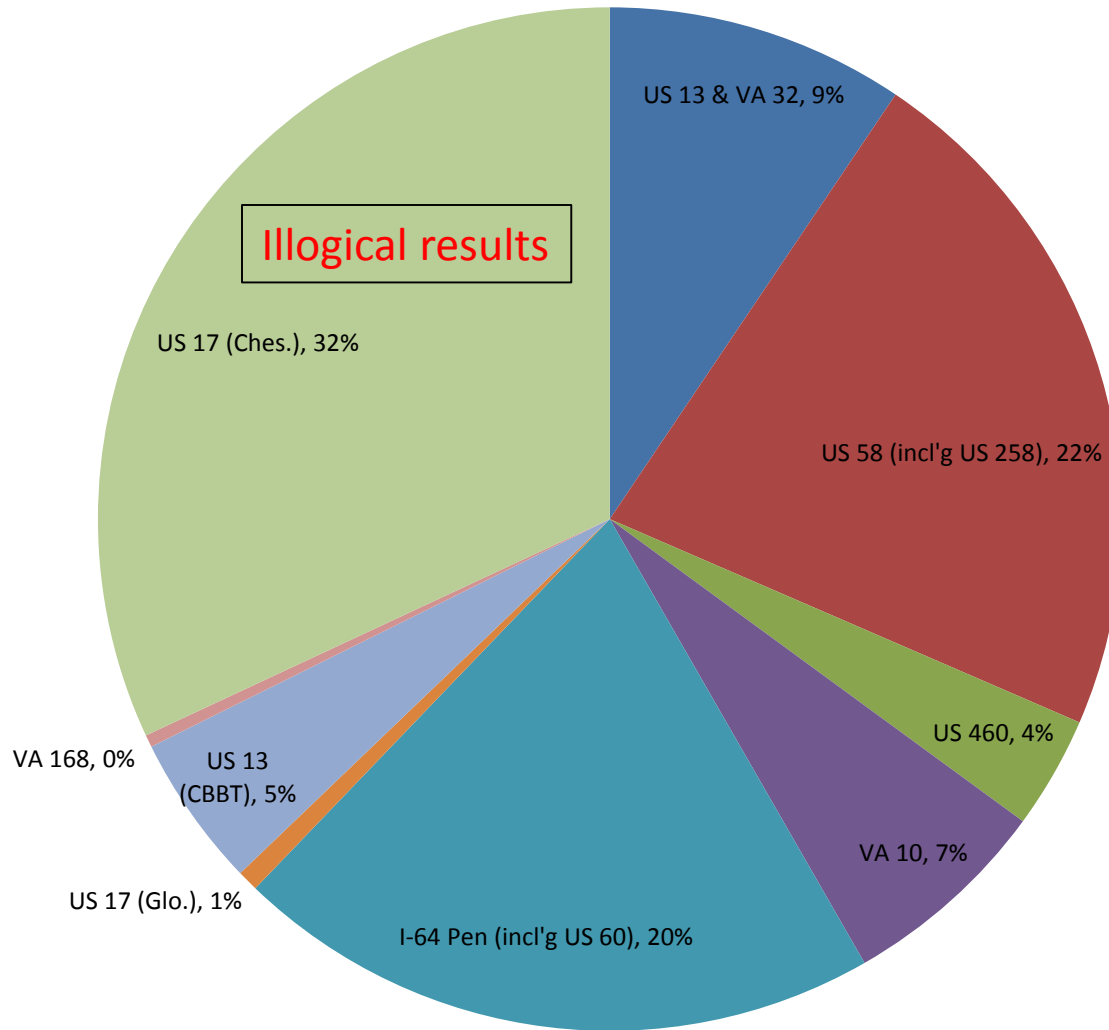
# Programming R to find trucks in a box

```
> POVtruckPings$in168window<-POVtruckPings$x>(-76.2575) & POVtruckPings$x<(-76.1724) & POVtruckPings$y>(36.5515) & POVtruckPings$y<(36.6766)
> objects()
 [1] "ATRIdata"                "NITtruckdates"                "NITtruckdatesin64window"      "NITtruckdatesinHBIIwindow"    "NITtruckPings"
 [6] "NITtruckPingsin64window"  "NITtruckPingsinHBIIwindow"    "NITtruckPingsinHBwindow"     "NITtruckPingsinTBwindow"     "NITwindowPings"
[11] "POVtruckdates"           "POVtruckdatesin10window"      "POVtruckdatesin13_32window"  "POVtruckdatesin17Cwindow"    "POVtruckdatesin17Gwindow"
[16] "POVtruckdatesin460window" "POVtruckdatesin58window"      "POVtruckdatesin64window"     "POVtruckdatesinCBBTwindow"   "POVtruckPings"
[21] "POVtruckPingsin10window"  "POVtruckPingsin13_32window"  "POVtruckPingsin17Cwindow"    "POVtruckPingsin17Gwindow"    "POVtruckPingsin460window"
[26] "POVtruckPingsin58window"  "POVtruckPingsin64window"      "POVtruckPingsinCBBTwindow"   "POVwindowsPings"            "temp"
> POVtruckPingsin168window<-subset(POVtruckPings, subset=POVtruckPings$in168window)
Error in eval(e, x, parent.frame()) : object 'POVtruckPings' not found
> POVtruckPingsin168window<-subset(POVtruckPings, subset=POVtruckPings$in168window)
> head(POVtruckPingsin168window)
  truckdate      x      y  truckid  readdate  speed  heading inNITwindow inNNMTwindow inVIGwindow inPOVwindows truckdate.Freq inTBwindow
507419 2420551910--2014-09-16 -76.24193 36.56797 2420551910 2014-09-16 39    NW    FALSE      FALSE      FALSE      FALSE      10    FALSE
507421 2420551910--2014-09-16 -76.23232 36.56478 2420551910 2014-09-16 41    NW    FALSE      FALSE      FALSE      FALSE      10    FALSE
507430 2420551910--2014-09-16 -76.20370 36.60767 2420551910 2014-09-16 40    S    FALSE      FALSE      FALSE      FALSE      10    FALSE
507438 2420551910--2014-09-16 -76.25629 36.56184 2420551910 2014-09-16 30    NE    FALSE      FALSE      FALSE      FALSE      10    FALSE
507447 2420551910--2014-09-16 -76.21599 36.63286 2420551910 2014-09-16 56    N    FALSE      FALSE      FALSE      FALSE      10    FALSE
507452 2420551910--2014-09-16 -76.19955 36.56737 2420551910 2014-09-16 54    S    FALSE      FALSE      FALSE      FALSE      10    FALSE
  in13_32window in58window in460window in10window in64window in17Gwindow inCBBTwindow in17Cwindow in168window
507419      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      TRUE
507421      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      TRUE
507430      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      TRUE
507438      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      TRUE
507447      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      TRUE
507452      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      FALSE      TRUE
> temp<-data.frame(x=POVtruckPingsin168window$x, y=POVtruckPingsin168window$y)
> write.csv(temp, file="POVtruckPingsin168window.csv", row.names=FALSE)
```

# Identifying trucks using a gateway



# Gateway Share of POV Trucks, ATRI, Sep. 2014





# III. Big Data Resources and Analytics for Trucks



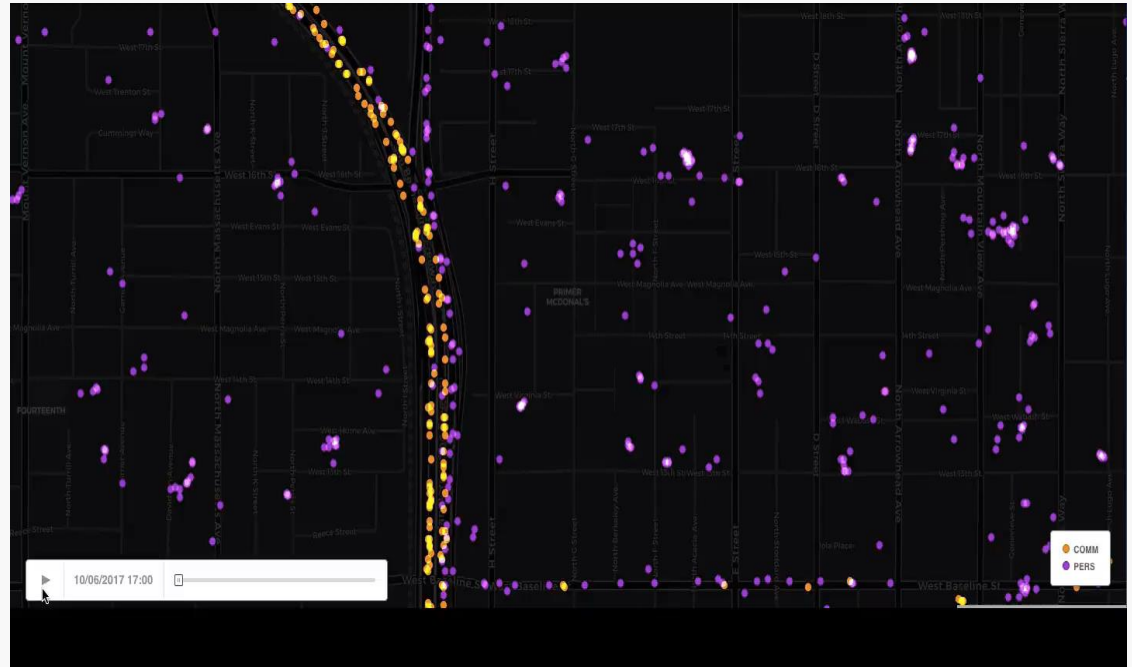


# Put Big Data to Work with StreetLight Data

We simplify data-driven infrastructure and policy planning by providing the best **Big Data resources and software together.**



# What Big Data are we working with?

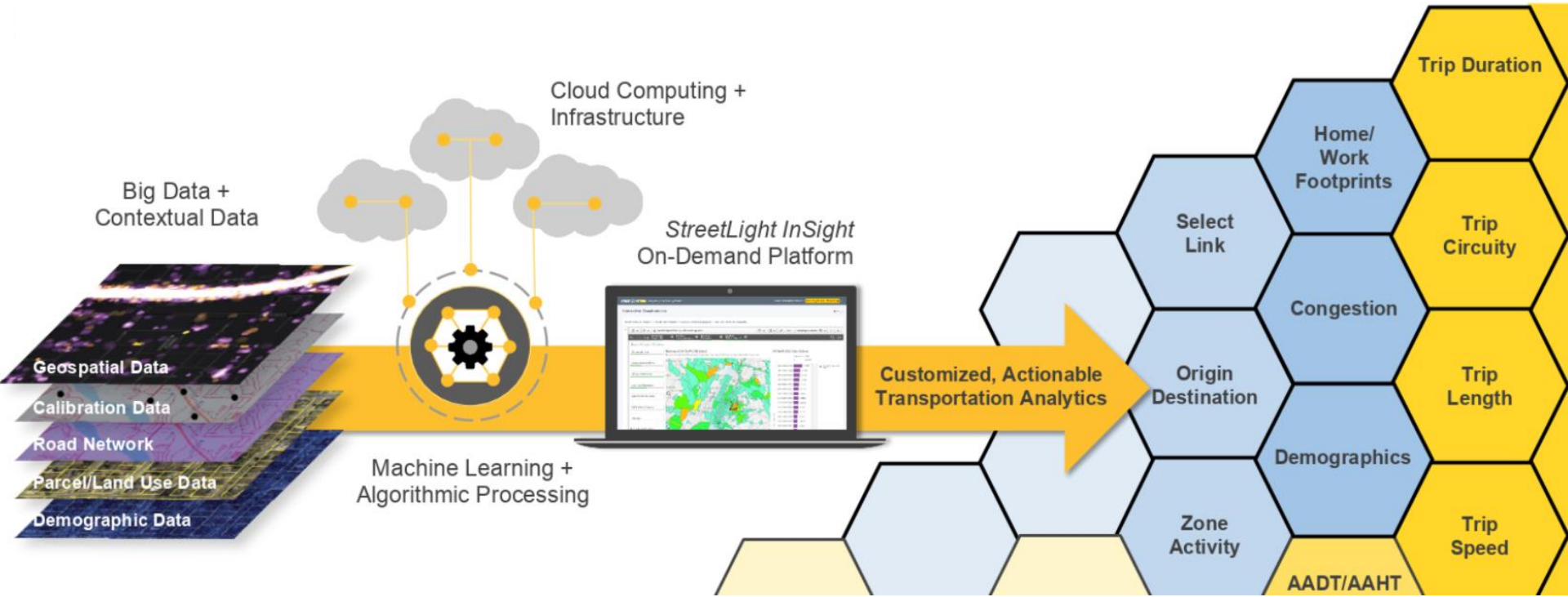


Mobile device data from ~23% of US and Canadian adults and ~12% of commercial truck trips.

Video shows a subset from Oct 8th, 2017 in San Bernardino, California.



# StreetLight InSight® turns Big Data into actionable transportation analytics on demand







# We offer the best combination of data resources for understanding travel behavior

## CONTEXTUAL DATA



**Road Network Maps**



**Parcel Data**



**American Community Surveys**

## LOCATIONAL BIG DATA



**Navigation-GPS Data**

- Segments commercial trucks
- 28B+ data points/month



**Location-Based Services Data**

- Large sample size
- 32B+ data points/month

# Our Navigation-GPS Data is Recommended for Commercial Truck Studies

1

**Data Feed  
from  
Truck  
Fleet  
Managem  
ent  
Systems**

2

**Separates  
Medium-  
Duty and  
Heavy-  
Duty  
Truck  
Trips**

3

**Very High  
Spatial  
Precision  
and  
Regular,  
Frequent  
Pings**



# Our Analytics for Commercial Trucks

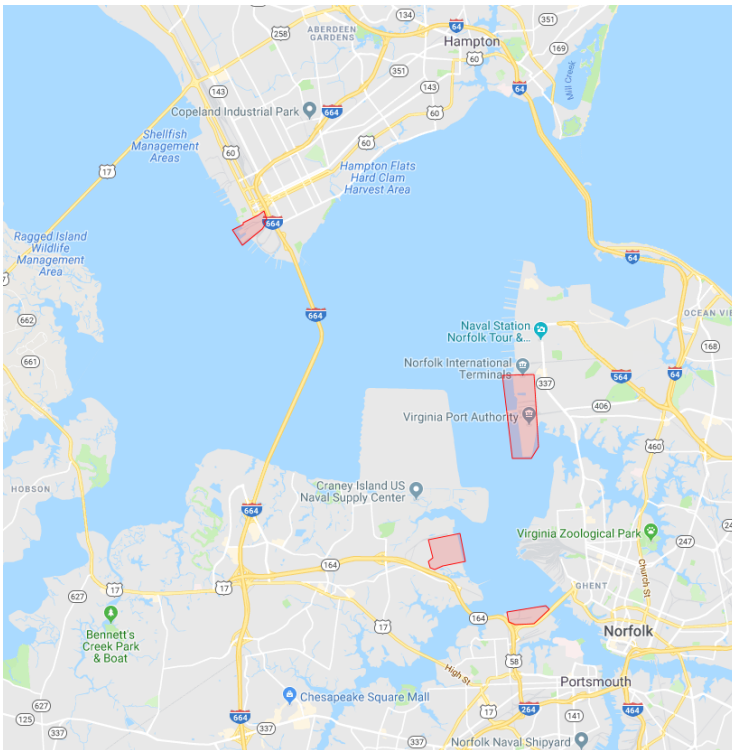
Commercial Trip Metrics	Commercial Tour Metrics
<p>For Trips</p> <ul style="list-style-type: none"><li>• Touching 1 Zone,</li><li>• Going between an origin/destination</li><li>• Select link (origin/middle/destination)</li><li>• Zone activity (relative volume of trips)</li></ul>	<p>For Tours</p> <ul style="list-style-type: none"><li>• Touching 1 Zone</li><li>• Going between a “final” O/D or “intermediary” O/D pairs</li><li>• With stops in a set of zones: O/D1/D2/D3</li></ul>
Average Values for Travel Time, Speed and Distance	Average total tour time/distance and distribution of total tour times/distances
Distributions of Travel Time, Speed, and Distance	# of trips/stops per tour
	Distribution of trip/stop duration per tour



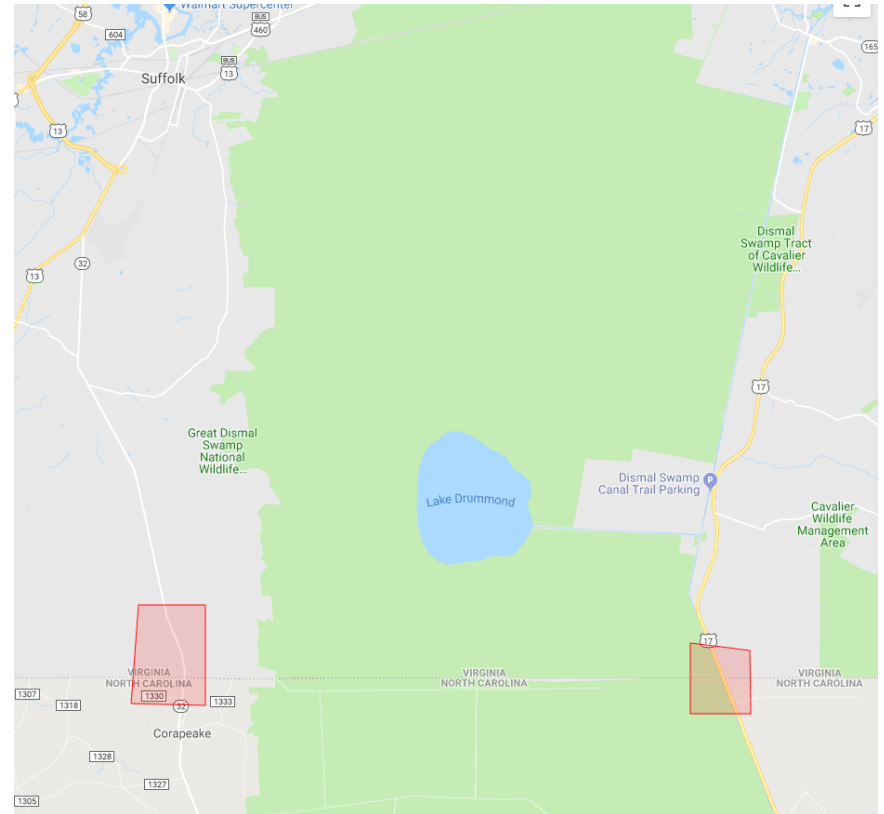
## IV. Using StreetLight Data



# Entering ports and gateways into StreetLight



**Ports** (where trips originate)



**Gateways** (where trips “pass through”)

# StreetLight- first try: using ports as origins

**General Information**

**Name:** 4 Ports and 12 Gateways  
**Folder:** HRTPO- Rob Case  
**Type:** O-D Analysis (GPS Data)  
**Premium Add-On Metrics:** None  
**Created By:** Not available yet

**Zones**

**Origin Zones** Destination Zones Trip Filters Calibration Zones

Search

Zone Name	Pass-through	Direction
Hampton Roads 4 ports - Polygon Set with 4 Zones.		
NIT	No	
NNMT	No	

**Options**

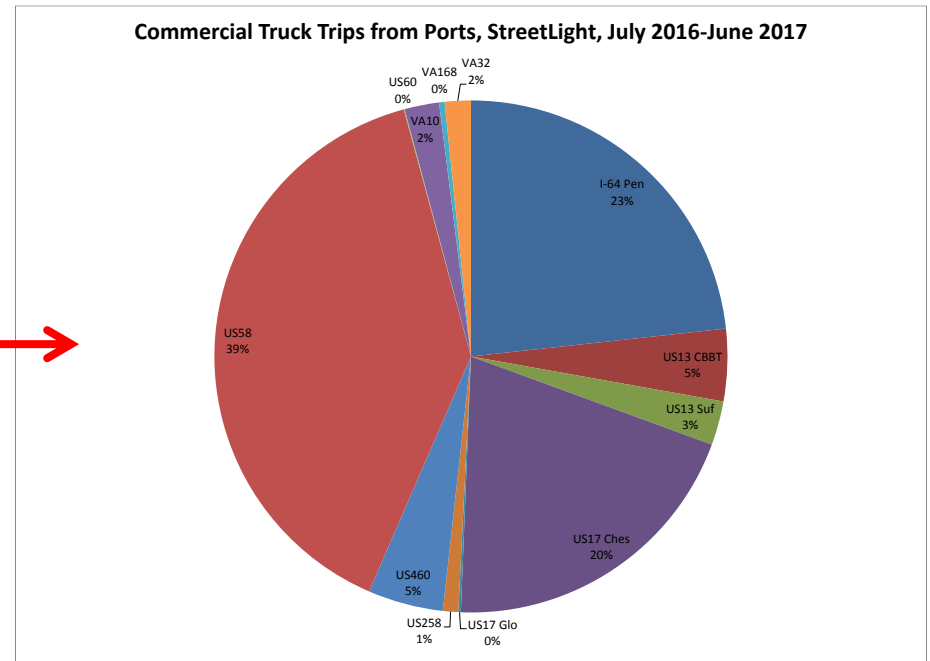
**Standard**

**Trip Type**  
Locked to Route

**Data Period(s)**  
Jul'16, Aug'16, Sep'16, Oct'16, Nov'16, Dec'16, Jan'17, Feb'17, Mar'17, Apr'17, May'17, Jun'17

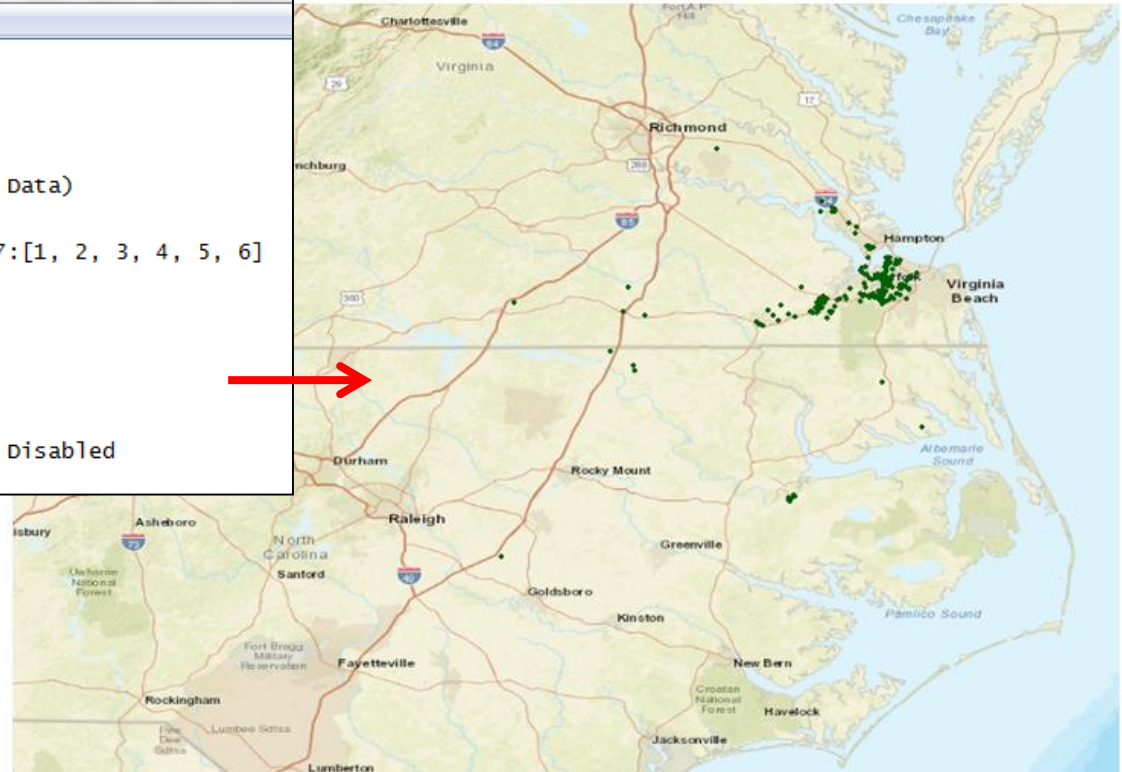
**Day Types**  
Average Day: M-Su  
Average Weekday: M-F

(different) illogical results:



# Checking the other end of trips

```
Project_OD_G.txt - Notepad
File Edit Format View Help
Project: HR-Ports-tofrom-Geography
Created by: rcase@hrtpo.org
Created on: 2017-10-05
Organization: VDOT - Master Account
Project Type: O-D to Pre-set Geography (GPS Data)
Geography: Census Block Group
Data Period: 2016:[7, 8, 9, 10, 11, 12] 2017:[1, 2, 3, 4, 5, 6]
Trip Type: Locked to Route
Day Type:
1: Average weekday (M-F)
Day Part:
0: All Day (12am-12am)
Commercial vehicle Results by weight Class: Disabled
```



StreetLight trips ended mostly within the region

(due apparently to 5-minute stop parameter)

**FIGURE 6 Virginia and North Carolina Trip “Ends” of Trucks from VIG, Jul’16-Jun’17, one dot equals 100 StreetLight Index Trucks**

Source: HRTPO mapping via ESRI using HRTPO staff programming of StreetLight (port trucks- StreetLight- VIG as origin.mxd)

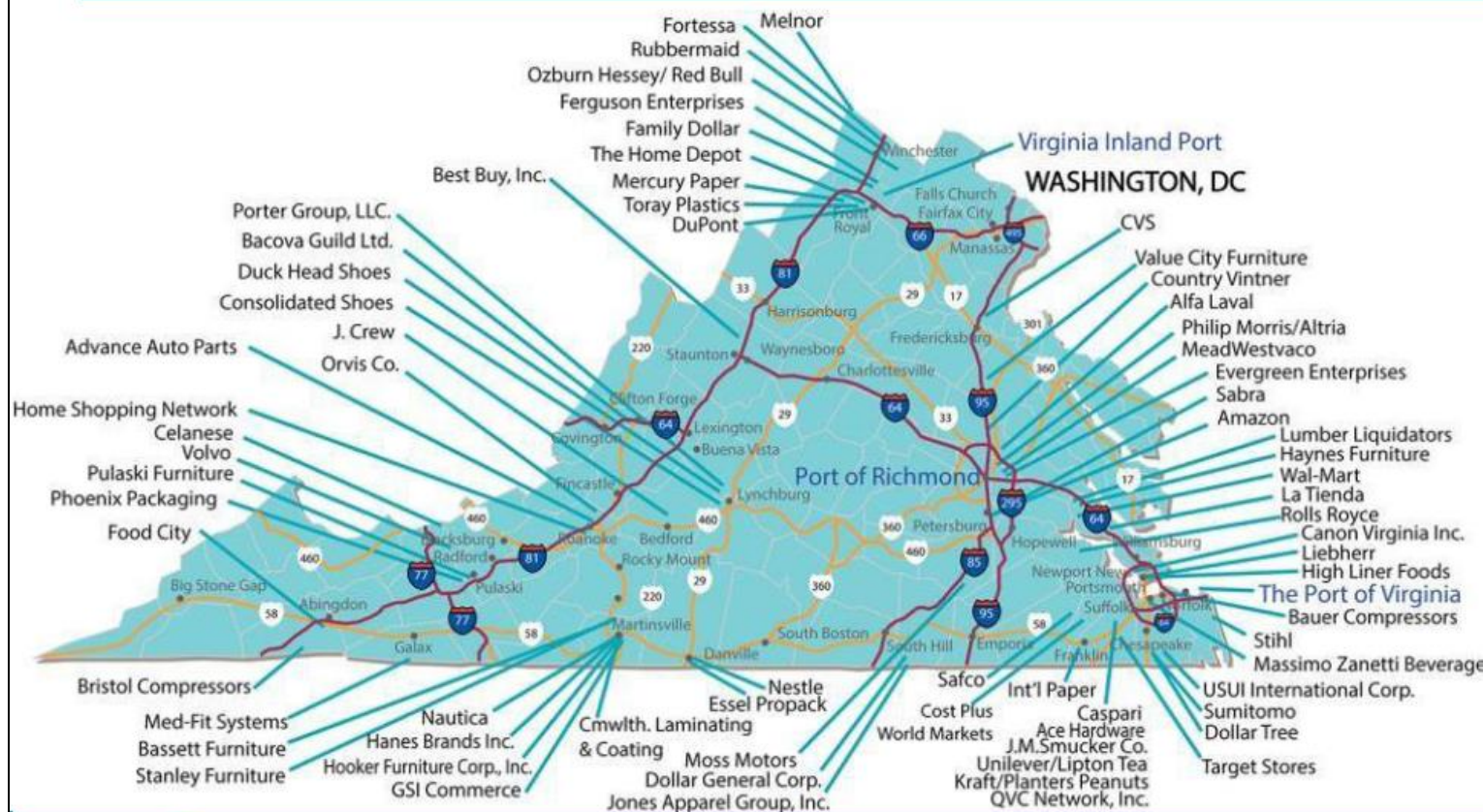
# Destinations vs. Origins- a solution?

- I ran the analyses programming the ports as “**origins**”.
- Programming ports as **origins** captures these trips:
  - Trucks that carry **imports** from the port, going where the imports need to go... (distribution centers?).
  - Trucks that carried **exports** to the port, going... (back to get more exports?)
- Programming ports as **destinations** captures these trips:
  - Trucks that carry **exports** to the port, coming from... (where the exports were produced?)
  - Trucks that will pick up **imports** at the port, coming from... (trucking company?)
- It would be instructive to re-run the analyses programming the ports as “**destinations**” to see if the “other” end results differ.

That not occurring to me at the time, I looked **beyond the ports** for port-related trips that might not “end” within the region.

# second try: using DCs as origins

## Distribution Centers Utilizing The Port



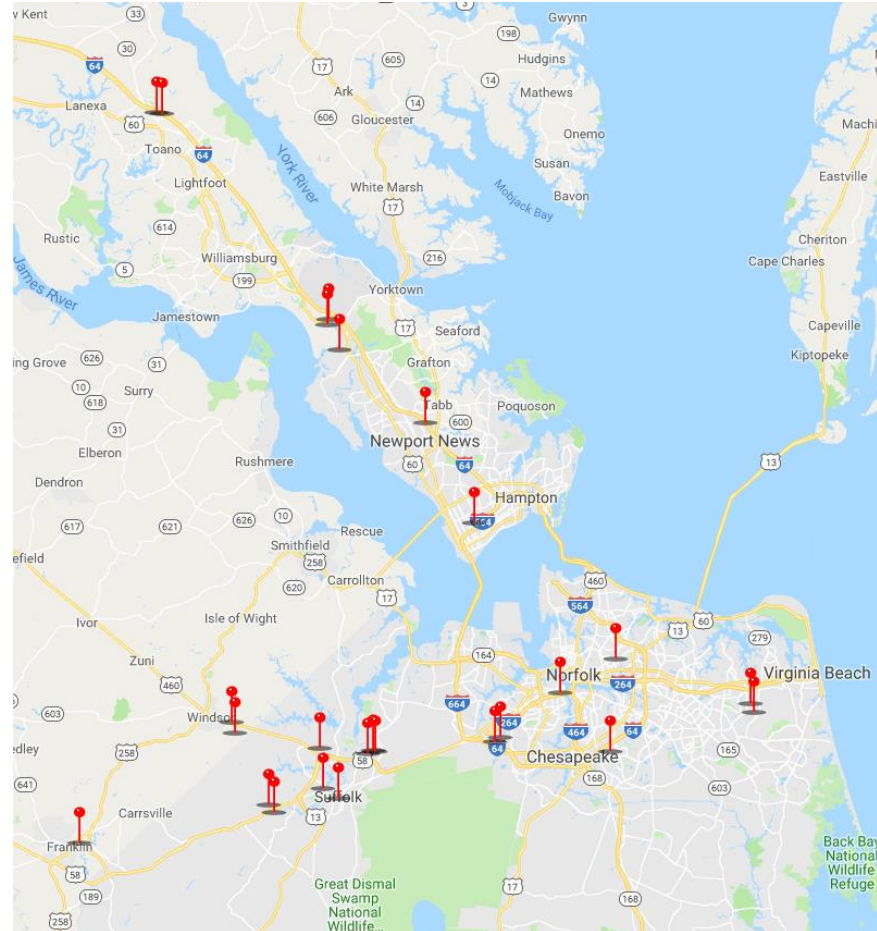
Stewards of Tomorrow

12



# Local Port-related Distribution Centers

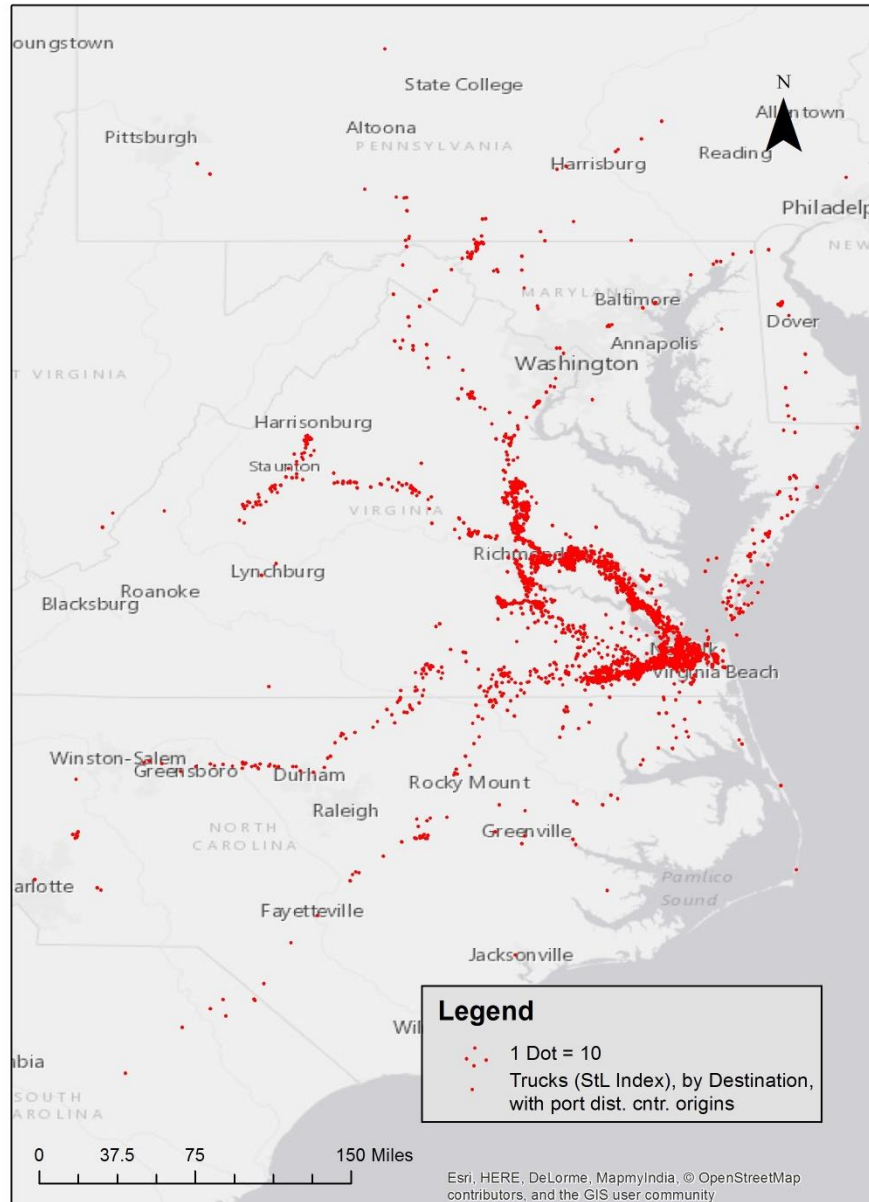
- Canon Virginia
- Liebherr
- High Liner Foods
- Bauer Compressors
- Stihl
- Massimo Zanetti Beverage
- USUI Intl.
- Sumitomo
- Dollar Tree
- Lumber Liquidators
- Haynes Furniture



- Target Stores
- Caspari
- Ace Hardware
- J.M. Smucker
- Unilever / Lipton
- Kraft / Planters
- QVC Network
- Intl. Paper
- Cost Plus World
- Safco
- Wal-Mart
- La Tienda

What type of port business do the distribution centers represent?

# Checking the other end of trips

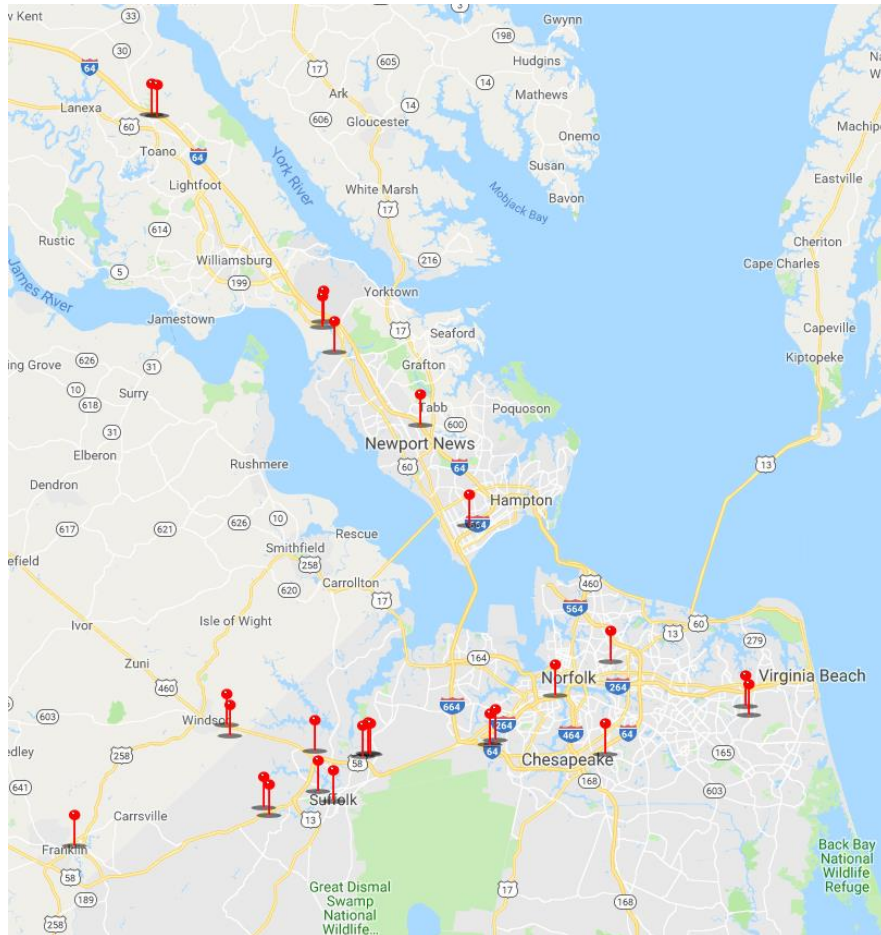


Many StreetLight trips from distribution centers ended **outside the region**

Logical location of destinations

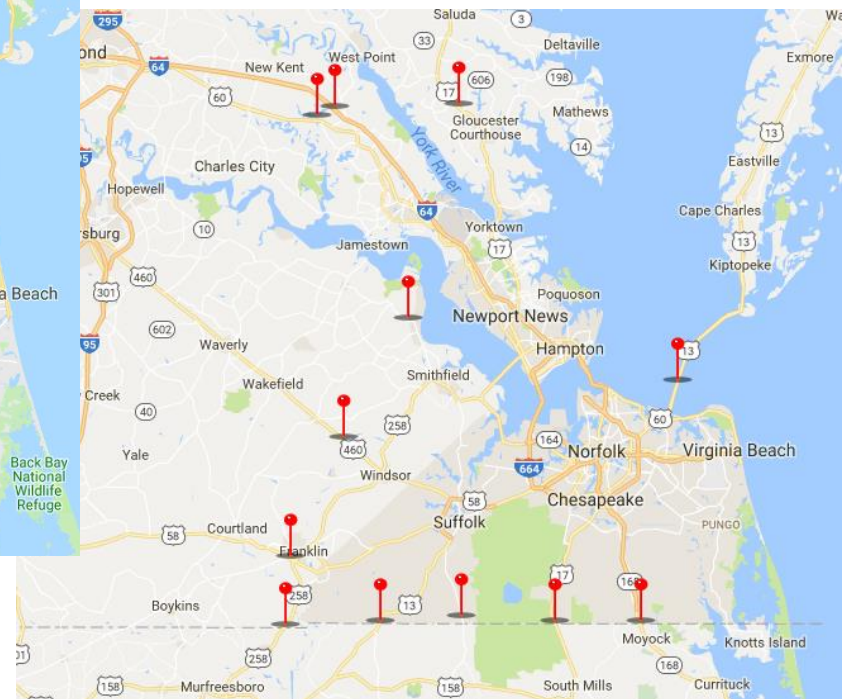
Note usage of ESRI

# O/D Analysis: DCs & Gateways



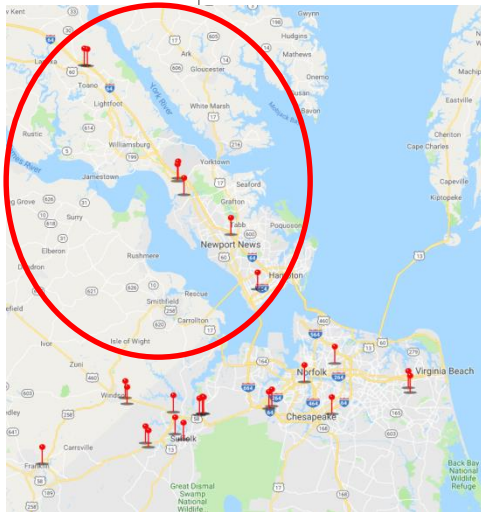
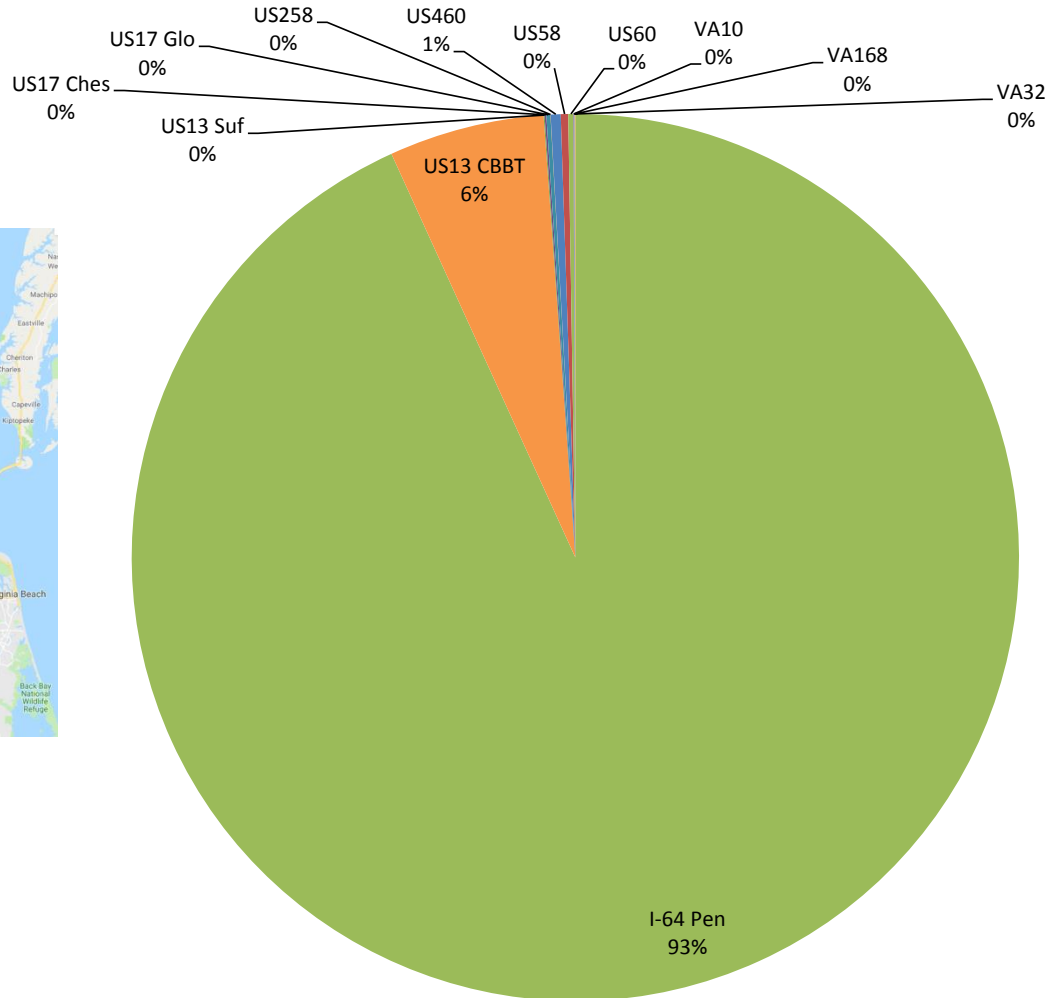
Distribution Centers (origins)

Gateways (destinations)



# Peninsula Distribution Centers

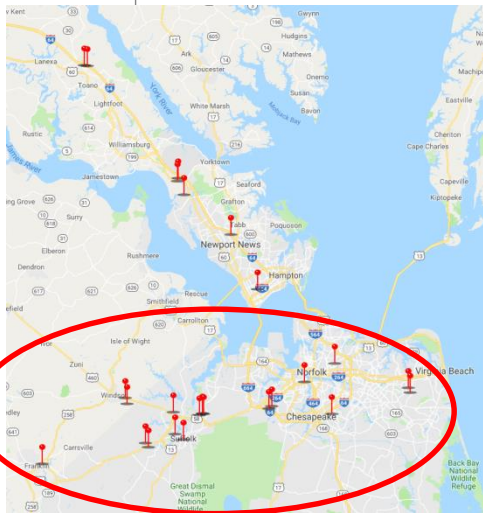
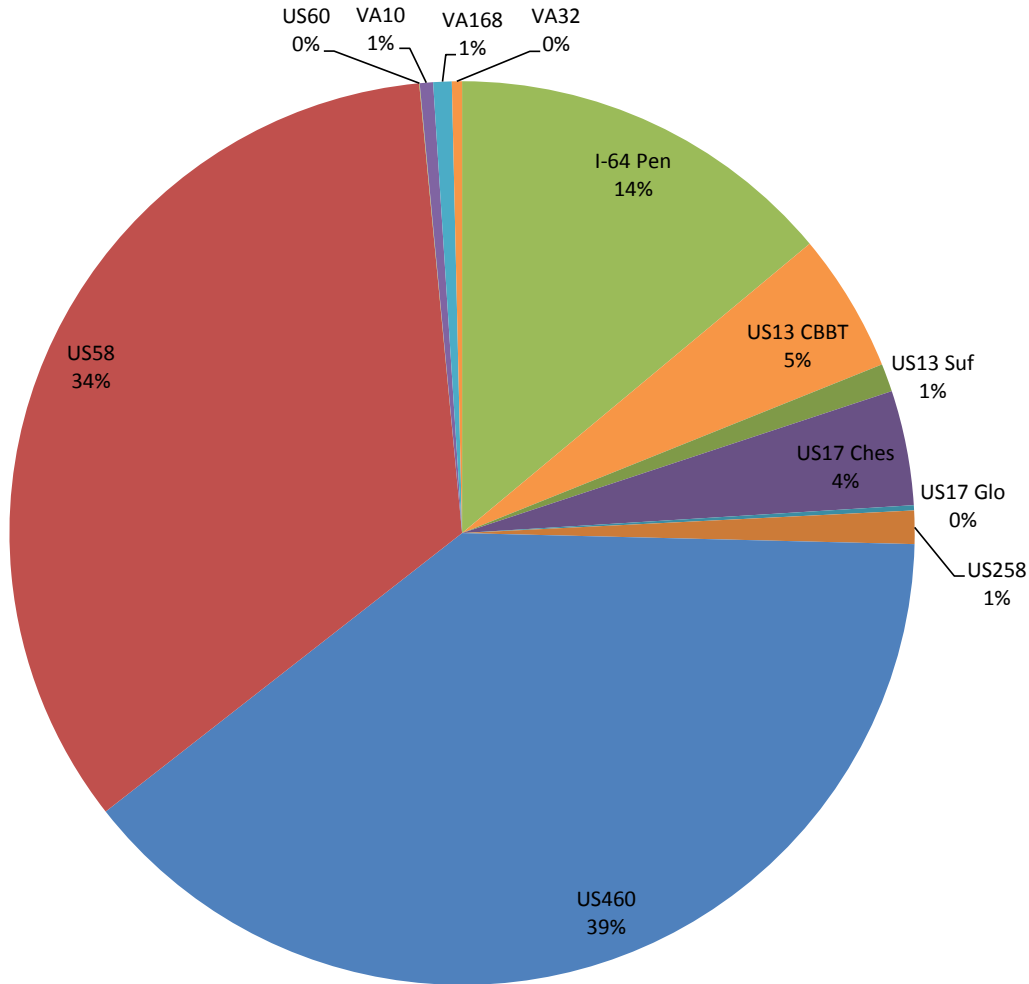
Gateways, by portion of all **Peninsula** port distribution center trucks thru gateways, average weekday, 7/2016-6/2017 (Source: HRTPO via StreetLight)





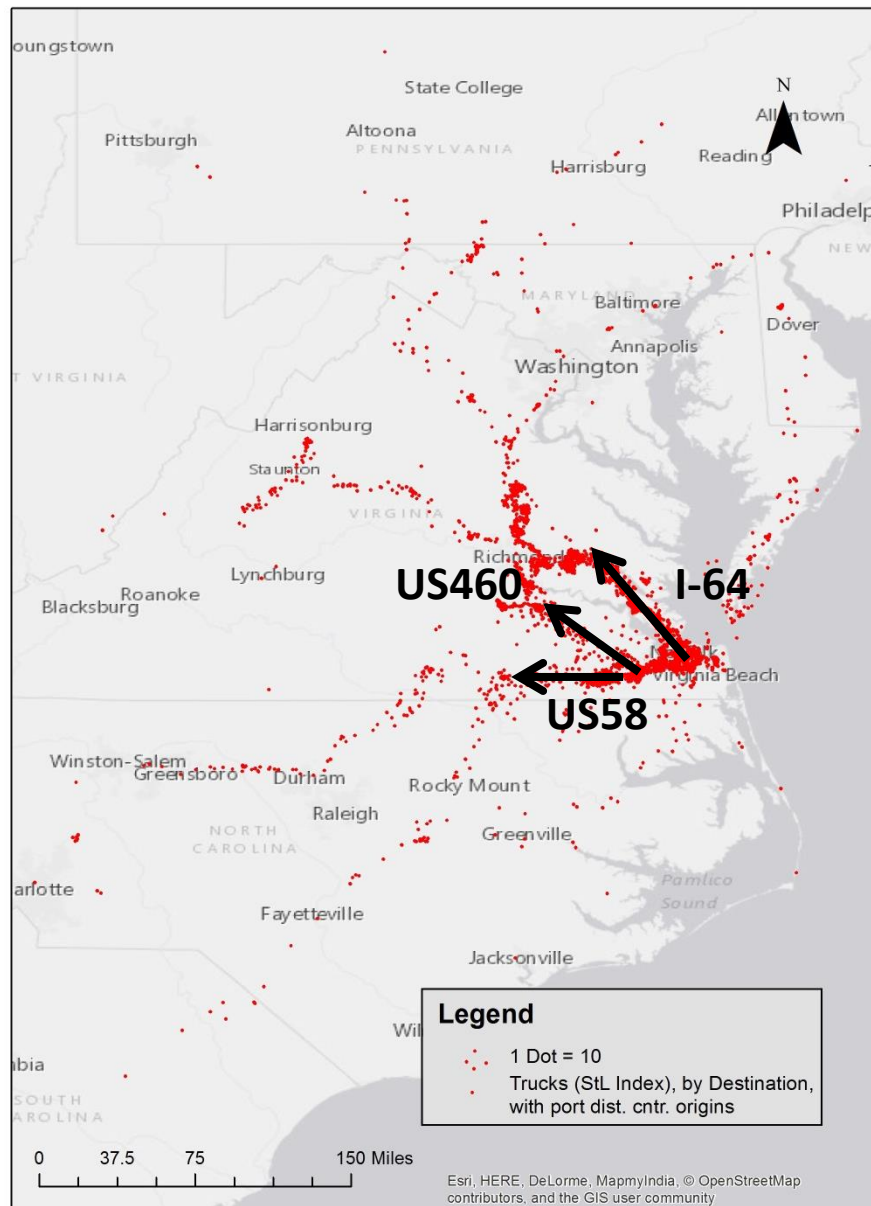
# Southside Distribution Centers

Gateways, by portion of all **Southside** port distribution center trucks thru gateways, average weekday, 7/2016-6/2017 (Source: HRTPO via StreetLight)





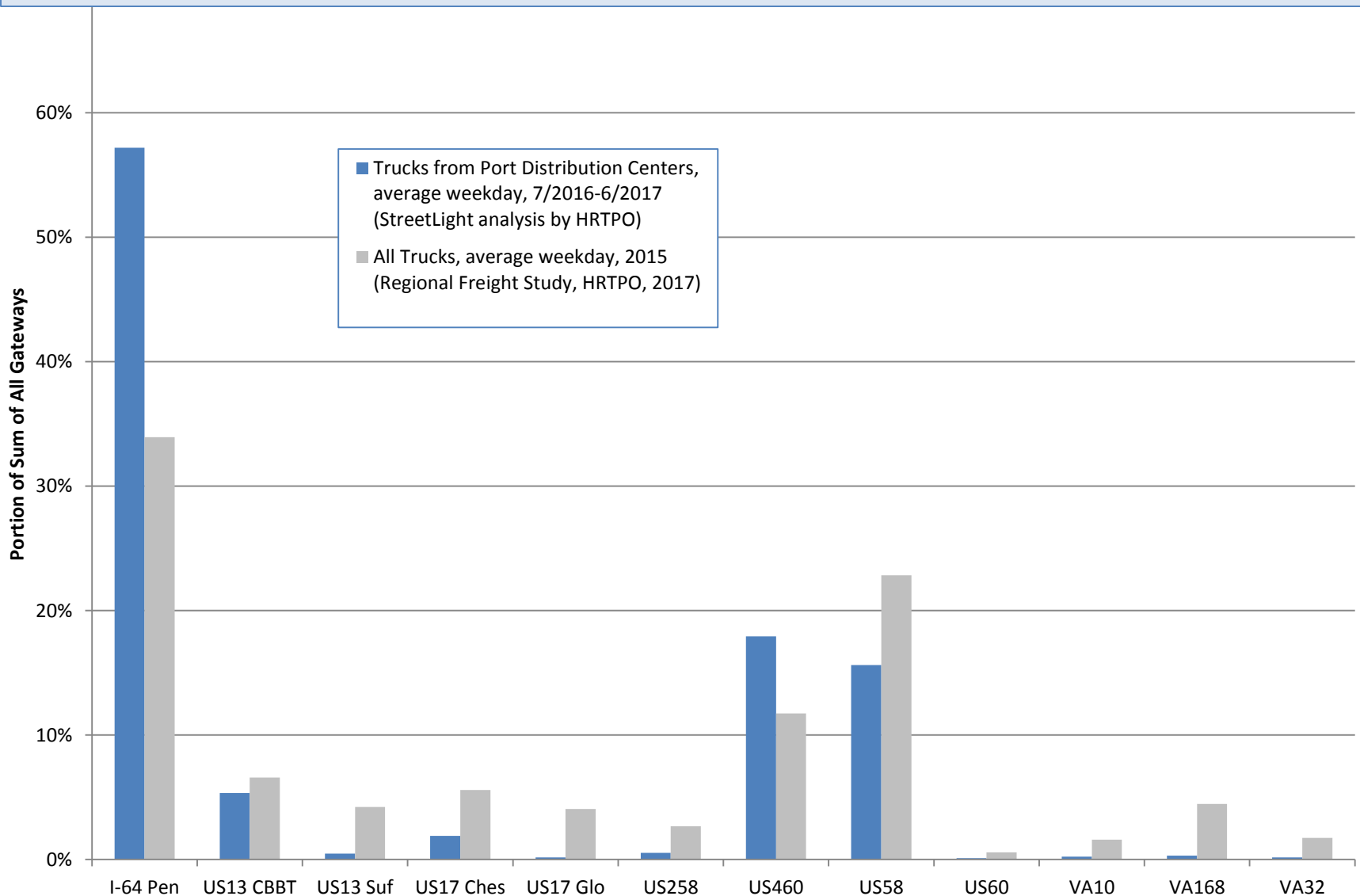
# Checking the logic of the results



I-64 and US460 serving trips to north and west

US58 serving trips to south

# We knew about trucks, but not port trucks



# Implementation

- Provide gateway usage to **current studies**:
  - US 58 Corridor Study
  - Skiffes Creek Connector
  - US 460/58/13 Connector
  - Regional Connectors Study
- Consider gateway usage when scoring projects via **HRTPO Prioritization Tool**
  - “increase access to port facilities” (10 points)

# Questions?

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