

BWI Traffic Analysis and Notional Paths

To: DC Metroplex BWI Community
Roundtable Working Group

Date: June 20, 2017

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Bennie Hutto (NATCA)



Federal Aviation
Administration



Contents

- **PBN Design Influences and Factors**
- **Lateral Analysis**
 - Traffic density changes
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 - Notional designs
- **Vertical Analysis**
 - Altitude distribution changes
 - Vertical profiles
- **Speed Analysis**
 - Ground speed distribution changes
- **Notional Path Discussion**
- **Notional Next Steps**



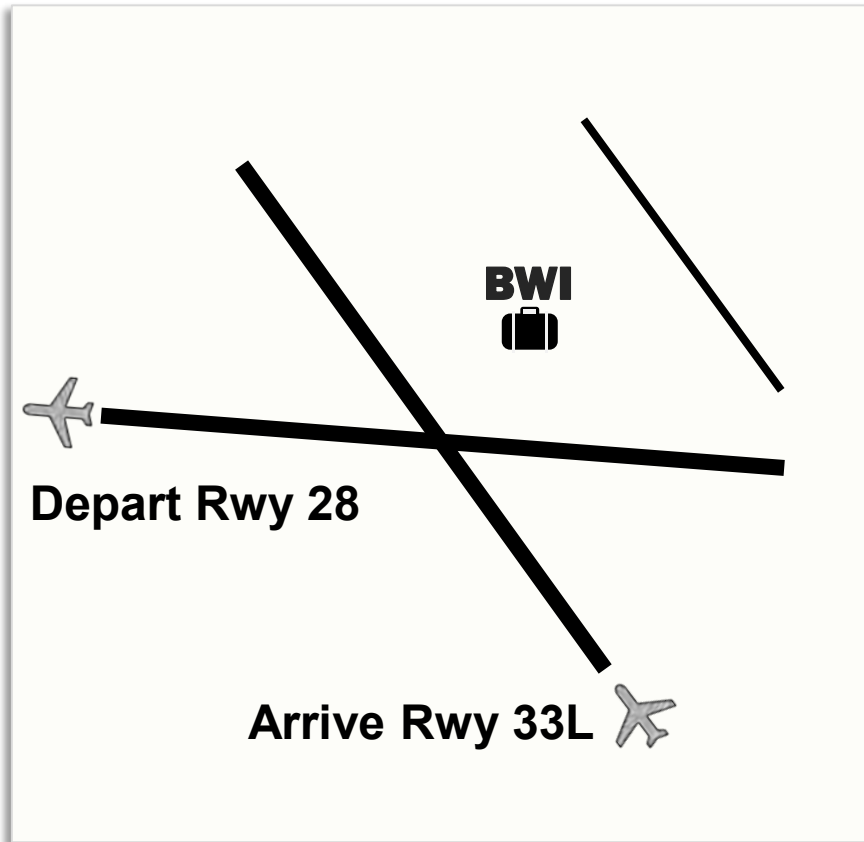
PBN Design Influences & Factors

- **Runway configuration**
 - Winds
 - Temporary runway closures
- **Air Traffic Control (ATC) considerations**
 - Requirements & constraints
 - Adjacent & Special Use Airspace
 - Vectoring & shortcuts
 - Sequencing & spacing
 - Equivalent Lateral Spacing Operations (ELSO)
- **Procedures**
 - Lateral (dispersion / track)
 - Vertical
 - Speed
 - Flyability (aircraft performance)

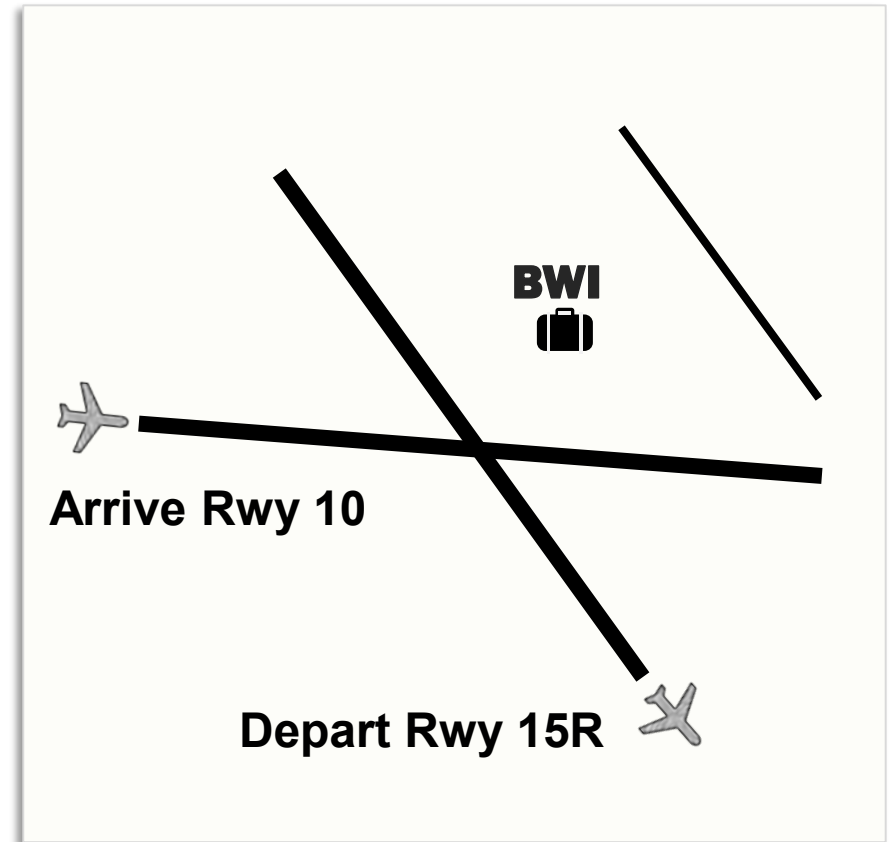


Runway Configurations

Primary

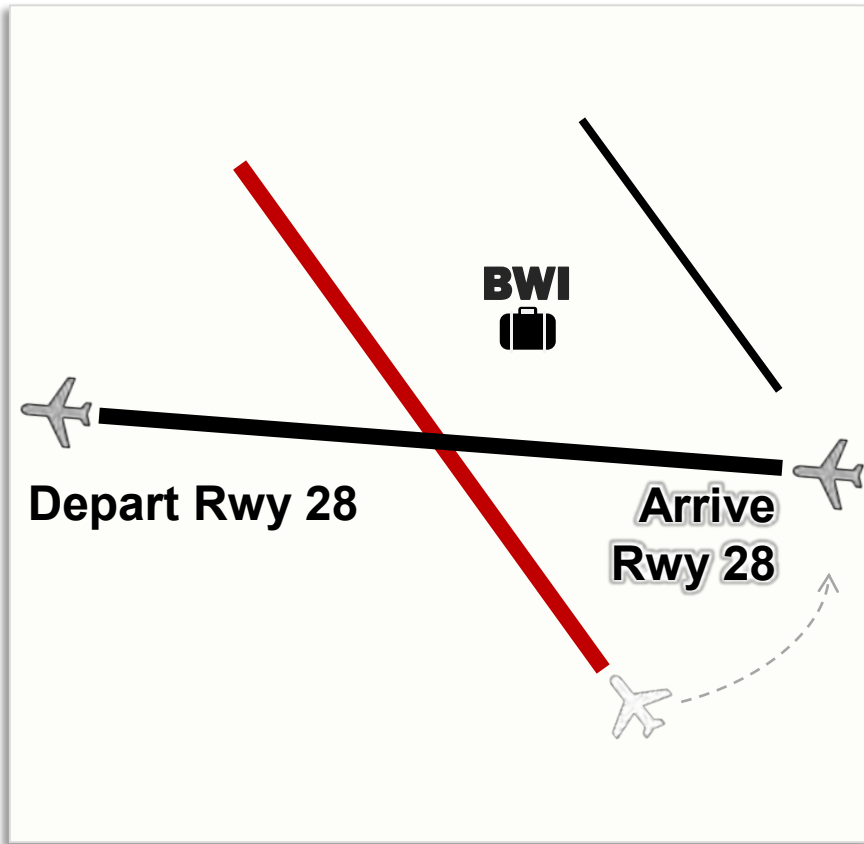


Secondary

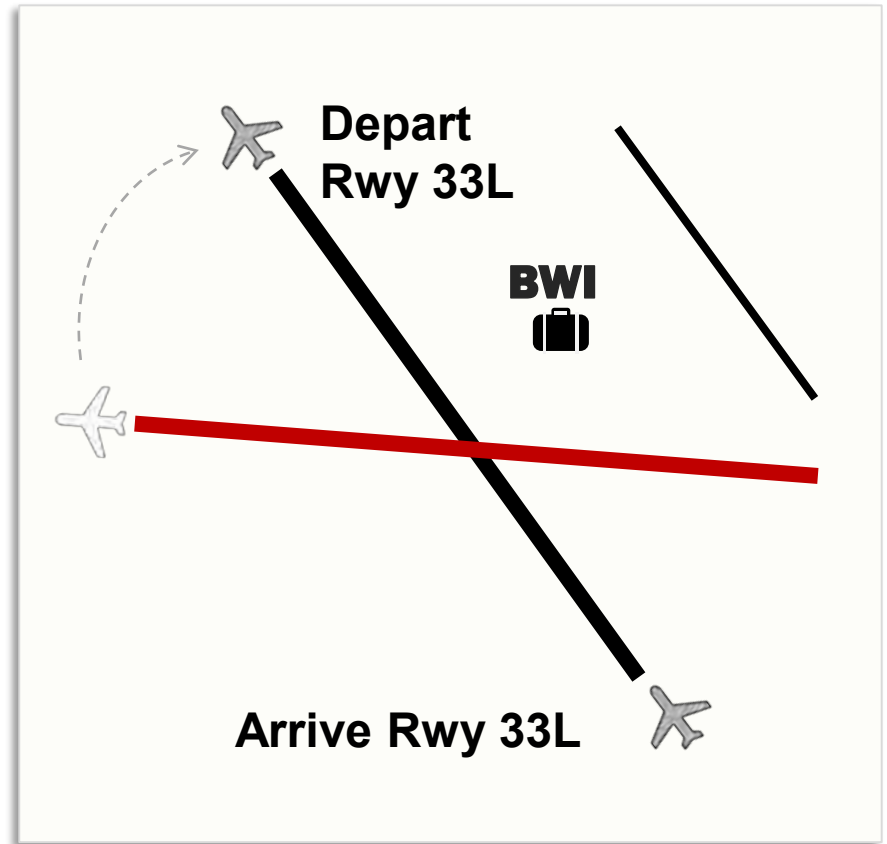


Runway Closures

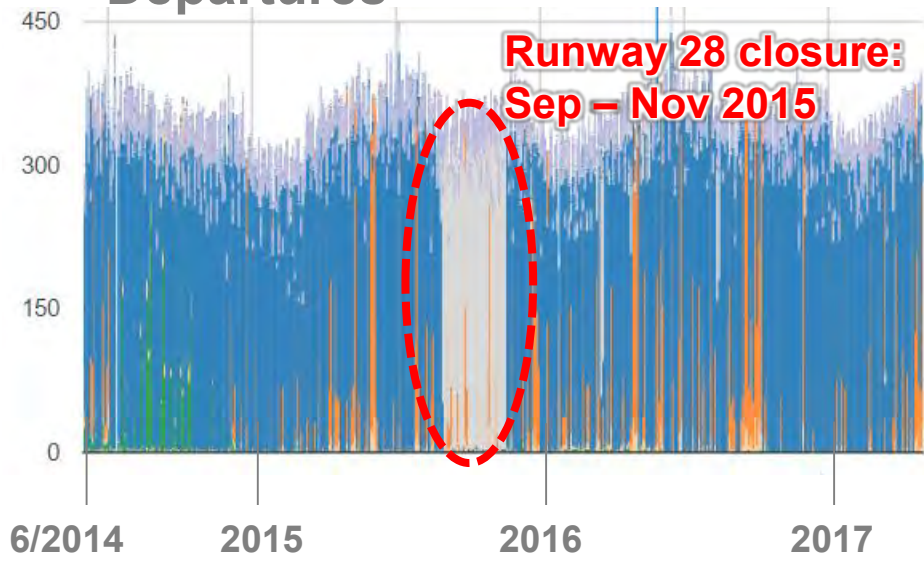
Primary
2014 Jul – Nov



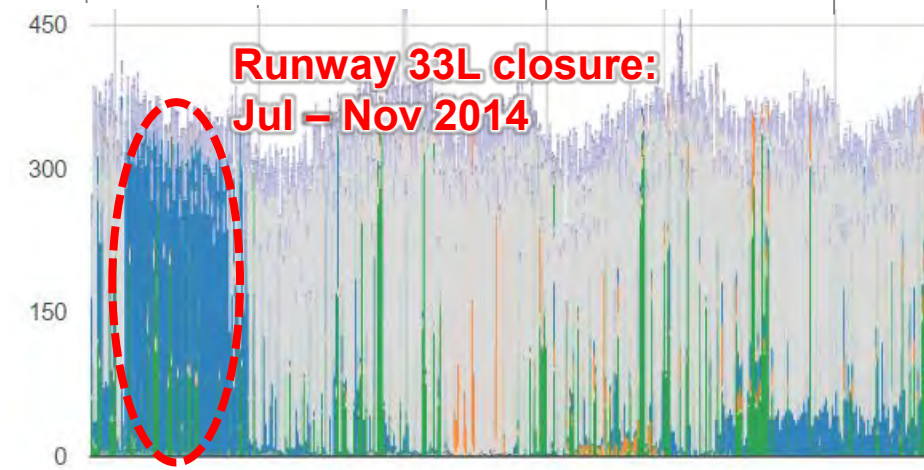
Primary
2015 Sep – Nov



Departures

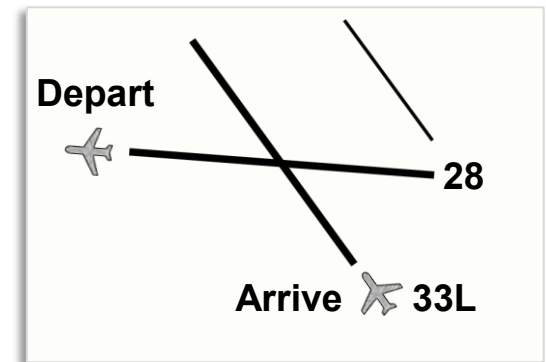


Arrivals



Daily Operations by Runway

- 33R
- 33L ← Primary for arrivals
- 28 ← Primary for departures
- 15R
- 15L
- 10



Note: Rwy 04 and Rwy 22 are excluded, as they have less than 0.2% of all operations

Special Flight Rules Area

BWI
↔

≡
IAD

DCA

||
ADW

Flight Restricted Zone

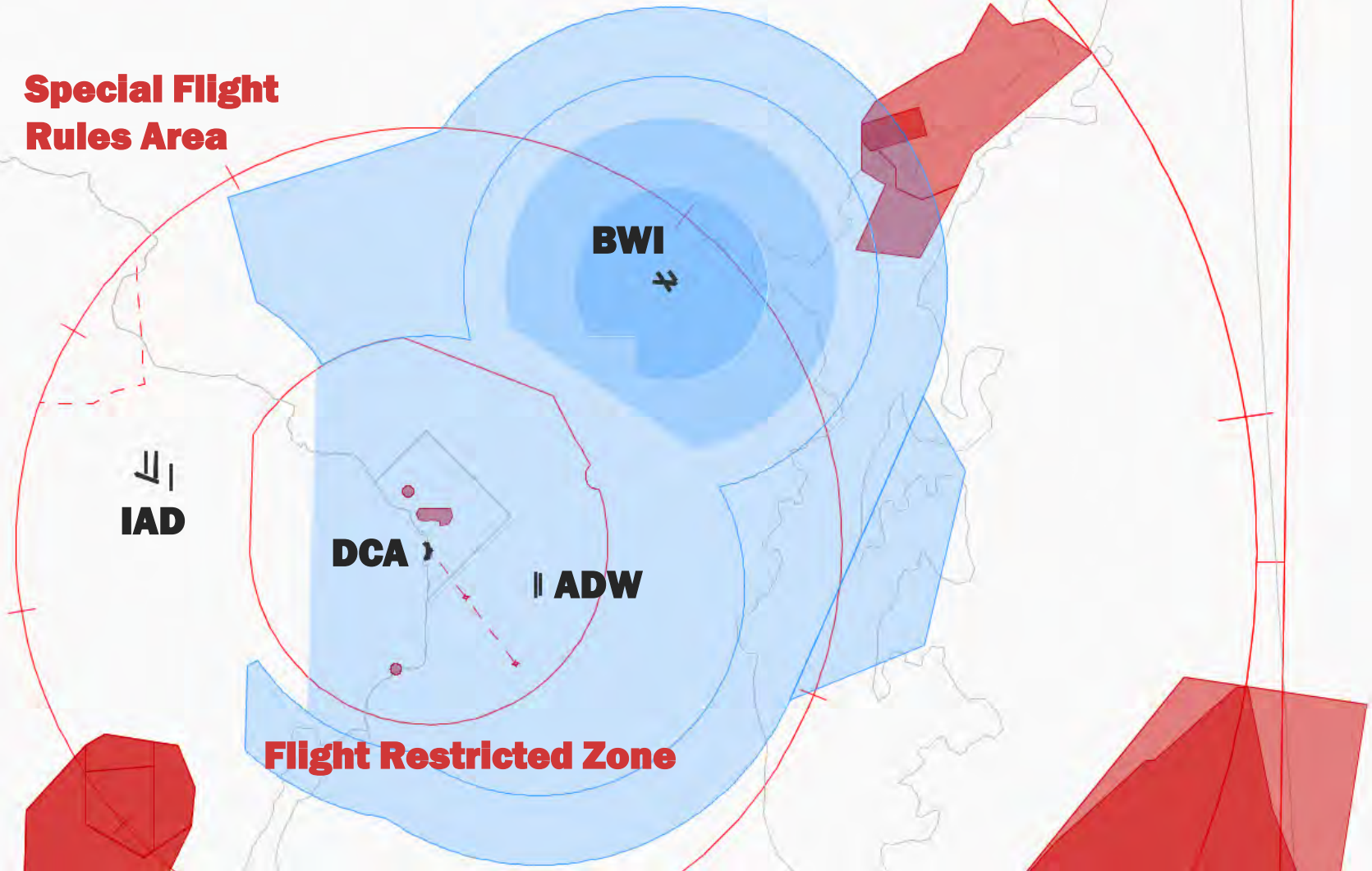
ATC Considerations



Federal Aviation Administration

**Class B Airspaces
(up to 10,000 ft)**

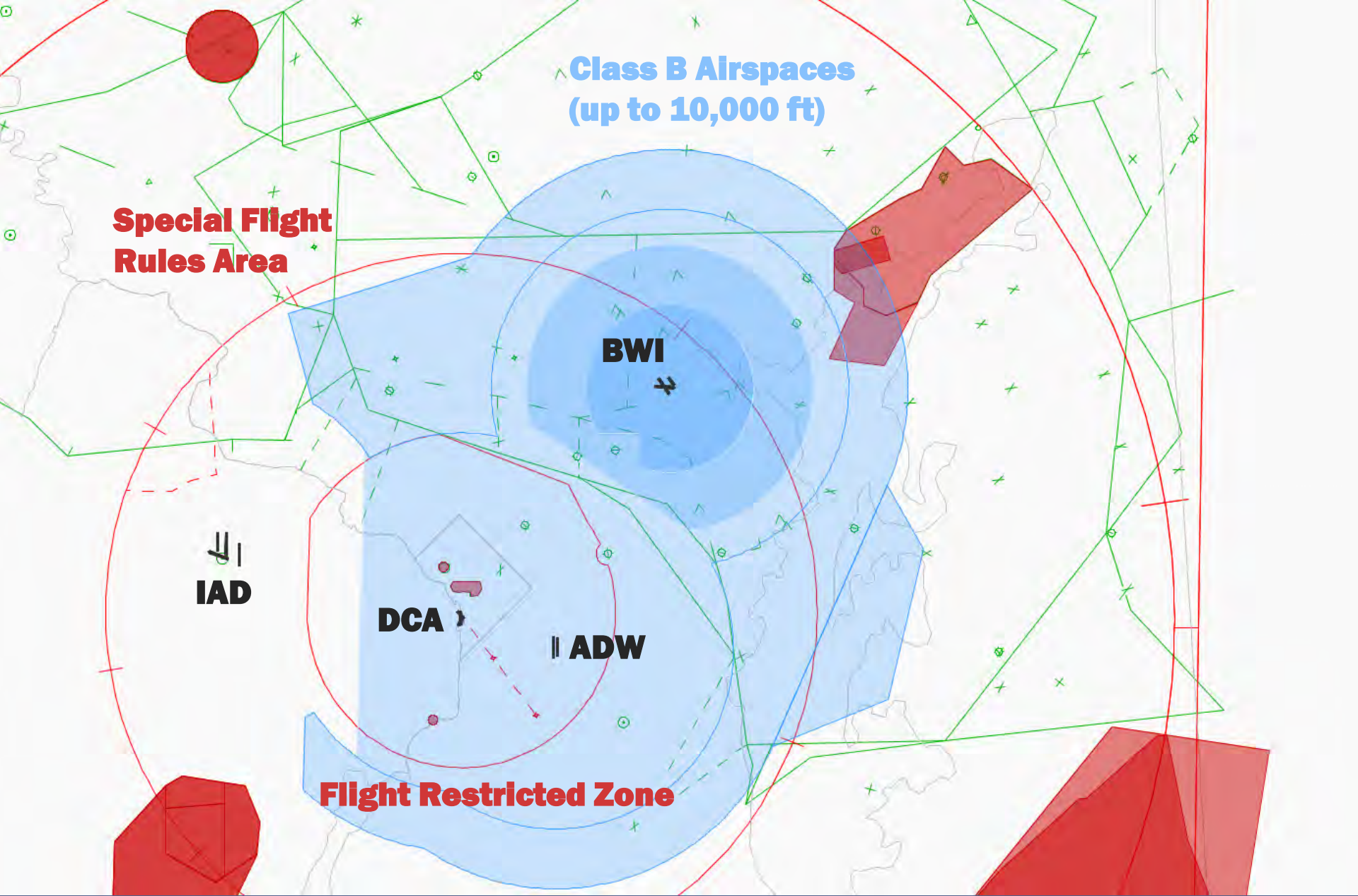
**Special Flight
Rules Area**



ATC Considerations



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ATC Considerations

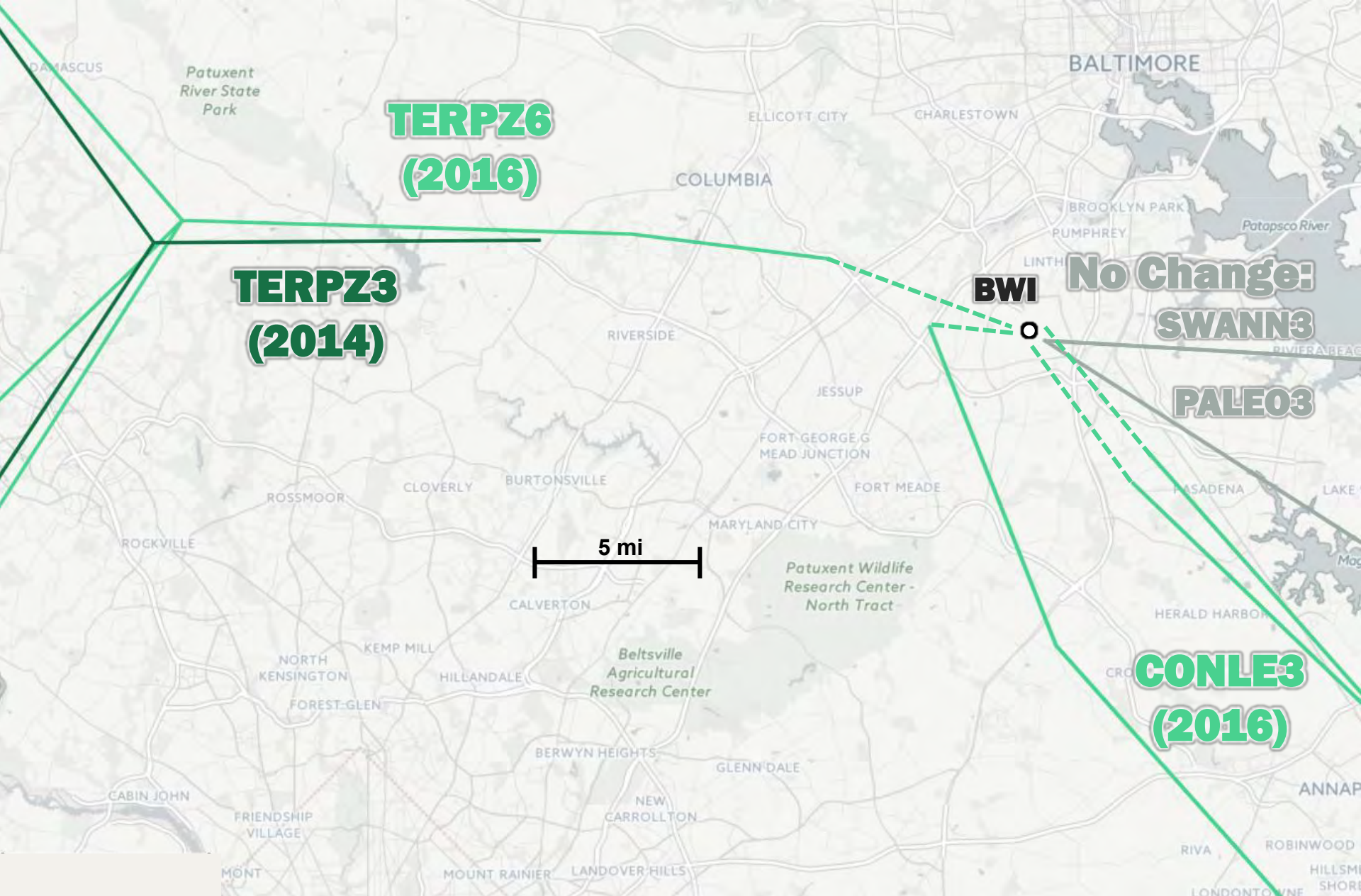


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Lateral Analysis

Runway 28 & 15R Departures





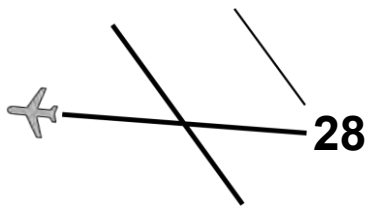
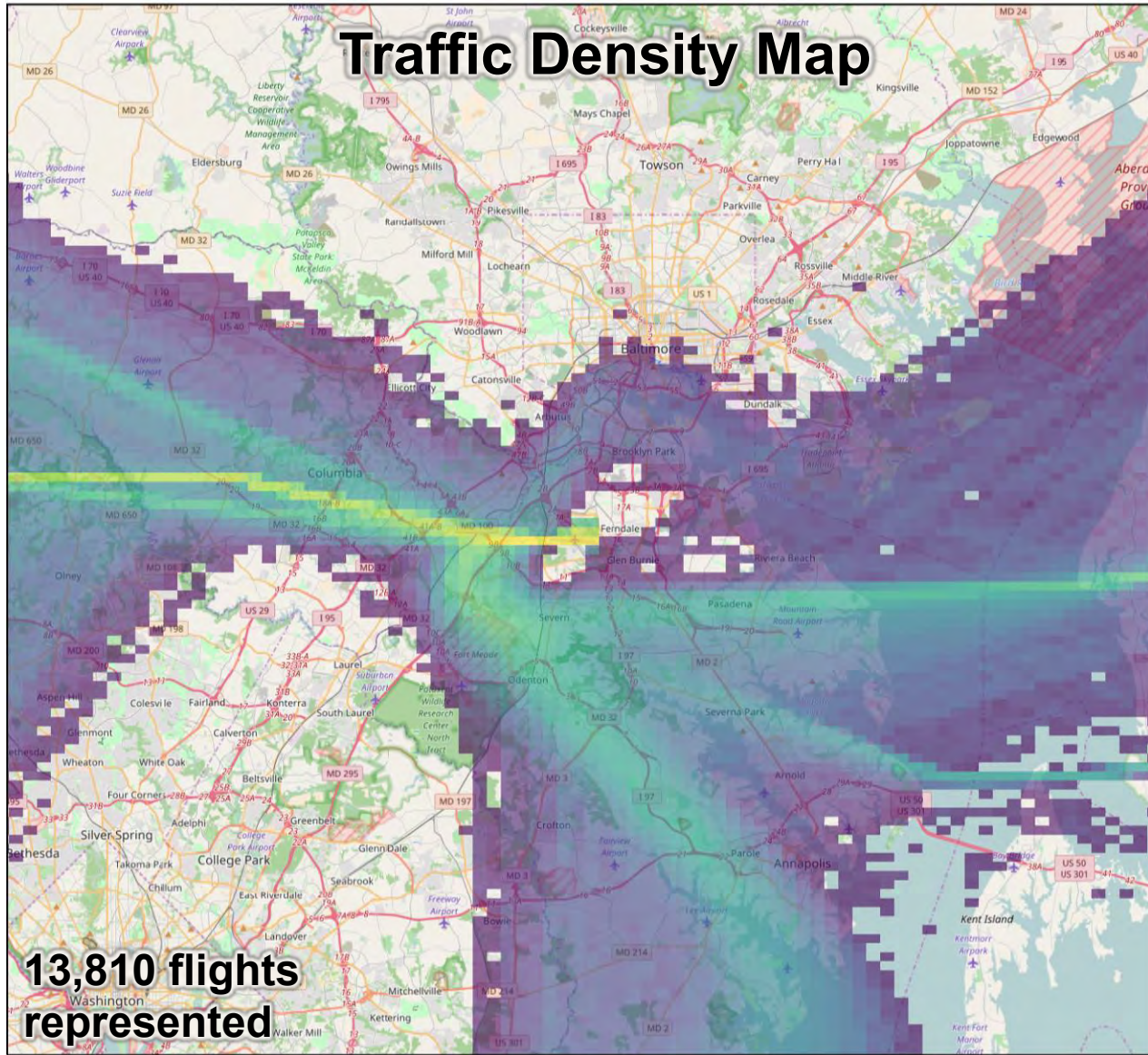
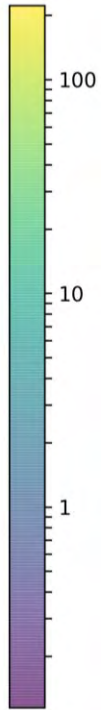
Departure Changes



Federal Aviation Administration

Traffic Density Map

June – July
2014
Daily Average
Flight Count



**13,810 flights
represented**

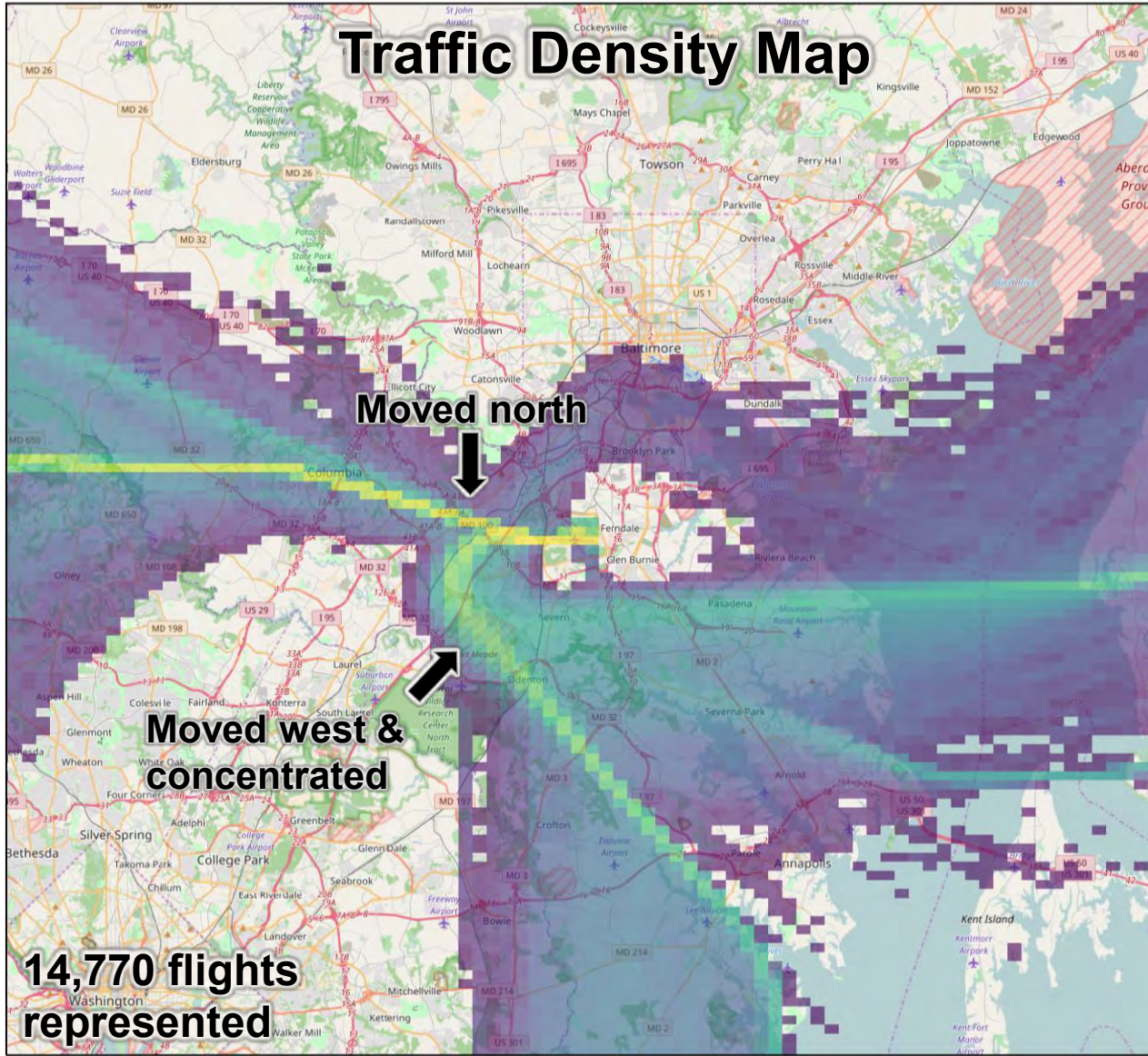
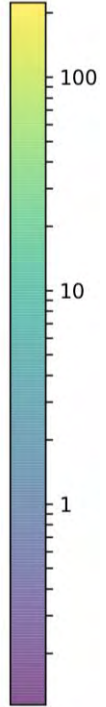
Rwy 28 Departures



Federal Aviation
Administration

Traffic Density Map

June – July
2016
Daily Average
Flight Count



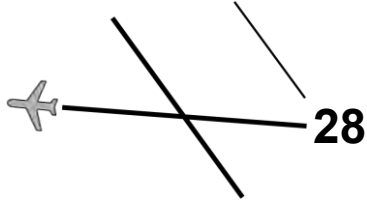
Moved north



Moved west & concentrated



**14,770 flights
represented**

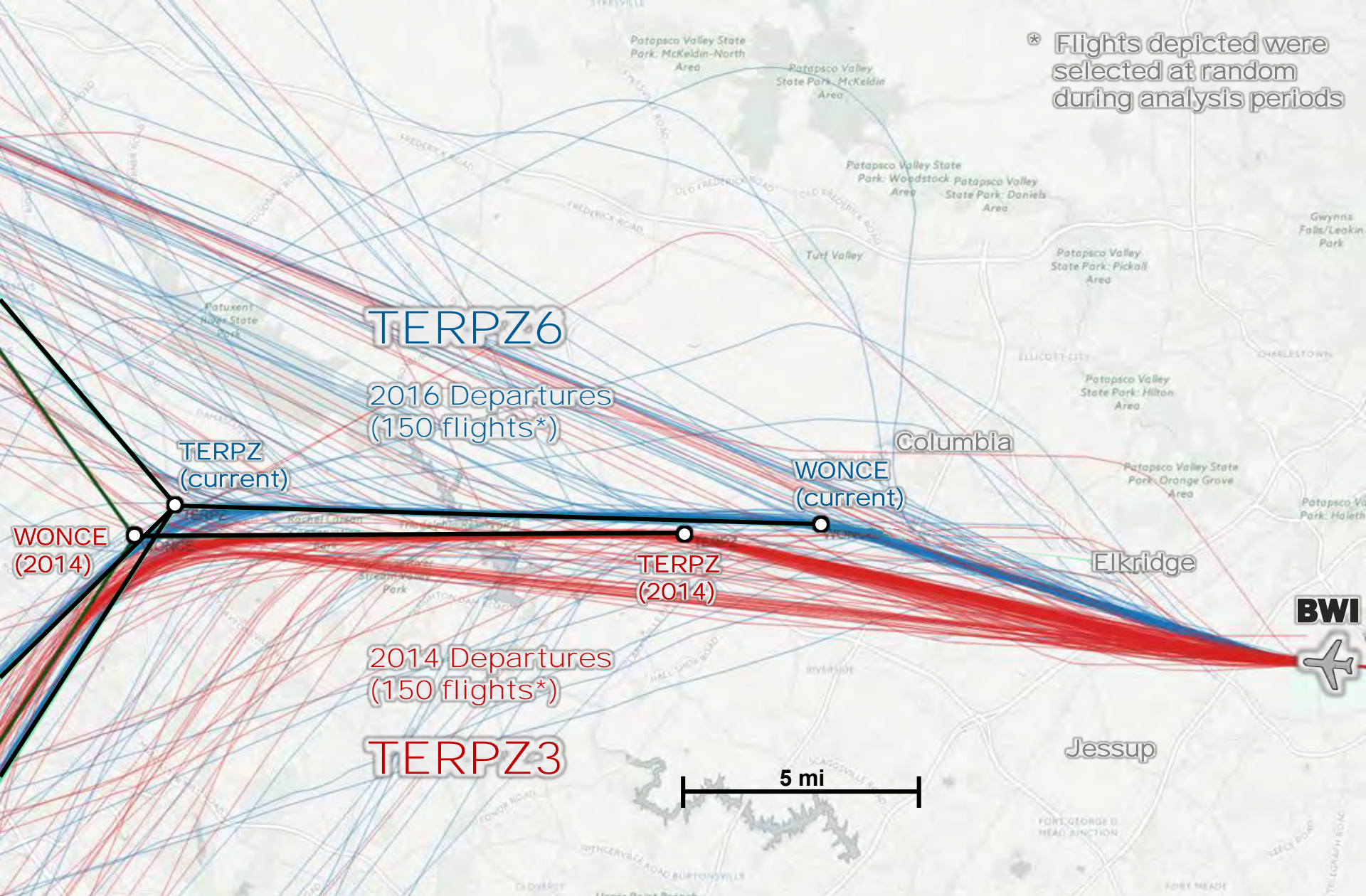


Rwy 28 Departures



Federal Aviation
Administration

* Flights depicted were selected at random during analysis periods

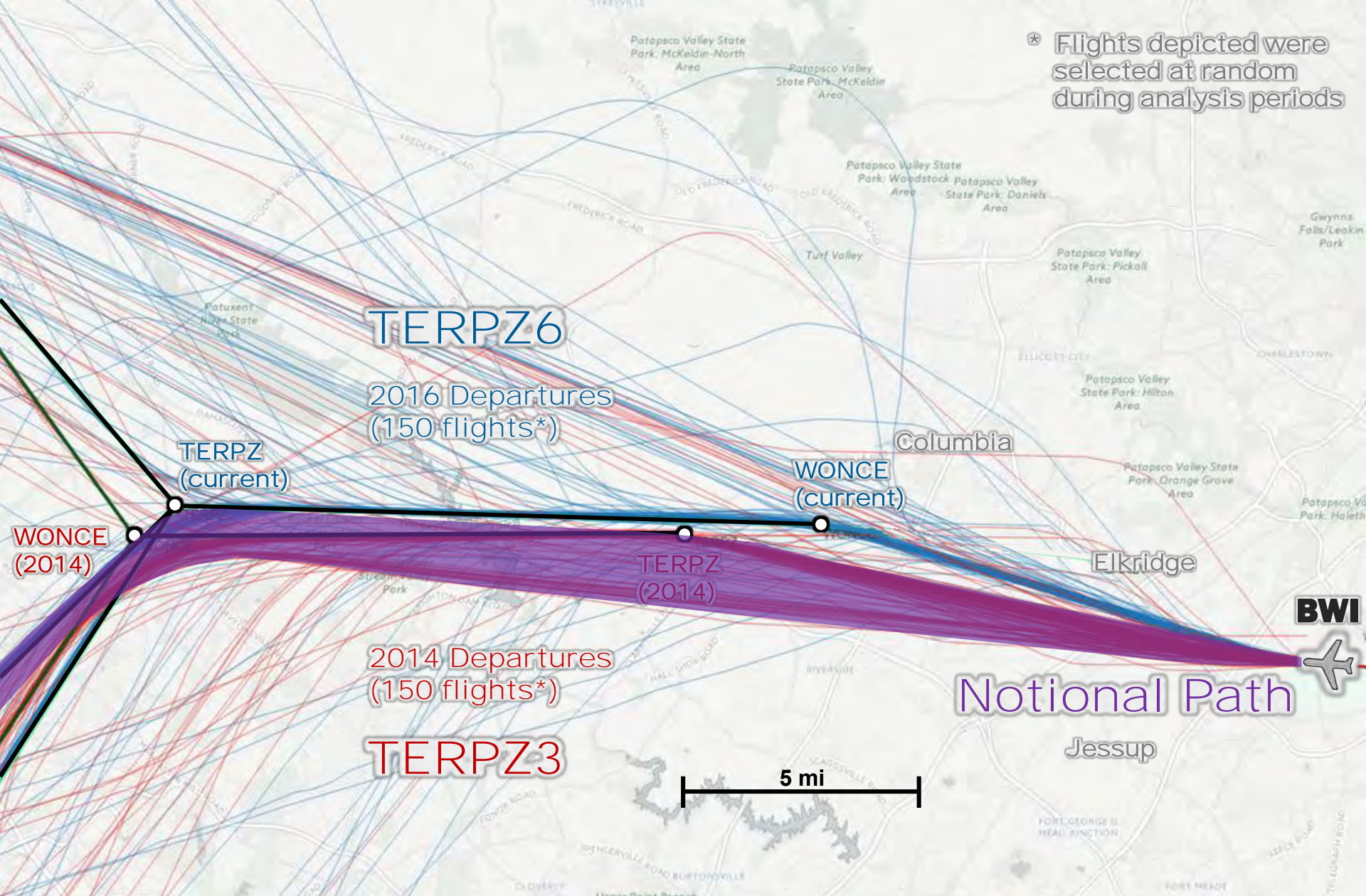


TERPZ Rwy 28



Federal Aviation
Administration

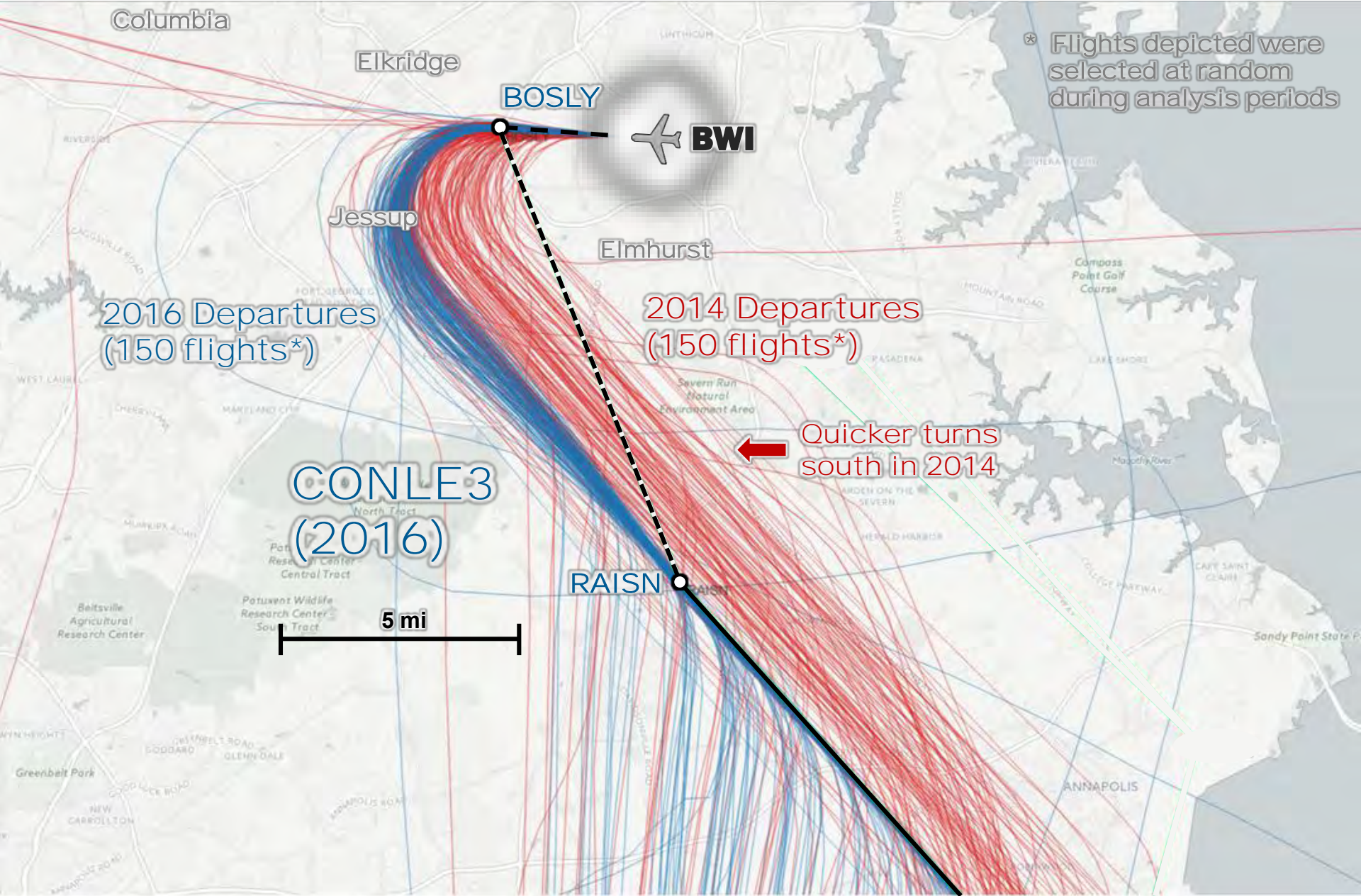
* Flights depicted were selected at random during analysis periods



TERPZ Rwy 28



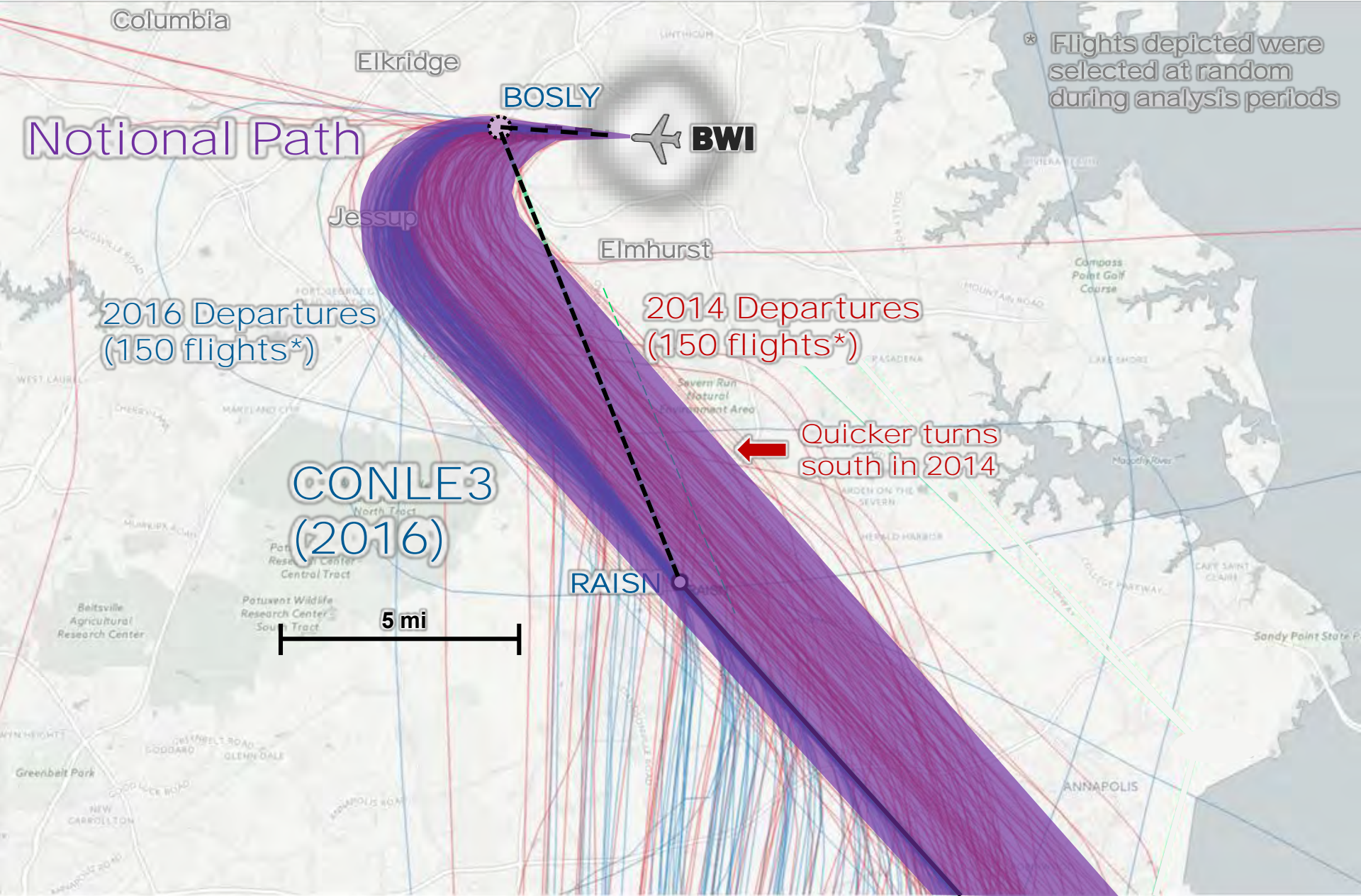
Federal Aviation Administration



CONLE3 Rwy 28



Federal Aviation Administration



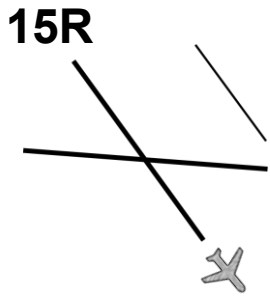
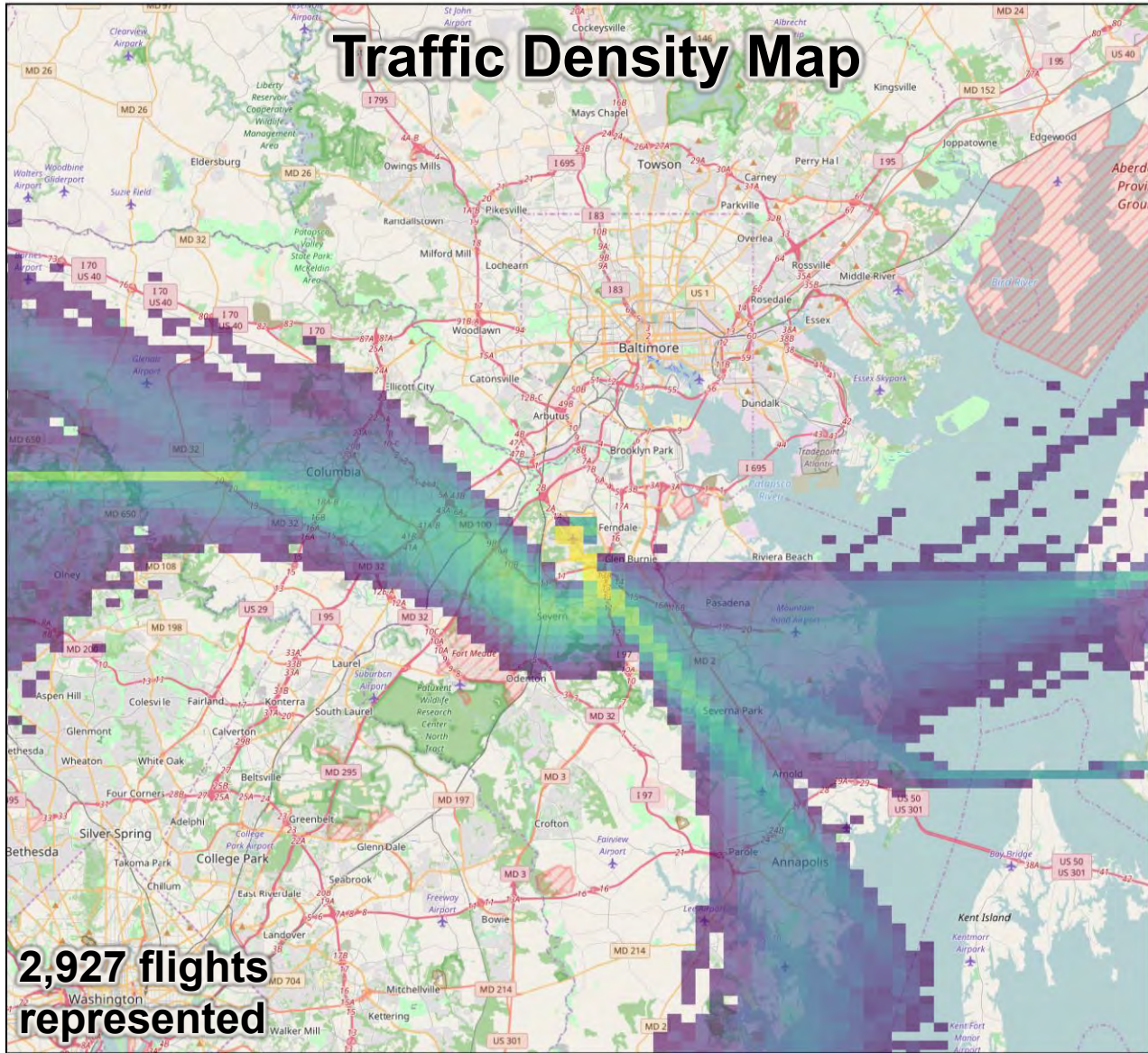
CONLE3 Rwy 28



Federal Aviation Administration

Traffic Density Map

June – July
2014
Daily Average
Flight Count



Rwy 15R Departures



Federal Aviation
Administration

Traffic Density Map

June – July
2016
Daily Average
Flight Count

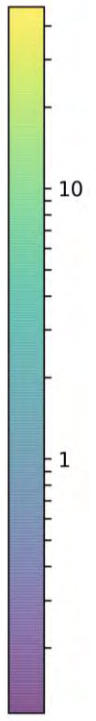
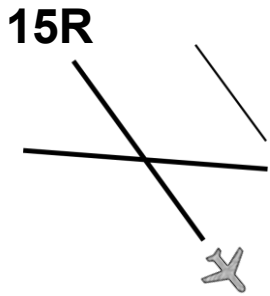
Moved north &
concentrated



Moved east &
concentrated



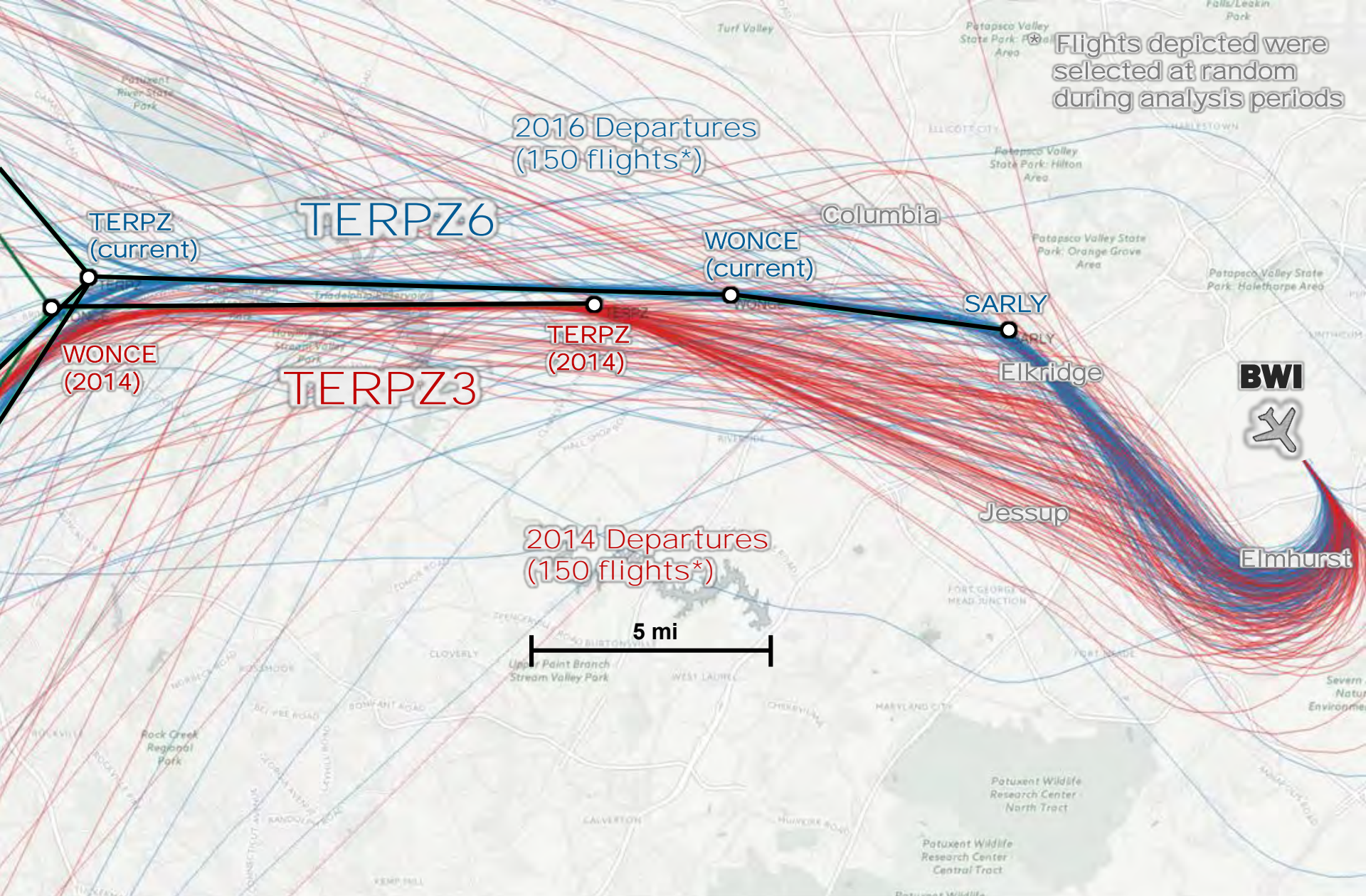
**5,715 flights
represented**



Rwy 15R Departures



Federal Aviation
Administration



Flights depicted were selected at random during analysis periods

2016 Departures (150 flights*)

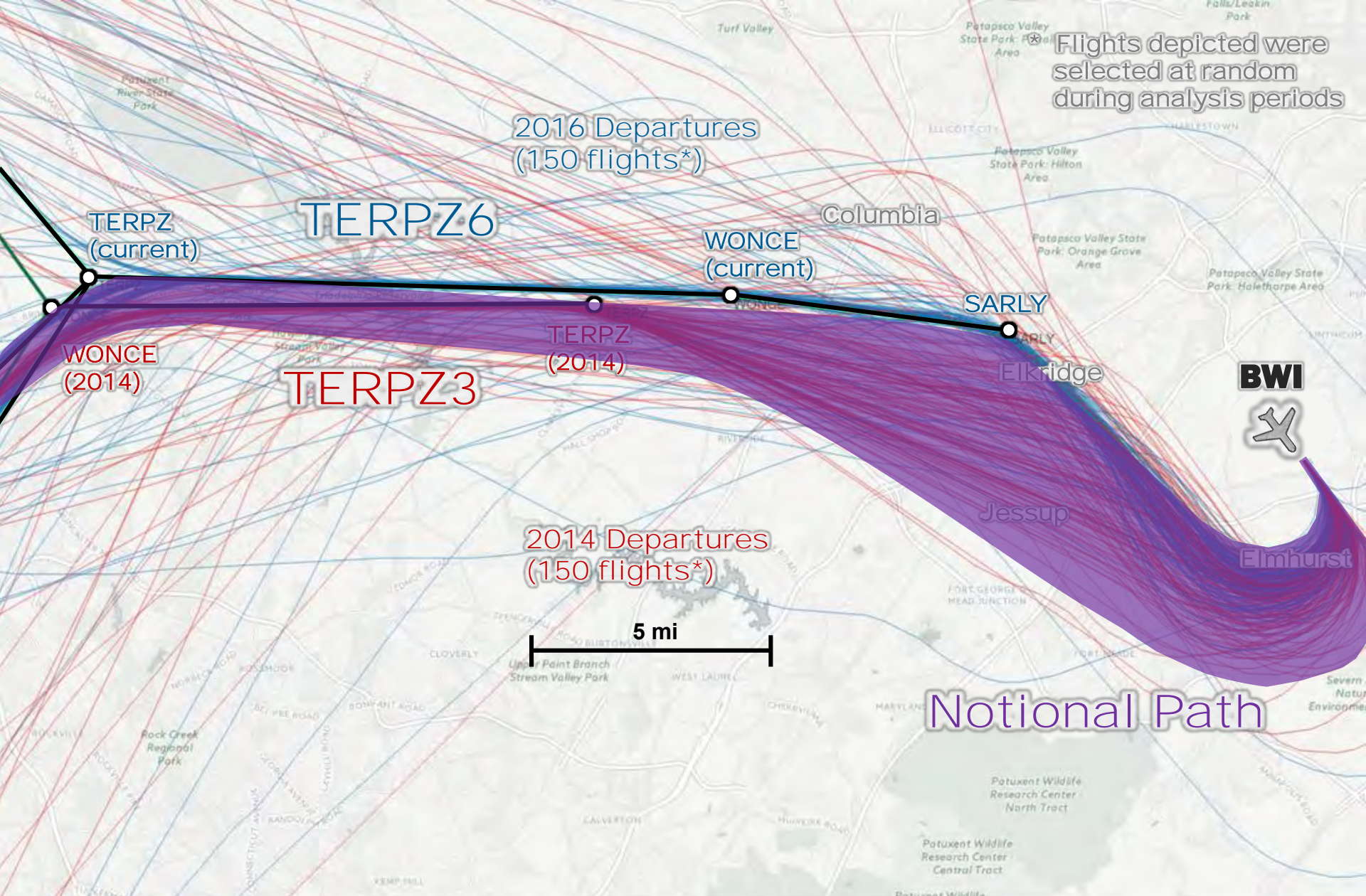
2014 Departures (150 flights*)

5 mi

TERPZ Rwy 15R



Federal Aviation Administration

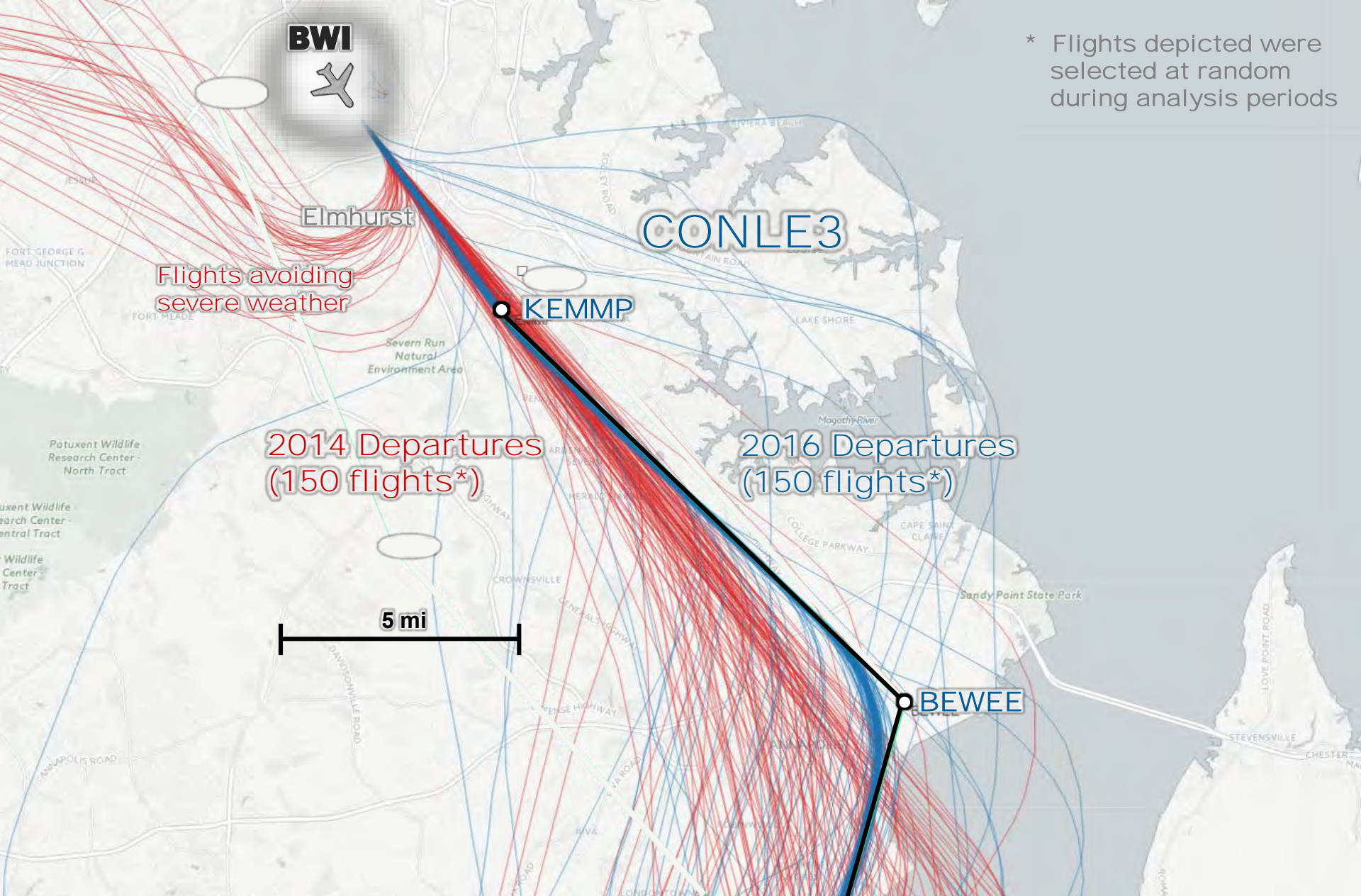


TERPZ Rwy 15R



Federal Aviation Administration

* Flights depicted were selected at random during analysis periods

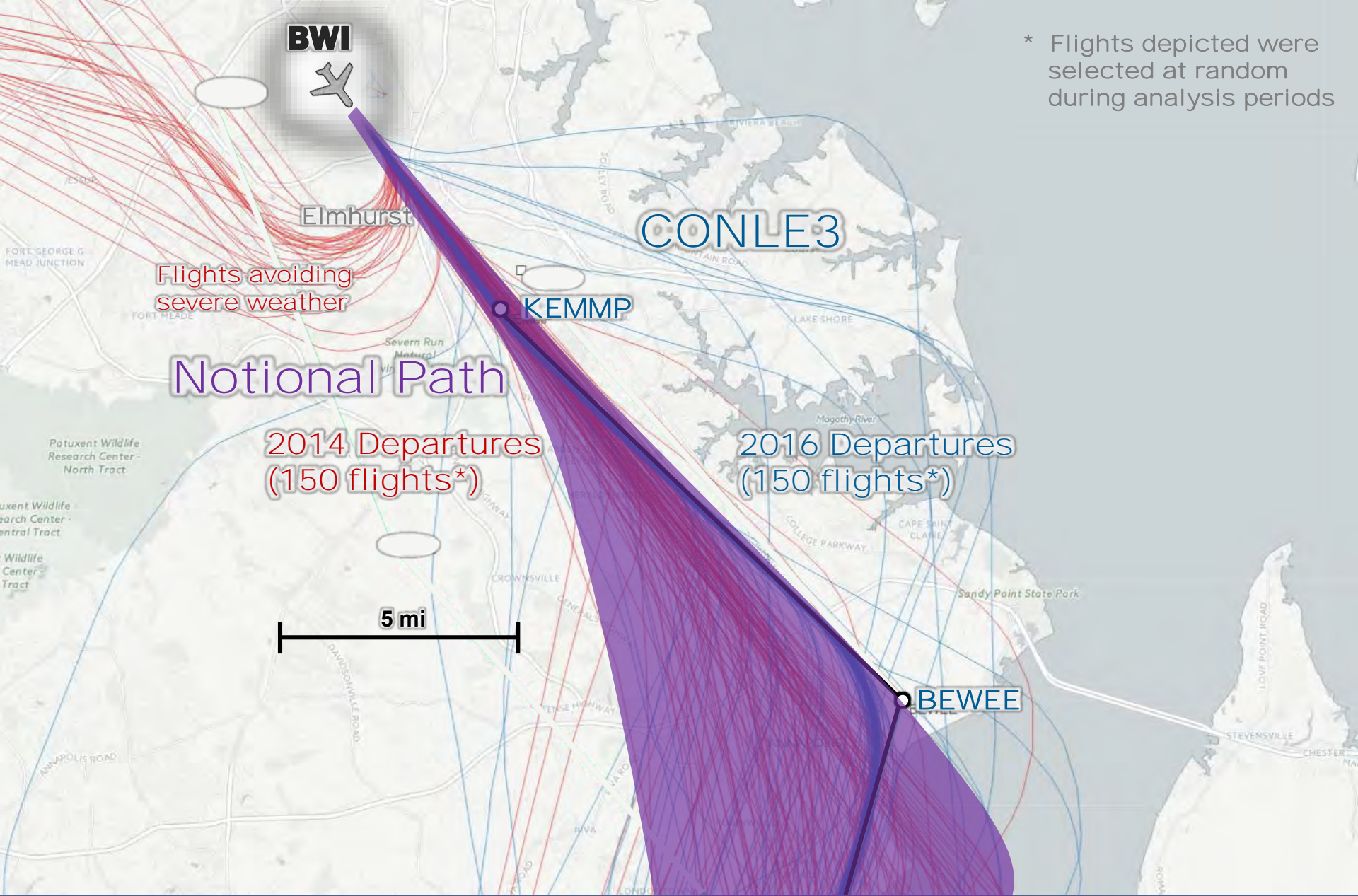


CONLE3 Rwy 15R



Federal Aviation Administration

* Flights depicted were selected at random during analysis periods



CONLE3 Rwy 15R



Federal Aviation Administration

Lateral Analysis | Departure Summary

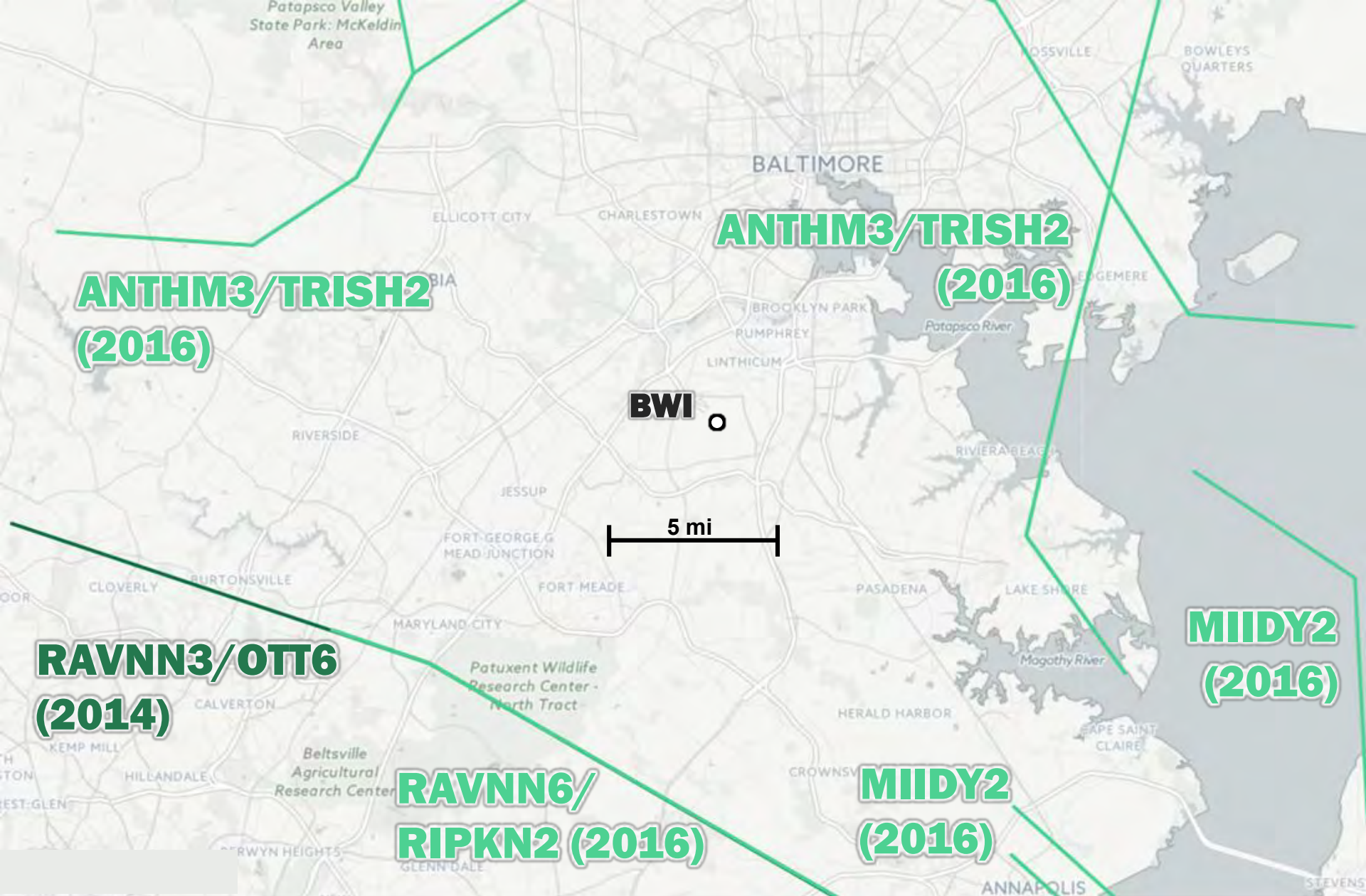
- **Runway 28 closure Sep. – Nov. 2015 changed the departure path during these 3 months**
- **TERPZ departures**
 - Runway 28: Flight path moved north
 - Runway 15R: Flight path moved north and concentrated on added segment
- **CONLE3 departures**
 - Runway 28: Flight path moved west and concentrated due to delayed turn south
 - Runway 15R: Flight path moved east and concentrated
- **SWANN and PALEO results are available in the full version of the presentation**



Lateral Analysis

Runway 33L & 10 Arrivals



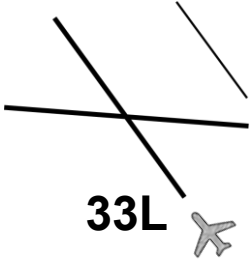
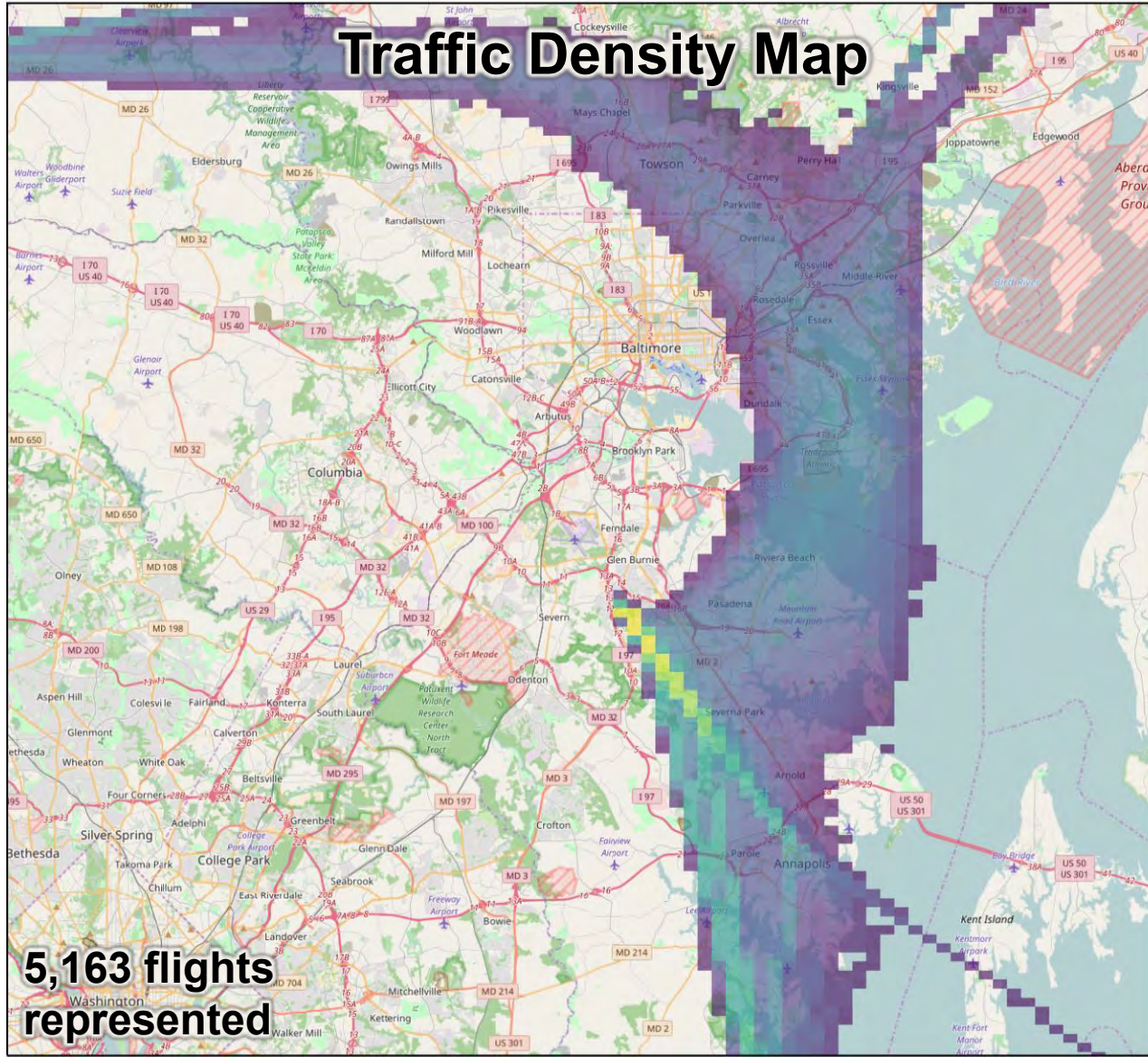


Arrival Changes



Traffic Density Map

June – July
2014
Daily Average
Flight Count



33L

**5,163 flights
represented**

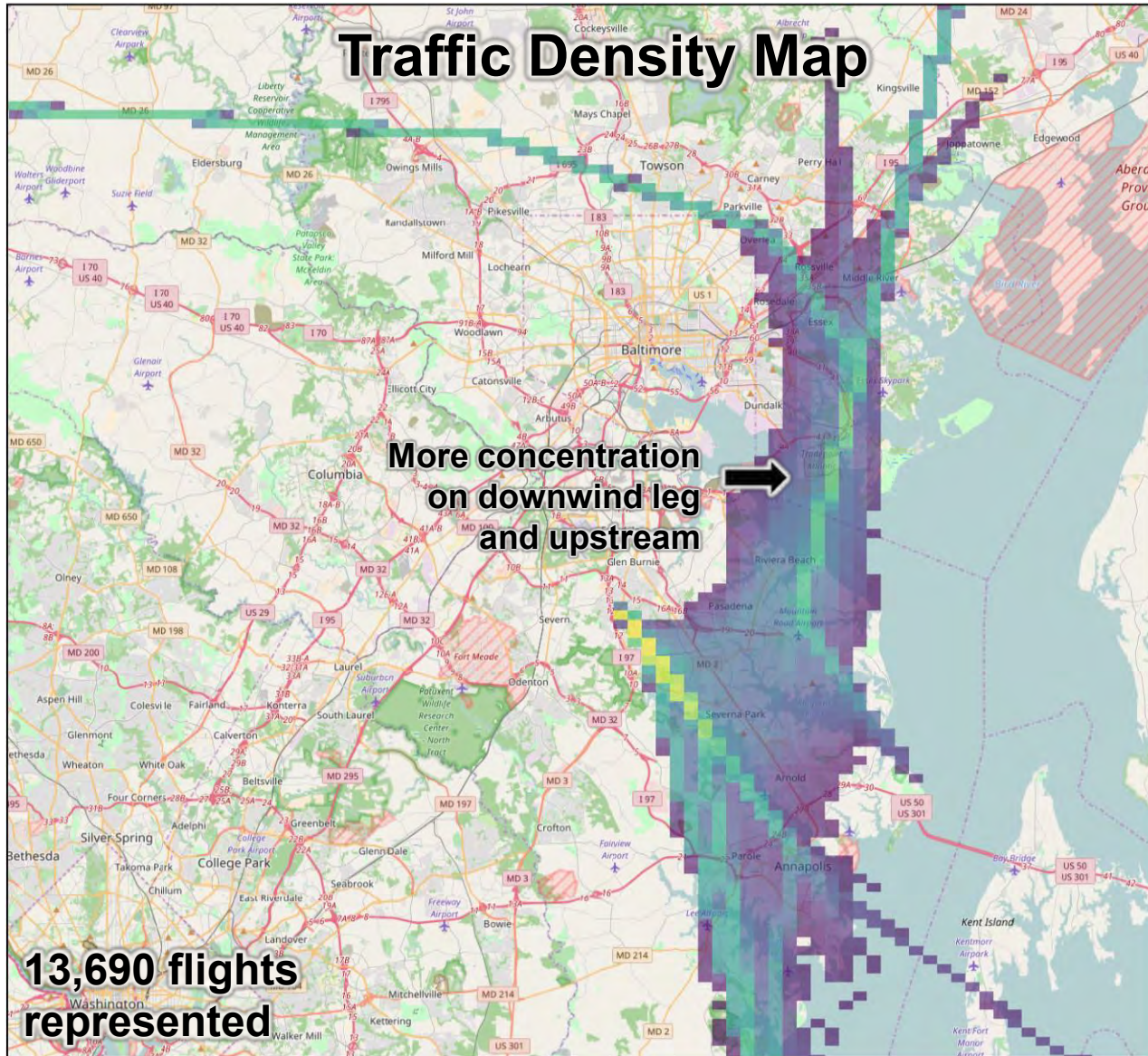
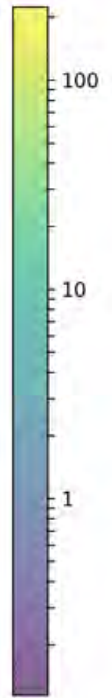
Rwy 33L Arrivals



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Traffic Density Map

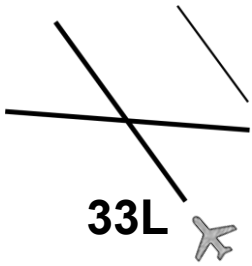
June – July
2016
Daily Average
Flight Count



More concentration
on downwind leg
and upstream



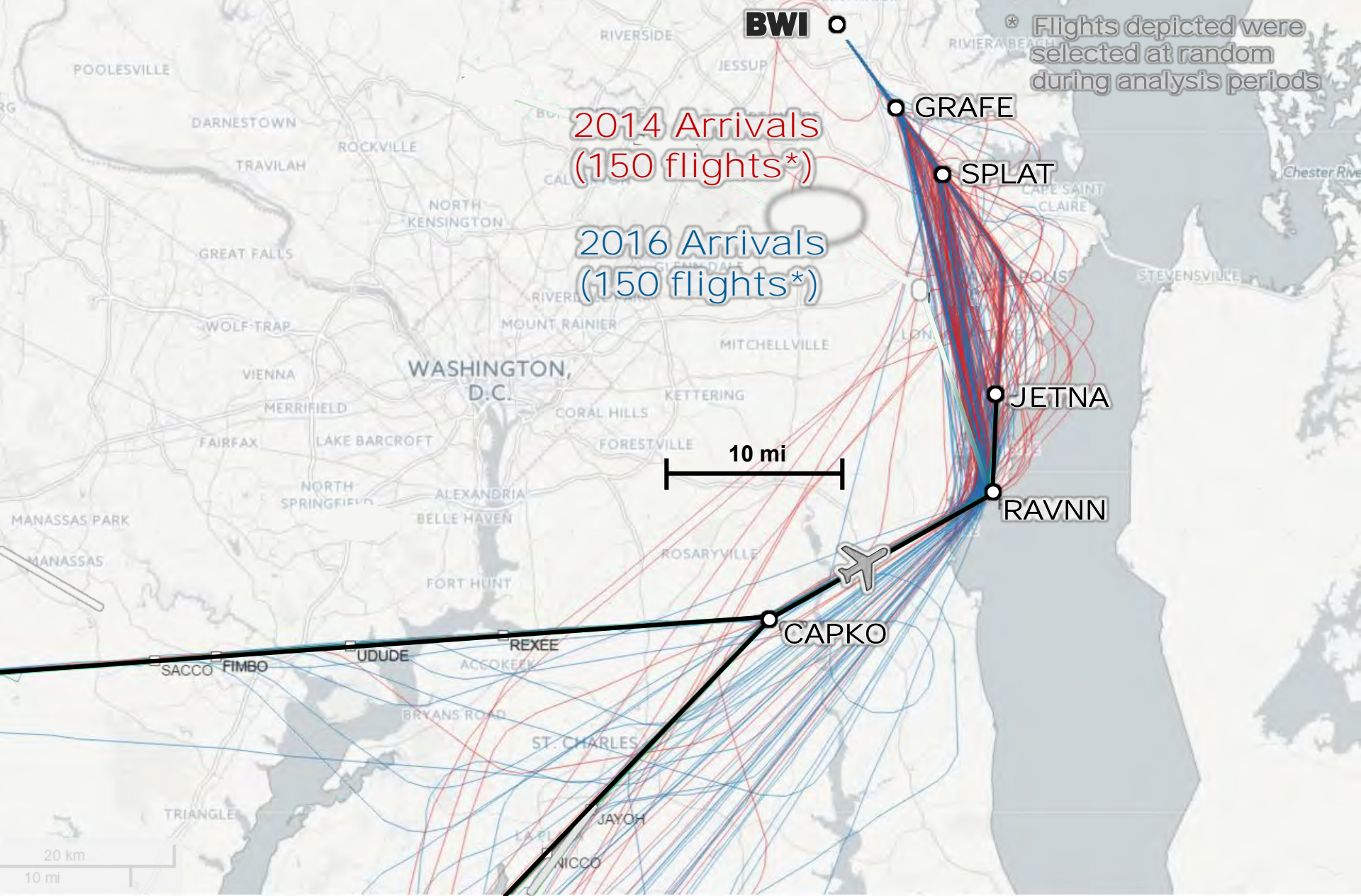
13,690 flights
represented



Rwy 33L Arrivals



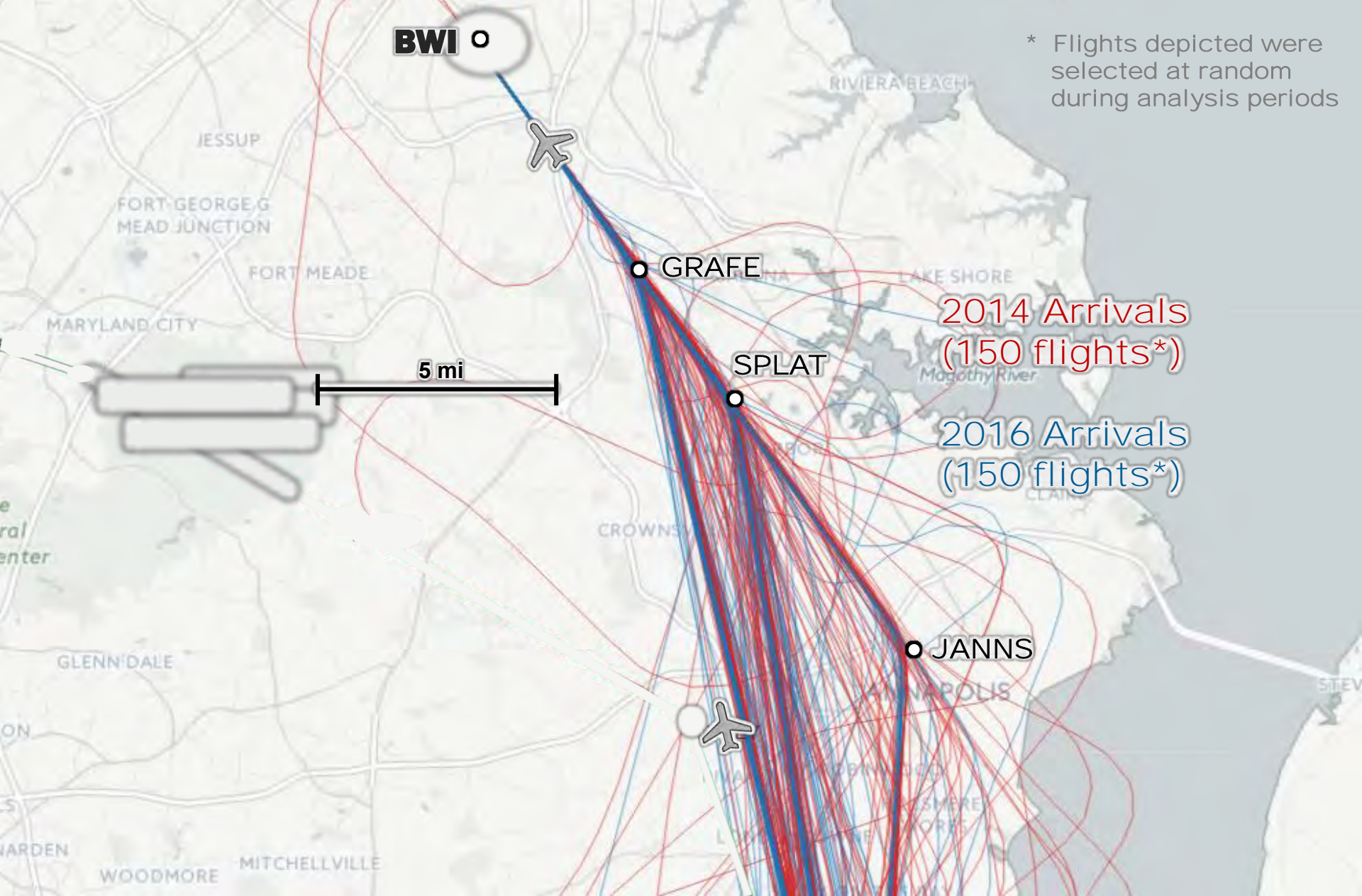
Federal Aviation
Administration



RAVNN Rwy 33L



Federal Aviation Administration



* Flights depicted were selected at random during analysis periods

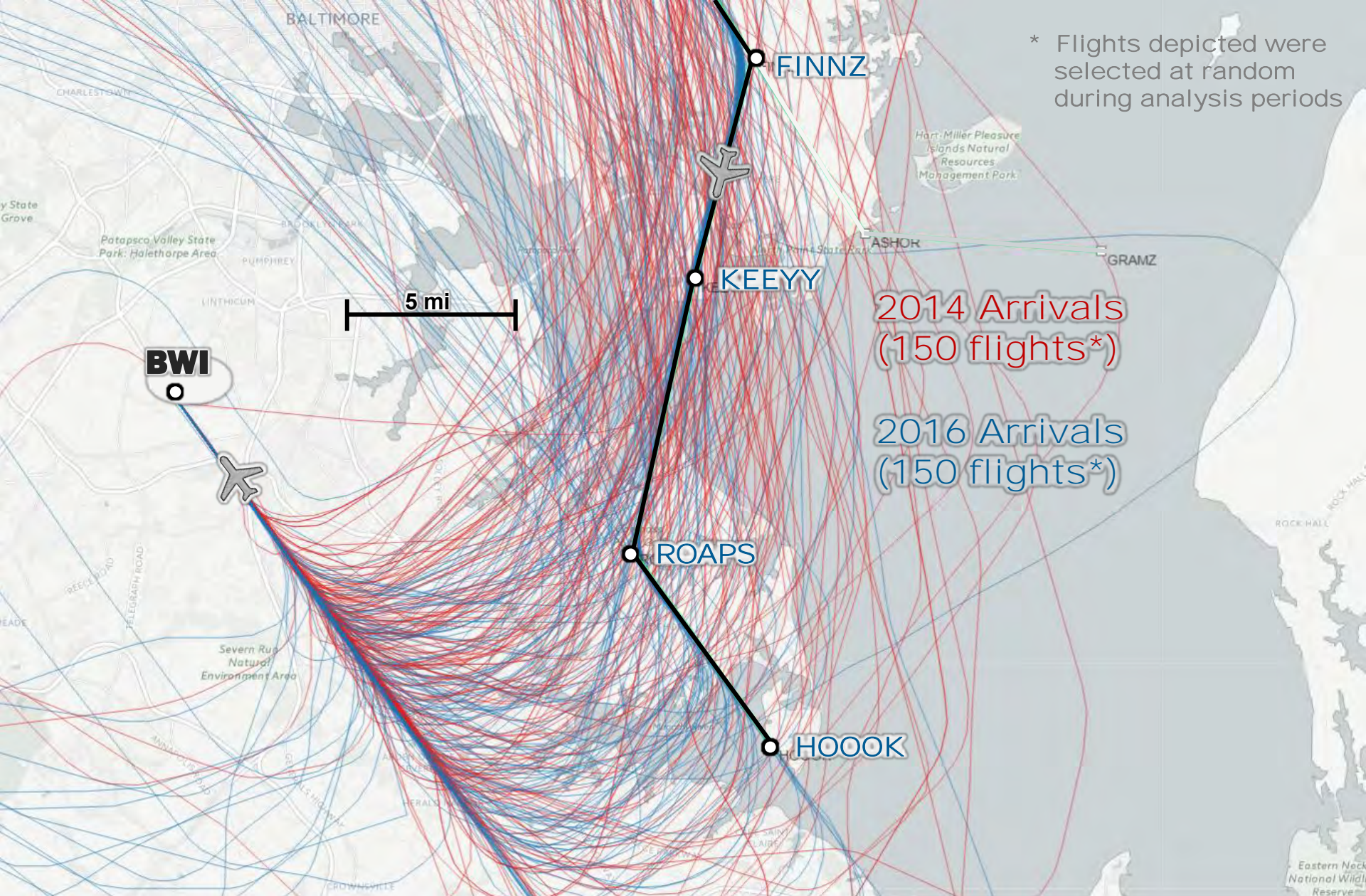
2014 Arrivals
(150 flights*)

2016 Arrivals
(150 flights*)

RAVNN Rwy 33L



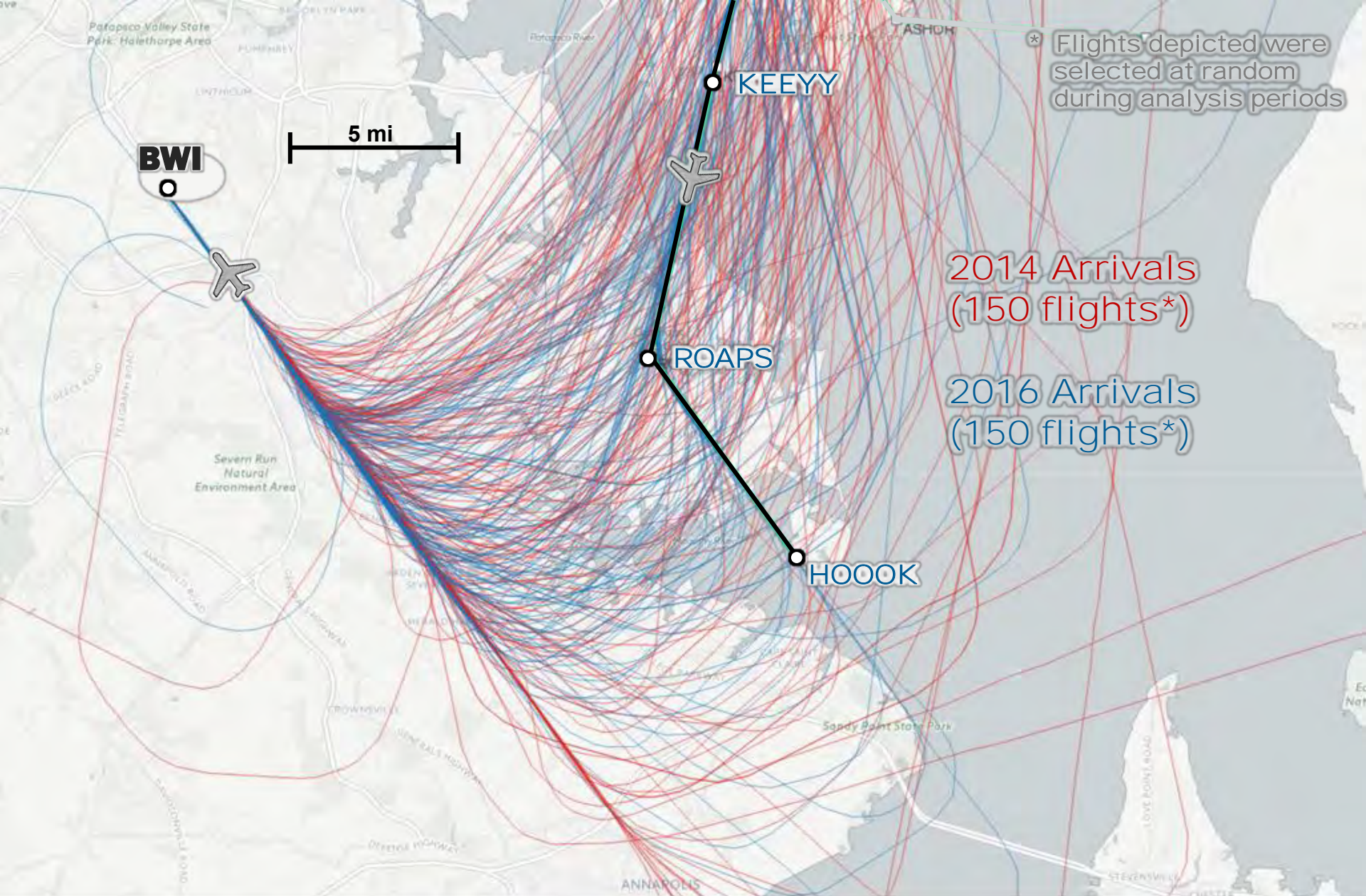
Federal Aviation Administration



EMI5 & ANTHM3 Rwy 33L



Federal Aviation Administration



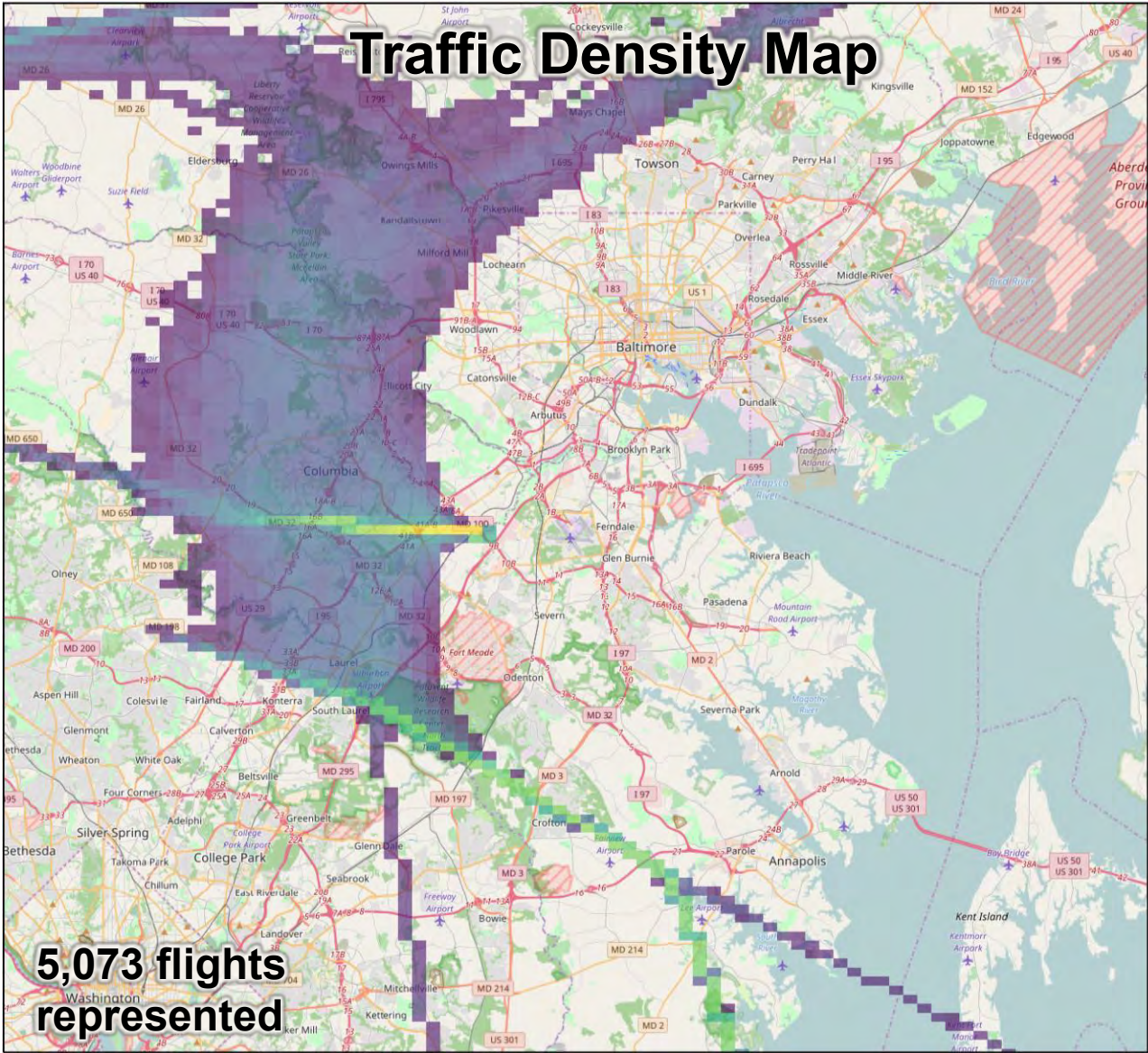
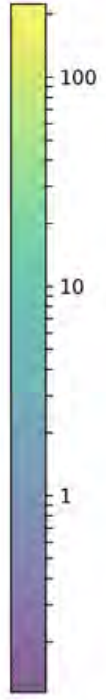
Southbound & TRISH2 Rwy 33L



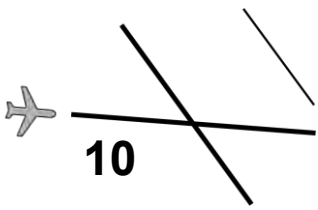
Federal Aviation Administration

Traffic Density Map

June – July
2014
Daily Average
Flight Count



**5,073 flights
represented**



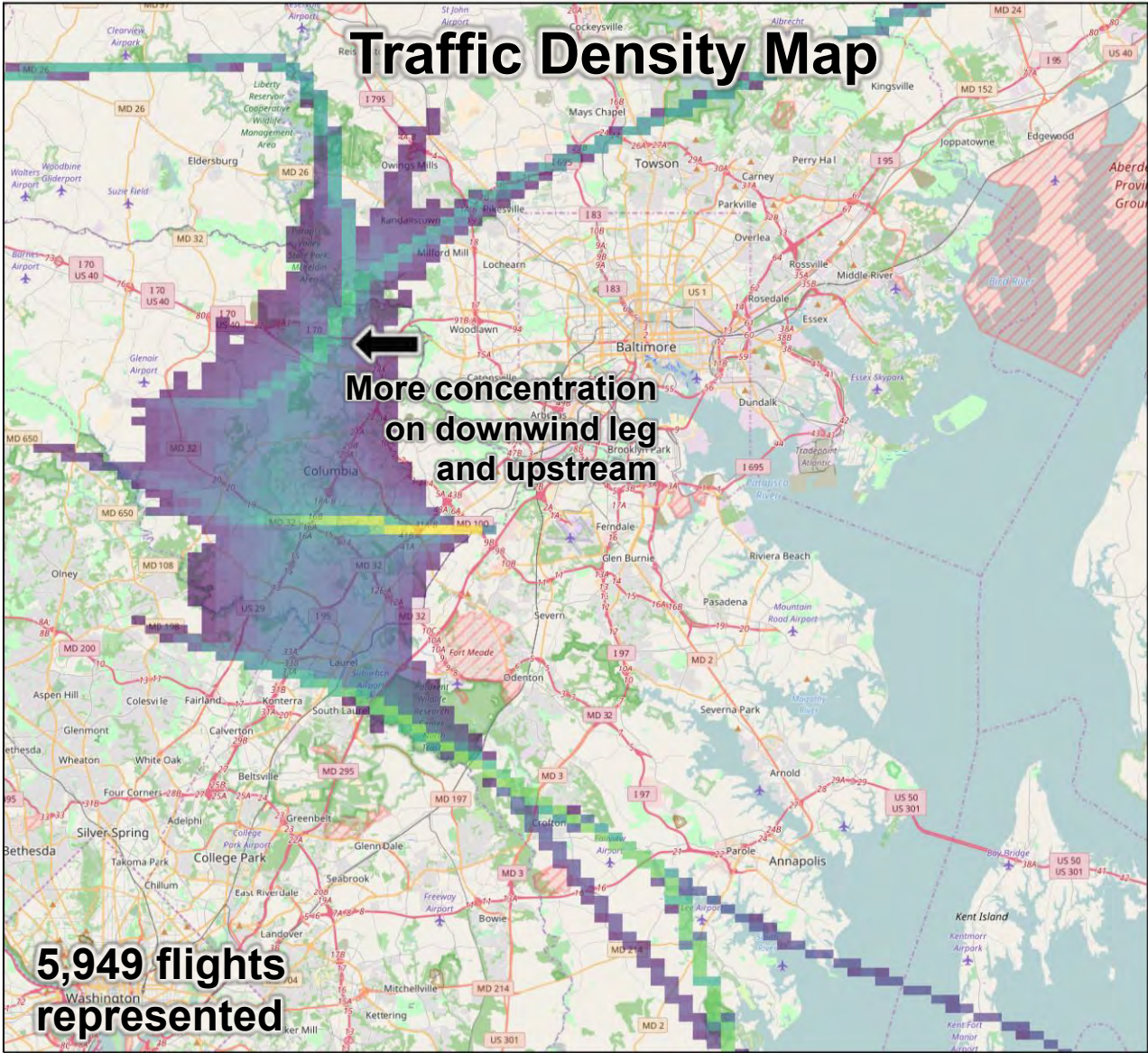
Rwy 10 Arrivals



Federal Aviation
Administration

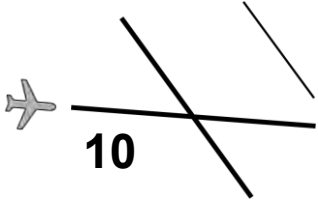
Traffic Density Map

June – July
2016
Daily Average
Flight Count



More concentration
on downwind leg
and upstream

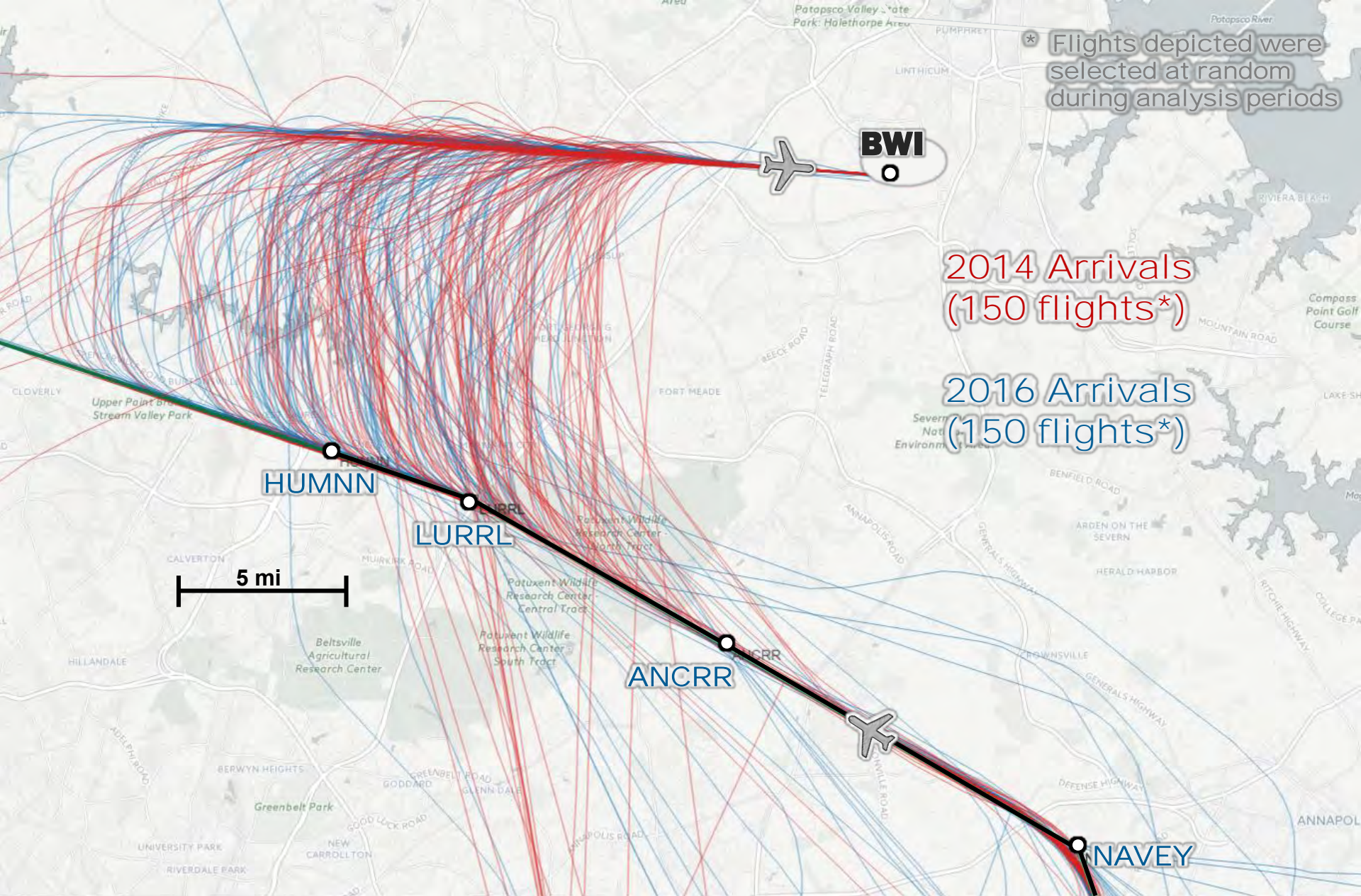
**5,949 flights
represented**



Rwy 10 Arrivals



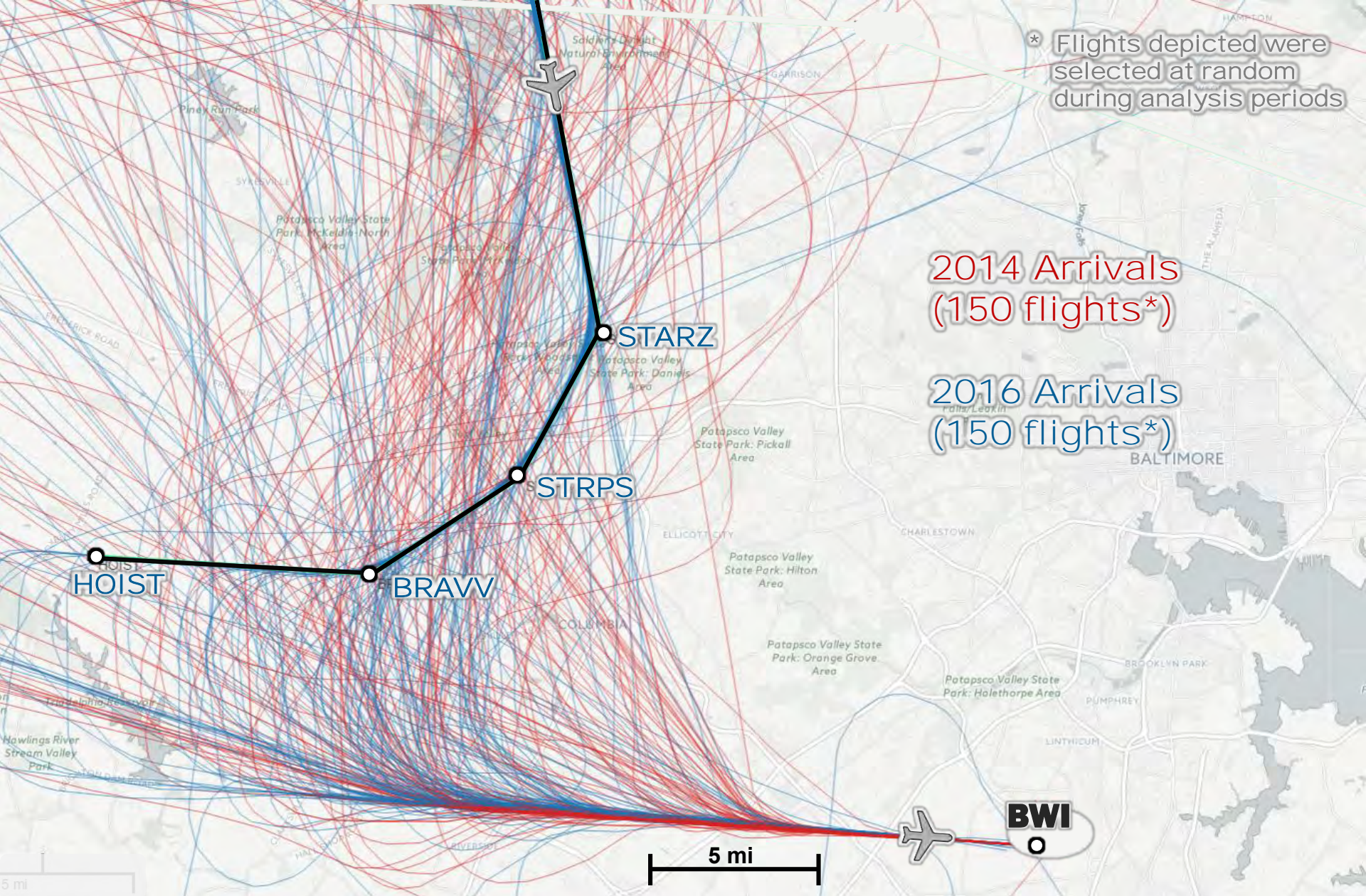
Federal Aviation
Administration



RAVVN Rwy 10



Federal Aviation Administration

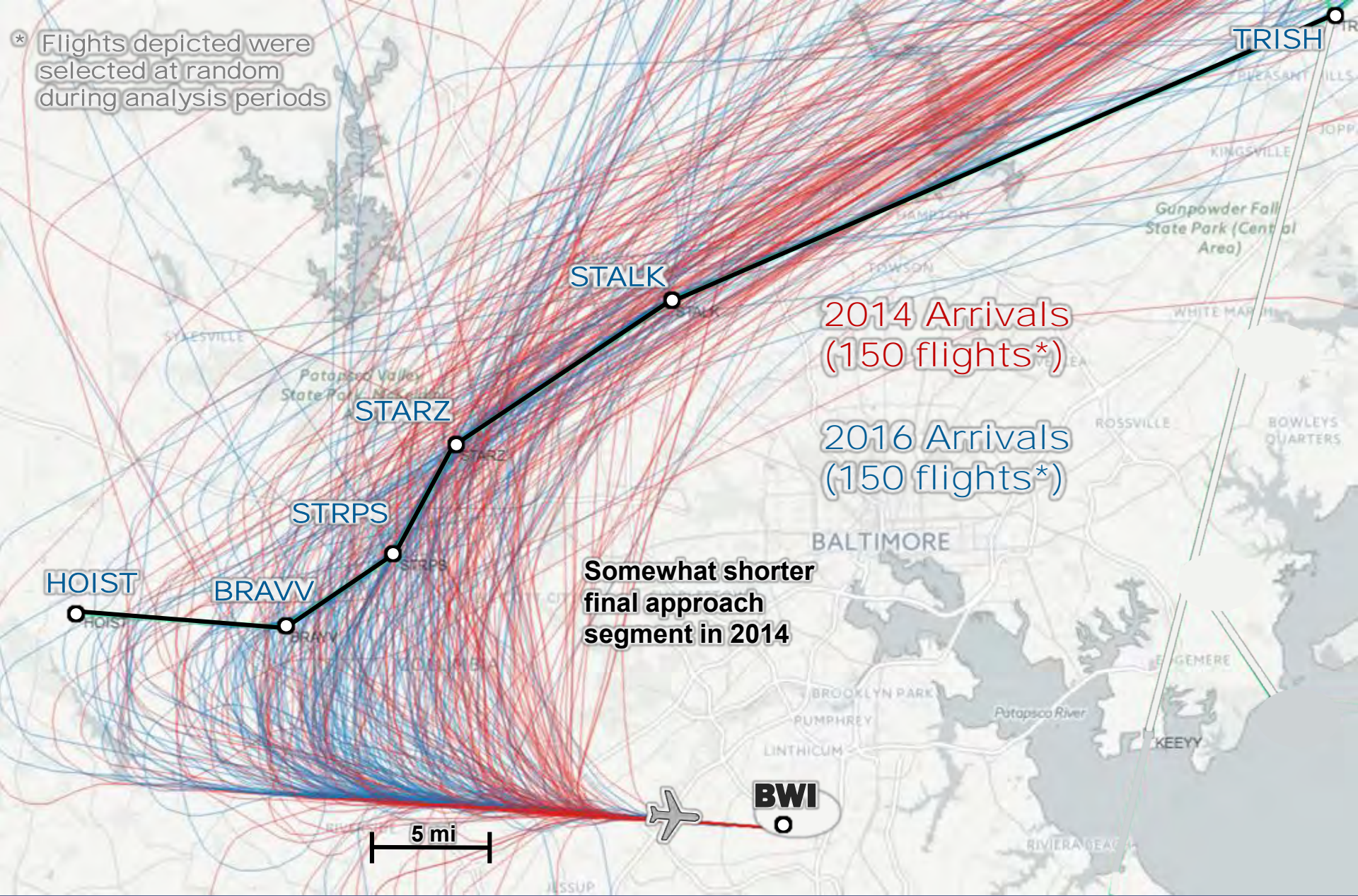


EMI5 & ANTHM3 Rwy 10



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* Flights depicted were selected at random during analysis periods



LRP/MXE & TRISH2 Rwy 10



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Lateral Analysis | Arrival Summary

- **Runway 33L closure Jul – Nov 2014**
 - Changed arrival paths during those 5 months
- **RAVNN6 arrivals**
 - Rwy 33L showed a similar final approach join before and after
- **ANTHM3 and TRISH2**
 - Introduced more concentration on downwind leg flight paths and upstream
 - Again, a similar final approach join before and after
- **EMI5, MIIDY2, and RIPKN2**
 - Used by 3% or less of flights

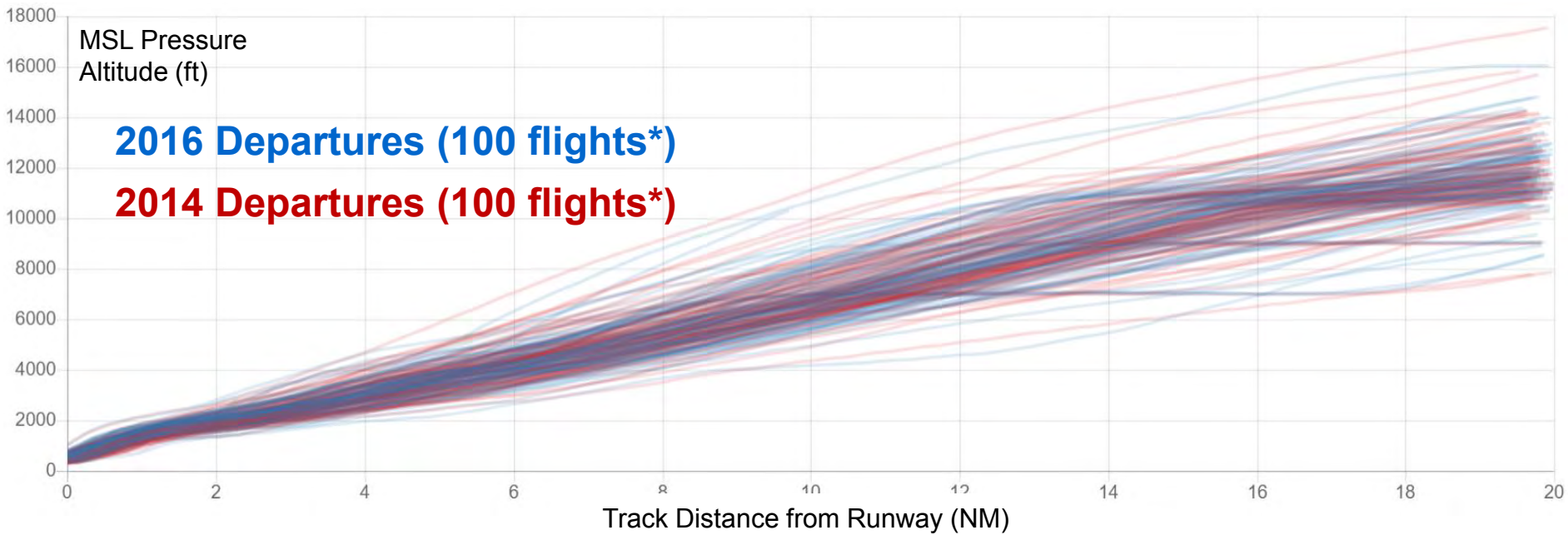


Vertical Analysis

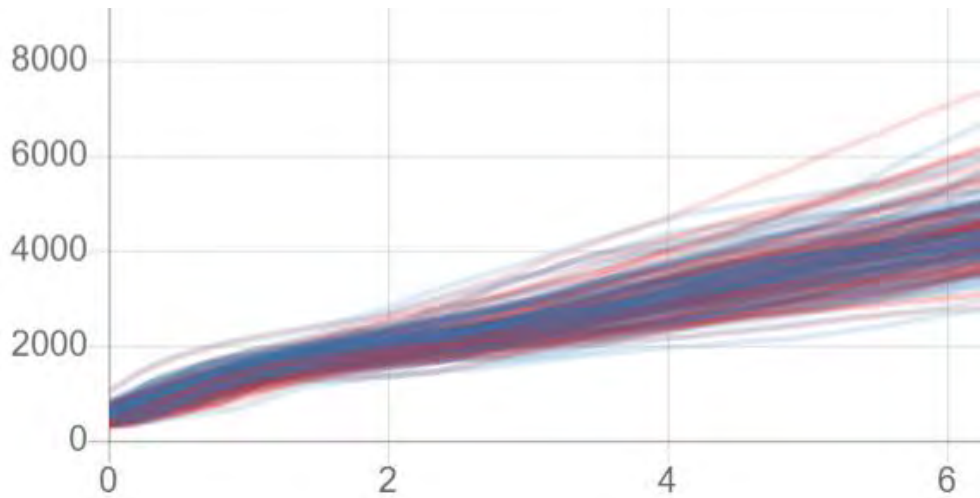
Runway 28 & 15R Departures



Vertical Profiles



* One flight plotted per percentile of climb gradient distribution



Rwy 28 Departures



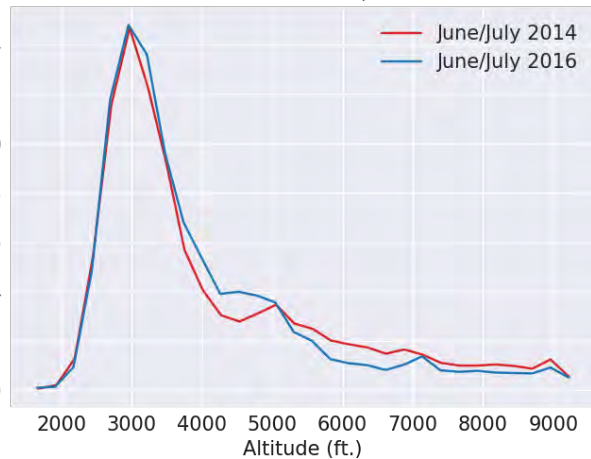
Federal Aviation
Administration

Rwy 28 Departure Altitude Distributions

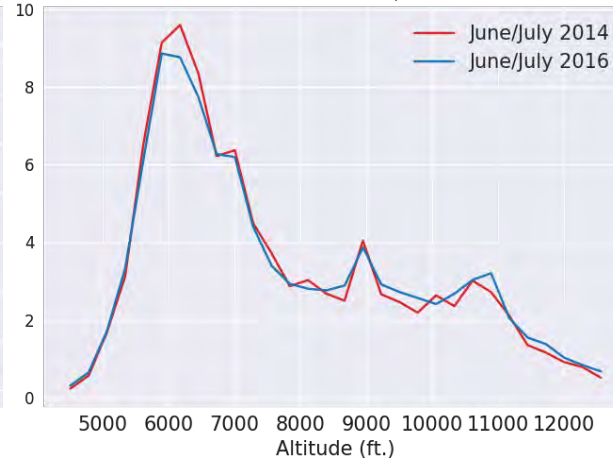
- **Similar altitude distributions at 5, 10, and 20 Nautical Miles (NM) from departure in 2014 vs. 2016**
 - At 5 NM, 160 ft lower on average in 2016
 - At 10 NM, 110 ft higher on average in 2016
 - At 20 NM, 70 ft lower on average in 2016

Percent of Flights

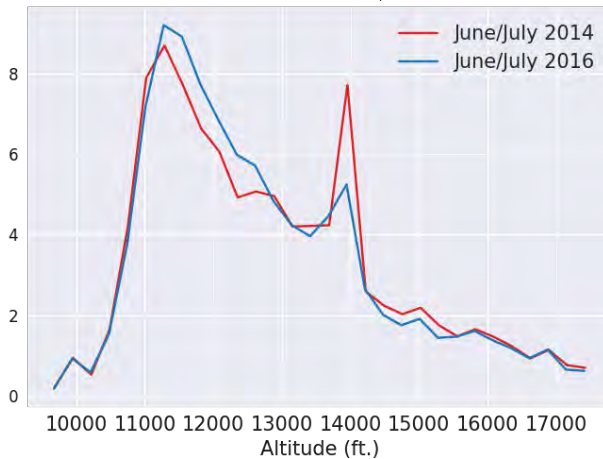
5 NM



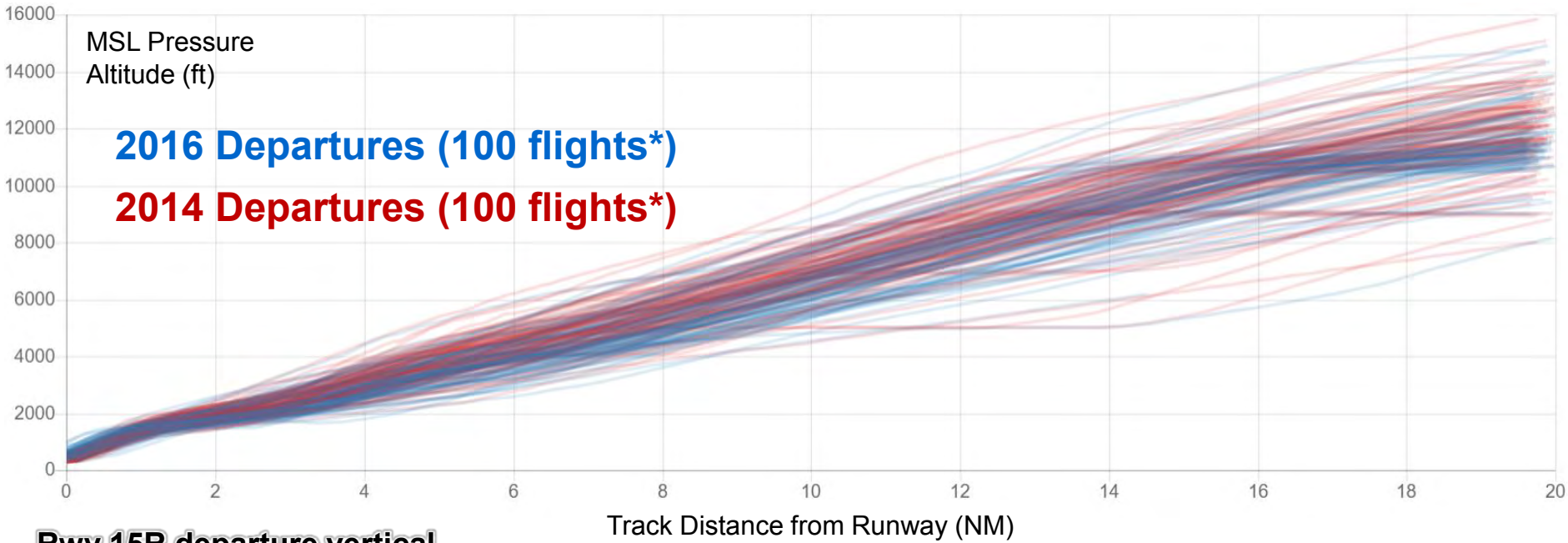
10 NM



20 NM

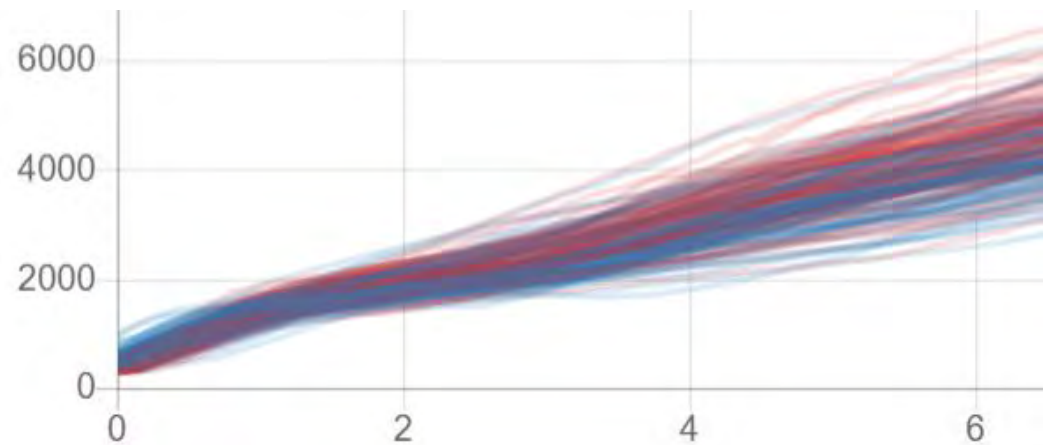


Vertical Profiles



Rwy 15R departure vertical profiles are slightly lower in 2016

* One flight plotted per percentile of climb gradient distribution



Rwy 15R Departures



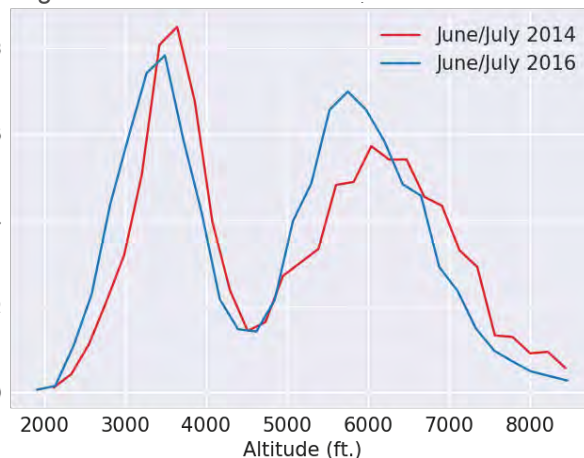
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Rwy 15R Departure Altitude Distributions

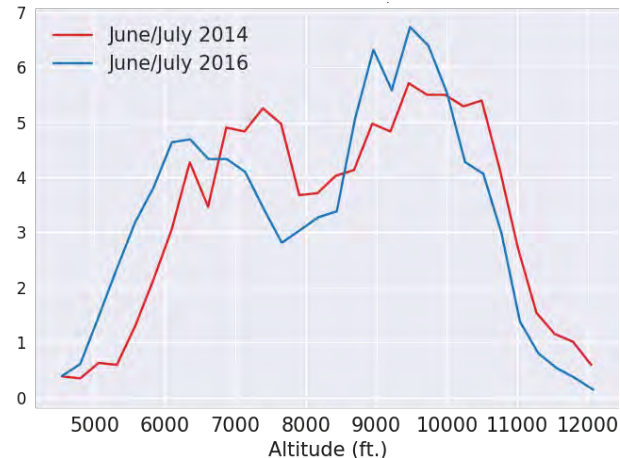
- **Rwy 15R departures tend to be slightly lower at 5/10/20 NM from BWI in 2016 vs. 2014**
 - At 5 NM, 220 ft lower on average in 2016
 - At 10 NM, 380 ft lower on average in 2016
 - At 20 NM, 490 ft lower on average in 2016

Percent of Flights

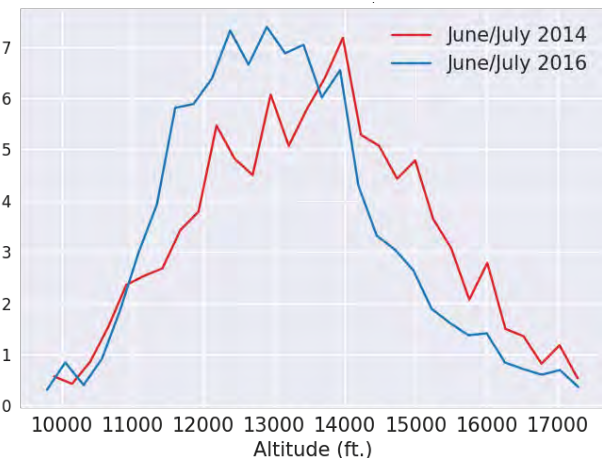
5 NM



10 NM



20 NM

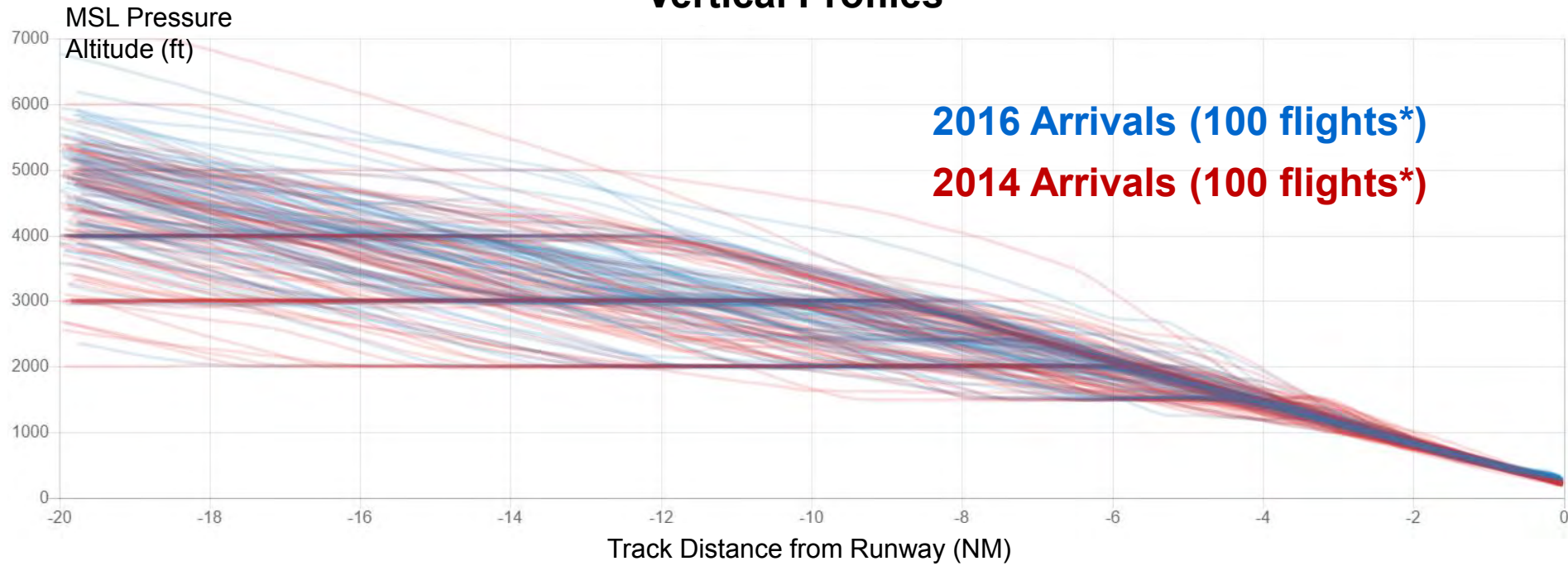


Vertical Analysis

Runway 33L & 10 Arrivals

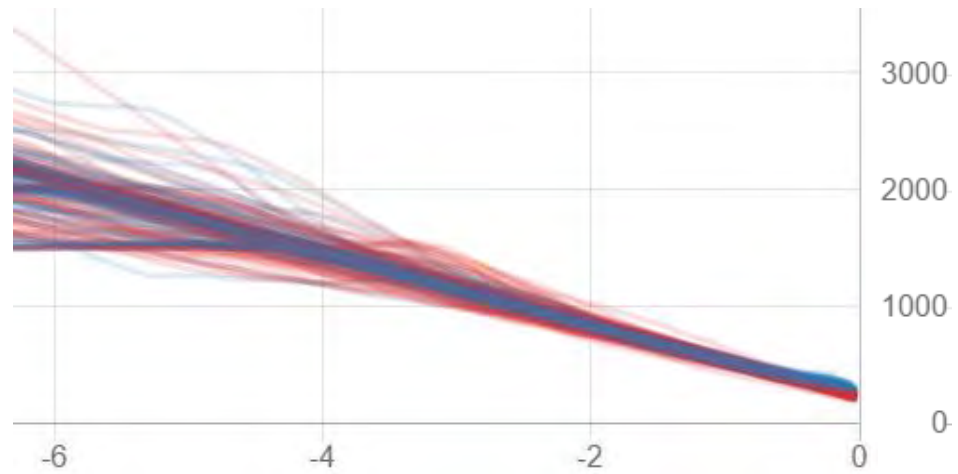


Vertical Profiles



Rwy 33L arrival vertical profiles are higher in 2016

* One flight plotted per percentile of altitude distribution at 40 NM



Rwy 33L Arrivals



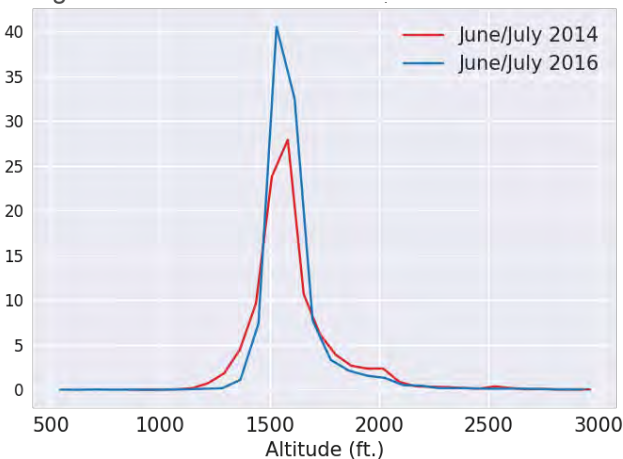
Federal Aviation Administration

Rwy 33L Arrival Altitude Distributions

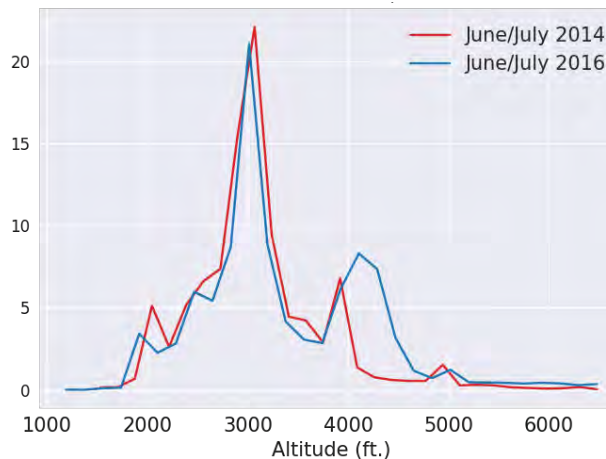
- **Rwy 33L arrivals tend to be higher at 10 and 20 NM from BWI in 2016 vs. 2014**
 - At 5 NM, 30 ft higher on average in 2016
 - At 10 NM, 350 ft higher on average in 2016
 - At 20 NM, 840 ft higher on average in 2016

Percent of Flights

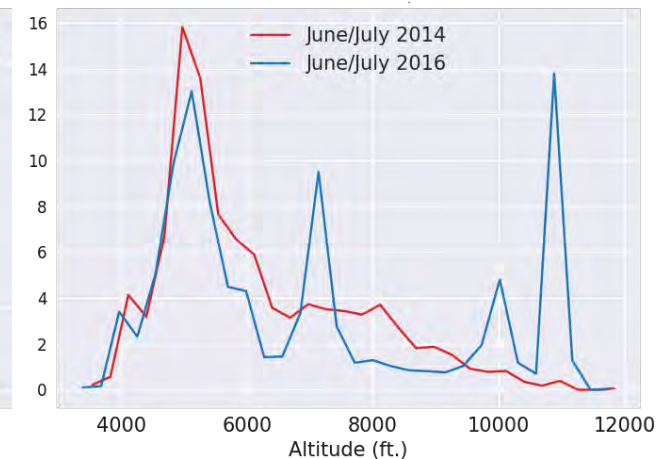
5 NM



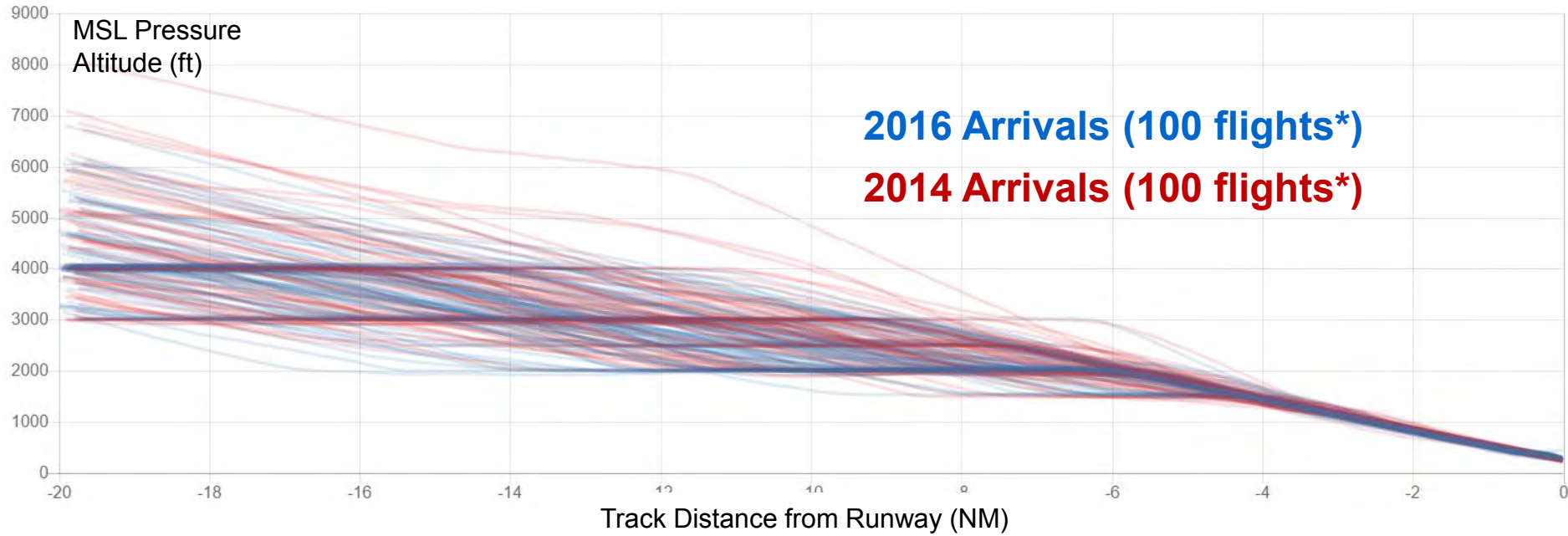
10 NM



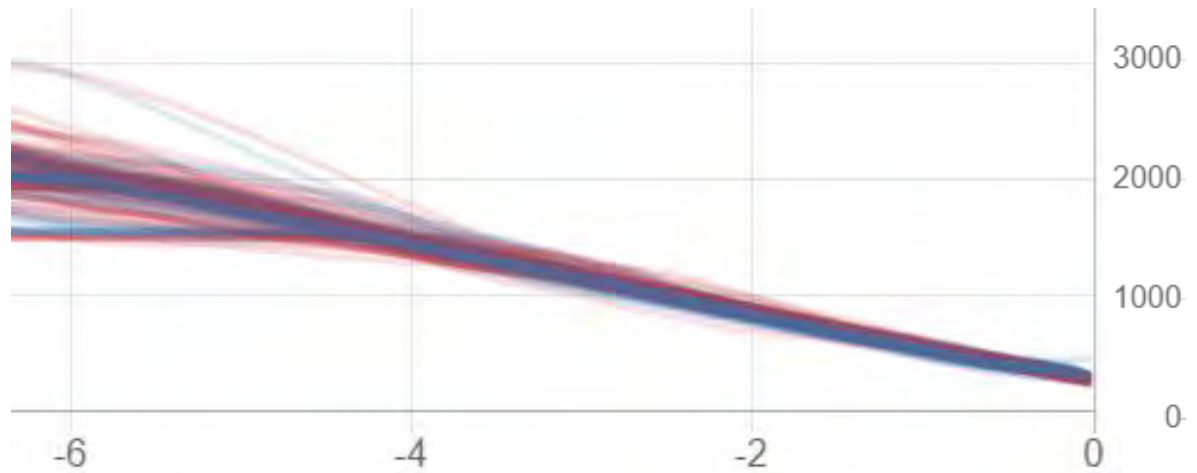
20 NM



Vertical Profiles



* One flight plotted per percentile of altitude distribution at 40 NM



Rwy 10 Arrivals



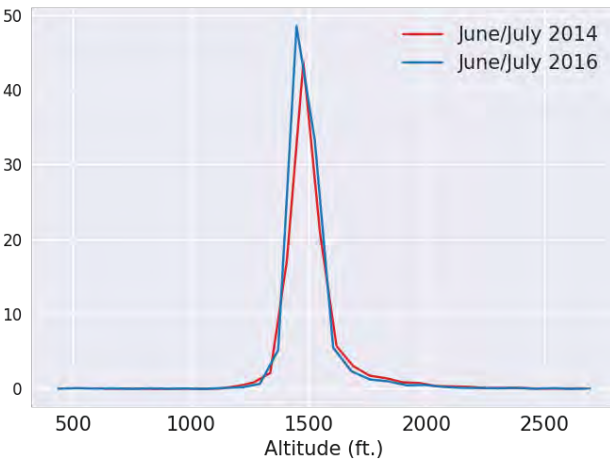
Federal Aviation
Administration

Rwy 10 Arrival Altitude Distributions

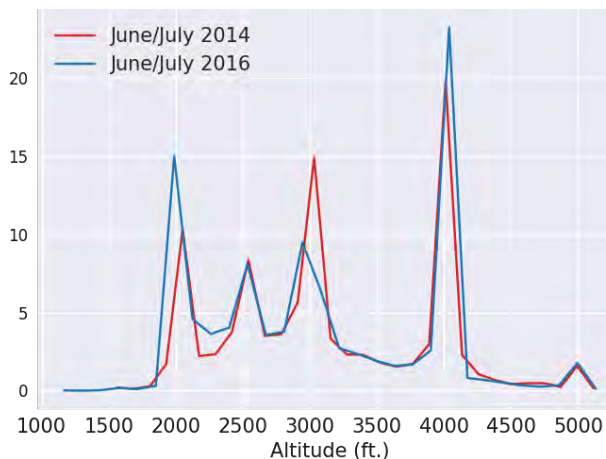
- **Rwy 10 arrivals tend to be higher at 20 NM from BWI in 2016 vs. 2014**
 - At 5 NM, average altitudes within 5 ft
 - At 10 NM, 40 ft lower on average in 2016
 - At 20 NM, 460 ft higher on average in 2016

Percent of Flights

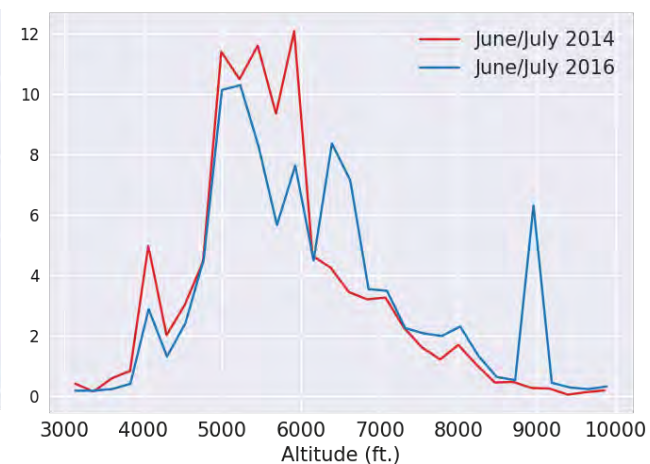
5 NM



10 NM



20 NM

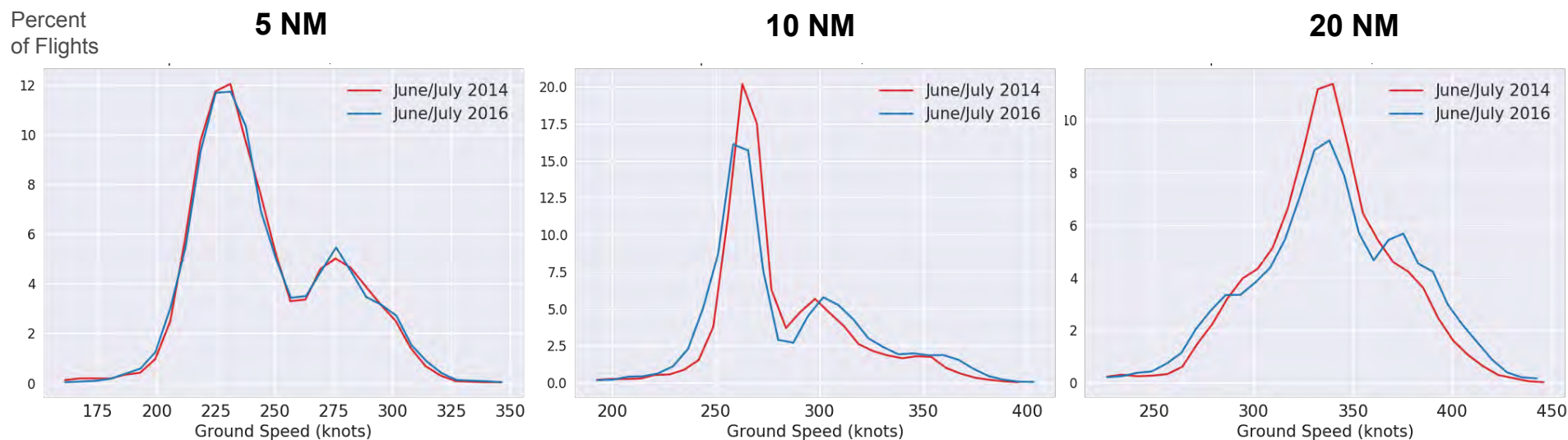


Speed Analysis



Rwy 28 Departure Speed Distributions

- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from departure in 2014 vs. 2016**
 - Average ground speeds all within 4 knots

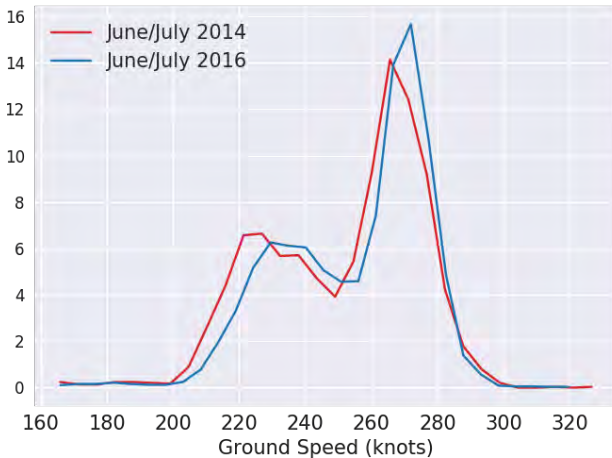


Rwy 15R Departure Speed Distributions

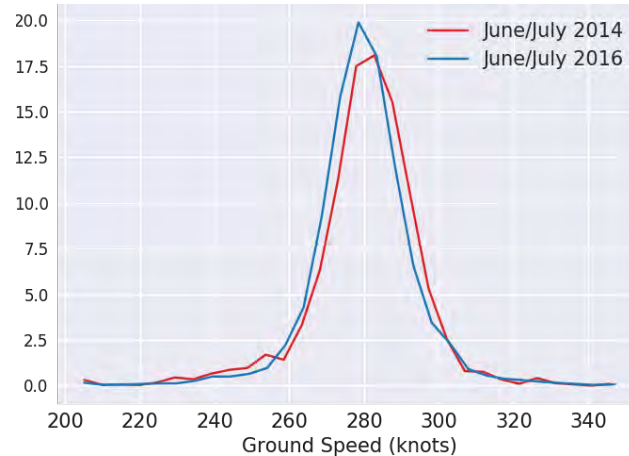
- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from departure in 2014 vs. 2016**
 - Average ground speeds all within 4 knots

Percent of Flights

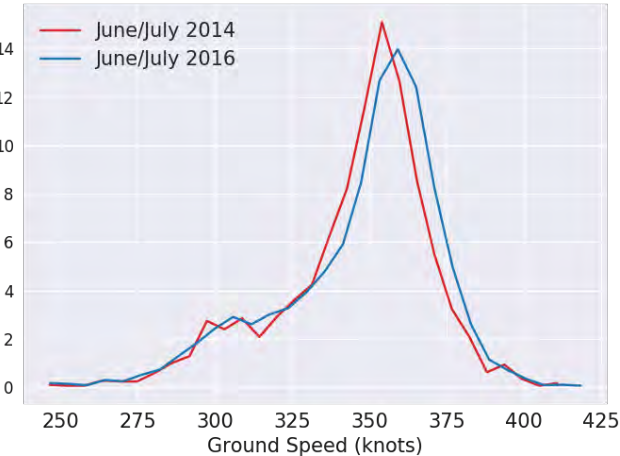
5 NM



10 NM



20 NM

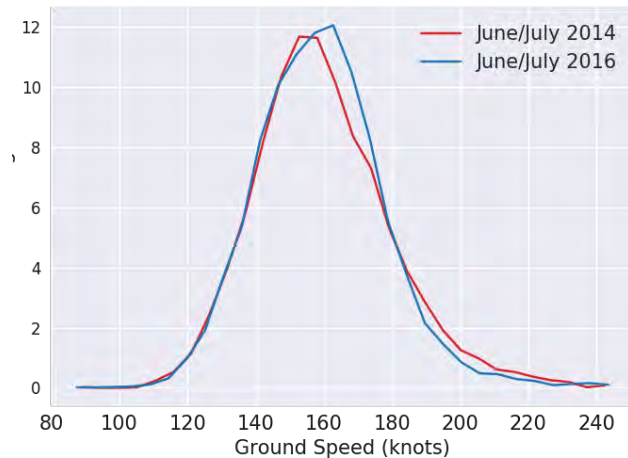


Rwy 33L Arrival Speed Distributions

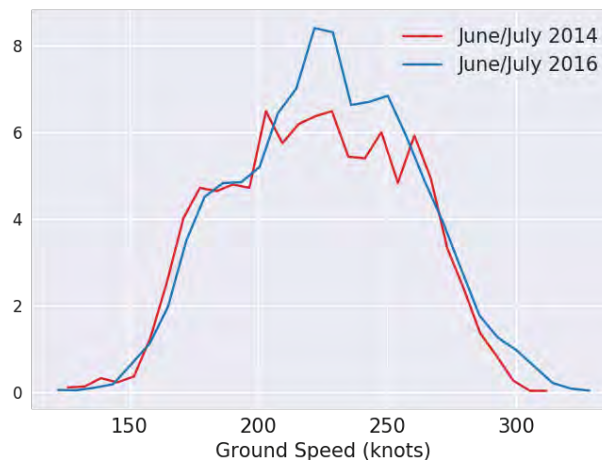
- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from arrival in 2014 vs. 2016**
 - Average ground speeds all within 6 knots

Percent of Flights

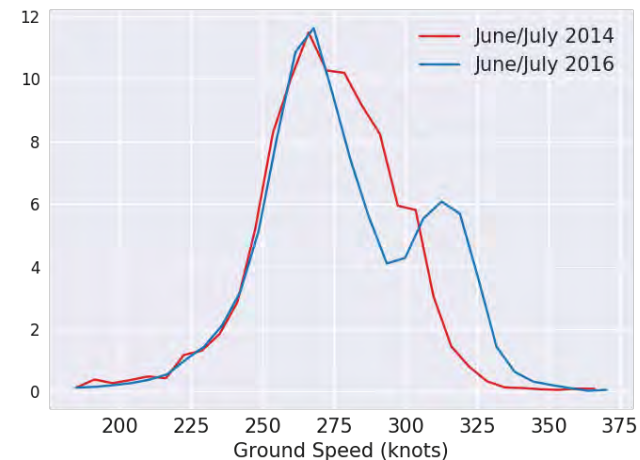
5 NM



10 NM



20 NM



Rwy 10 Arrival Speed Distributions

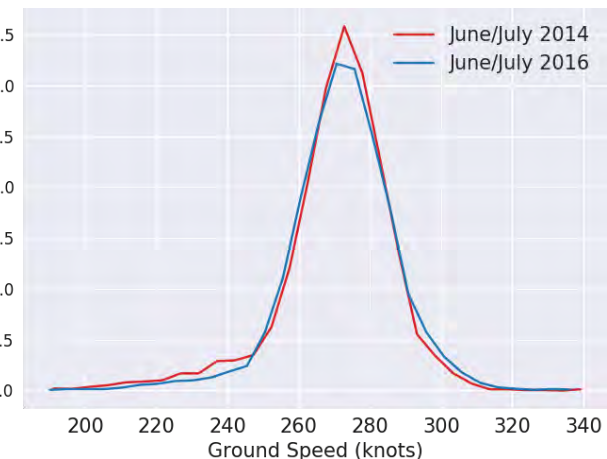
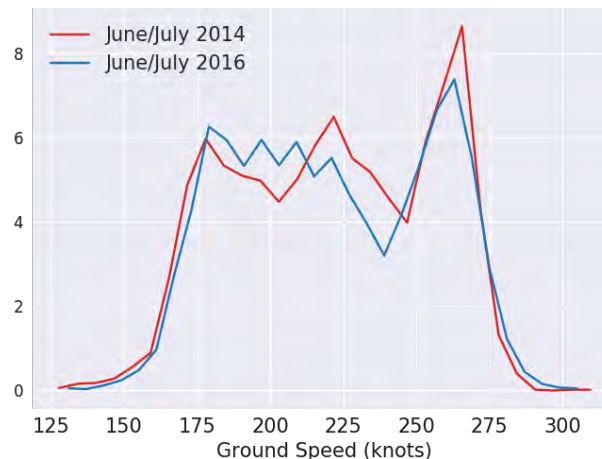
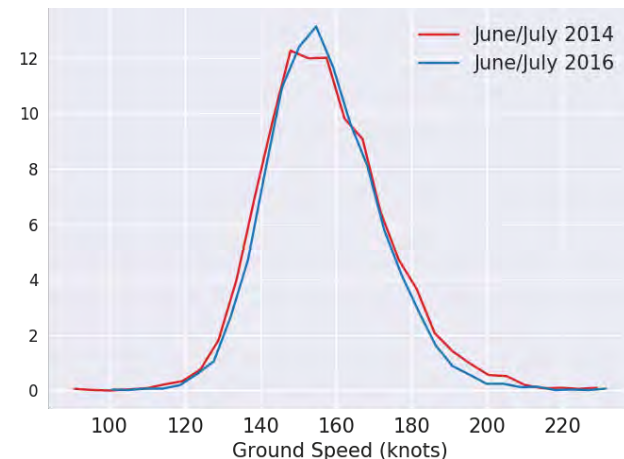
- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from arrival in 2014 vs. 2016**
 - Average ground speeds all within 3 knots

Percent of Flights

5 NM

10 NM

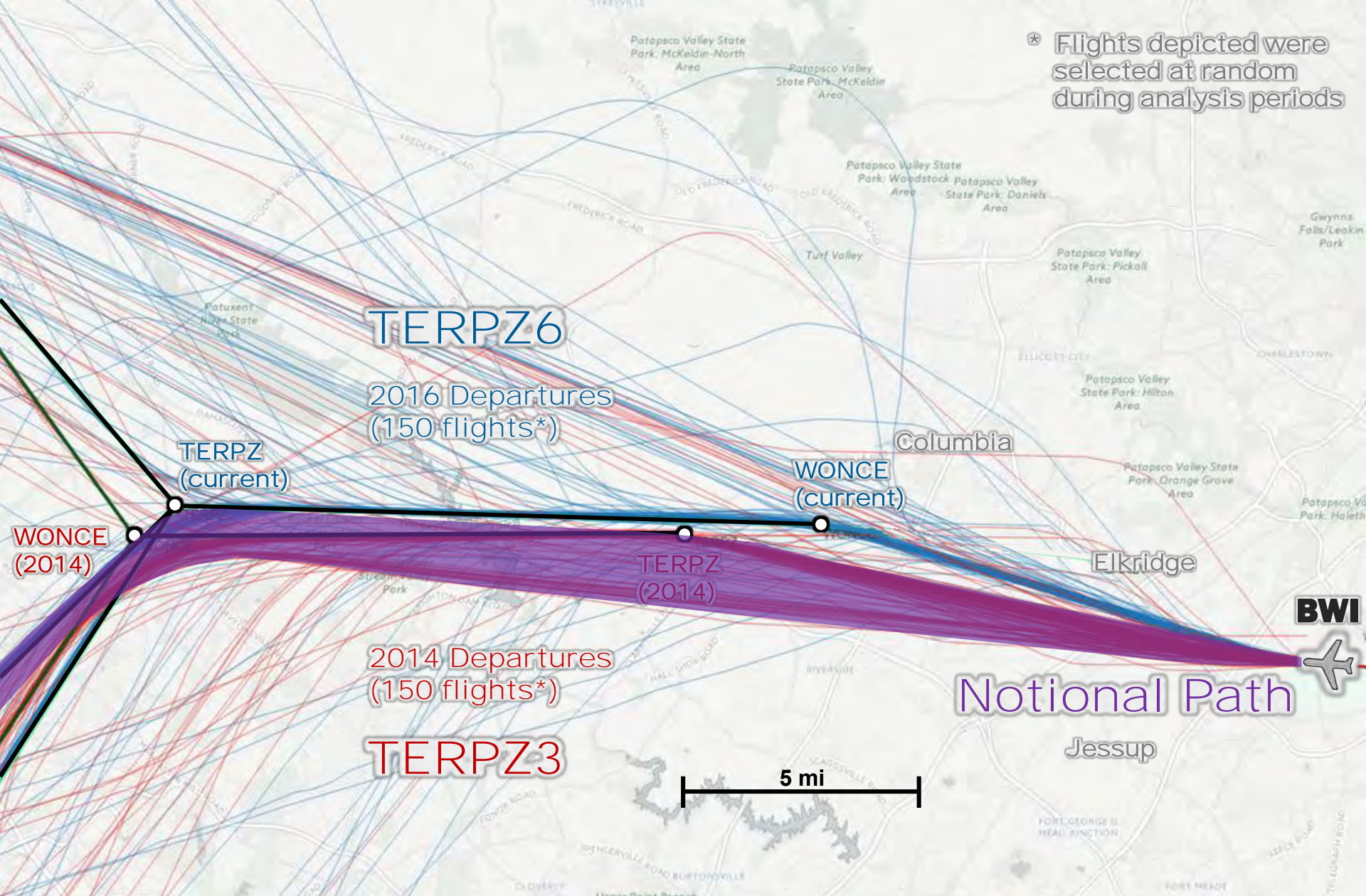
20 NM



Notional Path Discussion



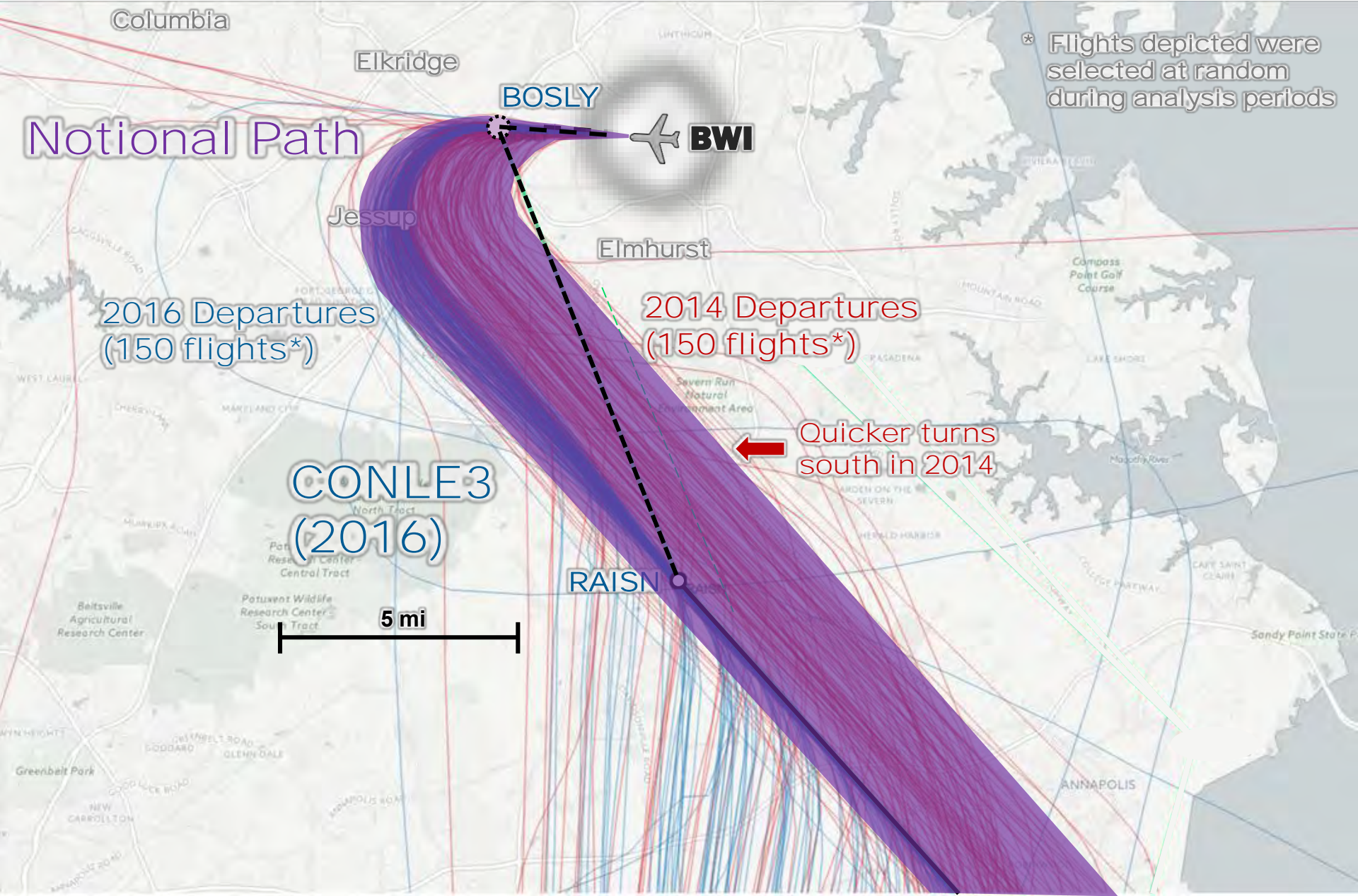
* Flights depicted were selected at random during analysis periods



TERPZ Rwy 28



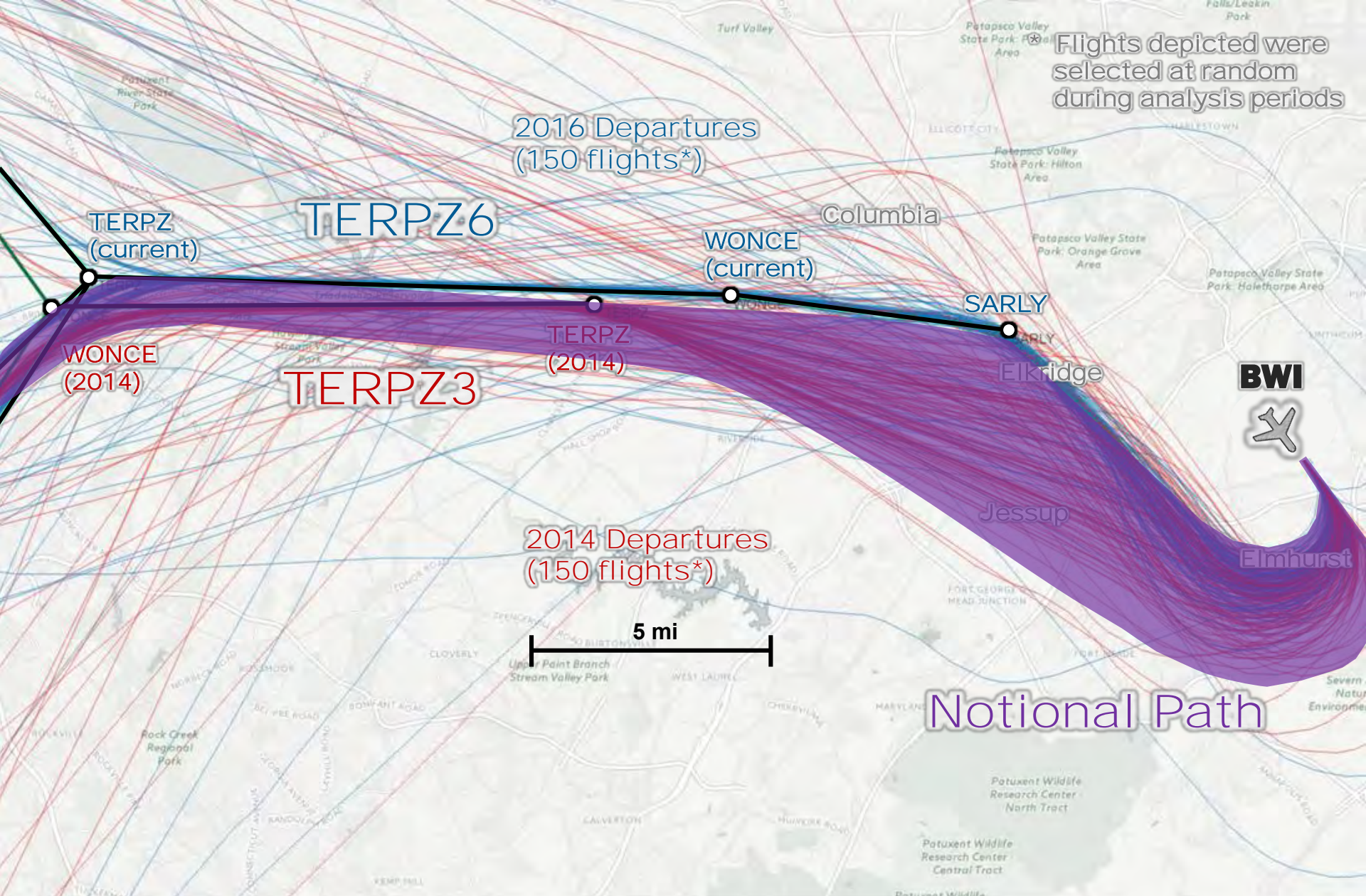
Federal Aviation Administration



CONLE3 Rwy 28



Federal Aviation Administration

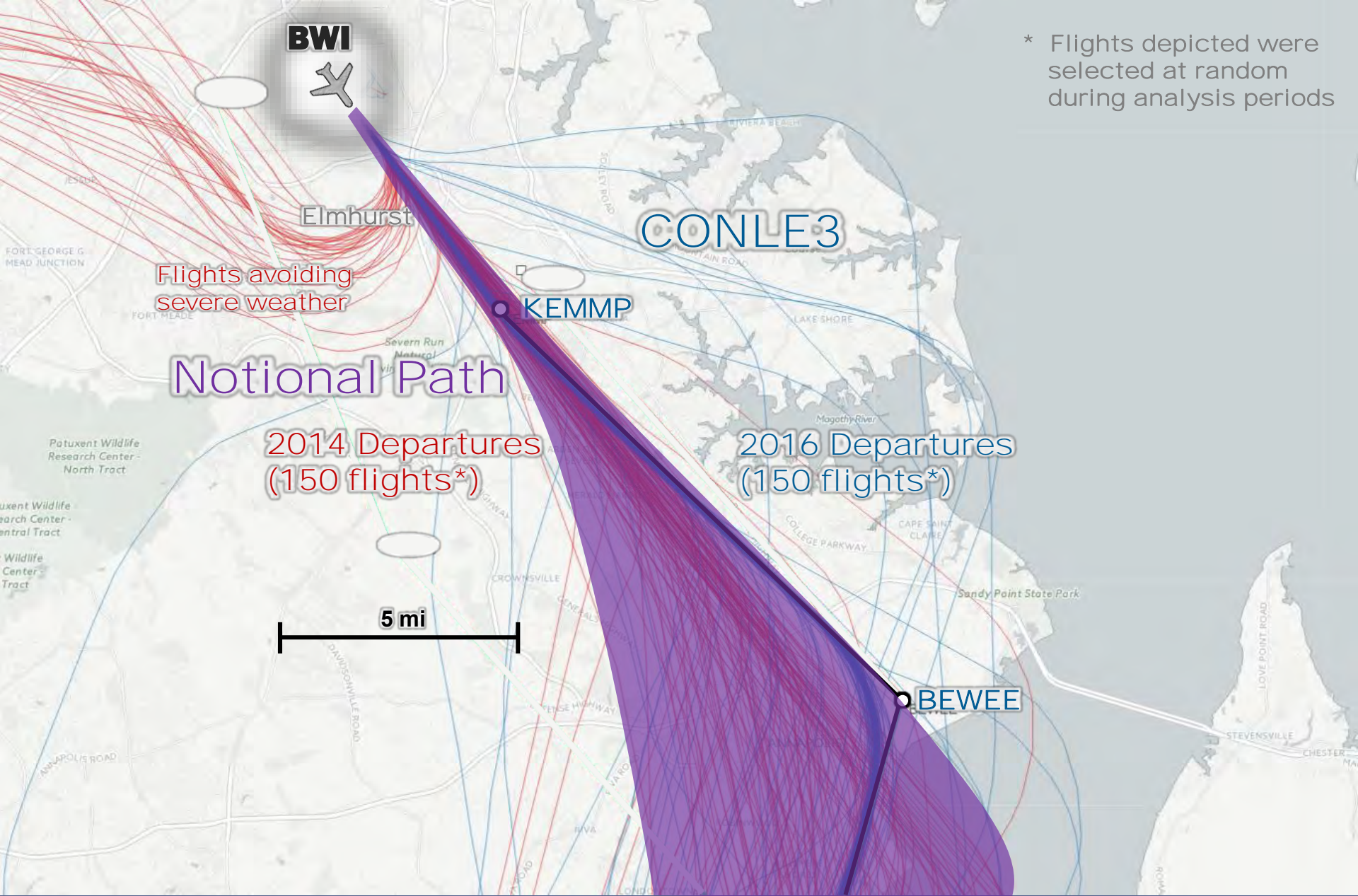


TERPZ Rwy 15R



Federal Aviation Administration

* Flights depicted were selected at random during analysis periods



CONLE3 Rwy 15R



Federal Aviation
Administration

Notional Next Steps

- **July/August:** Analysis review, if needed. FAA will return upon invite
- **August:** PBN DCA/BWI/IAD Working Group Five-Phase Kickoff Meeting
- **September or Early October 2017:** Follow-up Meeting with BWI Roundtable, Co-Leads and Facilities. Present notional designs...
- **February 2019:** Notional publication date



Questions

