

BWI Traffic Analysis and Notional Paths

To: DC Metroplex BWI Community
Roundtable Working Group

Date: June 20, 2017

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Federal Aviation
Administration



Contents

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



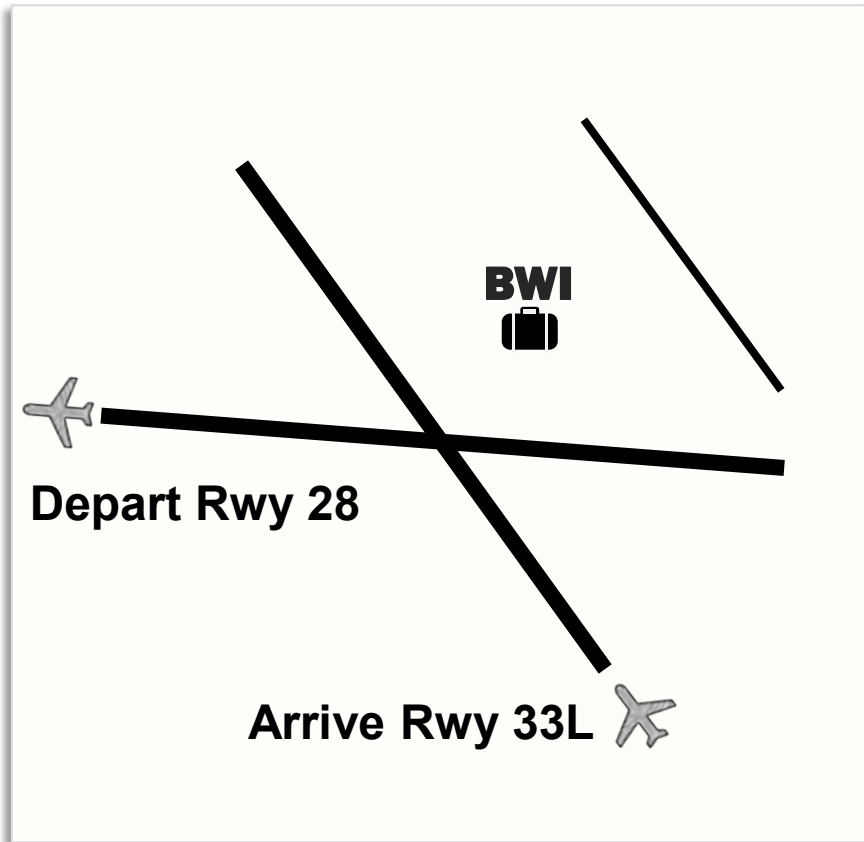
PBN Design Influences & Factors

- **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)

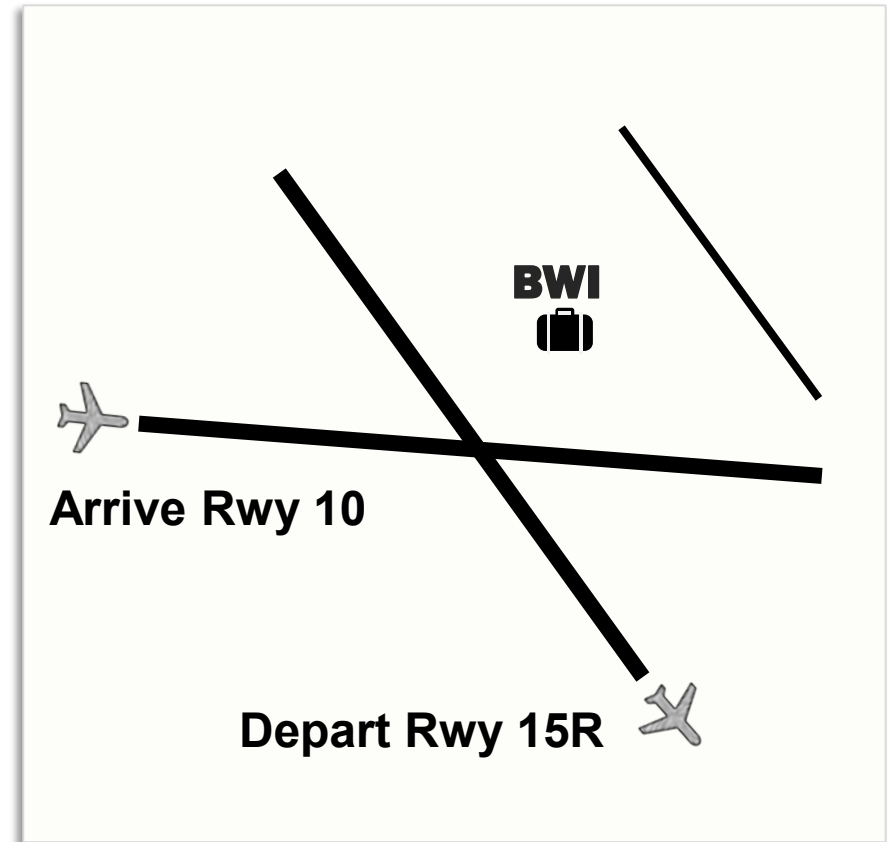


Runway Configurations

Primary

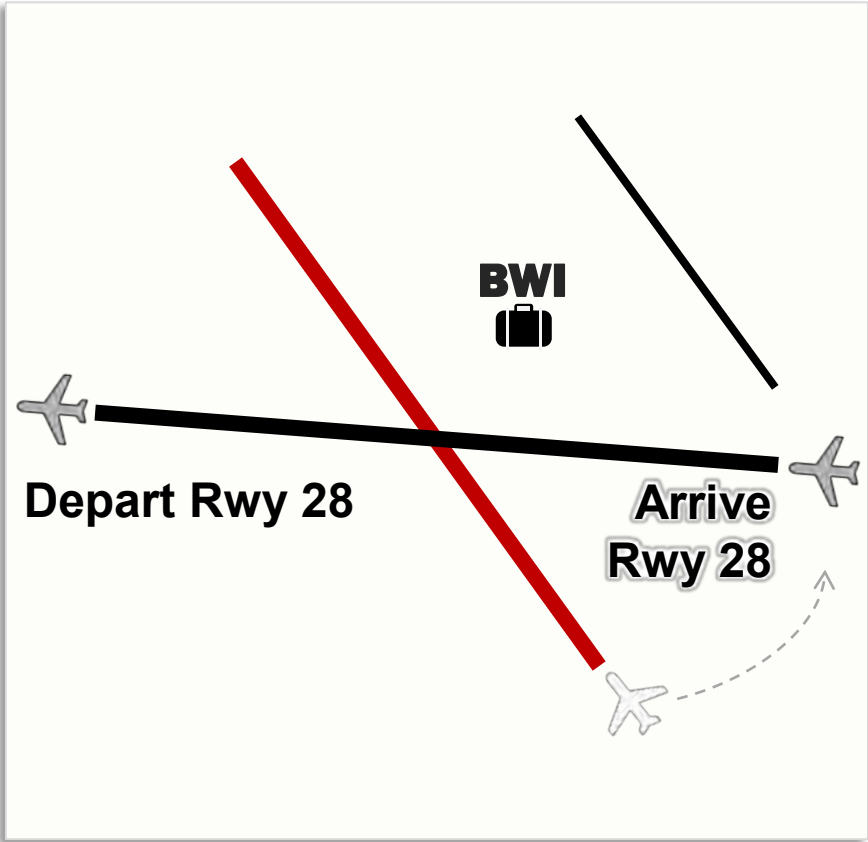


Secondary

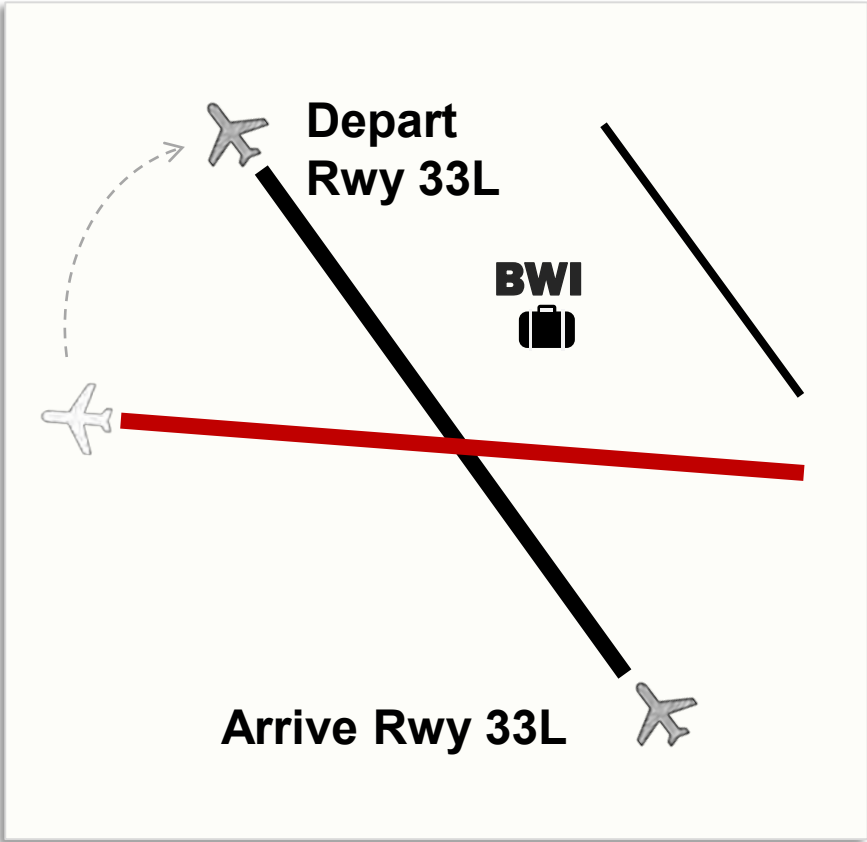


Runway Closures

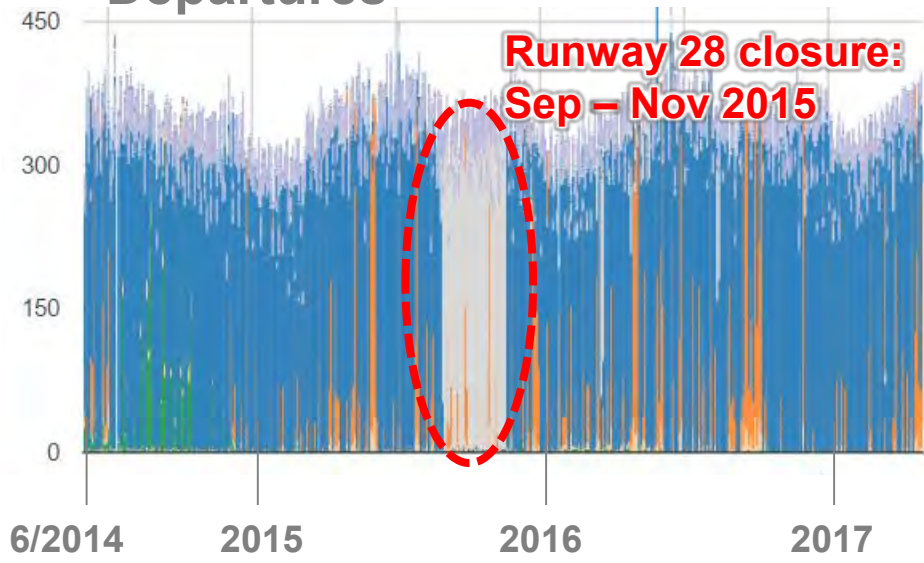
Primary
2014 Jul – Nov



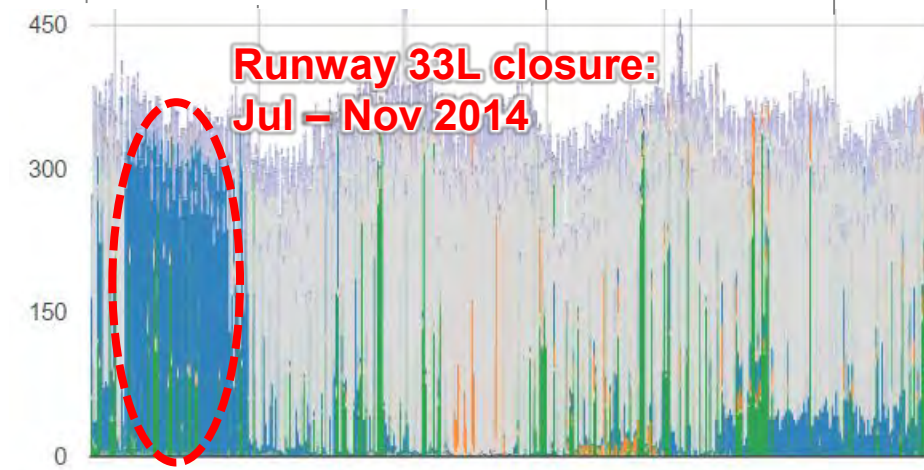
Primary
2015 Sep – Nov



Departures

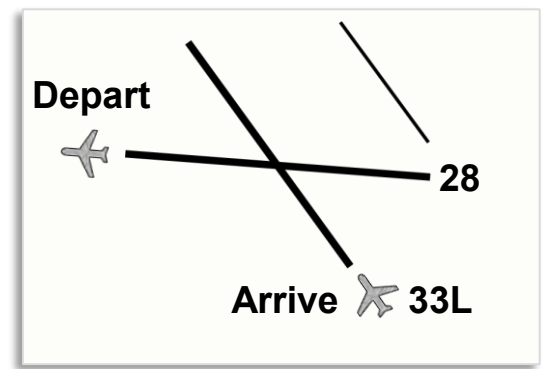


Arrivals



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

Runway Configurations



Federal Aviation Administration

Special Flight Rules Area

BWI



IAD

DCA

ADW

Flight Restricted Zone

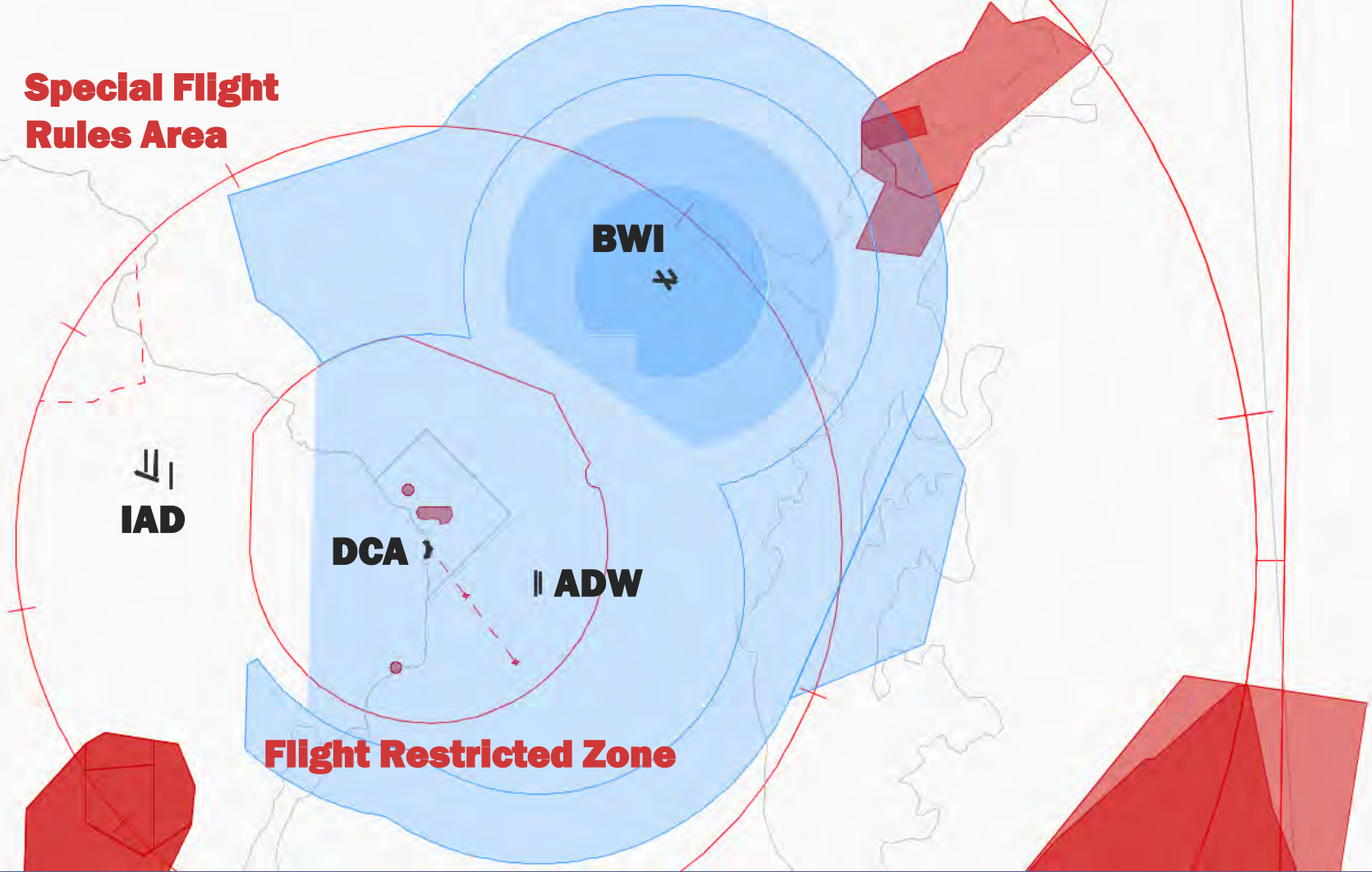
ATC Considerations



Federal Aviation Administration

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

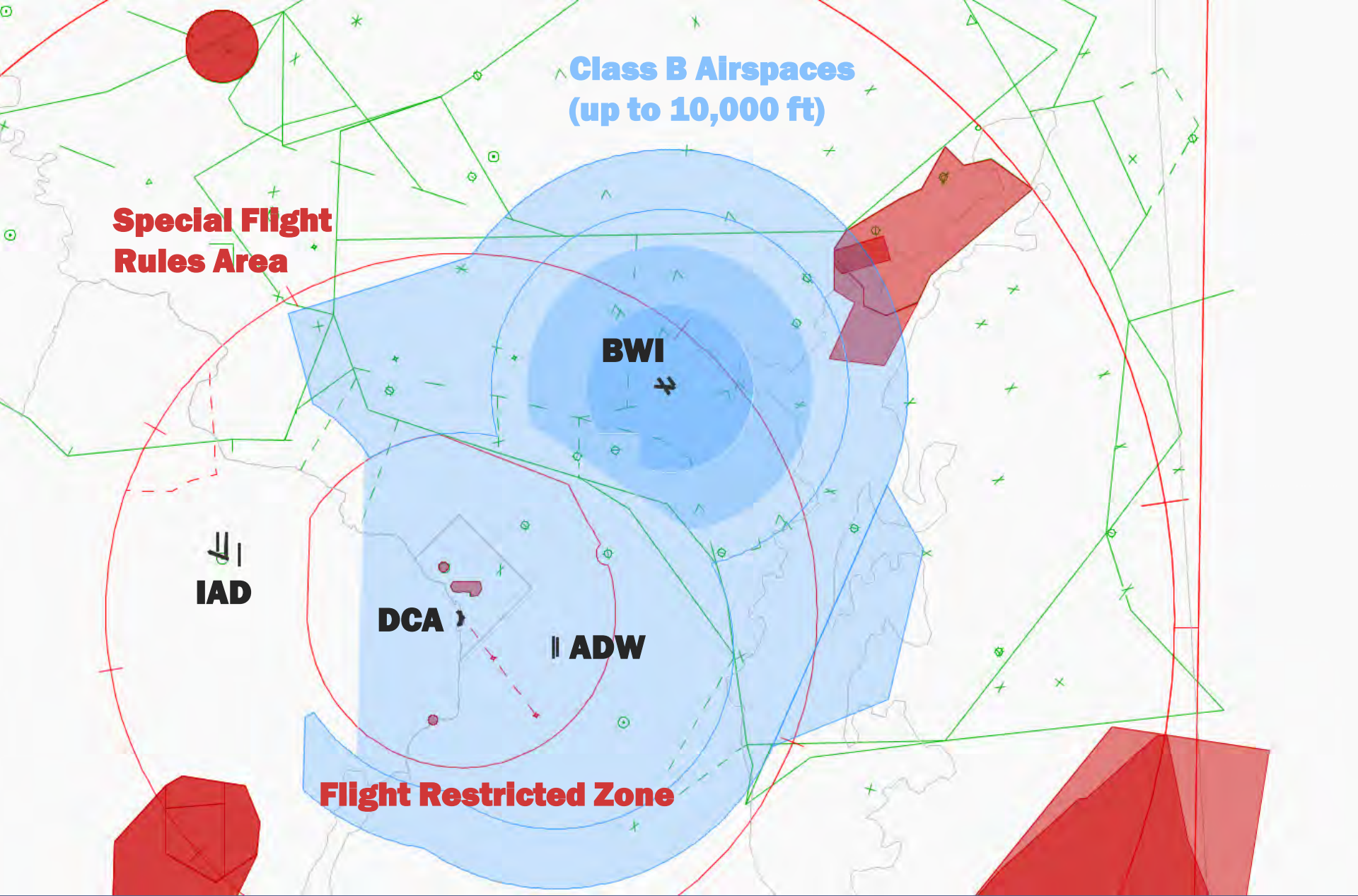
**Special Flight
Rules Area**



ATC Considerations



Federal Aviation
Administration



ATC Considerations

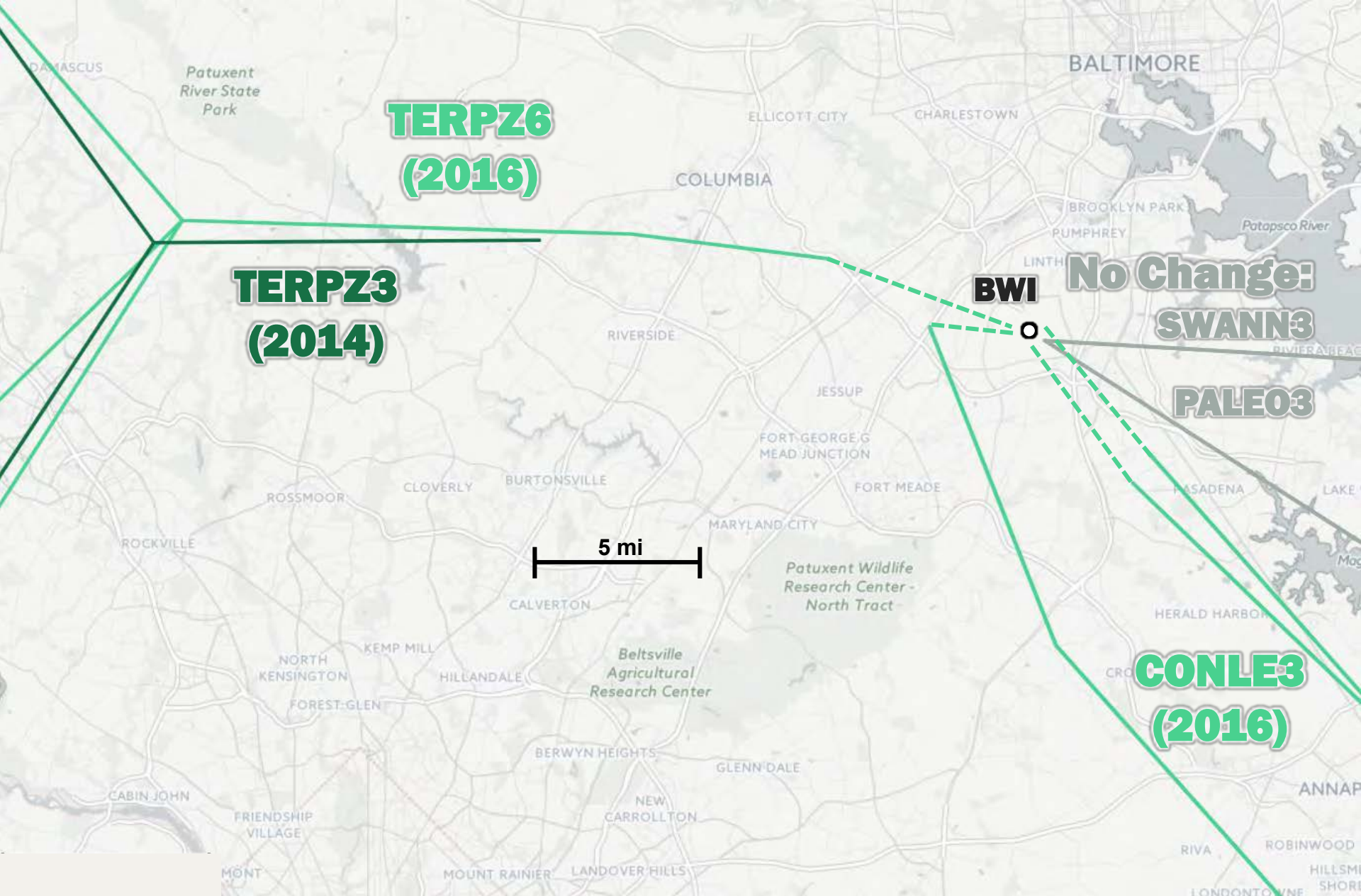


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Lateral Analysis

Runway 28 & 15R Departures





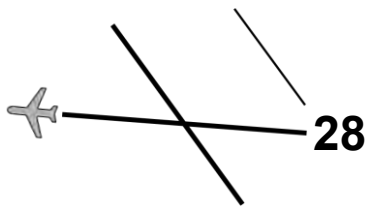
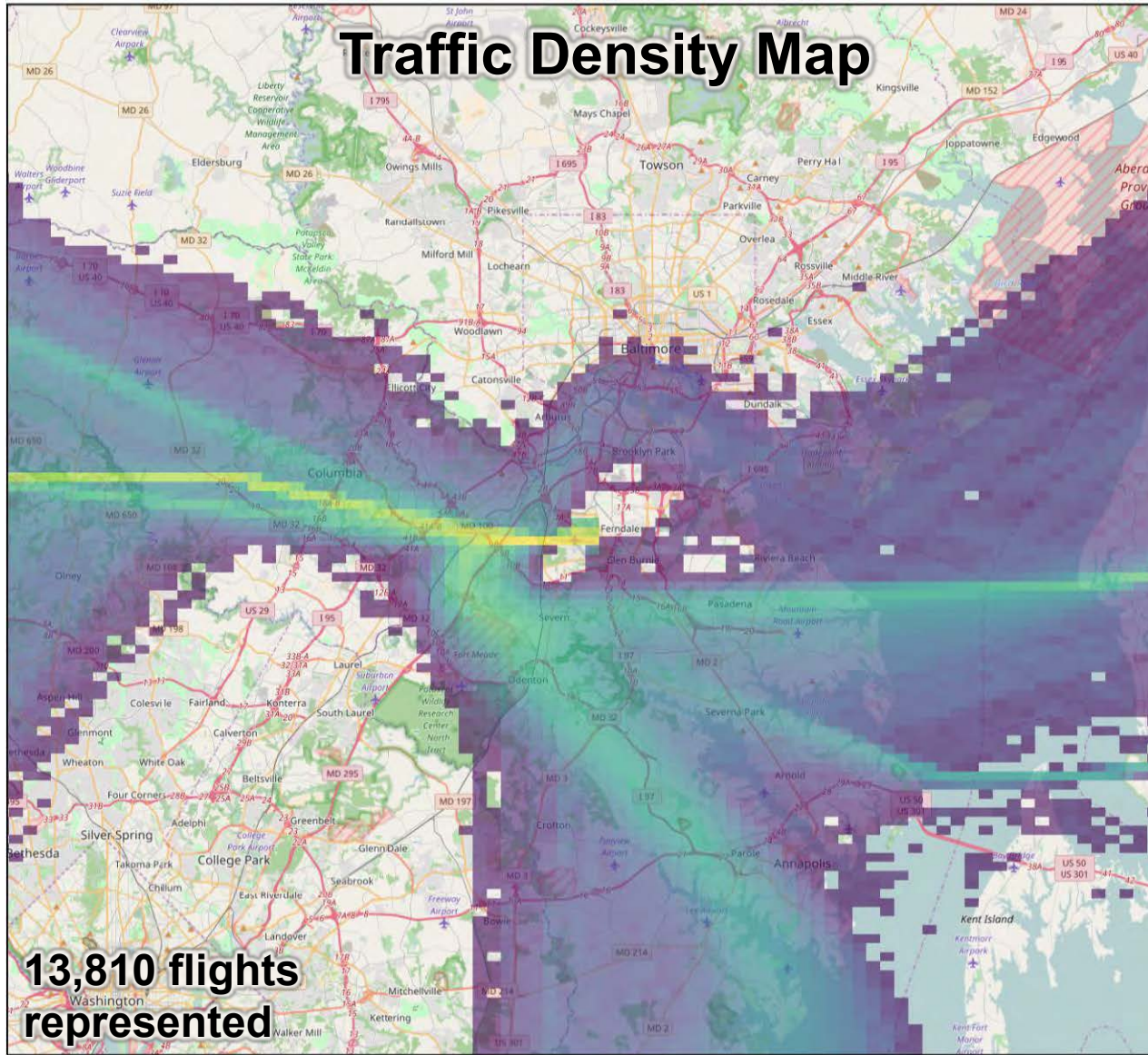
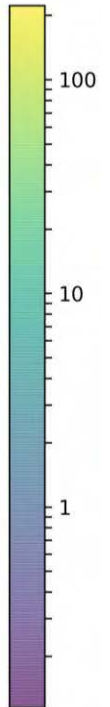
Departure Changes



Federal Aviation
Administration

Traffic Density Map

June – July
2014
Daily Average
Flight Count



**13,810 flights
represented**

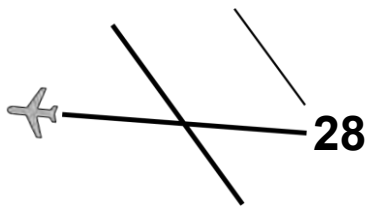
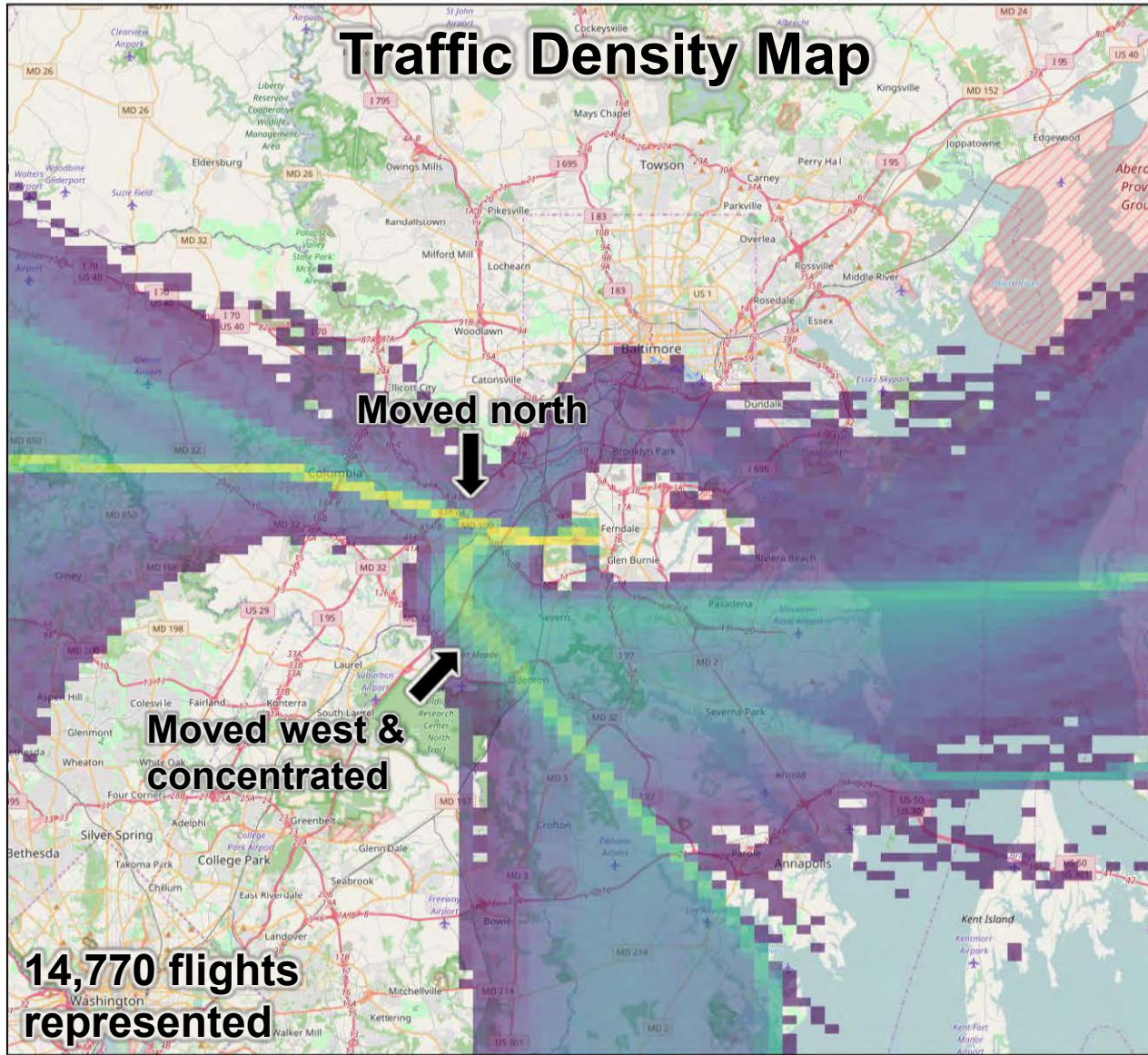
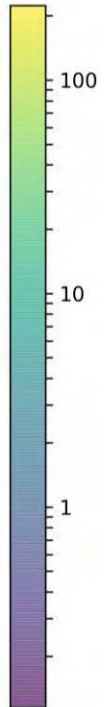
Rwy 28 Departures



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Administration

Traffic Density Map

June – July
2016
Daily Average
Flight Count

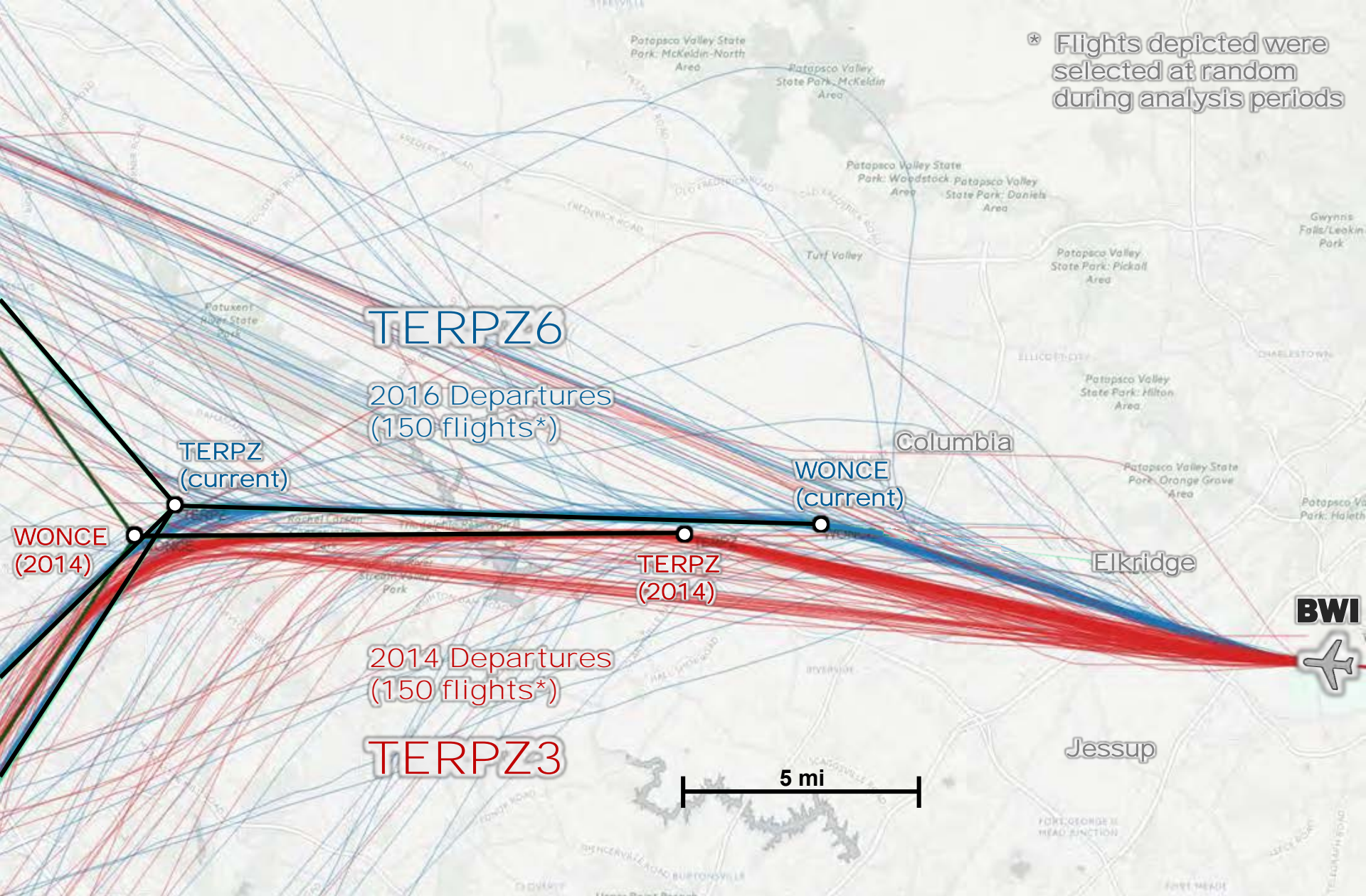


Rwy 28 Departures



Federal Aviation
Administration

* Flights depicted were selected at random during analysis periods



TERPZ6

2016 Departures
(150 flights*)

TERPZ
(current)

WONCE
(current)

TERPZ
(2014)

2014 Departures
(150 flights*)

TERPZ3

5 mi

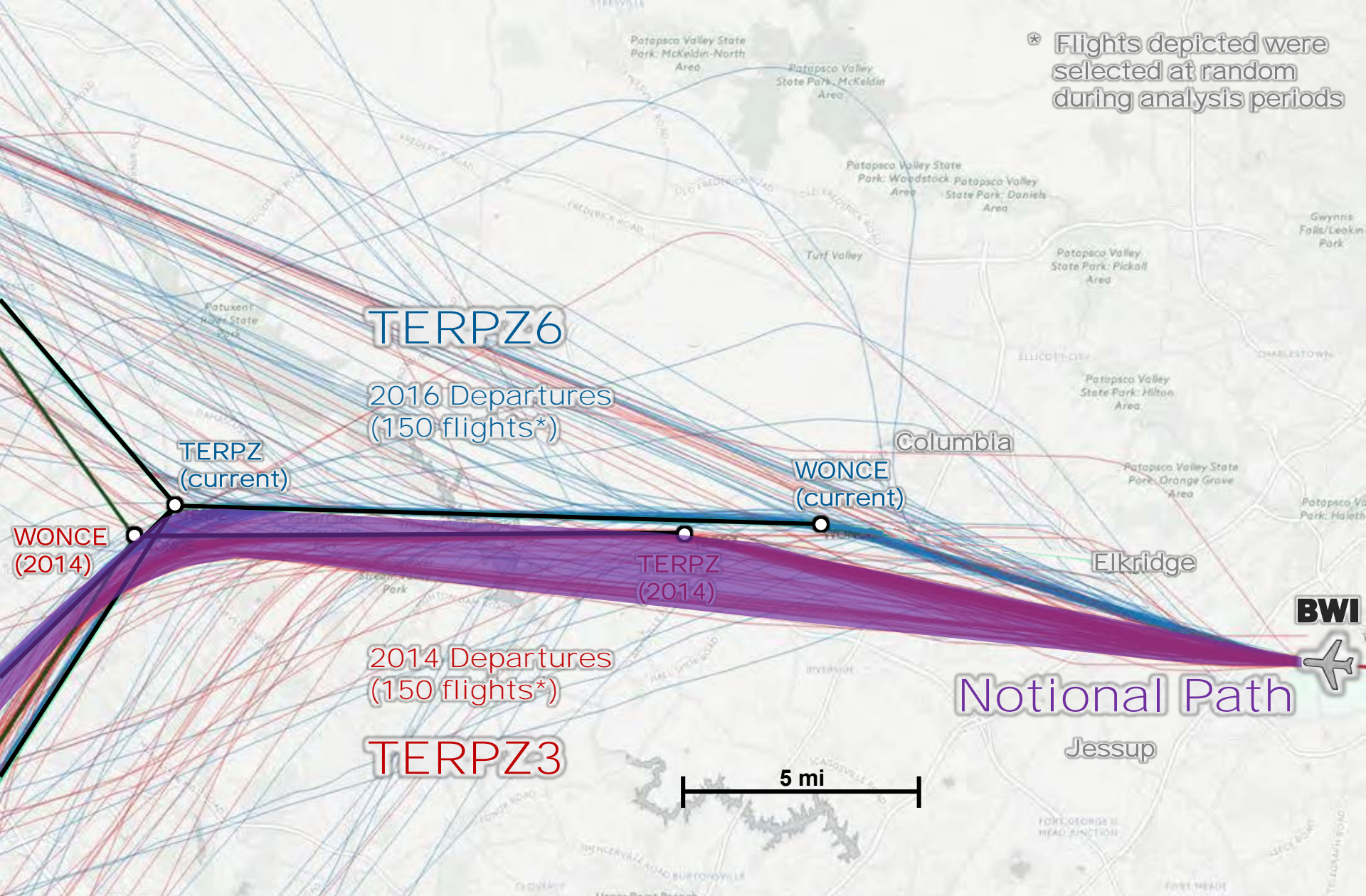


TERPZ Rwy 28



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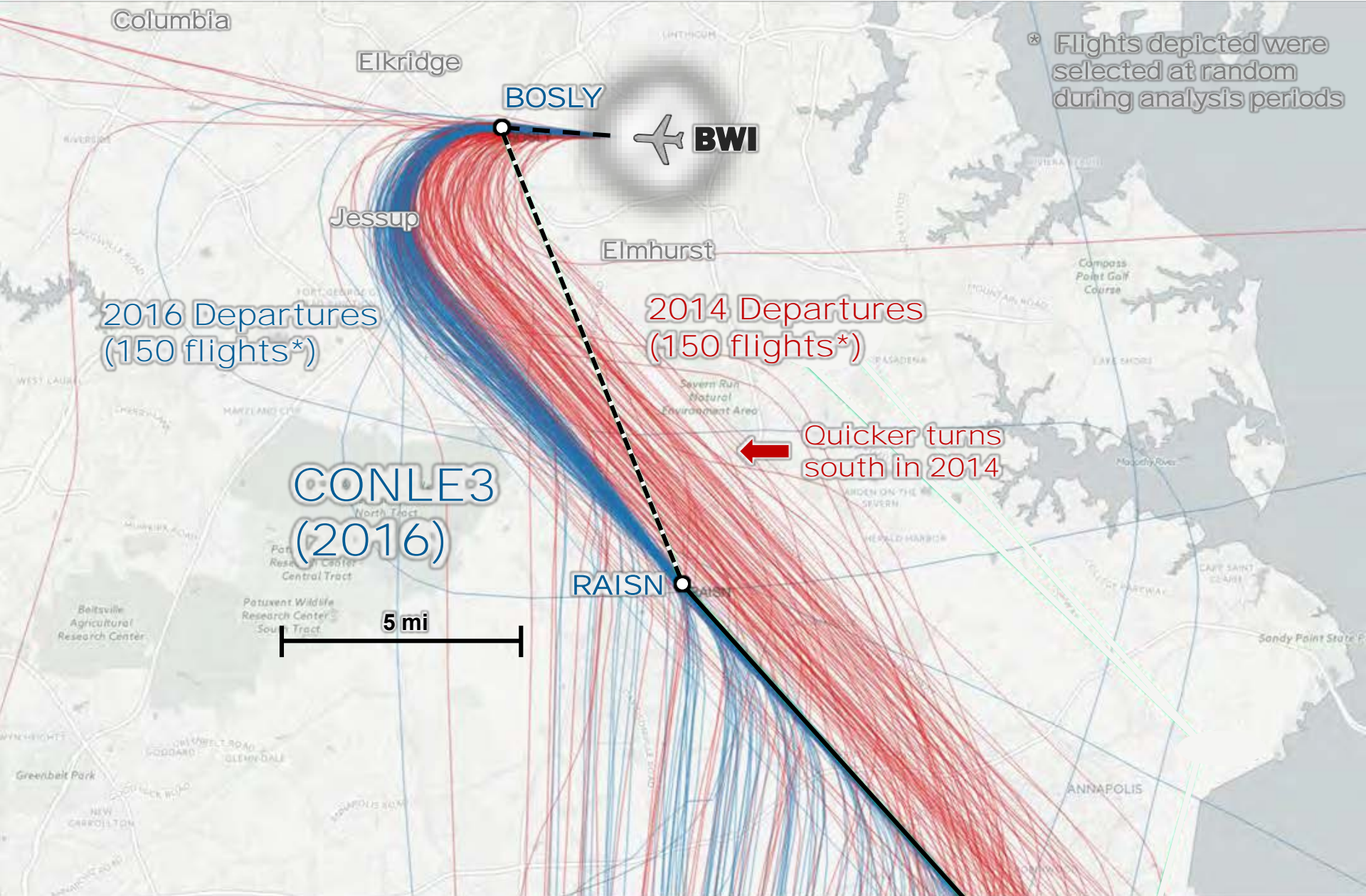
* Flights depicted were selected at random during analysis periods



TERPZ Rwy 28



Federal Aviation Administration



CONLE3 Rwy 28



Federal Aviation Administration

* Flights depicted were selected at random during analysis periods

Notional Path

BOSLY



Elkridge

Jessup

Elmhurst

2016 Departures (150 flights*)

2014 Departures (150 flights*)

Quicker turns south in 2014

CONLE3 (2016)

RAISN

5 mi

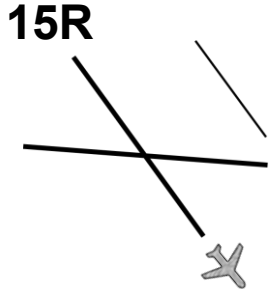
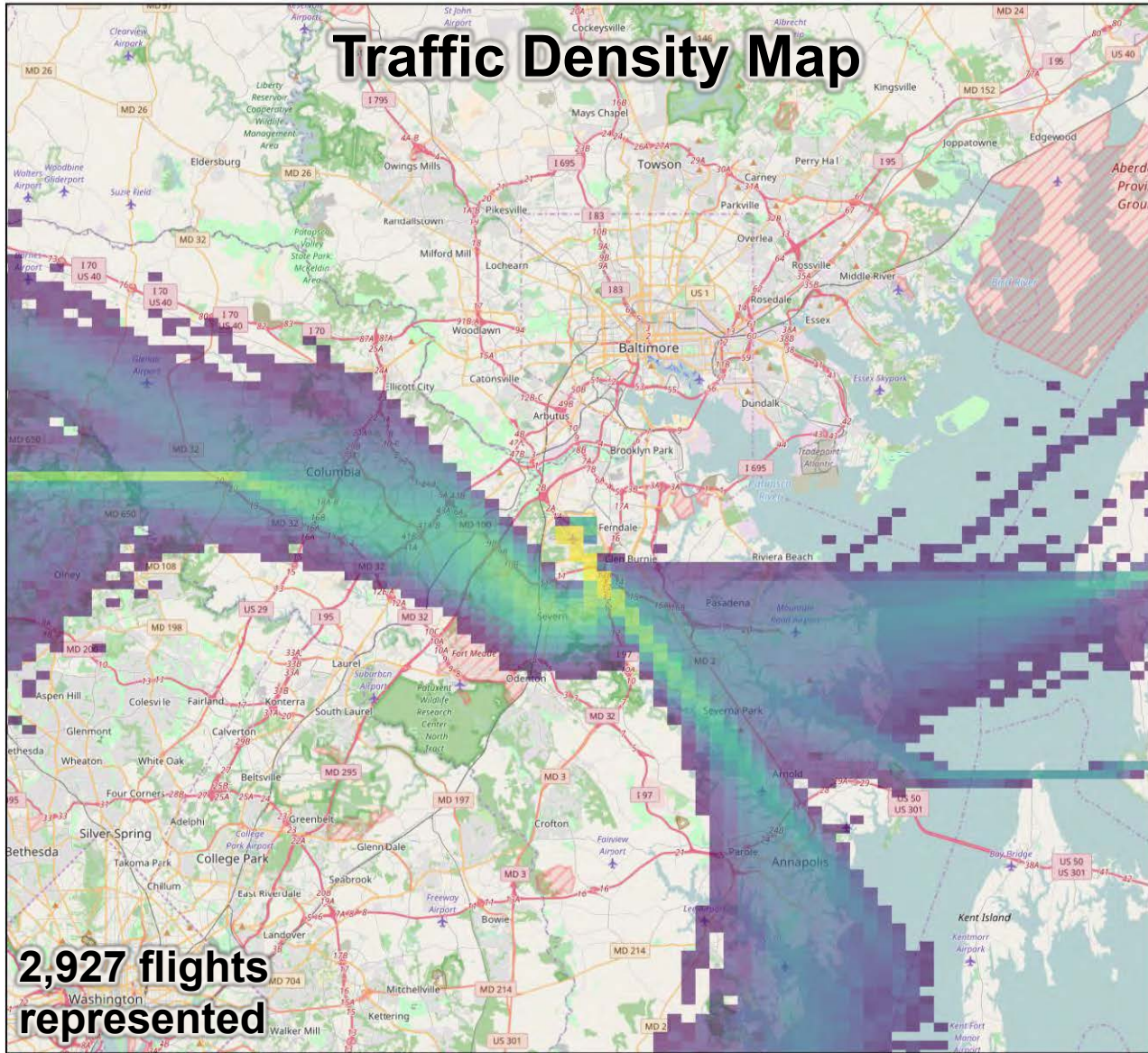
CONLE3 Rwy 28



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

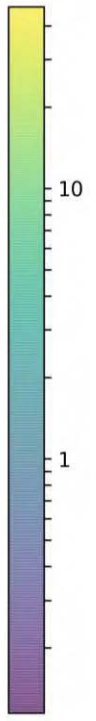
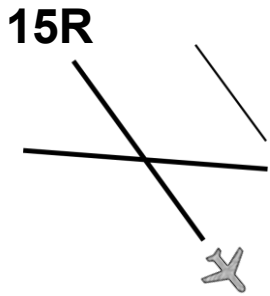
Moved north &
concentrated



Moved east &
concentrated



**5,715 flights
represented**

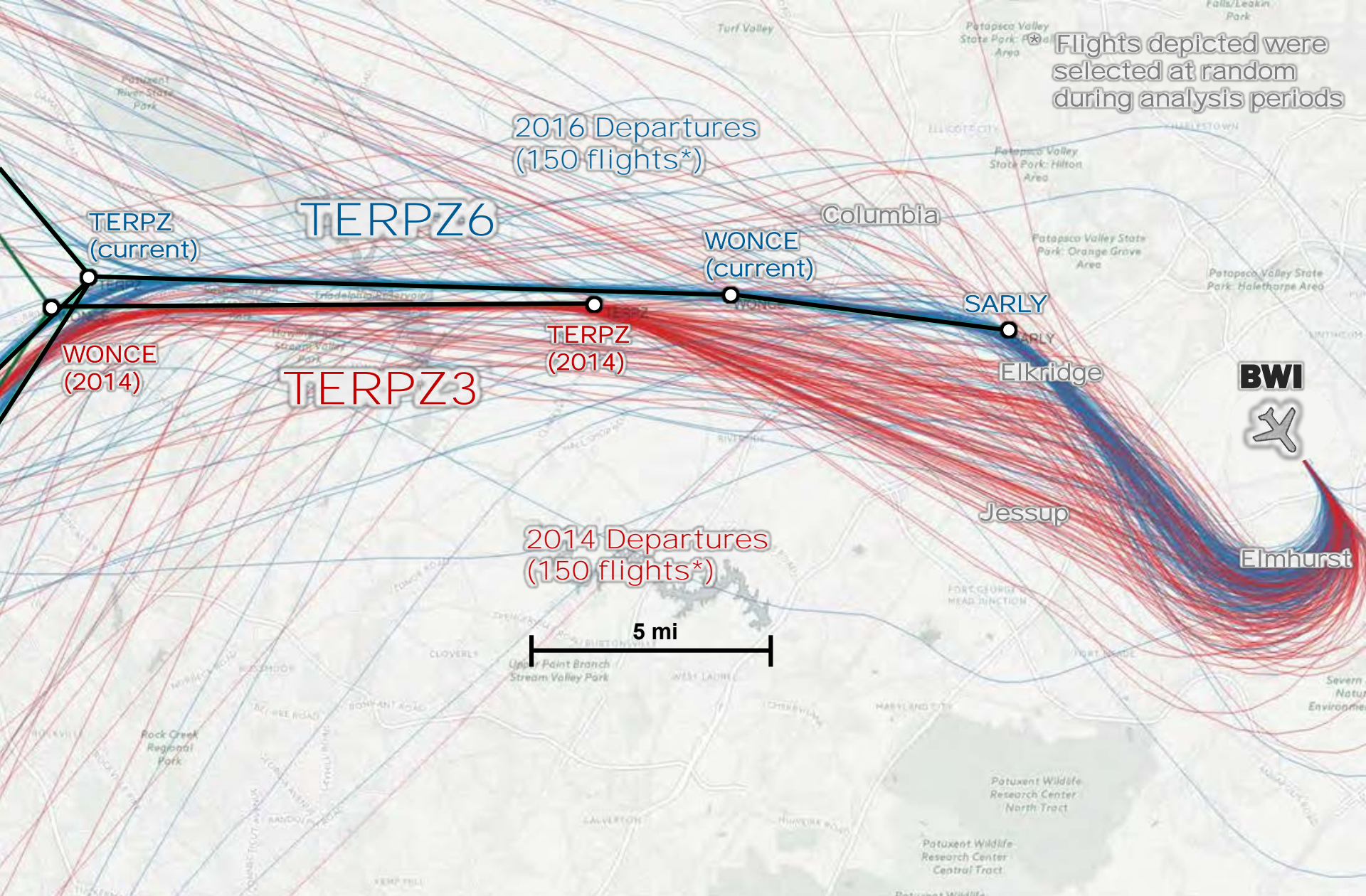


Rwy 15R Departures



Federal Aviation
Administration

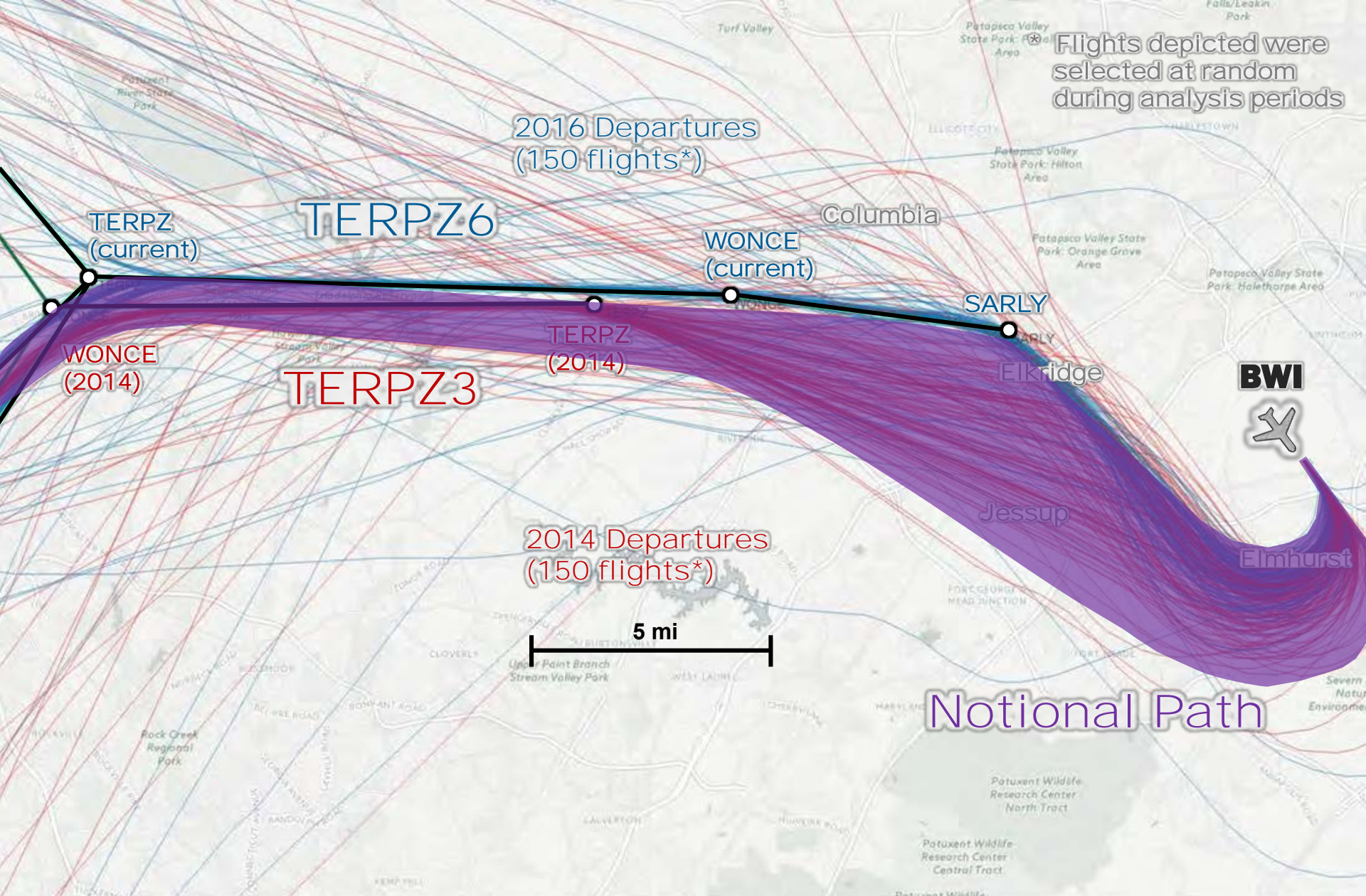
Flights depicted were selected at random during analysis periods



TERPZ Rwy 15R



Federal Aviation Administration

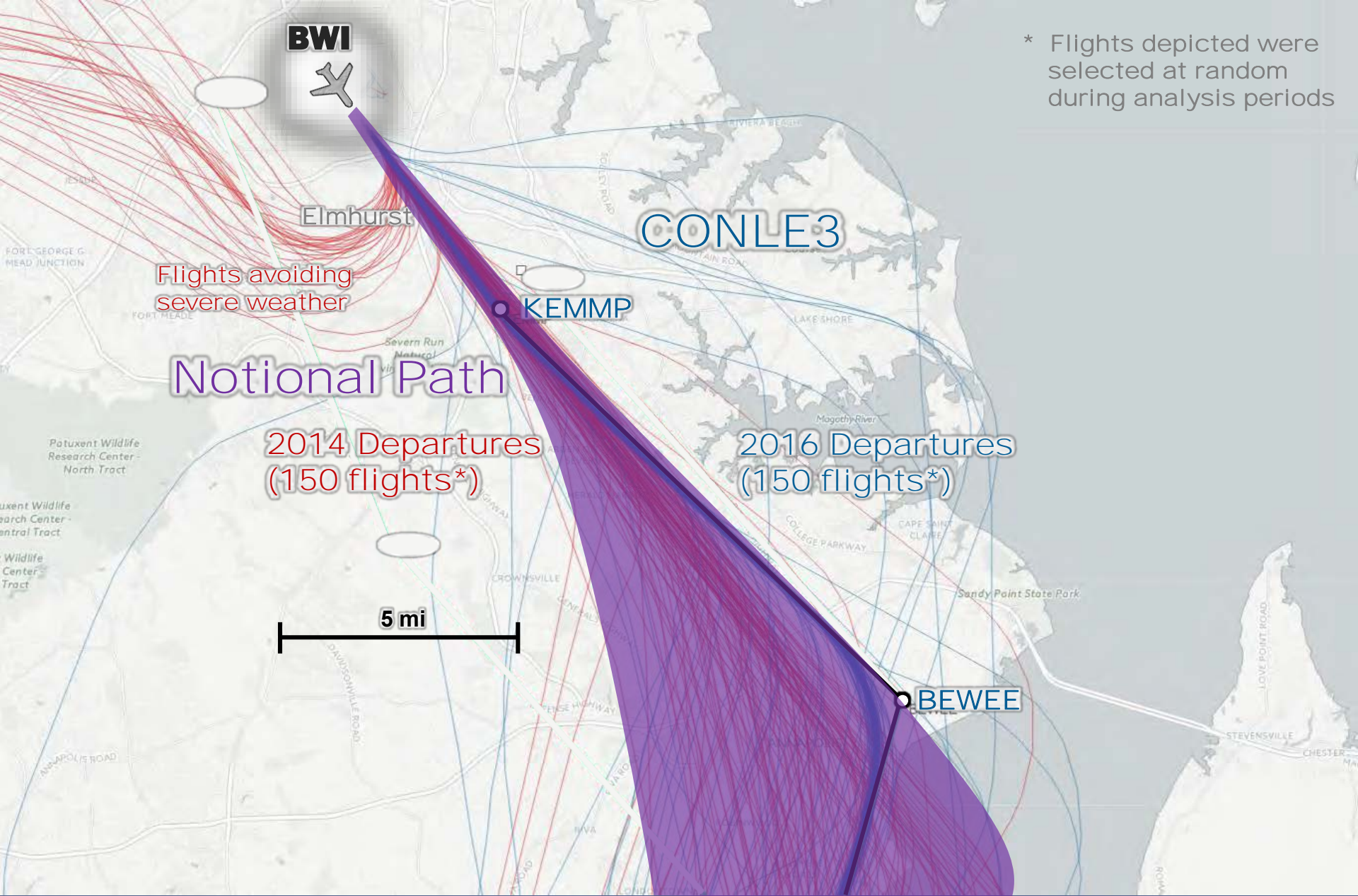


TERPZ Rwy 15R



Federal Aviation Administration

* Flights depicted were selected at random during analysis periods



CONLE3 Rwy 15R



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Administration

Lateral Analysis | Departure Summary

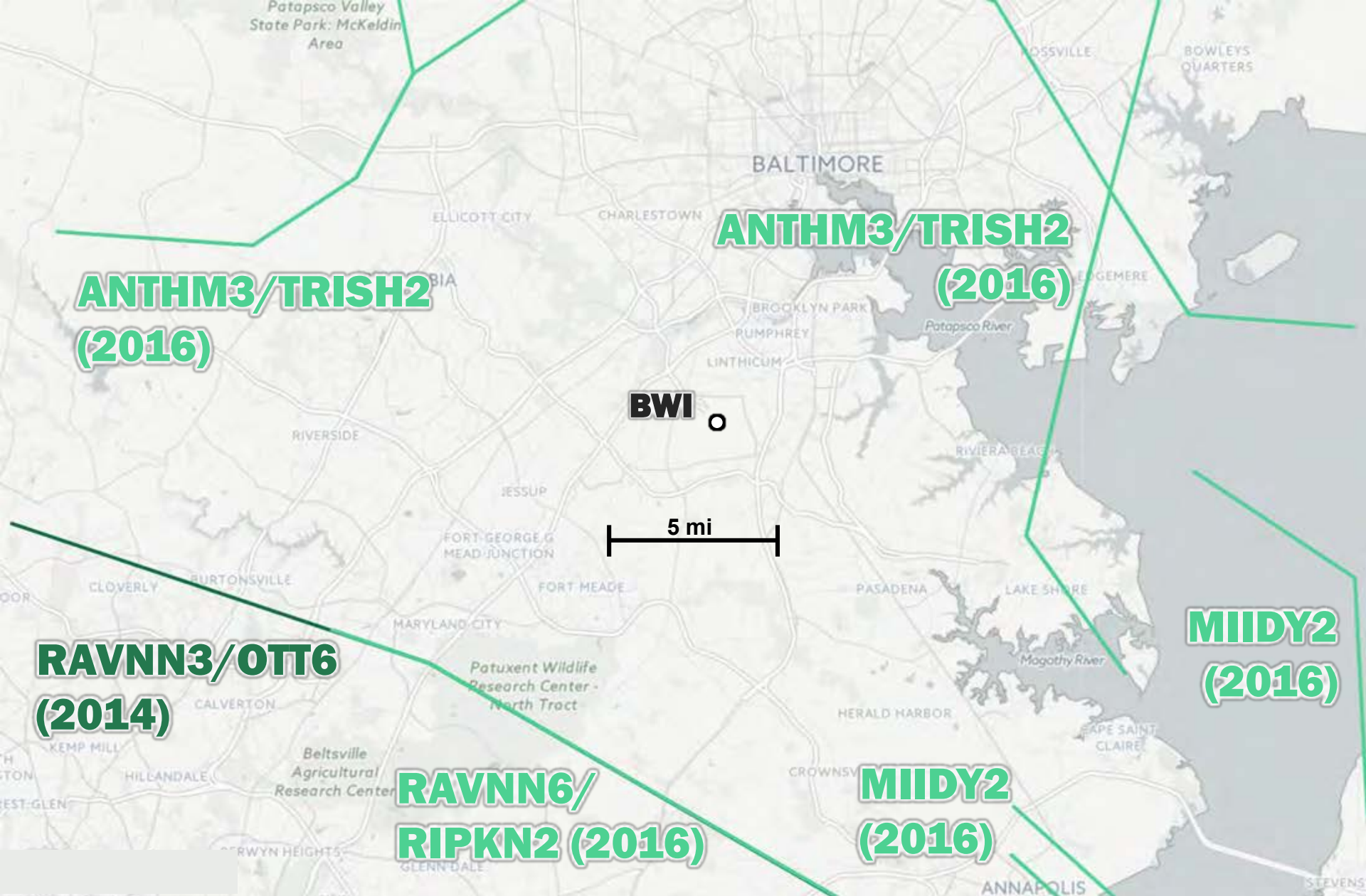
- **Runway 28 closure Sep. – Nov. 2015 changed the departure path during these 3 months**
- **TERPZ departures**
 - Runway 28: Flight path moved north
 - Runway 15R: Flight path moved north and concentrated on added segment
- **CONLE3 departures**
 - Runway 28: Flight path moved west and concentrated 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



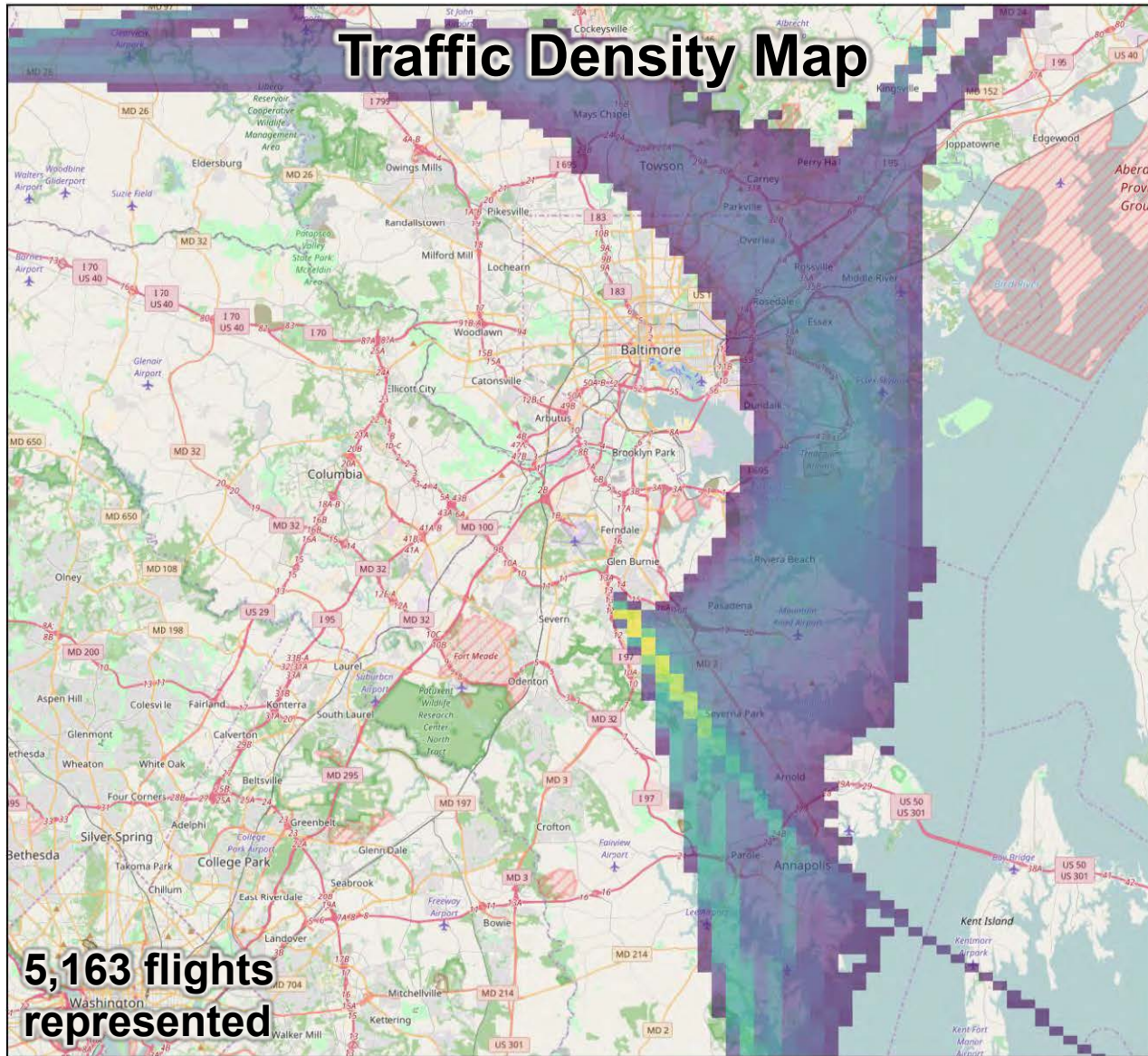
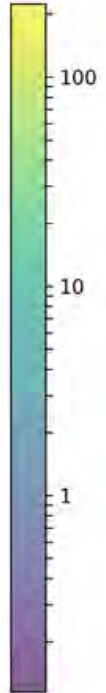


Arrival Changes

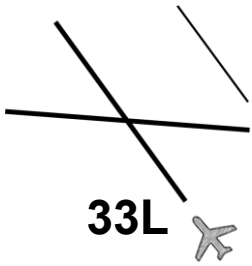


Traffic Density Map

June – July
2014
Daily Average
Flight Count



**5,163 flights
represented**



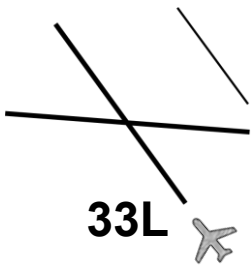
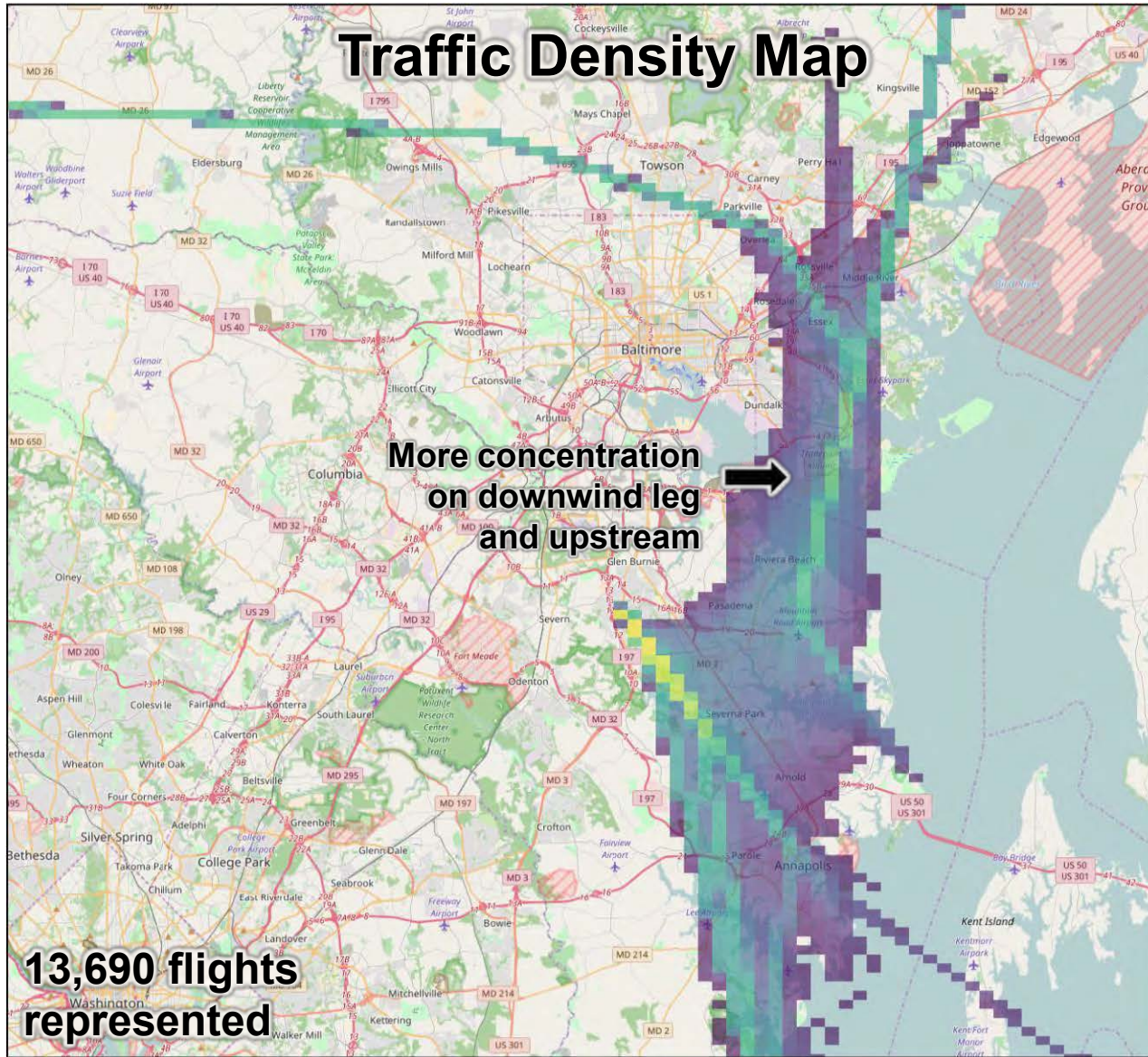
Rwy 33L Arrivals



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Traffic Density Map

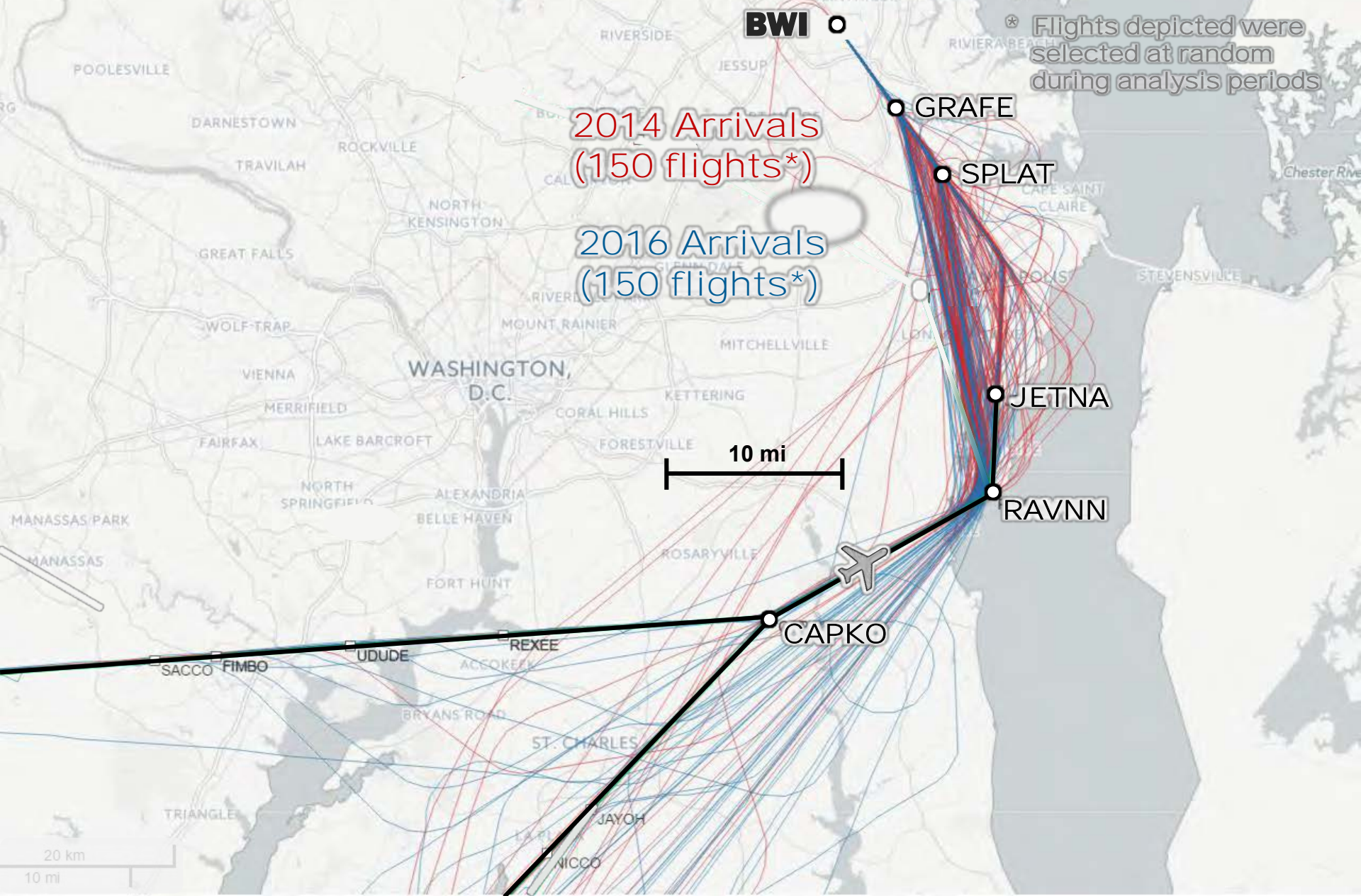
June – July
2016
Daily Average
Flight Count



Rwy 33L Arrivals



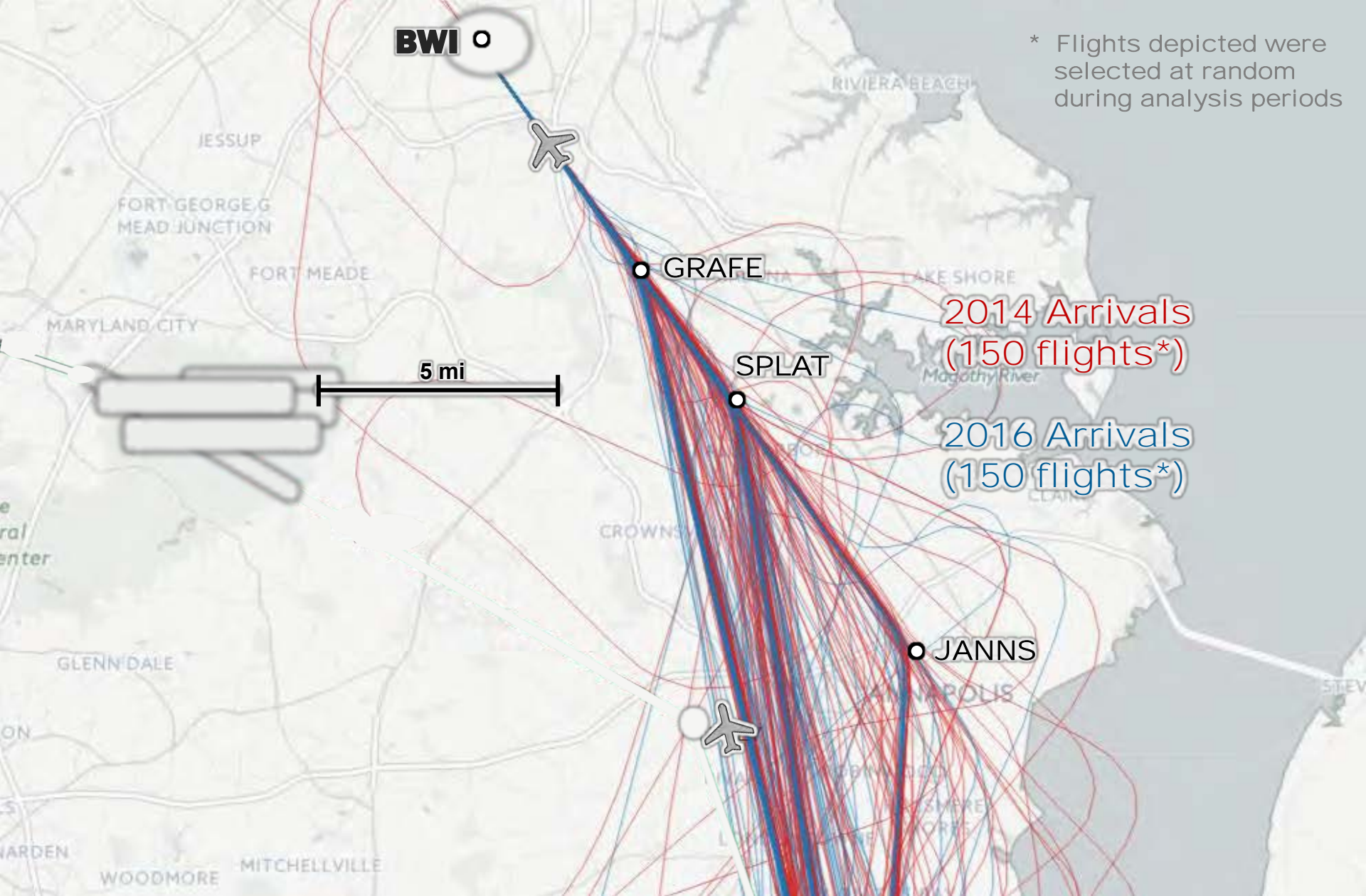
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RAVNN Rwy 33L



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* Flights depicted were selected at random during analysis periods

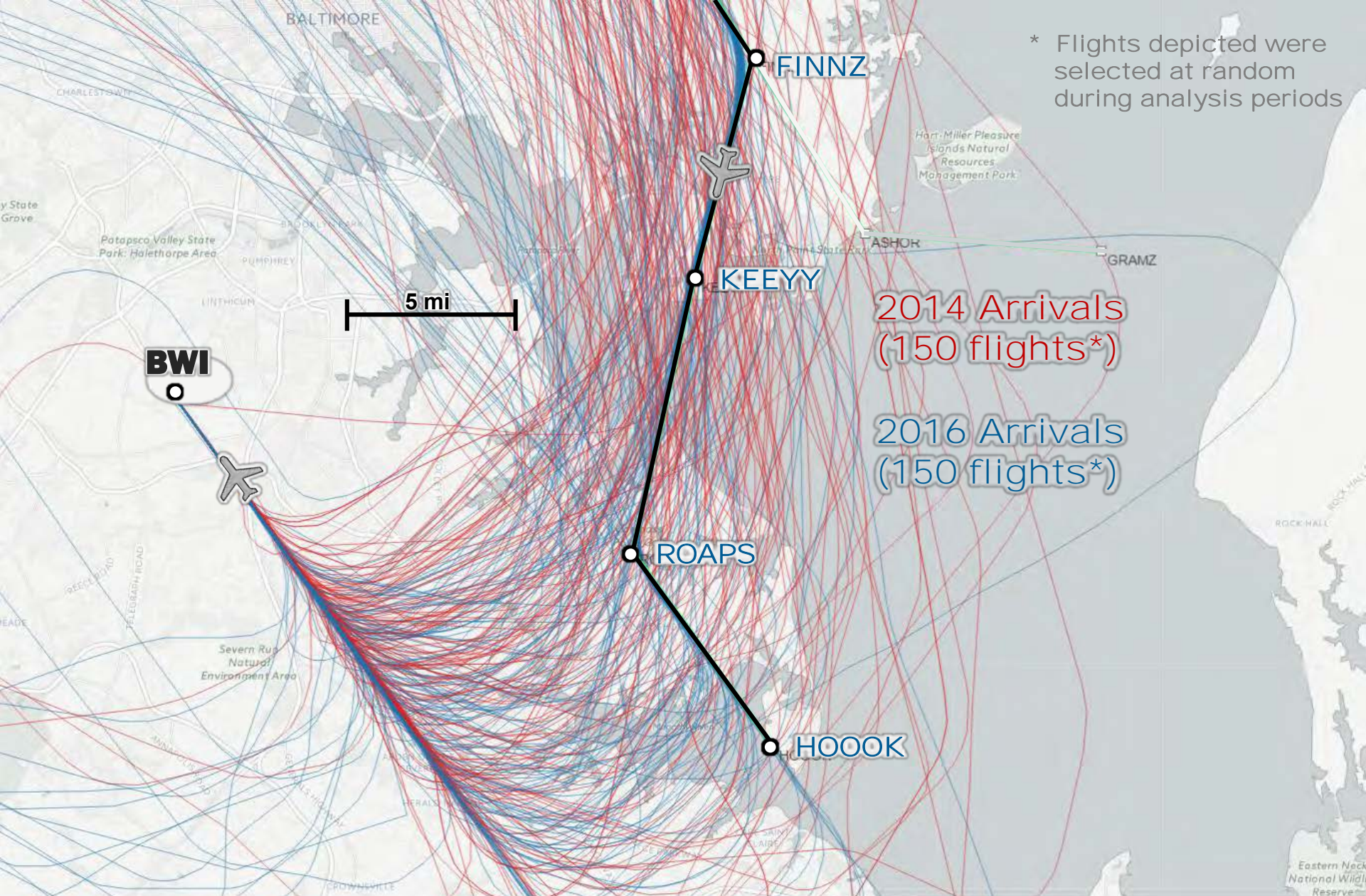
2014 Arrivals
(150 flights*)

2016 Arrivals
(150 flights*)

RAVNN Rwy 33L



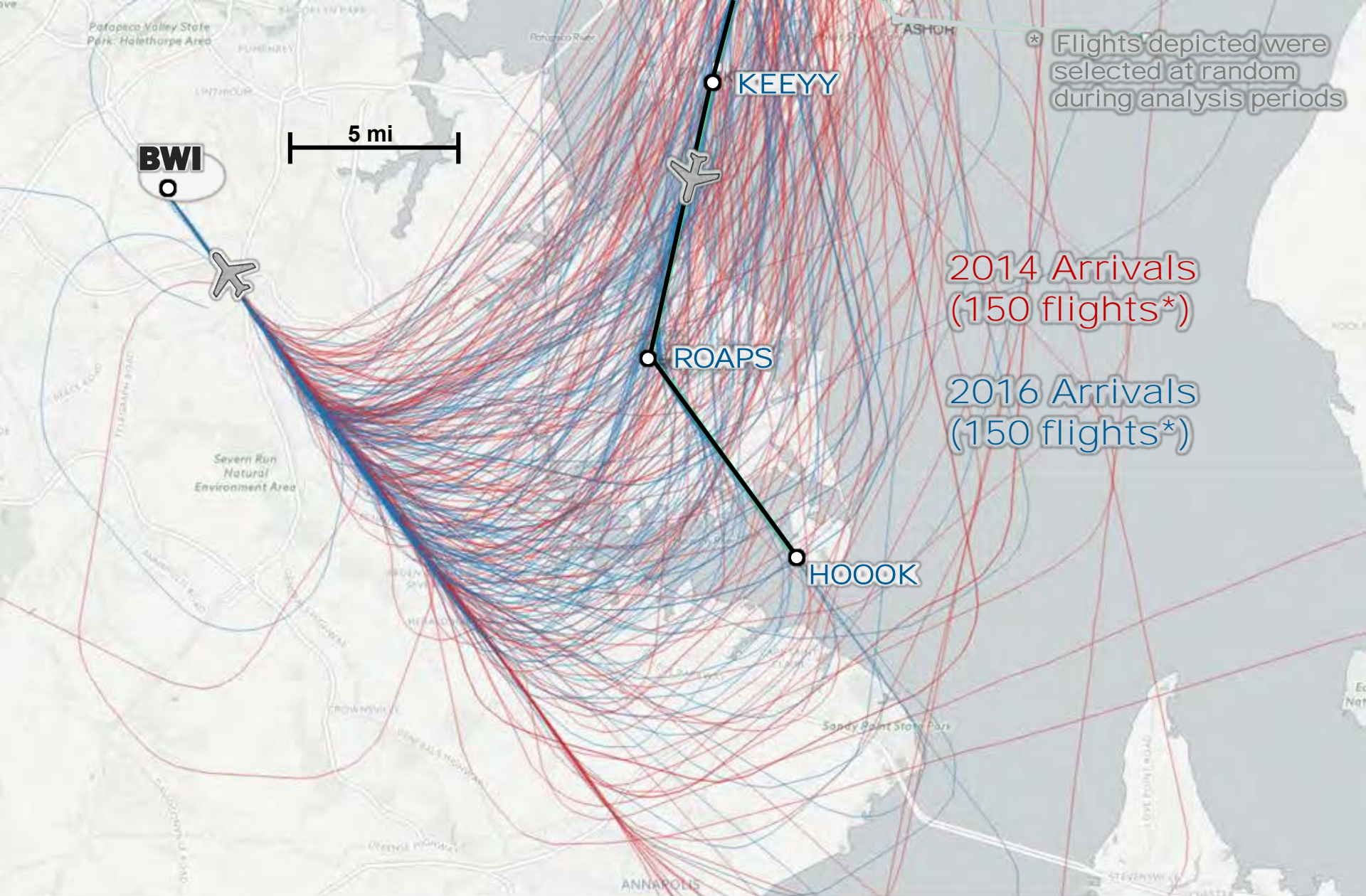
Federal Aviation Administration



EMI5 & ANTHM3 Rwy 33L



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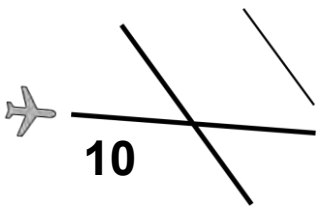
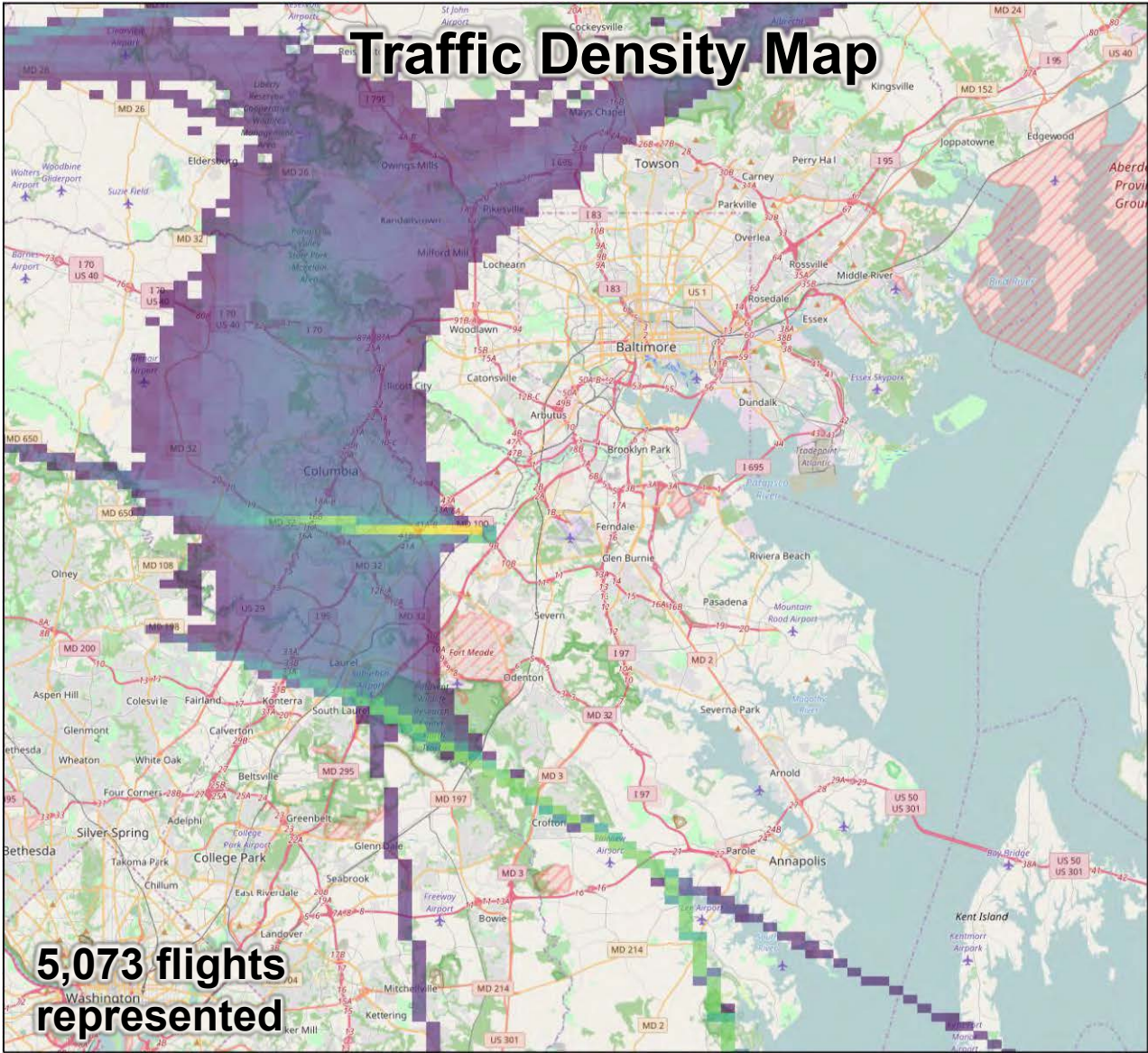
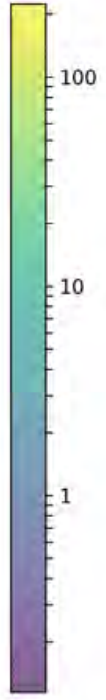
Southbound & TRISH2 Rwy 33L



Federal Aviation Administration

Traffic Density Map

June – July
2014
Daily Average
Flight Count



**5,073 flights
represented**

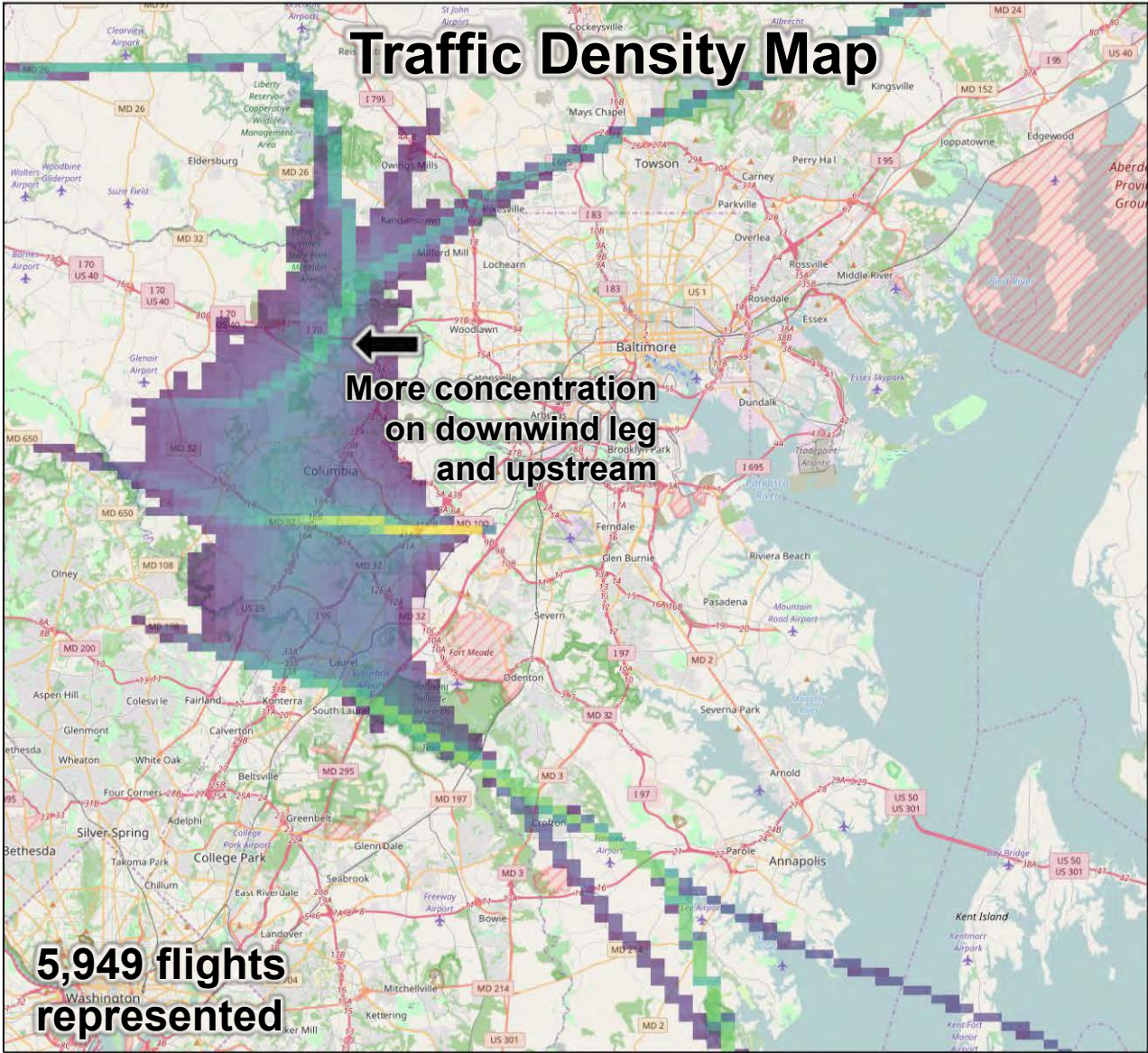
Rwy 10 Arrivals



Federal Aviation
Administration

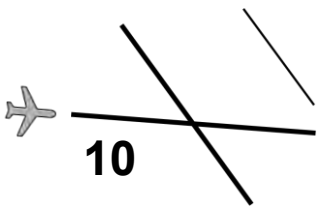
Traffic Density Map

June – July
2016
Daily Average
Flight Count



More concentration
on downwind leg
and upstream

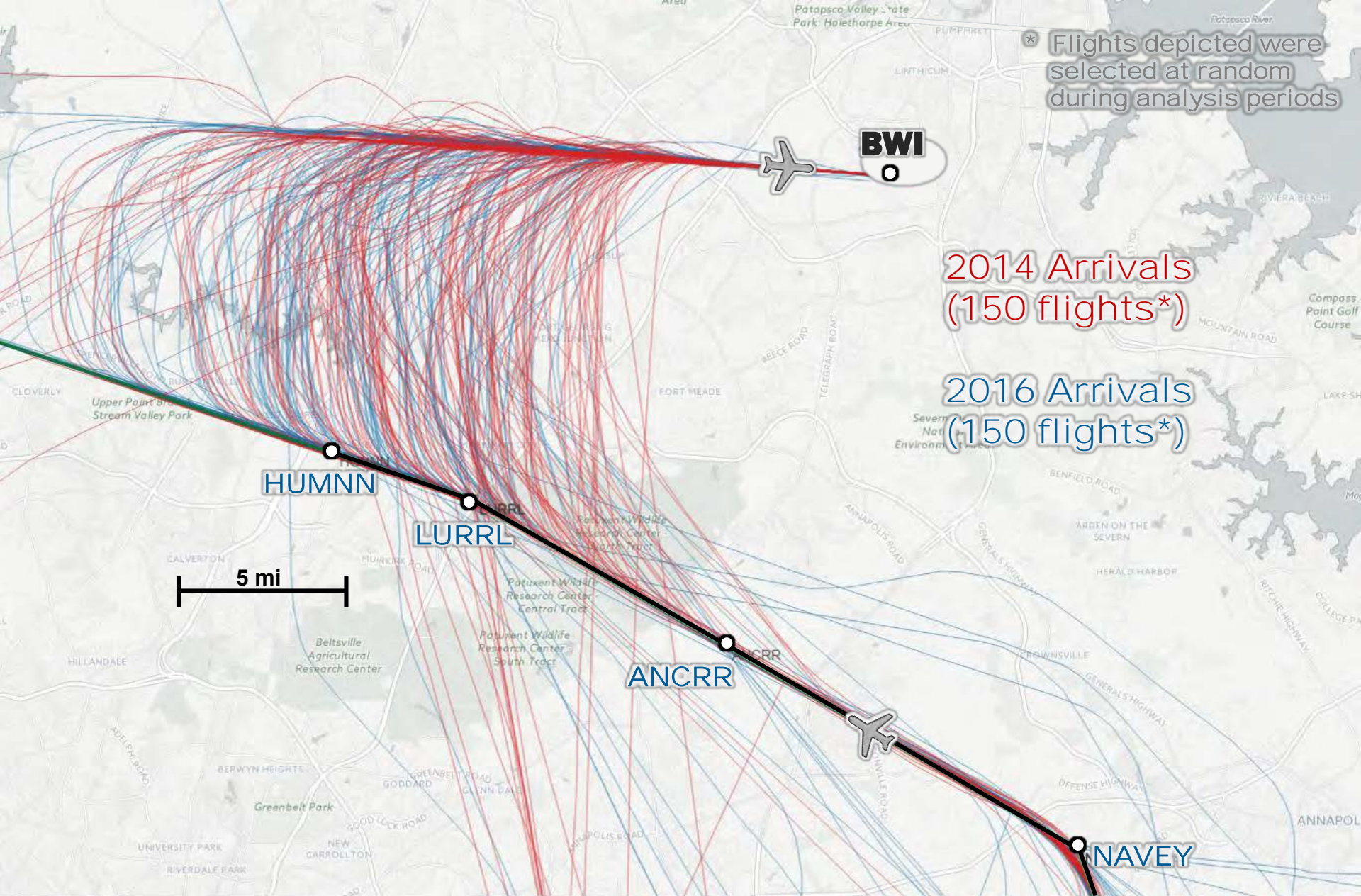
**5,949 flights
represented**



Rwy 10 Arrivals



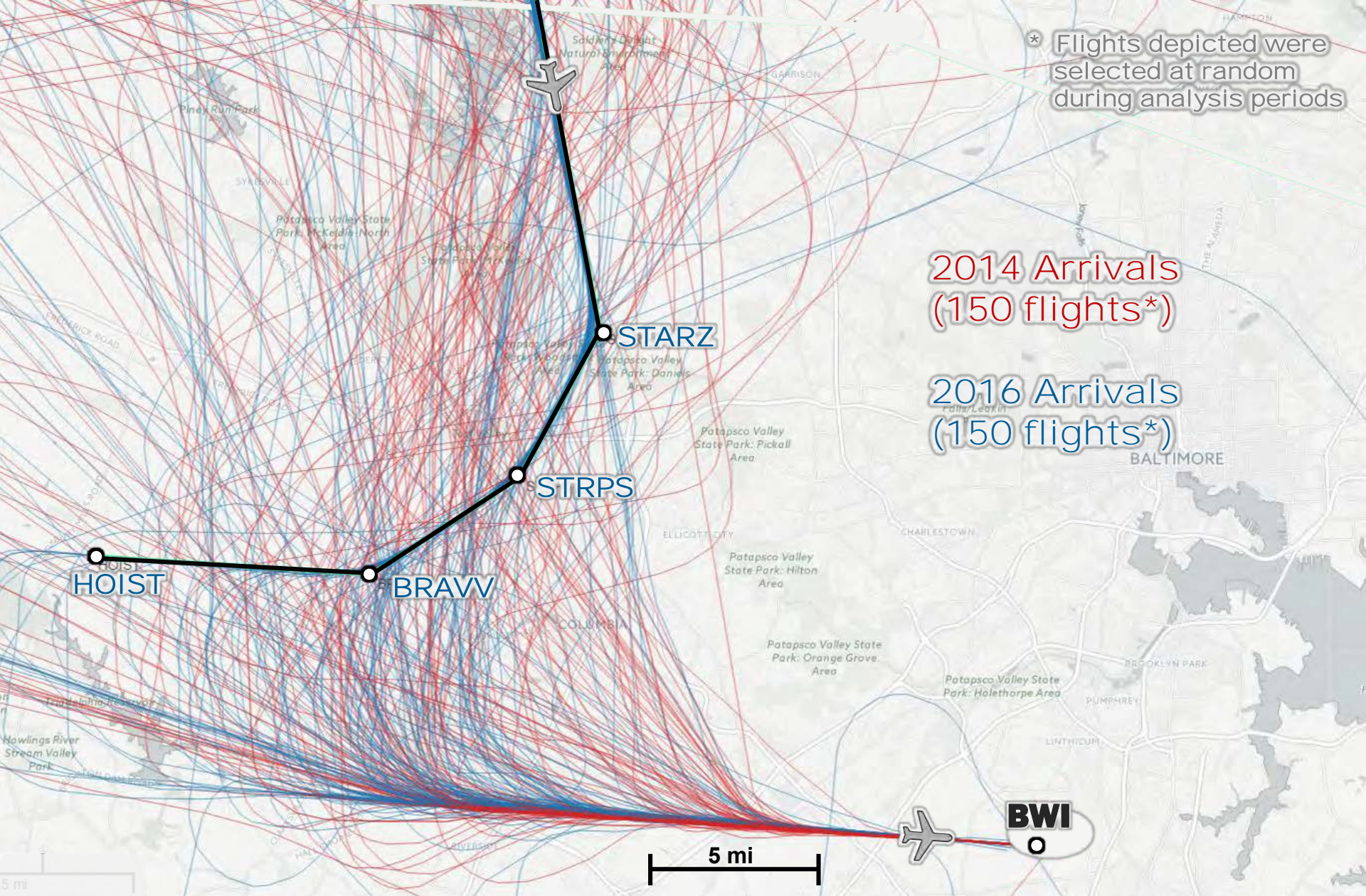
Federal Aviation
Administration



RAVVN Rwy 10



Federal Aviation Administration

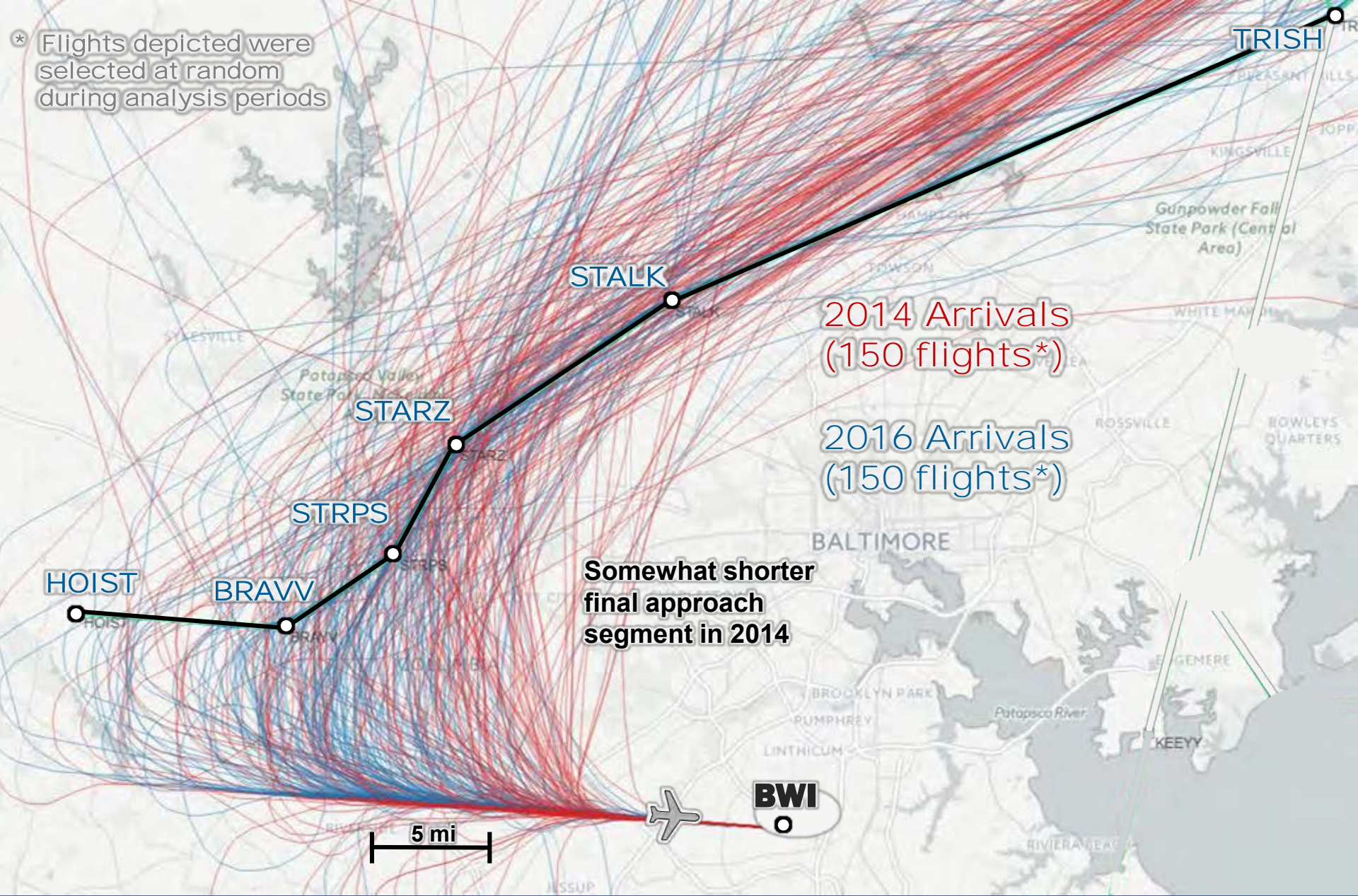


EMI5 & ANTHM3 Rwy 10



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* Flights depicted were selected at random during analysis periods



LRP/MXE & TRISH2 Rwy 10



Federal Aviation Administration

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

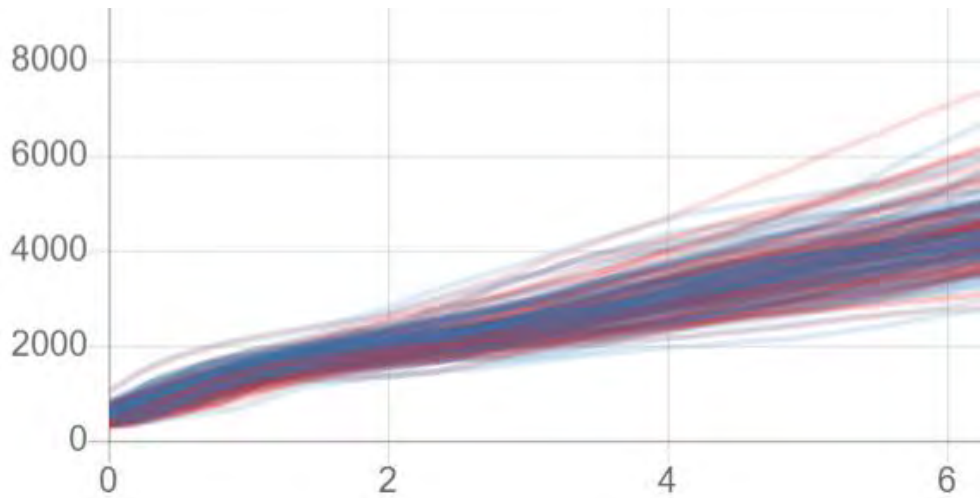
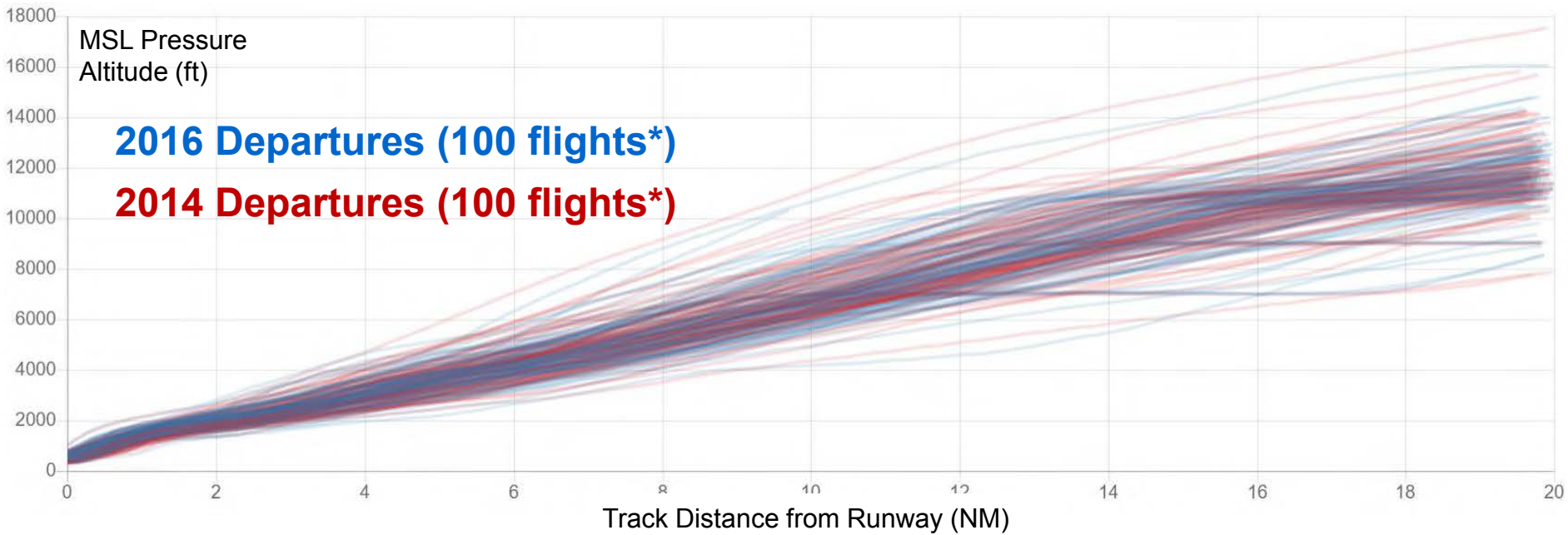


Vertical Analysis

Runway 28 & 15R Departures



Vertical Profiles



* One flight plotted per percentile of climb gradient distribution

Rwy 28 Departures



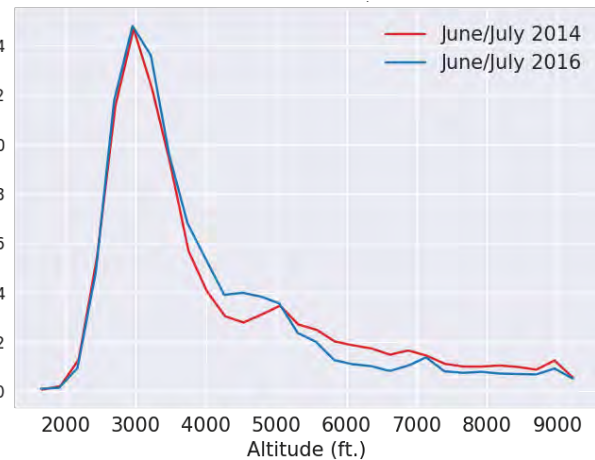
Federal Aviation
Administration

Rwy 28 Departure Altitude Distributions

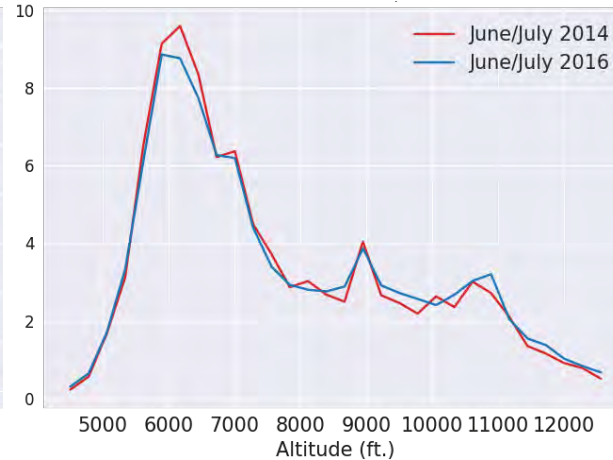
- **Similar altitude distributions at 5, 10, and 20 Nautical Miles (NM) from departure in 2014 vs. 2016**
 - At 5 NM, 160 ft lower on average in 2016
 - At 10 NM, 110 ft higher on average in 2016
 - At 20 NM, 70 ft lower on average in 2016

Percent of Flights

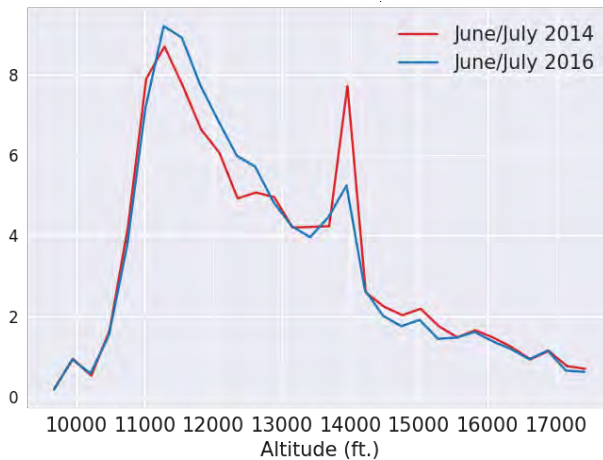
5 NM



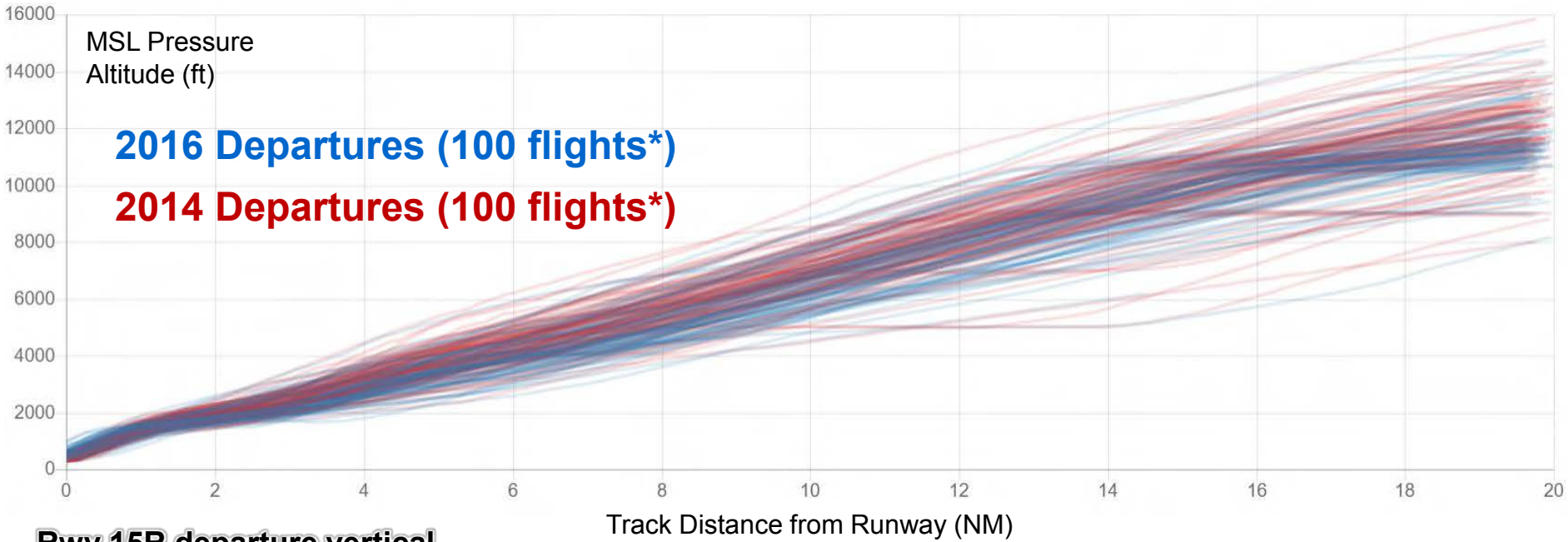
10 NM



20 NM

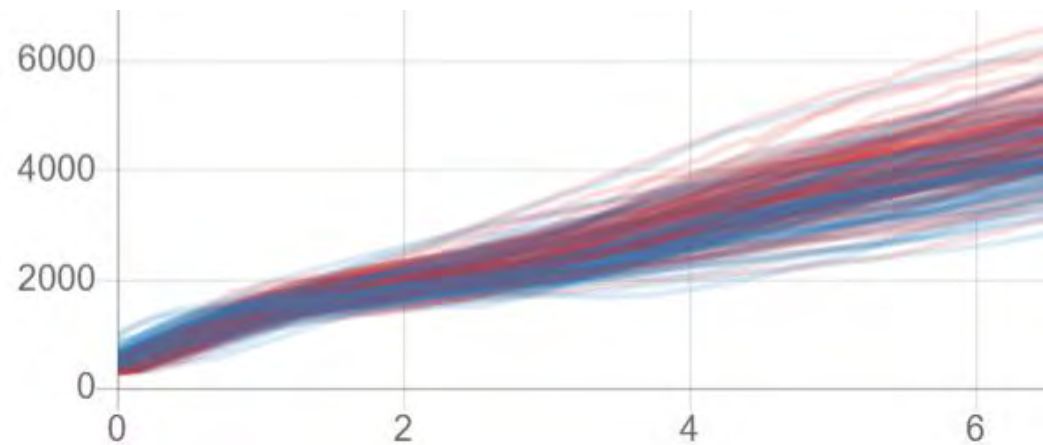


Vertical Profiles



Rwy 15R departure vertical profiles are slightly lower in 2016

* One flight plotted per percentile of climb gradient distribution

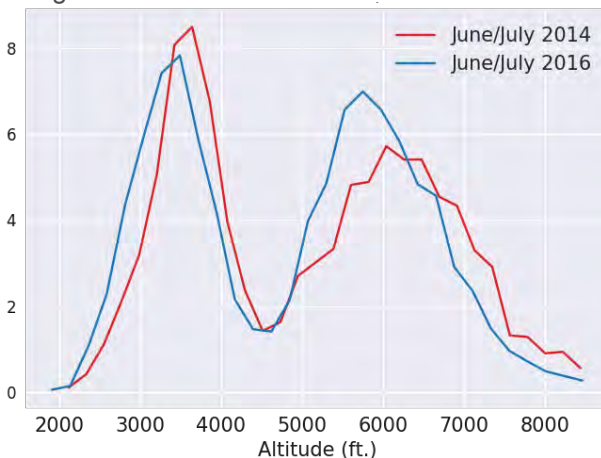


Rwy 15R Departure Altitude Distributions

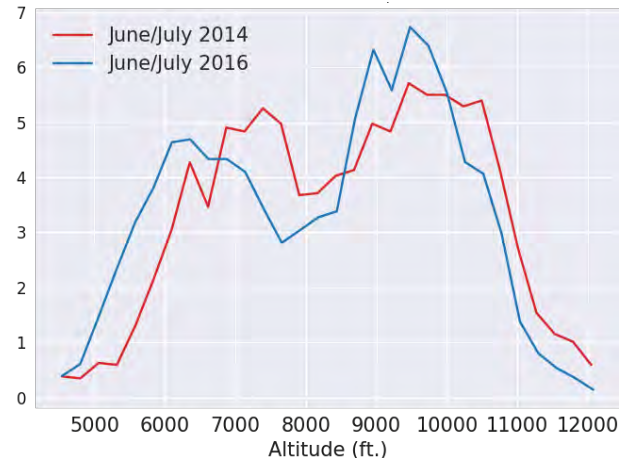
- **Rwy 15R departures tend to be slightly lower at 5/10/20 NM from BWI in 2016 vs. 2014**
 - At 5 NM, 220 ft lower on average in 2016
 - At 10 NM, 380 ft lower on average in 2016
 - At 20 NM, 490 ft lower on average in 2016

Percent of Flights

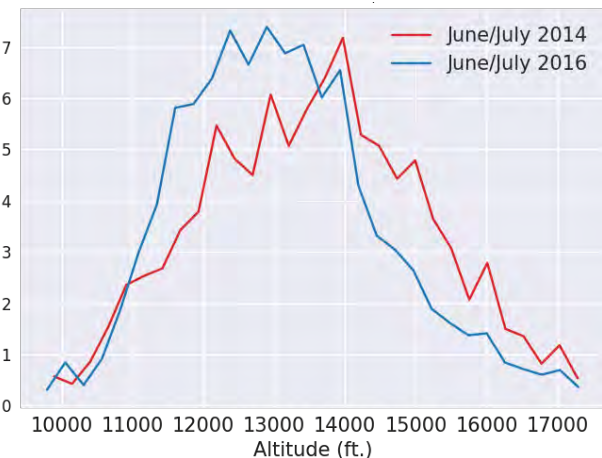
5 NM



10 NM



20 NM

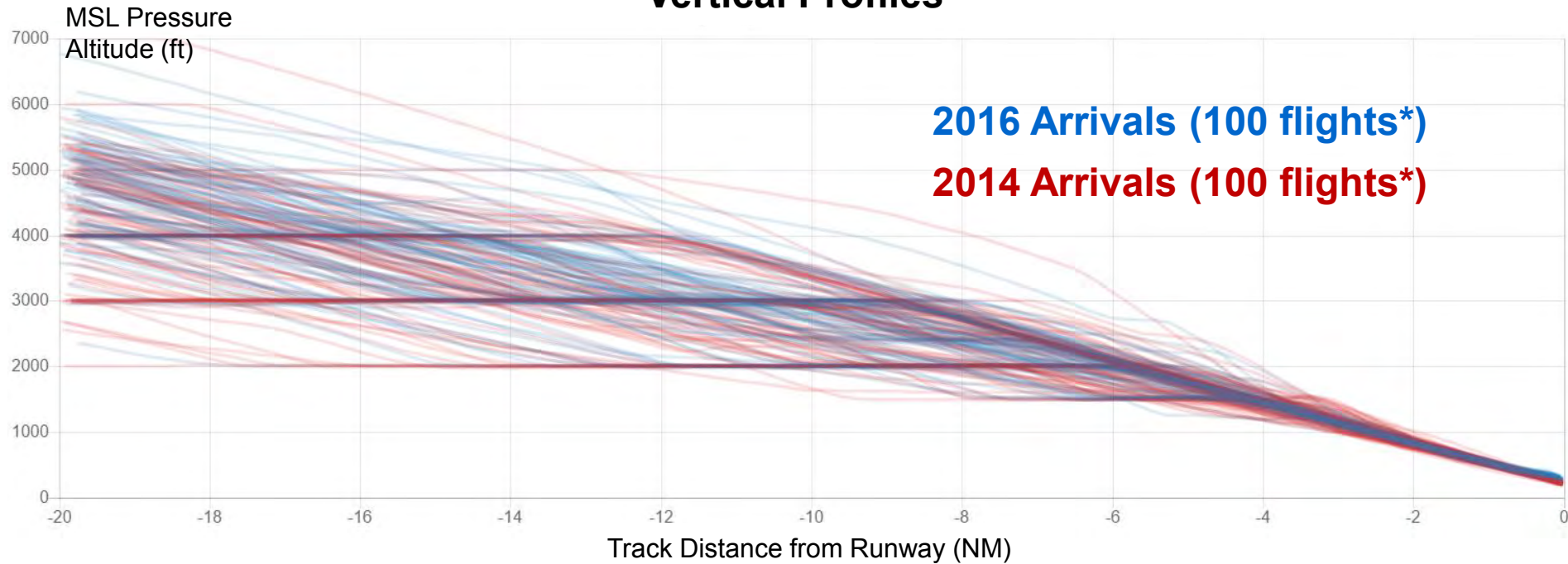


Vertical Analysis

Runway 33L & 10 Arrivals

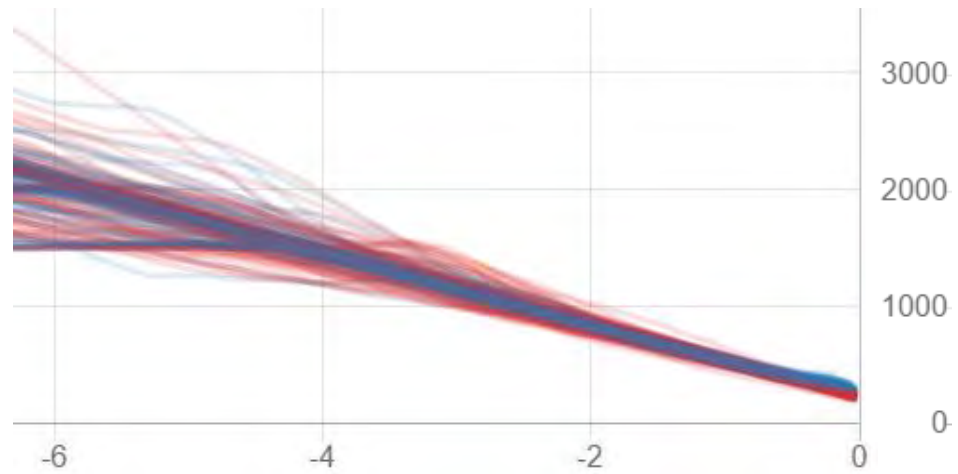


Vertical Profiles



Rwy 33L arrival vertical profiles are higher in 2016

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



Rwy 33L Arrivals



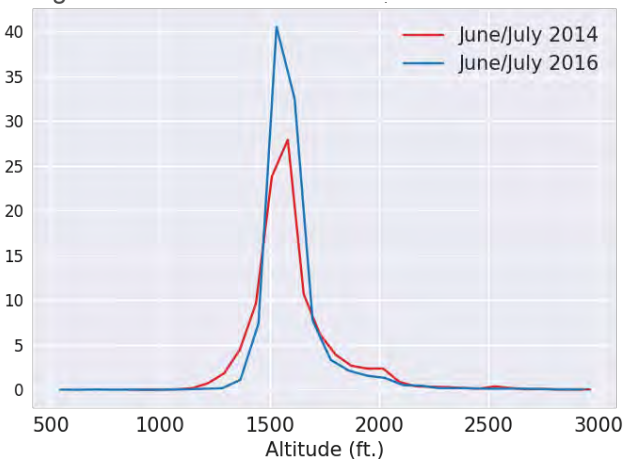
Federal Aviation Administration

Rwy 33L Arrival Altitude Distributions

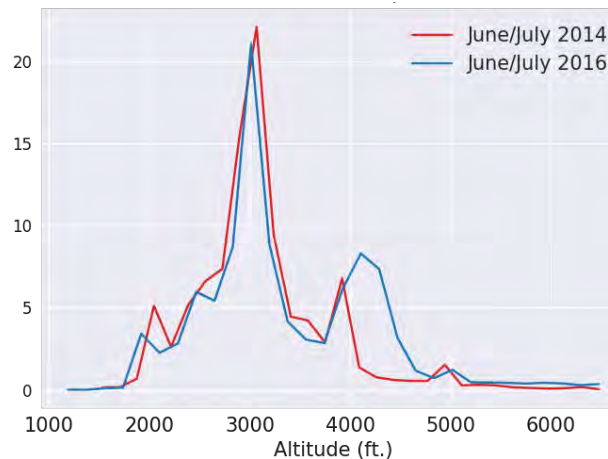
- **Rwy 33L arrivals tend to be higher at 10 and 20 NM from BWI in 2016 vs. 2014**
 - At 5 NM, 30 ft higher on average in 2016
 - At 10 NM, 350 ft higher on average in 2016
 - At 20 NM, 840 ft higher on average in 2016

Percent of Flights

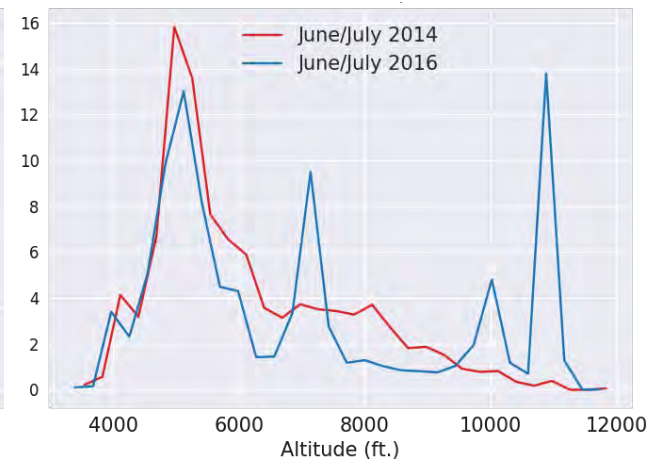
5 NM



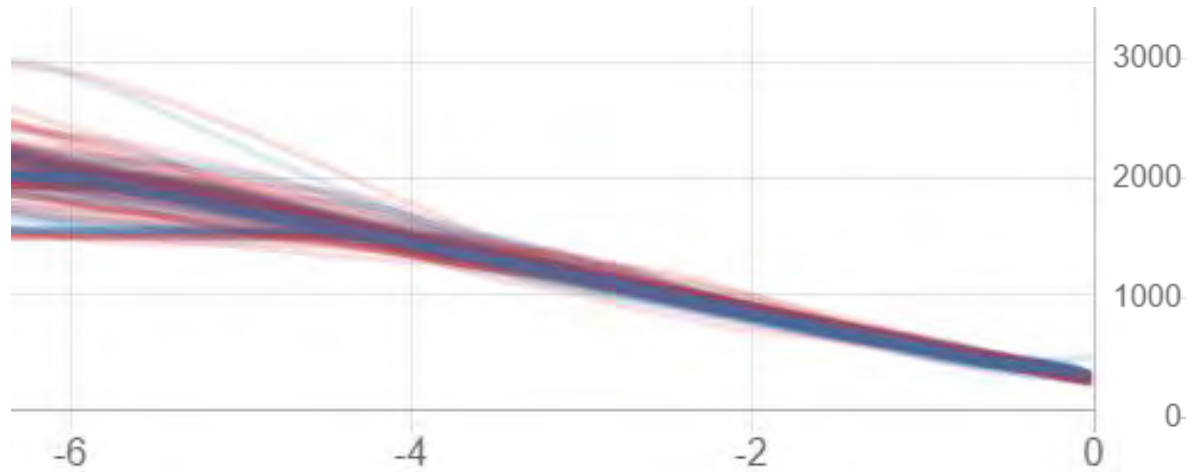
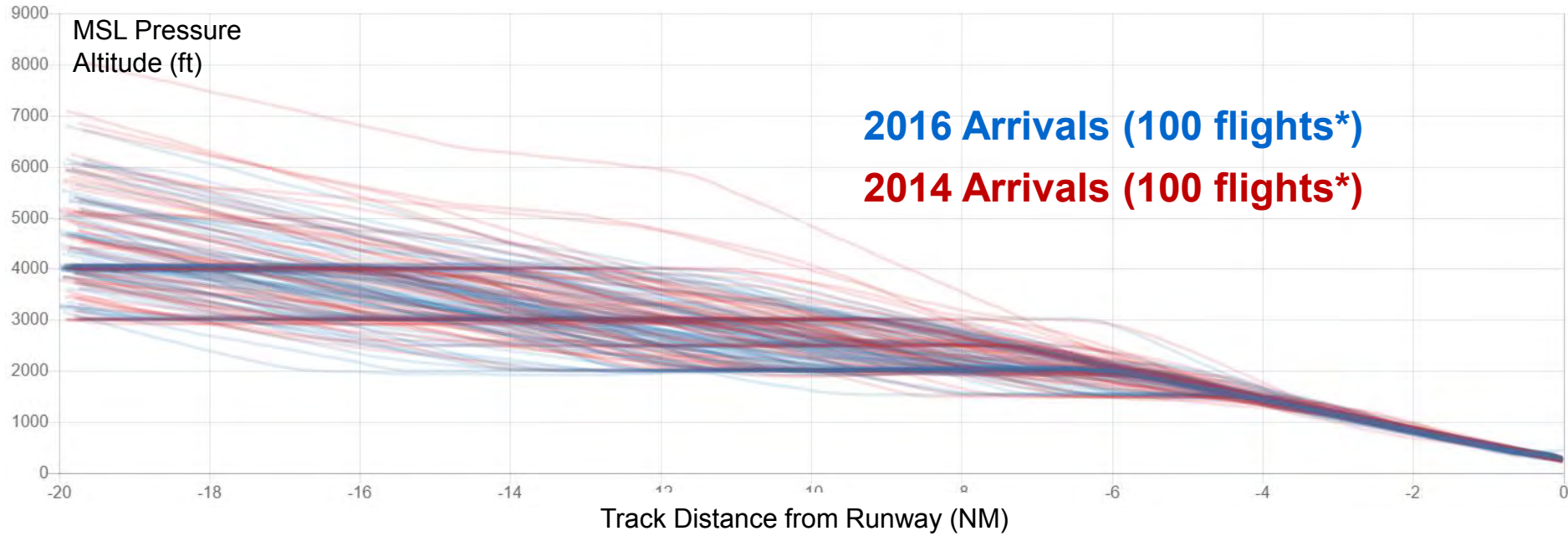
10 NM



20 NM



Vertical Profiles



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

Rwy 10 Arrivals



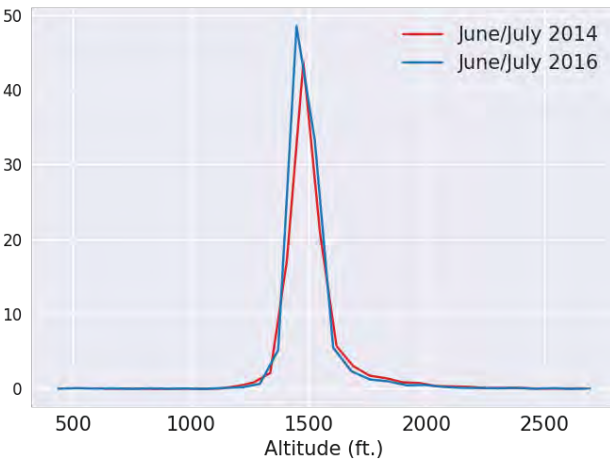
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Rwy 10 Arrival Altitude Distributions

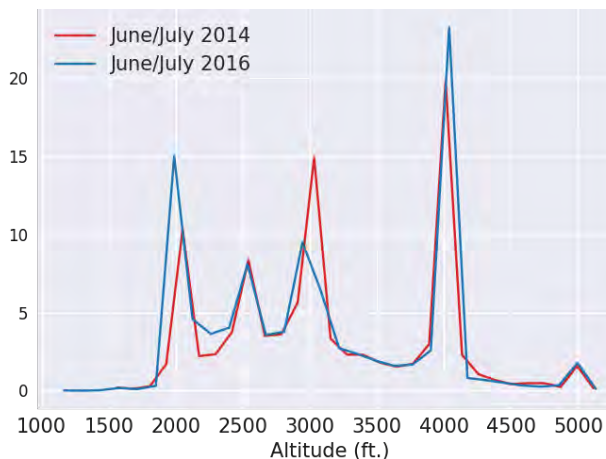
- **Rwy 10 arrivals tend to be higher at 20 NM from BWI in 2016 vs. 2014**
 - At 5 NM, average altitudes within 5 ft
 - At 10 NM, 40 ft lower on average in 2016
 - At 20 NM, 460 ft higher on average in 2016

Percent of Flights

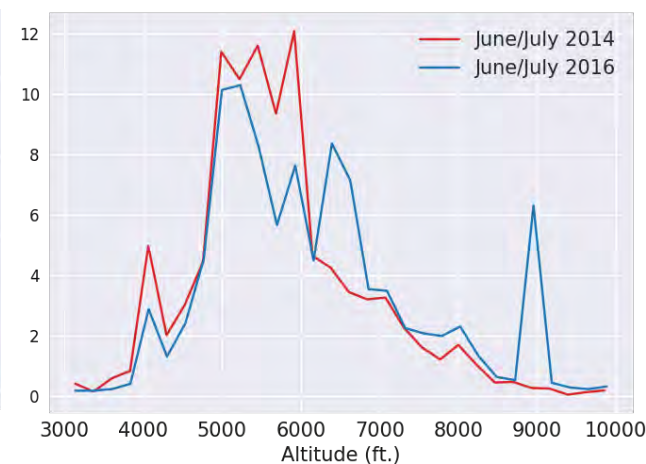
5 NM



10 NM



20 NM

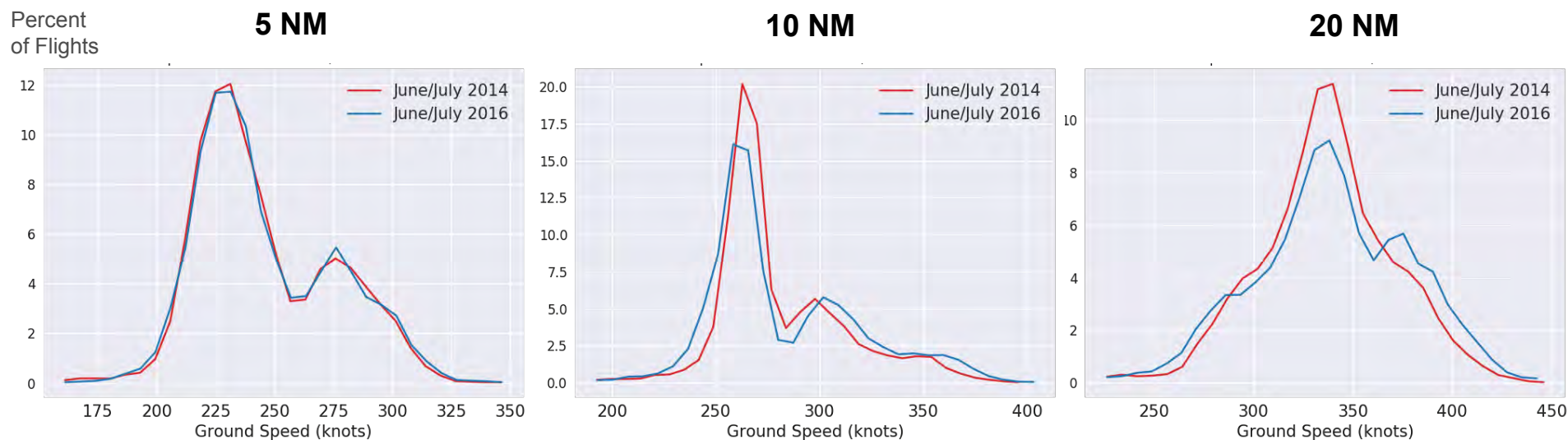


Speed Analysis



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

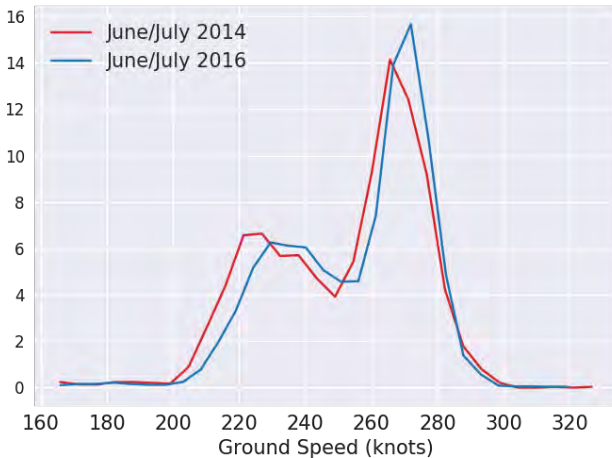


Rwy 15R Departure Speed Distributions

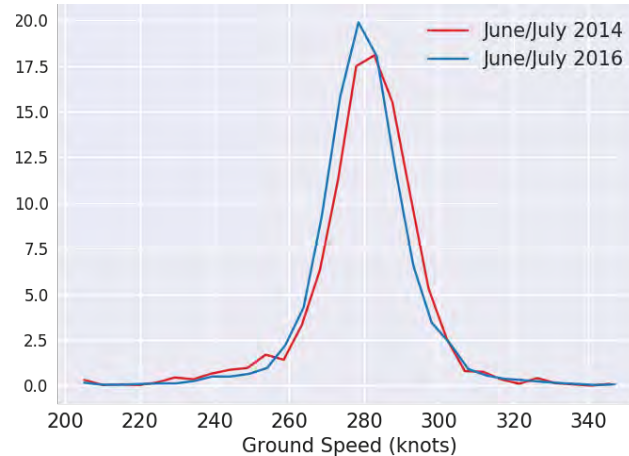
- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from departure in 2014 vs. 2016**
 - Average ground speeds all within 4 knots

Percent of Flights

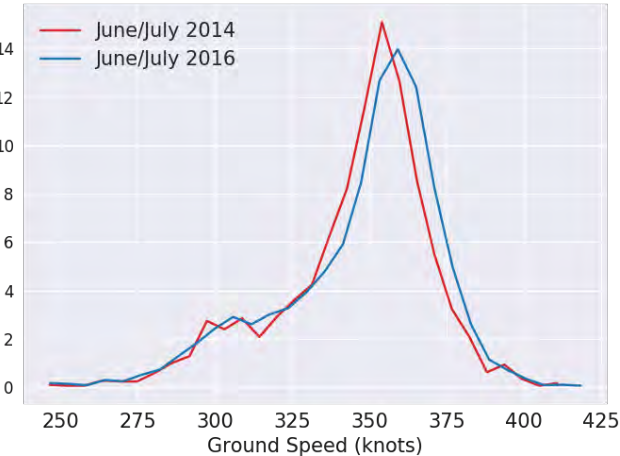
5 NM



10 NM



20 NM

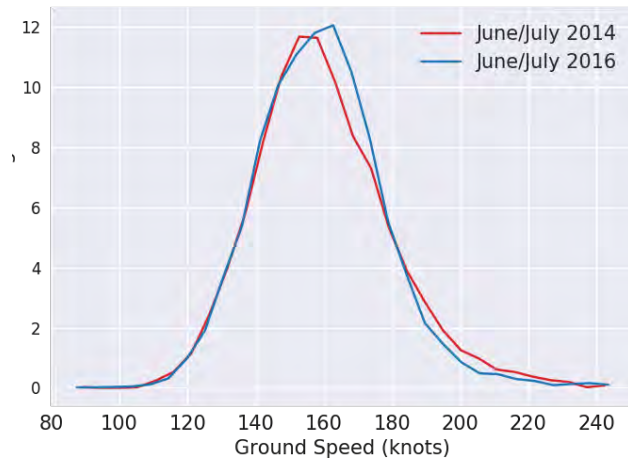


Rwy 33L Arrival Speed Distributions

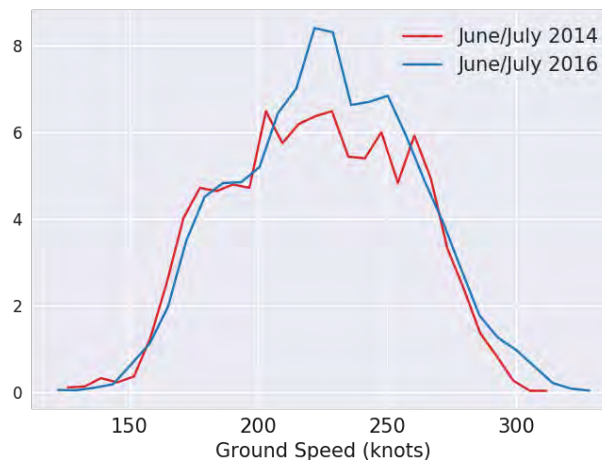
- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from arrival in 2014 vs. 2016**
 - Average ground speeds all within 6 knots

Percent of Flights

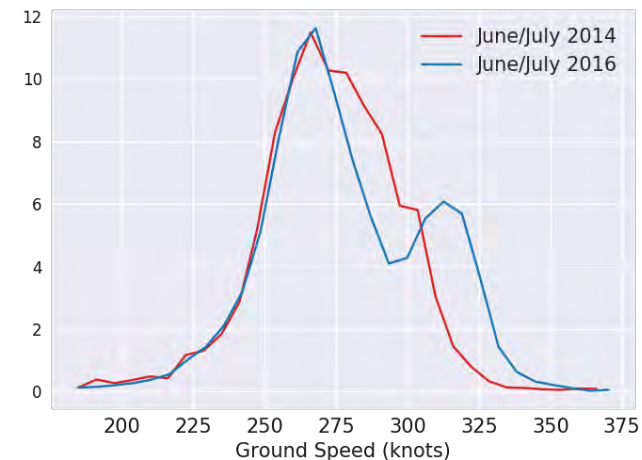
5 NM



10 NM



20 NM



Rwy 10 Arrival Speed Distributions

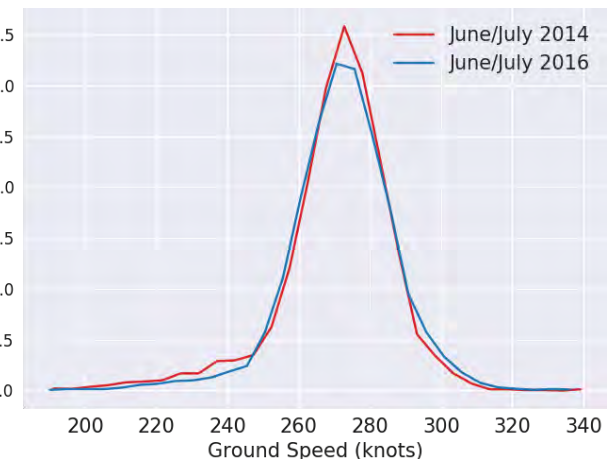
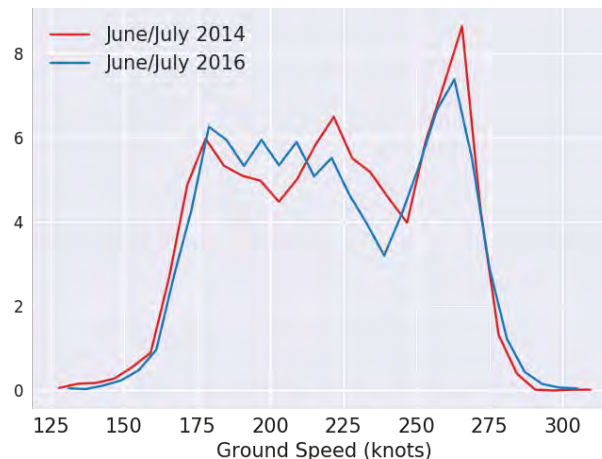
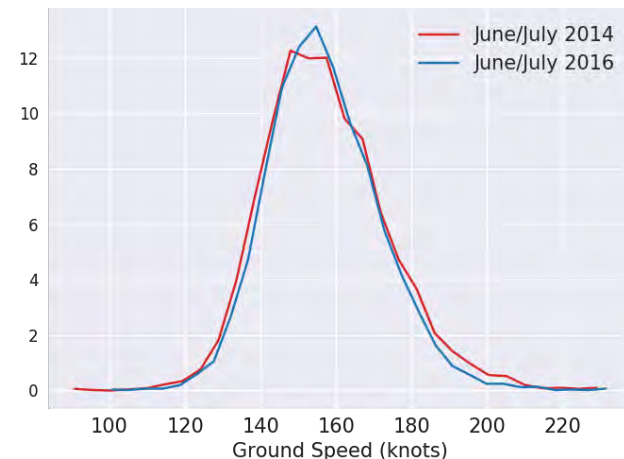
- **Similar ground speed distributions at 5, 10, and 20 Nautical Miles (NM) from arrival in 2014 vs. 2016**
 - Average ground speeds all within 3 knots

Percent of Flights

5 NM

10 NM

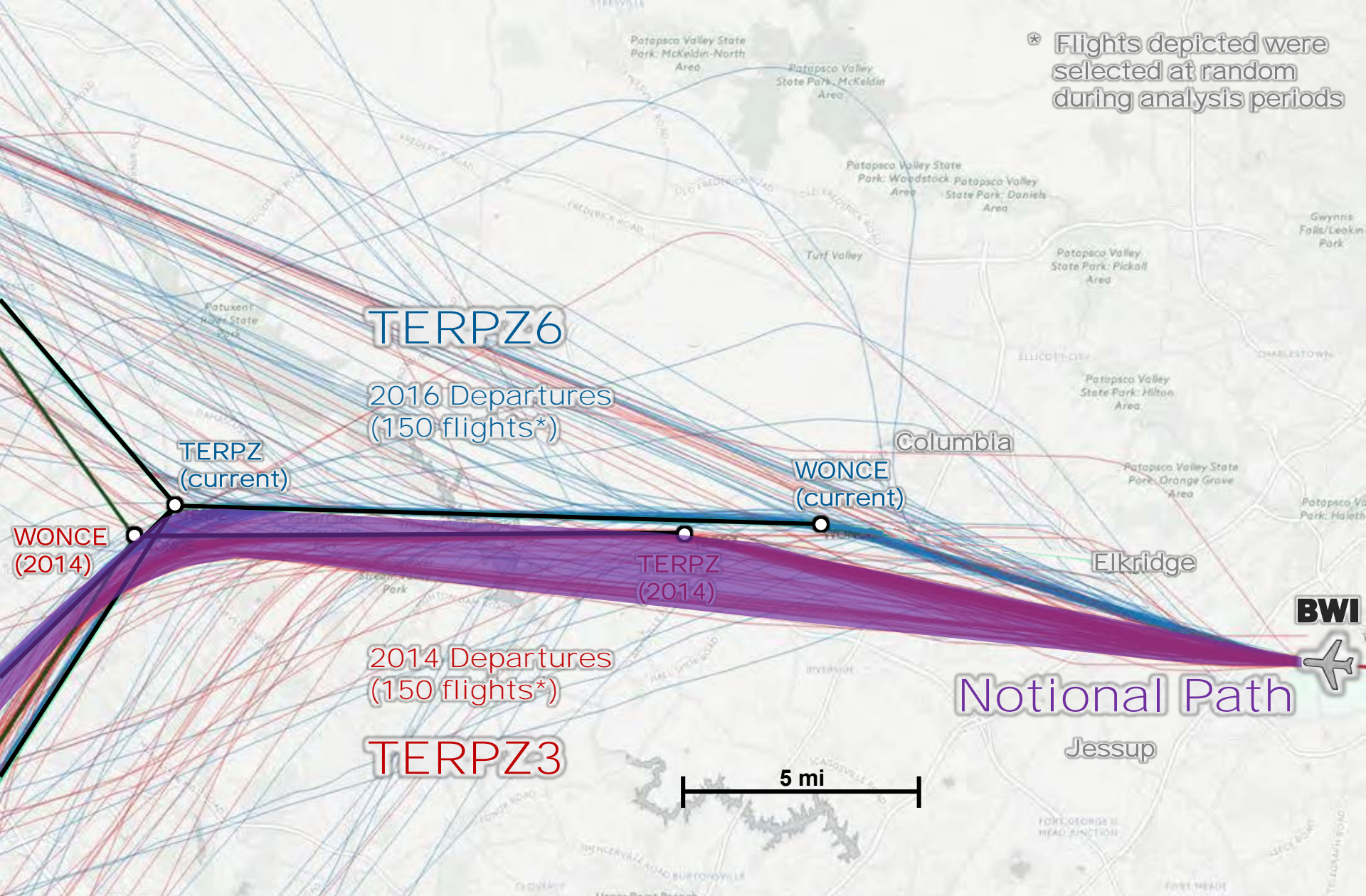
20 NM



Notional Path Discussion



* Flights depicted were selected at random during analysis periods



TERPZ6

2016 Departures
(150 flights*)

TERPZ
(current)

WONCE
(current)

TERPZ
(2014)

2014 Departures
(150 flights*)

TERPZ3

Notional Path



5 mi

TERPZ Rwy 28



Federal Aviation
Administration

* Flights depicted were selected at random during analysis periods

Notional Path

BOSLY



Elkridge

Jessup

Elmhurst

2016 Departures (150 flights*)

2014 Departures (150 flights*)

Quicker turns south in 2014

CONLE3 (2016)

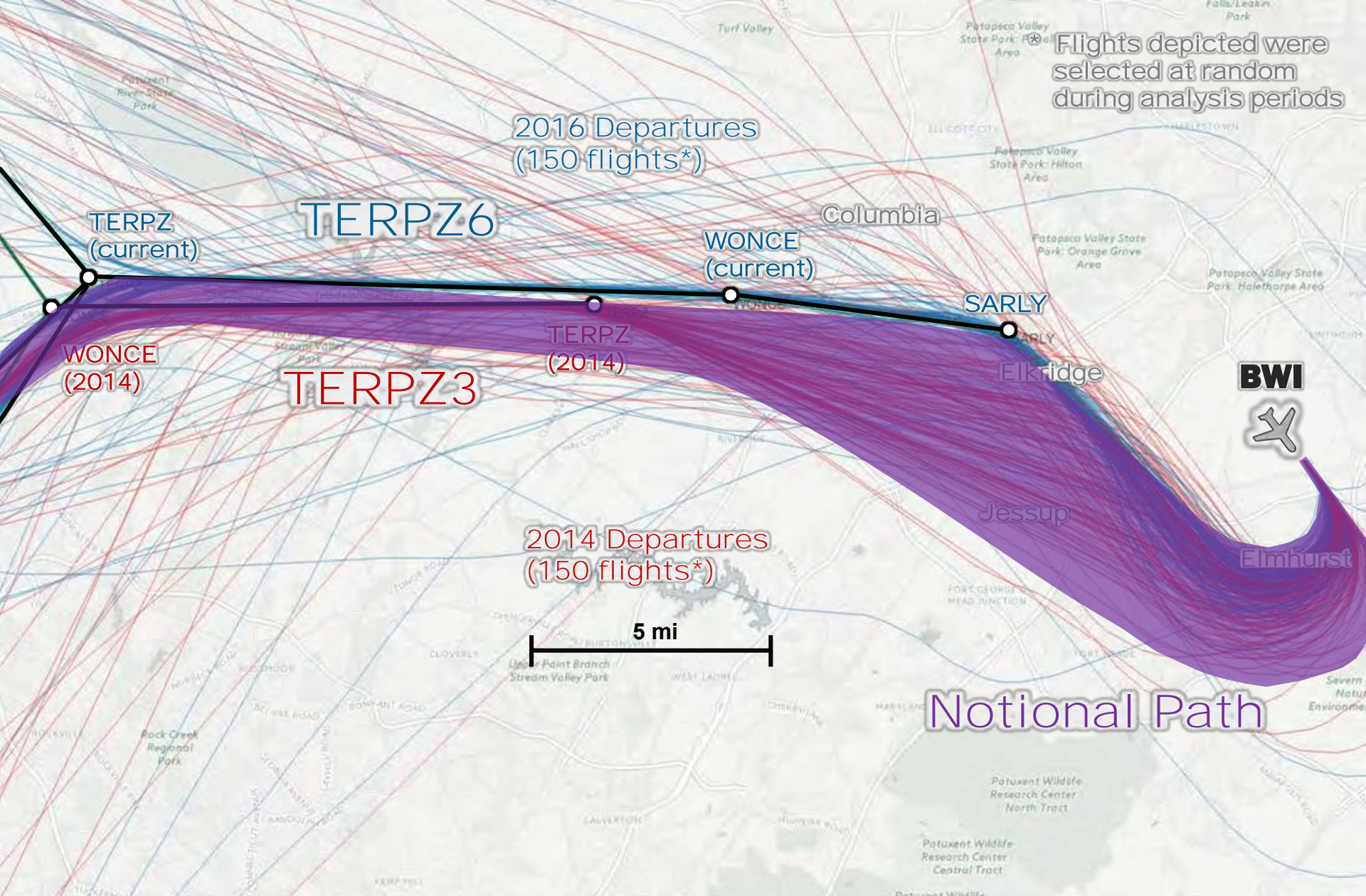
RAISN

5 mi

CONLE3 Rwy 28



Federal Aviation Administration

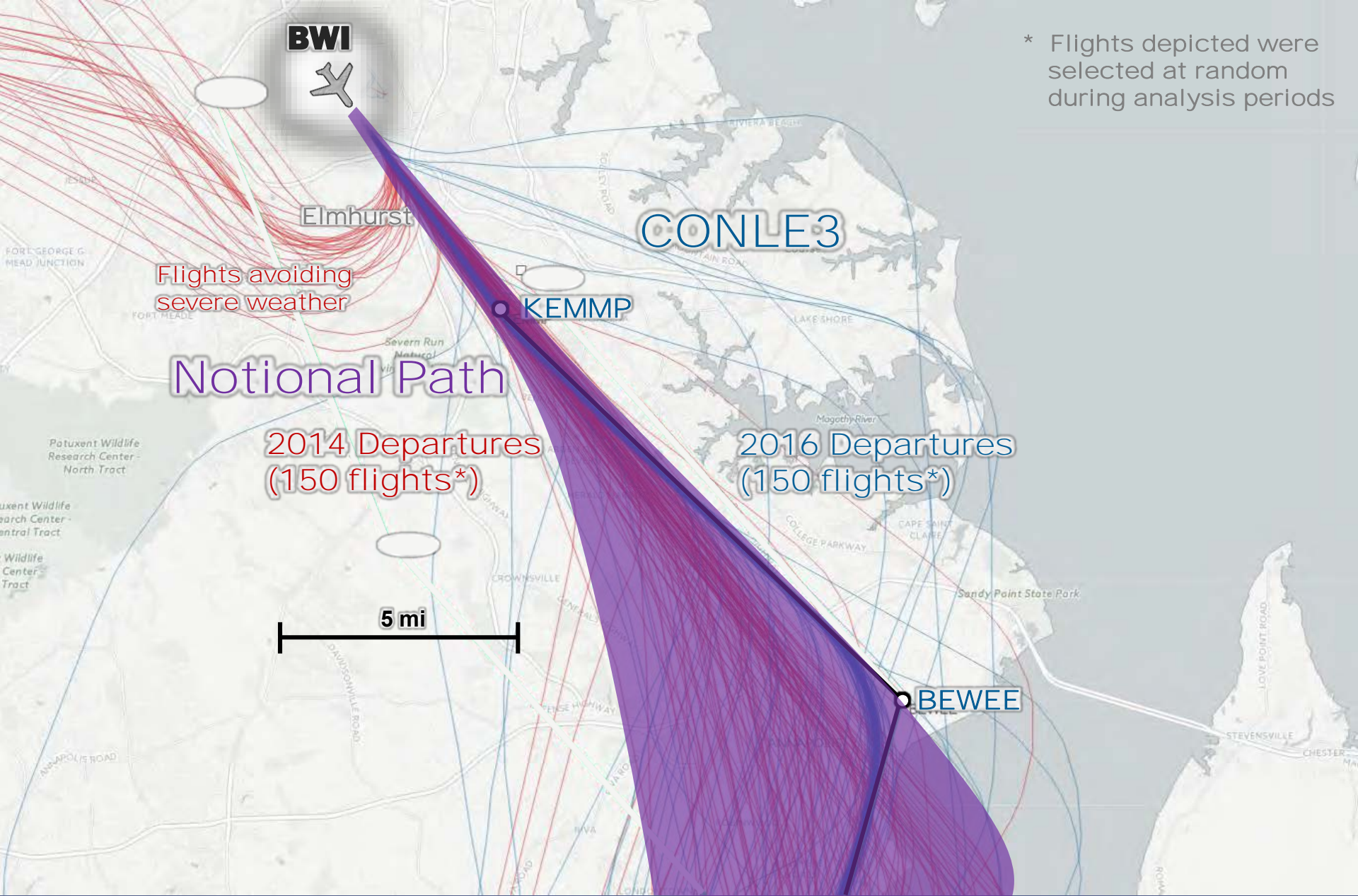


TERPZ Rwy 15R



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

