

Turbulence Impact Mitigation Workshop 3

McLean, Virginia
5-6 September 2018

Co-Sponsors: National Center for Atmospheric Research
P.O. Box 3000
Boulder, CO 80307

The MITRE Corporation (Host Facility)
7596 Colshire Drive
McLean, VA 22102

1. WORKSHOP OVERVIEW

1.1 WORKSHOP DESCRIPTION AND THEME

- The National Center for Atmospheric Research (NCAR) and MITRE are sponsoring the third workshop on the impacts and mitigation of atmospheric turbulence encounters in National Airspace System (NAS) operations. The Federal Aviation Administration (FAA) is assisting in organizing the workshop. The goal of the workshop is to bring together diverse representatives from throughout the aviation industry in order to:
 - Promote a common understanding of the impacts of turbulence on various elements of the NAS, such as air traffic management, airline flight operations, general aviation, and aviation weather forecasting
 - Examine on-going research and development of turbulence impact mitigation capabilities, such as remote sensing and *in situ* turbulence measurements, and more accurate and probabilistic forecasting techniques
 - Explore possible government and industry cooperative efforts to better integrate turbulence impact strategies capabilities into NAS operations in order to improve safety and help meet the demands for the increased capacity and efficiency that will occur as we transition to NextGen capabilities
- Topics for presentation and discussion include:
 - User community perspectives (airlines, dispatchers, regulatory, safety, international, weather forecasters)
 - Observing and reporting turbulence
 - Turbulence encounter investigations/identification of sources
 - Turbulence forecasting
 - Future challenges (data access, probabilistic forecasting, building business cases, visions)

1.2 WORKSHOP CHAIR

Chair: Dr. Bob Sharman, NCAR

Email: sharman@ucar.edu

Co-Facilitators:

Tammy Flowe, FAA

Email: tammy.flowe@faa.gov

Matt Fronzak, MITRE

Email: mfronzak@mitre.org

1.3 WORKSHOP REGISTRATION

Registration is free and may be accomplished by sending an email to Rhonda Moore (rhonda@ucar.edu). Please include detailed information on each participant that will be attending from your organization.

The following information is required to register:

Full first and last name

Email/Phone Number

Citizenship

Company or organization represented

Company or organization country

NOTE: Citizens of the following countries or U.S. citizens representing companies from these countries must have their registration information submitted no later than August 22, 2018 in order to

process security paperwork: China, Macau, France, Pakistan, Hong Kong, Russia, India, South Korea, Israel, Taiwan.

Lunch (sandwiches, drinks) will be offered each day for \$10. Please indicate with your registration whether you wish to purchase a lunch each day. We recommend this, as a vehicle is required to reach area restaurants and lunch breaks are limited.

1.4 WORKSHOP ATTIRE

Attire for both days of the workshop is business casual.

1.5 WORKSHOP AGENDA

The preliminary agenda for the Turbulence Mitigation Workshop 3 is given below.

Day 1

Advances in Detection, Forecasting, and Characterization of Aviation-scale Turbulence

- 8:30-8:45 Logistics/Intro: (Dr. Bob Sharman, NCAR/Matt Fronzak, MITRE/Tammy Flowe, FAA)
- 8:45-9:00 Dr. William Bauman, FAA, NextGen Aviation Weather Division: Welcome
- 9:00-9:20 Steve Abelman, American Airlines: KEYNOTE
- 9:20-9:40 Dr. Todd Lane, Univ. Melbourne, Australia: Convectively Induced Turbulence (CIT) Research
- 9:40-10:00 Katelyn Barber, Univ. North Dakota: CIT– Near Cloud Turbulence
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- 10:00-10:20 *Coffee/Tea/Networking Break*
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- 10:20-10:40 NASA Langley *and/or* Cooperative Institute for Meteorological Satellite Studies (CIMSS): Satellite-based Turbulence Detection
- 10:40-11:00 Dr. Wiebke Deierling, NCAR: Graphical Turbulence Guidance (GTG) CIT Development
- 11:00-11:30 Discussion
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- 11:30-12:30 *Lunch (Catered sandwiches and drinks, Cost ~\$10/person)*
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- 12:30-12:50 Dr. Hye-Yeong Chun, Yonsei University, Seoul, South Korea: Measurement of Turbulence From High-resolution Radiosondes
- 12:50-13:10 Dr. Greg Meymaris/Larry Corman, NCAR: In-situ Eddy Dissipation Rate (EDR)/Turbulence for Unmanned Aerial Vehicles (UAVs)
- 13:10-13:30 Dr. Domingo Muñoz-Esparza, NCAR: Low Level Turbulence (LLT)
- 13:30-13:50 DLR (German Aerospace Center): Turbulence Research Efforts/Wake Vortex Encounter Analysis
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- 13:50-14:10 *Coffee/Tea/Networking Break*
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- 14:10-14:30 NOAA & United Kingdom Met Office: World Area Forecast System (WAFS) Update
- 14:30-14:50 Dr. Jim Doyle, Naval Research Laboratory, Monterey: MWT/ Turbulence Predictability
- 14:50-15:10 Dr. Paul Williams, Univ. of Reading, UK: Climate Change in Aviation Impacts
- 15:10-15:30 Dr. Matthias Steiner, NCAR: Operational Frontiers for Turbulence Diagnosis/Forecasting
- 15:30-16:10 Discussion
- 16:10-16:30 Day 1 Summary & Wrap-Up

Day 2

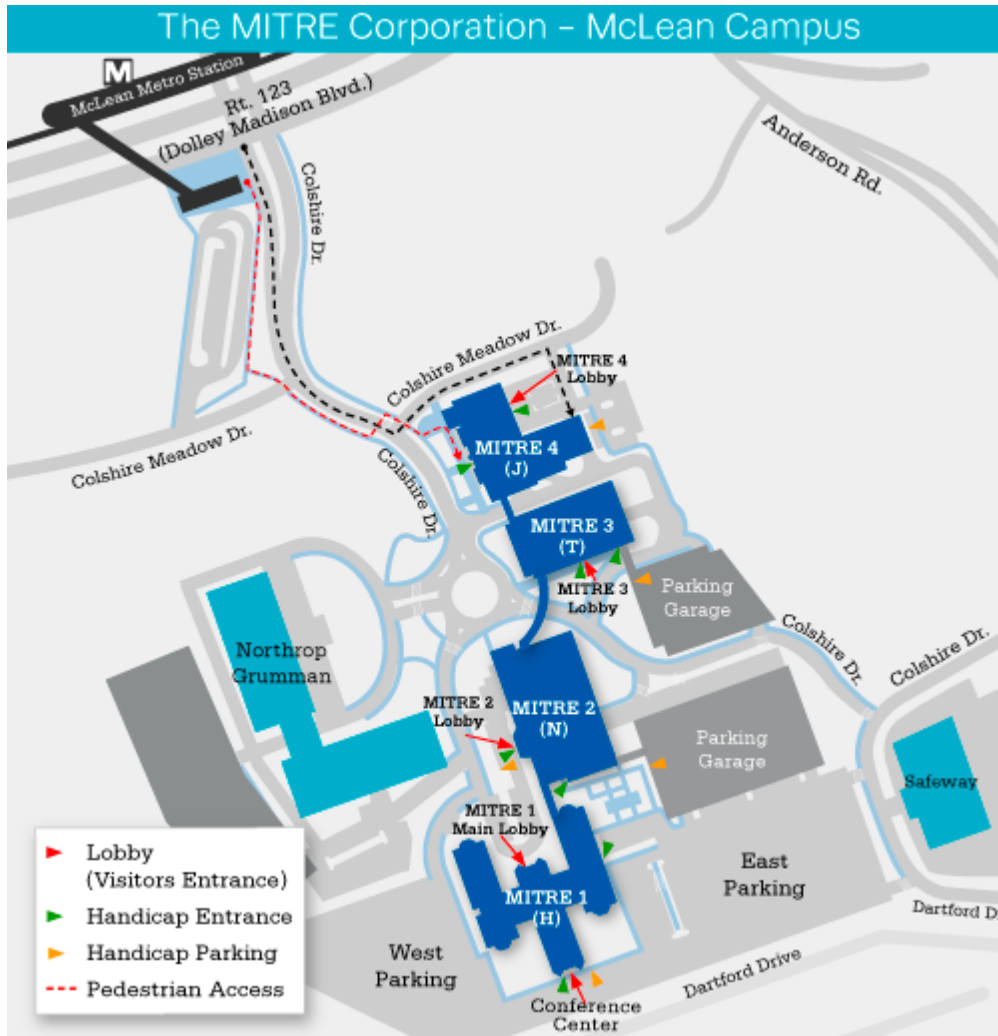
Mitigating Turbulence Impacts in Aviation Operations

- 8:30-8:45 Welcome, Summary of Day 1, and Logistics (Tammy Flowe, Dr. Bob Sharman)
- 8:45-9:15 Don Eick, National Transportation Safety Board: Update on Turbulence Events in National Airspace System
- 9:15-9:45 Captain Tom Staigle, Delta Air Lines: A Commercial Airline Perspective/Evaluation Of Use of GTG, GTGN and EDR in Real-time Operations
- 9:45-10:15 Eldridge Frazier, FAA Aviation Weather Division: Remote Oceanic Meteorology Information Operational (ROMIO) Overview
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- 10:15-10:45: *Coffee/Tea/Networking Break*
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- 10:45-11:15 Tim Rahmes, The Boeing Company; Rocky Stone and Nathan Polderman, UAL: Boeing and United Airlines Cooperative Turbulence Efforts
- 11:15-11:45 Rune Duke, Aircraft Operators and Pilots Association (AOPA): General Aviation Community Perspective
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- 11:45-13:00 *Lunch (Catered sandwiches and drinks, Cost ~\$10/person)*
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- 13:00-13:30 International Air Transport Association (IATA): Global Turbulence Database Development
- 13:30-14:00 Alfred Moosakhanian, FAA: Update on NWP and CSS-Wx and Turbulence Requirements
- 14:00-14:30 John Maffei (or representative), FAA ANG-C7: Trajectory Based Operations (TBO) and Weather Impacts
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- 14:30-15:00 *Coffee/Tea/Networking Break*
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- 15:00-15:15 Rocky Stone, UAL: Summary of Workshop and Lead In to Open Discussion/Q&A
- 15:15 –16:20 Discussion Period
- 16:20-16:30 Concluding Remarks
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2. Workshop Location and Venue

2.2 VENUE MAP OVERVIEW

The venue for the Turbulence Mitigation Workshop 3 is the MITRE 4 Building (J) on the campus of The MITRE Corporation in McLean, Virginia, near Washington, DC. The address of the facility is 7596 Colshire Drive, McLean, Virginia 22102-7539. The phone number is 703-983-8013.



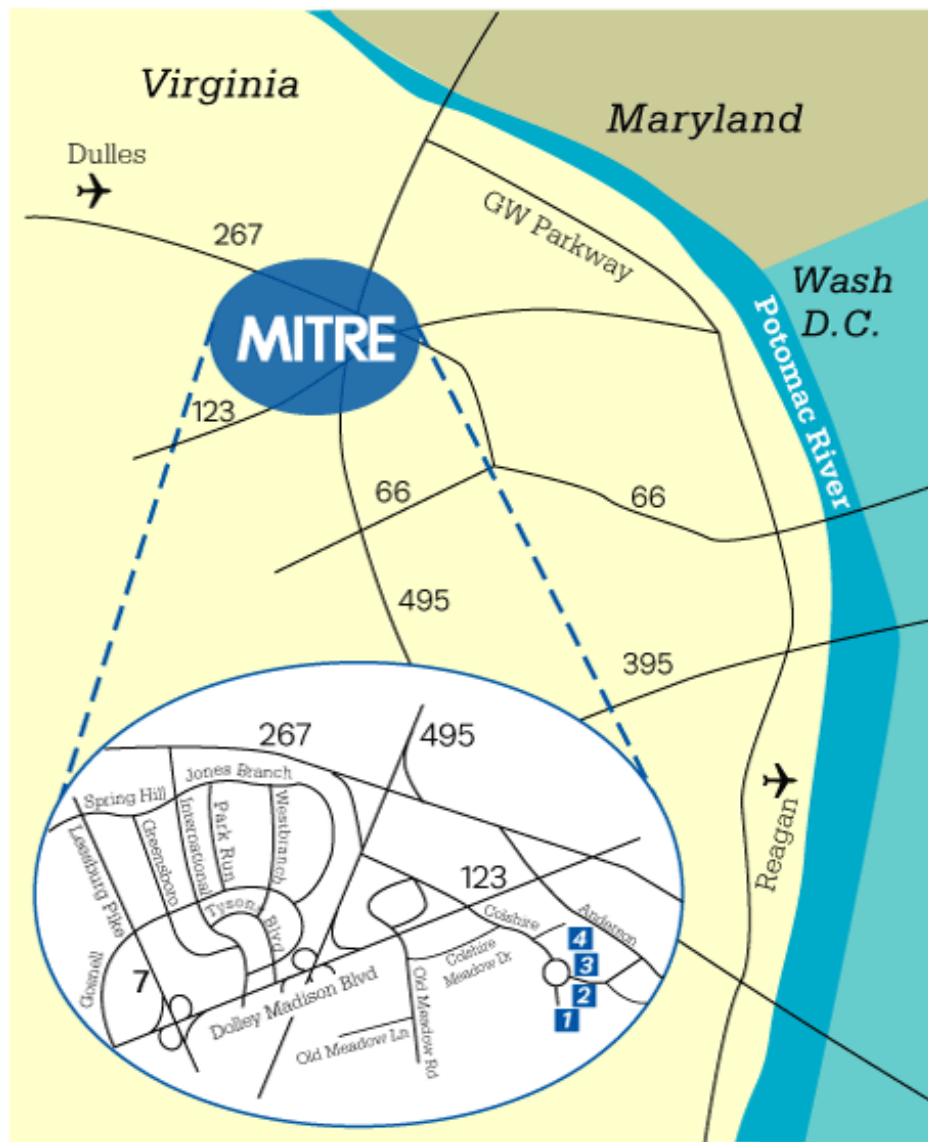
2.3 DIRECTIONS TO THE MITRE CORPORATION – MITRE 4 BUILDING (J)

From Reagan National Airport

Take the George Washington Parkway North approximately six miles to Route 123 South, McLean exit. Exit onto Route 123 (also called Dolley Madison Boulevard) and follow it south for approximately four miles to the traffic light at Colshire Drive (on left). Turn left onto Colshire Drive. Turn left onto Colshire Meadow Drive. Turn right into the MITRE 4 parking area, proceed straight into the MITRE 4 parking garage (all levels). The MITRE 4 Lobby is located on the top level of the garage,

-or-

Take I-66 West. Take Exit 67 to Route 267 (Dulles Toll Road). Take Exit 19A, following signs to Route 123 South, (also called Dolley Madison Boulevard) Tysons Corner. Go to second traffic light, Colshire Drive (on left). Turn left onto Colshire Drive. Turn left onto Colshire Meadow Drive. Turn right into the MITRE 4 parking area, proceed straight into the MITRE 4 parking garage (all levels). The MITRE 4 Lobby is located on the top level of the garage.



From Dulles Airport

Take the Dulles Airport Access and Toll Road to Exit 19A and follow the signs to Route 123 South, (also called Dolley Madison Boulevard), Tysons Corner. Bear right onto Route 123. Go to the first traffic light, Colshire Drive (on the left). Turn left onto Colshire Drive. Turn left onto Colshire Meadow Drive. Turn right into the MITRE 4 parking area, proceed straight into the MITRE 4 parking garage (all levels). The MITRE 4 Lobby is located on the top level of the garage.

From Route 495 (Beltway)

Take Exit 46B (McLean, Route 123). Take Route 123 (also called Dolley Madison Boulevard) North to the second traffic light and turn right onto Colshire Drive. Turn left onto Colshire Meadow Drive. Turn right into the MITRE 4

parking area, proceed straight into the MITRE 4 parking garage (all levels). The MITRE 4 Lobby is located on the top level of the garage.

By Metrorail

Take the Metro Silver Line train to the McLean Station. After exiting the fare gates, stay to the right and follow signs for "South Entrance/Buses/Parking/Kiss and Ride." Cross the pedestrian bridge over Dolley Madison Boulevard (Rt. 123) and then take the escalator/elevator down to street level before walking uphill on Colshire Drive toward the main MITRE campus. Walking from the fare gates to the MITRE 4 lobby takes about 6 to 10 minutes.

3. HOTEL ACCOMMODATIONS/TRAVEL INFORMATION

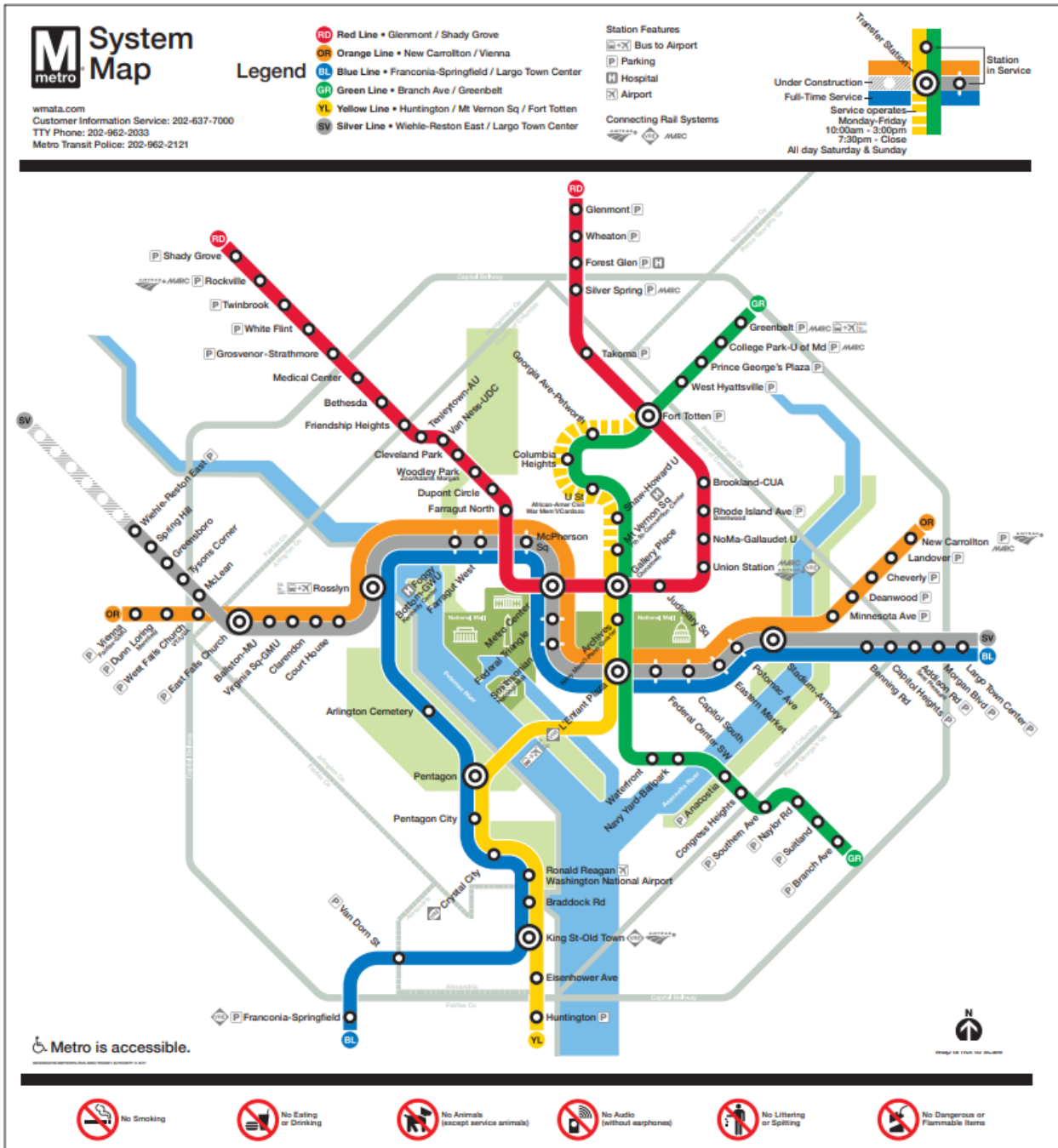
There are many good hotels within a few miles of the MITRE campus and along the Metro (subway) Silver line. Many offer free airport shuttle to Dulles International Airport, the nearest airport to McLean, VA. While the Metro service does not extend out to Dulles, there is a shuttle bus service to the nearest Silver Line Metro station. If you fly into Washington Reagan National Airport, you will be able to take the Metro. We have listed some of the hotels closest to The MITRE campus below. There are many shopping venues and restaurants along the Metro Silver line.

Hotels (H) and Apartments (A) within 3.5 miles of MITRE McLean Campus				
Distance	H/A	Name	Address	Phone
0.7 miles	H	Hilton McLean Tysons Corner	7920 Jones Branch Drive McLean, VA 22102	1-703-847-5000
0.8 miles	A	Global Luxury Suites at Tysons	7911 Westpark Drive McLean, VA 22102	1-888-723-7535
0.9 miles	A	Bridgestreet at Vita Luxury Apartments	7902 Tysons One Place McLean, VA 22102	1-703-208-9110
0.9 miles	H	Hyatt Regency at Tysons Corner Center	7901 Tysons One Place McLean, VA 22102	1-703-893-1234
1.0 miles	H	The Ritz Carlton Tysons Corner	1700 Tysons Boulevard McLean, VA 22102	1-703-506-4300
1.1 miles	H	Marriott Tysons Corner	8028 Leesburg Pike Tysons Corner, VA 22182	1-703-734-3200
1.2 miles	H	Westin Tysons Corner	7801 Leesburg Pike Falls Church, VA 22043	1-703-893-1340
1.2 miles	H	Courtyard Tysons Corner Marriott	1960-A Chain Bridge Road McLean, VA 22102	1-703-790-0207
1.2 miles	H	Doubletree McLean Tysons	1960 Chain Bridge Road McLean, VA 22102	1-703-893-2100
1.2 miles	A	National At Avalon Crescent	1569 Onyx Drive Building 1 McLean, VA 22102	1-303-863-7002
1.2 miles	A	Oakwood at Avalon Tysons Corner	1569 Onyx Drive McLean, VA 22102	1-602-687-3322
1.3 miles	A	Global Luxury Suites at Park Crest	8210 Crestwood Heights Drive McLean, VA 22102	1-855-410-0032
1.4 miles	A	Churchill at Ovation at Park Crest	8231 Crestwood Heights Drive McLean, VA 22102	1-866-599-6674
1.4 miles	H	Extended Stay America Wash DC Tysons	8201 Old Courthouse Road Vienna, VA 22182	1-703-356-6300
1.4 miles	A	Weichert Suites at the Ovation	8231 Crestwood Heights Drive McLean, VA 22102	1-866-599-6674

1.5 miles	H	Staybridge Suites McLean	6845 Old Dominion Drive McLean, VA 22101	1-703-448-5400
1.5 miles	H	Hilton Garden Inn Tysons Corner	8301 Boone Boulevard Vienna, VA 22182	1-703-760-9777
1.7 miles	H	Residence Inn Tysons Marriott	8400 Old Courthouse Road Vienna, VA 22182	1-703-917-0800
1.8 miles	H	Embassy Suites Tysons Corner	8517 Leesburg Pike Vienna, VA 22182	1-703-883-0707
2.1 miles	H	Quality Inn Tysons Corner	1587 Spring Hill Road Vienna, VA 22182	1-703-448-8020
2.2 miles	H	Residence Inn Tysons Marriott	8616 Westwood Center Drive Vienna, VA 22182	1-703-893-0120
2.2 miles	H	Sheraton Tysons	8661 Leesburg Pike Vienna, VA 22182	1-703-448-1234
2.7 miles	H	Hilton Garden Inn Falls Church	706 West Broad Street Falls Church, VA 22046	1-703-237-8700
2.9 miles	H	Inns of Virginia Falls Church	421 West Broad Street Falls Church, VA 22046	1-703-533-1100
3.0 miles	A	Execustay at Halstead Square at Dunn Loring	2750 Gallows Road Vienna, VA 22180	1-800-881-1523
3.1 miles	H	Courtyard Dunn Loring Marriott	2722 Gallows Road Vienna, VA 22180	1-703-573-9555
3.1 miles	H	Stratford Motor Lodge	300 West Broad Street Falls Church, VA 22046	1-703-534-4660
3.3 miles	H	Econo Lodge Metro	6800 Lee Highway Arlington, VA 22213	1-703-538-5300
3.5 miles	H	Homewood Suites Falls Church	8310 Porter Road Falls Church, VA 22042	1-703-560-6644

4. Washington DC Metrorail (subway) Map

<https://www.wmata.com/schedules/maps/upload/2017-System-Map.pdf>



5. WASHINGTON DC AREA AIRPORTS

5.1 RONALD REAGAN WASHINGTON NATIONAL AIRPORT

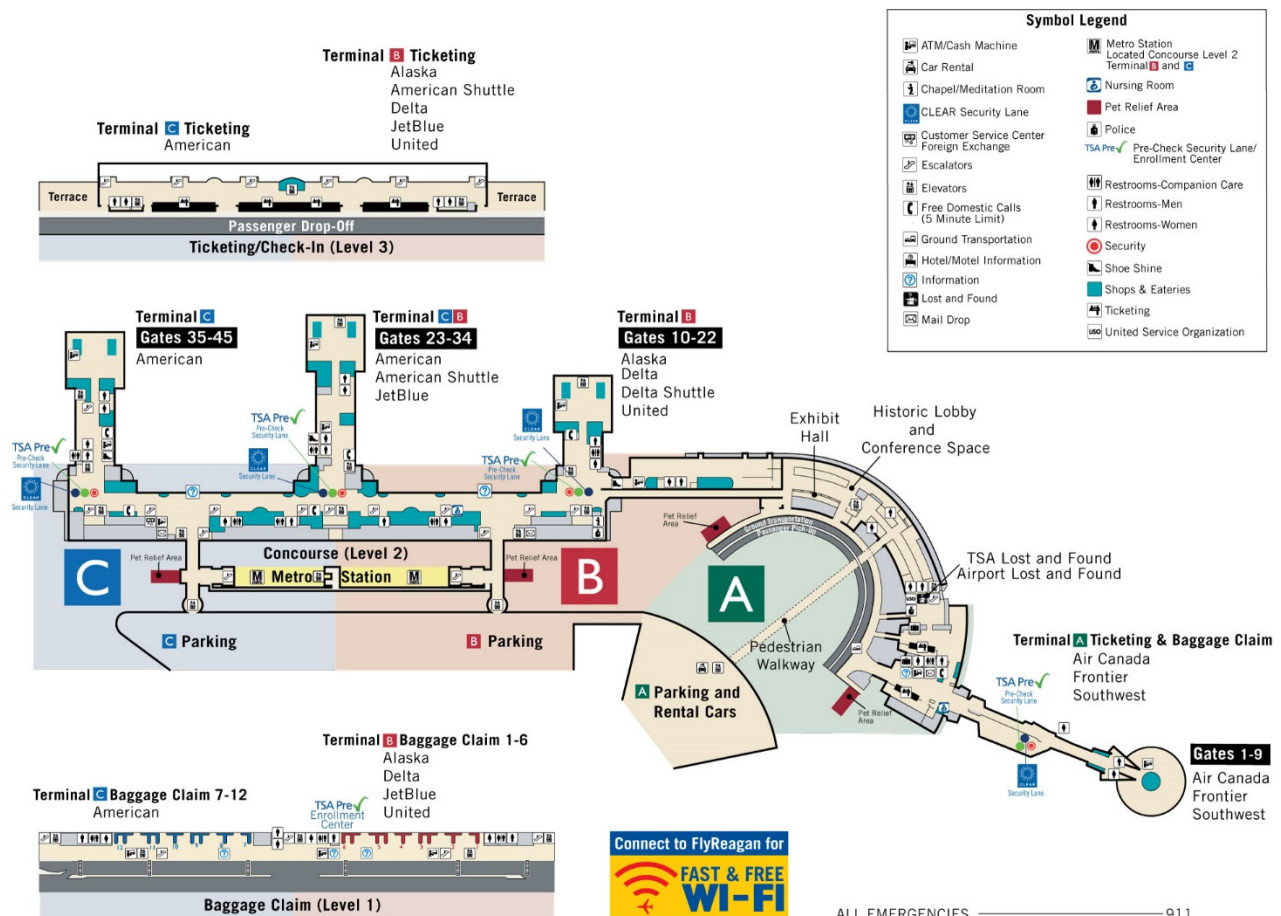
Ronald Reagan Washington National Airport (DCA) is located in Arlington, VA just across the Potomac River from the Nation’s Capital. Built in 1941, the airport’s original Terminal, now called Terminal A, is on the National Register of Historic Places. In 1987, the Metropolitan Washington Airports Authority was formed to operate Washington National and Dulles International Airports which were built and owned by the federal government. In 1997, Terminal B/C, designed by Cesar Pelli, was opened with a new roadway and parking garages. The airport features an unequalled view of Washington D.C. and key monuments and quality shopping and dining establishments located before and after security. Reagan National is directly linked to the region’s Metrorail Blue/Orange/and Yellow lines; the Metrorail station is adjacent to Terminal B/C.

<http://flyreagan.com/dca/reagan-national-airport>

DCA GROUND TRANSPORTATION

<http://www.flyreagan.com/dca/parking-blueprint>

MAP OF WASHINGTON REAGAN NATIONAL AIRPORT

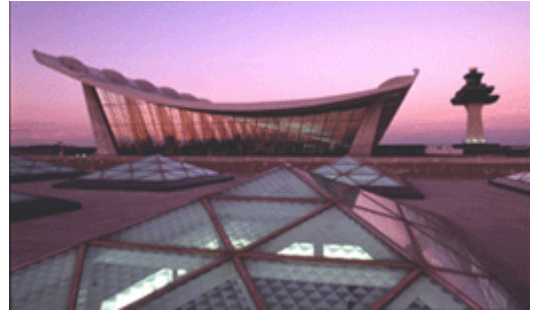


Information is effective as of April 25, 2018 and is subject to change without prior notification. Visit FlyReagan.com for more details.

ALL EMERGENCIES ————— 911
Police/Fire/Ambulance (Non-Emergency) ————— 703-417-2400
Police Station (Non-Emergency) ————— 703-417-8560
Airport Information ————— 703-417-8000

5.2 WASHINGTON DULLES INTERNATIONAL AIRPORT

Washington Dulles International Airport (IAD) is located in Chantilly, VA on 12,000 acres of land 26 miles from downtown Washington, DC. The Main Terminal opened in 1962 and was designed by architect Eero Saarinen. Dulles is a major hub for domestic and international air travel with a mixture of legacy and low fare carriers that provide air service throughout the world. Flights operate from midfield concourses A, B, C and D and from Z-gates connected to the Main Terminal. The Airport has invested in its infrastructure through a major construction program called D2, Dulles Development, which included two parking garages, a new airport traffic control tower, expanded B-gates, a new fourth runway, an automated people mover system called AeroTrain and an expanded International Arrivals Building. The airport is connected to the region's highway system via an Authority-operated, 16-mile Airport Access Highway dedicated to airport users.



<http://www.flydulles.com/iad/dulles-international-airport>

IAD TRANSPORTATION, DIRECTIONS AND MAPS

<http://www.flydulles.com/iad/directions-maps>

METRORAIL SILVER LINE CONNECTION TO IAD

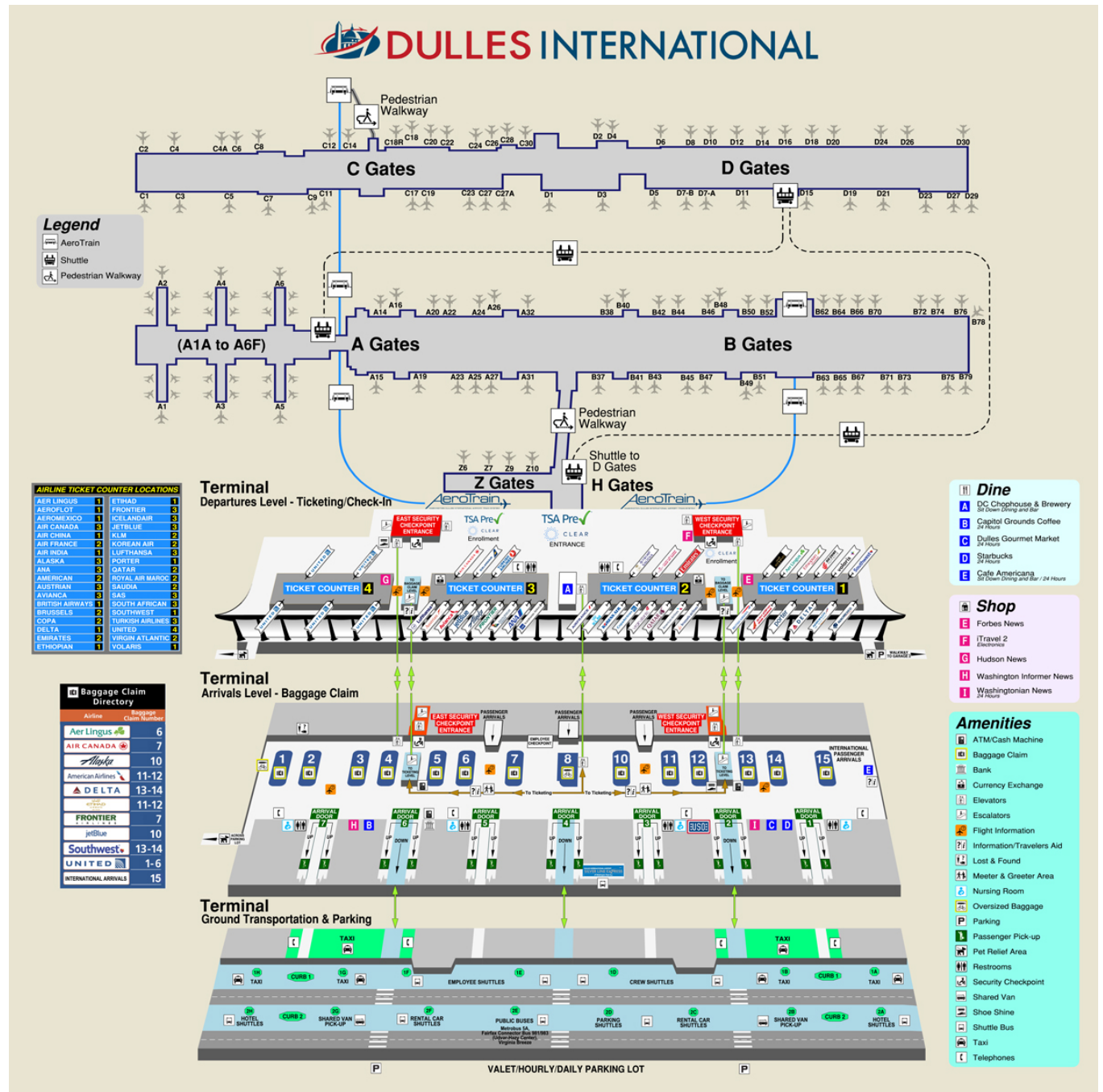
Metrorail to Washington Dulles is now closer than ever. The Silver Line Express Bus provides a convenient, economical connection between Dulles' Terminal and the Wiehle-Reston East [Metrorail](#) Station on Metrorail's Silver Line. The trip takes about 15 minutes. For more information, please call **703-572-7661**

<http://www.flydulles.com/iad/silver-line-express-bus-metrorail-station>



MAP OF DULLES AIRPORT

<http://www.flydulles.com/iad/airport-and-terminal-maps>



5.3 BALTIMORE/WASHINGTON INTERNATIONAL THURGOOD MARSHALL AIRPORT

BWI Marshall Airport is located just 9 miles south of downtown Baltimore and 32 miles northeast of Washington, D.C. It is the busiest airport in the region, serving over 25 million passengers. The airport is named after Thurgood Marshall, a Baltimore native who became the first African American to serve on the Supreme Court of the United States.



<https://www.bwiairport.com>

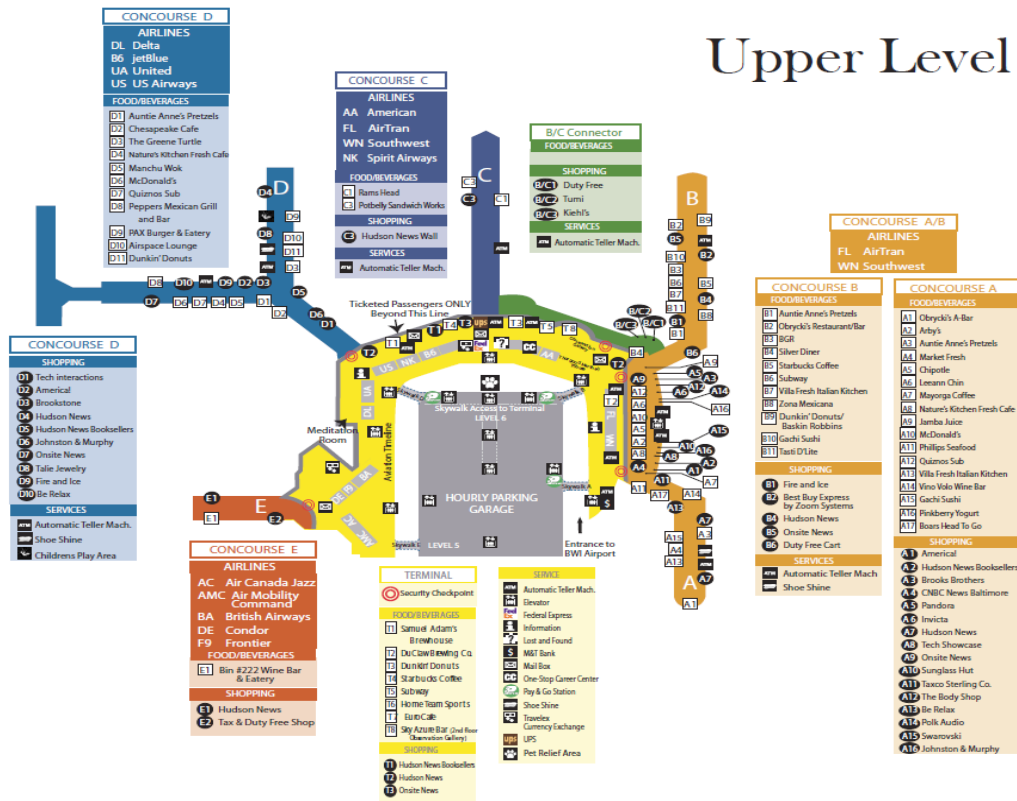
BWI GROUND TRANSPORTATION

Getting to and from the BWI Marshall Airport is easy with all of the different transportation options that are available. With options ranging from public transportation to app-based ride services, you can find a mode of transportation to meet your travel needs. Explore the choices BWI Marshall Airport has below to figure out which option is best for you.

<http://www.bwiairport.com/en/travel/ground-transportation>

MAPS OF BWI AIRPORT - UPPER LEVEL

https://www.bwiairport.com/sites/default/files/2018-02/UL_1.pdf



MAP OF BWI AIRPORT - LOWER LEVEL

http://www.bwiairport.com/files/pdfs/bwi_maps/LL091213.pdf

Lower Level

