*Testimony of*

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*Before the*

Committee on Commerce, Science, &
Transportation
United States Senate

– *On* –

The NTSB Final Report on the DCA Midair Collision
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Good morning. My name is Jennifer Homendy, and I'm honored to serve as Chairwoman of the National Transportation Safety Board (NTSB).

As you know, the NTSB is an independent federal agency charged by Congress with investigating and establishing the facts, circumstances, and cause or probable cause of all civil aviation accidents and serious incidents in the United States and defined accidents in all other modes of transportation, including roadway accidents, grade crossing incidents, railroad accidents, pipeline accidents, major marine casualties occurring on or under the navigable waters, internal waters, or the territorial sea of the United States, and other accidents related to the transportation of individuals or property when the Board decides the accident is catastrophic, the accident involves problems of a recurring character, or the investigation of the accident would carry out our statutory requirements. In addition, the NTSB carries out special studies concerning transportation safety and coordinates the resources of the federal government and other organizations to aid victims and their family members impacted by major transportation disasters.

Thank you for the opportunity to appear before you today to discuss our investigation of the midair collision between a Sikorsky UH-60L helicopter, operated by the US Army under the callsign PAT25, and an MHI (Mitsubishi Heavy Industries) RJ Aviation (formerly Bombardier) CL-600-2C10 (CRJ700), N709PS, operated by PSA Airlines as American Airlines flight 5342. These aircraft collided in flight about 0.5 miles southeast of Ronald Reagan Washington National Airport (DCA), Arlington, Virginia, about 8:48 pm eastern standard time on January 29, 2025.

The 2 pilots, 2 flight attendants, and 60 passengers on board the airplane and all 3 crewmembers on board the helicopter died. Flight 5342 was operating under the provisions of Title 14 Code of Federal Regulations Part 121 as a scheduled domestic passenger flight from Wichita Dwight D. Eisenhower National Airport, Wichita, Kansas, to DCA. PAT25 originated from Davison Army Airfield (DAA), Fort Belvoir, Virginia, for the purpose of the pilot's annual standardization evaluation flight with the use of night vision goggles (NVGs). Night visual meteorological conditions prevailed in the area of DCA at the time of the accident.

PAT25 departed DAA and landed at sites in Virginia and Maryland before the crew turned south toward Washington, DC, and was cleared by the DCA tower controller (who was working combined local control and helicopter control positions) to transition the DCA airspace via helicopter Routes 1 and 4 before proceeding back to DAA. The helicopter joined Route 1 near Cabin John, Maryland, and followed the Potomac River southbound at low altitude, passing the Key Bridge, Memorial Bridge, Tidal Basin, and Hains Point before continuing onto Route 4.

At the same time, flight 5342 was approaching DCA on an instrument flight rules flight that had been uneventful during departure, cruise, and initial descent. The airplane was inbound from the south on a visual approach to runway 1 when the DCA tower controller asked the flight crew if they could accept runway 33 instead.

Our final investigation report is being formatted for an anticipated public release date of February 17, 2026. To enable the Committee to adequately prepare for the hearing, we are providing the analysis section of the report in full here:

# Analysis

## Introduction

The accident occurred when PAT25, which was transiting southbound on Helicopter Route 4, impacted flight 5342, which had just turned onto final approach for runway 33 at DCA. At the time of the accident, the DCA local control (LC) controller was working both the LC and helicopter control (HC) positions. About 5 minutes before the collision, the first officer (FO) of flight 5342 contacted the tower while inbound on approach for landing on runway 1. The LC controller asked if they could switch to runway 33. After deliberation, the crew determined that they could accept the runway change and the FO informed the controller, who then instructed the flight crew to circle to runway 33 and issued a landing clearance.

About 2 minutes before the collision, when the aircraft were about 6.5 nautical miles (nm) apart, the LC controller issued a traffic advisory to PAT25, informing them of a "C-R-J just south of the Wilson Bridge circling to runway three three"; however, the helicopter's cockpit voice recorder (CVR) captured this transmission as, "PAT two five traffic just south of Wilson Bridge is a C-R-J at one thousand two hundred feet for runway three three," indicating that the PAT25 crew did not receive the word "circling" as part of the advisory due to degraded radio reception. At this time, PAT25 was crossing the Tidal Basin, and flight 5342 was one of five airplanes approaching DCA in darkness from the south. The PAT25 instructor pilot (IP) stated to the controller that they had the traffic in sight and requested visual separation, which the controller approved.

The LC controller contacted the helicopter crew again about 20 seconds before the collision and asked the crew if they had the CRJ in sight, followed by instructions to "pass behind that C-R-J"; however, the helicopter CVR indicated that the "pass behind that" portion of the transmission was blocked by a 0.8-second mic key from within the helicopter. The IP indicated that they had the airplane in sight and requested visual separation, which the controller again approved. About 6 seconds before the collision, the IP stated to the pilot, "alright kinda come left for me ma'am, I think that's why he's asking…we're kinda…out towards the middle." The pilot acknowledged and the helicopter subsequently started to move left. The aircraft collided at an altitude about 278 feet mean sea level (msl) about 2,500 feet from the runway 33 threshold.

The analysis discusses the accident sequence and evaluates the following safety issues:

- the extensive use of pilot-applied visual separation and the inherent limitations of the see-and-avoid collision avoidance concept;
- controller workload, position combining, and communications practices;
- the design of the Washington, DC, area helicopter routes and operators' awareness and interpretations of route structure and limitations;
- the limitations of the traffic awareness and alerting systems on both aircraft;
- shortcomings in Federal Aviation Administration (FAA) and US Army safety assurance and risk management processes; including lack of proactive data sharing and analysis to identify and mitigate midair collision risk; and
- deficiencies in FAA safety culture and postaccident drug and alcohol testing procedures.

The NTSB investigation's comprehensive review of the accident circumstances determined that the following factors did not contribute to the cause of the accident:

*Flight 5342 crew qualifications.* The pilots of flight 5342 were certificated and qualified in accordance with federal regulations. **[FINDING 1]**

*Flight 5342 crew medical factors.* The pilots of flight 5342 were medically qualified for duty, and available evidence does not indicate that they were impaired by effects of medical conditions or substances at the time of the accident. **[FINDING 2]**

*Flight 5342 crew fatigue*.[1] Review of the flight 5342 pilots' time since waking and sleep opportunities in the days before the accident indicated that the pilots were unlikely to have been experiencing fatigue. **[FINDING 3]**

*PAT25 crew qualifications.* The pilot, IP, and crew chief onboard PAT25 were qualified and current in their positions as designated by the unit commander in accordance with Army regulations. **[FINDING 4]**

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[1] In this report, "fatigue" is used consistent with human performance science to describe performance impairment associated with insufficient sleep, circadian disruption, and/or extended time awake. Operational factors such as high workload, sustained attention demands, stress, and task saturation can also degrade vigilance and situational awareness, but these effects are analytically distinct from fatigue and are addressed separately in the report.

*PAT25 crew medical factors.* The pilot, IP, and crew chief of PAT25 were medically qualified for duty, and available evidence does not indicate that they were impaired by effects of medical conditions or substances at the time of the accident. **[FINDING 5]**

*PAT25 crew fatigue.* Review of the PAT25 three crewmembers' time since waking and sleep opportunities in the days before the accident indicated that the crew were unlikely to have been experiencing fatigue. **[FINDING 6]**

*Airplane mechanical factors.* The airplane was properly certificated, equipped, and maintained in accordance with 14 *Code of Federal Regulations* (*CFR)* Part 121. The airplane was operated within its weight and balance limitations throughout the flight. Examination of the airplane revealed damage consistent with an in-flight collision and subsequent impact with water, and there was no evidence of any structural, system, or powerplant failures or anomalies. Review of surveillance videos indicated that the airplane's wing navigation, landing/taxi, and anti-collision strobe lights were operating at the time of the collision. **[FINDING 7]**

*Helicopter flight controls, rotor system, and powerplants.* The helicopter was properly certificated, equipped, and maintained in accordance with US Army regulations. Review of helicopter maintenance records did not reveal any open discrepancies or anomalous trends that contributed to the accident. The helicopter was operated within its weight and balance limitations throughout the flight. Examination of the helicopter revealed damage consistent with an in-flight collision and subsequent impact with water, and there was no evidence of any structural, main or tail rotor system, flight control system, or powerplant failures or anomalies. Review of surveillance videos indicated that the helicopter's right and tail position lights, the landing light, as well as both upper and lower anti-collision lights, were operating at the time of the collision. **[FINDING 8]**

*Air traffic controller qualifications and tower staffing.* The operations supervisor (OS) and four controllers who were working in the DCA airport traffic control tower (ATCT) cab at the time of the accident were properly certified, qualified in accordance with federal regulations and facility directives, and current. **[FINDING 9]** Although the DCA ATCT facility was not staffed to its target level at the time of the accident, the number of staff in the tower at the time of the accident was adequate and in accordance with FAA directives. **[FINDING 10]** Therefore, the NTSB concludes that the decision to combine the HC and LC positions was not the result of insufficient staffing, and personnel were available to staff the HC and LC positions separately had the OS chosen to do so. **[FINDING 11]**

*Controller medical factors.* The LC controller, assistant local control (ALC) controller, and OS were medically qualified for duty, and available evidence does not indicate they were impaired by effects of medical conditions at the time of the accident. **[FINDING 12]**

*Controller fatigue.* Review of the LC and ALC controllers' and OS's time since waking and sleep opportunities in the days before the accident indicated that the controllers, including the OS, were unlikely to have been experiencing fatigue. **[FINDING 13]**

*Weather conditions.* Visual meteorological conditions prevailed in the area at the time of the accident. A review of observations recorded throughout the night of the accident revealed no evidence of any local atmospheric pressure anomalies that would have impacted barometric altimeter readings. **[FINDING 14]**

*Airport response*. Metropolitan Washington Airports Authority (MWAA) aircraft rescue and firefighting (ARFF) and airport operations staff responded immediately and in accordance with applicable emergency plans and regulatory requirements, deploying land- and water-based resources, and coordinating mutual aid under complex nighttime and on water conditions. **[FINDING 15]**

# Accident Sequence

## Controller Performance

### *Workload and Resource Management*

Because the LC and HC positions were combined on the night of the accident, the LC was not only responsible for providing services to the arriving and departing fixed-wing aircraft, but had the added responsibility of providing services to numerous helicopters that were transitioning the airspace. In the 20 minutes before the accident, the total number of aircraft that the LC controller was handling fluctuated between 7 and 12 aircraft. In a postaccident interview, the LC stated that he felt "a little overwhelmed" about 10 to 15 minutes before the accident, and that he felt the volume was manageable when "one or two helicopters" left the airspace. This statement was consistent with a peak in observed traffic volume of 10 aircraft around this time (5 helicopters and 5 airplanes); 1 helicopter subsequently departed the airspace at 2040:28, or 7:31 before the collision. The LC controller reported that he would have asked to have the HC and LC positions staffed separately if he received two more helicopters.

In the 2 minutes before the accident, there were a total of 29 transmissions between the LC controller and airplanes/helicopters on his frequency, and about 90 seconds before the collision, the number of aircraft on the LC controller's frequency increased to 12. During that time, the controller spoke to or received communications from six of those aircraft: three inflight helicopters, one inflight airplane, and two airplanes on the ground. The other six aircraft, with which the controller did not directly communicate during the 2 minutes before the accident, but which he was still responsible for maintaining awareness of, included two inflight helicopters, two inflight airplanes, and two airplanes on the ground.

Human factors research has consistently shown that in air traffic control (ATC) operations, voice communications reliably capture and direct controller attention toward the aircraft involved. Several studies have shown that auditory communication events—including issuing clearances and receiving pilot readbacks—function as attentional anchors that trigger cognitive focus and updates to the controller's mental representation of that aircraft's trajectory and status (Endsley and Rogers 1997; McGee, Mavor, and Wickens 1997). Therefore, the LC controller's moment-to-moment subject attention allocation can be reasonably inferred from the aircraft with which he was communicating at any given point in time.

The complexity of the airspace and limited airfield surface area at DCA require controllers to carefully coordinate the flight paths and timing of aircraft taking off, landing, and transitioning through the airspace and to issue instructions and clearances as necessary to efficiently facilitate these various flight operations. The LC controller's communications in the 2 minutes before the accident are consistent with his continuous shifting of priorities between airborne, ground, and transitioning aircraft.

After initially approving PAT25's request to maintain visual separation from flight 5342, he turned his attention to an airplane waiting to depart, informing them about traffic three miles out circling to runway 33 (flight 5342) and additional traffic on a six-mile final approach for runway 1, and instructing them to line up and wait on the runway. At 2046:29.1 (about 1:30 before the collision), an Air Force helicopter checked in on the frequency, along with a simultaneous transmission from an inbound American Airlines airplane. The LC controller instructed the Air Force helicopter to standby, then instructed a landing airplane to continue their landing roll to "taxiway November." A medical transport helicopter then contacted the tower. The LC controller cleared the airplane waiting to depart runway 1 for an "immediate takeoff," as the airplane needed to be clear of the intersection of runways 1 and 33 before flight 5342 crossed the runway 33 threshold for landing. About 2046:58, the LC controller replied to the Air Force helicopter, which was west-southwest of the airport, and approved their requested route of flight. About 45 seconds before the collision, the American Airlines airplane that had attempted to contact the tower at the same time as the Air Force helicopter transmitted their location on the runway 1 approach; however, that transmission was stepped on by the medical transport helicopter's second transmission to tower. The LC controller then approved the medical transport helicopter's request to transition through the Class B airspace. A conflict alert was audible during two brief mic keys from the controller at 2047:37.8, and would have been visible on the controller's control tower radar display (CTRD). Less than 2 seconds later, about 20 seconds before the collision, the LC controller asked PAT25 if they had the CRJ in sight. Three seconds later, the LC instructed PAT25 to pass behind the CRJ. PAT25 said it had the aircraft in sight and requested visual separation; the LC controller stated, "vis separation." The American Airlines airplane inbound on the runway 1 approach then contacted the tower a third time, and the LC controller was communicating with that airplane when the collision occurred.

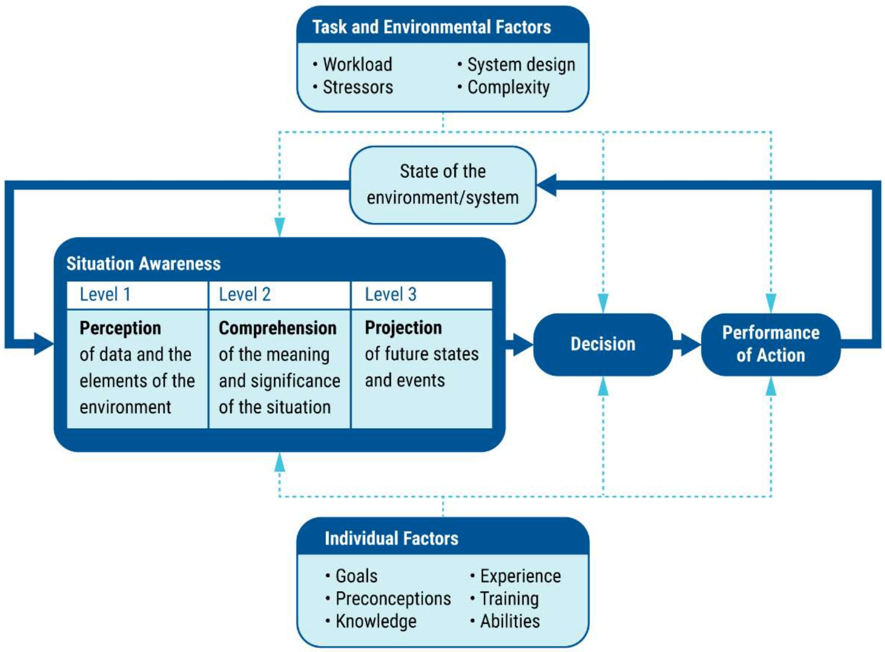
Given the LC controller's statement that he felt "a little overwhelmed" with a traffic volume of ten aircraft, it is likely he began to feel overwhelmed again in the 2 minutes before the accident when traffic volume increased. A review of the DCA ATCT standard operating procedures (SOPs) and training documents did not indicate any guidance specifically related to controller workload and how and when controllers should ask for relief.

Where a controller's attention is focused can influence the amount of time it takes to recognize and respond to an unexpected event. A study that evaluated scanning patterns and detection times of expert tower controllers to abnormal events found that the controllers' average detection times, beginning from the onset of the abnormal event, ranged from 14 seconds to 204 seconds (Crutchfield et al. 2021), which could lead to adverse outcomes for time-critical safety events. The conflict alert system acts as a safety net to assist controllers responding to traffic conflicts in a timely manner. During the 2 minutes before the accident, the LC controller was communicating with aircraft located primarily south and west-southwest of the airport; therefore, his attention would have been focused in that direction. Just before the conflict alert activated, the LC controller was communicating with a medical transport helicopter located about 16 miles west of the airport. The LC controller likely would have looked at the CTRD to confirm that helicopter's location. The LC controller recalled that he noticed the conflict between PAT25 and flight 5342 during his scan and queried PAT25 to ensure that they still had the airplane in sight, which PAT25 confirmed.

Situation awareness forms a basis for decision-making and is defined as the "perception of the elements in the environment within a volume of time and space [Level 1], the comprehension of their meaning [Level 2], and the projection of their status in the near future [Level 3]" (Endsley, 1988).[2] Figure 1 presents an illustration of the situation awareness concept. Situation awareness is not only what the controller is perceiving in the current air traffic situation (level 1) but how they interpret that information (level 2) and use it to project the future state of air traffic (level 3) moving in their airspace. Levels 2 and 3 are especially critical in the air traffic environment because it is dynamic and constantly changing.

[2] These three levels of situation awareness, which are sequential, are followed by decisions and performance of actions.

**Figure 1.** Diagram of the situation awareness concept.




Recognizing an impending collision requires information to be perceived from the environment, stored in working memory, and interpreted against knowledge stored in long term memory, allowing controllers to identify familiar situations, predict future events, and determine an appropriate response (Wickens, Mavor, and McGee, 1997). Controllers must routinely monitor the current state of an aircraft and predict its future location in relation to other aircraft (Endsley, 1995). Conflicts that develop slowly, particularly at night, are inherently difficult for people to recognize due to reduced visual cues and the fact that gradual change can reduce situation awareness and delay recognition.

Controllers must maintain awareness of each aircraft they are managing (to include, for example, location, altitude, and airspeed) and anticipate where that aircraft will be in the seconds and minutes to follow. A controller's ability to maintain situation awareness is impacted by their workload and divided attention. As remaining cognitive resources are reduced with increasing workload (such as increasing traffic complexity, traffic volume, and/or radio communications), a controller's ability to maintain situation awareness is reduced. Because the LC was working the combined LC and HC positions, he was required to manage and maintain awareness of fixed-wing aircraft arrivals and departures as well as the movements of helicopters in the airspace, which required dividing his attention between airborne, ground, and transiting traffic. The NTSB concludes that **keeping the HC and LC positions continuously combined on the night of the accident**

**increased the LC controller's workload and negatively impacted his performance and situation awareness. [FINDING 16]**

It is also likely that the controller was using expectation-driven processing, which directs a person's attentional focus. When events occur as expected or are routine, such as a pilot correctly reading back a clearance or adhering to a published flight path, information processing occurs rapidly with minimal effort. This expectation can lead to errors if a pilot or aircraft does not behave as expected. In this case, the controller expected that PAT25 would remain clear of flight 5342 because the PAT25 IP stated that they had the airplane in sight and would maintain visual separation. The frequent use of pilot-applied visual separation reinforces the expectation that the pilot of one aircraft will maintain separation from another aircraft, and because it has repeatedly worked as expected, it can be more difficult for a controller to notice deviations, especially when workload is high. It is likely that the controller did not expect the conflict between PAT25 and flight 5342 to occur, and felt comfortable dividing his attention between the accident aircraft and the numerous other aircraft under his control at the time of the accident.

The primary duties of the ALC control position were to alert the LC controller of any unusual situations or traffic conflicts, maintain surveillance of the local traffic pattern and landing area, and assist the LC controller with monitoring of aircraft on final via the CTRD. These duties would be accomplished by scanning the airspace as well as the tower displays. When the HC and LC positions were combined, the ALC position had the additional duty of monitoring the helicopter and airplane frequencies. In a postaccident interview, the ALC controller recalled that she was "writing down what the different helicopters were doing" when she heard the conflict alert and the LC controller asking PAT25 if they had the CRJ in sight, then instructing PAT25 to pass behind the CRJ.[3] Monitoring traffic is a workload-intensive task, and, like the LC, the ALC was also subject to high workload in the minutes before the accident. If the LC and HC positions had been staffed separately, the LC and ALC would have only been working fixed-wing traffic, and another controller would have been working helicopter traffic. This would have reduced the number of aircraft the LC and ALC were controlling and monitoring—for example, about 90 seconds before the accident, the LC/ALC would have been handling 7 airplanes while a separate helicopter controller handled the 5 helicopters on frequency at the time. This would have reduced cognitive loading and enabled the HC controller to more easily keep track of the movement of the helicopters and their potential conflicts with arriving airplanes. It is possible that if the positions had been staffed separately, a standalone HC controller could have detected the potential conflict between PAT25 and flight 5342 earlier, enabling an earlier and more effective traffic advisory to PAT25. The NTSB concludes that **had the HC and LC positions been staffed separately, PAT25**

[3] Note taking and recording aircraft information are routine components of local and assistant local controller duties, along with radio communications, coordination, and traffic sequencing. Such tasks require temporary shifts of attention between displays, communications, and the out-the-window visual scan.

**might have received a more timely and effective traffic advisory. [FINDING 17]** The NTSB further concludes that **the LC and HC positions should have been separated at the time of the accident given traffic volume and complexity. [FINDING 18]**

The NTSB also concludes that **in the 2 minutes before the accident when traffic volume was increasing, the ALC should have prioritized surveillance of aircraft in the air in order to assist the local controller, rather than diverting her attention to the lower priority task of documenting helicopter information, which could have been completed when traffic volume and complexity had subsided. [FINDING 19]**

The primary duties and responsibilities of the OS included providing operational supervision, directing the tower operation to ensure efficiency, and determining when the HC and LC positions should be combined or separately staffed. The DCA ATCT SOP stated that the OS, as the watch supervisor, must maintain situation awareness of traffic activity and operational conditions in order to provide timely assistance to controllers and ensure that available resources are deployed for optimal efficiency. To do this, the OS must not only maintain a general awareness of traffic volume and complexity within the airspace, but also continuously assess the risk of the operation to determine when a controller needs assistance and when the HC/LC positions should be separately staffed. The OS should also scan the airspace and CTRD to identify any potential conflicts.

The HC and LC positions were combined when the OS came on duty earlier on the day of the accident. Why the positions were combined earlier that day was not determined, as facility SOP had been revised in June 2024 to remove the requirement for documentation of the reason for combining. Some controllers interviewed felt that combining the HC and LC positions resulted in better situation awareness and reduced workload, because they did not have to coordinate with another controller the way they did when the positions were separately staffed. Controllers stated that the benefits to staffing the positions separately were having another set of eyes scanning traffic, less frequency congestion, and a controller dedicated to helicopters only. In other words, duties and responsibilities would be divided between two controllers, allowing for more focused attention to aircraft on their respective frequencies to recognize the development of a potential conflict. Although the DCA ATCT SOP specified hours during which the HC position "should normally be de-combined," the SOP allowed the OS to combine or separately staff the position at their discretion after considering factors such as staffing, weather conditions, and traffic volume. The LC controller stated he was feeling a little overwhelmed about 10 to 15 minutes before the accident and had thought about asking for the HC/LC positions to be staffed separately, but did not because a helicopter left the airspace. Helicopter and airplane traffic volume subsequently increased again in the 2 minutes before the accident; however, the OS stated in a postaccident interview that there was no need to staff the positions separately in the hour before the accident, as they only had one helicopter at a time.

The OS had been working multiple control positions for over 4 hours and had been working the OS position for over 2 hours at the time of the accident. From the OS position in the tower, he was listening to the LC controller's transmissions, which were broadcast on a speaker in the tower cab, and "look[ing] out the window." He could not recall the specifics of the traffic situation at the time of the accident, and did not recall the conflict alert activating, but witnessed the collision.

To provide timely assistance to controllers and ensure that available resources are deployed for optimal efficiency, the OS should continuously assess the risk of ongoing factors in the operation, including traffic volume and complexity, controller experience, time on position, nighttime conditions, and any other factors deemed relevant. However, given his extended time on position, it is likely that the OS was experiencing reduced alertness at the time of the accident, which decreased his ability to effectively assess operational risks. Research in a simulated air traffic control room showed that extended time on task (over 90 minutes) increased detection latency for complex events such as two aircraft at the same altitude on the same flight path (Thackray and Touchstone, 1989).

The OS's reduced alertness and attentiveness would be consistent with his extended time on position at the time of the accident and his not recognizing the increases in traffic volume that occurred 10 to 15 minutes before the accident and again in the 2 minutes before the accident. In addition, he did not recognize the developing traffic conflict as PAT25 continued toward flight 5342. The NTSB concludes that **due to extended time on position at the time of the collision and his complacency, the OS was likely experiencing reduced alertness and vigilance, which decreased his awareness of the operational environment and reduced his ability to proactively assess the risks posed by the traffic and environmental conditions at the time of the accident. [FINDING 20]**

FAA Order 7210.3DD, "Facility Operations and Administration"; the collective bargaining agreement (CBA) between the National Air Traffic Controllers Association (NATCA) and the FAA; and DCA ATCT SOPs outline the duties and responsibilities of supervisors, including the requirement to ensure that adequate relief opportunities are provided to all operational staff. However, none of these documents detail how a supervisor is expected to manage the supervisor's own relief periods throughout the duty day or shift. The CBA states that employees should not be required to spend more than 2 consecutive hours performing operational duties without a break from operational areas.[4] While breaks for controllers in accordance with the collective bargaining agreement (CBA) are closely monitored and strictly enforced, the CBA

[4] A break is defined in the CBA as, "a period of time during which no duties are assigned and offer employees opportunities to attend to personal needs or rejuvenate their mental acuity."

does not cover supervisory personnel such as operations supervisors and controllers-in-charge; therefore, individuals performing these duties are not subject to the same break requirements.

A supervisor's duties are extensive, and providing oversight in an operational environment can be as mentally taxing as working a control position. Under current rules, supervisors are often conducting supervisory duties for hours, and in some cases, entire shifts, but are not provided the same relief periods as operational personnel. The NTSB concludes that **the lack of mandatory relief periods for supervisory air traffic control personnel is contrary to human factors research that shows clear performance deterioration in situations of prolonged time on task. [FINDING 21]** Therefore, the NTSB recommends that the FAA **develop and implement time-on-position limitations for supervisory air traffic control personnel, including guidance for district and facility level management to adapt these limitations to account for their own staffing and local standard operating procedures. [RECOMMENDATION 1]**

*Traffic Advisories*

The LC controller's first advisory to PAT25 regarding flight 5342 occurred about 2 minutes before the collision. This advisory was consistent with air traffic policy. In response to the controller's traffic advisory, the PAT25 IP stated that they had the traffic in sight and requested visual separation. The controller did not issue a corresponding traffic advisory to the crew of flight 5342.

The controller later stated that he had other priority duties at the time he issued the initial advisory to PAT25 and that he intended to go back and issue an advisory to flight 5342. However, because he was attending to other priority tasks, he did not return to the airplane before the conflict alert activated about 1 1/2 minutes later. Although the crew of flight 5342 had other contextual clues about the presence of PAT25 (see discussion in section 0), they never received an advisory from the controller about the helicopter, which would have increased their situation awareness. The NTSB concludes that, **although the LC controller provided an initial traffic advisory to the crew of PAT25 in accordance with FAA Order JO 7110.65, he did not provide a corresponding advisory to the crew of flight 5342 regarding PAT25's location and intention, which could have increased situation awareness for the crew of flight 5342. [FINDING 22]**

FAA Order JO 3120.4, "Air Traffic Technical Training," conveys instructions, standards, and guidance for the administration of air traffic technical training (FAA, 2024c). The order lists "positive control" as a job subtask, which it defined, in part, as taking command of control situations and not acting in a hesitant or unsure manner. The LC controller reported that, after the conflict alert activated, he noted that the helicopter was "way closer" to the airplane than it was supposed to be. In response, the controller contacted the crew of PAT25 and stated, "PAT two five do you have that C-R-J in sight?" The controller then instructed PAT25 to "pass behind that C-R-J." The

PAT25 IP replied that they had “a- aircraft” in sight and again requested visual separation, which the controller approved.

FAA Order JO 7110.65AA, “Air Traffic Control,” paragraph 5-1-4, Merging Target Procedures, stated that controllers must provide traffic information to any turbojet aircraft whose target appears likely to merge with another aircraft, unless those aircraft are separated by more than the appropriate vertical separation minima. Safety alert procedures and phraseology requirements, contained in paragraph 2-1-6, stated that controllers should immediately issue a safety alert to an aircraft that is in unsafe proximity to another aircraft, and to offer the pilot an alternative course of action if feasible, ending the transmission with the word “immediately.”

When the LC controller recognized that the two aircraft were in unsafe proximity, the most appropriate action would have been to issue safety alerts to both aircraft regarding the other aircraft’s position and distance, and to issue positive control instructions to the pilots that would have prevented their courses from converging, such as climb, descend, or turn, as appropriate. However, the controller’s traffic call to PAT25 at this time provided no information that could have assisted the crew in visually locating and positively identifying the airplane, nor did it contain positive control instructions that the crew could have taken to resolve the conflict. Additionally, the controller did not issue a safety alert to flight 5342, contrary to merging target procedures. Timely issuance of positive control instructions by the controller and subsequent compliance with those instructions by the flight crew(s) could have averted the impending collision. The NTSB concludes that **if the LC controller had issued a standard safety alert to the flight crews of either aircraft as prescribed in FAA Order JO 7110.65, providing the conflicting aircraft’s position and positive control instructions, the crew of either aircraft could have taken immediate action to avert the impending collision. [FINDING 23]**

### *Threat and Error Management*

The primary purposes of the ATC system are to prevent a collision between aircraft operating in the system and to provide a safe, orderly, and expeditious flow of traffic. FAA Order 7110.65, Air Traffic Control, paragraph 2-1-2, “Duty Priority,” states, that controllers should “give first priority to separating aircraft and issuing safety alerts as required in this order. Good judgment must be used in prioritizing all other provisions of this order based on the requirements of the situation at hand.”

Because there are many variables involved, it is virtually impossible to develop a standard list of duty priorities that would apply uniformly to every conceivable situation. Controllers must evaluate each on its own merit, and when more than one action is required, exercise their best judgment based on the facts and circumstances known to them. According to FAA Order JO 7110.65AA, “That action which is most critical from a safety standpoint is performed first.” One way that controllers may do this is to use recognition primed decision making, which allows for quick and effective decision making in complex situations. Recognition primed decision making relies on pattern matching of the current situation with past experiences to identify a course (or courses) of action, and mental simulation of how the course(s) of action will play out (Klein, 1998).

In this accident, when the LC controller recognized that PAT25 and flight 5342 were converging after the conflict alert activated, he should have issued a safety alert to both aircraft; however, the LC controller asked PAT25 if they had the airplane in sight. Under high workload and time pressure, controllers have reduced cognitive capacity for responding to unusual situations (Damos, 1988). The LC controller knew he had to resolve the conflict, but had limited time and capacity to do so. Asking if PAT25 still had the CRJ in sight, then instructing PAT25 to pass behind the CRJ, required less processing load than issuing a safety alert, which should include a clock position or location of the traffic, distance, and an action for the pilot to take.

In November 2016, the NTSB issued Safety Recommendation A-16-51, asking the FAA to provide initial and recurrent training for air traffic controllers on controller judgment, vigilance, and/or safety awareness with specific reference to two midair collisions that occurred in 2015 to be used as case studies.[5] The FAA responded that, in July 2017, it delivered instruction to controllers on threat and error management (or TEM, which the FAA described as the practice of applying controller judgment, vigilance, and safety awareness) as part of instructor-led recurrent training and stated that the training would also be required training for future controllers. The FAA also stated that they delivered a web-based "Emergencies" training in July 2017 to highlight accidents similar to the two midair collisions cited in the recommendation. After reviewing this training, the NTSB determined that the materials did not highlight the safety issues identified in the 2015 midair accidents, nor did the training provided discuss those or similar accidents as recommended. When the FAA indicated that it did not plan to take further action, Safety Recommendation A-16-51 was classified Closed—Unacceptable Action in 2023.

A vast majority of the time, controllers perform very effectively and reliably; however, human vulnerabilities such as fatigue, increased workload, time pressure, and biases can increase errors. A controller's ability to anticipate, detect, and mitigate risks is essential. TEM provides a strategy to combat these vulnerabilities. TEM is a process for identifying safety risks—threats, errors, and undesired states—in the environment and mitigating those risks. In the context of air traffic control, threats include many of the complexities faced by controllers, such as airspace congestion, pilot errors, terrain or obstacles near the airport, and adverse weather conditions. Some threats can be anticipated, while others occur unexpectedly. Errors are actions or inactions by the controller that result in a deviation from the controller's intention or expectation, such as instructing an aircraft to taxi across an occupied runway, not detecting a pilot readback error, or providing an incorrect clearance, heading, or

[5] Additional information about the two accidents and the findings that led to our recommendations may be found, respectively, in the reports of the investigations (ERA15MA259A/B and WPR15MA243A/B) and the safety recommendation report (ASR-16-6).

altitude. Undesired states are operational conditions where the margin of safety is reduced. An undesired state often results from mismanaged or missed threats and errors and is often considered the "last stage" before an accident or incident. To restore the margin of safety, a controller must act to mitigate the risk by addressing the undesired state rather than the error (ICAO 2005).

In an observational study performed by the FAA at two air traffic control centers, they found that communication was the most frequent threat identified, resulting primarily from frequency congestion, simultaneous transmissions, incorrect pilot readback, or failure of a pilot to respond. On average, 15% of threats lead to an error and 13% of errors lead to an undesirable state (Eurocontrol, 2011). A review of United Kingdom incident data identified controller scanning patterns of radar and flight strips to be a primary contributor.

None of the controllers involved in this accident were familiar with the term "threat and error management" during postaccident interviews, nor were they familiar with the concepts that would be included in such training, suggesting that they did not receive training on this method of safety management. The NTSB requested and received controller training materials related to identifying and mitigating risk. Review of this material did not reveal any formal TEM training other than the 2017 workshop, and there was no evidence to indicate that the workshop or the subject matter it contained had been offered in any training since 2017.

Adequate training on the use of TEM can strengthen situation awareness by teaching controllers to continuously monitor their environment to more quickly identify threats; promote team communication to ensure that communications are clear, timely, and assertive; emphasize effective scanning habits; recognize patterns in the development of adverse events; and enhance decision making under stress by developing habits that balance procedural compliance with problem solving to mitigate the risks of threats and errors. TEM would have likely improved the situation awareness of all controllers in this event, which may have allowed for earlier conflict recognition or encouraged the OS to conduct a risk assessment of the steady helicopter traffic and its resulting workload on the LC and ALC controllers.

The NTSB continues to believe that including case studies in initial and annual air traffic controller training and highlighting situations in which controller judgment, vigilance, and safety awareness could be improved would enhance controllers' ability to identify and manage threats and errors. FAA guidance on the use of good judgment is vague, and case studies provide the opportunity to examine a real chain of events that had resulted in an accident, imparting valuable lessons without exposing participants to the potential risk of adverse outcomes inherent to on-the-job training, which the FAA often relies upon for controller training. The NTSB also believes that providing controllers the opportunity to discuss and practice applying TEM using scenario-based training is critical, as repetition of skills through training leads to automaticity of behaviors (Wickens et al. 2004), thus freeing up working memory.[6] Automaticity has been demonstrated to improve speed and accuracy (Wickens et al. 2004), situation awareness (Endsley, 2010), and decision making (Haith and Krakauer, 2018). Therefore, the NTSB concludes that **initial and recurrent scenario-based training in threat and error management would help controllers identify and mitigate risks and strengthen situation awareness. [FINDING 24]** Therefore, the NTSB recommends that the FAA **develop instructor-led, scenario-based training on threat and error management that trains controllers to continuously monitor their environment to more quickly and accurately identify threats; promote team communication to ensure that communications are clear, timely, and assertive; emphasize effective scanning habits; recognize patterns in the development of adverse events; and enhance decision-making under stress by developing habits that balance procedural compliance with problem solving to mitigate the risks of threats and errors, and provide this training to all air traffic controllers annually. [RECOMMENDATION 2]**

TEM training would also benefit controllers performing supervisory duties, who are responsible for overseeing facility operations and making operational decisions, such as when to combine or de-combine control positions, provide additional monitoring of a position or frequency, or rotate controller positions to allow for adequate break opportunities. When making these decisions, OSs must balance safety and risk management with the operational demands of the facility, which are continually changing based on factors such as traffic flow and weather conditions. Other than the list of factors that the accident OS was to consider when combining the HC and LC positions, there was no guidance or tool available in the DCA ATCT SOP to support supervisors in identifying risk, analyzing the potential impact of that risk on individual controllers or the overall operation, prioritizing risks based on likelihood and impact, or developing strategies to reduce or eliminate the identified risks. Additionally, no such tool or guidance was available in the Air Traffic Organization (ATO) *ATO SMS Manual* or in FAA Order 7110.65, which prescribes air traffic control procedures. There were several factors that increased risk to DCA ATCT operations on the night of the accident, including nighttime conditions, the steady volume of helicopter traffic, and the lack of requested miles-in-trail spacing from Potomac TRACON that resulted in offloading airplanes to runway 33. The NTSB concludes that **a risk assessment or decision making tool would likely have benefited the accident OS in identifying and mitigating the operational risk factors that were present on the night of the accident. [FINDING 25]** A risk assessment tool that could be tailored to the operational needs of each facility would benefit supervisory air traffic control personnel throughout the National Airspace System (NAS). Therefore, the NTSB recommends that the FAA ATO **develop and implement a risk assessment tool for supervisors that incorporates the principles of threat and error management to assist in risk identification, mitigation, and operational decision making. [RECOMMENDATION 3]**

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[6] "Automaticity" refers to highly learned skill performance driven by schemas that does not require much controlled attention.

## PAT25 Operations

### *Helicopter Radio Quality*

Review of recorded ATC communications on the night of the accident revealed that the transmissions made by PAT25 were accompanied by static interference, which likely made intelligibility of their transmissions difficult for both ATC and other aircraft. The helicopter's CVR also captured a conversation between the pilots earlier in the flight regarding the poor quality of the transmissions received from the controller, many of which were incomplete or broken. Most critically, the portion of the controller's initial traffic advisory regarding flight 5342, in which he stated that the airplane would be "circling runway 33," was not received in its entirety by the PAT25 crew; radio interference characteristic of that experienced by the helicopter crew throughout the flight caused the transmission to sound like, "for runway 33" inside the helicopter, omitting the word "circling."[7]

If the PAT25 crew had heard the word, "circling," it possibly would have served as a salient cue alerting the crew to the airplane's intended flight path and allowed the IP to better anticipate its subsequent movement. Without hearing the word "circling," the IP had to infer the circling pattern from the airplane's stated destination of runway 33. Interviews with other The Army Aviation Brigade (TAAB) pilots indicated that they were not very familiar with fixed-wing approaches to runway 33. Although the IP likely knew that airplanes landing on runway 33 approached from the southeast due to the runway's orientation, and although this implied that traffic landing on runway 33 had to cross over Route 4, anticipating this would have required the IP's deliberate thought and attention. The NTSB concludes that, **due to degraded radio reception, the crew of PAT25 did not receive salient information regarding flight 5342's circling approach to runway 33. [FINDING 26]**

Clear and effective communication is essential for safe air traffic control operations and pilot situation awareness. When radio quality is degraded, pilots and controllers can miss important information, and having to repeat control instructions can result in time lost for other safety-critical tasks. Given the importance of clear radio communications and the evidence presented in this accident, in which poor radio reception quality may have affected the PAT25 crew's awareness of flight 5342's position and intentions, the NTSB recommends that the Department of War Policy Board on Federal Aviation **conduct a study to evaluate the quality of radio transmissions and reception for those aircraft operated within the National Airspace System (NAS) to identify factors that degrade communications equipment performance and adversely affect the safety of civilian and military flight operations. [RECOMMENDATION 42]** The NTSB further recommends the Department of War **implement appropriate enhancements, based on the findings of the study recommended in Safety Recommendation [42],to remediate**

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[7] This instance of interference was different from the subsequent 0.8 second mic key that resulted in the PAT25 flight crew not hearing "two five pass behind that."

**identified deficiencies in air-ground radio communications performance. [RECOMMENDATION 43]**

### *Flight Crew Performance*

Visual meteorological conditions prevailed in the DCA area on the night of the accident, and the recorded wind about the time of the accident was from 300° at 14 kts with gusts to 23 kts, with the wind direction varying between 270° and 330°. These wind conditions would constitute a right quartering tailwind for the accident helicopter, which was traveling on a southerly course at the time of the collision. The helicopter's CVR captured several comments between the pilots throughout the accident flight regarding the wind and turbulence. The comments suggested that maintaining helicopter trim, altitude, and heading required the flying pilot's close attention.

During a postaccident simulator observation, investigators asked a current and qualified Army pilot with over 600 hours of flight experience in the UH-60L to retrace the accident helicopter's flight path in conditions programmed to simulate those present on the night of the accident. When asked to rate the workload, he reported that he had insufficient capacity for "easy attention" to additional tasks due to the conditions.

It is likely that the accident pilot, as the pilot flying, was experiencing similar workload during the accident flight and was relying on the IP, as the pilot monitoring, to respond to the controller and look for traffic. The IP's prompt reply to the controller that he had the aircraft in sight likely further reassured the pilot that he had visually acquired the airplane, although there was no discussion between the crew to confirm this.

At the time of the controller's initial traffic advisory to PAT25, four other airplanes were approaching runway 1 for landing, and flight 5342 would have appeared among them when viewed from the helicopter. None of these airplanes would have been discernable from PAT25's position at the time of the initial traffic advisory as anything other than a point of light in the distance. These airplanes were about 3, 7.5 (flight 5342), 11, 15, and 20 statute miles from PAT25. In the investigative hearing, an Army standardization instructor pilot stated that, when he was flying over Cabin John, Maryland, at night when wearing NVGs, he was able to see airplanes "lined up" at the Wilson Bridge, a distance of about 14 miles. He also stated that it was difficult to discern any individual aircraft's sequence in a group of airplanes, because the brightest landing or position light did not necessarily correspond to the closest aircraft. NTSB observations of airplane traffic at DCA from the roof of a building on the southwest Washington, DC, waterfront (near the location where PAT25 received the first traffic advisory) confirmed that investigators were able to see airplanes over 16 miles away when using NVGs. It is likely that the accident IP was able to see at least four, and possibly five, airborne targets on the horizon in the direction of the Wilson Bridge when the controller issued the initial traffic advisory.

The NTSB visibility study determined that these targets would have appeared as lights in a tight cluster near the horizon south of the airport.

During the NTSB NVG observation, investigators found it difficult to determine which of several tightly spaced approaching airplanes was closest to the Wilson Bridge; thus, the IP's task of identifying the "CRJ just south of the Wilson Bridge," would have been challenging. However, despite the ambiguous visual scene at the time, the IP responded almost immediately that he had the traffic in sight and requested visual separation. The speed of the accident IP's reply suggests a rote response that occurred without positively identifying flight 5342. This also seems likely because the IP never pointed out or discussed the traffic with the pilot, despite extensive discussions of other nearby targets earlier in the flight. This issue will be discussed further in section 0. The NTSB concludes that **the PAT25 IP did not positively identify flight 5342 at the time of the initial traffic advisory despite his statement that he had the traffic in sight and his request for visual separation. [FINDING 27]** The NTSB further concludes that, **with several other targets located directly in front of the helicopter represented by points of light with no other features by which to identify aircraft type, and without additional position information from the controller, the IP likely identified the wrong target. [FINDING 28]**

Several other reasons support the plausibility that the IP's response to the initial traffic advisory was automatic and that he likely did not fully realize the implications of the controller's message. First, the IP was busy. In the 47 seconds before the controller's transmission, the IP made a position report to the controller, instructed the pilot to apply additional right pedal, advised the pilot to begin a turn, corrected the pilot's altitude, and called out a nearby obstacle (a crane). Second, at the time of the initial traffic advisory, the IP knew that the airplane was at the Wilson Bridge, a distance that did not pose an immediate conflict. Finally, the IP understood that accepting visual separation was the most efficient means of transitioning the DCA Class B airspace. This factor will be discussed in additional detail in section 0.

The NTSB visibility study indicated that, from the IP's point of view, the airplane would have been visible in the right windshield for most of the 2 minutes before the collision, except for brief periods when it was obscured by aircraft structure, and would have appeared as a small dot of light low on the horizon among an area of bright cultural lighting. As the helicopter neared the approach path of runway 33, the lights of flight 5342 would have appeared in the helicopter's center windshield, outside the IP's NVG field of view when looking straight ahead. Spotting the airplane in the 30 seconds before the collision would have required the IP to turn his head to the left and perform a focused visual search of the sky in the approach area for runway 33. That he did not see the airplane at that time suggests that he did not scan the area in the center windshield, which in turn indicates that it did not occur to him that the airplane might be to his left. In the absence of a focused search in the proper area, it is unlikely that the PAT25 pilots would have spontaneously noticed the airplane because it was outside the NVG field of view in an area of very low visual acuity and would have appeared against a complex background of ground lighting. Further, because the airplane was on a collision course with the helicopter, it would have exhibited little relative motion.

The IP's visual search for traffic was likely hindered by the informational content of the LC controller's second traffic callout. If the controller had provided information about the location of the airplane in relation to the helicopter (for example, "ten o'clock"), the IP would have known where to look; however, the controller merely asked if the PAT25 crew had the "C-R-J in sight."

Review of the helicopter's CVR indicated that the IP did not verbally discuss with the pilot the location of flight 5342 after the controller's initial advisory about 2 minutes before the collision nor after the second call from the controller about 20 seconds before the collision. The helicopter CVR recording suggests that his attention was subsequently focused on coaching the pilot on the use of the rudder pedals to compensate for a quartering tailwind and on monitoring radio conversations between the local controller and two other helicopters. His instruction to the pilot to "kinda come left" following his final interaction with the controller just before the collision occurred reinforces the idea that he believed the "CRJ" referenced by the controller was among the airplanes approaching runway 1; however, he was likely unsure which of those airplanes was the airplane in question. Thus, the IP did not positively identify the location of the airplane and he did not communicate his uncertainty about its location to the pilot.

Information provided by the Army indicated that the accident IP and pilot received aircrew coordination training during Army Helicopter Flight School in 2019 and 2021, respectively. The crew also received annual aircrew coordination training. A TAAB standardization pilot stated that the 2024 aircrew coordination training involved the discussion of several class A mishaps (as defined by the Army, occurrences that are fatal or cause permanent disability or more than $2.5 million in damage) and what each accident crew could have done to improve the situation. Additionally, the accident IP was an aircrew coordination instructor and, according to the B Company safety officer, had provided aircrew coordination training 5 days before the accident.

The Army's *H-60 Series Aircrew Training Manual*, chapter 7, Aircrew Coordination Training, stated that crews "must use clear, concise terms that can be easily understood and complied with in an environment full of distractions," and further defined preferred terms for communicating about traffic. Terms included, "visual" to indicate that a target, traffic or obstacle was seen or identified; "traffic," indicating an aircraft that presented a collision hazard, followed by clock position, distance, and reference to altitude; and "no joy," indicating that a target, traffic or obstacle was not positively seen or identified. As an aircrew coordination training instructor, the accident IP would have been familiar with these terms.

Additional guidance was available in chapter 4, H-60 Crewmember Tasks, which stated that aircrews should "immediately inform other crewmembers of all air traffic or obstacles that pose a threat to the aircraft" using the "clock, altitude, and distance method." Although the IP could have used other methods to point out the airplane to the pilot, he most likely did not do so because he was uncertain about the airplane's position and assumed that it was one of the airplanes in front of the helicopter on approach to runway 1, as evidenced by his lack of a verbal affirmation to the pilot that he had located the airplane.

Another factor that contributed to the PAT25 crew not positively identifying flight 5342 was the lack of an integrated traffic awareness and alerting system in the helicopter that could have provided aural alerts to the crew's headsets and depicted traffic information on an instrument panel display in the pilots' primary field of view as part of their normal instrument scan. Although the crew had the capability to display ADS-B In traffic information on a moving map display on portable tablets using the ForeFlight application, The Army Aviation Brigade (TAAB) pilots told investigators that they did not typically monitor their tablets during low-level operations on the DC helicopter routes because the flying task was too demanding. They also stated that any aural alerts from the device could not be heard because of the high level of ambient noise in the helicopter and because their helmets were not equipped to receive audio from the tablets.

In the absence of an accurate mental model of the airplane's expected flight path to runway 33, the lack of instruction from the controller to direct his visual scan, and without an integrated traffic awareness system, the IP's baseline expectations about traffic flow in the DCA area likely drove his visual search. Aggregated flight tracking data from the FAA showed that, in the year before the accident, only 5–7% of northbound arrivals at DCA had landed on runway 33. Anecdotal statements from other TAAB pilots indicated that some had never encountered an airplane landing on runway 33 while traveling on Route 4.

Thus, the more common flight path for airplanes during a north operation at DCA was, by far, a straight-in approach to runway 1, and the IP's baseline expectation would have been for conflicting traffic to approach from the south for runway 1 (to the right of the helicopter) rather than from the southeast (to the left of the helicopter) for runway 33. The numerous airplanes on approach for runway 1 likely reinforced this expectation, making it likely that the IP considered one of them as the conflicting traffic. This scenario would be consistent with his statement to the pilot just before the collision, "alright kinda come left for me…I think that's why he's asking," because moving left would have increased the helicopter's separation from traffic approaching runway 1.

Expectations drive attention, and people sometimes have difficulty noticing a variance between what they usually see and the actual state of things. When expectations are strong, people tend to seek out and attend to confirmatory visual information while overlooking indications that the current situation is different. This phenomenon, known as expectation bias, not only influences perception in the present, it also influences perception of past events by promoting recollections that conform more closely to typical patterns. Expectation bias is a well-known vulnerability in human performance. In this case, expectation bias likely played a role in the IP's ineffective scan following the controller's traffic callouts. The NTSB concludes that **interference that obscured the controller's "circling to" call, the microphone keying that blocked the PAT25 crew from receiving the instruction to "pass behind," ambiguous visual cues, and the lack of an integrated traffic awareness and alerting system likely reinforced the PAT25 crew's expectation bias that the airplane was among the traffic approaching runway 1 and did not pose a conflict. [FINDING 29]**

It could not be determined whether the PAT25 pilots received specific training addressing DCA runway use and traffic patterns, including fixed-wing approach and departure procedures. However, given the proximity and routine interaction of published helicopter routes with DCA fixed-wing traffic flows, additional airspace-specific training on DCA arrival and departure corridors and runway configurations would likely have improved the PAT25 crew's understanding of the risks inherent in the Army's routine mission-related operations in this environment. Therefore, the NTSB concludes that **the absence of documented training on DCA fixed-wing procedures and the mixed-traffic operating environment represented a safety vulnerability for Army flight crews operating in the DCA Class B airspace. [FINDING 30]** As a result, the NTSB recommends that the US Army **revise training procedures for flight crews assigned to operate in the Washington, DC, area to ensure that they receive initial and recurrent training on fixed-wing operations at DCA, including approach and departure paths, runway configurations, and the interaction of those traffic flows with published helicopter routes. [RECOMMENDATION 34]**

### *Helicopter Altimetry*

Aircraft pitot-static systems and barometric altimeters have defined performance specifications. These include allowable instrument errors, which are tolerances for allowable errors after manufacture and during operation. They also include tolerances for position errors, which are errors caused by external aerodynamic effects from the airflow over the aircraft and (on helicopters) the main rotor downwash. Although cockpit instruments are designed to be accurate, in general it is not feasible to design barometric altimeters to be perfectly accurate in all flight conditions or throughout their entire service life. Older design mechanical barometric altimeters, such as those on the accident helicopter, have multiple types of allowable errors that can accumulate while still remaining within design and performance criteria. Additionally, changes to the aerodynamic shape of the aircraft, such as adding external stores support system (ESSS) tanks, change the pressure effects on the pitot-static system and can increase the position error. Altimeter testing showed that the 100-ft pressure altitude discrepancy seen in the flight data recorder data for the accident flight was observed on three other UH-60L helicopters operated by the 12th Aviation Battalion. These altimeter testing results also showed that the pressure altitude data recorded by the helicopters' FDRs, when corrected for local conditions, was representative of what was indicated on the right side altimeter. Therefore, the FDR pressure altitude data for the accident helicopter, when corrected for local conditions, was likely representative of what was indicated on the IP's barometric altimeter during the accident flight.

The allowable tolerances are additive, with the total error having the potential of exceeding 100 ft. These tolerances are not unique to military aircraft; they apply to civil aircraft as well. While a difference of 100 ft would have little consequence at higher altitudes, given the low altitudes prescribed along portions of the DC helicopter routes and Army procedures that stated that flight should be conducted no lower than 100 ft agl, such a discrepancy resulted in the increased likelihood of altitude exceedances along these routes.

Although the instrument error specific to the accident helicopter could not be determined, disassembly and examination of the internal components did not reveal any anomalous wear that would have prevented normal operation. Additionally, the CVR recording did not capture any conversations between the flight crew regarding any malfunction of the barometric altimeters during the accident flight. It is likely that the behavior of the accident helicopter's static system position error and barometric altimeter instrument error were similar to that observed on other 12th Aviation Battalion UH-60L helicopters. The NTSB concludes that, **due to additive allowable tolerances of the helicopter's pitot-static/altimeter system, it is likely that the crew of PAT25 observed a barometric altimeter altitude about 100 ft lower than the helicopter's true altitude, resulting in the crew erroneously believing that they were under the published maximum altitude for Route 4. [FINDING 31]**

The accident helicopter's FDR should have contained a radio keying parameter; however, these data were not present on the accident helicopter's recorder. The radio keying parameter is needed to synchronize timing between the FDR and CVR, and accurate parametric data from the FDR is crucial for accident investigation purposes as well as for flight operations quality assurance (FOQA) programs used to support a safety management system (SMS). The investigation found that after the initial installation of the helicopter's FDR, there was no scheduled recurrent task to verify the continued accuracy of the recorded data. FAA Advisory Circular (AC) 20-141B recommends that operators of aircraft equipped with a digital FDR perform a "reasonableness check" at an interval not to exceed 18 months (FAA, 2010). The NTSB concludes that **a recurrent task to verify the continued accuracy of recorded flight data for US Army aircraft would help ensure the data integrity needed to support quality assurance and safety programs and accident investigations. [FINDING 32]** Therefore, the NTSB recommends that the US Army **develop and implement a recurring procedure, at an interval not to exceed 18**

**months, to verify the continued accuracy of recorded flight data. [RECOMMENDATION 35]**

The Washington, DC, helicopter route altitudes, particularly the low altitudes specified for Routes 1 and 4 in the vicinity of DCA, did not account for the errors inherent to barometric altimeters, nor did they account for human error tolerances—both Army standards and FAA commercial pilot standards require pilots to maintain altitude within ±100 ft while in flight. Review of aggregated aircraft flight track information for helicopters on the DC helicopter routes from January 1, 2024, through January 30, 2025, indicated that helicopters regularly exceeded published maximum route altitudes. For the northern segment of Route 4, which included the area of the collision, of the 523 flights analyzed, 260 flights (49%) were identified as exceeding route altitude limitations at some point during the flight. Had the error tolerances of barometric altimeters been considered during design of the helicopter route maximum altitudes, the incompatibility of a 200-ft ceiling and barometric altimeter errors may have been identified. Although the data did not attribute an exact number or rate of altitude exceedances specifically to Army helicopters, the data indicated that military users comprised about 79% of the helicopter flight track data; therefore, it is reasonable to assume that at least some Army helicopters were exceeding maximum route altitudes. The NTSB concludes that **the FAA and the Army failed to identify the incompatibility between the helicopter routes' low maximum altitudes and the error tolerances of barometric altimeters, which contributed to helicopters regularly flying higher than published maximum altitudes and potentially crossing into the runway 33 glidepath. [FINDING 33]**

Despite helicopter manufacturer flight testing that showed increased barometric altimeter position errors with the ESSS installed, the Army's UH-60L operator's manual did not contain an altimeter correction chart for the ESSS configuration. The lack of this information in the operator's manual would result in UH-60L pilots being unaware that the ESSS could result in a greater-than-anticipated position error in flight. Neither maintenance checks nor the pilot's preflight check against local field elevation would detect this error, as these checks are not performed with the helicopter's main rotor turning.

The US Army issued Standardization Communication message 25-02 to inform pilots of the potential for increased position error in UH-60 helicopters equipped with ESSS.[8] This message included instructions to maintain a minus 50-ft margin when flying with a clearance with a maximum altitude to ensure the maximum altitude is not exceeded. However, at the time of this report, the US Army has not incorporated information into the UH-60 series operator's manuals to inform pilots of the increased position error with the ESSS configuration. The NTSB concludes that **pilots need all available information on the potential total error, allowed by design, that could**

[8] The message was signed by the Director of the US Army Aviation Center of Excellence's Evaluation and Standardization Directorate on August 5, 2025.

**occur in flight on an airworthy barometric altimeter. [FINDING 34]** Therefore, the NTSB recommends that the US Army **incorporate information within the appropriate operator's manual for all applicable aircraft on the potential total error allowed by design that could occur in flight on an otherwise airworthy barometric altimeter, including the increased position error associated with the ESSS configuration. [RECOMMENDATION 36]**

### *Helicopter Transponder*

Postaccident examination of the helicopter's transponder revealed that it was transmitting the incorrect aircraft address during the accident flight due to a broken solder connection, which was the result of an incomplete bond at the time of the unit's manufacture. This incorrect address was not a factor in the accident flight, because no other aircraft in the geographic area was transmitting an identical address, but it could pose a safety risk if two aircraft in the same vicinity were to broadcast the same address.[9] The examination also revealed that the transponder Automatic Dependent Surveillance – Broadcast (ADS-B) squitter was off and the time source was incorrectly set, which prevented the transponder from broadcasting ADS-B Out. Given that there was no historical ADS-B data for the accident helicopter following the installation of the transponder in April 2023, it is likely that either the squitter or time source setting, or both, were incorrectly set at the time of installation. A functional check of the transponder that was required after its installation should have detected that ADS-B Out was not broadcasting. Therefore, the NTSB concludes that **the Army's post-installation functional check of the transponder on the accident helicopter was insufficient to detect that it was not broadcasting ADS-B Out. [FINDING 35]** Inspection of other helicopters from the 12th Aviation Battalion found incorrect time source settings on several aircraft equipped with APX-123A transponders, resulting in the Army directing a one-time inspection of transponders to verify ADS-B Out functionality. It could not be determined how or why the time source setting was changed following installation of the transponders. At the time of the accident, the Army had no established recurrent procedure for verifying transponder ADS-B functionality or confirming that it was transmitting the correct address. The NTSB concludes that **the Army's lack of a recurrent transponder inspection procedure resulted in the incorrect aircraft address being transmitted by the accident helicopter's transponder, and the incorrect ADS-B settings on several other helicopters being undetected. [FINDING 36]** As of the date of this report, the Army has not yet developed a recurring procedure for this task, and it is possible that future ADS-B Out or aircraft address issues could go undetected. Therefore, the NTSB recommends that the US Army **develop and implement a transponder inspection procedure on all aircraft with transponders capable of transmitting Mode S and ADS-B and operated in the NAS, at least annually and upon each aircraft's entry into service in the NAS, that ensures**

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[9] Although there is a very low probability that two aircraft in the same geographical vicinity and covered by the same radar may broadcast the same aircraft address, the scenario is not impossible.

**1) the transponder ADS-B settings are correct,**

**2) the transponder is transmitting ADS-B, and**

**3) the transponder is transmitting the correctly assigned address. [RECOMMENDATION 37]**

Additionally, the NTSB concludes that, **because the APX-123A transponder is designed for use on multiple aircraft platforms, it is possible that incorrect settings may be present on other aircraft used throughout the Department of War armed services. [FINDING 37]** Therefore, the NTSB recommends that **the** Department of War Policy Board on Federal Aviation **require the Department of War to verify on all aircraft with transponders capable of transmitting Mode S and ADS-B and operated in the NAS, at least annually and upon each aircraft's entry into service in the NAS, that**

**1) the transponder ADS-B settings are correct,**

**2) the transponder is transmitting ADS-B, and**

**3) the transponder is transmitting the correctly assigned address. [RECOMMENDATION 44]**

## Flight 5342 Operations

FDR and CVR information from the airplane indicated that the airplane's control columns rapidly moved aft and the crew indicated surprise and alarm about 1 second before the impact; these actions are consistent with the crew of flight 5342 not detecting the helicopter until it was too late to avoid a collision. The limitations of see-and-avoid, discussed in section 0, likely explain the crew's late detection. Factors particularly relevant in this case include a complex background of dense cultural lighting behind the helicopter until about 10 seconds before impact, which would have made the helicopter's external lighting inconspicuous, and the helicopter's minimal relative motion in the flight 5342 crew's field of view, which also would have made it difficult to spot. The crew's moderate to high workload during the final stage of the circling approach, as shown in simulator studies conducted as part of this investigation, likely also reduced the odds of the flight crew detecting the helicopter.

The CVR recording indicated that the crew did not verbally communicate about the traffic alert and collision avoidance system (TCAS) traffic advisory (TA) they received 19.2 seconds before the collision. Guidance provided by PSA Airlines did not specify standard callouts pilots were required to make in response to a TA. PSA's *Flight Operations Manual (FOM)* stated that, upon receiving a TA, a crew should "attempt to see the reported traffic" and "should not maneuver based on a TA alone." The *FOM* referred to FAA AC 120-55, which contained guidance indicating that crews should "respond to TAs by attempting to establish visual contact with the intruder aircraft and other aircraft which may be in the vicinity." The AC also included the statement, "coordinate to the degree possible with other crewmembers to assist in searching for traffic. Do not deviate from an assigned clearance based only on TA information." Thus, crew members were advised to search for the conflicting traffic and coordinate with each other as workload allowed, but were not permitted to maneuver in response to a TA without seeing a target that posed a collision risk.

The TA aural alert activated when the airplane was 1.05 nm from the helicopter and as the captain was turning the airplane left to align it with the runway 33 final approach path about 450 ft radio altitude. Simulator observations with current and qualified PSA CRJ pilots indicated that this was a visually demanding task that required the captain to control the airplane's lateral path, thrust, airspeed, and glidepath (as indicated by the precision approach path indicator or PAPI). It is unlikely that he had spare capacity to perform an extensive visual search for traffic at this time. The FO was also performing visually demanding tasks, such as monitoring the airplane's lateral alignment, glidepath, and energy state to ensure that the approach remained stable, and monitoring the position of an airplane that had been cleared for takeoff on runway 1 to ensure that it would not pose a conflict. That airplane was still on or near the surface of the runway at the time the TA occurred, and it did not cross the centerline of runway 33 (thus no longer posing a conflict) until 4 seconds after the TA. The FO also would have been required to adjust the airspeed indicator bug for the airplane's final approach speed as soon as the captain had aligned the airplane with the runway. Thus, both pilots were busy and had limited opportunity to search for traffic in response to the TA.

If, despite this workload, the FO had promptly reacted to the TA, it is likely that he would have glanced at the multifunction display (which was set to show traffic within a 5 nm radius) to determine the traffic's location. This would have revealed a traffic icon 1 nm mile in front of the airplane at a relative altitude of -200 feet. He would then have looked directly in front of the airplane. For 9 seconds after the TA occurred, the helicopter was surrounded by, and likely indistinguishable from, a dense array of both steady and flashing lights that stretched along the horizon to the right of the airport. Given the complexity of this background and the helicopter's lack of apparent motion when viewed from the airplane, it is likely that the FO would have been unable to spot it during a brief search. Even if the crew was unsuccessful in visually locating the helicopter, they were trained not to maneuver unless they received an resolution advisory (RA). Many of the PSA pilots interviewed were unaware of the altitude below which RAs were inhibited.

It is also possible that the radio transmissions audible to the flight crew reduced the extent of their visual search for the helicopter. Although the crew could not hear PAT25's transmissions to the controller, they could hear the controller's transmissions to the helicopter. These transmissions would have been reassuring if the crew heard them and recognized their airplane as the "CRJ" being referenced. One second before they received the TA aural alert, they would have heard the LC controller transmit, “PAT two five you got the C-R-J in sight?” followed by, “PAT two five pass behind the C-R-J.” A few seconds later, they would have heard the LC controller transmit “vis sep.” The crew of flight 5342 undoubtedly understood the terminology associated with approving visual separation. Thus, these transmissions (if listened to) would have indicated to the crew that the helicopter had their airplane in sight and intended to avoid them. The fact that the controller did not issue them any advisories or instructions would also have been reassuring, because it would have indicated that the responsibility for deconfliction had been assigned to the helicopter. If heard and attended to, the radio communications audible to the flight 5342 crew could have reassured them that the helicopter was not a significant threat and that they could focus their attention on completing their approach and landing. However, because the CVR did not contain any discussions between the crew about these transmissions or the potential of a conflict with the helicopter, their level of awareness of the transmissions and their involvement in the traffic conflict could not be determined.

The NTSB concludes that **the crew of flight 5342 did not see the helicopter until it was too late to avoid a collision because of the high workload imposed during the final phase of their approach, and due to the helicopter’s low conspicuity and lack of apparent motion. [FINDING 38]**

## DCA Air Traffic Control Tower Facility

### Traffic Management, Volume, and Flow

Postaccident interviews and investigative hearing testimony provided by DCA ATCT and Potomac terminal radar approach control (TRACON) personnel, as well as FAA Air Traffic Organization (ATO) leadership, indicated that managing the flow of traffic at DCA had been a longstanding challenge that could be attributed to several factors, one of which was DCA’s airport arrival rate (AAR).

Potomac TRACON and DCA ATCT personnel stated in interviews and investigative hearing testimony that managing the rate of arrivals into DCA while providing adequate MIT spacing between arriving aircraft was a continual issue. Potomac TRACON and DCA ATCT had agreed that aircraft would arrive at the runway threshold at DCA with a spacing of 4 miles in trail (MIT); however, the FAA found through a systematic review conducted after the accident that DCA ATCT controllers were provided with less than 4 MIT about 40% of the time. This spacing was critical because it allowed adequate time for departures to take place between arriving aircraft, thereby reducing backups on DCA’s limited taxiway surface area.

In 2023, Potomac TRACON requested a decrease to the existing AARs due to changes to the mix of aircraft types serving DCA over the previous decade, flight schedule increases that did not allow for use of reduced separation of aircraft on final approach, airspace and weather constraints, and an inability to regulate traffic flow based on time, also referred to as "metering." The Potomac TRACON air traffic manager (ATM) stated in postaccident interviews that the request to reduce DCA's AARs was not forwarded to higher levels because it was "too political." The FAA's denial of the documented request to change the AAR at DCA without feedback to the requester effectively eliminated what could have been an important operational safety improvement and violated their established review process.

Another factor that DCA ATCT controllers cited as contributing to traffic complexity was that airlines often grouped their allotted departures or arrivals for a given 2-hour period into the last 30 minutes of the first hour and the first 30 minutes of the second hour rather than spreading them evenly throughout the hour, which resulted in times of "compacted demand" on controllers to accommodate traffic surges. The NTSB concludes that **times of compacted demand as a result of air carrier scheduling practices increased operational complexity and required mitigations by controllers to maintain spacing and surface movement. [FINDING 39]** Other airports, including New York's LaGuardia Airport, have mitigations in place to prevent this practice through federal regulations contained in 14 *CFR 93* Subpart K, which prescribes air traffic rules for aircraft operating to and from high density traffic airports. The regulation specifies the number of operations that can occur during any 30-minute period or any two consecutive 30-minute periods. In order to alleviate the effects of compacted demand at DCA, the NTSB recommends that the FAA **initiate rulemaking in 14 *CFR* Part 93 Subpart K, High Density Traffic Airports, that prescribes air carrier operation limitations at DCA in 30-minute periods, similar to those imposed at LaGuardia Airport, to ensure that the airport does not exceed capacity and to mitigate inconsistent air carrier scheduling practices. [RECOMMENDATION 4]**

A time-based flow management (TBFM), or metering, system had been in place at Potomac TRACON for at least 10 years before the accident and controllers had been trained in its use; however, the system was never activated. The core function of TBFM is the ability to schedule aircraft to reach a defined point at a specified time, creating a time-ordered sequence of traffic.

According to testimony provided in the investigative hearing by the FAA's Washington District traffic management officer, TBFM would allow for better management of the compacted demand at DCA. A representative of American Airlines testified that TBFM was in use at several of the airline's other hub airports and that it "smooths out the volume" of traffic while providing more accurate MIT. Information provided by the FAA indicated that, as of February 2025, the TBFM project at Potomac TRACON was on hold until further notice due to budget constraints. A manager at Potomac TRACON testified that they had "not seen it yet, and it is supposed to come in March of [20]26."

In interviews with DCA ATCT personnel, as well as review of ATC audio and personal observation by investigators, "offloading" arrivals to another runway was common practice at DCA to build spacing between aircraft, particularly during times of heavier traffic flow and when the airport was in a north configuration (airplanes landing on runway 1).

The DCA ATCT operations manager at the time of the accident stated that controllers routinely offloaded traffic on approach to runway 1 by having them circle to runway 33. Although other methods were available to DCA controllers to build additional spacing between aircraft, the operations manager stated that offloading traffic to runway 33 was a preferred mitigation at DCA ATCT because it continued the flow of arrivals and departures during compacted demand times.[10] In contrast, having an airplane decrease airspeed on final approach to increase separation would cause traffic buildup behind that aircraft that would also affect Potomac TRACON.

Many of the factors that contributed to DCA's uniquely complex traffic situation were present on the night of the accident and contributed to high controller workload. The LC controller stated in a postaccident interview that a traffic "push," or compacted demand, had begun about 2000 that night, but he believed that traffic was decreasing around the time of the accident. He also stated that the tower "wasn't getting spacing on final" at the time of the accident, referring to the 4 MIT agreement with Potomac TRACON. Further, he had traffic on the ground waiting to depart. As a result, he was asking pilots of aircraft inbound for landing whether they could switch to runway 33 as a means of increasing space between arrivals to allow for departures. The NTSB concludes that **DCA ATCT routinely received less than the requested miles in trail spacing from Potomac TRACON, which increased controller workload by requiring them to generate additional spacing to prevent delays or gridlock. [FINDING 40]** The NTSB also concludes that **the practice of "offloading" arrival traffic on approach to runway 1 by asking pilots if they could accept a circling approach to runway 33 was a routine mitigation strategy for DCA controllers to generate spacing that was not provided by Potomac TRACON. [FINDING 41]** The NTSB further concludes that **TBFM, or metering, would provide Potomac TRACON and DCA ATCT with a consistent flow of traffic with more accurate spacing and greater predictability, thereby reducing controller workload. [FINDING42]**

The NTSB recognizes that, according to the FAA, Potomac TRACON began limited operational use of TBFM in October 2025; however, TBFM had not yet been implemented at the Potomac TRACON or the DCA ATCT at the time of the accident, and full implementation and operational use of TBFM in both facilities is expected by March 2026. Therefore, the NTSB recommends that the FAA **fully implement operational use of the TBFM system at Potomac TRACON and its associated air traffic control towers. [RECOMMENDATION 5]** The NTSB also recognizes that FAA also made a temporary adjustment to the AAR following this accident, which remains

[10] During the NTSB's investigative hearing, the ATO's acting deputy COO testified that other methods included slowing aircraft after check-in on final approach, instructing aircraft to perform S-turns on final approach, and "demand[]" that Potomac TRACON provide a certain MIT interval between aircraft, if needed.

in effect as of the date of this report. In order to fully address the traffic management, volume, and flow issues in the DCA airspace, the NTSB recommends that the FAA **reassess the DCA AAR with special consideration to its airspace complexity, airfield limitations, mixed-fleet operations, and traffic volume. [RECOMMENDATION 6]**

The NTSB is concerned also that the spacing issue observed in this accident may exist elsewhere in the NAS. Therefore, the NTSB also recommends the FAA **require each Class B or Class C ATCT facility to evaluate its existing MIT procedures or agreements to ensure that the spacing provided is appropriate for operational safety, and make the results publicly available. [RECOMMENDATION 7]**

During the course of the investigation, the NTSB learned that the DCA ATCT had been downgraded from a level 10 facility to a level 9 facility in 2018. Facility level is a factor that determines controller compensation, and controllers stated that the downgrade at DCA ATCT impacted employee morale and resulted in the loss of experienced controllers, who left for higher paying facilities. Despite several requests from the NTSB during this investigation, the FAA did not provide documentation of the criteria or formula it used in its determination to downgrade DCA ATCT's facility level.

The NTSB is concerned about the impacts of the downgrade on the DCA ATCT's long-term facility health and by the FAA's lack of transparency regarding the metrics used to define facility levels throughout the NAS. Although the DCA ATCT's facility level downgrade could not be directly correlated to the circumstances of this accident, the NTSB concludes that **DCA ATCT has significant airspace, airfield, mixed fleet, and operations complexities that appear to be inconsistent with its current facility level classification. [FINDING 43]** Therefore, the NTSB recommends that the FAA **define objective criteria for the determination of air traffic facility levels considering traffic and airspace volume, operational factors unique to each facility, and cost of living. [RECOMMENDATION 8]** Using this criteria, **determine whether the classification of the DCA ATCT as a level 9 facility appropriately reflects the complexity of its operations. [RECOMMENDATION 9]**

## Visual Separation

The FAA's Pilot-Controller Glossary states that visual separation is a means employed by ATC to separate aircraft in terminal areas and enroute airspace in the NAS. In the terminal, or airport, area, visual separation can be either tower-applied, in which the tower controller sees the aircraft involved and issues instructions to effect separation; or pilot-applied, in which a pilot sees the other aircraft involved and provides their own separation by maneuvering as necessary to avoid it. Visual separation does not require a certain minimum separation distance between aircraft; therefore, pilots are permitted to determine their own spacing. In the absence of visual separation at DCA, Class B radar separation minimums would apply, which require 1 1/2 mile lateral or 500 ft vertical distance between IFR (airplane) and VFR (helicopter) traffic.

Postaccident interviews with controllers and testimony provided in the NTSB investigative hearing revealed that visual separation was the primary means of separating helicopter and fixed-wing traffic in the DCA area when weather conditions permitted. One controller testified that the use of visual separation was "paramount" to efficient operations at DCA given the volume of traffic and the complexity of the airspace. Due to the proximity of the helicopter routes and zones to the approach and departure corridors for fixed-wing traffic, applying standard Class B separation minimums at all times would likely require controllers to frequently issue holds to helicopter traffic and, depending on traffic priority, could also result in controllers frequently issuing go-around instructions to fixed-wing traffic, all of which would increase controller workload and contribute to additional airspace congestion and traffic complexity. To avoid these difficulties, controllers were motivated to provide a traffic advisory and authorize visual separation for helicopters transiting DC airspace as early as possible, and interviews with controllers indicated that this practice had become the norm.

Previous external compliance verifications (ECVs) at the DCA ATCT identified issues such as shortcutting standard phraseology, instances in which the HC position was combined or de-combined without required documentation in the facility logs, and occurrences in which helicopters flew in close proximity to arriving fixed-wing aircraft and traffic information was not issued to either aircraft. The team also observed occasions where fixedwing traffic was not advised regarding helicopters operating in close proximity to the final approach course.-wing traffic was not advised regarding helicopters operating in close proximity to the final approach course.

During a November 2024 ECV, the ECV team noted "a few occurrences" in which the LC controller advised aircraft on final approach that helicopters operating near the final approach course had them in sight and were maintaining visual separation. However, at the time these transmissions were made, the helicopter had not reported the traffic in sight and had not been advised to maintain visual separation. The LC controller appeared to be anticipating that the helicopters would visually acquire the arrival traffic, report traffic in sight, and then be instructed to maintain visual separation.

A retired FAA air traffic specialist who was subsequently employed as a contractor to perform ECVs at DCA ATCT stated that, during his 9 months at the facility, he had concerns about potential conflicts with the helicopter routes, which he raised to the ATM at the time.

In the NTSB's investigative hearing, the DCA ATCT operations manager (OM) at the time of the accident stated that the controllers at DCA would "just make it work" by utilizing all available tools to compensate for the traffic volume.

Because DCA was a high volume, complex airport with "not a lot of real estate," controllers had to "keep things moving" in order to provide safe and efficient service. He stated that this "make it work" mentality had become normalized at DCA ATCT before the accident and that, "it can be taxing on a person…constantly having to give, give, or push, push, push in order to efficiently move traffic." He further stated that, "Whenever the controllers at DCA just make it work, they are going above and beyond to approach the limit of the rules and regulations. They're pushing the limits of what can be done to safely and efficiently move the aircraft and/or helicopters at DCA…you're pushing the line."

The issues identified by previous ECVs at DCA should have served as symptoms of a controller workforce under constant pressure to "make it work." Controllers relied on the use of pilot-applied visual separation in order to accommodate helicopters operating on the routes and zones while moving a high volume of aircraft through complex airspace into and out of an airport with limited surface area. The NTSB concludes that **the FAA ATO failed to recognize ECV results as indicators of systemic traffic management, volume, and flow issues at DCA for which controllers were required to compensate. [FINDING 44]**

Interviews and testimony from helicopter operators in the DCA area indicated widespread understanding that visual separation allowed more efficient traffic flow and that requesting and receiving approval for visual separation was normal practice. Helicopter operators reported receiving traffic advisories at distances that made it difficult to identify specific targets. Nevertheless, they were generally comfortable using pilot-applied visual separation, particularly on clear nights and when using NVGs, which allowed aircraft lights to be seen from long distances.

The expectation that helicopter crews would maximize use of visual separation to facilitate traffic flow likely promoted a pattern of automatic responses when flight crews received traffic advisories. An Army standardization instructor pilot stated in a postaccident interview that he sometimes responded to traffic advisories before visually acquiring the traffic if he knew that it was far away and was not an imminent threat. The accident IP's significant experience flying on the DC helicopter routes and the speed of his reply to the controller's traffic advisory support the likelihood that he had also developed this habit. This practice was contrary to FAA requirements that a crew should visually identify aircraft before requesting visual separation.

The acceptance of a gap between typical operating practices and formal operating requirements has been described as normalization of deviance. Coined after the Space Shuttle Challenger disaster in 1986, "normalization of deviance" refers to the gradual shift away from standards or acceptable practices (Vaughan 1996).

Such deviations originate from frontline personnel trying to manage conflicting goals, such as maximizing production, protection, and minimizing workload (Rasmussen, 1999). When such gaps develop, they can become incrementally larger if they persist without negative consequences, and this can lead to systemic safety vulnerabilities.

In this case, controller expectations that a helicopter crew would have a specific aircraft in sight before requesting and receiving approval for visual separation were not necessarily valid. As a result, there was potential for controllers to overestimate the level of traffic awareness a helicopter crew had, following a traffic advisory, and to underestimate the level of information and assistance they might subsequently require to ensure collision avoidance.

The NTSB concludes that **the longstanding practice of relying on pilot-applied visual separation (see-and-avoid) as the principal means of separating helicopter and fixed-wing traffic in the Washington, DC, area by DCA tower, the Army, and other helicopter operators led to a drift in operating practices among controllers and helicopter crews that increased the likelihood of a midair collision. [FINDING 45]**

There are inherent limitations to seeing and avoiding other airborne traffic. These include the limited field of view from the cockpit, including the obscuring effects of aircraft structures or, in this accident, the limited field of view provided by NVGs. Even the positioning of aircraft in a pilot's field of view near the cockpit structure reduces the odds of detection due to the effect of nearby objects on visual accommodation (Chong and Triggs 1989).

In this accident, both aircraft were located adjacent to or within a field of background lights when viewed from the other's perspective. Aircraft superimposed on or adjacent to complex backgrounds are more difficult to detect (Steedman and Baker 1960). Although aircraft lighting may improve the conspicuity of aircraft flying at night, the effect of a complex background of ground lighting may offset the advantages of such lighting. An Army standardization instructor pilot testified during the investigative hearing that, although it was easy to identify airplanes on approach to runway 1, it would be much more difficult to maintain visual contact with an airplane circling for runway 33, particularly as the helicopter descended to 200 ft. He also testified to the challenges inherent to NVG use, including the limited field of view and the difficulty in identifying aircraft operating near or below the horizon against dense cultural lighting.

Attentional limitations also play a role. Research indicates that fixed-wing pilots spend, on average, 30% to 35% of their time scanning outside, and even less time when engaged in tasks that demand their attention inside the cockpit (Wickens et al. 2001). When pilots do scan outside for traffic, they are biased toward the area directly in front of them, or toward outside features most pertinent to their current task (Colvin et al. 2005). Aircraft on a collision course lack relative motion in a pilot's field of view, which makes them less likely to attract visual attention because peripheral vision is more sensitive to motion than fine detail (Gibb et al. 2010).

These and other factors contribute to delays in detection that can lead to a midair collision when crews are visually self-separating. Research involving actual test flights indicates that most unalerted visual acquisitions of conflicting aircraft occur after two aircraft have closed to within 1 to 2 nm of each other. Mathematical modeling of the probability of visual acquisition based on these studies has indicated that, for a closure rate of 120 kts, the probability of detecting an intruder aircraft in the daytime does not reach 85% until 12 seconds before a collision (Andrews 1991). In this accident, CVR and FDR data indicate that the crew of flight 5342 detected the helicopter about 1 second before the collision, and that the crew of PAT25 had no awareness of the impending collision.

The NTSB has highlighted the limitations of see-and-avoid in previous investigations and argued that these limitations cannot be overcome by recommending greater pilot diligence and scanning for traffic. Traffic awareness and alerting technologies with aural alerts, however, can significantly improve detection and reaction times (Andrews 1991). This underscores the importance of such technology in airspace with a high concentration of commercial air traffic.

This accident, in which neither the crew of PAT25 nor the crew of flight 5342 detected each other in time to avoid a collision, amplifies the serious inherent limitations of the see-and-avoid concept, a primary means of separation between helicopters and commercial airplanes at DCA. The NTSB concludes that **reliance on pilot-applied visual separation (see-and-avoid) as a primary means of separating mixed traffic introduced unacceptable risk to the DCA Class B airspace. [FINDING 46]**

Although this accident occurred in the uniquely complex DCA Class B airspace, the underlying limitations of pilot-applied visual separation are inherent to human performance and are present wherever see-and-avoid is used as a means of aircraft separation in the NAS. Because controllers nationwide routinely apply visual separation in mixed-traffic environments, mitigating this risk requires consistent, systemwide training that emphasizes the limitations of see-and-avoid and the conditions under which its use may introduce unacceptable risk. Therefore, the NTSB recommends the FAA **develop a new and comprehensive instructor-led, scenario-based training on the proper use of visual separation, both tower- and pilot-applied. This training should include information on the inherent limitations of see and avoid, responsibilities when applying visual separation, and guidance for controllers on factors, such as current traffic volume, workload, weather or environmental factors, experience, and staffing, that should be considered when applying visual separation. Require this training for all controllers and include on a recurrent basis thereafter in annual simulator refresher training. [RECOMMENDATION 10]**

## Radio Frequency Management

The DCA air traffic control tower utilized a discrete frequency for communicating with helicopters to avoid interference and frequency congestion. When the HC and LC positions were combined, it was normal practice to keep helicopters on their own frequency rather than directing all traffic to use the same frequency. This also made the process of de-combining the helicopter and local control positions easier. When the HC and LC positions were combined, all pilots could hear all transmissions made by the controller; however, the use of separate frequencies meant that transmissions made from helicopters were not audible to airplanes and transmissions made from airplanes were not audible to helicopters. Pilots indicated that there were advantages and disadvantages to this practice. The advantages included reducing non-pertinent transmissions that could impede communication between crewmembers and alleviating frequency congestion; however, pilots reported that being able to hear transmissions from all other aircraft would be an asset to flight crew situation awareness. Had the accident crews been able to hear each other's transmissions to the controller, PAT25 would have heard flight 5342's acceptance of the runway 33 circling approach and their subsequent readback of the landing clearance. Flight 5342 would have heard PAT25's position report at the Memorial Bridge. These transmissions contained additional salient information regarding each aircraft's position and intentions, which may have increased the crews' awareness of the potential for a traffic conflict. The NTSB concludes that **DCA tower's procedure of maintaining a discrete helicopter frequency when the local and helicopter control positions were combined decreased overall situation awareness for pilots operating in the area. [FINDING 47]** Therefore, the NTSB recommends the FAA **conduct a comprehensive evaluation, in conjunction with local operators, to determine the overall safety benefits and risks to requiring all aircraft to use the same frequency when the helicopter and local positions are combined in the DCA ATCT. [RECOMMENDATION 11]**

The very high frequency (VHF) radio communications used by air traffic control do not allow for simultaneous transmissions. If a pilot or controller attempts to broadcast on the same frequency at the same time as another pilot, one or both transmissions may be garbled, incomplete, or blocked from reception entirely. This leads to missed control instructions, lack of clarity, loss of situation awareness, or readback errors; however, there is currently no system in use that allows controllers to know when a simultaneous broadcast has occurred.

Review of the helicopter's CVR indicated that the controller's instruction 17 seconds before the collision, which stated, "PAT two five pass behind that C-R-J," was interrupted by a 0.8-second microphone key from one of the helicopter crewmembers, which resulted in much of the transmission being interrupted, and the crew did not receive the instruction to "pass behind."

In 1984, the FAA was petitioned to enact rulemaking requiring two-way radio communication systems employing anti-blocking and stuck microphone protection circuitry. In response, the FAA issued Technical Standard Order (TSO) C128, which provided standards for preventing blocked channels used in two-way radio communications due to unintentional transmissions, and TSO C122, which provides standards for equipment designed to prevent blocked channels in two-way radio communications caused by simultaneous transmissions. TSO-C128 and its subsequent revision has proven effective and popular with VHF radio manufacturers; however, only one manufacturer had been issued a letter of TSO design approval under TSO-C122 since its original issuance in 1994. In June 2012, the FAA issued a Notice of Intent to Cancel C122a, the current revision, citing the lack of design approvals and "the eventual obsolescence of TSO-C122a equipment"; however, the FAA has not finalized the cancellation of the TSO. In July 2025, citing the circumstances of this accident, the FAA announced that it was withdrawing its previous intent to cancel TSO-C122a and was reopening the associated comment period. The FAA stated that it welcomed comments on whether TSO-C122a and the standard it references, RTCA/DO-209, are obsolete, as well as input to identify current technologies that may have replaced these standards.

The NTSB recognizes that implementing same-frequency communications for airplanes and helicopters in a high traffic volume area such as DCA increases the risk of simultaneous radio transmissions that prevent critical information from being transmitted or received by both pilots and controllers. Therefore, the NTSB recommends that the FAA **implement anti-blocking technology that will alert controllers and/or flight crews to potentially blocked transmissions when simultaneous broadcasting occurs. [RECOMMENDATION 12]**

## Conflict Alert System

The conflict alert system is designed to draw the controller's attention to a potential conflict and is presented in three ways, an aural alert, a flashing conflict alert "(CA)" on the display, and a conflict list on the display, which indicates in red the aircraft involved. The activation criteria comprises three algorithms that each detect conflicts independently, sensing potential linear, maneuver, and proximity conflicts. Some of these logics predict where the aircraft is going, while others consider where the aircraft is located at that time; however, the CA presented to the controller is the same regardless of which algorithm is activated. This requires the controller to identify and interpret the severity of the conflict and evaluate the action they should take based on other available information. Interviews with DCA ATCT personnel indicated that CAs were heard "often" and were "pretty common" at DCA. In the 30 minutes before the accident occurred, the conflict alert could be heard in the background during 18 controller transmissions.[11] Controllers reported that they often

[11] As previously noted in section 1.7.8.4, these instances did not necessarily represent 18 distinct CA activations. Review of available radar display replay data for the final 18 minutes before the accident identified five separate CA activations, several of which persisted long enough to be audible across multiple transmissions.

received CAs for non-conflicts, such as when aircraft were on diverging paths, or that the CA would continue to activate even after the controller had taken action to mitigate the conflict. In this accident, the controller responded about 6 seconds after the alert activated. There was a slight delay in the LC controller's response, as he was completing a transmission with another helicopter when the CA activated, and he did not query PAT25 until after the other helicopter had responded.

Allendoerfer et al. (2007) analyzed 607 CAs from 5 enroute and 17 terminal ATC facilities and categorized controller responses to the alerts and the timing of the responses. Their research indicated that the majority of CAs (44% in the terminal area) received no response from controllers; many are so brief that controllers have resolved the situation before the alert activated, or that the situation resolved itself without any controller input. They noted that no operational errors nor deviations occurred in these instances. Alerts that activate and require no controller action may increase workload, as the alert directs the controller's attention away from their current tasks and toward the aircraft involved in the alerting event. Of the alert situations where controllers acted, they most often acted before the alert activated (67% of the time). This suggests that, while many alerts are valid according to the alert algorithms, they do not provide useful information to controllers; that nuisance alerts are common (81–87% of CAs are estimated to be nuisance alerts); and that high nuisance alert rates may desensitize controllers and lead to poor responses to critical alerts.

The current system displays all CAs in the same manner regardless of the algorithm that triggered the alert. In the absence of any salient information conveying the severity of the conflict, controllers must make their own determination regarding whether the conflict alert requires immediate action, thus increasing cognitive load. The FAA's Human-Systems Integration Branch manager stated during the NTSB's investigative hearing that improvements are available to the CA software that could provide color coding or various aural alerts depending on which of the three conflict alert algorithms was activated. The NTSB concludes that **providing controllers with additional salient cues regarding the perceived severity of a potential conflict would reduce controller cognitive load and would likely improve reaction time to the most critical conflict alerts. [FINDING 48]** Therefore, the NTSB recommends that the FAA **develop and implement improvements to the conflict alert system to provide more salient and meaningful alerts to controllers based on the severity of the conflict triggering the alert. [RECOMMENDATION 13] Once the improvements to the conflict alert system discussed in Safety Recommendation [13] are implemented, provide training to controllers on its use. [RECOMMENDATION 14]**

## Postaccident Drug and Alcohol Testing

The LC controller, ALC controller, and OS underwent US Department of Transportation (DOT) workplace postaccident drug testing about 18 hours, 20 hours, and 18 hours after the accident, respectively. This testing did not detect any tested-for substances indicative of prohibited drug use. They did not undergo alcohol testing.

The 14 tested-for substances on the DOT workplace drug testing panel in effect at the time of the accident may be detectable in urine for a day or more after last drug use. As such, the testing was worthwhile, although it was less sensitive for identifying pre-accident prohibited drug use than it would have been if it was conducted sooner after the accident. There was no evidence to indicate that any of the controllers were under the influence of alcohol at the time of the accident; however, had timely postaccident alcohol testing been conducted, controller alcohol use might have been definitively excluded as a factor in the accident. Unfortunately, postaccident alcohol testing was not conducted, so there was no toxicological evidence available to support such a determination. The NTSB concludes that **there was no evidence that the LC controller, ALC controller, or OS were under the influence of alcohol or prohibited drugs at the time of the accident; however, evidence was substantially limited by the lack of postaccident alcohol testing, and evidence was of somewhat lower quality than it would have been if drug testing had been conducted sooner following the accident. [FINDING 49]**

DOT Order 3910.1D, "Drug and Alcohol-Free Departmental Workplace Program," stated that air traffic controllers must undergo postaccident drug and alcohol testing as soon as possible after a fatal accident, any accident that involved a need for medical treatment away from the accident site, or following an accident which resulted in substantial damage to aircraft or other vehicles or property. The order also required that, whenever possible, alcohol testing must take place within 2 hours after the accident, and drug testing within 4 hours after the accident. Review of documentation provided by the FAA indicated that the drug and alcohol testing determination was not made until almost 3 1/2 hours after this accident, when the FAA ATO determined that there was a requirement to test the LC controller, ALC controller, and OS. By that time, the controllers had left the facility. Although DOT Order 3910.1D permitted alcohol testing for another 4 1/2 hours after the determination was made and stated that controllers must remain readily available for testing, the ATO decided to test for drugs only, and the testing was scheduled for late the following afternoon. Thus, the NTSB concludes that **the FAA ATO's drug and alcohol testing determination did not meet DOT timeliness requirements; furthermore, the ATO's decision to not conduct drug testing as soon as possible after the testing determination, and to not conduct alcohol testing at all, violated DOT requirements. [FINDING 50]**

FAA Order JO 1030.3B, "Initial Event Response," outlines ATO procedures following an accident, to include the postaccident/incident drug and alcohol testing determination being made concurrently with the ATO's Services Rendered Telephone Conference (SRT), which is a management review to assess air traffic services associated with an event (FAA, 2014a). However, initiating an SRT requires multiple initial notifications and preliminary review of the event, to include preparing audio and radar display recordings of the event for playback. These administrative and investigative actions take time. When possible, SRTs are convened the administrative day following the accident to allow time for such actions to be completed, though major air carrier accidents or fatal accidents involving air traffic control services require an SRT to be convened no later than 3 hours following initial notification. However, an SRT conducted 3 hours after an accident is already outside the 2-hour postaccident alcohol testing window outlined by the DOT, and an SRT conducted the next administrative day is likely to fall outside both the 4-hour postaccident drug testing window and the 8-hour maximum time for alcohol testing.

Additionally, there was evidence that ATO staff lacked a complete understanding of DOT postaccident drug and alcohol testing requirements. First, the testing determination itself violated DOT requirements. Also, a DOT-required memorandum as to why testing was not performed in a timely manner was not prepared, which an ATO representative attributed to staff's lack of awareness of this requirement.[12]

The NTSB concludes that **the delayed and inappropriate drug and alcohol testing determination was due in part to the ATO's determination process being inadequately designed to routinely meet DOT requirements for timely testing, and in part to ATO staff's incomplete understanding of those requirements. [FINDING 51]**

A primary intended purpose of DOT workplace drug and alcohol testing is to deter and identify abuse of alcohol and use of certain illegal drugs by individuals performing security- and safety-sensitive duties, with the recognition that those substances may have impairing effects on the performance of those duties (US Congress, 1991). Systemic obstacles to accomplishing timely and appropriate postaccident and postincident testing weaken the ability of such testing to serve its intended safety purpose. Accordingly, the ATO's inadequately designed determination process presents a public safety risk that extends beyond any single accident investigation.

The ATO representative testified at the NTSB's investigative hearing that the FAA had begun efforts to revise the initial event response procedures outlined by FAA Order JO 1030.3B. As of the date of this report, those initial event response procedures have not been revised. In this process, the FAA could consider the example of drug and alcohol testing requirements for FAA-regulated employers such

[12] This accident was not the only recent NTSB investigation to identify delayed drug testing and missed alcohol testing of an air traffic controller who was providing services during a serious safety event. The NTSB's investigation of a 2023 runway incursion involving a Southwest Airlines passenger airplane and a Federal Express cargo airplane identified that the controller who had been communicating with both airplanes had not undergone postincident alcohol testing, and did not undergo postincident drug testing until the day after the event. In response to NTSB queries about the drug testing determination in that event, the FAA provided a copy of an FAA email request to "please test" the controller that had been sent more than 8 hours after the event, by which time the window for alcohol testing had closed.

as airlines, which are closely related to the requirements for FAA-employed air traffic control specialists.

The DOT requires the FAA to conduct postaccident testing of FAA-employed controllers whose performance is thought to have contributed to an accident or cannot be completely discounted as a contributing factor, and the FAA imposes similar requirements on its regulated employers. FAA regulations contain language clarifying the permissive intent of the requirement imposed by the FAA on regulated employers, stating that the employer's decision not to administer a test must be based on a determination, using the best information available at the time of the determination, that the employee's performance could not have contributed to the accident.[13]

There is no requirement in the DOT's workplace drug and alcohol testing program, or in DOT/FAA regulations for regulated employers, for each drug and alcohol testing determination to be based on upper managerial consensus after investigation. DOT's own workplace drug and alcohol testing guidance states, "the decision to subject an employee to a postaccident test shall be made using the best information that is reasonably available to management at or about the time of the accident." DOT's guidance to DOT/FAA-regulated employers is more explicit:

> *The supervisor at the scene of the accident/event should know the testing criteria and make a* ***good-faith effort decision*** *to test or not test based on the* ***information available at the time*** *[emphasis in original]. The supervisor may consult with others, but the supervisor is the person who has to make the decision.*

If the FAA were to adopt a process whereby on-site supervisors are empowered to make postaccident/incident testing determinations using available information independently from SRTs, this would not only remove many of the barriers to timely decision making but also would achieve parity with DOT's guidance on best practices for DOT/FAA-regulated employers. Any such process change would need to be effectively communicated throughout the ATO, including by revising FAA Order JO 1030.3B, leveraging existing training procedures, and possibly developing new tools, to ensure that ATO staff possess a strong understanding of associated requirements. This institutional understanding would need to be resilient to workforce turnover, and to the relative infrequency of events triggering postaccident and incident testing. Therefore, the NTSB recommends that the FAA **revise the Air Traffic Organization's initial event response procedures so that an appropriate on-site supervisor makes each postaccident and postincident drug and alcohol testing determination, based on their assessment of whether the event meets testing criteria and which controllers had duties**

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[13] For corresponding DOT/FAA workplace testing language, see DOT Order 3910.1D, Chapter III, paragraph 6.i(2). For corresponding language pertaining to safety-sensitive employees of FAA-regulated employers, see 14 *CFR* 120.109(c) and 14 *CFR* 120.217(b)(1).

**pertaining to the involved aircraft, without needing to wait for investigation or approval. [RECOMMENDATION 15]**

The NTSB additionally recommends that the FAA **at least annually, provide training on the revised postaccident and postincident drug and alcohol testing determination procedure discussed in Safety Recommendation [15] to all staff who have responsibilities under that procedure; this training should include a post-learning knowledge assessment. [RECOMMENDATION 16]**

FAA ATO procedures that limit the timeliness of postaccident/incident testing determinations also limit opportunities to evaluate potential downstream barriers to timely testing. It is possible that successful revision of ATO procedures might expose other weaknesses—for example, in contractor availability to conduct timely testing once a timely drug and alcohol testing determination is made. The DOT, including the Assistant Secretary for Administration and the Departmental Drug Office (DDO), has the responsibility to oversee FAA adherence to DOT workplace drug and alcohol testing requirements and associated required training of supervisors. To enforce its workplace drug testing requirements effectively, the DOT should ensure that the FAA systematically identifies and addresses barriers to timely postaccident and postincident drug and alcohol testing at its facilities. Importantly, addressing these barriers likely would require administrative support from the DOT DDO, not just oversight.

Accordingly, the NTSB recommends that the DOT **require the FAA to demonstrate at least annually that each air traffic control facility it operates has the routine capability to accomplish required postaccident and postincident drug and alcohol testing within the US DOT's specified timeframes of 2 hours for alcohol and 4 hours for drugs, and implement a process to ensure that any facility without such capability will demonstrate timely remediation. [RECOMMENDATION 47]**

## Helicopter Route Design and Information

Preliminary investigative findings of this accident revealed that, when flown at the recommended maximum altitude of 200 ft, a helicopter operating over the eastern shoreline of the Potomac River on Helicopter Route 4 would have about 75 ft of vertical separation from an airplane approaching runway 33. This vertical separation decreases the farther west of the shoreline the helicopter is flown, or if the airplane is operating below the 3° visual glidepath provided by the runway 33 precision approach path indicator (PAPI).

In an urgent safety recommendation report published on March 11, 2025, the NTSB concluded that the separation distances between helicopter traffic operating on Route 4 and aircraft landing on runway 33 that existed at the time of the accident were insufficient and posed an intolerable risk to aviation safety by increasing the chances of a midair collision. The NTSB also concluded that it was critical for public safety helicopter operators to have an alternate route available for operating in and around Washington, DC, without increasing controller workload.

As a result of our findings, we issued two urgent safety recommendations to the FAA. Urgent Safety Recommendation A-25-1 asked the FAA to prohibit operations on Helicopter Route 4 between Hains Point and the Wilson Bridge when runways 15 and 33 were being used for departures and arrivals, respectively, at DCA. Urgent Safety Recommendation A-25-2 asked the FAA to designate an alternative helicopter route that could be used to facilitate travel between Hains Point and the Wilson Bridge when that segment of Route 4 was closed.

Immediately following the accident, the FAA implemented temporary airspace restrictions around DCA. On March 14, 2025, the FAA removed from helicopter route charts the section of Helicopter Route 4 between Hains Point and the Wilson Bridge. Additionally, the FAA prohibited use of runways 15/33 and 4/22 at DCA during "specific, limited helicopter operations" in the vicinity of DCA. The NTSB responded that these actions exceeded the intent of Safety Recommendation A-25-1 and classified it Closed—Exceeds Recommended Action.

In correspondence dated March 26, 2025, the FAA stated that it would collaborate with stakeholders to develop a new helicopter route connecting the Wilson Bridge to the Anacostia River and would provide updates on the alternative route designation process as it progresses. The NTSB stated that this planned work was responsive to Safety Recommendation A-25-2 and, pending its completion, the recommendation was classified Open—Acceptable Response.

FAA Order JO 7210.3DD listed criteria and procedures for the development and modification of helicopter route charts. One of the listed criteria was that, "Care should be exercised to avoid recommending altitudes or flight ceilings/floors which would cause helicopters operating on a designated route to encounter inflight wake turbulence generated by large, fixed-wing traffic." The order stated that Terminal Operations Service Area Directors were responsible for reviewing and approving new or revised helicopter route chart proposals and assuring that they complied with all prescribed criteria. These directors were also responsible for conducting annual reviews of existing visual flight rules (VFR) helicopter route charts to determine their accuracy and continued utility; however, the FAA was unable to provide documentation of the required annual reviews for the Baltimore-Washington Helicopter Route Chart. As of the date of this report, no information has been provided regarding annual reviews conducted, including criteria used, if such reviews were conducted. The NTSB concludes that **annual reviews of helicopter route charts as required by FAA Order 7210.3DD would have provided an opportunity to identify the risk posed by the proximity of Route 4 to the runway 33 approach path, but there is no evidence to support that these reviews were being performed at DCA. [FINDING 52]** The NTSB is concerned that the lack of documentation of annual reviews for the Baltimore-Washington Helicopter Route Chart may be an indication that these annual reviews are not occurring at other locations throughout the NAS. Therefore, the NTSB recommends that the FAA **ensure that annual reviews of helicopter route charts are being conducted throughout the NAS as required by FAA Order. [RECOMMENDATION 17]**

Although the FAA took immediate action following this accident to remove the portion of Route 4 between Hains Point and the Wilson Bridge, the NTSB remains concerned about the potential for other areas of conflict within this airspace. Following the accident, the FAA published a NAS Helicopter Operations Helicopter Route Analysis, which summarized the ATO's safety analysis of domestic airports with charted helicopter routes. Using Performance Data Analysis and Reporting System (PDARS), TCAS events, and Near Midair Collision System (NMAC) data, the FAA reviewed charted routes and high-traffic-volume areas for possible conflicts with traffic patterns and reviewed the descriptions for charted and agreement-established routes. The analysis identified hazards in the airspace encompassing the routes and proposed actions to address priority concerns. This analysis, however, did not include DCA.

The NTSB reviewed PDARS data provided by the FAA regarding encounters between fixed-wing airplanes and helicopters operating on Routes 1 or 4 from January 2018 to February 2025. During this time, there were 4,067 encounters (65.6 encounters per month) in which separation was less than or equal to 1,000 ft and 348 encounters (5.6 encounters per month) in which separation was less than or equal to 500 ft. A heat map depicting the frequency of these events showed several areas where encounters between helicopters and fixed-wing aircraft were concentrated, including the area of the accident site, as well as north of DCA, consistent with encounters with aircraft on approach to runway 19, and south of DCA, consistent with encounters with aircraft on approach to runway 1.

In unofficial correspondence dated January 16, 2026, the FAA reported that it had conducted an in-depth analysis of the helicopter operations within DCA's airspace and made additional changes to the Baltimore-Washington Helicopter Route Chart. As of the date of this report, that analysis has not been provided to the NTSB. Therefore, the NTSB recommends that the FAA **conduct an SRM process to evaluate whether modifications to the remaining DCA helicopter route structure are necessary to safely deconflict helicopter and fixed-wing traffic and provide the results to the NTSB. [RECOMMENDATION 18]** In addition, the NTSB recommends that the FAA **amend their helicopter route design criteria and approval process to ensure that current and future route designs or design changes provide vertical separation from airport approach and departure paths. [RECOMMENDATION 19]** Once the criteria and approval process referenced in Safety Recommendation [17] are developed and implemented, **review all existing helicopter routes to ensure alignment with these updated criteria. [RECOMMENDATION 20]**

According to testimony provided by personnel from the FAA's Aeronautical Information Services office during the NTSB's investigative hearing, the routes depicted on a helicopter chart do not have lateral limitations unless explicitly outlined on the chart's route description. The routes were described as "recommended paths" that served to streamline traffic flow and facilitate easier communication between pilots and controllers regarding expected flight paths, reporting points, and area ingress and egress locations. According to the FAA, helicopter routes were not specifically designed to provide separation between helicopters and fixed-wing traffic.

The Baltimore-Washington Helicopter Route Chart included depictions of each helicopter route and associated altitudes; however, it provided inconsistent guidance on route altitudes, showing the depicted altitudes as both "maximum" and "recommended" in the chart legend, textual route description, and additional information sections. The chart did not describe any lateral boundaries associated with the helicopter routes nor were the visual depictions of each route on the chart associated with any specific measurement or scale. The description of Route 4 stated that pilots should fly "via east bank of Potomac River" between the Anacostia River north of DCA and the Wilson Bridge south of DCA. The version of the Baltimore-Washington Helicopter Route Chart effective October 2, 2025, removed language in the route descriptions that stated, "All Route Altitudes are Maximum."

Three pilots from the 12th Aviation Battalion stated in postaccident interviews that they assumed that the published helicopter route altitudes provided separation from the flow of fixed-wing aircraft, and, as long as they remained at or below the published altitude, they would be deconflicted from fixed-wing traffic. In testimony provided at the NTSB investigative hearing, a standardization instructor pilot stated that the battalion did not have written guidance regarding the proximity to the east bank that they were required to maintain, but that "tribal knowledge" was to "hug the shoreline" along this portion of the route unless it was necessary to deviate for traffic avoidance.

Given the low altitudes of the routes, the fact that these route altitudes decreased nearer to DCA, and that the battalion's letter of agreement with the DCA ATCT required adherence to the published route altitudes, it is understandable that helicopter pilots would conclude that the purpose of the route altitudes was to separate fixed-wing and helicopter traffic; and the FAA provided no warnings or advisories on the helicopter route chart to ensure that they understood this was not the case. The NTSB concludes that **the information published by the FAA regarding Washington, DC, area helicopter routes was insufficient to provide helicopter and fixed-wing operators with a complete understanding of the helicopter route structure and its lack of procedural separation from fixed-wing traffic. [FINDING 53]**

Interviews with four DCA-based PSA pilots revealed that only one of the pilots, who was previously a military pilot in the area, had specific knowledge of the helicopter routes, locations, and altitudes. Another pilot was aware that there were helicopter routes but was not aware of their associated lateral or altitude limitations. The other two pilots had no knowledge of the helicopter routes. FAA-published terminal procedures did not contain any information to inform fixed-wing pilots operating at DCA about the presence or location of the helicopter routes, and DCA-specific airport and approach information published by PSA also did not include information about the helicopter routes.

Without this information, fixed-wing pilots were left uninformed to the potential that they may come in close proximity to or conflict with helicopters utilizing visual separation on published helicopter routes underlying the DCA approach and departure corridors. The NTSB concludes that **current aeronautical charting does not provide information on VFR helicopter routes that may conflict or come in close proximity to approach and departure corridors, which reduces pilot situation awareness. [FINDING 54]** Although the flight 5342 crew's awareness of the helicopter routes could not be determined, other PSA pilots interviewed displayed a varying level of knowledge about the routes. Including helicopter route information on approach procedure charts would increase pilot situation awareness of the operating environment and potential risk. Therefore, the NTSB recommends that the FAA **incorporate the lateral location and published altitudes of helicopter routes onto all instrument and visual approach and departure procedures to provide necessary situation awareness to fixed-wing operators of the risk of helicopter traffic operating in their vicinity. [RECOMMENDATION 21]**

## ADS-B and Collision Avoidance Technologies

The accident helicopter was equipped with a transponder that could transmit ADS-B Out information. This capability was tied to the Mode S function of the transponder such that, when Mode S was selected, the helicopter should have broadcasted ADS-B Out information. As of January 1, 2020, all aircraft operating above 10,000 ft msl or in Class B and C airspace are required to transmit ADS-B Out; however, federal regulations exempt Department of War aircraft from broadcasting ADS-B Out when performing sensitive government missions.

Due to the routes and landing sites used during the accident flight, the Department of War considered PAT25's flight path sensitive and, therefore, the helicopter was not required to be broadcasting ADS-B Out at the time of the accident. Radar data indicated that the helicopter's transponder switched from Mode 3/A and C to Mode S near Cabin John, Maryland, before proceeding south along the Potomac River about 8 minutes before the accident, but the helicopter was not broadcasting ADS-B Out despite the crew's selection of the Mode S function. Although the helicopter's CVR did not capture any crew conversation about activating Mode S, it is likely that the crew turned on the transponder's Mode S function before flying south on Helicopter Route 1 toward the high-traffic airspace near DCA in order to provide ADS-B Out data to air traffic control and other aircraft; however, the crew's activation of Mode S during the flight was contrary to Army SOP, which stated that flight crews should not change transponder modes during flight.

The TAAB commander testified during the NTSB's investigative hearing that the reason for the prohibition on changing transponder modes during flight was due to the amount of "heads down" time required to change the transponder mode; however, the UH-60L operator's manual, as well as testimony by a former TAAB standardization pilot at the NTSB's investigative hearing, indicated that activating Mode S required just two button pushes.

Although the helicopter was not transmitting ADS-B Out, its position and speed was available to the DCA local controller because its transponder was responding to Mode S interrogations, and ADS-B Out information would not have appreciably changed the timing of the conflict alert the controller received before the collision. Flight 5342 was not equipped with ADS-B In, nor was its TCAS II system capable of receiving ADS-B In information as part of its activation algorithm. The NTSB concludes that **the lack of ADS-B Out from the accident helicopter did not contribute to this accident, as the helicopter was still being tracked by radar, and ADS-B Out would not have provided improved traffic alerting for the DCA controller or the crew of flight 5342, because the airplane was not equipped with ADS-B In. [FINDING 55]**

Although the lack of ADS-B Out information from the accident helicopter did not change the circumstances of this accident, collision avoidance technologies that leverage ADS-B In information are most effective if all aircraft broadcast ADS-B Out at all times. The NTSB concludes that **the Army's standard operating procedures that prevent flight crews from enabling ADS-B Out while in flight, when not performing sensitive missions that require ADS-B to be disabled, limit the visibility of military aircraft on collision avoidance technologies that leverage ADS-B information. [FINDING 56]** Therefore, the NTSB recommends that the Department of War Policy Board on Federal Aviation **require armed services to amend their operational procedures to allow flight crews to enable ADS-B Out while in flight. [RECOMMENDATION 45]**

The accident airplane was equipped with TCAS II, and information obtained from the airplane's FDR and CVR indicated that the crew received a TA regarding PAT25 about 20 seconds before the collision, which was within TCAS system alerting specifications. This TA remained active until the collision occurred; however, the crew had been trained not to maneuver based solely on a TA, and their workload at the time they received the TA was high, resulting in limited available capacity to look for and visually acquire the traffic. The TCAS system did not generate a subsequent RA even though the two aircraft continued to converge, because TCAS II inhibit logic was designed to suppress RAs below 900 ft above ground level during descent. A known limitation of TCAS II is that it often issues RAs during some normal and routine operations, including when visual separation is being applied. The TCAS II RA inhibit altitude threshold was established based on the technological limitations available at the time it was developed to maximize effective alerting while minimizing these types of nuisance alerts.

PSA crews were trained to respond promptly to RAs and maneuver as indicated by the advisory, even if such a maneuver conflicted with ATC instructions. Therefore, it is probable that the crew of flight 5342 would have maneuvered in accordance with the instructions provided by the RA had they received one, which may have prevented the collision. The NTSB concludes that **although the airplane's TCAS operated as designed, it was ineffective in preventing the collision because of current activation criteria and resolution advisory inhibit altitudes. [FINDING 57]**

The NTSB has previously advocated for the FAA to require ADS-B In technology on the basis that equipping aircraft with ADS-B In capability would provide an immediate and substantial contribution to safety, especially near airports. Simulations using the circumstances of this accident reaffirm this conclusion and demonstrate the value of ADS-B In-derived traffic information in improving pilots' situation awareness and supporting earlier identification of potential traffic conflicts.

ADS-B traffic advisory system (ATAS) is an ADS-B application intended to reduce the number of midair collisions and near midair collisions involving general aviation aircraft. ATAS utilizes ADS-B information to generate verbal alerts indicating the clock position, relative altitude, range, and vertical tendency of proximate traffic.

In this accident, the TA that the flight 5342 crew received consisted simply of the annunciation, "Traffic, traffic." No information about the location of the traffic threat relative to the airplane was annunciated, and the crew would have had to refer to the TCAS display to determine the relative position of the threat before directing their visual scan in the appropriate area. Given the crew's high workload at the time they received the TA, it is unlikely that they performed a focused visual search for the helicopter at this time.

The NTSB performed a simulation to determine how an ADS-B based system capable of providing ATAS-style alerts would have performed in the accident scenario. The simulation indicated that the crew of flight 5342 would have received two alerts concerning PAT25 had it been equipped with such a system. The first aural and visual alert would have occurred 59 seconds before the collision, annunciating "Traffic, 12 o'clock, low, three miles, descending." A second aural alert would have occurred 35 seconds before the collision, annunciating "Traffic, 12 o'clock, low, two miles." These two alerts would have occurred 40 and 16 seconds, respectively, before the TCAS TA that the crew received before the collision, providing the crew with additional awareness of the helicopter.

While TCAS TAs provide a verbal annunciation that a potential traffic conflict exists, the annunciations do not include the position and range of the target, requiring the pilot to first refer to the TCAS display inside the cockpit to determine the direction in which they need to direct their visual search. An ATAS-style TA indicating the clock position, relative altitude, range, and vertical tendency of nearby traffic would allow pilots to immediately direct their visual search in the proper direction outside the aircraft. The NTSB concludes that **TA aural alerts that include additional information about the location of traffic could reduce the time pilots need to visually acquire target aircraft. [FINDING 58]** The NTSB recommends that the FAA **modify airborne collision avoidance system (ACAS) TA aural alerts to include clock position, relative altitude, range, and vertical tendency. [RECOMMENDATION 22]**

The crew of flight 5342 could have intervened in the accident sequence if they had more knowledge about the level of the threat posed by the traffic that triggered the TCAS TA. While a TCAS display does depict traffic targets, a pilot must monitor the display over time to determine in what direction the target is moving. By leveraging ADS-B In traffic information, an ACAS display can depict the ground track of traffic targets, increasing pilots' awareness of the movements of nearby traffic and providing more timely information to help a pilot determine whether that target may become a collision threat. The NTSB concludes that **had the airplane been equipped with an airborne collision avoidance system that used ADS-B In information to show directional traffic symbols, the crew of flight 5342 would have received enhanced information about the risk posed by the helicopter, which could have enabled them to take earlier action to avert the collision. [FINDING 59]** Therefore, the NTSB recommends that the FAA **require existing and new TCAS I, TCAS II, and ACAS X installations to integrate directional traffic symbols. [RECOMMENDATION 23]**

The helicopter was not equipped with an integrated cockpit display of traffic information (CDTI), nor was it required to be under current regulations. As previously discussed, the pilot and IP onboard PAT25 had tablets that were capable of displaying ADS-B traffic information from other aircraft and providing visual and aural alerts.[14] A simulation of the ForeFlight CDTI display available on the tablets indicated that the application would have generated a visual and aural alert concerning the airplane at 2047:11, or 48 seconds before the collision. The tablets, which would likely have been strapped to the pilots' thighs, were normally referenced in flight by the pilot monitoring (in this accident, the IP); however, statements from Army helicopter pilots indicated that it was unlikely that the accident crew were referring to the tablets for traffic information at the time of the accident given the demands of visual, low-level flight at night under NVGs. Simulator testing indicated that, when

[14] Although tablets and other portable traffic-display devices can provide helpful supplementary awareness, they are not a functional substitute for an integrated CDTI within the normal instrument scan or for timely ATC traffic advisories and safety alerts—particularly in complex Class B environments.

using a tablet secured to a thigh, a pilot would be required to divert their attention below a normal scan of the cockpit instruments in order to view the tablet screen. Additionally, the aural alerting that could have been provided by the tablets was not integrated into the crew's helmets and would not have been heard by the crew over the ambient noise inside the helicopter, even if the application had been configured to provide aural traffic alerts. At the time of the accident—and still as of the date of this report—the DOW had no requirement for military aircraft to receive ADS-B In, or to be equipped with any integrated cockpit display of traffic information derived from ADS-B In data. The NTSB concludes that, **although the pilot and IP onboard PAT25 were equipped with tablets that had the ability to display traffic transmitting ADS-B Out, it is unlikely that the pilots were using the tablets to monitor or identify traffic at the time of the accident due to the workload associated with low-altitude flight. [FINDING 60]**

The NTSB has investigated numerous midair collision accidents that occurred within controlled airspace or in which air traffic control was in contact with at least one of the involved aircraft. In many of these investigations, the NTSB noted that a CDTI with ADS-B In information would enhance pilots' situation awareness by providing information regarding traffic conflicts that may otherwise go undetected due to the numerous documented limitations of see-and-avoid.[15]

Following the investigation into a midair collision between two air tour airplanes in Ketchikan, Alaska, in 2019, the NTSB issued several safety recommendations to the FAA, asking them to identify areas with a high concentration of air tour traffic and to require that *CFR* Parts 91 and 135 air tour operators which operate within those areas be equipped with an ADS-B Out- and In-supported traffic advisory system that includes visual and aural alerts (NTSB, 2021). We also recommended that the FAA require all aircraft operating within those high density traffic areas, not just those conducting air tours, be equipped with ADS-B Out.

In an October 24, 2023, follow-up letter regarding Safety Recommendation A-21-17, the NTSB emphasized that the absence of an ADS-B In requirement for Part 135 passenger-carrying operations fails to take advantage of the demonstrated safety benefit of ADS-B In traffic awareness and alerting and is inconsistent with the "appropriate level of public safety" the FAA itself expects for operations in which passengers bear no responsibility for the aircraft's operation (NTSB, 2023). In a response dated November 2024, the FAA stated that they had determined that, "current ADS-B requirements continue to adequately address the needs of aviation safety," and that they would "not pursue additional ADS-B operator requirements at this time" (FAA, 2024e).

During the NTSB's investigative hearing for this accident, the FAA ATO's acting deputy chief operating officer (COO) stated that the agency supported requiring that

[15] Examples include ERA09MA447, CEN19MA141AB, ANC20LA074, ERA22FA318, CEN22FA081, and ERA23FA142.

newly manufactured aircraft in the United States be equipped with ADS-B In. He also stated that the agency supported requiring that aircraft operating in airspace where they are required to transmit ADSB Out, also be required to install and operate ADS-B In.-B Out, also be required to install and operate ADS-B In.

The circumstances of this accident illustrate that the additional information provided by an ACAS system supplemented with ADS-B In information, including ATAS alerts and directional traffic displays, further enhance the safety benefit provided by ACAS. For all pilots, ADS-B In information provided on a CDTI with alerting that is audible to the pilot would provide critical situation awareness to help mitigate the risk of midair collisions, even if their aircraft are not equipped with an ACAS. In order to take full advantage of the safety benefits provided by ADS-B, the NTSB recommends that the FAA **require all aircraft operating in airspace where ADS-B Out is required to also be equipped with ADS-B In with a cockpit display of traffic information that is configured to provide alerting audible to the pilot and/or flight crew. [RECOMMENDATION 24]** In order to provide the same situation awareness advantages to military flight crews, the NTSB recommends that the Department of War **require all military aircraft operating in the NAS be equipped with ADS-B In with a cockpit display of traffic information that is configured to provide alerting audible to the pilot and/or flight crew, and that such requirement apply wherever in NAS the FAA requires any aircraft to operate with ADS-B Out. [RECOMMENDATION 46]**

Advances since the development of TCAS II standards allow ACAS X, the next generation of airborne collision avoidance systems, to provide improved alerting. Among other enhancements, ACAS X systems utilize ADS-B In information in addition to transponder interrogations, and include improved algorithms to more accurately reflect actual collision risk.

A series of simulations conducted using the circumstances of this accident showed that the crew of flight 5342 would have received a TA about 8 seconds earlier if the airplane had been equipped with ACAS Xa, an ACAS X variant for airplanes, even though ADS-B information from the helicopter was unavailable. However, although ACAS Xa can deliver earlier and more accurate alerts than TCAS II, the current RA inhibit altitudes under ACAS Xa are the same as those of TCAS II, and would also have prevented ACAS Xa from issuing a RA under the accident circumstances. The results of the simulation indicated that the risk of a NMAC was reduced by more than 90% when the ACAS Xa logic was modified to allow RAs down to 300 ft, because it is possible that the crew would have taken the action prescribed by the RA to avoid the collision. The NTSB concludes that **technological advances since the development of TCAS II operating standards may allow ACAS Xa with reduced inhibit altitudes to have an expanded alerting envelope while reducing nuisance alerts. [FINDING 61]** Furthermore, the NTSB believes that ACAS X, as the standard is currently defined, would improve the safety of aircraft that are currently required to be equipped with TCAS. Therefore, the NTSB recommends that the FAA **require the use of the appropriate variant of ACAS X on new production aircraft that are subject to TCAS equipage regulations [RECOMMENDATION 25]** and that the FAA **require existing aircraft that are subject to TCAS equipage regulations be retrofitted with the appropriate variant of ACAS X. [RECOMMENDATION 26]** Given the results of the TCAS and ACAS X simulation study, which showed a significant reduction in the risk of a NMAC when the RA inhibit altitude was lowered, the NTSB also recommends that the FAA **evaluate the feasibility of decreasing the TA and RA inhibit altitudes in ACAS Xa to enable improved alerting throughout more of the flight envelope. [RECOMMENDATION 27]** If the FAA's evaluation resulting from Safety Recommendation [27] finds that inhibit altitudes can be safely decreased, the NTSB further recommends that the FAA **require retrofitting of the applicable ACAS X variant incorporating the reduced TA and RA inhibit altitudes on all aircraft that are subject to TCAS equipage regulations. [RECOMMENDATION 28]**

The ACAS simulations using the circumstances of this accident also showed that, had the helicopter been equipped with ACAS Xr, a version of ACAS X that is still under development and intended specifically for rotorcraft, the risk of a NMAC was reduced by more than 50%, with no changes to the TCAS or ACAS Xa inhibit altitudes. This information would have been provided to the crew via a cockpit display that would have been part of their normal instrument scan and also would have provided aural alerting integrated with the helicopter's internal communications system. Therefore, the NTSB concludes that, **although not yet commercially available, had the helicopter been equipped with ACAS Xr with integrated aural alerting, the crew could have received an alert regarding flight 5342 and could have taken action to avert the collision. [FINDING 62]**

Given the significant reduction in the risk of a NMAC as shown in the simulations when the helicopter was equipped with ACAS Xr, the NTSB recommends that the RTCA Program Management Committee **finalize and publish the minimum operational performance standards for ACAS Xr for rotorcraft. [RECOMMENDATION 50]** The NTSB also recommends that the FAA **require that all rotorcraft operating in Class B airspace be equipped with ACAS Xr technology once the ACAS Xr standard has been published. [RECOMMENDATION 29]**

## Safety Management Systems and Safety Data

### Indicators of Midair Collision Risk

Multiple safety occurrence reporting systems contained reports from pilots and controllers about close calls between airplanes and helicopters in the vicinity of DCA in the years before the accident, some of which included airplanes on approach to runway 33.[16] Several of those reports described issues similar to those found in this

[16] These included a NMAC (1070511144 in the NMAC database) for the May 2013 near-miss between an airplane and a military

investigation, including airspace complexity, problems with ATC communications, challenges associated with combining helicopter and local control positions, and helicopters flying above recommended altitudes. An Aviation Safety Information Analysis and Sharing (ASIAS) review of Aviation Safety Action Program (ASAP) reports filed by pilots from February 2020 through October 2024 found 85 reports, or about 18 reports per year, that contained information on close calls between helicopters and airplanes near DCA.[17] Reports of close calls near DCA were also found in other safety occurrence reporting systems, including Air Traffic Safety Action Program (ATSAP), Aviation Safety Reporting System (ASRS), NMACS and mandatory occurrence reports (MORs). Although it is possible that some of the reports in these systems described the same events, it is reasonable to conclude that there were more than 18 close calls per year, or more than 1 close call per month on average, reported in the 4 years before the accident.

Safety occurrence reporting systems rely on subjective self-reports with varying submission criteria and are therefore unlikely to capture all safety events (Dy and Mott, 2024).[18] By comparison, objective aircraft position data, such as TCAS RA data captured by ground-based receivers, indicated that there were about 15 TCAS RAs per month, on average, within 10 nm of DCA between April 2023 and March 2025. Aviation Risk Identification and Assessment (ARIA) data showed that airplanes and helicopters came within 1 nm laterally and 400 feet vertically 390 times per month, on average, between October 2021 and December 2024. PDARS data identified an average of 5.6 instances per month between 2018 and 2025 in which helicopters flying on Routes 1 or 4 came within 500 ft of airplanes arriving or departing DCA.

Some objective measures of aircraft proximity that were examined after the accident were not used for safety assurance before the accident occurred. For example, postaccident review of PDARS radar-based data identified close encounters between aircraft in the vicinity of airports and revealed instances of helicopters flying above maximum route altitudes; however, the FAA had not previously used those data to track such metrics. Additionally, ARIA proximity data and TCAS RA data from ground-based receivers were available to ASIAS, but those data were also not actively monitored by ASIAS or widely available before the accident.[19]

The Army and PSA had varied knowledge of and limited access to safety data systems. The Army did not participate in ASIAS, did not request FAA data, and did

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helicopter that was the catalyst for the formation of the HWG at DCA ATCT; an ASRS report from July 2015 that involved a near miss between an airplane on a circling approach to runway 33 and a helicopter (ACN 1283693); and an ASRS report from June 2013 in which an airplane on the River Visual approach to runway 19 received a TCAS RA due to a helicopter passing below (ACN 1095485).

[17] The term "close calls" commonly refers to events in which the proximity between two aircraft was perceived as potentially unsafe. See, for example, Ending Serious Close Calls (FAA). Other terms, such as near misses, close proximity events, and airborne encounters have been used by different groups to describe similar types of events.

[18] Additionally, pilots may not be aware of close proximity events or may have been successfully applying visual separation, which would not result in safety reporting in instances when objective measures indicated close proximities.

[19] TCAS TA and RA data were available through an operator's FOQA and could have provided useful information, but those data are proprietary and only represented information from, and were only available to, operators who participated in ASIAS.

not routinely use information that the FAA made publicly available. The Army did not have a robust safety occurrence reporting system, nor did it collect and aggregate safety data from their helicopters. PSA had an SMS, as required by 14 *CFR* Part 5, and participated in the ASIAS program. Although PSA reported reviewing safety occurrence reports from its pilots and FOQA-based TCAS data provided by the ASIAS program, PSA did not have access to objective proximity data from PDARS or ARIA. As a result, their safety assurance and safety risk management processes did not identify a heightened risk of midair collision at DCA.

The FAA ATO had access to many sources of data, including ASIAS, PDARS, ARIA, ATSAP, MORs, ASRS, and NMACs, as well as limited access to ASAP and TCAS RA information. Although the ATO reported that they reviewed a large number of data sources as part of their safety assurance process, they also did not identify the risk of a midair collision between helicopters and fixed-wing traffic at DCA. In the investigative hearing, FAA officials acknowledged that the ATO had missed these indicators of risk.

The ARIA system was designed specifically to use objective criteria to automatically identify air traffic operations that represented potential safety risks and generate reports known as preliminary ARIA reports, or PARs. However, ATO's subsequent reviews of PARs were subjective and largely focused on regulatory compliance rather than potential risk. For example, ARIA generated 874 PARs for the area surrounding DCA between June 2022 and May 2025, but ATO classified none of them as NMACs, even though pilots and controllers made multiple reports of close calls during that period. Additionally, the safety group manager for the FAA's Eastern Service Area noted that their Quality Assurance Office reviewers did not normally search for voluntary reports and acknowledged that, "from one validator to another, or from somebody that's looking at that report, their perception of what is the possibility of collision may be different." As a result of these subjective reviews, potentially valuable objective risk-based safety data were not tracked. The NTSB concludes that **multiple data sources provided evidence of midair collision risk between fixed-wing aircraft and helicopters at DCA, including on approach to runway 33, before this accident; however, the limited access to and use of available objective and subjective proximity data hindered industry and government stakeholders' ability to identify hazards and mitigate risk. [FINDING 63]**

In its Safety Risk Management Policy, the FAA recognized the value of objective data, stating, "While any data is better than no data, when available, analytical data is preferred, followed by empirical, and finally, judgmental. This is due to the margin of error associated with each type of data. Analytical data typically has the lowest margin of error; the margin of error of empirical data can be controlled by sample size; and judgmental data has the largest margin of error due to human biases and subjective experience" (FAA, 2023d).

Since the accident, the FAA ATO has used objective proximity data to identify areas of potential conflict between airplanes and helicopters in the NAS. It conducted a helicopter route analysis using multiple data systems to count "close proximity" events with objective measures based on parameters such as vertical/horizontal proximity, slant range, or time to contact. In addition to identifying near midair collisions, analyses of objective proximity data can identify areas of high traffic density and potential routing conflicts, and depict areas with a high concentration of encounters involving distances less than those provided by standard IFR separation, which could have shown evidence of the dependence on visual separation to manage traffic in the DCA airspace before the accident.[20]

Although there is value in using multiple data sources to understand a problem, the lack of standard proximity metrics or indexes to signify when aircraft are "too close" results in difficulty comparing the risk levels of different locations or tracking the incidence of events over time. The NTSB concludes that **improving stakeholder access to standardized and objective information about aircraft close proximity encounters for use in safety assurance processes would increase the likelihood of detecting and mitigating hazards before accidents occur. [FINDING 64]** Therefore, the NTSB recommends that the FAA **create an objective definition of close proximity encounter and a public database of those encounters and their locations that can be used to monitor their prevalence and identify areas of potential traffic conflict for safety assurance and safety risk management. [RECOMMENDATION 30]**

### Safety Information Sharing

Most of the stakeholder groups involved in the investigation described internal processes for evaluating and addressing safety occurrence reports. That the midair collision between PAT25 and flight 5342 occurred despite these reported activities raises the question of why they did not lead to more meaningful risk mitigations at DCA. Some evidence suggests that safety occurrence reports were used at DCA tower to identify hotspots, including a hotspot in the same location as the midair collision, and propose changes to helicopter route charting through the safety risk management panel (SRMP) process; however, these efforts met with resistance from ATO, yielding little success.

The investigation also revealed that, although helicopters routinely triggered TCAS RAs for airplanes on approach to DCA and were the subject of many voluntary pilot reports, helicopter operators were largely unaware of their involvement in these events. Upon learning of its involvement in TCAS RA events involving airplanes on approach to DCA, one helicopter operator made changes to its standard operating procedures to help mitigate such events. Additionally, an Army representative stated

[20] During the investigative hearing, the FAA ATO acting deputy COO cited the dependence on visual separation between helicopters and IFR traffic at DCA as an example of risk that was missed prior to the accident.

in the investigative hearing that learning of Army helicopter involvement in TCAS RAs would be valuable for risk mitigation.

FAA regulations (see 14 *CFR* Part 5.57) state that, if a hazard is identified through an operator's SMS, that operator must provide notice to anyone involved that could address the hazard or mitigate the risk. Additional guidance in FAA Order JO 1000.37C states that safety promotion activities include actively sharing safety-related information with other external parties, such as industry stakeholders, air navigation service providers, and other federal agencies.

Despite this guidance, this investigation revealed that reviews of close proximity events around DCA appeared to have occurred in isolation rather than involving all relevant parties. For example, preliminary ARIA reports were only reviewed by FAA ATO Quality Assurance Office staff and did not incorporate the operators involved in the events. PSA Airlines reported reviewing TCAS RAs involving its aircraft, but noted that there was often a delay of several months between the occurrence and the review. Additionally, PSA relied on the Confidential Information Share Program (CISP) or the FAA to identify other aircraft that triggered TCAS RA activations on PSA aircraft.

When two TCAS-equipped aircraft come into conflict, both aircraft receive RAs that alert the pilots and are captured on flight data recorders. However, when a TCAS RA is triggered by an aircraft without TCAS, the pilot of the unequipped aircraft may never become aware of the event. If timely steps are taken to identify the threat aircraft, the pilots or operators can be notified of their involvement in the event. However, as this investigation showed, it may be difficult to identify aircraft that triggered TCAS RAs if not attempted until months or years after the event, particularly if they are not broadcasting ADS-B Out. The NTSB concludes that **the FAA's lack of an established process to inform parties about their involvement in events such as NMACs or TCAS RAs reduces the likelihood of fully understanding and mitigating future midair collision risk. [FINDING 65]** Therefore, the NTSB recommends that the FAA **develop and implement a process that will, in a timely manner, notify involved parties after events such as NMACs or TCAS RA activations, such that notification occurs while relevant data remain available and before meaningful safety analysis, reporting, or corrective action is no longer practicable. [RECOMMENDATION 31]**

## FAA Air Traffic Organization Safety Management System

### *Safety Risk Management and Safety Assurance*

At the time of the accident, the FAA had an established SMS for several of its organizations, including the ATO and ATO facilities (such as DCA ATCT). FAA policy required that each organization establish and maintain each of the four components of SMS—safety policy, safety risk management, safety assurance, and safety promotion. However, despite the ATO's established and well documented safety policy, this investigation indicated significant gaps in its safety risk management, safety assurance, and safety promotion processes and procedures.

FAA guidance for SMS implementation clearly establishes responsibility and requirements for operators and external service providers to coordinate safety risk management and safety assurance activities with external parties to collect and share safety hazard information and monitor safety risk controls. For example, the FAA stated that airport operators, tenants, and users should coordinate SMS efforts to the fullest extent possible, and that a method of data sharing and reporting among the separate SMSs be included in the safety risk management process. The FAA also required that air traffic managers coordinate with local airport operators to increase awareness and understanding of local operations and safety challenges, including convening conferences to discuss and clarify operations.

By contrast, the FAA ATO Order on identification and mitigation of hazards at the local level does not require external stakeholder involvement. Participation is limited to bargaining unit representatives and management at FAA air traffic facilities (FAA, 2020b). Although the 2021 GAO report called on the FAA to develop a mechanism to exchange information with operators in the DC area, there was no formal process in place at DCA for operators and the FAA to share information about helicopter route traffic, TCAS RAs, or potential traffic conflicts. In the absence of a formal process, formation of helicopter working groups in the Washington, DC, area demonstrated recognition by local controllers and operators of safety risks and attempted coordination of the diverse helicopter operations in the DCA Class B airspace. However, these groups were described as informal, did not include a mission statement or statement of work, and their attempts to recommend changes were met with resistance from, and little action by, the ATO.

As an example of informal collaboration, the DCA ATCT helicopter working group (HWG) identified areas of increased collision risk between airplanes and helicopters, and proposed changes to the charted helicopter route and zone altitudes to mitigate those risks. One of the proposed changes included relocating or eliminating the section of Route 4 adjacent to DCA due to the risk posed by the proximity of that route to fixed-wing approach and departure paths. A near midair collision between a military helicopter and a regional jet in 2013 (which occurred in the same vicinity as this accident) was the catalyst for this initial proposal, and the DCA ATCT HWG made additional recommendations to move Route 4 in the years after; however, members of the group recalled a lack of feedback from management at higher levels within the ATO regarding why their suggestions to move or eliminate Route 4 were not adopted.

The group also proposed the addition of “hotspots” to the Baltimore-Washington Helicopter Route Chart to highlight areas that posed an increased risk of potential conflicts between airplanes and helicopters to increase pilot and controller vigilance in those areas. However, the FAA also rejected the proposal to chart these hotspots because, "hotspots are associated with ground or surface movement and are not within the VFR aeronautical chart specification." The HWG comprised DCA ATCT controllers—the individuals most familiar with the flow and separation of helicopter and fixed-wing traffic around DCA and with the greatest insight into its vulnerabilities and areas of highest risk; however, the FAA repeatedly failed to act on proposals provided by the group and rejected changes that would have raised pilot awareness of areas of increased midair collision risk and increased separation between Helicopter Route 4 and fixed-wing approach and departure paths.

In addition, the investigation did not identify evidence showing that the ATO conducted annual, documented reviews of helicopter route charts in the Washington, DC, area as required by FAA Order JO 7210.3DD. Further, review of FAA data programs did not indicate that the ATO routinely used available data to evaluate separation risk between fixed-wing traffic and helicopter operations at congested airports, including DCA.

The NTSB concludes that, given their access to a wide range of data sources and information, **the FAA ATO was made aware of, and had multiple opportunities to identify the risk of a midair collision between airplanes and helicopters at DCA; however, their data analysis, safety assurance, and risk assessment processes failed to recognize and mitigate that risk. [FINDING 66]** The NTSB further concludes that **the FAA ATO's application of its safety management system did not effectively coordinate safety assurance and safety risk management activities with external stakeholders in the DCA Class B airspace. [FINDING 67]**

The FAA established the Air Traffic Safety Oversight Service (AOV) in 2004 as the safety oversight authority to ensure effective and independent safety oversight of ATO and to enforce safety regulations related to air navigation services, including ATO SMS functions (FAA, 2024a). However, in December 2025, the FAA Administrator announced that the FAA was implementing a single, agencywide SMS, stating in testimony before the House Committee on Transportation and Infrastructure's Subcommittee on Aviation that, "This unified approach will help the FAA detect, analyze, and mitigate risk more consistently and ensure that lessons from accidents, incidents, and near misses are acted upon quickly across the agency" (FAA, 2025f). Additionally, in a document titled, "FAA Flight Plan 2026" the agency stated its intent, as part of creating one FAA SMS, to establish a Safety Integration Office and implement an FAA-wide safety risk management process (FAA, 2026).

Therefore, the NTSB recommends that the US Department of Transportation Office of Inspector General complete **an audit of the FAA ATO SMS functions and data sharing activities at all air traffic control facilities and determine whether these activities are conducted in collaboration with all relevant external stakeholders, ensuring that the audit's results are documented, reported to the**

**Secretary of Transportation and the FAA Administrator, and made available to the public. [RECOMMENDATION 49]** Additionally, the NTSB recommends that the FAA, **based on results of the audit, ensure that all SMS functions and data sharing activities at all air traffic control facilities are conducted in collaboration with all relevant external stakeholders. [RECOMMENDATION 32]**

At the NTSB's investigative hearing, the DCA ATCT OM at the time of the accident testified that controllers would routinely compensate for the conditions provided by reduced MIT spacing and compacted demand times by "making it work," and using "all available tools." The "make it work" mindset had become normalized and "routine" at DCA ATCT.

Although processes were in place to conduct risk assessments of hazards at the facility level, existing procedures did not provide robust guidance to assist controller and supervisor risk assessment and decision making in real-time, day-to-day operations. For example, the DCA ATCT SOP contained a list of seven factors that an OS should consider when deciding to combine or de-combine the HC position, but did not provide additional information on how to effectively evaluate the impact of those factors on the control position(s). Changes to the DCA ATCT SOP in 2023 removed the requirement for the OS to document the time and reason for combining or de-combining the HC position in the facility log. Requiring this information to be recorded made it more likely that the OS would consider and evaluate the risks associated with combining or de-combining the position under the existing operational and environmental conditions, and it is likely that the removal of this requirement normalized combining the positions without a thorough evaluation of the associated risk factors. Maintaining this record could also provide background information for safety assurance processes to determine whether the positions were being combined and de-combined appropriately. The NTSB concludes that **changes to DCA ATCT SOPs prior to the accident removing the requirement for the OS to document the time and reason for combining or de-combining the HC position in the facility log made it less likely that the OS would consider and evaluate the risks associated with combining or de-combining the position. [FINDING 68]** Because operational position-combining decisions are made routinely at towers throughout the NAS under time pressure and with similarly limited documentation requirements, establishing a standardized, nationwide requirement to record the time and rationale for combining or de-combining positions would strengthen real-time risk-based decision making and provide consistent safety assurance inputs across facilities. Therefore, the NTSB recommends that the FAA **establish a requirement across all ATCT SOPs that the OS or controller in charge (CIC) document in the daily facility log when any control position is combined with the LC position, or when the OS/CIC position is combined with a control position, along with a rationale for doing so. [RECOMMENDATION 33]**

A number of hazards existed within the DCA ATCT at the time of the accident. Nighttime operations reduced visibility and made identification of aircraft more difficult; traffic volume was increasing with reduced MIT, which increased controller workload and required the use of runway 33 to build additional spacing; helicopter traffic was present; and the HC and LC positions were combined, which increased workload for the LC and ALC controllers. The DCA ATCT SOP stated that the OS was responsible for maintaining situation awareness of the operation, providing assistance to controllers, and deploying available resources for optimal efficiency; however, there was no guidance provided by the ATO or the ATCT SOP that would have assisted the OS in assessing, anticipating, or alleviating controller workload. Because concerns about potential conflicts between airplanes and helicopters had been identified in previous ECVs at the tower facility, the night conditions, helicopter traffic on Route 4, and use of runway 33 at the time of the accident should have raised an additional level of awareness and vigilance, particularly on the part of the OS, as all of those factors increased the likelihood that an airplane and helicopter may come in close proximity. However, the guidance available to the OS was insufficient to help him evaluate these factors and apply operational risk management in a manner that could have more effectively mitigated these hazards.

It is apparent that controllers in the DCA area were under pressure to accommodate more traffic volume, and in response, developed their own methods of traffic management in order to maintain operational efficiency. A functional SMS should have identified and addressed these locally accepted operational practices, the "make it work" mentality described by controllers, and the lack of a robust process for day-to-day risk assessment and mitigation. The NTSB concludes that **safety risk management practices were not fully integrated into DCA ATCT operations and did not identify or mitigate the operational challenges faced by controllers or the lack of guidance regarding operational risk assessments for controllers and supervisors. [FINDING 69]**

*Safety Promotion and Positive Safety Culture*

According to ICAO, safety promotion is how an organization builds and sustains a positive safety culture and the foundation for an effective SMS. It does this by actively communicating safety information, policies, priorities, and lessons learned. The goal is to ensure that everyone understands their shared responsibility for safety, feels supported by leadership, and has the awareness, tools, and motivation to manage safety risks effectively. During the investigative hearing, the ATO acting deputy COO stated that there was no formal SMS training for controllers, though he believed that facility management would be familiar with the *ATO SMS Manual*. Ensuring that every employee is familiar with their organization's SMS through training and consistent, transparent communication is essential for building trust and collaboration. FAA AC 120-92D stated that organizations are required to provide initial safety training for employees so that they can perform their SMS-related duties, and that recurrent training may be necessary to maintain employee competencies. The FAA's previously discussed failure to deliver recurrent TEM training highlights a missed opportunity to reinforce controllers' abilities to recognize and mitigate hazards, which are critical skills that they can apply not only in their day-to-day duties of managing air traffic, but also in providing feedback through established safety reporting systems to foster continuous improvement of the SMS.

At the facility level, ATO utilized and encouraged use of formal safety reporting systems, such as ATSAP, to collect safety concerns from tower personnel without fear of punishment. However, the practice of a just culture was not consistently followed by ATO management. Interviews with some ATO staff indicated that there was a fear of retaliation for raising safety issues, and some individuals would only speak to investigators because they were close to retirement or had retired. An air traffic safety specialist, who would not speak to investigators until after her retirement was finalized, discussed multiple occasions where mandatory reporting events went unreported as well as harassment for pushing back on unsafe practices. Following this accident, DCA ATCT management personnel were reassigned, an action that appeared inconsistent with the characteristics of a positive safety culture defined by the ATO acting deputy COO. During the NTSB's investigative hearing, ATO management witnesses had to be separated from subordinate witnesses due to concern that answers were being influenced due to their close proximity. Organizations involved in the investigative hearing were asked to confirm that there would not be any retaliation against the witnesses participating in the hearing, and all affirmed this commitment. Additionally, interviews with current and former DCA ATCT personnel indicated that morale had been low for years before the accident due to the 2018 facility level downgrade and the FAA's lack of transparency regarding the metrics used to support that decision.

DCA ATCT controllers were familiar with the ATSAP program for reporting safety concerns. As previously discussed, between January 2011 and August 2023, a total of 520 ATSAP reports (approximately 40 reports per year) were filed related to DCA, supporting controller statements that they felt comfortable reporting safety concerns through the system. If a safety concern did not warrant filing an ATSAP report, controllers stated they also felt comfortable expressing their concerns to facility management.

Although there were multiple indicators of the risk of a midair collision in the DCA airspace from numerous objective and subjective data sources, such as ATSAP, ASRS, MORs, ARIA and NMACs, these risks were not identified by ATO safety assurance processes. The FAA also lacked an established process for informing parties about their involvement in NMACs and TCAS RAs. Without adequate awareness that such risks exist, ATO and parties were unable to take adequate mitigations and the DCA airspace remained vulnerable to the risk of a midair collision.

Although traffic flow volume and management issues had been longstanding challenges at DCA, ATO management did not adequately respond to concerns expressed by frontline personnel. For example, suggestions from personnel who were involved in efforts to reduce DCA's AAR were often met with resistance and a lack of communication from ATO management. Instead, controllers were required to adopt a "make it work" mindset and compensated for these conditions by relying on mitigations such as extensive use of pilot-applied visual separation and offloading arrivals to runway 33. Potomac TRACON personnel stated that they also employed workarounds for dealing with the high volume of traffic in the DCA airspace. Proposals from the DCA ATCT HWG to move Route 4 and add "hotspots" to the helicopter route chart were rejected despite their identification of risks in these areas.

Finally, on numerous occasions during the course of this investigation, the FAA failed to provide the NTSB with requested investigative information, even after agreeing to do so, or provided incomplete responses to information requests.

The lack of flexibility in adapting procedures to changes in air traffic, the dismissal of safety improvements suggested by frontline personnel, the fear of retaliation expressed by some former employees, and the ATO's actions following this accident all suggest an organization that does not embrace the principles of open communication, just culture, and continuous improvement inherent to a positive safety culture. The NTSB concludes that **FAA ATO management did not follow the tenets of SMS to support its workforce, encourage open communication, identify and mitigate risks, or foster a just culture, which eroded the overall safety culture within ATO. [FINDING 70]** The NTSB recognizes that the FAA's postaccident initiative to introduce a single, agencywide SMS presents an opportunity to identify and correct inconsistencies between ATO SMS guidance and its other SMS policies and guidance. Therefore, the NTSB recommends that the Secretary of Transportation **work with the FAA Administrator to convene an independent panel to conduct a comprehensive review of the safety culture within the FAA's ATO, and use the findings to enhance the ATO's existing SMS and integrate it into all levels of the organization. [RECOMMENDATION 48]**

## US Army Safety Assurance

Although helicopters and airplanes had routinely experienced close encounters in the DCA area, the organizations involved appeared to lack awareness of how common such encounters were, or the safety-related implications. Aside from the DCA ATCT controllers who recommended the relocation of Helicopter Route 4 away from the runway 33 approach path, neither FAA or Army was effectively monitoring the risk of a midair collision between military helicopters and civilian fixed-wing aircraft in the area.

The NTSB's review of the Army's safety management processes revealed deficiencies in safety assurance that were not in compliance with DOW requirements and that left the Army unaware of the potential for a midair collision in the DCA area (DOD, 2019b). For example, the Army lacked a flight data monitoring program that could have detected deviations above the published altitudes on Route 4. Flight data monitoring programs have been used by commercial operators, manufacturers, and the FAA to identify, evaluate, and monitor the risks of specific categories of accidents and design and implement safety enhancements to mitigate such risks; however, these programs depend on the collection of relevant operational data, which the Army was not collecting.

Flight data monitoring programs analyze data from a variety of sources, such as flight recorders, dedicated quick access recorders, and ADS-B. If Army safety professionals had been analyzing operational data from its helicopters, it is likely they would have identified altitude exceedances on the helicopter routes adjacent to DCA and would have taken steps to understand why the exceedances were occurring at such a high rate. This may have also raised their awareness about cumulative errors in the UH-60's barometric altimetry system, and the lack of compatibility between the narrow acceptable range of operating altitudes on Route 4 and the acceptable range of error in the barometric altimeters. The NTSB concludes that **the Army did not have a flight safety data monitoring program for helicopters, and as a result, was unaware of routine altitude exceedances and related risks in the DCA terminal area. [FINDING 71]** Given the density of civil air traffic in close proximity to the helicopter routes, this was an unacceptable oversight. Class B airspace surrounds the busiest airports in the country used by passenger-carrying airlines. The Army must take extraordinary care that it does not routinely introduce unacceptable risk to civil aircraft operations in such areas. A 2020 report from the National Commission on Military Aviation Safety found that, if all military services fully employed FOQA, Line Operations Safety Audit (LOSA), and ASAP programs, "the Department of Defense and services would have an invaluable collection of data that would support the development of predictive analysis safety programs" (National Commission on Military Aviation Safety, 2020). Therefore, the NTSB recommends that the Secretary of the Army **establish a flight data monitoring program for rotary-wing aircraft the US Army operates in the NAS. [RECOMMENDATION 38]**

Another limitation in the Army's safety assurance capability was the absence of a mature, front-line incident reporting program capable of capturing first-hand accounts of close encounters between aircraft. The Army's framework for hazard identification, reporting, and analysis consisted of operational hazard reports (OHRs) and the Army Safety Management Information System (ASMIS) "mishap and near miss reporting" module; however, participation in these programs was limited, and they had not yet matured into full operational use.

The TAAB safety manager stated that ASMIS 2.0 was being used to record monthly inspection results, mishaps, and near-misses, but described these as company-level safety inputs rather than individual pilot submissions. TAAB pilots similarly described company safety officers as responsible for most safety paperwork and data entry. Pilot interviews gave no indication of flight crew-initiated OHRs, and no interviewee described pilots directly logging events in ASMIS.

According to the brigade safety manager, no ASMIS near-miss reports or OHRs related to near mid-air collisions between aircraft had been filed, and no OHRs had been filed about near midair collisions in the DCA area. The brigade safety manager stated that no OHRs had been submitted by brigade pilots for any reason in the year preceding the accident. This low utilization could explain, in part, the Army's lack of awareness about the prevalence of close proximity events in the DCA area. The NTSB concludes that **the Army's safety reporting systems for pilots were not well utilized and did not provide the organization with information about close encounters between Army helicopters and other aircraft that were later found to have occurred frequently. [FINDING 72]**

Given the number of close encounters between helicopters and fixed-wing aircraft in the DCA area revealed by postaccident analysis of safety data, the NTSB believes that it is important for the Army to improve its capability in this area. Interviewed pilots did not offer reasons for their lack of utilization of the safety reporting systems. Research literature suggests that common reasons for underreporting cited by pilots include the effort required to file a safety report, concern over negative consequences, and disbelief that safety reporting will lead to safety improvements (Haslbeck, Schmidt-Moll, and Schubert, 2015, 596-601). Such barriers might be addressed by reducing the effort required to file a report, cultivating a supportive ("just") culture, or providing feedback to pilots about changes resulting from safety reports. The first step in addressing this issue would be for the Army to identify the specific reasons for the low utilization of safety reporting systems among its pilots. Therefore, the NTSB recommends that the Secretary of the Army **survey US Army helicopter pilots to identify barriers to the utilization of flight safety reporting systems, develop a plan to address the identified barriers, and implement that plan across Army aviation units. [RECOMMENDATION 39]**

The deficiencies noted above likely existed because the Army had yet to fully implement best practices for safety management. Based on testimony from the TAAB commander during the investigative hearing, TAAB was in the beginning stages of implementing the Army's version of SMS (Army Safety and Occupational Health Management System, or ASOHMS) and had not yet reached the point where it was focused on the development of effective safety assurance capabilities.

The Army's slow progress in implementing ASOHMS could stem from several causes. First, responsibility for different aspects of safety management was widely distributed across various Army organizations. Second, the program was designed to address the full range of safety issues that a commander might seek to manage, both on- and off-duty, not only safety of flight operations. Third, the Army encountered resource issues, as evidenced by comments made at the NTSB's investigative hearing by the director of the Data Analysis and Prevention Directorate that the military flight operations quality assurance (MFOQA) mandate was unfunded. Fourth, TAAB safety personnel indicated that staffing was an issue. Until shortly before this accident, TAAB had only one full-time safety manager, who was responsible for five battalions and a variety of different functions. Due to his broad range of responsibilities, only half of his time was available for working on flight safety issues, and only a portion of that time was spent specifically on helicopter safety. The 12th Aviation Battalion safety officer, who was also a pilot, spent about 75% of his time on ground safety and occupational health matters and 25% on aviation safety. B Company's safety officer, also a pilot, estimated that 80% of his time was spent on occupational health and safety matters. By comparison, a Part 121 airline typically employs several individuals working full-time on flight safety management-related functions.

A 2023 GAO study of Army National Guard helicopter units found that workload and staffing imbalances hindered the scope of safety officer efforts in the Guard's aviation units. Safety officers interviewed by the GAO described struggling to address the broad scope of their ground and flight safety responsibilities and their roles as pilots. This impeded their ability to do such things as "coordinating with other safety organizations; using data systems to perform hazard analysis; communicating with unit personnel for aircraft-specific insights; and overseeing the quality of hazard and accident reporting processes." Evidence from this investigation suggests that TAAB and the 12th Aviation Battalion faced similar challenges with safety-related staffing and workload allocations.

At the NTSB's investigative hearing, the director of safety and occupational health for the US Army Secretariat acknowledged the existence of these challenges and said that the Army was updating its "manpower evaluation" model to address the issue. Although updating the manpower evaluation model was an annual requirement, past updates did not result in adequate safety staffing. The NTSB concludes that **the Army's process for allocating resources to aviation safety management did not ensure the development of a robust SMS for helicopter operations in the Washington, DC, area. [FINDING 73]** This accident demonstrates the importance of having the capability for, at a minimum, implementing safety assurance processes to monitor the safety of Army aviation operations in densely utilized airspace with a high concentration of commercial air traffic. Therefore, the NTSB recommends that the Secretary of the Army **revise the method for allocating resources to ensure the development of a robust SMS that will, at a minimum, identify and monitor the potential for midair collisions between Army aircraft and civil air traffic operating in the NAS. [RECOMMENDATION 40]**

## US Army Safety Culture

Our investigation identified several characteristics of the Army's safety culture relevant to this accident.

**Just culture**: At the operational unit level (brigade and battalion), investigators found evidence of a generally non-punitive and non-repressive safety climate. Frontline personnel reported feeling comfortable expressing safety-related concerns to safety officers and to their chain of command. The absence of a repressive climate did not appear to be a limiting factor in safety information flow.

**Reporting culture**: Although formal safety reporting systems existed, including OHRs and ASMIS near-miss reports, their utilization by flight crews was low. As a result, the organization had limited visibility into emerging operational risks, including the frequent close proximity of helicopters to jet aircraft arriving at DCA. This gap reflects a reporting culture that was formally established but not functionally embedded in routine operations.

**Informed culture**: The Army's ability to maintain an informed understanding of operational risk was constrained by organizational structure and priorities. Safety professionals who might otherwise analyze safety reports and operational data were largely consumed by ground safety and occupational health responsibilities mandated at the Army level. In combination with the low volume of flight safety reports and the absence of flight data monitoring capability, these constraints limited the organization's capacity to synthesize available information and maintain awareness of hazards, such as routine altitude exceedances on Washington, DC, helicopter routes.

**Flexible culture**: The Army's safety system lacked the structural flexibility and analytical capability necessary to adapt its safety focus in response to changes in the operational environment. Consequently, safety oversight did not adjust to the increasing density of aircraft arrivals at DCA, the reliance on visual separation to maintain traffic flow, or the infrequent use of runway 33, which made encounters between helicopters on Route 4 and low-flying airplanes approaching from the southeast atypical and less anticipated.

**Learning culture**: Organizational learning within the Army was primarily reactive, occurring in response to mishaps rather than through anticipatory identification of weak signals and emerging trends. The Secretary of the Army had mandated adoption of the ASOHMS in 2024, and the Army Combat Readiness Center had developed tools to support hazard tracking and analysis; however, these capabilities were not effectively utilized due to the structural and cultural limitations described above.

Although Army leadership had recently initiated policy changes intended to shift aviation safety management in a more proactive direction, these efforts were constrained by limitations in organizational capacity and safety culture. Specifically, Army aviation exhibited an underdeveloped reporting culture, limited informed awareness of operational hazards, insufficient flexibility to adapt safety oversight to changing risk, and a learning culture oriented toward reactive rather than anticipatory risk management.

The NTSB concludes that **the Army's aviation safety system failed to consistently detect, interpret, and act on signals of latent hazards, resulting in degraded safety assurance, organizational learning, and safety culture. [FINDING 74]**

The NTSB believes that addressing the identified safety culture limitations described above would require the Army to take several interrelated, system-level steps. First, the Army would need to ensure that flight safety management functions are adequately staffed and resourced, including the assignment of competent safety professionals with the expertise and time necessary to cultivate a robust reporting culture and to identify weak signals of risk through effective analysis.

Second, the Army would need to structurally protect these personnel from collateral duties unrelated to aviation safety that dilute their capacity to perform proactive safety oversight.

Third, the Army would need to provide flight safety personnel with objective data collection and analysis tools, such as a funded and institutionalized MFOQA capability, to support the detection of emerging risk trends during normal operations.

Finally, the Army would need to ensure that flight safety personnel are empowered, through organizational authority and access to leadership, to effectively advocate for safety-related changes based on the risks they identify.

As a result, the NTSB recommends that the US Army **develop and maintain a flight safety management capability that is independently resourced and functionally separate from its occupational and environmental health management system, and ensure that this capability is both culturally and functionally integrated with units conducting sustained flight operations in the NAS. [RECOMMENDATION 41]**

## Attachment:
## NTSB Findings, Probable Cause, and Recommendations List

**Findings**

1. The pilots of flight 5342 were certificated and qualified in accordance with federal regulations.
2. The pilots of flight 5342 were medically qualified for duty, and available evidence does not indicate that they were impaired by effects of medical conditions or substances at the time of the accident.
3. Review of the flight 5342 pilots' time since waking and sleep opportunities in the days before the accident indicated that the pilots were unlikely to have been experiencing fatigue.
4. The pilot, instructor pilot, and crew chief onboard PAT25 were qualified and current in their positions as designated by the unit commander in accordance with Army regulations.
5. The pilot, instructor pilot, and crew chief of PAT25 were medically qualified for duty, and available evidence does not indicate that they were impaired by effects of medical conditions or substances at the time of the accident.
6. Review of the three PAT25 crewmembers' time since waking and sleep opportunities in the days before the accident indicated that the crew were unlikely to have been experiencing fatigue.
7. The airplane was properly certificated, equipped, and maintained in accordance with 14 CFR Part 121. The airplane was operated within its weight and balance limitations throughout the flight. Examination of the airplane revealed damage consistent with an in-flight collision and subsequent impact with water, and there was no evidence of any structural, system, or powerplant failures or anomalies. Review of surveillance videos indicated that the airplane's wing navigation, landing/taxi, and anti-collision strobe lights were operating at the time of the collision.
8. The helicopter was properly certificated, equipped, and maintained in accordance with US Army regulations. Review of helicopter maintenance records did not reveal any open discrepancies or anomalous trends that contributed to the accident. The helicopter was operated within its weight and balance limitations throughout the flight. Examination of the helicopter revealed damage consistent with an in-flight collision and subsequent impact with water, and there was no evidence of any structural, main or tail rotor system, flight control system, or powerplant failures or anomalies. Review of surveillance videos indicated that the helicopter's right and tail position lights, the landing light, as well as both upper and lower anti-collision lights, were operating at the time of the collision.
9. The operations supervisor and four controllers who were working in the Ronald Reagan Washington National Airport air traffic control tower cab at the time of the accident were properly certified, qualified in accordance with federal regulations and facility directives, and current.
10. Although the Ronald Reagan Washington National Airport air traffic control tower facility was not staffed to its target level at the time of the accident, the number of staff in the tower at the

time of the accident was adequate and in accordance with Federal Aviation Administration directives.

11. The decision to combine the helicopter control and local control positions was not the result of insufficient staffing, and personnel were available to staff the helicopter control and local control positions separately had the operations supervisor chosen to do so.

12. The local control controller, assistant local controller, and operations supervisor were medically qualified for duty, and available evidence does not indicate they were impaired by effects of medical conditions at the time of the accident.

13. Review of the local control and assistant local control controllers' and operations supervisor's (OS) time since waking and sleep opportunities in the days before the accident indicated that the controllers, including the OS, were unlikely to have been experiencing fatigue.

14. Visual meteorological conditions prevailed in the area at the time of the accident. A review of observations recorded throughout the night of the accident revealed no evidence of any local atmospheric pressure anomalies that would have impacted barometric altimeter readings.

15. The Metropolitan Washington Airports Authority Airport Rescue and Firefighting and airport operations staff responded immediately and in accordance with applicable emergency plans and regulatory requirements, deploying land- and water-based resources, and coordinating mutual aid under complex nighttime and on-water conditions.

16. Keeping the helicopter control and local control positions continuously combined on the night of the accident increased the local control controller's workload and negatively impacted his performance and situation awareness.

17. The local control and helicopter control positions should have been separated at the time of the accident given present traffic volume and complexity.

18. In the two minutes before the accident when traffic volume was increasing, the assistant local controller should have prioritized surveillance of aircraft in the air in order to assist the local controller, rather than diverting her attention to the lower priority task of documenting helicopter information, which could have been completed when traffic volume and complexity had subsided.

19. Had the helicopter and local control positions been staffed separately, PAT25 might have received a more timely and effective traffic advisory.

20. Due to extended time on position at the time of the collision and his complacency, the operations supervisor was likely experiencing reduced alertness and vigilance, which decreased his awareness of the operational environment and reduced his ability to proactively assess the risks posed by the traffic and environmental conditions at the time of the accident.

21. The lack of mandatory relief periods for supervisory air traffic control personnel is contrary to human factors research that shows clear performance deterioration in situations of prolonged time on task.

22. Although the local control controller provided an initial traffic advisory to the crew of PAT25 in accordance with Federal Aviation Administration Order Job Order 7110.65, he did not provide a corresponding advisory to the crew of flight 5342 regarding PAT25's location and intention, which could have increased situation awareness for the crew of flight 5342.

23. If the local control controller had issued a standard safety alert to the flight crews of either aircraft as prescribed in FAA Order Job Order 7110.65, providing the conflicting aircraft's position and positive control instructions, the crew of either aircraft could have taken immediate action to avert the impending collision.

24. Initial and recurrent scenario-based training in threat and error management would help controllers identify and mitigate risks and strengthen situation awareness.

25. A risk assessment or decision making tool would likely have benefited the accident OS in identifying and mitigating the operational risk factors that were present on the night of the accident.

26. Due to degraded radio reception, the crew of PAT25 did not receive salient information regarding flight 5342's circling approach to runway 33.

27. The PAT25 instructor pilot did not positively identify flight 5342 at the time of the initial traffic advisory despite his statement that he had the traffic in sight and his request for visual separation.

28. With several other targets located directly in front of the helicopter represented by points of light with no other features by which to identify aircraft type, and without additional position information from the controller, the instructor pilot likely identified the wrong target.

29. Interference that obscured the controller's "circling to" call, the microphone keying that blocked the PAT25 crew from receiving the instruction to "pass behind," ambiguous visual cues, and the lack of an integrated traffic awareness and alerting system likely reinforced the PAT25 crew's expectation bias that the airplane was among the traffic approaching runway 1 and did not pose a conflict.

30. The absence of documented training on Ronald Reagan Washington National Airport's fixed-wing procedures and the mixed-traffic operating environment represented a safety vulnerability for Army flight crews operating in the Ronald Reagan Washington National Airport Class B airspace.

31. Due to additive allowable tolerances of the helicopter's pitot-static/altimeter system, it is likely that the crew of PAT25 observed a barometric altimeter altitude about 100 ft lower than the helicopter's true altitude, resulting in the crew erroneously believing that they were under the published maximum altitude for Route 4.

32. A recurrent task to verify the continued accuracy of recorded flight data for US Army aircraft would help ensure the data integrity needed to support quality assurance and safety programs and accident investigations.

33. The Federal Aviation Administration and the Army failed to identify the incompatibility between the helicopter routes' low maximum altitudes and the error tolerances of barometric altimeters,

which contributed to helicopters regularly flying higher than published maximum altitudes and potentially crossing into the runway 33 glidepath.

34. Pilots need all available information on the potential total error, allowed by design, that could occur in flight on an airworthy barometric altimeter.

35. The Army's post-installation functional check of the transponder on the accident helicopter was insufficient to detect that it was not broadcasting Automatic Dependent Surveillance–Broadcast Out.

36. The Army's lack of a recurrent transponder inspection procedure resulted in the incorrect aircraft address being transmitted by the accident helicopter's transponder, and the incorrect automatic dependent surveillance–broadcast settings on several other helicopters being undetected.

37. Because the APX-123A transponder is designed for use on multiple aircraft platforms, it is possible that incorrect settings may be present on other aircraft used throughout the Department of War armed services.

38. The crew of flight 5342 did not see the helicopter until it was too late to avoid a collision because of the high workload imposed during the final phase of their approach, and due to the helicopter's low conspicuity and lack of apparent motion.

39. Times of compacted demand as a result of air carrier scheduling practices increased operational complexity and required mitigations by controllers to maintain spacing and surface movement.

40. Ronald Reagan Washington National Airport air traffic control tower routinely received less than the requested miles in trail spacing from Potomac Consolidated Terminal Radar Approach Control, which increased controller workload by requiring them to generate additional spacing to prevent delays or gridlock.

41. The practice of "offloading" arrival traffic on approach to runway 1 by asking pilots if they could accept a circling approach to runway 33 was a routine mitigation strategy for Ronald Reagan Washington National Airport controllers to generate spacing that was not provided by Potomac Consolidated Terminal Radar Approach Control.

42. Time-based flow management, or metering, would provide Potomac Consolidated Terminal Radar Approach Control and Ronald Reagan Washington National Airport air traffic control tower with a consistent flow of traffic with more accurate spacing and greater predictability, thereby reducing controller workload.

43. Ronald Reagan Washington National Airport air traffic control tower has significant airspace, airfield, mixed fleet, and operations complexities that appear to be inconsistent with its current facility level classification.

44. The Federal Aviation Administration Air Traffic Organization failed to recognize external compliance verification results as indicators of systemic traffic management, volume, and flow issues at Ronald Reagan Washington National Airport for which controllers were required to compensate.

45. The longstanding practice of relying on pilot-applied visual separation (see-and-avoid) as the principal means of separating helicopter and fixed wing traffic in the Washington, DC, area by Ronald Reagan Washington National Airport air traffic control tower, the Army, and other helicopter operators led to a drift in operating practices among controllers and helicopter crews that increased the likelihood of a midair collision.

46. Reliance on pilot-applied visual separation (see-and-avoid) as a primary means of separating mixed traffic introduced unacceptable risk to the Ronald Reagan Washington National Airport Class B airspace.

47. Ronald Reagan Washington National Airport air traffic control tower's procedure of maintaining a discrete helicopter frequency when the local and helicopter control positions were combined decreased overall situation awareness for pilots operating in the area.

48. Providing controllers with additional salient cues regarding the perceived severity of a potential conflict would reduce controller cognitive load and would likely improve reaction time to the most critical conflict alerts.

49. There was no evidence that the local control controller, assistant local control controller, or operations supervisor were under the influence of alcohol or prohibited drugs at the time of the accident; however, evidence was substantially limited by the lack of postaccident alcohol testing, and evidence was of somewhat lower quality than it would have been if drug testing had been conducted sooner following the accident.

50. The Federal Aviation Administration Air Traffic Organization's (ATO) drug and alcohol testing determination did not meet Department of Transportation (DOT) timeliness requirements; furthermore, the ATO's decision to not conduct drug testing as soon as possible after the testing determination, and to not conduct alcohol testing at all, violated DOT requirements.

51. The delayed and inappropriate drug and alcohol testing determination was due in part to the Air Traffic Organization's (ATO) determination process being inadequately designed to routinely meet Department of Transportation requirements for timely testing, and in part to ATO staff's incomplete understanding of those requirements.

52. Annual reviews of helicopter route charts as required by Federal Aviation Administration Order 7210.3DD would have provided an opportunity to identify the risk posed by the proximity of Route 4 to the runway 33 approach path, but there is no evidence to support that these reviews were being performed at Ronald Reagan Washington National Airport.

53. The information published by the Federal Aviation Administration regarding Washington, DC, area helicopter routes was insufficient to provide helicopter and fixed-wing operators with a complete understanding of the helicopter route structure and its lack of procedural separation from fixed-wing traffic.

54. Current aeronautical charting does not provide information on visual flight rules helicopter routes that may conflict or come in close proximity to approach and departure corridors, which reduces pilot situation awareness.

55. The lack of Automatic Dependent Surveillance–Broadcast (ADS-B) Out from the accident helicopter did not contribute to this accident, as the helicopter was still being tracked by radar, and ADS-B Out would not have provided improved traffic alerting for the Ronald Reagan Washington National Airport controller or the crew of flight 5342, because the airplane was not equipped with ADS-B In.

56. The Army's standard operating procedures that prevent flight crews from enabling Automatic Dependent Surveillance–Broadcast (ADS-B) Out while in flight, when not performing sensitive missions that require ADS-B to be disabled, limit the visibility of military aircraft on collision avoidance technologies that leverage ADS-B information.

57. Although the airplane's traffic alert and collision avoidance system operated as designed, it was ineffective in preventing the collision because of current activation criteria and resolution advisory inhibit altitudes.

58. Traffic advisory aural alerts that include additional information about the location of traffic could reduce the time pilots need to visually acquire target aircraft.

59. Had the airplane been equipped with an airborne collision avoidance system that used Automatic Dependent Surveillance–Broadcast In information to show directional traffic symbols, the crew of flight 5342 would have received enhanced information about the risk posed by the helicopter, which could have enabled them to take earlier action to avert the collision.

60. Although the pilot and instructor pilot onboard PAT25 were equipped with tablets that had the ability to display traffic transmitting Automatic Dependent Surveillance–Broadcast Out, it is unlikely that the pilots were using the tablets to monitor or identify traffic at the time of the accident due to the workload associated with low-altitude flight.

61. Technological advances since the development of traffic alert and collision avoidance system II operating standards may allow airborne collision avoidance system Xa with reduced inhibit altitudes to have an expanded alerting envelope while reducing nuisance alerts.

62. Although not yet commercially available, had the helicopter been equipped with airborne collision avoidance system Xr with integrated aural alerting, the crew could have received an alert regarding flight 5342 and could have taken action to avert the collision.

63. Multiple data sources provided evidence of midair collision risk between fixed-wing aircraft and helicopters at Ronald Reagan Washington National Airport, including on approach to runway 33, before this accident; however, the limited access to and use of available objective and subjective proximity data hindered industry and government stakeholders' ability to identify hazards and mitigate risk.

64. Improving stakeholder access to standardized and objective information about aircraft close proximity encounters for use in safety assurance processes would increase the likelihood of detecting and mitigating hazards before accidents occur.

65. The Federal Aviation Administration's lack of an established process to inform parties about their involvement in events such as near midair collisions or traffic alert and collision avoidance

system resolution advisories reduces the likelihood of fully understanding and mitigating future midair collision risk.

66. The Federal Aviation Administration Air Traffic Organization was made aware of, and had multiple opportunities to identify the risk of a midair collision between airplanes and helicopters at Ronald Reagan Washington National Airport; however, their data analysis, safety assurance, and risk assessment processes failed to recognize and mitigate that risk.
67. The Federal Aviation Administration Air Traffic Organization's application of its safety management system did not effectively coordinate safety assurance and safety risk management activities with external stakeholders in the Ronald Reagan Washington National Airport Class B airspace.
68. Changes to Ronald Reagan Washington National Airport air traffic control tower's standard operating procedures to the accident removing the requirement for the operations supervisor (OS) to document the time and reason for combining or de-combining the helicopter control position in the facility log made it less likely that the OS would consider and evaluate the risks associated with combining or de-combining the position.
69. Safety risk management practices were not fully integrated into Ronald Reagan Washington National Airport air traffic control tower operations and did not identify or mitigate the operational challenges faced by controllers or the lack of guidance regarding operational risk assessments for controllers and supervisors.
70. Federal Aviation Administration Air Traffic Organization (ATO) management did not follow the tenets of safety management systems to support its workforce, encourage open communication, identify and mitigate risks, or foster a just culture, which eroded the overall safety culture within ATO.
71. The Army did not have a flight safety data monitoring program for helicopters, and as a result, was unaware of routine altitude exceedances and related risks in the Ronald Reagan Washington National Airport terminal area.
72. The Army's safety reporting systems for pilots were not well utilized and did not provide the organization with information about close encounters between Army helicopters and other aircraft that were later found to have occurred frequently.
73. The Army's process for allocating resources to aviation safety management did not ensure the development of a robust safety management system for helicopter operations in the Washington, DC, area.
74. The Army's safety system failed to consistently detect, interpret, and act on signals of latent hazards, resulting in degraded safety assurance, organizational learning, and safety culture.

**Probable Cause**

We determined that the probable cause of this accident was the FAA's placement of a helicopter route in close proximity to a runway approach path; their failure to regularly review and evaluate helicopter routes and available data, and their failure to act on recommendations to mitigate the risk of a midair collision near Ronald Reagan Washington National Airport; as well as the air traffic system's overreliance on visual separation in order to promote efficient traffic flow without consideration for the limitations of the see-and-avoid concept.

Also causal was the lack of effective pilot-applied visual separation by the helicopter crew, which resulted in a midair collision. Additional causal factors were the tower team's loss of situation awareness and degraded performance due to the high workload of the combined helicopter and local control positions and the absence of a risk assessment process to identify and mitigate real-time operational risk factors, which resulted in misprioritization of duties, inadequate traffic advisories, and the lack of safety alerts to both flight crews. Also causal was the Army's failure to ensure pilots were aware of the effects of error tolerances on barometric altimeters in their helicopters, which resulted in the crew flying above the maximum published helicopter route altitude.

Contributing factors include:

- The limitations of the traffic awareness and collision alerting systems on both aircraft, which precluded effective alerting of the impending collision to the flight crews;
- An unsustainable airport arrival rate, increasing traffic volume with a changing fleet mix, and airline scheduling practices at DCA, which regularly strained the DCA ATCT workforce and degraded safety over time;
- The Army's lack of a fully implemented safety management system, which should have identified and addressed hazards associated with altitude exceedances on the Washington, DC, helicopter routes;
- The FAA's failure across multiple organizations to implement previous NTSB recommendations, including ADS-B In, and to follow and fully integrate its established safety management system, which should have led to several organizational and operational changes based on previously identified risks that were known to management; and
- The absence of effective data sharing and analysis among the FAA, aircraft operators, and other relevant organizations.

**What We Recommended**

On Mar. 7, 2025 we issued an urgent recommendation report (AIR-25-01) with two urgent recommendations on mitigating the risk of midair collisions at DCA.

**To the Federal Aviation Administration**:

- Prohibit operations on Helicopter Route 4 between Hains Point and the Wilson Bridge when runways 15 and 33 are being used for departures and arrivals, respectively, at Ronald Reagan Washington National Airport (DCA). (Urgent)
- Designate an alternative helicopter route that can be used to facilitate travel between Hains Point and the Wilson Bridge when that segment of Route 4 is closed. (Urgent)

As a result of this investigation, we made the following new safety recommendations.

**To the Federal Aviation Administration:**

1. Develop and implement time-on-position limitations for supervisory air traffic control personnel, including guidance for district and facility level management to adapt these limitations to account for their own staffing and local standard operating procedures.
2. Develop instructor-led, scenario-based training on threat and error management that trains controllers to continuously monitor their environment to more quickly and accurately identify threats; promote team communication to ensure that communications are clear, timely, and assertive; emphasize effective scanning habits; recognize patterns in the development of adverse events; and enhance decision-making under stress by developing habits that balance procedural compliance with problem solving to mitigate the risks of threats and errors, and provide this training to all air traffic controllers annually.
3. Develop and implement a risk assessment tool for supervisors that incorporates the principles of threat and error management to assist in risk identification, mitigation, and operational decision making.
4. Initiate rulemaking in 14 Code of Federal Regulations Part 93 Subpart K, High Density Traffic Airports, that prescribes air carrier operation limitations at DCA in 30-minute periods, similar to those imposed at LaGuardia Airport, to ensure that the airport does not exceed capacity and to mitigate inconsistent air carrier scheduling practices.
5. Fully implement operational use of the time-based flow management system at Potomac Consolidated Terminal Radar Approach Control and its associated air traffic control towers.
6. Reassess the Ronald Reagan Washington National Airport's airport arrival rate with special consideration to its airspace complexity, airfield limitations, mixed-fleet operations, and traffic volume.
7. Define objective criteria for the determination of air traffic facility levels considering traffic and airspace volume, operational factors unique to each facility, and cost of living.
8. Using the criteria established by Safety Recommendation [7], determine whether the classification of the Ronald Reagan Washington National Airport's air traffic control tower as a level 9 facility appropriately reflects the complexity of its operations.
9. Conduct a comprehensive evaluation, in conjunction with local operators, to determine the overall safety benefits and risks to requiring all aircraft to use the same frequency when the helicopter and local positions are combined in the Ronald Reagan Washington National Airport air traffic control tower.
10. Implement anti-blocking technology that will alert controllers and/or flight crews to potentially blocked transmissions when simultaneous broadcasting occurs.
11. Develop and implement improvements to the conflict alert system to provide more salient and meaningful alerts to controllers based on the severity of the conflict triggering the alert.

12. Once the improvements to the conflict alert system discussed in Safety Recommendation [11] are implemented, provide training to controllers on its use.
13. Revise the Air Traffic Organization's initial event response procedures so that an appropriate on-site supervisor makes each postaccident and postincident drug and alcohol testing determination, based on their assessment of whether the event meets testing criteria and which controllers had duties pertaining to the involved aircraft, without needing to wait for investigation or approval.
14. At least annually, provide training on the revised postaccident and postincident drug and alcohol testing determination procedure discussed in Safety Recommendation [13] to all staff who have responsibilities under that procedure; this training should include a post-learning knowledge assessment.
15. Ensure that annual reviews of helicopter route charts are being conducted throughout the National Airspace System as required by Federal Aviation Administration Order.
16. Conduct a safety risk management process to evaluate whether modifications to the remaining helicopter route structure in the vicinity of Ronald Reagan Washington National Airport are necessary to safely deconflict helicopter and fixed-wing traffic and provide the results to the National Transportation Safety Board.
17. Amend your helicopter route design criteria and approval process to ensure that current and future route designs or design changes provide vertical separation from airport approach and departure paths.
18. Based on the criteria and approval process established by Safety Recommendation [17], review all existing helicopter routes to ensure alignment with these updated criteria.
19. Incorporate the lateral location and published altitudes of helicopter routes onto all instrument and visual approach and departure procedures to provide necessary situation awareness to fixed-wing operators of the risk of helicopter traffic operating in their vicinity.
20. Modify airborne collision avoidance system traffic advisory aural alerts to include clock position, relative altitude, range, and vertical tendency.
21. Require existing and new traffic alerting and collision avoidance system (TCAS) I, TCAS II, and airborne collision avoidance system X installations to integrate directional traffic symbols.
22. Require all aircraft operating in airspace where Automatic Dependent Surveillance–Broadcast (ADS-B) Out is required to also be equipped with ADS B In with a cockpit display of traffic information that is configured to provide alerting audible to the pilot and/or flight crew.
23. Require the use of the appropriate variant of airborne collision avoidance system X on new production aircraft that are subject to traffic alert and collision avoidance system equipage regulations.
24. Require existing aircraft that are subject to traffic alert and collision avoidance system equipage regulations be retrofitted with the appropriate variant of airborne collision avoidance system X.

25. Evaluate the feasibility of decreasing the traffic advisory and resolution advisory inhibit altitudes in airborne collision avoidance system Xa to enable improved alerting throughout more of the flight envelope.

26. If the evaluation resulting from Safety Recommendation [25] finds that the inhibit altitudes can be safely decreased, require retrofitting of the applicable airborne collision avoidance system X variant incorporating the reduced traffic advisory and resolution advisory inhibit altitudes on all aircraft that are subject to traffic alert and collision avoidance system and equipage regulations.

27. Require that all rotorcraft operating in Class B airspace be equipped with airborne collision avoidance system (ACAS) Xr technology once the ACAS Xr standard has been published.

28. Create an objective definition of close proximity encounter and a public database of those encounters and their locations that can be used to monitor their prevalence and identify areas of potential traffic conflict for safety assurance and safety risk management.

29. Develop and implement a process that will, in a timely manner, notify involved parties after events such as near midair collisions or traffic alert and collision avoidance system resolution advisory activations, such that notification occurs while relevant data remain available and before meaningful safety analysis, reporting, or corrective action is no longer practicable.

30. Based on the results of the audit completed in accordance with Safety Recommendation [49], ensure that all safety management system functions and data sharing activities at all air traffic control facilities are conducted in collaboration with all relevant external stakeholders.

31. Establish a requirement across all air traffic control tower standard operating procedures that the operations supervisor (OS) or controller-in-charge (CIC) document in the daily facility log when any control position is combined with the local control position, or when the OS/CIC position is combined with a control position, along with a rationale for doing so.

32. Develop a new and comprehensive instructor-led, scenario-based training on the proper use of visual separation, both tower- and pilot-applied. This training should include information on the inherent limitations of see and avoid, responsibilities when applying visual separation, and guidance for controllers on factors, such as current traffic volume, workload, weather or environmental factors, experience, and staffing, that should be considered when applying visual separation. Require this training for all controllers and include on a recurrent basis thereafter in annual simulator refresher training.

33. Require each Class B or Class C air traffic control tower facility to evaluate its existing miles-in-trail procedures or agreements to ensure that the spacing provided is appropriate for operational safety, and make the results publicly available.

**To the US Army:**

34. Revise training procedures for flight crews assigned to operate in the Washington, DC, area to ensure that they receive initial and recurrent training on fixed-wing operations at Ronald Reagan

Washington National Airport, including approach and departure paths, runway configurations, and the interaction of those traffic flows with published helicopter routes.

35. Develop and implement a recurring procedure, at an interval not to exceed 18 months, to verify the continued accuracy of recorded flight data.

36. Incorporate information within the appropriate operator's manual for all applicable aircraft on the potential total error allowed by design that could occur in flight on an otherwise airworthy barometric altimeter, including the increased position error associated with the external stores support system configuration.

37. Develop and implement a transponder inspection procedure on all aircraft with transponders capable of transmitting Mode S and automatic dependent surveillance—broadcast (ADS-B) and operated in the National Airspace System (NAS), at least annually and upon each aircraft's entry into service in the NAS, that ensures 1) the transponder ADS-B settings are correct, 2) the transponder is transmitting ADS-B, and 3) the transponder is transmitting the correctly assigned address.

38. Establish a flight data monitoring program for rotary-wing aircraft the US Army operates in the National Airspace System.

39. Survey US Army helicopter pilots to identify barriers to the utilization of flight safety reporting systems, develop a plan to address the identified barriers, and implement that plan across Army aviation units.

40. Revise the method for allocating resources to ensure the development of a robust safety management system that will, at a minimum, identify and monitor the potential for midair collisions between Army aircraft and civil air traffic operating in the National Airspace System.

41. Develop and maintain a flight safety management capability that is independently resourced and functionally separate from its occupational and environmental health management system, and ensure that this capability is both culturally and functionally integrated with units conducting sustained flight operations in the National Airspace System.

**To the Department of War Policy Board on Federal Aviation:**

42. Conduct a study to evaluate the quality of radio transmissions and reception for those aircraft operated within the National Airspace System to identify factors that degrade communications equipment performance and adversely affect the safety of civilian and military flight operations.

43. Implement appropriate enhancements, based on the findings of the study recommended in Safety Recommendation [41], to remediate identified deficiencies in air–ground radio communications performance.

44. Require the Department of War to verify on all aircraft with transponders capable of transmitting Mode S and automatic dependent surveillance—broadcast (ADS-B) and operated in the National Airspace System (NAS), at least annually and upon each aircraft's entry into service in the NAS, that 1) the transponder ADS-B settings are correct, 2) the transponder is transmitting ADS-B, and 3) the transponder is transmitting the correctly assigned address.

45. Require armed services to amend their operational procedures to allow flight crews to enable Automatic Dependent Surveillance—Broadcast Out while in flight.
46. Require all military aircraft operating in the National Airspace System (NAS) be equipped with Automatic Dependent Surveillance-Broadcast (ADS-B) In with a cockpit display of traffic information that is configured to provide alerting audible to the pilot and/or flight crew, and that such requirement apply wherever in the NAS the Federal Aviation Administration requires any aircraft to operate with ADS-B Out.

**To the Department of Transportation:**

47. Require the Federal Aviation Administration to demonstrate at least annually that each air traffic control facility it operates has the routine capability to accomplish required postaccident and postincident drug and alcohol testing within the US Department of Transportation's specified timeframes of 2 hours for alcohol and 4 hours for drugs, and implement a process to ensure that any facility without such capability will demonstrate timely remediation.
48. Work with the Federal Aviation Administration (FAA) Administrator to convene an independent panel to conduct a comprehensive review of the safety culture within the FAA's Air Traffic Organization (ATO), and use the findings to enhance the ATO's existing safety management system and integrate it into all levels of the organization.

**To the Department of Transportation Office of Inspector General:**

49. Complete an audit of the Federal Aviation Administration (FAA) Air Traffic Organization safety management system functions and data sharing activities at all air traffic control facilities and determine whether these activities are conducted in collaboration with all relevant external stakeholders, ensuring that the audit's results are documented, reported to the Secretary of Transportation and the FAA Administrator, and made available to the public.

**To the RTCA Program Management Committee:**

50. Finalize and publish the minimum operational performance standards for airborne collision avoidance system Xr for rotorcraft.