US Airways Flight 1549

Accident Board Findings

1. The flight and cabin crewmembers were properly certificated and qualified under federal regulations. No evidence indicated any preexisting medical or physical condition that might have adversely affected the flight crew's performance during the accident flight.
2. The accident airplane was equipped, dispatched, and maintained in accordance with federal regulations.
3. The LaGuardia Airport departure controller's decision to display only correlated primary radar targets on his radar display was appropriate.
4. Examinations of the recovered components revealed no evidence of any preexisting engine, system, or structural failures. The airplane met the structural ditching certification regulations in effect at the time of its certification, and the engine met the bird-ingestion certification regulations in effect at the time of its certification, as well as an anticipated additional regulation that it was not required to meet at that time.
5. The airframe damage was caused by the high-energy impact at the aft fuselage and the ensuing forward motion of the airplane through the water.
6. Both engines were operating normally until they each ingested at least two large birds (weighing about 8 pounds each), one of which was ingested into each engine core, causing mechanical damage that prevented the engines from being able to provide sufficient thrust to sustain flight.
7. If the accident engines' electronic control system had been capable of informing the flight crewmembers about the continuing operational status of the engines, they would have been aware that thrust could not be restored and would not have spent valuable time trying to relight the engines, which were too damaged for any pilot action to make operational.
8. The size and number of the birds ingested by the accident engines well exceeded the current bird-ingestion certification standards.
9. The current small and medium flocking bird tests required by 14 Code of Federal Regulations 33.76(c) would provide a more stringent test of the turbofan engine core resistance to bird ingestion if the lowest expected fan speed for the minimum climb rate were used instead of 100-percent fan speed because it would allow a larger portion of the bird mass to enter the engine core.
10. Additional considerations need to be addressed related to the current 14 Code of Federal Regulations 33.76(d) large flocking bird certification test standards because they do not require large flocking bird tests on smaller transport-category airplane engines, such as the accident engine, or a test of the engine core; the circumstances of the accident demonstrate that large birds can be ingested into the core of small engines and cause significant damage.
11. Although engine design changes and protective screens have been used or considered in some engine and aircraft designs as a means to protect against bird ingestion, neither option has been found to be viable on turbofan engines like the accident engine.
12. Although the Engine Dual Failure checklist did not fully apply to the accident event, it was the most applicable checklist contained in the quick reference handbook to address the event, and the flight crew's decision to use this checklist was in accordance with US Airways procedures.
13. If a checklist that addressed a dual-engine failure occurring at a low altitude had been available to the flight crewmembers, they would have been more likely to have completed that checklist.
14. Despite being unable to complete the Engine Dual Failure checklist, the captain started the auxiliary power unit, which improved the outcome of the ditching by ensuring that a primary source of electrical power was

available to the airplane and that the airplane remained in normal law and maintained the flight envelope protections, one of which protects against a stall.

15. The captain's decision to ditch on the Hudson River rather than attempting to land at an airport provided the highest probability that the accident would be survivable.
16. The captain's difficulty maintaining his intended airspeed during the final approach resulted in high angles-of-attack, which contributed to the difficulties in flaring the airplane, the high descent rate at touchdown, and the fuselage damage.
17. The captain's difficulty maintaining his intended airspeed during the final approach resulted, in part, from high workload, stress, and task saturation.
18. The captain's decision to use flaps 2 for the ditching, based on his experience and perception of the situation, was reasonable and consistent with the limited civilian industry and military guidance that was available regarding forced landings of large aircraft without power.
19. The professionalism of the flight crewmembers and their excellent crew resource management during the accident sequence contributed to their ability to maintain control of the airplane, configure it to the extent possible under the circumstances, and fly an approach that increased the survivability of the impact.
20. Comprehensive guidelines on the best means to design and develop emergency and abnormal checklists would promote operational standardization and increase the likelihood of a successful outcome to such events.

21. Training pilots how to respond to a dual-engine failure occurring at a low altitude would challenge them to use critical thinking and exercise skills in task shedding, decision-making, and proper workload management to achieve a successful outcome.
22. The flight crewmembers would have been better prepared to ditch the airplane if they had received training and guidance about the visual illusions that can occur when landing on water and on approach and about touchdown techniques to use during a ditching, with and without engine power.
23. The guidance in the ditching portion of the Engine Dual Failure checklist is not consistent with the separate Ditching checklist, which includes a step to inhibit the ground proximity warning system and terrain alerts.
24. Training pilots that sidestick inputs may be attenuated when the airplane is in the alpha-protection mode would provide them with a better understanding of how entering the alpha-protection mode may affect the pitch response of the airplane.
25. The review and validation of the Airbus operational procedures conducted during the ditching certification process for the A320 airplane did not evaluate whether pilots could attain all of the Airbus ditching parameters nor was Airbus required to conduct such an evaluation.
26. During an actual ditching, it is possible but unlikely that pilots will be able to attain all of the Airbus ditching parameters because it is exceptionally difficult for pilots to meet such precise criteria when no engine power is available, and this difficulty contributed to the fuselage damage.
27. This accident was not a typical bird-strike event; therefore, this accident demonstrates that a bird strike does not need to be typical to be hazardous.
28. The accident bird strike occurred at a distance and altitude beyond the range of LaGuardia Airport's (LGA) wildlife hazard responsibilities and, therefore, would not have been mitigated by LGA's wildlife management practices.
29. A proactive approach to wildlife mitigation at 14 Code of Federal Regulations Part 139-certificated airports would provide a greater safety benefit than the current strategy of waiting for a serious event to occur before conducting a wildlife hazard assessment.

30. Although currently no technological, regulatory, or operational changes related to wildlife mitigation, including the use of avian radar, could be made that would lessen the probability of a similar bird-strike event from occurring, considerable research is being conducted in this area.
31. Research on the use of aircraft systems such as pulsating lights, lasers, and weather radar may lead to effective methods of deterring birds from entering aircraft flightpaths and, therefore, reduce the likelihood of a bird strike.
32. The emergency response was timely and efficient because of the proximity of the emergency responders to the accident site, their immediate response to the accident, and their training before the accident.
33. Flight attendant B was injured by the frame 65 vertical beam after it punctured the cabin floor during impact, and, because of the beam's location directly beneath the flight attendant's aft, direct-view jumpseat, any individual seated in this location during a ditching or gear-up landing is at risk for serious injury due to the compression and/or collapse of the airplane structure.
34. The Federal Aviation Administration's (FAA) current recommended brace positions do not take into account newly designed seats that do not have a breakover feature, and, in this accident, the FAA-recommended brace position might have contributed to the shoulder fractures of two passengers.
35. The flight attendants initiated the evacuation promptly, and, although they all encountered difficulties at their exits, they still managed an effective and timely evacuation.
36. Although the airplane was not required by Federal Aviation Administration regulations to be equipped for extended overwater operations to conduct the accident flight, the fact that the airplane was so equipped, including the availability of the forward slide/rafts, contributed to the lack of fatalities and the low number of serious cold-water immersion-related injuries because about 64 occupants used the forward slide/rafts after the ditching.
37. The determination of cabin safety equipment locations on the A320 airplane did not consider that the probable structural damage and leakage sustained during a ditching would include significant aft fuselage breaching and subsequent water entry into the aft area of the airplane, which prevents the aft slide/rafts from being available for use during an evacuation.
38. Given the circumstances of this accident and the large number of airports located near water and of flights flown over water, passenger immersion protection needs to be considered for nonextended-overwater (EOW) operations, as well as EOW operations.
39. If the life lines had been retrieved, they could have been used to assist passengers on both wings, possibly preventing passengers from falling into the water.
40. Equipping aircraft with flotation seat cushions and life vests on all flights, regardless of the route, will provide passengers the benefits of water buoyancy and stability in the event of an accident involving water.
41. Briefing passengers on, and demonstrating the use of, all flotation equipment installed on an airplane on all flights, regardless of the route, will improve the chances that the equipment will be effectively used during an accident involving water.
42. Passenger behavior on the accident flight indicated that most passengers will not wait 7 to 8 seconds, the reported average life vest retrieval time, before abandoning the retrieval attempt and evacuating without a life vest.
43. The current life vest design standards contained in Technical Standard Order-C13f do not ensure that passengers can quickly or correctly don life vests.
44. Most of the passengers did not pay attention to the oral preflight safety briefing or read the safety information card before the accident flight, indicating that more creative and effective methods of conveying safety information to passengers are needed because of the risks associated with passengers not being aware of safety equipment.