JOHN F. KENNEDY INTERNATIONAL AIRPORT OPERATIONS DURING WINTER STORM GRAYSON: FINDINGS AND RECOMMENDATIONS

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Executive Summary

"If you have seen one airport, then you have only seen one airport." For anyone who understands aviation and air travel, this motto makes perfect sense. Airports are all different. And JFK International Airport may be the most different of them all.

For the past four months, my team and I have studied all aspects of John F. Kennedy International Airport ("JFK" or the "Airport"). We were asked by the Port Authority to conduct an independent investigation so that we could help the Port Authority and all Airport stakeholders: (1) first, understand the various problems that arose during Winter Storm Grayson on January 4, 2018, and the days that followed ("Grayson" or the "Storm"); and (2) second, to prevent them from recurring.

We learned many things. JFK is one of the busiest and most diverse airports in the world. It is quite literally in many cases the gateway to the world for countless of its travelers. It is home to many different airlines servicing destinations all over the world. It moves an enormous volume of passengers and cargo daily. Perhaps most unique is its terminal structure. There are six terminals that are operated by six different entities. None are operated by the Airport authority. The Airport operates at all hours of the day and night. It covers a large geographic area that is constrained on one side by water. It faces blizzard conditions in the winter, thunderstorms in the summer, and wind conditions unpredictably at times. The employees who work at JFK face a challenging task, given the volume and complexity of the operations there, and they live in an area with a high cost of living. Nonetheless, we met many individuals working at JFK and employed by the Port Authority and other stakeholders who have proudly worked at the Airport for three decades (or more). We met individuals with a great deal of experience and expertise and a real passion for their work at JFK.

The Airport has often been criticized for its terminal structure, because, it is said, this can lead to "silos" and a lack of coordination and communication. To be sure, we found deficiencies in communication at critical points during Grayson and the following days that no doubt exacerbated already difficult conditions. We also found that there was inadequate leadership by JFK management during the Storm itself. But it was <u>not</u> for lack of effort. To the contrary, we found that when faced with the difficult conditions of Grayson, JFK management and other stakeholders pitched in to help each other. They tried, as best they could, to mitigate the poor conditions. Some worked 24 hours a day for days. People literally rolled up their sleeves and unloaded bags, carried passengers off planes, moved cots, and mopped up water—they did whatever they could to help—whether or not it was their job.

Their effort did not end when the Storm did. In the weeks and months after Grayson, JFK stakeholders participated in after action debriefings and attended working group meetings. They met with me and my team and tirelessly provided witnesses, documents, and information. One thing was made clear—all had a desire to change JFK for the better.

It is my strong belief that JFK can and will do better. What it needs are the critical tools to help each of the stakeholders perform seamlessly under even treacherous conditions. In the report that follows, we have made numerous recommendations addressing a multitude of different issues that arose during Grayson and sometimes more generally at JFK. Chief among

our recommendations is to enhance the functions of the JFK Emergency Operations Center (or "EOC") that was activated in the days immediately following Grayson to assist in providing a critical response. Many of our specific recommendations build upon the EOC, which has been activated during the many additional weather events that occurred since Grayson. We saw the EOC in action, and it is an impressive operation. It is our goal that by adding to this already powerful mechanism, we can build a true command and control center for JFK. The EOC is the structure that will provide the critical leadership that was lacking during Grayson and will lead to seamless communication, coordination, and execution of all Airport procedures in a way that will greatly benefit all stakeholders at JFK.

From the passengers' point of view—and it is our aim to improve JFK from this perspective—the fact that thousands of bags were stranded at JFK for days on end was another great source of frustration. This cannot be permitted to happen again. We studied the baggage issue from all vantage points. A number of our recommendations here aim to fix the baggage problem. First, it is critical that airlines take all appropriate measures to prevent passengers from being separated from their bags in the first instance. Airlines should cancel flights in advance, waive rebooking fees in cases of inclement weather (to encourage passengers to change their plans), and delay checking in passengers and bags when flight delays and cancellations are likely. Next, when flights are canceled after passengers have already checked their bags, airlines should prioritize reuniting passengers with their bags within the terminals. Also, the airlines and terminal operators must commit to making baggage service offices available for all passengers and to streamlining the process by which passengers file claims. Finally, the Port Authority can help by devoting additional resources to help airlines in moving baggage to remote storage facilities, where it can be efficiently organized, sorted, and returned to passengers. We are confident that these steps are critical in avoiding a repeat of the inexcusable baggage issue that arose in the wake of Grayson.

The important work of moving forward after Grayson was started by the Port Authority in the days immediately following the Storm with the Interim Measures enacted by JFK General Manager's Bulletin in January, which included the implementation of the EOC for winter weather events. My team observed the EOC in action during JFK's March storms and were impressed by the collaborative efforts of the Airport community to effectively manage those weather events. The April 30 JFK General Manager's Bulletin enacted additional measures, which our team used in making some of our recommendations in this report. The Port Authority also commissioned this investigation and gave us unfettered access to conduct it. In this report, we build upon these initial measures with dozens of other recommendations directed at various other operational issues experienced at JFK during Grayson and afterward. It is our goal and hope that, in creating the recommendations described here, we have continued the process the Port Authority started by designing the critical tools necessary to help JFK achieve great things.

The recommendations in this report can assist JFK perform better for the flying public not just during weather events. They will help JFK operate more efficiently on a day to day basis, which is good for everyone who travels here. With a strong leadership structure, effective communication, and coordination among various stakeholders, the unique structure of JFK—including its independently operated terminals—can be a strength, rather than a weakness. We look forward to watching the progress unfold.

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A. Scope of the Investigation

On January 19, 2018, the Port Authority of New York and New Jersey (the "Port Authority") retained former U.S. Secretary of Transportation Ray LaHood (currently a Senior Policy Advisor at DLA Piper LLP (US) ("DLA Piper")), to lead an independent and comprehensive investigation into the operational difficulties experienced at JFK Airport during and following the winter storm of January 4 ("Grayson" or the "Storm"). The goals were to (1) assess the causes of the operational difficulties experienced at JFK during Grayson and (2) create recommendations to prevent their future recurrence. In addition, the investigation team reviewed JFK operations more generally, and considered enhancements for the benefit of the Airport community and consumer public. The Port Authority committed to and did give the investigative team unfettered access to all of its personnel and documents.

B. Investigation Team

Secretary LaHood requested that the Port Authority engage DLA Piper to assist in the investigation. The DLA Piper team was led by Joan DeBoer, a policy advisor in its Washington D.C. office and a former Chief of Staff of the U.S. Department of Transportation ("DOT"), and Jessica Masella and Jeffrey Rotenberg, partners in its New York office, who have extensive experience in conducting investigations on behalf of public entities, private entities, not-for-profits, and law enforcement organizations. They were supported by a team of associates and staff directed by Lane McKee and Michael Lewis. DLA Piper engaged PASSUR Aerospace ("PASSUR") in connection with the investigation. The PASSUR team was led by experts with decades of experience in the aviation industry, including with airlines, airport authorities, and the Federal Aviation Administration (the "FAA"). PASSUR's work included reviewing JFK's operations generally, analyzing flight and other data during Grayson, and assisting with the development of operational recommendations as compared against best practices in the industry.

C. Investigative Steps

1. Document Review and Analysis

Over the course of the investigation, DLA Piper reviewed and analyzed relevant documents provided by the Port Authority, terminal operators, airlines, the FAA, the International Air Transport Association ("IATA"), contractors providing fuel and other ground handling services at JFK, and various other JFK stakeholders. DLA Piper also collected and reviewed industry publications regarding airport operations best practices, including relating to snow removal and traffic management.

2. Witness Interviews

DLA Piper conducted nearly 100 separate interviews of over 150 individuals.[1] These interviews included individuals from all significant JFK stakeholders and others.

One area of focus was on Port Authority Aviation Department personnel at JFK and at the Port Authority's World Trade Center headquarters. These interviews were generally individualized and were conducted in-person at either JFK or the Port Authority's headquarters. Personnel interviewed include the former General Manager, Deputy General Manager, Aeronautical Manager, Director of Aviation, and Deputy Director of Aviation/Interim General Manager.

Within the JFK community, DLA Piper also met with each of the six terminal operators—a number of them multiple times. The team interviewed airline employees with responsibilities at JFK and, in some instances, regional staff for select airlines operating at the Airport. DLA Piper also interviewed individuals associated with certain JFK community entities, including the Terminal Four Airport Consortium ("TFAC") and the Kennedy Airport Airlines Management Council ("KAAMCO"). In addition, the investigation team met with the two leading ground handlers operating at JFK and contractors involved in snow removal and fueling operations at the Airport. All of these interviews and meetings were held onsite at JFK.

The investigation also included interviews of management at Newark Liberty International Airport ("EWR" or "Newark") and LaGuardia Airport ("LGA" or "LaGuardia"). These interviews focused on those airports' experiences during Grayson and their operations more generally. Interviews of the members of management teams from a number of other airports in the United States and abroad were also conducted.

Finally, DLA Piper met with representatives of other significant organizations, including the FAA, IATA, and the DOT.

3. Site Visits

As part of its investigation, DLA Piper conducted site visits of certain key locations in and around JFK. The investigation team observed JFK's EOC on multiple occasions during its activation in subsequent winter storms. The team toured various JFK operations buildings significant to snow removal and aeronautical operations generally, including Building 145, Building 111, and Hangar 19. The investigation team inspected JFK's runways, taxiways, and ramps, and observed the snow removal teams in action as they cleared the runways during subsequent snowstorms. DLA Piper also visited several terminals' operations facilities. The team toured the baggage transportation and processing facilities at Terminal 4 and observed the terminal areas, towers, security checkpoints, ticket counters, baggage service offices ("BSOs"), and other relevant areas in a number of the terminals.

[1] Several of the interviews, where appropriate, were conducted with multiple representatives from a given agency or stakeholder participating in a single interview.

SECTION II. BACKGROUND

A. Overview of JFK

JFK is located on Jamaica Bay in the southeastern section of Queens in New York City (or the "City")—15 miles by highway from midtown Manhattan. The Airport presently has six passenger terminals, a significant air cargo operation, four runways, and over 30 miles of roadway spread across 4,930 acres.

JFK is the busiest airport in the New York City metropolitan area and among the busiest in North America and the world. Approximately 80 different airlines operate out of JFK, serving about 155 nonstop destinations. In 2017, JFK handled a record 59.4 million passengers, including 32.5 million international passengers, and more than 1.4 million tons of cargo. Substantially more international passengers to the United States arrive through JFK than any other airport in the country. The number of international passengers serviced at the Airport during 2017 was an all-time record and is expected to continue to grow.

JFK is connected to New York City destinations by an automated light rail system ("AirTrain"), which links the Airport's terminals with each other and with the Long Island Rail Road and New York City subway and bus lines. Many of the Airport's customers, as well as the employees of various JFK stakeholders, travel to the Airport using the AirTrain. JFK is also accessible by car, taxi, several airport coaches, and New York City bus.

The Port Authority has operated JFK since it first opened under a lease agreement with New York City.[2] The current agreement extends through 2050. The lease provides the Port Authority with rights for the use, occupancy, and control of the Airport, in exchange for annual rents payable to the City. The lease enables the Port Authority to enter into subleases for the operation and development of JFK's facilities, including its terminals.

New York Governor Andrew Cuomo announced his "Vision for JFK" Plan (the "Vision Plan") in January 2017. The Vision Plan's estimated $10 billion renovation of JFK endeavors to end the "piecemeal" approach to development that has characterized the Airport's past projects. Among other things, the Port Authority is presently considering expansion and modernization proposals from each of the six terminal operators with respect to the implementation of JFK's redevelopment.

JFK's airfield is comprised of four runways: two widely spaced parallel runways oriented in a northwest/southeast direction (runways 13L/31R and 13R/31L) and two closely spaced parallel runways oriented in a northeast/southwest direction (runways 4L/22R and 4R/22L). Three of the runways are 200 feet wide to accommodate Aircraft Design Group VI aircraft.[3] Runway 13R/31L, the so-called Bay Runway, is JFK's main runway, handling

[2] Since the 1940s, the Port Authority has operated each of the three major airports in New York and New Jersey: Newark, LaGuardia, and JFK. Two of the region's smaller airports are also owned or operated by the Port Authority (Stewart International Airport and Teterboro Airport).

[3] The Airplane Design Group is an FAA-defined grouping of aircraft types based on wingspan and tail height. Group VI aircraft refers to the largest class of commercial passenger aircraft with a wingspan ranging from

approximately one-third of all flight operations, and is one of the longest commercial runways in the country. JFK's runways total approximately ten miles in length and its taxiways total approximately 45 miles.

1. JFK Oversight and Management

The Port Authority Department of Aviation oversees the operations of each of the Port Authority's five airport facilities. The Department is headed by the Director of Aviation, who is assisted by a Deputy Director of Aviation, both of whom are based at the Port Authority's World Trade Center offices. The Deputy Director has a number of direct reports, including the General Managers of JFK, Newark, and LaGuardia airports and the Port Authority's Aviation Operations Officer, who also works out of the World Trade Center offices and is responsible for all Port Authority airports.

Along with JFK management, the key Aviation Department functions at JFK relevant to our investigation are the operations and maintenance teams. Operations runs and manages aeronautical, landside, security, and customer care functions. One of the key responsibilities of operations staff is to ensure the safe movement of aircraft, equipment, and personnel on the airfield in compliance with FAA rules and regulations. Maintenance personnel ensure that the facilities' assets, infrastructure, and equipment operate at the highest level of performance, including code and regulatory compliance. Maintenance staff include electrical personnel that maintain airfield lighting and electrical systems according to the FAA's regulatory standards.

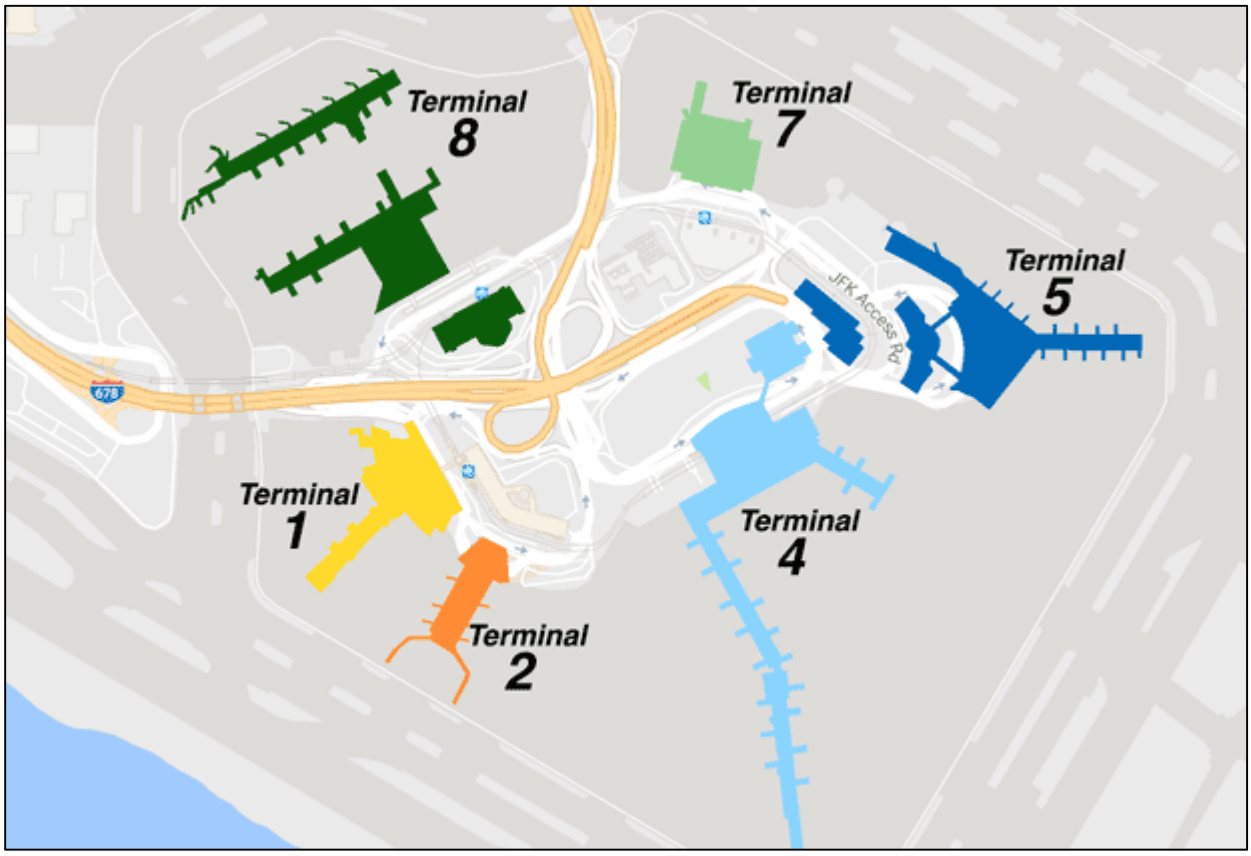
2. JFK's Passenger Terminals and Airlines

JFK has a unique operational structure in that none of its six passenger terminals are run by JFK personnel. Rather, each terminal is independently operated by either an individual airline, an airline consortium, or a private company. JFK personnel typically oversee terminals without injecting themselves into day-to-day management, leaving the terminal operators a great deal of autonomy. Terminal gates are not controlled by JFK personnel, and JFK personnel do not manage the terminals' ramp areas and flight schedules or operate any ground service equipment. The Port Authority has elected to use this business model during recent decades as a way to enhance terminal development and infrastructure.

Airlines operating at JFK may be accommodated at any of the six passenger terminals by contracting with a terminal operator directly. Each airline that is itself a lessee and operator of one of JFK's passenger terminals houses its own flight operations as well as those of a select group of additional airlines, as sub-lessees, at its respective terminal facility.

214–62 feet and a tail height ranging from 66–80 feet, including such aircraft as the Boeing 747-8 and the A380, two-tiered passenger planes that hold approximately 467 and 525 passengers, respectively.

The terminals are arranged cyclically within an 880-acre space known as the Central Terminal Area ("CTA") and are connected by the AirTrain and access roads.



Source: Port Authority.

Certain terminal buildings at JFK were constructed as recently as within the last decade, whereas others were constructed as long ago as 1962.[4] They collectively house more than 125 aircraft gates, and are surrounded by a dual ring of peripheral taxiways. In addition to the gate positions, there are approximately 50 remote aircraft parking positions or "hardstands" within the CTA that service the airlines' operations.

[4] Terminal 4 (2015); Terminal 8 (2007); Terminal 5 (2008); Terminal 1 (1998); Terminal 2 (1962); and Terminal 7 (1972).

The six terminals were organized, structured, and operated as follows at the relevant time:

Terminal	Operator	Number of Gates	Number of Airlines (domestic)	2017 International Passengers	2017 Total Passengers
1	Terminal One Group ("TOGA")	11	24 (0)	7,843,318	7,843,318
2	Delta Airlines ("Delta")	11	1 (1)	293,583	4,339,166
4	JFK International Air Terminal, LLC ("JFK IAT")	38	30 (1)	12,652,199	20,740,411
5	JetBlue	31	4 (2)	3,942,774	14,075,182
7	British Airways	12	12 (1)	3,479,349	3,479,349
8	American Airlines	27 mainline, 8 regional	6 (1)	4,220,196	7,394,866

As reflected above, JFK has two terminals that are not operated by an individual airline—Terminal 1 and Terminal 4. Terminal 1 is operated by TOGA, a consortium of four international carriers: Air France, Japan Airlines, Korean Air, and Lufthansa. Terminal 4 is managed by JFK IAT.[5] JFK IAT is affiliated with Amsterdam-based Schiphol Group, a leading airport operator. Delta's international operations are managed out of Terminal 4, along with three domestic Delta destinations. 27 gates within Terminal 4 are Delta preferred gates under the anchor tenant agreement between Delta and JFK IAT. These gates are used exclusively by Delta and certain affiliated airlines. Delta comprises approximately 60 percent of Terminal 4's total operations.

3. JFK Terminal Operators and Ground Handling

Ground handling is an integral part of airport operations and its execution is a primary driver of an airport's success. Ground handling, as the name suggests, refers to aircraft-related services performed while an aircraft is on the ground at an airport. These include guiding aircraft to or from the airfield and into and out of gates, loading and offloading baggage, fueling aircraft, and otherwise servicing aircraft as needed between flights. Reduction in ground handler productivity and efficiency can hamstring an airline, a terminal, and ultimately an entire airport.

[5] Terminal 4 is the only terminal at JFK that has the ability to process international arrivals passengers 24 hours a day and seven days a week at its Federal Inspection Services facility.

At JFK, relationships with ground handling servicers vary within and across the terminals. Certain terminals contract with a single ground handler, and those terminals' airline contracts require all airline tenants to use that specific handler. The ground handler manages the purchasing of the equipment on behalf of each terminal, subject to the contractual terms with the terminal. The quantity and quality of equipment and staffing at these terminals differ by virtue of the contracts in place. At others, the airline terminal operator uses its own employees for ground handling services, while other tenants contract directly with ground handlers of their choice. One terminal's tenants are similarly free to contract with a ground handler of their choice (or to use their own employees). Absent an established contractual arrangement between an airline and a ground handler, including during an irregular operation ("IROP"), ground handling entities will not provide services to an airline. There are two primary non-airline ground handling service providers at JFK, both of which have significant clientele and operations at the Airport.

Ground handlers are responsible for fueling aircraft at JFK, and there is one exclusive fuel provider for the Airport. Fueling is conducted primarily through a hydrant fueling system, comprised of a network of underground pipes with hydrant connections at each of the passenger terminals. Ordinarily, most fueling is done by using trucks that connect to the fuel hydrants to pump fuel into aircraft. Where there are no hydrant connections, such as at certain hardstands, tanker trucks are deployed to deliver fuel to aircraft. This often necessitates several truck deliveries to fuel larger aircraft and can be a very time-consuming operation.

Ground handlers are also an essential part of the checked baggage process. For flights departing from JFK, this process begins at the airline check-in desk when the passengers check in their baggage for a scheduled flight. The airline agent is responsible for printing baggage tags and ensuring that the bags are entered into the airline's baggage system. Once in the system, the bags are routed on automated belts to Transportation Security Administration ("TSA") screening. The airline's ground handler then collects the baggage from the designated unit and loads it onto the appropriate aircraft.

For arrivals, the baggage process begins when the aircraft reaches the gate. Generally, once the aircraft arrives, the airline's ground handler will offload the baggage onto baggage carts or dollies. The baggage is then brought to the terminal and offloaded onto the baggage carousel belts for passenger retrieval.

Disruptions in operations after the baggage has entered the system can lead to the mishandling of and delays in reuniting luggage with its owner. Late cancellations, diversions, and remote deplaning operations all have the potential to disrupt the baggage process. If baggage is mishandled or lost, the passenger must file a claim with the airline directly before the airline can begin the repatriation process.

B. The Federal Government's Regulation of JFK Operations

Operations at JFK, like at all airports, are regulated by the FAA, which is the division of the DOT responsible for all aspects of our nation's civil aviation industry. Among its principal functions, the FAA directs air traffic in and around the nation, monitors airport safety through inspections, and implements standards for airport design, construction, and operation. The Air

Traffic Organization is the operational arm of the FAA and is primarily responsible for safely and efficiently moving air traffic within the airspace, navigation facilities, and airports of the United States (the "National Airspace System" or "NAS"). In addition to its management of the airspace, the FAA has certain ground control authority over airport "movement areas" (*i.e.*, the runways and taxiways).

Different departments within the FAA are responsible for different areas of the airspace. Air traffic controllers are responsible for the efficient movement of aircraft and vehicles operating on the taxiways and runways of the Airport itself, as well as airborne aircraft near the Airport (generally within five to ten nautical miles). JFK's 321-foot Air Traffic Control Tower ("ATCT") is equipped with communications, radar, and wind shear alert systems to support FAA operations. From the ATCT, the FAA handles arrivals and departures for the Airport. The New York Terminal Radar Approach Control facility ("TRACON") oversees and coordinates the overlapping air traffic patterns of the City's three primary airports (usually handling air traffic within a radius of 30 to 50 nautical miles).[6] Outside this radius, en route air traffic controllers work in facilities called Air Route Traffic Control Centers ("ARTCC").[7]

The FAA is also responsible for the safe and efficient operation of runways. If runway constraints threaten safe flight operations, the FAA will place aircraft into a holding pattern. The airline must then decide whether to stay in the holding pattern until it can land or divert to another airport. The FAA may also take action to address taxiway congestion.

Because the Port Authority accepts federal grants, JFK personnel must comply with certain conditions and assurances, including under Part 139 of the Federal Aviation Regulations ("Part 139"). These regulations mandate that airports, such as JFK, are required to obtain airport operating certificates from the FAA. To do so, airports must submit to the FAA for approval an Airport Certification Manual ("ACM") that sets forth how it will comply with certain FAA operational and safety standards. After the FAA approves an airport's ACM, the airport must follow its ACM procedures in order to avoid a violation. Section 313 of Part 139 governs snow and ice control. JFK's snow removal operations are outlined in the JFK Snow and Ice Control Plan ("SICP"). The SICP sets forth the policies and methods by which JFK personnel and the Airport community work together to ensure safe and efficient operations at JFK during snow events in compliance with the ACM.

The JFK Airport Duty Manager ("ADM") is the employee tasked with ensuring that the Airport complies with the FAA's standards. As such, the ADM makes the decision whether to close a runway or the Airport based upon standards set forth in Part 139, and the FAA's Air Traffic Office is responsible for helping manage the NAS in response to such closures. The FAA has no role in deciding whether to close an airport or its runways except when pilots report that safety reasons dictate closure (*i.e.*, when pilots report "poor" or "nil" braking action). When

[6] The New York TRACON is located in Westbury, New York, and is responsible for air traffic in the New York metropolitan area.

[7] TRACON controllers handle flights between an airport tower and an ARTCC, facilitate departures transitioning from an airport to the ARTCC environment, and then guide the aircraft from the ARTCC environment and line them up in sequence to land at an airport. Each ARTCC is responsible for many thousands of square miles of airspace (known as a flight information region) and for the airports within that airspace.

an airport has limited runway availability, the FAA can become involved in helping to manage traffic flow. If the FAA foresees that a weather event will cause capacity constraints, it will implement "ground stops" (holding planes before takeoff) based on a computer modeling system which assesses the number of scheduled and airborne flights destined for a particular location. An FAA-imposed "ground delay" allows aircraft to launch but imposes restrictions on the timing of departures. The airlines have some discretion about how to disperse delays amongst their own aircraft during their allotted takeoff periods. The FAA only has the authority to issue ground delays or ground stops for domestic flights and flights from Canada.

SECTION III. THE WEATHER EVENT

A. Overview

In early January 2018, Grayson, a powerful Nor'easter described by the National Weather Service as a "bomb-cyclone" moved up the East Coast of the United States. Blizzard warnings were issued due to the anticipated severity of the Storm, with several states, including New York, declaring states of emergency. Upon arriving, the Storm delivered hurricane-force winds, heavy snowfall, and frigid temperatures, resulting in whiteout conditions, coastal flooding, power outages, and fatalities. Disruptions to the region's air traffic and airports (collectively, the "Northeast Corridor"), including JFK, began on Thursday, January 4 and continued through Sunday, January 7.

Operations at JFK were severely and disproportionately impacted by the Storm as compared to other airports in the Northeast Corridor. While LGA was temporarily closed and EWR operated throughout the Storm, JFK was closed and remained closed for approximately 19 hours from January 4 into Friday, January 5. In addition, JFK, unlike other Northeast Corridor airports, struggled with its recovery efforts.

B. The Storm's Impact at JFK

1. Pre-Storm Preparations

JFK personnel continuously monitored weather reports and forecasts in the days and hours leading up to the Storm. As is typical, Aviation Department and JFK personnel consulted multiple sources for weather information, including paid subscription weather forecasting services, various online weather forecasts, and forecast data provided by the Airport's system of in-pavement runway sensors and shared by airlines. Weather reports received during the early evening hours of Wednesday, January 3 predicted snowfall of approximately four to seven inches.

Based on this forecast, the ADMs set a Snow Condition 4 (the second most severe level under the Airport's five-tiered system) and prepared accordingly. Snow removal teams were assigned staggered shifts to facilitate seamless snow removal efforts as one shift gave way to another. The teams were fully staffed in preparation for the impending Storm.

On January 3 at 13:00,[8] JFK management hosted an Airport community teleconference for Storm planning purposes and to coordinate preparations among the broader JFK community. These calls are generally attended by 60–70 individuals representing various JFK stakeholders, including terminal operators, TSA, Customs and Border Protection ("CBP"), the Port Authority Police Department ("PAPD"), as well as the FAA.

The terminal operators monitor weather on an ongoing basis independent from JFK personnel and, in some instances, in consultation with their tenant airlines. Once the Storm was forecasted, in addition to participating in the Airport community calls and having other informal

[8] All times, unless otherwise stated, are in Eastern Standard Time.

communications with JFK personnel, the operators began planning with their respective stakeholders, including airlines and ground handlers, through conference calls, email and, in some cases, in-person meetings.

In response to the forecasts and discussions, between 20:30 on January 3 and 07:30 on January 4, JFK carriers canceled approximately 200 flights, representing a 25 percent reduction of a normal January day's roughly 1200-operation schedule. This number was markedly lower than advanced flight cancellations at both EWR and LGA.[9] A review of early-stage cancellation rates reveals that certain airlines approached cancellations differently depending on the airport; for example, one airline canceled a far greater percentage of its flights operating out of LGA during the Storm than it did for its flight operations at JFK.

The degree of consultation and coordination between terminal operators and airlines differed between and even within terminals in advance of and then during the Storm. The domestic airline terminal operators are best positioned to (and effectively did) drive preemptive schedule management by their tenants due to both their relationships and their limited number. For example, one such operator advised a tenant in advance of the Storm that the tenant would not have access to its regular gates due to snow removal planning and instructed the tenant to cancel flights accordingly, which it did. If an airline terminal operator communicates to an airline that it cannot launch, despite the absence of any formal legal enforcement mechanism, that airline's decision to disregard the directive and launch will, nonetheless, have consequences with respect to the airline tenant's continued relationship with the terminal operator. Given that access to the domestic airline terminals—as well as Terminal 7—is generally coveted across the Airport community, and given the alliance and partnership relationships that exist there, tenants operating out of those terminals tend to be cooperative and compliant.

Airlines operating their own terminals have the additional advantage of directly controlling a large percentage of their own terminal's flight activity. Accordingly, these terminal operator airlines benefit from their own pre-planning and the flexibility to adjust their own operations as warranted.

The large international terminal operators tend to play less direct roles in the management of their airline tenants' schedules. For one thing, these terminal operators, like their airline operator counterparts, do not possess the formal authority to require cancellations and have historically been reticent to make such requests. This approach is at least partially a response to the decision-making processes for many of the international carriers operating out of those terminals. Local station managers frequently do not have authority to dictate an airline's decision to launch a flight. Instead, decisions about whether to fly are typically made in the airline operations centers around the world. And, when an airline has only one or two flights per day into and out of JFK—and in some cases the United States—that airline is extremely hesitant to adjust its schedule given the commercial and logistical ramifications. In terms of flights flying into JFK, some airlines would potentially prefer a diversion than a cancellation.

[9] On January 4, the percentage of canceled flight operations at Newark and LaGuardia were 83.8 percent and 97.9 percent, respectively.

2. Snowfall and Snow Removal Efforts

At approximately 02:30 on January 4, it began to snow at JFK. Airport operations immediately deployed snow removal teams to begin conducting removal operations. During the initial hours of the Storm, snow removal efforts were working as intended. The ADMs along with other senior JFK staff oversaw the snow removal operation from the Snow Control Center ("SCC"). These efforts were aimed at clearing the "priority" areas identified in the SICP and meeting the associated clearance goals for those areas. The snow removal teams were able to achieve these goals during the early morning hours of January 4.

As the morning progressed, airfield conditions worsened. At 06:00 on January 4, JFK operations upgraded its Snow Condition Level to the highest level, Level 5, mandating the maximum deployment of staff and equipment. By that time, weather reports had generally been revised, predicting snow accumulations at JFK of between nine and twelve inches. Later that morning, at approximately 10:13, the deteriorating conditions led JFK operations to issue an IROP advisory due to weather delays at JFK.

Conditions substantially worsened during the 10:00 hour with the arrival of the first wave of heavy snow, which was accompanied by high winds gusting up to 53 mph. The combination of rapid snowfall and heavy winds hampered the snow removal teams' efforts to maintain the two operable runways, 4L/22R and 4R/22L. The teams made passes on these runways, but the dry powdery nature of the snow caused it to be quickly blown back onto the runway surfaces by the strong winds. By 10:35, more than two inches of dry snow had accumulated on the runways' surfaces, requiring their closure under the ACM.

The rapidly falling snow coupled with high winds generated "whiteout conditions." At 10:42, the snow removal teams reported zero visibility and indicated that they were unable to identify their exact locations on the airfield. When it became apparent that conducting snow clearing operations was no longer safe due to the whiteout conditions, at 10:47, the ADMs suspended all operations and ordered the snow removal teams to exit the airfield. With operations suspended and the two runways having exceeded the parameters set forth in the ACM, JFK operations issued a notice to airmen ("NOTAM") at 10:57, advising that the Airport was closed. By this time, approximately two-thirds of the flights that would divert that day were already airborne.

When JFK operations issues NOTAMs closing the Airport it is required to designate an estimated time that the Airport will reopen. That initial NOTAM set the time by which the Airport was to resume operations ("RESOP") as 15:00 that afternoon. The 15:00 RESOP time did not take into account the whiteout conditions, that snow removal operations had ceased, that the snow removal teams were leaving the airfield with their equipment, and that there was no indication as to when snow removal operations could resume. Around that time, JFK personnel also issued a revised weather forecast, indicating 4.6 inches accumulated snow, with a two-inch-per-hour rate in that hour.

Terminal operators took steps to manage traffic and expectations in anticipation of the Airport's noticed RESOP time. One international terminal has a contractual requirement that its tenant airlines obtain preapproval of any non-scheduled flights, including diverted flights looking

to recover. That terminal operator advised its tenants not to assume that the terminal had the capacity to accommodate an airline's additional or recovery flight activity absent the cancellation by that airline of scheduled flights. It further admonished that the terminal would be resuming operations slowly and that airlines should be mindful of tarmac delays. Appropriately, the terminal operator emphasized a community-based approach to the recovery process.

Another terminal advised all airlines that planned to fly non-scheduled flights into or out of the Airport to confirm the availability of gates and belts, and to inquire into any limitations on other essential functions, such as deicing. Later that same day, the terminal operator asked airlines to diligently assess the airfield before conducting flight operations after RESOP.

3. Rolling RESOP Times

After the decision was made to close the Airport, the snow removal teams struggled to actually exit the airfield and return to the hangar due to the whiteout conditions. Numerous vehicles, including those of the ADMs, became stuck in snow drifts on the airfield. It was not until approximately 13:00—over two hours after the cessation of snow removal operations—that all snow removal teams had successfully left the airfield. From the time the teams began to withdraw, there were no snow removal operations taking place on the airfield and snow naturally continued to accumulate. Meanwhile, the RESOP time remained set at 15:00, which gave the Airport community the impression that aircraft would be able to operate after that time. Additionally, JFK did not receive the predicted relief from the whiteout conditions and associated snowfall. A heavy band of snow continued to hang over the Airport, effectively hampering snow removal efforts. These conditions increasingly impacted snow removal efforts in and around the Airport beyond the runways. There were highway shutdowns, AirTrain service was suspended, snow removal was suspended at the terminals, and the suspension of snow removal on the vehicle service road ("VSR") rendered it impassable.

At 12:48, in response to an inquiry from a European carrier seeking to determine whether a flight had sufficient fuel to circle until a runway reopened, a member of JFK management expressed doubt about making the 15:00 RESOP time. About 30 minutes later, JFK issued a NOTAM extending the RESOP time until 18:00. A significant number of flights diverted in the wake of this announcement. And, snow removal operations had still not yet resumed and there was no timetable for their resumption.

At 14:45, the ADMs and other JFK operations personnel met with Airport maintenance staff to formulate a plan for cleaning and opening the priority runways and taxiways once the whiteout conditions subsided. By then, the depth of the accumulated drifts exceeded the capabilities of the multi-functional equipment ("MFE"), which are the primary and most efficient equipment within the snow team's arsenal. As a result, it was determined that an all-blower operation was the best option for clearing snow from the runways. Although this type of operation is very effective in removing large snow piles and drifts, it is much slower than an MFE-led operation.

Around 15:00, the visibility conditions at JFK began to improve, although wind-blown snow remained an issue. JFK management advised the Airport community that it was reassessing the 18:00 RESOP time and, at 15:38, another NOTAM was issued, which further

delayed the 18:00 RESOP time until 20:00. This resulted in continued uncertainty among the airlines and terminals as to the actual RESOP time for JFK.

It was not until approximately 16:00 on January 4 that the whiteout conditions abated to the point where snow removal operations could resume. As a result of a wind shift—typically experienced at JFK during storms—the ADM, in consultation with JFK ATCT personnel, planned to resume snow removal efforts focused on utilizing runways 13R/31L and 13L/31R. Crews were assembled and allowed to reenter the airfield to recommence snow removal operations.

By that time, the decision had been made to collapse JFK's standard five snow removal team configuration into two teams, which included the two teams traditionally deployed on the airfield during shift changes. At 16:06, the two teams left the staging area to clear the priority areas of the airfield, which they worked on for approximately two hours. During that period, conditions impeded snow removal efforts, as strong winds continued to push snow back onto the runways. Despite the teams' efforts, it became clear that a 20:00 Airport reopening was not feasible for even the most restricted operations. Accordingly, at 18:24, a fourth NOTAM revising the JFK reopening time was issued, pushing the 20:00 RESOP until 07:00 on January 5. In sum, after initially announcing a 15:00 RESOP time on January 4, the Airport was now expected to RESOP 16 hours later.

Later that night, JFK management heard from at least one major carrier, which expressed concern over the multiple RESOP announcements and their impact on that carrier's operations, including on flight crews and passengers. In its response, JFK management identified the failure to receive anticipated relief from whiteout conditions, the snowfall levels, and the continued heavy winds into the nighttime hours, as the primary drivers of the issues at the Airport. JFK management attributed the overly optimistic predictions to its goal of helping Airport operations get back up and running.

4. Reopening of Runway 13R/31L

The snow removal crews continued their work on the airfield after the RESOP time was revised for the next morning. At 18:40 on January 4, the teams, including the usual stagger teams that had been collapsed into the all-blower operation, returned to the staging area for a shift change. In conducting this shift change, the night shift failed to hot seat the snow removal equipment and immediately redeploy to the airfield. The result was a 90-minute period during which no snow removal operations took place.

When the night shift did eventually set out to resume snow removal, it did so with the goal of opening runway 13R/31L by 07:00 on January 5, as well as making substantial progress clearing snow from runway 13L/31R. At approximately 02:00 on January 5, surface conditions improved and JFK operations, in consultation with maintenance personnel, reintroduced the MFEs. The MFEs took two hours to sweep and clean the areas that had become re-contaminated with snow due to the persistent high winds. Thereafter, in accordance with standard safety procedures, electrical teams followed the snow removal teams to ensure the runway lighting equipment was in working order.

During winter storms, the Electrical Unit is primarily responsible for maintaining certain of JFK's navigation aid devices, which include in-pavement and runway edge lighting that may become obscured by snow and ice. The runway edge lights are located every 100 feet along the outer edges of the runways. They are two feet tall, top-heavy, and frangible—designed to break away and fall down if they are struck, such that they will not cause damage to aircraft in the event of an accidental collision. Although made to withstand 300 mph winds, it is common for these runway edge lights to be knocked down during snow removal operations, either from snow being pushed forcefully into the lighting fixtures or when struck by the snow removal equipment in low-visibility conditions.

The high winds and blowing snow caused snow drifts to develop on the runways, which completely covered the runway edge lights, making them difficult to locate. In their efforts to clean the areas around the runway edge lights so as to meet ACM requirements, the teams damaged a large number of these lighting fixtures. Further, when the runway edge lights were knocked over, the heat generated from the lamps had caused the surrounding snow to melt. The Storm's frigid overnight temperatures then caused the melted snow to freeze, encapsulating the runway edge lights in ice. As a result, the electrical teams were required to chop at the ice to free the lighting fixtures before they could even begin the necessary repairs, which further complicated and delayed the operation. In total, the Electrical Unit completed repairs of close to 60 runway edge lights on runway 13R/31L. At 06:08 on January 5, the Airport successfully reopened runway 13R/31L to air traffic ahead of the Airport's revised 07:00 RESOP time, with the first plane landing shortly thereafter.

5. Decision to Reopen 13L/31R

Once the snow removal teams had successfully cleared 13R/31L and while the Electrical Unit was working to correct the damaged runway edge lights, snow removal efforts were refocused on runway 13L/31R. By the time the day shift returned to JFK to take over snow removal operations from the night shift, substantial progress had been made clearing 13L/31R. At 06:11 on January 5, a NOTAM was issued advising that runway 13L/31R would remain closed until 11:00 that morning. Later on the morning of January 5, JFK received additional blowers from LGA to assist in its ongoing snow removal operations.

After the morning's shift change, it became apparent that more runway edge lights had been damaged on 13L/31R in the final hour of the night shift's snow removal efforts than had been anticipated. It was determined that there would not be enough time to fix these lights and still meet the 11:00 scheduled reopening of 13L/31R. Accordingly, at 07:13, another NOTAM was issued announcing a revised reopening time of 12:00 on January 5 for that runway.

Safety protocols mandate that snow be cleared from a runway before the Electrical Unit begins to repair any damaged lighting fixtures. At 10:30, the snow removal teams had not yet concluded operations on runway 13L/31R, which meant that the Electrical Unit still could not begin repairing the lighting fixtures in anticipation of the revised 12:00 reopening time.

During daylight hours, runway edge lights are not legally required because aircraft can safely operate without them. At night, however, the Airport could not continue to operate runway 13L/31R without edge lights and still be compliant with the ACM. As a result, when the

ADM communicated that the Electrical Unit was unable to repair the damaged runway edge lights by the revised 12:00 opening time, there were two options: (1) issue another revised NOTAM that pushed the opening time to 13:00 so that the Electrical Unit could finish repairing the damaged runway edge lights; or (2) immediately open the runway and then, at a later point that afternoon (before nightfall), close the runway and send teams of electricians to finish the repairs. JFK management relayed these two potential courses of action to the FAA's ATCT personnel, who responded that they wanted to open the runway as soon as possible and preferred that the Electrical Unit deal with the runway edge lights at a later point that afternoon.

As JFK management contemplated which course to take, at 11:35, snow removal operations were finally concluded and the Electrical Unit was directed to respond to 13L/31R to begin repairing the damaged runway edge lights. When the Electrical Unit took the field, it was told by JFK operations to fix the runway edge lights within the hour, although it was unclear how long it would actually take. The Electrical Unit finished a significant number, but not all, of the necessary repairs in less than the hour provided, under treacherous weather conditions. The ADMs again recommended pushing back the opening time of runway 13L/31R. However, JFK management decided to keep the opening time at 12:00, over the ADMs' recommendations. Shortly after 12:00, a NOTAM was issued advising that 13L/31R was open with runway edge lights that were still out of service. By 12:27, the runway had accepted its first arrival.

Our investigation revealed that JFK management's decision was influenced by a number of factors. The prior day's rolling NOTAMs and JFK's struggles in managing and recovering from the Storm, coupled with the Airport's prior statements that runway 13L/31R would be reopened by 11:00, only to subsequently push that time to 12:00, created pressure to resume close-to-normal operations. In addition, input from the FAA influenced the decision. JFK management could have ignored the ATCT's preference to open the runway by 12:00, and instead repaired the remaining light fixtures before opening the runway. However, JFK management was influenced by the FAA's view that it was preferable to open sooner to land the numerous aircraft then circling over JFK. This decision was widely criticized in our interviews.

JFK management's decision to reopen 13L/31R was made with the understanding that the runway's remaining runway edge lights needed to be repaired before dark. JFK operations coordinated with the ATCT to identify a time to make the necessary repairs, and the ATCT designated between 16:00 and 16:30. At 12:24, a NOTAM was issued advising that runway 13L/31R would be closed later that afternoon, from 16:30 until 18:30, to accommodate the repairs. At 13:02, another NOTAM was issued revising the closure period as 16:00 to 18:00.

The late afternoon time period is one of the busiest at JFK for arriving and departing flights. From an operational standpoint, shifting back to a one-runway configuration at that time aggravated the aircraft congestion on the ground, particularly given the unusually heavy arrival traffic (resulting from recovery flights). In effect, the one-runway configuration shifted the priority to arrival operations, which then left little room for departures as more planes continued to land while few were permitted to leave. There is no doubt that this contributed to the backlog of planes and Airport congestion that would reach a peak later that night and continue into the following morning.

At 16:14, a few hours before dusk, 11 teams of electricians took to the airfield and in single-digit temperatures successfully repaired approximately 60 runway edge lights. After the electrical teams finished their repairs, the snow removal teams reentered the runway for approximately 20 minutes. At 17:33, the NOTAM that advised 13L/31R's closure until 18:00 was canceled, and the runway was reopened with operable runway edge lights.

6. Impact to Aircraft Operations on January 4–6

a. Diversions

As should be evident, airlines receive and follow different weather assessments. We heard varying reports regarding the extent to which the Storm's extreme conditions and their ramifications were evident from advanced forecasts and where things were headed as January 4 progressed. We heard from certain airlines and terminal operators that it was readily apparent by midday on January 4 that there would be no resumption of operations that day due to the extreme weather conditions. These airlines canceled all operations relatively early that day. Others reported that, based on JFK's past performance in responding to extreme weather events, there was no reason to think the Airport would not meet its announced RESOP times. These airlines planned to fly up to and until the Airport announced it would not reopen any runways until the following day.

In addition, every airline has a different risk tolerance and approaches storms differently from a strategic standpoint. While certain airlines aggressively cancel operations in anticipation of a storm with an eye toward rapid recovery, others make targeted cancellation decisions and undertake to operate to the fullest extent possible during a storm, balancing risk mitigation with meeting key performance indicators. These divergent strategies are evident in cancellation rates in the run-up to and during a typical storm, and Grayson was no exception. In this instance, for a number of the domestic carriers, advance cancellations forestalled any significant impact to their operations resulting from the rolling RESOP times on January 4 and the runway re-closure decision on January 5. Passenger and baggage issues are exacerbated when a passenger is disrupted at the airport and early cancellation decisions help prevent passengers from traveling to the airport. Regardless, even better informed and more conservative airlines can run into trouble when the weather turns in a way they did not anticipate. That too happened here. In such situations, the question becomes how airlines plan their flights—scheduled, diverted, and canceled—during the recovery period.

On January 4 and January 5, approximately 120 aircraft that launched destined for JFK were required to divert. The majority of these aircraft diverted during the period when the Airport was closed. Many diversions were the direct result of the issuance of unrealistic RESOP times throughout the day on January 4. On that day, JFK management and operations personnel failed to account for existing and projected airfield conditions, resulting in overly aggressive predictions as to the time by which the Airport could resume operations. These RESOP estimations, based on JFK's historically successful snow removal experience, failed to consider numerous factors that distinguished the Storm's conditions and JFK's snow removal operations from prior winter weather events. Most importantly, JFK personnel relied on a forecast (incorrectly) predicting that the whiteout conditions would abate in the early afternoon. They also failed to realize how snow removal operations would be impeded by gusting winds, which

continued to blow the light dry snow back onto the runways throughout the afternoon and evening.

We heard from airlines and terminal operators that to some degree JFK's strong reputation for delivering on its RESOP times engendered confidence, such that international airlines dispatched flights destined for JFK, notwithstanding JFK's earlier miscalculations. These NOTAMs and the resulting rolling RESOP times were directly responsible for dozens of diversions. Aircraft around the world were dispatched with the expectation of arriving at an open Airport sometime after the noticed RESOP time then in effect, only to learn that an updated RESOP time had been issued and that the revised RESOP would require a diversion (and in some cases a return to the departure airport).

The JFK diversions caused operational issues elsewhere. For example, one A380 aircraft destined for JFK was forced to refuel in Pittsburgh before flying to Dallas to offload its passengers. Other planes made multiple stops within the United States before finally making it to JFK. O'Hare International Airport ("O'Hare" or "ORD") in Chicago received 28 diverted flights carrying approximately 8,400 passengers, the volume of which disrupted O'Hare's operations. Some diverted airlines had no representation on the ground at O'Hare, leaving their passengers virtually abandoned, and hotel shuttles were similarly overwhelmed by the passenger volume.

b. Aircraft Volume and Flow Rate

When runway 13R/31L was reopened at 06:03 the morning of January 5, the Airport's flight operations were initially manageable. In a one-runway configuration, air traffic flow rate is managed to ensure some balance between arrivals and departures. That morning, the flow rate began with a ratio of departures to arrivals of approximately 15 to 20. This overall rate is well below that seen in normal operations.

As the morning progressed, the FAA began prioritizing landing aircraft on 13R/31L. Arrivals generally take precedence over departures due to the safety and fuel considerations of approaching aircraft. The prioritization of arrival operations in a one-way runway configuration restricts departures, particularly where arrivals are landing relatively close together, as became the case on the morning of January 5. As a result, the number of aircraft waiting to depart began to build.

By the time the decision was made to open runway 13L/31R at 12:17, there were a significant number of aircraft on the tarmac waiting to depart. Once runway 13L/31R was opened, the operational capacity of JFK's runways doubled, yet JFK's two-runway configuration continued to favor arrivals over departures. In addition to that day's normal flight activity, flights that were diverted the day before were coming back to JFK and airlines were running recovery flights to JFK to compensate for disrupted operations on January 4. The high number of aircraft destined for JFK that morning continued to impede departure operations. Aircraft waiting to depart began experiencing issues with flight crews timing out and having to leave the departure queue for additional de-icing.

c. Gridlock

The planned re-closure of 13L/31R was not widely known throughout the Airport community. Generally speaking, airlines were working under the impression that JFK would begin operating normally with a two-runway configuration from 12:00 onward and managed their schedules accordingly. As discussed above, that was not the plan.

The Aviation Department administers a departure metering program at JFK (the "Metering Department"), which predicts departure demand and assigns 15-minute departure slots to airlines based on their scheduled number of departures.[10] By 14:00 on January 5, gridlock was already beginning to develop at JFK with nearly 40 aircraft waiting to depart. Yet, the Metering Department was not advised until approximately 15:00 (one hour in advance) of the planned re-closure of 13L/31R to correct the damaged runway edge lights. As a result, the Metering Department had continued to assign departure slots based on an aircraft departure rate of 42–44 operations per hour. Thus, the queue of aircraft waiting to depart grew, and the departures began to back up onto the runways. Once 13L/31R was re-closed for lighting repairs, the Airport reverted back to a one-runway configuration, which exponentially worsened the existing runway congestion and departure backlog. When runway 13L/31R was reopened around 17:30, there were aircraft everywhere.

Standing alone, the 90-minute closure of runway 13L/31R would have had limited impact. But, the day after a major disruption, JFK was already straining to recover and resume its normal operations. The closure exacerbated aircraft congestion and thwarted any progress toward recovery that had been made up to that point. The airfield congestion also led to additional issues. Snow removal teams (still conducting cleanup operations) and ground handling personnel became pinned in place by the numerous aircraft. Arrivals could not access available gates because they were effectively blocked from terminal areas by the queue of aircraft waiting to depart. Departures got stuck in terminals due to traffic.

d. Emergency Operations

Within the large diverse international terminals, the impact of the extreme weather undermined the traffic and gate management planning that did take place, including by extending de-icing and turn times and exacerbating fueling breakdowns. What might otherwise have been a manageable volume of air traffic on a normal January day at JFK became entirely unmanageable given the conditions the Airport faced after the Storm. Too many stakeholders failed to adequately account for this fact in both preparing for and responding to the situation on the ground following the Storm and effective communication between these stakeholders was slow to develop.

In the 24 hours following the Airport's return to a two-runway configuration, the congestion across JFK drove airlines to offload thousands of passengers that had been waiting

[10] The Port Authority contracts with the manufacturer of its Aerobahn system to administer its surface management program.

for hours on the airfield, at remote locations in frigid temperatures.[11] In particular, congestion became a major issue for the diverse international terminals. Even airlines that canceled in advance of the Storm, or sought to adapt appropriately as the situation on the ground deteriorated, struggled tremendously in its aftermath. One international airline that on January 3 canceled all of its flights for the following day, nonetheless dealt with extensive tarmac delay and ground traffic issues during the recovery period—despite bringing in only a single recovery flight in addition to its scheduled flights, which the terminal operator approved.

In 2007, the Port Authority introduced "PAPRICA"—Port Authority Passenger Relief In Cooperation with the Airlines—to formalize assistance protocols in situations where aircraft experience lengthy tarmac delays and are running up against the DOT's Tarmac Delay Rule.[12] PAPRICA provides that if the terminal operator or airline is having a problem identifying a gate or hardstand for a flight, it should reach out to sister terminals for assistance, and only after it exhausts that option should it contact JFK operations. As discussed, the terminal gates are under exclusive lease to terminal operators. JFK personnel are authorized to direct terminal operators to make gates and other facilities available to air carriers seeking to deplane at these exclusively-leased gates during those time periods that the gates are not in use or scheduled to be in use. JFK personnel are unable, however, to direct a tenant terminal operator to accommodate another air carrier's aircraft at a tenant terminal operator's gates during those times that the gate is in use or is scheduled to be used.

In the event that an aircraft does not have a gate or hardstand available to offload its passengers, and one is not projected to become available for a period of two hours for domestic flights and three hours for international flights, PAPRICA requires that the terminal operator or airline responsible for the delayed aircraft contact other JFK terminal operators to secure a gate or hardstand to offload the passengers. If the terminal operator or airline is still unable to identify a gate or hardstand location, it is then required to contact JFK operations to request use of a hardstand on Airport property outside of the terminal areas. JFK personnel, in these cases, provide the hardstand location and buses to transport the passengers from the remote hardstand location to the terminal. Importantly, the terminal operator or airline is required to provide all necessary ground support equipment to effectively offload the aircraft (*i.e.*, a stair truck, tug, etc.), including a lift device for deplaning any physically challenged passengers. Additionally, for international flights, the airline is required to coordinate with CBP to arrange for bus escorts from the hardstand location to the Federal Inspection Services ("FIS") facility. PAPRICA's mutual aid framework reflects the fact that the Port Authority does not own ground support

[11] The airlines' calculus as to remote deplaning should be understood in the context of Part 259, Title 14 of the Code of Federal Regulations (the "Tarmac Delay Rule"). Both U.S. and foreign airlines are required to report tarmac delays of more than three hours (for domestic flights) or four hours (for international flights) to the DOT. In calculating departure delays under the rule, the time period ends at the point that the aircraft begins the process of returning to the gate. The DOT may fine an airline up to $2,700 per passenger for violating the rule.

[12] By statute, covered U.S. carriers and airports must submit tarmac delay contingency plans to the DOT for review and approval. JFK's Tarmac Delay Contingency Plan (the "Plan") describes how, following excessive tarmac delays and to the extent practicable, the Airport will: (1) provide for the deplanement of passengers; (2) provide for the sharing of facilities and make gates available at the Airport; and (3) provide a sterile area following excessive tarmac delays for passengers who have not yet cleared CBP. The Plan notes that certain unique features of JFK's terminal structure limit the Port Authority's ability to maintain the Airport's safe operation and to accommodate diverted flights, including those discussed above.

equipment at JFK and JFK personnel are not trained to assist in the deplanement of passengers using equipment owned by air carriers or contract service providers.

By the time that runway 13L/31R was reopened around 17:30 on January 5, aircraft were beginning to experience lengthy tarmac delays. The congestion was, in part, a product of, and became exacerbated by, the frigid temperatures and strong winds that hampered normal operations at the terminals and resulted in longer aircraft turn times at the gates. Between leaving the gate and taking off, the DOT's tarmac delay clock starts to tick. Accordingly, airlines prefer to leave aircraft at a gate when there is the potential for excessive delay. As a result, on January 5, as the FAA favored arrivals over the departures and the line of aircraft waiting to depart grew, gated aircraft were frequently either unable or unwilling to depart from the gates due to the existing airfield congestion. This prevented the arriving aircraft from accessing gate or hardstand positions.

The FAA is only responsible for the movement of aircraft on the airfield's movement areas—*i.e.*, the runways and taxiways—whereas the individual terminals are responsible for the movement of aircraft within their respective ramp areas. So long as aircraft are not bumping up against the runways and taxiways, the FAA will continue facilitating flight operations at JFK. Because the congestion on January 5 was largely isolated to individual terminal ramps, the FAA continued landing aircraft as it normally would. This only worsened the congestion in the individual terminals' ramp areas, and prevented arrivals from accessing gates that were otherwise available, but were being blocked by aircraft waiting to depart from JFK.

This congestion was aggravated as delays caused certain aircraft flight crews to time out. For example, on January 5, a European carrier's flight landed at 22:30, five minutes ahead of schedule. Approximately one hour later, the airline's station manager emailed JFK operations, copying the terminal's executive director, and seeking a status update as the flight had yet to receive gate information. The station manager expressed concern that the crew for the aircraft's outbound flight to Europe was picked up in anticipation of an on-time departure because the airline had not been advised of the gate issue. He noted that he was advised of a 02:00 departure cutoff for the crew. Ultimately, the outbound flight had to be canceled because the flight crew timed out as a result of the unavailability of a gate for the arriving aircraft.

In such instances, gated aircraft were further delayed as the airline was forced to arrange for a substitute crew to operate the flight. Until then, the timed-out aircraft sat at the gate, only further depleting the already limited gate capacity at the Airport and preventing any arrivals from using that gate position. There were also emergency landings and aircraft equipment malfunctions that resulted in the further diversion of limited resources—aircraft were required to remain at the terminal gates, which only further disrupted terminal operations and prevented gate access for arrivals. One flight reportedly returned multiple times due to a combination of mechanical and medical issues.

By 02:00 on January 6, there were several planes at one terminal bumping up against the time limitations of the Tarmac Delay Rule. There appears to have been a disconnect between the terminal operator and JFK operations personnel with respect to the monitoring of aircraft on the ground. JFK operations was not tracking these aircraft on the Aerobahn system, which would have shown how long they had been waiting for parking. The terminal operator reported surprise

that JFK personnel were not doing so and assumed that they knew of the looming situation. Over the next hour, JFK operations was thus caught off guard when it received calls about eight planes in need of gates at this terminal.

In response to the PAPRICA call, JFK operations first identified hardstand locations where flights could be parked. Certain of these hardstands first required snow removal, so JFK operations asked its snow removal teams or contractors to clear the hardstands. Next, JFK operations looked to hangars that could facilitate aircraft parking and deplaning. After identifying a suitable location for the particular aircraft (certain aircraft are too heavy to be parked on particular surfaces or are too large to fit in certain spaces) JFK operations personnel instructed the terminal operators or airlines to call back once the aircraft was ready to be offloaded and all necessary equipment was on-site at the hardstand location. JFK operations then dispatched personnel to escort the requisite buses and terminal and ground handler personnel onto the airfield and to the hardstand location, to shuttle the passengers back to the respective terminal.

The PAPRICA process was not without its hiccups. In certain instances, JFK operations mobilized buses to a hardstand location only to find that the airline did not have the necessary equipment on-site to offload the aircraft. This caused additional delays as the JFK operations personnel and Port Authority buses were required to wait for the equipment to arrive before any passengers could be deplaned. At one point, an international aircraft was deplaned and its passengers were transported back to the terminal only to find that the doors to the FIS facility were blocked by a container of snow. The passengers were then forced to remain on the buses as the container was moved, which first required that an airplane be moved. Snow removal from ramp areas, as in that instance, is the responsibility of the respective terminal.

With every PAPRICA movement, such as these, operations elsewhere are compromised as ground handlers and terminal operators are required to divert their personnel to offload an aircraft in a remote location. One of the more extreme examples involved a taxiway deplanement. A long-haul international carrier's regularly scheduled flight arrived at JFK early in the morning of January 6. Upon arrival, the terminal operator advised the airline that there was no gate or hardstand available. According to the airline, no prior warning was provided. After an extended period of delay, the passengers deplaned onto the taxiway and were transported by Port Authority buses to the terminal for CBP processing. The airline's impression was that its ground handler was short-staffed relative to the activity at the Airport, and once the passengers deplaned the aircraft and its baggage were no longer a priority. The aircraft was moved to a hardstand and later to the terminal. By that time, the passengers that deplaned many hours earlier had left the Airport. The airline decided to wait until the morning to offload the baggage. After offloading, the bags were placed in the Terminal 4 arrivals halls to await delivery to passengers. While the baggage sat in the arrivals hall, a water pipe burst in Terminal 4. The bags were moved to avoid damage. The airline then hired a delivery service to arrange for the baggage to be returned to the airline's customers.

At one point during the early morning hours of January 6, JFK operations received nine simultaneous calls requesting PAPRICA assistance. JFK operations struggled to accommodate this number of PAPRICA movements at once. Similarly, the terminals were forced to mobilize

large numbers of ground handler equipment and staff to remote locations to offload passengers, which impacted their ability to contemporaneously handle other flight operations.

One airline declined repeated offers of PAPRICA assistance. This long-haul carrier had two recovery flights arrive a few hours apart overnight, both of which were unable to secure a gate at the airline's regular terminal upon arrival. The station manager reached out to other terminals without success. The airline's options were to wait indefinitely for a gate or to call for PAPRICA assistance. The station manager assessed the weather, which included freezing cold temperatures, high winds, and ice on the deck, and made the decision to wait for a gate as a matter of passenger safety, notwithstanding the risk of running afoul of the Tarmac Delay Rule.

Another carrier capitalized on its relationships within the Airport community to avoid PAPRICA procedures. This international carrier became aware that no gate was available for its regularly scheduled flight on January 6, approximately 30 minutes prior to arrival after contacting the terminal operator. The airline observed that the terminal's contracted ground handler was not active on the ramp and there was no indication that the aircraft then parked at the terminal's gates would be moved to create a vacancy for the arriving aircraft. After waiting for over an hour on the tarmac, with no resolution in sight, the airline contacted another terminal out of which it regularly operates a different flight to request gate access to deplane passengers and offload baggage. This terminal granted the request, on the condition that the aircraft would then immediately leave the gate—which it did, moving to a remote parking position. The aircraft subsequently moved back to its normal gate position in time for its regularly scheduled afternoon departure.

As the situation on the airfield turned critical in the early morning hours of January 6, there were substantial efforts to stem the tide. However, by that time, severe disruption was unavoidable. Overnight into Saturday morning, at one time, there were nine flights waiting for gates at one terminal and eleven at another. Aircraft were stranded for extended periods of time—some for over five hours—as they waited for gate positions that were otherwise unavailable. We also heard complaints that terminal operators failed to offer available gates to tenant airlines during this time. Specifically, the complaints referenced instances of airline terminal operators "saving" open gates for their own aircraft while their tenant airlines, which had pre-cleared flight schedules with the terminal operators, suffered lengthy tarmac delays.

From midnight to 13:00 on January 6, JFK operations conducted PAPRICA movements for 17 aircraft. In that period of time, JFK personnel facilitated the deplanement of roughly 5,000 passengers using buses that could accommodate only 33 passengers (requiring approximately 160 bus trips). Not a single passenger was injured during the PAPRICA operations, despite the volume of passengers offloaded in frigid temperatures and intense winds, and even though JFK personnel literally carried passengers off the aircraft.

e. Collaborative Movement Towards Recovery

As the gridlock reached its peak, JFK operations requested information from certain terminals regarding their departure and arrival rates by hour, flights with possible gate shortfalls for arriving aircraft and confirmation that those flights would still deplane within the terminal area for a defined time period. JFK operations personnel directed that any terminal that could

not confirm its capacity for such operations instruct the flight either to divert or not to launch for JFK.

By midday on January 6, aircraft were parked everywhere—including on taxiways and, in one instance, on a closed runway. One terminal reported that it usually begins the day with one aircraft at its terminal gates; that morning every gate was occupied. This terminal subsequently advised its airline tenants and other stakeholders that it lacked the capacity to handle its regularly scheduled operations for the day and requested by email that airlines "seriously consider flight cancellations" and even diversions for airborne flights. The terminal warned of tarmac delays in excess of four hours. It reported that all of the terminal's gates were occupied by disabled aircraft and canceled flights and that all remote terminal and Airport parking positions were filled. While some airlines quickly canceled flights in response, others did not. The terminal repeated its request and further advised that departures consider leaving without baggage.

Another terminal acknowledged challenges in its recovery efforts due to flight volume, weather, staffing issues, and other incidents in the terminal area. Many carriers were facing delays in excess of three hours, which the terminal operator attributed to ground handling issues. It noted in an email the "ripple effect" for flights scheduled to subsequently use the same gates housing delayed aircraft. The terminal operator indicated that airlines and ground handlers required additional resources to advance the recovery process.

While we believe that, generally, the terminal operators and many airlines undertook to do their best under extremely challenging circumstances, there were certain exceptions to this rule. International carriers did not, or did not adequately, consider the Airport's existing conditions when deciding to dispatch flights. In addition, we received reports of airlines having no staff present at the Airport during the recovery, despite having an empty plane parked at a gate at an over-capacity terminal that could have been used by an arriving aircraft. An airline station manager reportedly refused to move his plane off a needed gate due to concern that the airline would not be able to return to the gate in a sufficiently timely fashion for its subsequent departure, which was many hours away. Ultimately, the airline relented and its plane was moved.

Over the course of the day, Aviation Department personnel based at Port Authority headquarters played an increasingly active role in working with JFK management and operations in addressing the issues at the Airport. With their involvement, JFK operations, in coordination with certain terminal operators, issued a Prior Permission Request ("PPR") NOTAM for those terminals. This PPR purported to require that flights confirm gate availability with the destination terminal and include that approval on the flight plan. The PPR did not work. First, the FAA does not enforce PPRs and if an aircraft shows up, the FAA will land the plane. There were several flights that arrived, landed, and went to a gate despite the issuance of the PPR. Second, the PPR was poorly communicated to the Airport community, such that multiple European carriers—who have experience with the PPR construct from its use abroad—were confused as to what was required. The number included on the PPR, which the airlines were supposed to call, was curiously a direct line to JFK's Metering Department. But the Metering Department staffer was not given any guidance with respect to how to administer the PPR. He started receiving calls from operations centers at JFK and around the world asking for

authorization numbers. The staffer did not want to turn away arriving international flights so he started giving out numbers sequentially to all callers. He discussed the PPR procedure with FAA representatives while it was in place. All of the parties involved had questions and were confused about what was going on. Ultimately, the Metering Department staffer advised JFK operations to pull the plug, which it eventually did. For at least one airline, the PPR almost caused an unnecessary diversion as it sought to comply but could not get a clearance that should have been and ultimately was provided.

In midafternoon on January 6, JFK management followed up with international terminals requesting data on how many flights would not have gates upon arrival. The FAA had requested this information as a prerequisite to its diverting flights to address terminal capacity issues. While one terminal indicated no issues, the other international terminals requested assistance. One terminal provided a list of flights approved for arrivals that afternoon, while the other stated that in order to clear out the existing departures backlog, it could not receive any arrivals until the following morning.

Subsequently, JFK operations issued NOTAMs restricting international air traffic and then closing certain terminals to airlines without prior authorization. We understand that the NOTAMs helped the terminal operators convince carriers to adjust their schedules. Nonetheless, a number of aircraft still disregarded the NOTAMs and flew without obtaining prior authorization. With the reduced flow of aircraft, however, accommodating these violators was relatively straightforward.

The following day, January 7, saw the dissipation of airfield congestion and substantial progress toward resumption of normal operations at JFK.[13]

f. Ground Handling

The extreme weather conditions that persisted following the Storm had a significant impact on various ground handling functions.

After the Airport reopened on January 5, aircraft turn times—the time it takes to unload a flight after its arrival at a gate and prepare it for remote parking or departure—were delayed, causing aircraft to occupy gate positions for longer periods of time than contemplated by the terminals' schedules. Most terminals base scheduling decisions on estimated aircraft turn times. Prolonged turn times means gates are unavailable when scheduled aircraft arrive at JFK. In planning for the recovery, we believe that there was insufficient attention paid to the impact of prolonged turn times on the Airport's capacity, including by ground handlers.

As discussed above, the airlines' schedule management did not sufficiently take into consideration ground handling capacity after the Storm. Weather conditions on January 5 required ground handling crews to be brought inside to warm up—as frequently as every twenty minutes—which slowed down operations as a whole. De-icing throughput similarly dropped as a result of these conditions. Further, the snow that was plowed off runways, taxiways, and

[13] Attached as Appendix 1 is a timeline depicting key events that took place between January 4 and January 6 relating to JFK's operations during and after the Storm.

terminal ramps and piled elsewhere continued to hamper ground operations. Aircraft congestion also made navigating the terminal areas challenging for ground handlers.

Equipment and infrastructure was also an issue. The frigid temperatures caused power outages at ground handling facilities and caused ground handling equipment and infrastructure to break down. Prolonged exposure to the weather caused equipment to freeze. There were concerns raised regarding equipment preparedness—that ground handlers did not have the right or enough of the right equipment to handle the weather conditions. In addition, the guard gates that ground handlers utilize to gain access to the airfield, and through which snow removal equipment must pass, froze and malfunctioned, preventing the necessary equipment and manpower from accessing the airfield and creating a bottleneck at the guard gates. Snow became packed under automated vehicle barriers, such that they were not able to close properly, further hindering certain operations.

We heard that ground handlers were not sufficiently staffed to meet the excess airline demand in the Storm's aftermath. As a general matter, these entities tend to staff with little to no extra capacity. When unanticipated needs arise and weather inhibits travel, there will be and were significant issues. We heard reports from airlines that ground handlers were not able to timely provide essential services, if at all, during the Storm. In addition to issues offloading baggage, described below, flights canceled because their ground handler did not have the personnel or equipment necessary to move the aircraft off the gates. The result was fewer aircraft capable of leaving JFK and freeing up essential space.

Staffing and equipment issues were only further exacerbated by mutual aid efforts and PAPRICA operations. Where a carrier obtains alternative parking at a hardstand, remote hangar, or other terminal, more often than not, ground handlers from the airline's home terminal must travel to that new parking location at least once, if not twice, if and when the plane needs to load new passengers and baggage at the terminal. This has a cascading effect back at the home terminal, from which personnel from an already-stretched staff has been relocated across the Airport.

Neither JFK personnel nor the airlines had adequate contingencies for short-staffing or equipment deficiencies. JFK does not have standby or communal emergency equipment, or qualified standby operators that might otherwise act on behalf of the Airport (as opposed to ground handlers that serve just one airline or terminal) in such emergency situations.

JFK's aircraft fueling operation was similarly impacted by the extreme conditions on the airfield. We heard reports of snow and ice covering and jamming the access ports to JFK's hydrant fueling system, which inhibited the fueling process and caused aircraft to remain at gate positions for extended periods awaiting fuel. Others rejected the notion that lack of access due to snow or ice was, or should have been, an issue and believed that JFK's fueling contractor was simply overwhelmed. Airlines could not get through to the fuel provider, and those that did were told trucks were on their way, yet it was hours before they arrived, if at all. Nonetheless, during and immediately after Grayson, twice as much fuel was delivered than is typically delivered during normal operations.

The most severe ground-handling-related individual incident occurred just after midnight on January 6. A plane loaded with baggage but no passengers was being towed away from a terminal gate by a ground handler. The lead tow-vehicle reportedly proceeded through an area that was too restrictive for the aircraft, given the presence of other aircraft parked alongside it. As a result, the plane being towed clipped the tail of a parked aircraft loaded with passengers. The towed plane suffered wingtip damage and the stationary plane suffered damage to its auxiliary power unit. While there were no reported injuries, the incident required the immediate attention of numerous Airport stakeholders, further straining already stretched resources. The passengers were evacuated from the one aircraft and both aircraft were ultimately moved to remote parking areas for maintenance.[14]

g. Baggage Displacement and Repatriation

The baggage process at JFK involves the airlines and ground handlers utilizing infrastructure provided by the terminals to transport baggage from check-in to the aircraft and from the aircraft to the baggage carousel. As is the case at many airports, the airport authority has no role in managing the baggage process.

During and after the Storm, a number of factors caused many thousands of passengers to become separated from and unable to retrieve their baggage at the Airport. Cancellations after check-in and even more so after bags had been loaded onto a plane caused significant problems. In particular, the announcement on the evening of January 4 that the Airport would not resume operations until the following morning stranded thousands of bags in one terminal alone. The situation only got worse the following day. Passengers who checked baggage for international flights that had been canceled attempted to retrieve their bags, but the baggage had been reclassified as domestic because the aircraft never left U.S. soil. This not only made it difficult for international passengers to know where to look to retrieve their bags, but also resulted in all of the international bags from canceled flights being directed to domestic baggage carousels. In turn, that area quickly became overwhelmed by baggage and passengers, as evidenced in media reports.

Also, inside the terminals, certain airlines did not have sufficient personnel to remove the baggage that was not being picked up by passengers from the carousels. It fell to the terminals to work to clear the carousels so as not to entirely shut down the baggage operation. Even so, congested baggage carousels led to baggage belt stoppages resulting in further delays. Eventually, passengers were asked to leave certain terminals without their bags to relieve terminal crowding. Other passengers chose to abandon their baggage on their own in favor of returning home or making connecting flights. The absence of airline personnel inside the terminals also left passengers in the dark as to the status of and what was being done about their missing bags.

In many sectors of the Airport, ground handling crews struggled to keep up with offloading baggage from arriving aircraft and canceled departures. We heard of instances where airline and terminal personnel were physically offloading baggage from aircraft themselves

[14] There was limited information available about this incident because it is presently under investigation and possibly the subject of legal proceedings.

because there was nobody else to do so. Baggage was backed up on terminal ramps and in baggage dollies. The poor conditions on the ground made it difficult to maneuver the baggage tugs and bags fell off of dollies unnoticed. Ground handlers reportedly had to clear snow from certain locations on the airfield so that the abandoned baggage could be piled up out of the way of other essential activities.

Strategic decisions also contributed to the baggage buildup. During the recovery, baggage was de-prioritized to facilitate departures. Aircraft were advised to depart without loading baggage to free up terminal gates. Aircraft loaded with only baggage were flown in to JFK in response to previous disruptions. In PAPRICA movements, the focus is on safely deplaning passengers and transporting them to the terminals. By the time baggage could be offloaded from remote aircraft, passengers were often gone, or at least through FIS and customs, which meant that terminal or airline staff had to manage bags across these hurdles to re-entry.

In the end, thousands of bags were separated from their owners during Grayson and in the ensuing days. The terminal operators and airlines went to work right away attempting to repatriate baggage with customers. JFK management and operations engaged with the terminal operators and airlines to assist with coordinating the repatriation.

This effort faced a number of obstacles. There are a limited number of vendors that handle baggage deliveries for airlines. As should be evident, these vendors did not have the capacity to handle the volume of bags in a timely manner and airlines therefore had to look elsewhere for ways to reunite passengers with their bags.

Importantly, the repatriation process does not begin on the airlines' side until the passenger files a claim. Here, in many instances passengers left the Airport expecting to return the next day for their flights, but did not. Other passengers spent many hours waiting out their departures or waiting on arrivals that were subjected to lengthy tarmac delays. A significant number of these passengers left the airport without filing a claim and were then delayed in doing so. Some airlines did not have staff available to receive claims at the Airport as flights arrived or were canceled. This left the airlines with a large volume of bags and nowhere to send them. In the weeks following the Storm, there were still many bags that had not yet been claimed.

We found that the terminal operators and most airlines committed to expeditiously reuniting passengers with bags and had some success in doing so. Certain airlines made significant financial expenditures as part of this effort, including by hiring additional outside vendors, bringing in staff from other parts of the country (or world), and upgrading aircraft to increase baggage movement capabilities.

h. Water Main Break

On January 7, at approximately 14:00, a pipe burst in the Terminal 4 arrivals hall, causing water to flood down from the ceiling. The burst pipe impacted the fire suppression system, so the entire terminal had to be shut down and passengers evacuated. Three to four inches of water rapidly filled the western side of the hall, including the FIS facility, eventually causing a power outage. The water then streamed outside, where it froze, creating a slick area that subsequently

needed to be treated with salt and cleared by JFK maintenance personnel. As a result, the terminal's arrivals roadway was closed for a period of several hours before being reopened.

The FIS was unable to scan bags because of the flooding, and roughly half of the bags being held in the area got wet as a result of the resulting flood. International passengers were allowed to clear customs, but their bags were not, so up to 2,500 additional bags were stuck at CBP. Building 87 was opened so that Delta could move and distribute the bags that had been impacted by the water leak.

JFK personnel sent out numerous notices regarding the flooding, including an Everbridge community-wide notification and several notices to passengers informing them that their flights might be delayed and to check with their carriers. The independent terminal operator was initially unable to locate the water suppression mechanism and was then unable to fix the pipe due to a lack of resources. JFK personnel stepped in and successfully repaired the pipe within hours of the burst. Ultimately, JFK maintenance concluded that the terminal's main sprinkler pipe snapped due to freezing temperatures attributable at least in part to the pipe's location near a terminal door that is regularly opened and closed.

Several aircraft diverted from JFK as a result of this incident, which was particularly unfortunate because, at that time, the terminal and Airport had made substantial steps toward full recovery.

C. The Storm's Impact at LaGuardia and Newark

LGA and EWR saw limited disruption during Grayson, in particular relative to JFK.

LGA is a very different airport than JFK in all respects save capacity limitations. Notably, all flights at LGA are operated by U.S. or Canadian carriers and LaGuardia's operations are almost entirely domestic. On January 4, LGA conducted only 26 operations (or 2 percent of the scheduled operations). Virtually all LGA flights were canceled in advance of the Storm, as is typical for that airport. Due to advance cancellations, customers did not travel to LGA, which obviated the terminal congestion and baggage issues experienced at JFK. The airport's snow removal teams were initially able to clear its two runways relatively quickly through a combination of snow melting and removal between flights. However, at approximately 11:30, snow removal operations ceased due to whiteout conditions. The snow removal teams and equipment remained by the runways to enable an expedient return to operations once it was safe to do so, which took place at approximately 14:00.

On January 5, LGA had about half of its normal activity, with operations aided by a Ground Delay Program ("GDP") implemented from early afternoon to late that evening. By January 6, LGA had fully recovered from Grayson. From the perspective of LGA management, because the airport is substantially smaller than JFK, is comprised almost entirely of domestic operations, and sees widespread cancellations during such weather events, the pressure on the airport to stay open or reopen is much less than that at JFK. The ramifications of failing to stay open or improperly predicting RESOP times are also significantly diminished.

Although EWR, like JFK, operates international flights, EWR is operationally distinct from JFK in a number of important respects. EWR has three passenger terminals. Terminal A

and Terminal C are operated by United Airlines ("United"). Terminal A exclusively services domestic and Canadian operations, while Terminal C is used only by United. Terminal B houses primarily foreign carriers and certain international flights for domestic carriers and, notably, is operated by EWR itself.

United conducts approximately 70 percent of EWR's operations. United's dominant position in terms of overall operations and as operator of two of the three terminals consolidates primary control over the successful functioning of the airport with the airline. United is regularly and directly involved with EWR management on operational planning and strategy, including in anticipation of storm conditions. Separately, as the international terminal operator, EWR has been readily positioned to directly track flow and manage gate capacity.

Unlike JFK, EWR stood up an EOC at 07:00 on January 4, which remained open overnight into January 5. The EOC sent out Situation Reports ("SITREPs") throughout the day so that airlines could schedule and adjust their operations accordingly. SITREPs were also presented on calls hosted by the airport to discuss the weather conditions and the numbers for the conference calls are distributed throughout the airport community.

EWR did not experience the same weather conditions as JFK. EWR did not have snow drifts on its runways, which would have prevented the use of MFEs or broom equipment. In response to worsening conditions on the morning of January 4, the snow teams reduced the speed of their removal efforts and took other precautions, including keeping a safer distance from one another. Because most flights had been canceled, the slower pace of removal did not pose an operational challenge. EWR never stopped conducting snow removal operations during the course of the Storm and at no point did the teams request permission to leave the airfield.

EWR's real challenge emerged as the airport began accepting diversions on January 4. The diverted aircraft anticipated recovering to JFK when the Airport was expected to reopen later that day, which ultimately did not happen. EWR did not have gate availability for all the international flights that landed. As a result, the airport issued a NOTAM that advised that EWR was closed to diversions and later issued another NOTAM requiring a PPR, which mandated that aircraft obtain permission from a terminal to ensure a gate would be available for that aircraft before it arrived at Newark.

Notwithstanding the diversions, EWR did not have to remotely deplane passengers. This helped avoid baggage displacement issues. In anticipation of Grayson, airlines canceled a significant volume of flights, such that the airport was generally empty during the Storm. EWR's January 4 operations were 86 percent below average.

Due to continued strong winds, EWR had a GDP in effect on January 5 from approximately 10:00 until shortly after midnight. The arrival rate was adjusted during the day as conditions warranted. In the end, EWR's operations that day were only 17 percent below average. The following day, EWR saw approximately 30 percent more operations than usual.

SECTION IV. OBSERVATIONS AND RECOMMENDATIONS

JFK is a large, busy, and complex airport. It consists of an interdependent system of thousands of individual operations, and, as Grayson demonstrated, disruption to one or more of those operations can have a domino effect across the system. The disruption to regular operations experienced by the JFK community during Grayson could not have been avoided altogether. However, there were numerous deficiencies in planning, preparation, communication, execution, and response by various JFK stakeholders. With better systems in place, the disruption may have been substantially mitigated.

To its credit, the Port Authority immediately recognized that what transpired during Grayson could not be repeated. In addition to engaging me and my team to conduct this independent investigation and issue recommendations, the Port Authority took rapid action. On January 24, a General Manager's Bulletin issued interim measures for snow events (the "Interim Measures"). The Aviation Department organized "working groups" composed of key JFK stakeholders, including representatives from terminal operators, airlines, and ground handlers, to provide feedback on the Interim Measures and help develop additional measures necessary for safe and efficient operations. Based on discussions during working group sessions and written submissions, a new General Manager's Bulletin was released on April 30 (the "GM Bulletin"). The GM Bulletin supplemented the Interim Measures and outlined immediate steps intended to improve JFK operations during winter storm conditions. Both the Interim Measures and the GM Bulletin were important and decisive initial steps. And as a result of our investigation, we have built upon, supplemented, or revised these initial steps.

In this report, we provide recommendations on how to better prepare for and manage future winter weather events, and, where applicable, other irregular circumstances beyond weather. First and foremost, we note that implementing a community-based approach is essential to managing irregular as well as daily operations at JFK. These recommendations are designed to foster such an approach while operating within the current landscape of JFK, which has for years allowed the six terminal operators to act autonomously of each other and of the Port Authority. There are many recommendations here, and it will take months to implement, refine, and adapt them to operations at JFK. The highest priority recommendations are the creation of the JFK EOC and the JFK Airport Operations Center ("AOC"), and the recommendations that relate to enhancing their structure, communications, technology, and related standard operating procedures ("SOPs"). We recommend that JFK move forward quickly to build and enhance the EOC and AOC. The majority of our recommendations are directed to JFK management. We believe that in responding to and implementing our recommendations, JFK management must work closely with Aviation Department personnel, who are well-situated to provide helpful guidance in this process.

A. JFK Command and Control

Observation 1: Command and Control

The lack of a command and control center at JFK resulted in the Airport's failure to effectively mitigate issues that arose during Grayson and increased the amount of recovery time needed to resume normal operations following the Storm.

JFK needs a strong command and control center that includes all JFK stakeholders. A command center—with capable leadership at the top, a clear chain of command, and effective SOPs—is the critical foundation upon which most of our other recommendations are built. With that structure in place, almost all of the breakdowns experienced during Grayson would have been mitigated or eliminated. And having such a structure as part of JFK's routine operations will strengthen collaborative decision-making.

- **Recommendation 1.1: JFK management should strengthen the EOC led by the General Manager and including active roles for all JFK stakeholders.**

JFK management has already formally established an EOC to serve as a centralized command and control center during winter storm emergencies.[15] The EOC is intended to facilitate information and resource sharing so that JFK stakeholders can effectively manage emergency situations. The EOC requires that key JFK stakeholders participate during emergency situations and, in so doing, it enhances the community's ability to understand the challenges facing the Airport and implement coherent response and recovery plans. Many major U.S. and international airports regularly employ an EOC, including EWR, and by observing how those airports handled Grayson and other storms, we saw the importance of an EOC for managing IROPs. We believe the EOC has and will continue to transform JFK's ability to respond to emergency situations—when communication, knowledge, and collaboration are most needed. Due to the many occurrences of winter weather at JFK since Grayson, JFK management has already activated the EOC on numerous occasions, and my team observed it in action. It is an impressive operation. While still a work in progress, it is already an effective vehicle that allows JFK stakeholders to cooperatively solve problems as they arise.

While the EOC offers all JFK players a spot at the table, the General Manager must ultimately call the shots and be held accountable. During emergency events, when decisions must be made in the best interests of JFK as a whole—and not just in the best interests of any individual stakeholder or group of stakeholders—the General Manager needs to lead by making and owning those decisions. JFK has already begun putting in place SOPs to ensure the smooth and effective functioning of the EOC. In the following areas, we recommend additional measures to build upon the EOC already in place.

[15] JFK previously only used an EOC during scheduled one-off events, such as the annual United Nations meeting in New York. The EOC had not been a tool utilized in response to severe weather events or other unplanned IROPs. However, JFK management stood up the EOC on January 8 (in Grayson's aftermath) and added detail to its operational parameters in the Interim Measures and the GM Bulletin.

Observation 2: Scope of the EOC

The EOC should be activated during all types of IROPs, not just winter weather events.

The current EOC, as outlined in the GM Bulletin, specifies that the measures are only in effect during a "Storm Emergency," which is defined as a "winter storm that has the potential to have a serious impact on the safe or efficient functioning of the Airport." However, JFK is vulnerable to threats other than winter storms, such as other severe weather events, natural disasters, terrorist attacks, and individual acts of violence. JFK needs to implement clear policies and procedures that empower the Airport community to work collaboratively through the EOC to manage and recover from airport disruptions of all types.

- **Recommendation 2.1: The General Manager should activate the EOC for all types of emergencies and tailor corresponding SOPs accordingly.**

The EOC's mission, to serve as a critical command and control center, is applicable to various emergency situations. Accordingly, JFK management should implement policies and procedures that empower the Airport community to work collaboratively to prevent, manage, and recover from disruptions of all types. These SOPs should include when and how the EOC will convene in those varying scenarios to protect lives, preserve property, maximize the ability for continued operations, and expedite any needed recovery. The General Manager decides when an emergency warrants activation of the EOC, and the General Manager should issue an SOP with respect to the timing of activation (*i.e.*, for what types of events and how far in advance). The SOPs should also consider whether it is appropriate, depending on the type of emergency, to allow certain EOC representatives to participate telephonically or simply to be "on call," as opposed to physically appearing. JFK's finalized SOPs should be distributed to all Airport stakeholders. As appropriate, the General Manager should solicit input from JFK stakeholders in creating these SOPs.

We further recommend that, in developing SOPs for JFK's EOC, JFK management consult with peer airports to develop a set of best practices. For purposes of discussing the EOC-related measures in the GM Bulletin, the remainder of this section assumes they will be utilized in all emergency situations where the EOC is activated (unless specified otherwise).

Observation 3: EOC Participation

Participation by representatives from all key stakeholders is essential to facilitating a community-based approach to command and control during IROPs.

The GM Bulletin requires the following mandatory EOC participants: (1) the General Manager and designated JFK staff (including senior managers responsible for JFK's operations, the AirTrain, and the airport rescue and firefighting team); (2) PAPD representatives; (3) representatives from each of the six JFK terminals and their major airlines with gate handling responsibilities; (4) ground handler representatives; and (5) communications personnel from JFK and each terminal. Optional EOC members who are invited, but not required, to participate in-person or telephonically include officials from: (1) the FAA; (2) TSA; (3) CBP; and (4) New

York state or local law enforcement or public safety officials. We believe that the mandatory and optional participants set forth by the GM Bulletin should be expanded.

- **Recommendation 3.1: The General Manager should expand EOC participation to include additional key stakeholder participants.**

It is critical that EOC participation cover all key stakeholders in JFK's operations. As reflected in the GM Bulletin, the FAA should be invited and encouraged to attend the EOC. This attendance can be in-person, by telephone, or by other means as appropriate. The FAA already conducts planning calls every two hours during storm emergencies and on recovery days, and these calls are a critical tool for managing IROPs. The FAA's planning calls should be routed through the EOC so that the General Manager can participate. The significance of traffic management in and out of JFK, including on the runways and taxiways, cannot be overstated on a regular day, let alone during an IROP. The FAA has a critical role in managing Airport traffic; for example, during a weather event in which JFK is forced to close one or more runways, the FAA can assist by issuing ground stops, ground delays, and diversions. The FAA can also play a critical role in helping JFK manage traffic flow by regulating the rate of aircraft arrivals versus departures, as dictated by the situation on the ground. Having the FAA regularly participate in EOC meetings is the best way to ensure consistent messaging and avoid communication issues.

JFK's landside and airside snow removal companies should be required to participate in the EOC during snow events. JFK's aircraft fueling company, currently Allied Aviation ("Allied"), should also be a mandatory EOC participant. The snow removal companies' and Allied's operations during Grayson were hindered by unclear communications. One terminal operator recounted being told overnight that Allied was operating effectively only to see its airline tenants suffer delays (adding to issues with terminal congestion) due to excessive waiting time for fuel. The snow removal and fuel contractors are critical to the restoration and functioning of Airport operations during a weather event, and all JFK stakeholders need transparency as to the status of their operations in real time to account for any shortfalls.

IATA's participation in the EOC is also important, and we understand IATA has already agreed to do so. IATA serves a critical role in disseminating information to and from the large number of different international carriers that regularly operate at JFK (which otherwise are not represented in the EOC). IATA maintains a liaison desk at the FAA Command Center, which serves as an information-sharing and decision-making conduit between the FAA and member airlines. IATA will make its liaison desk resources available to JFK operations during all EOC operations.

- **Recommendation 3.2: The General Manager should ensure EOC information is disseminated broadly to JFK stakeholders in real time.**

JFK stakeholders should take advantage of dashboard capabilities to give community members, including airlines not otherwise participating in the EOC, the benefit of real-time information. During Grayson, all stakeholders did not receive timely information about airport closure decisions and other important developments. By way of illustration, a major snow removal company first learned that JFK was closing during Grayson through news outlets and calls from family members who had heard about it on the news, rather than being notified by the

Airport. Station managers heard about changes in RESOP times from their airline pilots. JFK management should determine if this enhanced information sharing would be best accomplished using its existing Aerobahn software or a different technology platform like WebEOC that provides community status boards for mass notifications. The platform should have an open chat feature accessible to the Airport community. Written communication in a chat setting will enable airlines and other airport personnel to track EOC information generated when they are not present or are otherwise occupied.

- **Recommendation 3.3: JFK management should develop a robust training program for EOC participants.**

After JFK management finalizes the SOPs for the EOC, it should develop a training program for all participants to ensure that EOC response plans are well developed and successfully executed. This training program should include short-term exercises to familiarize participants with new protocols, as well as periodic trainings to keep participants abreast of changing policies or Airport developments. As part of the training, prior to the snow season, JFK should hold EOC simulation exercises. JFK management should invite feedback from participants in training exercises and track lessons learned.

Observation 4: Ongoing Assessment of the EOC

Soliciting regular feedback and developing a structured process to review and refine EOC operations jointly with JFK stakeholders is critical to the EOC's long-term success.

The GM Bulletin outlines an "After Action Review" ("AAR") following the deactivation of the EOC in connection with any severe storm emergency pursuant to which EOC participants will work with the General Manager to assess EOC and stakeholder performance. JFK management should build on the AARs by establishing an EOC "Review Board" to help oversee the AAR processes and invite ongoing feedback from stakeholders to build a culture of communication and compliance. JFK management acted quickly to adopt the operational changes made in the Interim Measures and the GM Bulletin. Decisive action was necessary to immediately mitigate the conditions experienced during Grayson. Long-term success, however, depends on the systematic solicitation and incorporation of feedback from all JFK stakeholders.

- **Recommendation 4.1: JFK management should establish a structured process to review and refine EOC operations jointly with stakeholders.**

The Review Board should solicit feedback from JFK stakeholders and meet periodically with the General Manager to discuss any potential changes to EOC processes. In addition, the Review Board should perform an annual assessment of successes and failures of the EOC processes to implement systematic changes. Soliciting feedback from all impacted JFK stakeholders will help foster buy-in to the EOC and related initiatives. The identity of Review Board members and the SOPs for its review process should be published to the JFK community. Additionally, as part of this review and refinement, JFK management should consider seeking peer review from other top performing airports with EOCs that deal with similar weather and traffic challenges.

Observation 5: Regular Communication System Enhancements

JFK operations and other Airport stakeholders must have a common operational picture of the Airport on a day-to-day basis, which requires systematic communication enhancements.

JFK stakeholders consistently identified poor communication as one of the largest contributing factors to the disruption caused by Grayson. Given the number of individual operations that are part of JFK's network, effective response depends upon a regular flow of information across the Airport. Maintaining general awareness of Airport activity and addressing routine issues to prevent them from escalating requires coordination amongst the various JFK players, including all Airport tenants and passengers. JFK operations should strengthen its communication channels.

- **Recommendation 5.1: JFK management should create an AOC that operates 24 hours a day, seven days a week.**

In addition to the EOC, JFK management should create an AOC that operates 24 hours a day, seven days a week so that it has a constant finger on the pulse of the Airport's full operations. We understand that JFK management is developing an AOC. The AOC will provide continuous situational awareness and promote collaborative decision-making on a daily basis. The AOC should be run by the General Manager or his designee with decision-making authority, and it should be staffed by representatives from JFK maintenance, landside operations, and the PAPD. Additionally, it is critical to have some form of participation from each of the six terminal operators, particularly those with more diverse operations. For example, when a terminal is open and operating flights, it should always have a designated person "on call" for the AOC. The AOC should establish communication procedures requiring that terminal operators provide periodic updates about terminal operations, and the terminal designees should remain accessible via telephone or radio during their "on call" shifts. There should also be an instant message and group chat function to facilitate communication among the AOC staff and the terminal operators.

By implementing an AOC, JFK management will be able to proactively oversee Airport operations. JFK management should develop SOPs for the AOC to identify: (1) mandatory participants, including a clear chain of command among those participants; (2) protocols for routine monitoring of Airport operations, including identifying early warning indicators of potentially threatening natural and manmade events; (3) information collection and dissemination protocols that establish regular communication between the AOC and other community members, including periodic all-community conference calls; (4) protocols for escalating major issues to the General Manager; and (5) protocols for determining when and how to transition from the AOC to the EOC. These SOPs should be provided to every JFK terminal operator, their airlines, ground handlers, and any other community member invited to participate in community conference calls.

- **Recommendation 5.2: The General Manager should hold short daily operational briefings for the entire JFK community.**

To develop a common operational picture at JFK, the General Manager should host brief (typically 10 or 15 minutes long) daily in-person briefings and invite all stakeholders, including Aviation Department leadership, the FAA, CBP, TSA, PAPD, terminal operators, ground handlers, fuelers, IATA, and airlines. Stakeholders can share updates concerning the day's operations and any other pertinent information. JFK management should identify a centrally located area at the Airport to host the briefings to encourage in-person attendance. However, it should also maintain an open conference line for telephone participation. The General Manager or his designee should circulate to the Airport community a recap (by text message, email, or otherwise) of the briefing. Other airports, including Logan International Airport in Boston ("BOS" or "Logan") and Heathrow International Airport in London ("Heathrow), have found similar daily briefings invaluable.

- **Recommendation 5.3: JFK management should develop SOPs for deciding and communicating conservative RESOP times after emergency closures.**

The changing RESOP times (also referred to as "false starts" or "rolling reopening times") issued by JFK operations via NOTAMs on January 4 were detrimental to JFK's operations. International flights and long-haul domestic flights launched for New York, believing JFK would open in time for their arrivals only to have the RESOP time pushed back after they were already en route. This contributed to the diversion of a substantial number of aircraft headed for JFK, which had ramifications for the entire air traffic system and placed an enormous strain on JFK during recovery days as those flights sought to complete their original journey. Airlines also did not cancel departures from JFK because of the announced RESOP times, which resulted in crew and passengers arriving and checking luggage for flights that were canceled when the RESOP times were pushed back. As a result, crews timed-out and baggage was stranded.

A clear business resumption plan for the Airport was missing when JFK reopened after Grayson. JFK management must develop clear SOPs that set forth who is authorized to set RESOP times and the factors that must be considered in doing so. The General Manager will be running the EOC, and we believe that person should be accountable for RESOP decisions so that those decisions can be made with visibility into all of the information needed for a comprehensive resumption plan. We recommend that the ADM on duty make a RESOP recommendation to the General Manager, who will then run it through the EOC and make a final decision before its official issuance. It should be noted that the ADMs are focused exclusively on the runway surface and ACM requirements. They are not trained or directed to analyze broader impacts on the Airport.

When a complex entity like JFK is closed for an extended period of time, many inter-related processes need to be considered, reset, or prepared prior to resuming Airport operations. These processes fall under the jurisdiction and control of different JFK stakeholders, and these stakeholders must be aware of where one another stand in making decisions. JFK management and operations should coordinate with key stakeholders prior to setting a RESOP time, including assessing the need for restrictions on operations upon reopening. With an effective EOC, much

of this coordination and communication will occur continuously. And it is particularly important to consult the FAA because its approach for air traffic is integral to planning for a resumption of operations.

We encourage a conservative but realistic approach to setting RESOP times. JFK management and operations must be cautious so that if they miscalculate and have to issue a corrected RESOP time—in a worst case scenario—they are pushing that time up rather than pushing it back. During Grayson, unrealistic RESOP times were announced, which were impossible to meet given the situation on the ground. To avoid a repeat of that scenario, JFK management and operations should: (1) not issue RESOPs until they have a reliable prediction for when the Airport will be able to resume operations; (2) investigate whether the previous practice of issuing an Until Further Notice ("UFN") NOTAM, at least initially until a realistic RESOP time can be determined, is proper and feasible; and (3) consider setting a minimum number of hours for which JFK must remain closed after ceasing operations in any snow event. There must also be an ongoing assessment of JFK's ability to meet an announced RESOP time, and if that projection changes for any reason, all affected parties must be notified immediately.

- **Recommendation 5.4: The Port Authority should coordinate with JFK management to develop a comprehensive external and internal communication plan for mass alert notifications during crises, which implements new technology and capitalizes on existing forms of public address capability.**

Timely and accurate situational awareness throughout the duration of any emergency event is essential. JFK's network includes hundreds of separate yet codependent entities as well as thousands of travelers, making mass real-time communications challenging. To address this challenge, the communication plan should outline a chain of command to ensure consistent messaging and to disseminate real-time information across the board as set forth in the GM Bulletin. To reach as many people as possible, it should also include a multi-layered public notification system that takes advantage of new and existing messaging platforms at JFK. The plan should include better utilization of existing platforms like news media, customer service agents, the JFK website, Twitter, and other social media.

- **Recommendation 5.5: Airlines should provide JFK operations with contact information for at least one representative who will be physically present during (1) airlines' operations and (2) while the EOC is activated.**

All airlines are required to have representatives physically present at JFK during critical operation times, including in anticipation of arrivals and departures to ensure that passengers and bags are successfully loaded or offloaded. In addition, airlines should have representatives physically present while the EOC is activated. It is important that information about who is present and authorized to do what for each airline is readily available, including when airlines are using third parties such as ground handlers for operations roles. The ADM and others in JFK operations should have access to electronic records about airline representatives at all times.

- **Recommendation 5.6: The terminal operators should make surveillance cameras across terminals accessible to JFK management and operations personnel in the EOC and the AOC.**

All terminal operators should provide JFK management and operations with access to their surveillance cameras in the EOC and the AOC (including for internal areas as well as external gate and ramp areas). On a short-term basis, JFK management should work with terminal operators to explore the most efficient way to integrate video feeds from each terminal's cameras so that JFK operations can access all surveillance footage. On a long-term basis, JFK management should consider making the types of surveillance cameras (or the software used to operate them) uniform. Streamlining the ability to access these security cameras would help JFK management and operations achieve a common operational picture of JFK at any given point in time. In turn, this would enhance oversight of JFK's general operations.

Observation 6: FAA Engagement with the Airport Community

The FAA, Aviation Department, and JFK management should explore ways to enhance collaboration with JFK stakeholders, including operations personnel, terminal operators, and major airlines, particularly during IROPs.

We understand that the FAA tower at JFK has access to the Aerobahn system but is reluctant to utilize it in performing its traffic control function. The FAA also is not coordinating with JFK's Metering Department, which is active daily. Particularly in an IROP, the FAA's understanding of pending gate conflict and tarmac delay issues should not be divorced from its traffic management function.

We heard that, in certain instances, the FAA did not have sufficient situational awareness of activity on the terminal ramps and the intersection of taxiing aircraft and aircraft attempting to exit to movement areas, which resulted in aircraft becoming trapped in terminals. This is not to exclude others in the community from responsibility. Terminal operators, airlines, and JFK management and operations must be proactive in calling the FAA for intervention as required. We learned that some of these entities' communications to the FAA were inconsistent. Facilitating an open line of communication between the FAA, the EOC, terminal towers, and airlines during IROPs—and between the AOC and FAA during regular operations—would mitigate these issues and enhance operational efficiency at JFK.

- **Recommendation 6.1: JFK management should place an operations representative in JFK's ATCT during weather events to collaborate with the FAA.**

During IROPs, JFK management should place an operations team member in JFK's ATCT to facilitate collaboration with the FAA about traffic flow. During snowstorms, both Denver International Airport ("DEN" or "Denver") and Logan have airport personnel in their respective FAA towers and find the practice invaluable in improving communications and coordination. The FAA and JFK management should work together to develop processes and protocols that clearly define the role and responsibilities of the JFK operations representative in the tower. That role should include participating in the FAA's planning calls (discussed above in

Recommendation 3.1) that are led by the FAA's Command Center and occur every two hours during a weather event and the recovery days that follow. During these collaborative calls, the FAA and airlines discuss RESOP times, diversions, and other traffic management issues that will inevitably be the subject of questions JFK management and operations will receive during EOC sessions. Both the FAA and the Airport would benefit from JFK operations' participation in these critical planning calls.

B. Traffic Management

Observation 7: Inbound Traffic During IROPs

During Grayson, JFK's airfield became gridlocked. Planes had nowhere to go. Passengers were stuck on inactive planes for unacceptable periods of time, with many ultimately offloaded remotely in severe weather conditions.

During Grayson, there was inconsistent communication about the Storm's severity, and there was no recommendation by JFK management or operations as to whether airlines should cancel flights. Many international airlines told us that carriers would be far more likely to cancel flights due to weather if they received clear cancellation recommendations from the airport authority (as opposed to recommendations from a local station manager or from a terminal operator). The GM Bulletin's new measures regarding incoming flights will help mitigate issues with inbound traffic during future IROPs, including by establishing PPR policies, restrictions on recovery flights, and "Planning Calls" between JFK management and operations and domestic and international carriers in the 24 hours leading up to storm emergencies. However, these policies can be further strengthened to help prevent the infrastructure overload JFK faced during Grayson.

- **Recommendation 7.1: The General Manager should make cancellation recommendations, and JFK management should actively engage with terminal operators and airlines to promote decision-making consistent with these recommendations.**

After pre-weather event Planning Calls, the GM Bulletin states that the General Manager (after consulting with the FAA and JFK terminal operators) will recommend cancellations for flights scheduled to arrive during a set "Storm Critical Time Period" if necessary to ensure JFK's safe and effective functioning. Terminal operators should convey these cancellation recommendations to all airlines that operate out of their terminals. Since Grayson, we have seen JFK management issue clear and consistent messages through the EOC requesting that airlines cancel flights, and airlines have largely abided.

Because it is too soon to tell whether these habits will continue, JFK management should periodically reassess whether more oversight is needed. If necessary, JFK management should adopt policies to incentivize airlines to act upon its recommendations. First, to encourage airlines to self-police one another and increase transparency among stakeholders, JFK management should publish to the JFK community all IROP cancellation recommendations that are intended to reduce volume and avoid an Airport-wide cancellation. Subsequently, JFK management should publish which airlines actually canceled flights. Heathrow has had success

with a similar community system that has generated effective peer pressure. Airlines with positive compliance records should receive gate prioritization and prioritization with respect to mutual aid requests. Second, terminal operators should establish procedures for penalizing non-compliant airlines, such as assignment to a hardstand in lieu of a gate or de-prioritized parking access.

If airlines choose not to comply with cancellation recommendations, JFK management could consider using a third-party negotiator for flight cancellations. Heathrow utilizes a third party, Airport Coordination Limited, to facilitate negotiation of cancellations when a reduction of operations is required and has found its services effective in creating an equitable system. A third party could work with KAAMCO, TFAC, and a consortium of Terminal 1 airlines in its effort to organize cancellations.

- **Recommendation 7.2: JFK management and operations should offer airlines "ride alongs" on the runways to help make flight cancellation decisions during weather events.**

In order to help JFK's major airlines make cancellation decisions during snow events, JFK management and operations should give chief pilots for those airlines the opportunity to accompany operations personnel in a car ride on the airfield to assess the conditions firsthand. Pilots who participate in ride alongs should share their evaluations of the runway and taxiway conditions with all JFK airlines to assist them in making cancellation decisions.

- **Recommendation 7.3: Terminal operators should consider the safe and efficient functioning of the Airport as a whole when confirming recovery flights and making operational recommendations to airlines.**

In making decisions on capacity to accept recovery flights and on whether airlines should cancel flights, terminal operators (as the GM Bulletin requires) should consider their gate availability and the operational impact on their terminals. Additionally, when making these decisions, terminal operators should consider the functioning of the Airport as a whole by consulting with the General Manager to capitalize on the information available in the EOC. Over the course of our interviews, terminal operators acknowledged a failure to assess JFK holistically when authorizing flights and making (or not making) recommendations to airlines. A terminal may have more than adequate gate capacity for scheduled arrivals, but if ground handlers are over-extended or movement areas are congested, planes may still struggle to reach the terminal upon arrival or be unable to depart their gate at the planned interval. All terminal operators—and really all stakeholders—owe it to the Airport community and their customers to assess the impact of their operations on JFK as a whole when its operations are strained.

Terminal operators should develop (and JFK management should review) SOPs to standardize the process by which terminal operators evaluate whether an aircraft will in fact have a negative impact on JFK's safety or functionality. If terminal operators experience airline compliance problems with this PPR process, terminal operators should consider implementing incentives to enhance compliance. For example, if an aircraft ignores a PPR request, it could lose gate privileges and be required to offload at a hardstand. The terminals' operations vary

greatly from each other, and it is critical that terminal operators and airlines have the opportunity here, as elsewhere, to provide input concerning the proposed PPR SOP.

C. Capacity and Gate Availability

Observation 8: Gate Availability Issues

JFK generally runs at or near capacity, leaving little margin for disruption. Certain JFK terminals regularly lack gate availability sufficient to meet demand.

This issue is compounded by JFK's existing taxiway configurations and privatized autonomous terminals. An effective gate management program will alleviate gate congestion issues arising during normal operations. This will also help prevent capacity constraints from reaching a breaking point during a weather event or other IROP.

- **Recommendation 8.1: JFK management should implement a gate management system that tracks flight activity and potential gate conflicts across terminals on a single platform.**

JFK management should identify and obtain gate management technology that allows the JFK operations team to track flight schedules across terminals on a single platform, including current and forecasted gate conflicts. The technology should alert JFK operations of potential gate conflicts before an aircraft lands in order to avoid ground congestion. JFK management should also develop SOPs to provide a response framework for when one terminal has a gate conflict and gates appear available at other terminals. If the AOC had access to this information, it could assess the need for real-time solutions to traffic issues and alert stakeholders, who could then adjust gate assignments proactively. This collaborative problem-solving is only possible if JFK management and operations can view and manage the Airport operations as one system..

- **Recommendation 8.2: JFK management should designate additional hardstand locations and invest in hardstand equipment that can be used by terminal operators to meet the demand of their flight schedules.**

JFK management should designate additional hardstand areas at JFK and invest in additional equipment to offload passengers there. In the short term, JFK management should identify locations that can currently act as additional hardstands that will be controlled by the Airport. And in the longer term, the Port Authority should consider creating additional hardstands as part of future development projects. These additional spaces can be used to offload passengers or to park inactive planes.

JFK management should oversee the evaluation and assessment of the optimal type and volume of equipment needed to effectively use the hardstands to offload passengers. The equipment should include covered passenger stair trucks that protect passengers from inclement weather and handicap lifts to accommodate planes of various sizes. Additionally, the Port Authority should procure buses optimized to quickly offload passengers from aircraft and transport them to their intended terminals.

JFK management and operations should also consider working with airlines and other critical stakeholders to develop a rotating schedule that identifies which airlines will be required to use hardstands during disruptive weather events and other IROPs. Logan Airport regularly sets in advance scheduled rotations for which airlines will be required to use alternate gating during the next weather event or period in which Logan receives a high volume of diversions. And when it is their "turn" to use the hardstands during the next IROP, those airlines can plan to increase their ground service provider ("GSP") staffing to handle the hardstand operations.

- **Recommendation 8.3: The Port Authority should consider building a remote offloading gate area at JFK for airlines that miss their arrival windows.**

In order to minimize disruptions to flights that are on time—and to encourage airlines to make their arrival windows—the Port Authority should consider constructing a remote gate area to be operated by JFK personnel. This would act as a "pop-up" terminal for flights that miss their arrival window. Los Angeles International Airport ("LAX") currently utilizes such a remote operations facility that has been effective in reducing tarmac delays by handling overflow. The LAX facility affords ten additional gates with indoor jet bridges so that it can be used year-round. The facility acts purely as a deplaning area for passengers, who are then bused over to the actual terminals. If a similar facility was developed at JFK, then JFK management would need to develop SOPs for the use of the remote gate area and insert provisions relating to its use in contracts with its tenant operators (who in turn should consider including similar provisions in their airline contracts). The remote gate facility could also be used during weather or other emergencies as appropriate based on the prevailing conditions. Outside of emergency situations, costs associated with transporting customers and baggage to terminals should be borne by the terminals and air carriers as appropriate. Careful thought should be given to the location of such a facility to maximize accessibility.

Observation 9: Gate Availability During IROPs

During winter storms and other IROPs that may increase congestion at JFK, it is critical that stakeholders work together to turn around planes at terminal gates or hardstand locations as quickly as possible—both so passengers and baggage can quickly be offloaded and so there is space for arriving aircraft.

During Grayson, turnaround times at gates were prolonged due to weather conditions. At the same time, inactive planes remained at terminal gates for unreasonably long periods due to insufficient staffing or equipment among ground handlers, fuelers, and airlines. In other instances, airlines actually decided not to move aircraft out of self-interest. The GM Bulletin seeks to address these issues by establishing protocols relating to moving inactive aircraft away from gates and improving traffic flow at critical airfield intersections to facilitate quicker turnaround times at JFK gates. We believe these policies should be modified to take into account the practicalities of moving aircraft, with the goal of avoiding a scenario in which JFK personnel (or a GSP without a contract with the airline at issue) are the only option for moving an inactive aircraft.

- **Recommendation 9.1: Each airline should have representatives authorized to move the airline's planes present at all times that carrier has an airplane at a gate while the EOC is activated.**

During Grayson, certain carriers refused terminal operators' requests to move unoccupied, inactive planes away from gates because they feared that another airline would occupy the gate when they eventually were ready to use it. The airlines' attempts to "save their spot" increased tarmac delays and amplified gridlock. Other airlines simply had no one present to coordinate the move. To combat this issue during storm emergencies, the GM Bulletin sets forth a process by which terminal operators may direct inactive aircraft to immediately move off of a gate.[16] The last resort is for the General Manager to authorize the use of machinery to move the aircraft or direct another GSP to do so. JFK management is developing an Airport-wide agreement to govern the process by which such movements would take place and address potential issues relating to liability and indemnification.

This issue is best addressed at the terminal level. To that end, and to avoid triggering the need to have a non-contracted GSP or JFK personnel move an aircraft, airlines should take proactive measures. When the EOC is activated, JFK airlines should be required to have representatives who are authorized to move the airline's plane from a gate to another designated place (whether it be an airline pilot, mechanic, GSP representative, or other authorized personnel) stay with the plane so long as it is at a gate. We recommend that terminals develop escalating penalties for non-compliance, including, but not limited to, fines and temporary loss of gate privileges. Willful refusal to move from a gate at the terminal operator's request during an IROP creates safety risks that cannot be tolerated.

- **Recommendation 9.2: JFK management should utilize the vacant radiant de-icing tent and Hangar 19 as alternative areas for passenger offloading during weather emergencies.**

When gate availability becomes an issue during weather emergencies, JFK management should consider utilizing the radiant de-icing tent located in Building 145 and Hangar 19 for passenger offloading. The de-icing tent has not been utilized in years, but the facility is still functional and would provide another option for passenger offloading when gates or hardstands are scarce. Hangar 19 is a large, covered location that similarly could provide for safe remote deplaning. These facilities would provide a protected area for passengers to unload without facing the elements, and buses could then take those passengers to their terminals.

[16] As noted in the GM Bulletin, such actions would take place pursuant to Article VIII, Section U, Part 10, of the Airport Rules and Regulations, which states: "Upon direction from the [Airport] Manager, the operator of any Aircraft parked or stored at an Air Terminal shall move said aircraft from the place where it is parked or stored to any other designated place. If the operator refuses to comply with such direction, the Port Authority may tow said Aircraft to such designated place at the operator's expense, and without liability for damage which may result in the course of such moving."

- **Recommendation 9.3: Airlines should review and enhance tarmac delay protocols.**

Each airline should already have a tarmac delay plan that was developed in consultation with its terminal operator. Airlines should submit to JFK management copies of these plans, which should include a detailed timeline for the airline's response to a tarmac delay, including the time by which the airline will formally contact the terminal operator for remote parking in the terminal and the time by which the airline will formally contact for PAPRICA. The airline should describe its preferences for remote offloading and the contingencies that impact those preferences. Airlines should also engage partners within the community as primary providers of mutual aid and formalize those arrangements for inclusion in their plans. We recommend that airlines identify potential partners operating in multiple terminals and who contract with, or utilize through their terminal operator, the same GSP. This will facilitate the airlines' response to an emergency and position the terminal operators and JFK management and operations to expeditiously coordinate that response with the designated providers of mutual aid.

JFK management and terminal operators should carefully critique the plans under a variety of weather scenarios and provide feedback to carriers about any needed modifications. Whenever the EOC is activated, all carriers should be required to positively affirm with their respective terminal operator that they are able to execute their plan in the given scenario.

D. Resource Management and Mutual Aid

Observation 10: Mutual Aid Policies

Even with the best preparation, emergency situations can overwhelm individual stakeholders' operational capacities in terms of gates, equipment, and personnel.

The GM Bulletin includes a "mutual aid" policy for storm emergencies under which the General Manager may direct certain entities to provide immediate emergency assistance, including unused equipment, gates, property, or staff. This should be bolstered by clear SOPs developed with input from all stakeholders and should ensure effective utilization of all available resources. Whatever mutual aid protocols existed prior to Grayson were predicated on Airport community members reaching out to JFK management or operations, not the other way around. The terminals hardly reached out to one another, and, with limited exceptions, airlines did not reach out to other Airport community members for assistance. And when JFK operations was contacted, it was in some cases long after a situation was past its breaking point.

- **Recommendation 10.1: The Port Authority should establish a direct contract with a GSP to provide equipment and personnel in emergency situations.**

During a storm emergency and other IROPs, GSP services (both personnel and their equipment) are in high demand. Short-staffing may result from challenges GSP employees face in reaching the Airport. The Port Authority should have a contract with a GSP in place to help bridge any staffing and equipment shortages. This would provide JFK operations with essential resources to make available to Airport community members on an emergency basis. With a contract in place, the Port Authority could pass along any costs associated during a storm to the

relevant airline or terminal. To help streamline the process, the Port Authority could allow existing GSPs at JFK to "bid" on an IROP contract.

- **Recommendation 10.2: The Aviation Department should inventory and JFK management should utilize available equipment and personnel across Port Authority airports.**

The Aviation Department should expand efforts to make resources and personnel from other Port Authority airports available to JFK when feasible. If there are excess personnel or equipment available at a neighboring airport, the Aviation Department should work with relevant stakeholders from those airports to make those resources available for use at JFK as well. The same approach should obviously apply with respect to using JFK resources to assist other airports as appropriate. The Aviation Department should develop SOPs for cross-airport resource sharing.

- **Recommendation 10.3: JFK management should implement peer review to leverage the specialized knowledge and capabilities of other airports with expertise in critical areas.**

JFK management should implement peer review of its newly implemented policies and procedures following Grayson. Pursuant to the peer-review plan, airports with demonstrated success in a specific area, such as baggage repatriation, snow removal operations, or customer service and passenger welfare, would be asked to review JFK's plans to improve those respective areas, provide feedback, and suggest improvements based on their demonstrated expertise.

JFK management should consider which airports would be best suited to offer advice for each of the specific components of the updated policies and procedures. For example, LAX is comparable to JFK in terms of volume of operations, international travelers, and terminals operated by different airlines. Accordingly, JFK should consider asking LAX to peer review JFK's plans for improving communications with international carriers, coordination between different terminals, and management of large volumes of travelers during a weather event. With respect to JFK's plans for improving snow removal operations, Denver and Logan experience comparable weather conditions to JFK and could therefore provide valuable peer review of JFK's planned improvements to its snow removal operations and equipment.

- **Recommendation 10.4: JFK management should solicit feedback from stakeholders on a draft Airport-wide agreement to regularize the process by which emergency mutual aid is provided before finalizing the agreement.**

The GM Bulletin states that the General Manager will provide an "Airport-wide agreement to regularize the process by which emergency mutual aid is provided during a Storm Emergency, and to ensure that potential issues with respect to liability, indemnification, and employee work rules are handled in an appropriate manner." In order to institute an agreement that will best serve all Airport community members, JFK management should strengthen the process by which key stakeholders can provide feedback and comments before it is finalized. The agreement should outline resource planning prior to an emergency event and resource management under various emergency scenarios. The agreement should also define which JFK

entities are eligible for mutual aid and the appropriate situations for requesting such aid, including how requests will be prioritized. To be effective, there must be a system for tracking availability, deployment, and return of equipment.

It is worth noting that, although Grayson's impact at JFK shows the need to establish better mutual aid processes, there were also exemplary demonstrations of cooperation and aid. For example, when airplanes did not have GSPs to unload bags, some terminal operators went onto the airfield and assisted in the offloading themselves. When the requisite equipment was not available to offload disabled or elderly passengers from hardstands, airline employees physically carried them off of planes. Terminal operators made gates and equipment available to others. The Airport should organize and capitalize on the cooperative spirit that many stakeholders demonstrated during Grayson.

E. Below-the-Wing Enhancements

Observation 11: Baggage System

Baggage is the responsibility of the airlines and their ground handlers. But JFK management should implement Airport-wide policies and provide resources to help improve the baggage repatriation process for all passengers.

Baggage handling is key to customer satisfaction for airlines. Failure to deliver a passenger's baggage will quickly overshadow whatever pleasant memories existed from positive inflight service when a passenger is suddenly without whatever necessities were packed in their bags for a vacation, business trip, or return home. Accordingly, airlines must do everything they can to avoid baggage mishandling and quickly repatriate bags to customers when issues arise.

When weather events or other major disruptions occur, airports can find themselves with large numbers of mishandled or lost bags, like those at JFK that were featured on the news after Grayson. These challenges do not reflect typical baggage operations at JFK. However, they do demonstrate that the terminal operators and JFK management and operations should take a more active role with respect to baggage management. The GM Bulletin's new baggage requirements reflect the needed leadership. They create new "Minimum Standards" that each terminal operator must meet, including ensuring its airlines have BSOs on the terminal's arrivals level and establishing a common-use BSO for any airlines without their own.[17] Additionally, the GM Bulletin includes a mandate that BSOs have appropriate systems in place to repatriate all bags within 48 hours. We recommend that the "48-hour clock" (or any other timeline) begin no earlier than when the passenger files a claim. We were also pleased to see that JFK management has committed to assist carriers with baggage repatriation issues during weather events by providing alternative areas to store, organize, and distribute excess baggage.

However, despite the enhanced standards established in the GM Bulletin, there is room for additional infrastructure improvements for JFK's baggage systems and repatriation policies.

[17] Some terminals have already taken strides toward meeting the standards set forth in the GM Bulletin. For example, over the past year, one terminal has been working to create a common-use BSO and has reached an agreement as of March 20, 2018, with a third party to operate it.

The first goal should always be to prevent separating customers from their bags to minimize the need for repatriation. And the second goal should be to improve the repatriation process for bags. Such policies need to cover the main scenarios where baggage repatriation issues arise, including when: (1) departing passengers check bags for outbound flights that are canceled; (2) departing passengers' planes take off before their bags are loaded onto the plane; (3) arriving passengers leave the airport without bags because the bags are not promptly available at the carousel; and (4) passengers and bags arrive at different times because of a missed connection or diverted flight.

- **Recommendation 11.1: Airlines should make flight cancellation decisions and communicate schedule changes to passengers as early as possible during predicted weather events.**

When airlines make earlier flight cancellation decisions, they drastically reduce their baggage repatriation issues on the backend. Some JFK airlines do this better than others, but it would help alleviate baggage issues for the entire airport system if this was a priority for all JFK airlines during anticipated weather events. One major airline, for example, has a "four-hour rule" in place; it tries to cancel flights at least four hours in advance of scheduled takeoff so that passengers ideally learn about cancellations before they travel to JFK (and almost certainly before they try to check their bags in for a flight). To the extent cancellation decisions must be made closer to (or past) the scheduled takeoff time, airlines should make cancellations on a rolling basis to avoid overwhelming operational systems with excess baggage.

- **Recommendation 11.2: Airlines should waive rebooking fees if customers change flights within 48 hours of predicted weather events.**

Many JFK airlines already offer "weather waivers" to passengers that allow them to make itinerary changes with no penalty during predicted weather events when there is a risk of flight cancellations. But these waivers should be offered by airlines for all JFK flights. They create a win-win situation by allowing customers to avoid dealing with delayed or canceled flights and allowing the airlines to mitigate the backlog of re-bookings that follows from mass flight cancellations as well as related costs from baggage repatriation.

- **Recommendation 11.3: Airlines should delay baggage check-in times in accordance with flight delays during anticipated weather events.**

In order to help prevent bags from being inserted into the baggage system when the flight may ultimately be canceled due to inclement weather, airlines should be required to delay baggage check-ins. When flights are delayed in connection with a weather event, airlines should create related timing restrictions for when bags may be checked before the flight. These time limits should be properly adjusted for domestic and international flights.

- **Recommendation 11.4: Airlines should escort passengers who have already checked bags to designated areas to be reunited with baggage when flights are canceled.**

One way to help prevent repatriation delays is to reunite passengers with their bags immediately after a flight cancellation. One airline terminal operator responds to late canceled flights by having a representative promptly escort passengers to a designated carousel where they can retrieve their baggage. Once passengers get their bags, they are taken to the terminal departures lobby, where they can speak with an airline agent if needed. For all canceled flights where the bags are still at JFK, terminals should implement a similar policy where a terminal, airline, or their designated GSP representative actively reunites passengers with baggage. The terminal operators should confer with their airlines to develop SOPs for this process that are tailored to address the unique circumstances of each airline and terminal.

- **Recommendation 11.5: JFK management should make it easier for passengers to file baggage claims.**

JFK management should simplify the process for passengers on any airline to file and track a baggage claim. The GM Bulletin's requirement that terminals ensure their airlines' BSOs and any common-use BSOs include an option to file missing baggage claims online is a big step in the right direction. Because some JFK airlines only had paper claims forms during Grayson, and passengers therefore had to search for a representative with a clipboard amongst the sea of stranded luggage and people, an online option will streamline the process for passengers, airlines, and baggage carriers during regular and irregular operations. Additionally, JFK management should arrange for training of its Customer Care representatives stationed in each terminal so that they can assist passengers with submitting claims. Terminal operators should also consider investing in kiosks in their arrival areas that would allow passengers to immediately submit claims.

- **Recommendation 11.6: JFK management should contract with a third party to assist with baggage handling in IROPs when airlines cannot keep up with demand.**

Because existing terminal GSPs who handle baggage for JFK airlines will likely be inundated during an emergency situation, JFK management should explore negotiating a contract with a new third-party baggage handling provider. When an airline does not have proper staffing in place or there is an unexpected event that overwhelms an airline's capacity to handle bags and terminal operators cannot help, the Port Authority should have a contract in place with a third-party provider. This third-party baggage handler should have capability to offload, inventory, transport, and store large volumes of luggage. The Port Authority could charge the costs of the service provider back to the airlines.

- **Recommendation 11.7: JFK management should arrange for and JFK operations should be prepared to deploy vehicles and equipment to move large volumes of baggage from remotely parked aircraft in adverse conditions.**

Remote parking and deplaning generates baggage issues, which are exacerbated in extreme weather conditions. The vehicles and equipment used to offload and transfer baggage from a gate-parked plane will be inefficient, if not impractical, in a remote parking situation. Accordingly, we recommend that JFK operations be prepared to deploy vehicles and equipment better suited to such a situation. This may include flat-bed tractor trailers that can hold and move large quantities of baggage and forklifts that can accelerate the offloading and transfer process.

Observation 12: Ground Handlers and Equipment

During Grayson, there was a shortage of GSPs due to increased demand and staffing issues. Equipment was also scarce because some malfunctioned in the freezing temperatures.

JFK terminal operators and airlines rely on GSPs for ground handling services, including baggage handling, ramp services, and towing of aircraft—along with maintaining all of the equipment necessary to provide these services. Accordingly, GSPs play a primary role in the safety and efficiency of JFK's operations. While the EOC's mutual aid and resource sharing may mitigate these issues during future storm emergencies, the airlines and terminal operators should also analyze their existing GSP contracts to determine if they are meeting minimum standards for regular operations.

- **Recommendation 12.1: Terminal operators and airlines should perform audits to ensure GSPs are meeting minimum standards for regular operations.**

Terminal operators and airlines should audit their GSPs' operations to confirm they have the staff and equipment necessary to meet minimum operational standards on a daily basis and during IROPs. For example, the GSPs' baggage tugs at JFK do not have indoor cabins for operators, who instead rely on goggles to navigate the airfield during snow conditions. This equipment should be upgraded to include indoor cabs with windshield wipers to avoid predictable and preventable delays with baggage and aircraft turnaround times during inclement weather. To help ensure GSPs are meeting minimum standards, JFK management should consider requiring all GSPs undergo certification pursuant to IATA's Safety Audit for Ground Operations ("ISAGO").

- **Recommendation 12.2: JFK management should publish monthly score cards grading GSPs' performance levels.**

In order to monitor GSPs' performance levels on an ongoing basis, and help incentivize those GSPs to provide the best services, JFK management should create a system by which the airlines and terminal operators grade the GSPs periodically (monthly or quarterly). Heathrow has improved its ground handling operations by using a similar system. Each month, Heathrow circulates to the entire airport community a ground handler "score card," which tracks GSP performance in several key areas. Heathrow has found this system allows airlines to ensure they

are contracting for the best available ground handling services and encourages ongoing improvements to each GSP's operations. JFK management should develop SOPs to collect periodic feedback from each airline and terminal operator as well as a means for publishing the information. Scoring should include ratings for: volume of aircraft handled; staffing performance; aircraft incidents or other safety issues; equipment functionality; baggage service; customer service; adaptability and contingency staffing during IROPs; and adherence to JFK mutual aid policies.

Observation 13: Aircraft Fueling

JFK's fueling operations suffered during Grayson due to a combination of factors, including malfunctioning equipment, blocked access to refueling areas, and potentially insufficient staffing.

The fueling issues experienced during Grayson highlight the need for modified SOPs relating to the Port Authority's only aircraft fueling company at JFK, Allied, during regular operations and storm emergencies. The majority of aircraft at JFK are fueled by a hydrant fueling system using fixtures that pump fuel from underground pipes. A much smaller portion of aircraft are fueled by tanker trucks.

- **Recommendation 13.1: JFK management and terminal operators should review Allied's current SOPs and make any needed adjustments.**

Stakeholders disagree about the main causes of the fueling issues experienced during Grayson, with some terminal operators pointing to staffing and equipment issues and Allied pointing to ineffective snow and ice removal over access ports to the fueling system. These disagreements demonstrate a need for JFK management and terminal operators to evaluate Allied's current SOPs to ensure there is sufficient equipment and staffing to handle JFK's operations, including personnel, trucks, hydrants, and refilling stations. But first, JFK management and terminal operators need to agree on the metrics for evaluating benchmark compliance. We suggest a review of best practices of other major airports' fueling operations to assist with this process.

- **Recommendation 13.2: Allied should survey whether additional tanker trucks are needed to fuel aircraft at hardstands.**

The majority of hardstands at JFK lack connections to the underground hydrant fueling system and instead must be fueled by tanker trucks. Hardstand operations are one of the chief tools for combating tarmac congestion, and Allied should be equipped with a sufficient number of tanker trucks to keep up with foreseeable demand at hardstands. Accordingly, Allied should survey the hardstand to tanker truck ratio at other airports, like LAX, that do a high volume of fueling at hardstands to determine the number of additional trucks needed at JFK.

- **Recommendation 13.3: Terminal operators, airlines, and ground handlers should ensure that aircraft and other equipment do not obstruct fuel hydrant connections.**

During Grayson, already difficult fueling circumstances were compounded by the fact that some aircraft parked over the fuel hydrant connections, thereby making them inaccessible to others. Terminal operators should work with their airlines to develop (if not already in existence) or enforce (if already in place) SOPs that prohibit aircraft from parking over or otherwise blocking connections to terminal fuel hydrants, including by establishing maximum times by which planes must move away from the fuel hydrants after receiving service. The terminal operators, airlines, and ground handlers are responsible for ensuring that their activities do not disrupt airport operations.

- **Recommendation 13.4: Terminal operators should explore whether to designate gates at each terminal where tanker trucks could load fuel during weather emergencies.**

During Grayson, Allied faced an 80 percent increase in demand for tanker truck fueling at remote hardstand locations and could not keep up with the demand. By designating a gate at each terminal to refuel the tanker trucks, truck drivers could avoid time-consuming trips to the offsite truck refueling area. This should help decrease turnaround times for aircraft.

- **Recommendation 13.5: Terminal operators should prioritize clearing fuel hydrant connections of equipment, ice, and snow during winter storms.**

Even when a fuel hydrant was "free" during Grayson (in the sense that another aircraft was not utilizing it), planes reportedly had issues accessing the hydrant connections because they were covered with snow and ice. During snow events, terminal operators must ensure that the fuel hydrant connections are free of snow and ice and otherwise accessible to aircraft. Terminal operators should work with their snow removal teams to develop SOPs that ensure sufficient equipment and personnel are available to keep hydrant valves clean and free of debris. These SOPs should take into account any snow removal equipment restrictions relating to proximity of aircraft parked near the fuel hydrants.

F. Snow Removal Operations

Observation 14: Snow Removal Procedures

The impact of Grayson demonstrated the need to adapt JFK's snow removal plan to address different types of winter weather conditions.

Section 313 of JFK's ACM outlines the Port Authority's FAA-approved SICP that was developed in accordance with requirements under Part 139. The means by which the Port Authority carries out the SICP is further governed by internal SOPs (the "Snow SOPs"). Historically, JFK operations and maintenance have successfully executed snow removal operations during significant winter storms. However, their snow removal operations struggled during Grayson. JFK management and operations should develop alternative tactics to combat

winter conditions, so its operations are adaptable to the full range of winter storm conditions JFK may face. While there is always a chance that blizzard conditions will force a JFK closure no matter the preparation, improvements to and increased flexibility in the approach to snow removal should minimize the duration of any closures. JFK's existing SCC, which oversees the snow removal operations on the airport movement areas, and its senior staff, should be involved with formulating these improvements.

- **Recommendation 14.1: JFK management and operations should host snow removal meetings with the entire JFK community at the beginning of each season.**

In accordance with the SICP, the Port Authority holds snow and ice control meetings pre- and post-snow season with JFK operations and maintenance personnel, airline representatives, the FAA, and others "deemed necessary." The SICP also states that other snow and ice control meetings will be conducted throughout the season "as needed." To foster collaboration amongst Airport stakeholders during winter storms, JFK management and operations should formalize in its Snow SOPs a series of focused snow removal meetings for a broader audience. At the beginning of each season, they should conduct "snow orientation meetings" to provide updates on new policies and procedures to the entire Airport community, including airlines and terminal operators, government agencies, public safety officials, private security firms, fueling companies, GSPs, de-icing vendors, concessionaires, and landside companies. In addition, they should hold separate pre-season snow meetings with each terminal and their snow removal companies to discuss terminal-specific issues. The meetings should be run by the General Manager and JFK operations personnel that are part of the SCC. Other airports that regularly deal with snow, including LGA, conduct similar meetings each season and have found that they enhance stakeholder cooperation in responding to winter weather events.

- **Recommendation 14.2: JFK management and operations should conduct ongoing review of, and implement improvements to, snow removal plans throughout the snow season.**

While the SICP states that certain Port Authority representatives will "discuss any issues that have arisen" after each snow event, this review process should be enhanced and formalized in the Snow SOPs. During the snow season, the General Manager should hold weekly (or biweekly) teleconferences with the SCC representatives, other JFK operations and maintenance representatives in charge of snow removal operations, and representatives from the terminal operators and their snow removal companies. The purpose will be to review snow removal practices, good and bad, and to build upon lessons learned from each event. In efforts to measure snow removal performance, JFK management and operations should develop quantitative and qualitative metrics to evaluate performance during snow events that can be discussed in these teleconferences. These metrics will help objectively evaluate performance during a snowstorm and highlight areas for improvement.

- **Recommendation 14.3: JFK management and operations should enhance existing post-season review processes for JFK's snow removal operations.**

Building upon the existing post-season snow meeting provided for in the SICP, JFK management and operations should develop and incorporate into its Snow SOPs a structured

review process to identify best practices and improve snow removal operations based on lessons learned that season. In advance of these meetings, JFK management and operations should assess key performance indicators and agreed upon performance metrics. Understanding detrimental impacts and positive outcomes of snow removal efforts throughout the season will help formulate corrective actions for future events. Results of this review should be shared with the JFK community in advance of the post-season snow meeting. With the benefit of hindsight and input from other stakeholders at the meeting, the Port Authority can make changes to its snow removal plans for the next year. Indeed, many airports consider the post-season review the start of the planning process for the following season.

- **Recommendation 14.4: JFK management and operations should incorporate into Snow SOPs alternative tactics designed to address varying types of conditions, including low-visibility and whiteout conditions.**

Because the conditions in every snow event are different, JFK's Snow SOPs should be adaptable to a range of weather and traffic scenarios. Although the existing Snow SOPs include different procedures for storms based on their determined severity level, they do not offer sufficient guidance as to what changes are required to handle condition differences within each category. Snowfall rates, wind direction and speed, ground temperature, time of day, expected duration of weather event, and number of aircraft operations, among other factors, will determine the best course of action. It is critical that the SOPs be enhanced so that snow removal crews know what to do in any given scenario.

In particular, while formulating its Snow SOPs for the 2018-2019 season, JFK management and operations should create modified snow removal protocols for low-visibility and whiteout conditions. JFK management and operations should carefully consider and define what equipment, staffing, and snow removal formations are best for low-visibility conditions short of whiteouts. By putting in place a series of alternative snow removal protocols that include different numbers and types of equipment in different formations, JFK management and operations personnel and the Airport community will be better able to quickly adapt to different weather conditions.

Whiteout conditions that suspend snow operations also require adaptation. Rather than having snow crews immediately retreat from the airfield to Hangar 19 (or an alternative remote staging area), JFK management and operations should develop procedures permitting the snow removal teams to suspend operations but remain on the airfield or regroup in a designated nearby area for a period of time to assess next steps in light of the weather forecast. During Grayson, after JFK operations discontinued snow removal operations and all teams were instructed to retreat from the airfield, it took over two hours for the teams to return to Hangar 19 because of the distance and the conditions on the airfield (including large snowdrifts that could not be avoided due to low visibility). If there is a possibility that conditions will improve within a reasonable timeframe, it is preferable for snow removal teams to hold their positions on the airfield so they can resume quickly. Alternatively, they may be able to leave the equipment in place and have personnel picked up to at least avoid moving and returning the equipment. Policies should afford flexibility so that teams can react to changing conditions, but they should at minimum be modified so that teams do not immediately evacuate the airfield and instead pause to assess the forecast and formulate the best plan of action. Any period of time that drivers

remain on the field should be no longer than necessary (and at no point should exceed the twelve-hour maximum set forth in the SICP), so as to avoid driver fatigue.

- **Recommendation 14.5: JFK management and operations should enhance snow removal efforts for clearing JFK's VSR and the hardstands used for deplaning passengers.**

Although the SICP already prioritizes clearing JFK's VSR, JFK management and operations should work with its contracted snow staff responsible for the VSR to further enhance related snow removal efforts. During Grayson, the contractor stopped snow removal operations on the VSR, which became impassable and was therefore closed. In turn, snow removal companies and other ground handlers for JFK terminals and airlines that relied on the VSR to get staff and supplies to their equipment areas were left paralyzed. Moreover, JFK management and operations did not notify service providers along the VSR that they planned to close it. Accordingly, vehicles and employees that attempted to drive on the VSR became stuck, as did the vehicles that went out to try to help them. The VSR is an essential artery to JFK and therefore the contractor (even in low visibility) must continue clearing efforts at least until the Airport community is fully aware of the potential closure and that snow removal efforts have stopped. And JFK management and operations should promptly communicate with stakeholders when a closure is unavoidable to allow contingency planning.

Additionally, use of hardstands for passenger offloading is critical during weather events where gate availability is limited. During Grayson, ground handlers also had difficulty maneuvering around the remote parking areas, negatively impacting turnaround times for aircraft and passengers retrieving bags. Accordingly, the terminal operators and JFK operations should also prioritize plowing of their hardstand parking areas during snow events.

- **Recommendation 14.6: JFK management and operations should consider whether there is a more centralized location (or multiple locations) that could be used for staging of snow removal equipment.**

Hangar 19, the facility where JFK operations' snow removal equipment is staged during winter storms, does not provide an easy access route to the JFK airfield. Time is of the essence during snow removal operations, and every minute lost leads to greater accumulation. It takes snow removal crews approximately 30 minutes each way to get snow removal equipment from Hangar 19 to the airfield. JFK management and operations should consider if there is a more central location or multiple locations that are practical to use for snow removal equipment and would afford teams quicker airfield access.

- **Recommendation 14.7: JFK management should provide support to snow removal teams and ground handlers by making its towing contractor available.**

JFK management should modify its Snow SOPs to provide assistance from its tow truck contractor to snow removal teams and JFK ground handlers. During Grayson, numerous service providers (including JFK operations' own snow removal teams) experienced difficulties and delays in maneuvering equipment on the airfield, and numerous vehicles became stuck in snow drifts. In any weather event that is a Snow Condition 5, JFK management should have tow

trucks dedicated to airfield equipment available around the clock through the duration of the event. Part of the General Manager's role in an EOC implemented for a Snow Condition 5 should be to determine how many dedicated tow trucks are needed and to identify a strategic location to station them throughout the weather event. JFK management should work with its tow contractor to make any necessary revisions to their contract in order to accommodate this broader scope.

- **Recommendation 14.8: Terminal operators should have adequate snow removal capabilities, and JFK management should periodically assess their capabilities.**

During Grayson, some terminal operators experienced delays with snow removal operations in gate and ramp areas of their respective terminals due to staffing and equipment shortages of their snow removal operators. The terminal operators should ensure that they have adequate snow removal capabilities and should be required to report their planning in advance of the snow season and during the days before an anticipated storm. JFK Management should periodically assess the snow conditions and snow removal efforts in the areas controlled by the terminal operators. If there are areas that are not adequately cleared of snow, the Port Authority should retain its own snow removal contractor (or use its own personnel and equipment) to clear the snow and may bill the terminal operator for providing that service.

G. Facilities

Observation 15: Facility Inspections and Maintenance

The water main break that occurred in Terminal 4 on January 7 was a proverbial "kick" to JFK while it was "already down." After extensive recovery efforts, the water main break poured water into the Terminal 4's arrivals hall, damaging stranded luggage while staff struggled to determine the source of the leak.

While this was an isolated incident, terminal infrastructure is essential to JFK operations as a whole, and routine inspections and maintenance should be a continuing obligation for JFK terminal operators.

- **Recommendation 15.1: Terminal operators should include in their maintenance plans requirements for periodic infrastructure inspections by qualified engineers and send inspection results to JFK maintenance.**

Terminal operators should implement proactive measures to detect infrastructure weaknesses in their terminals so that they can be fixed before they surface during the stresses imposed by winter storms. JFK management took steps to accomplish this in its Interim Measures by requiring terminal operators to conduct an immediate inspection of all pipes and plumbing components within their facilities to ensure they were properly protected from winter weather conditions.[18] While this was an effective short-term measure, this should be an ongoing

[18] All terminal operators promptly conducted these inspections and took steps toward fixing issues detected. And certain terminals went a step further and implemented preventative measures recommended by the outside contractors commissioned for the inspections.

requirement at the outset of each snow season. JFK management should work with the terminal operators to develop SOPs outlining the requirements for facility inspections and the method by which certifications are submitted to JFK maintenance.

- **Recommendation 15.2: JFK maintenance teams should perform regular maintenance on airside guard gates.**

JFK management should prioritize regular maintenance of the guard gates at each terminal leading on and off the airfield. During Grayson, issues with the guard gates severely hindered snow removal operations by delaying snow teams' access to the airfield. For example, multiple guard gates froze and subsequently broke, preventing terminals' snow removal companies from entering the airfield. This caused greater snow accumulation and created a bottleneck at the guard gates that remained open. Moreover, malfunctioning of the guard gates is not limited to winter temperatures. Similar issues have been reported in the summer months as well. Regular maintenance and upkeep of the guard gates will reduce delays for ground handlers' access to the airside of the terminals throughout the year.

Appendix 1

Timeline of JFK Operations During Grayson