APPENDIX C

Apron Safety Evaluations of Signature Aviation's TEB South & TEB East Facilities

DELTA AIRPORT CONSULTANTS, INC.

APRON SAFETY EVALUATIONS OF SIGNATURE AVIATION'S TEB SOUTH & TEB EAST FACILITIES

Teterboro Airport

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INTRODUCTION

Teterboro Airport (TEB) is one of the busiest and most important airports in the United States. Safety is a high priority for the Federal Aviation Administration (FAA), Port Authority of New York & New Jersey (Authority) and airport tenants. Maintaining a high level of safety on the ground is a challenge that many airports are facing due to the change in aircraft characteristics and existing infrastructure.

The FAA has developed a plan for public-use airports in the United States. The plan is the National Plan of Integrated Airport Systems (NPIAS). There are two major categories of public-use airports in the NPIAS. Primary airports are public airports receiving scheduled air carrier service with 10,000 or more enplaned passengers per year. These airports are further grouped into large hub, medium hub, small hub and nonhub. Nonprimary airports predominately support general aviation aircraft. The nonprimary category includes nonprimary commercial service airports, general aviation airports and reliever airports. These airports are further grouped into national, regional, local, basic and unclassified.

TETERBORO AIRPORT

Teterboro Airport (TEB) is classified by the FAA as a National public use airport. National airports are located in metropolitan areas near major business centers and support flying throughout the Nation and the world. These airports provide pilots with attractive alternatives to the busy primary airports. National airports have very high levels of activity with many jets and multiengine propeller aircraft. Some national airports are identified as relievers for large, medium and small hub primary airports. Teterboro is also classified as a reliever airport.

TEB is the busiest general aviation airport in the NY/NJ Metro Area. Because of its location, TEB attracts significant business aircraft activity for those traveling to New York City. While the level of aircraft activity at TEB has remained relatively flat over the past 10 years, what has changed is the composition of the aircraft that utilize TEB.

To accommodate GA activity at TEB, the Port Authority leases space to companies referred to as Fixed Based Operators (FBOs). Signature Flight Support (Signature) owns and operates three FBO facilities at TEB: Signature East,Signature South, and Signature West. Signature serves private aviation tenants operating aircraft based at TEB as well as transient operations, which are flights operated by aircraft based at other airports. Services provided include ground handling of aircraft, parking, fuel, hangars, and aircraft maintenance. Signature private aviation tenants include two fractional ownership companies, FlexJet and NetJets, operating at Signature East and South facilities, respectively. Signature contracted with Delta Airport Consultants, Inc. to evaluate the safety of apron operations within their Signature East and Signature South leaseholds.

GENERAL AVIATION AIRCRAFT

The FAA has six categories for grouping sizes of aircraft. Group I is the smallest, and Group VI is the largest. Teterboro Airport is designed to accommodate aircraft up to Group III. Group I aircraft have wingspans less than 49 feet (Cessna 172, Embraer Phenom 100), Group II have wingspans less than 79 feet (Beechcraft King Air 200, Cessna Citation XLS), and Group III have wingspans less than 118 feet (Gulfstream 650ER, Bombardier Global Express). Photos of the representative aircraft are presented below. Table 1 provides the surface area required for a single aircraft per group including access into and out of the parking space.



Cessna 172



Cessna Citation XLS



Bombardier Global 7500 (Photo from Vistajet.com)

TABLE 1: SURFACE AREA REQUIRED FOR A SINGLE AIRCRAFT PER GROUP

Aircraft Category	Surface Area (sf)*
Small Aircraft (Group I)	3,600
Medium Jet (Group II)	7,600
Large Jet (Group III)	13,500

*Areas from EA Appendix B

Between 1961 and 2004, only three models of Group III business jet aircraft were manufactured, representing approximately 4% of all business jet aircraft models. Between 2005 and 2024, 13 models of Group III business jet aircraft were manufactured, with four more anticipated entering the market in 2025. These 17 Group III business jet aircraft models represent approximately 31% of all business jet aircraft models being manufactured. The smallest Group I models dropped from a 42% market share to 15%. The percentage of Group II business jet aircraft models has stayed roughly the same. Table 2 provides a summary of the aircraft models per Group.

TABLE 2: AIRCRAFT MODELS IN PRODUCTION

	Aircraft Models in Production		
	Group I	Group II	Group III
1961-2004	32	41	3
% of Production	*42%*	*54%*	*4%*
2005-2025	8	30	17
% of Production	*15%*	*54%*	*31%*

AIRCRAFT AT TETERBORO

The figures below depict the trend in the operations per type of aircraft in the NY/NJ Metro Area (Figure 1) and TEB (Figure 2) between 2015 and 2023. Both figures reflect the shift from smaller Group I aircraft to larger Group III aircraft.

FIGURE 1: NY/NJ METRO AREA AIRCRAFT OPERATIONS

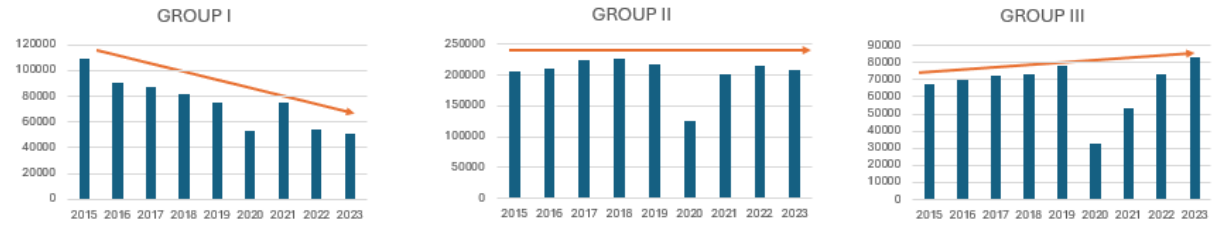
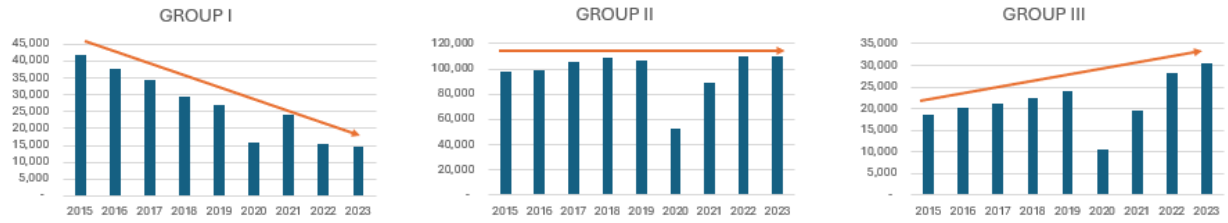


FIG 2: TEB AIRCRAFT OPERATIONS



The largest user of the Signature South apron is the private business jet charter and aircraft management company NetJets. NetJets is currently in the process of updating its fleet of aircraft. They are replacing the Cessna Citation XLS (56' wingspan) with the Cessna Citation Latitude (72' wingspan) and the Bombardier Challenger 650 (64' wingspan) with the Bombardier Global 7500 (104' wingspan). These new aircraft are considerably larger in both wingspan and length than the aircraft they are replacing, causing apron and hangar space issues.

One of the largest users of the Signature East apron is the private business jet charter and aircraft management company Flexjet. Flexjet is adding the Gulfstream G700 to its fleet, which has a wingspan of 103 feet. They are also upgrading from the Embraer Praetor 500 (63' wingspan) to the Embraer Praetor 600 (70' wingspan). Like Signature South, these larger aircraft are reducing the number of aircraft that can be accommodated with the existing apron and hangar space.
While the based aircraft and the flight operations are not significantly increasing at Signature, the changes in the overall aircraft fleet are resulting in less utility of the existing Signature infrastructure.

APRON EVALUATIONS

Delta Airport Consultants, Inc. visited Teterboro Airport (TEB) on Tuesday, October 1, 2024, to observe the apron operations of both the Signature South facility (Signature South) and the Signature East facility (Signature East). Both facilities were very busy with numerous aircraft arriving and departing. In addition to arriving and departing aircraft, Signature personnel were constantly in motion to reposition aircraft on the ground to make space for the arriving and departing aircraft. In addition to the staff working directly with the aircraft, there were pilots walking to and from their aircraft, vehicles transporting passengers to and from their aircraft and fuel trucks driving to and from aircraft to refuel them. The operations staff were professional and appeared very focused on their task to ensure the operation ran smoothly and safely.
During the visits, we did notice several issues regarding the operational environment of the aprons. Although the aprons operated without incident while we were there, we noticed several risks associated with the apron environments. From a safety risk standpoint, we noticed the following issues:

- Aircraft Size: The average size of business jet aircraft has grown considerably across the country and at Signature. To fit the same number of aircraft on the apron, the aircraft are being parked closer together, with less clearances than those recommended. The greater wingspan has also required the taxilane clearances to be adjusted, as larger aircraft require greater taxilane clearances per FAA planning criteria, to improve safety resulting in less available space to park aircraft. A larger apron will allow for the use of proper clearances for parked aircraft and taxilanes. Newer aircraft are being built with winglets on the ends of their wings. These winglets stick up eliminating the possibility of "stacking" aircraft by overlapping wings. This scenario has resulted in the need for additional apron space to avoid winglets clipping each other.

  Using the information from Tables 1 and 2, we can determine how the increase in aircraft size has affected the parking situation at Signature South and Signature East. Tables 3 and 4 compare the first four decades of business jet aircraft to the last two decades and the number of aircraft that can be accommodated on the Signature aprons.

TABLE 3: SIGNATURE SOUTH APRON PARKING

	1961-2004	2005-2025
Total Apron Area (sf)*	629,400	629,400
Square footage of Apron Parking Allocated to Group I based on percentages in Table 2	265,011	91,549
Equivalent Number of Aircraft Using Table 1	74	25
Square footage of Apron Parking Allocated to Group II based on percentages in Table 2	339,545	343,309
Equivalent Number of Aircraft Using Table 1	45	45
Square footage of Apron Parking Allocated to Group III based on percentages in Table 2	24,845	194,542
Equivalent Number of Aircraft Using Table 1	2	14
Total Aircraft That Can Be Accommodated	**120**	**85**

*From EA Appendix B, TEB Signature Facility Requirements

Numbers may not add due to rounding.

The Signature South apron can accommodate an equivalent **35 (29%)** fewer aircraft due to the increase in the average size of aircraft.

TABLE 4: SIGNATURE EAST APRON PARKING

	1961-2004	2005-2025
Total Apron Area (sf)*	353,400	353,400
Square footage of Apron Parking Allocated to Group I based on percentages in Table 2	148,800	51,404
Equivalent Number of Aircraft Using Table 1	41	14
Square footage of Apron Parking Allocated to Group II based on percentages in Table 2	190,650	192,764
Equivalent Number of Aircraft Using Table 1	25	25
Square footage of Apron Parking Allocated to Group III based on percentages in Table 2	13,950	109,233
Equivalent Number of Aircraft Using Table 1	1	8
Total Aircraft That Can Be Accommodated	**67**	**48**

*From EA Appendix B, TEB Signature Facility Requirements

Numbers may not add due to rounding.

The Signature East apron can accommodate an equivalent **20 (29%)** fewer aircraft due to the increase in the average size of aircraft.

Demand for aircraft parking at both facilities has not decreased, meaning both facilities are attempting to accommodate the same number of aircraft, which are anywhere from 2 to 4 times

larger, in the same space. This is causing a congested apron increasing the risk of aircraft-to-aircraft incidents.

- People & Vehicles: Due to constraints on the apron, larger aircraft are parked further from the FBO Terminal. This requires many pilots and passengers to either walk further across an active apron, or more FBO vehicles to transport the people across the apron. Larger aircraft tend to have poorer pilot sightlines and require additional personnel and time to properly direct the aircraft on the apron. The more people and vehicles on the apron, the greater safety risk to them and the aircraft. Table 5 summarizes the average walking distances from the FBO Terminal to the parking areas for large aircraft at nearby Signature FBO facilities. As evidenced from the table, the walking distance at Signature South is 2 to 3 times further than comparable FBO facilities, increasing the risk to passengers and pilots.

TABLE 5: AVERAGE WALKING DISTANCE FROM FBO TO PARKING AREAS FOR LARGE AIRCRAFT

FBO Facility	Average Walking Distance (ft)
Trenton-Mercer (TTN)	100 to 300
Newark Liberty (EWR)	100 to 300
Morristown (MMU)	100 to 200
Westchester County (HPN)	100 to 300
Chester County (MQS)	100 to 200
New York Stewart Int'l (SWF)	100 to 300
Signature East (TEB)	100 to 300
Signature West (TEB)	100 to 300
Signature South (TEB)	200 to 600

- Ground Repositioning: To accommodate the larger aircraft, a greater number of aircraft must be repositioned on the ground for long-term parking or in preparation for departure. Repositioning aircraft on the ground introduces more people and vehicles to an active apron. It also introduces a greater risk of aircraft collision. A larger apron that can accommodate the aircraft demand will help to minimize or eliminate the need to reposition aircraft reducing risk of property damage and bodily injury.

- Foreign Object Debris (FOD): The more people and vehicles on an active apron, the greater the chance of introducing FOD. Tools, bags, ground handling equipment, etc. that are dropped or fall from a vehicle could be run over by an aircraft, damaging the aircraft or it could be sucked into the engine causing even greater damage and possible harm to people on the apron. The FOD could also be blown by the engines and hit and injure people on the apron or damage other aircraft.

From FAA Advisory Circular 150/5210-24A:

> *"FOD can severely injure airport or air carrier personnel or damage equipment. Types of potential damage include: cutting aircraft tires; being ingested into engines; or becoming lodged in mechanisms affecting flight operations. Personnel injuries or even death can occur when jet blast propels FOD through the airport environment at high velocities"*
>
> *"FOD comes from many sources, which complicates efforts to maintain safe airfield operations. FOD can be generated from* **personnel,** *airport infrastructure (pavements, lights, and signs), the environment (wildlife, snow, ice) and the equipment operating on the airfield (aircraft,* **airport operations vehicles, maintenance equipment, fueling trucks, other aircraft servicing equipment***, and construction equipment)."*
>
> *"FOD can collect both on and below ground support equipment stored or staged on the airport apron,* **particularly in apron areas***. Jet blast can then blow FOD onto personnel or an aircraft."*

Based on our observations, Signature does an outstanding job of managing FOD on their aprons, but reducing the number of people and ground handling equipment will reduce the chance of FOD on the apron and improve safety.

CONCLUSION

The size and number of large general aviation business aircraft has grown considerably across the country, and their activity and impacts are being felt at Signature South and Signature East. As noted above, larger aircraft have had a cascading effect on airfield operations and apron safety. In April of this year, an accident occurred involving two large business jets with winglets at Signature South. To accommodate the aircraft, they were parked close together. One of the aircraft was taxied without the appropriate staff on the ground and clipped the wing of an adjacent aircraft causing significant damage. Fortunately, no one in the other aircraft (which was empty) or on the ground was injured. Providing more apron to properly space out the aircraft could have prevented this accident. A second incident occurred in September of this year. An arriving business jet was taxiing between a row of parked aircraft and a hangar. The brakes failed on the aircraft. In order to stop the aircraft from hitting other aircraft or personnel on the apron, the pilot directed the aircraft to make contact with the hangar to stop it. There were no injuries reported. A larger apron would have provided the pilot with more options to safely bring the aircraft to a stop.

Based on the observations in the field, and discussions with Signature Staff, the number of aircraft and the limited size of both aprons have had a negative impact on operations and safety for both the Signature South and Signature East facilities. The increase in wingspan and length of business jet aircraft has required Signature to park aircraft closer together, reduce taxilanes clearances, in some cases during peak periods, converting taxilanes to parking apron, and utilize more staff and vehicles to position aircraft. A larger apron will allow aircraft to be parked further apart, maintaining standard taxilanes and taxilane clearances, reducing the risk of an aircraft collision as well as the liability to all parties involved. Expanding the apron and constructing new storage hangars will require fewer staff and ground handling equipment to marshal aircraft and passengers on the active aprons. Any opportunity to reduce people and vehicles on an active aircraft apron will help reduce FOD and exponentially improve safety. Signature

has done an excellent job managing the aircraft traffic with the apron and hangar space that they have; however, due to the level of activity and limited space, the potential for incidents that could result in significant property damage and bodily injury have a higher probability of occurring. Expanding both aprons would significantly improve the safety of a complex operating environment that is becoming more complex.

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About Douglas Sander

Douglas Sander has over 28 years of airport planning, design and construction experience, all at Delta Airport Consultants, Inc. Mr. Sander is a registered Professional Engineer in several states and has served as the Project Manager and lead designer and planner on many of the firm's projects for clients ranging from commercial service airports like Raleigh-Durham International Airport to smaller general aviation facilities. Prior to joining Delta, he worked as an intern with the North Carolina DOT – Division of Aviation. Mr. Sander graduated from NC State University with a BS in Civil Engineering. He is a member of the Airport Consultants Council (ACC) Engineering Committee, where he previously served as Chairman. He has been a moderator, subject matter expert, and presenter at aviation conferences and workshops across the country. He is also a Certified Member of the American Association of Airport Executives (AAAE).