Unmanned Aerial Systems (UAS)

In the past two decades the use of drones for non-military applications, either personal or commercial, has become common place in our skies. Technological advancements in battery systems, smartphones, and camera sensors have made drones readily accessible to many different users. Drones are now the fastest growing segment of aviation in the United States.[1] Thus far, increases in drones for commercial use, meaning use for any compensation, have primarily been driven by increased use of small drone systems in applications such as engineering and construction, filmmaking and photography, search and rescue, and agriculture. As improvements to drone infrastructure allow for longer flight times and the ability to operate beyond line of sight, market forecasts predict logistics/shipping companies and energy sector (oil/gas/renewables) will be the main driver of growth in the U.S.[2,3] The Twin Cities metro area is a diverse landscape and could see great benefits from increased drone use across many applications. The dense urban environment could be served by services such as drone delivery, while our agricultural land and natural resources will benefit from mapping and monitoring use cases.[4]

Widespread adoption and implementation of drones in our National Airspace System (NAS) comes with numerous challenges. There is a negative perception of drones amongst large portions of the population that will need to be addressed.[5] Security of sensitive data is a major concern for both operators and customers of drone services.[6,7] Autonomous drone applications will require additional infrastructure such as landing pads, charging stations, and communication networks.[8,9] The most immediate challenge with increased drone activity is the increased likelihood of incidents involving drones and manned aircraft or ground-based obstacles and people. Safe implementation of autonomous drones will require advancements in detection and avoidance capabilities of drones, network connectivity, and clear, standardized regulatory guidelines.[10] In response to these challenges, the Federal government has authorized the Federal Aviation Administration (FAA) to create rules for safely and efficiently integrating drones into our NAS.

Most significant of these was the regulatory framework established though 14 CFR Part 107 Small Unmanned Aircraft Systems in 2016.[11] Part 107 led to significant growth in the number of drone users because it established rules for safe operations of drone in the NAS (**Table 1**),

[1] Drone Safety Day *Federal Aviation Administration.* Retrieved July 24, 2024
[2] Delivery Drones Market Size, Share & Trends Analysis Report By Component (Hardware, Services), By Application (Agriculture, Healthcare), By Drone Type, By Range, By Payload, By Duration, By Operation Mode, By Region, And Segment Forecasts, 2023 - 2030 *GrandView Research*. Retrieved September 10, 2024
[3] Commercial Drone Market Fortune Business Insights. Retrieved September 10, 2024
[4] The Twin Cities Region *Metropolitan Council.* Retrieved September 10, 2024
[5] Through the Looking Glass: Public Safety Agency Drone Policies and The Fourth Amendment Monica J. Manzella, JD & Greggory J. Favre, MS United *States Naval Postgraduate School: Center for Homeland Defense & Security*. Retrieved September 10, 2024
[6] The Current Opportunities and Challenges in Drone Technology Mohamed Emimi, Mohamed Khaleel, Abobakr Alkrash. *International Journal of Electrical Engineering and Sustainability.* Retrieved September 10, 2024
[7] Unmanned aerial vehicles (UAVs): practical aspects, applications, open challenges, security issues, and future trends Syed Agha Hassnain Mohsan, Nawaf Qasem Hamood Othman, Yanlong Li, Mohammed H. Alsharif & Muhammad Asghar Khan. *Intelligent Service Robotics* Retrieved September 10, 2024
[8] Facility location decisions for drone delivery: A literature review Okan Dukkanci, James F. Campbell, Bahar Y. Kara *European Journal of Operational Research*. Retrieved September 10, 2024
[9] Last-Mile Drone Delivery: Past, Present, and Future Hossein Eskandaripour &Enkhsaikhan Boldsaikhan. *Drones* Retrieved September 10, 2024
[10] Comprehensive Review of Drones Collision Avoidance Schemes: Challenges and Open Issues Mohammad Reza Rezaee, Nor Asilah Wati Abdul Hamid, Masnida Hussin and Zuriati Ahmad Zukarnain. *Transactions on Intelligent Transportation Systems* Retrieved September 10, 2024
[11] Part 107 – Small Unmanned Aircraft Systems *Code of Federal Regulations.* Retrieved July 24, 2024

created a pathway for commercial drone operators to become FAA certified, and created an exemption for recreational drone flyers to operate under a Community Based Organization set of rules. Prior to Part 107, the 2012 FAA Modernization and Reform Act allowed commercial drone operators to operate if they could obtain a Section 333 exemption which had much stricter requirements and were approved case by case.[12] In the first year that the FAA approved these exemptions, 2014, only six exemptions were granted.[13] As of May 2024, there are over 382,000 Certified drone operators and over 782,000 drones registered with the FAA, of which nearly 383,000 are registered for commercial purposes.[14] Market forecasts anticipate drone use to continue over the next decade. Current sales of drones in the U.S. are approximately 6.6 billion (USD) and are forecasted to grow to 31.3 billion (USD) by 2034 with a compounded annual growth rate of 16.9% over that time. As drone use and technology has increased, the FAA has responded by developing rules to better integrate drones in the NAS and expand on the Part 107 guidelines. Other notable events in drone integration include:

- 2017 – FAA partners with industry partners to develop the Low Altitude Authorization and Notification Capability (LAANC) system. LAANC provides drone pilots with an automated system to request and receive approval in the field to fly in controlled airspace at designated altitudes around airports (Figure 2 through 7 below).[15] LAANC airspace restrictions are only developed around airports with FAA controlled airspace. Some smaller general aviation facilities may not have LAANC systems in place. One example of an airport without LAANC within the regional system is Forest Lake Municipal Airport (25D).
- 2021 – FAA publishes rule change that allows for flights over people and night operations under certain conditions.[16]
- 2023 – FAA's Remote ID rule went into effect. The Remote ID rule requires all drones registered with the FAA, regardless of use, to broadcast a signal that provides identification and location information of the operator. Drones can operate without Remote ID capabilities within FAA-Recognized Identification Areas (FRIA).[17]

Conclusion

As drone technology continues to develop, the FAA will continue to publish rules that increase the flexibility and integration of drones in the NAS. The Metropolitan Council will monitor these developments to better understand how regulation changes will impact the region and how best to implement planning, infrastructure, and policies that promote drone integration. The Metropolitan Council will implement the changes in ways that align with the regional goals which are equitable and inclusive, healthy and safe for communities, dynamic and resilient, address climate change and protect and restore natural systems. The following is a list of anticipated areas of growth and regulation regarding drone integration that should be considered:

- **Beyond Visual Line of Sight (BVLOS)** drone operations – The FAA Reauthorization Act of 2024 provides a pathway for the FAA to publish rules that allow drones to be operated beyond visual line of sight.[18] This is a key component of more advanced drone operations such as delivery, agricultural, and public safety uses. Safe and effective BVLOS operations

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[12] H.R.658 - FAA Modernization and Reform Act of 2012 *112th U.S. Congress.* Retrieved July 24, 2024
[13] Section 333 Authorizations Granted *Federal Aviation Administration.* Retrieved July 24, 2024
[14] Drones by the Numbers *Federal Aviation Administration.* Retrieved July 24, 2024
[15] UAS Data Exchange (LAANC) *Federal Aviation Administration.* Retrieved July 24, 2024
[16] Operations Over People General Overview *Federal Aviation Administration.* Retrieved July 24, 2024
[17] Remote Identification of Drones *Federal Aviation Administration.* Retrieved July 24, 2024
[18] Senate Overwhelmingly Approves FAA Reauthorization Act U.*S. Senate Committee on Commerce, Science, and Transportation*.

will require reliable communications/connectivity systems, detection and avoidance systems, and real-time environmental monitoring systems.

- **Advanced Air Mobility (AAM)/Urban Air Mobility (UAM) –** AAM/UAM systems are focused on the low-altitude transportation of people or cargo using electric vertical take-off and landing aircraft. Development of these systems will bring increased accessibility to underserved communities and increase the ability of first responders to respond to an emergency. Adoption of AAM/UAM systems will require enhanced communications systems, take-off and landing infrastructure, and integration with land use and established transportation systems.[19]
- **Drone Delivery** – Last-mile delivery is an essential component for retailers and the logistics chain to customers. The ability to deliver goods and services via drone can benefit citizens' day to day lives, increase accessibility to medical services in underserved areas, and have environmental benefits.[9] Currently, delivery trucks are the most common last-mile delivery tool. These vehicles account for approximately 4% of vehicles on the road, but account for nearly 7% of all greenhouse gas emissions from traffic.[9] Drones provide a pathway to significantly decrease those emissions. The 2024 FAA Reauthorization Act extends the FAA's BEYOND program which focuses on establishing community partnerships and research into the social and economic benefits of drone delivery systems.[10, 20] Currently there are 5 drone delivery companies authorized by the FAA and operating within the United States.[20] Amazon Prime Air has been offering medication deliveries in 60 minutes or less to portions of Texas and California and has the global goal of drones delivering 500 million packages per year by 2030.[21] More widespread use of drones for deliveries will require improvements to infrastructure such as designated landing pads and/or charging stations along with robust communications including air traffic control, cellular, and internet connectivity. Increased drone deliveries will also impact land use by expanding regular aviation activity outside of traditional locations like airports or heliports. The evolution of drone use for deliveries may require additional considerations for industrial land uses like warehousing and their interaction with adjacent residential or other land.
- **Unmanned Aircraft System Traffic Management (UTM)** - The FAA, NASA, other federal agencies, and industry are collaborating to develop operational concepts, data exchange requirements, and a framework for beyond visual line-of-sight drone operations at low altitudes in non-FAA-controlled airspace. UTM will allow drone operators and the FAA to communicate real-time airspace status and provide real-time constraints to UAS operations. Communication and coordination will primarily occur through a network of automated systems. This rea-time communication will provide added safety and collision avoidance for BVLOS in non-FAA-controlled airspace.
- **Counter-Drone Operations –** With increased integration of drones in the NAS, there is a need to develop counter-drone systems to combat rogue drone systems or nefarious actors. Counter-drone systems will be important around airport facilities and places of public gathering to provide additional security and safety to persons and aircraft operations. In the Twin Cities metro area, areas of focus for counter-drone technology implementation would be public gathering spaces such as sports facilities and outdoor venues and around our airport facilities with controlled airspace which corresponds to the LAANC maps provided below. Some counter-drone operations are already in place through geofencing

[19] Advanced Air Mobility Mission *NASA.* Retrieved July 24, 2024
[20] Package Delivery by Drone (Part 135) *Federal Aviation Administration.* Retrieved July 24, 2024
[21] Amazon Gets Key FAA Drone Delivery OK; Clears Path To 500M Package Goal *Forbes Magazine.* Retrieved September 10, 2024

with manufacturers not allowing operations beyond the limits of the LAANC airspace restrictions.

- **Drone Education and Workforce** Training – Increased adoption of drones will provide a pathway for jobs related to drone operations, data processing, and engineering of drone systems and infrastructure. The FAAs Integration Pilot Program centers around developing standards and informing policy on how to facilitate safe integrations of drones into our society.[9] The FAA has partnered with U.S. colleges to provide UAS Training Initiatives and with K-12 schools through their FAA STEM AVSED program which aims to raise awareness about aerospace career opportunities to students. [22,23]

The Metropolitan Council will continue to monitor UAS trends in relation to achieving the goals established to meet the Metropolitan Councils vision for 2050.

Table 1: Summary of Part 107 Operational Limitations[24]

- *Must maintain visual line of sight with drone*
- *Must yield to manned aircraft*
- *Must fly during daylight hours unless using anti-collision lighting*
- *Maximum operating altitude of 400' above ground*
- *Do not fly drones over people not participating in operation or moving vehicles*
- *Do not operate from moving vehicle unless flying over a sparsely populated area*
- *Do not operate in a careless or reckless manner*
- *Drone must weigh less than 55 pounds*
- *Maximum operating speed is 100 mph*
- *Can only operate one drone at a time*
- *Must have 3 miles of visibility from control station*

Figure 1. *Small UAS Flight Restrictions in Different Classes of the National Airspace System[25] This figure identifies the controlled airspace that requires Air Traffic Authorization through the use of the LAANC system. This figure also identifies the operational limitations in uncontrolled airspace.*

[22] About STEM AVSED *Federal Aviation Administration.* Retrieved July 24, 2024
[23] UAS Collegiate Training Initiative *Federal Aviation Administration.* Retrieved July 24, 2024
[24] Small Unmanned Aircraft Systems (UAS) Regulations (Part 107) *Federal Aviation Administration.* Retrieved July 24, 2024
[25] Airspace 101 – Rules of the Sky *Federal Aviation Administration.* Retrieved September 9, 2024

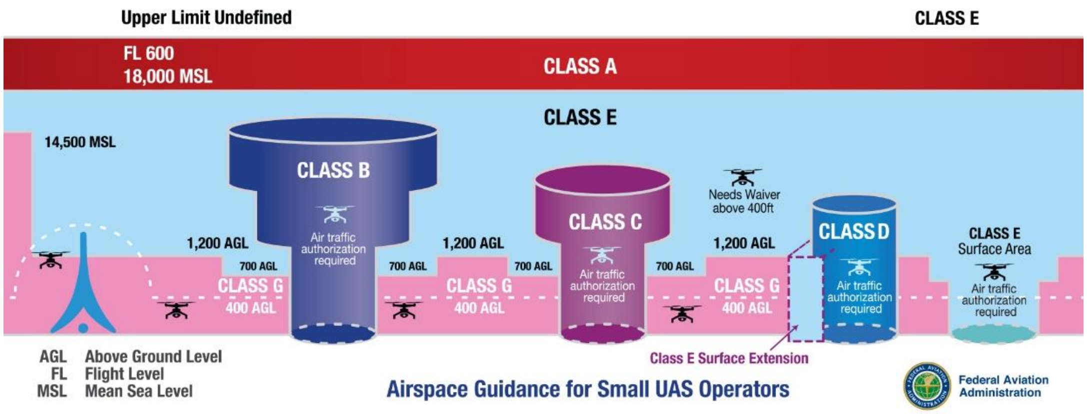


Figure 2. *LAANC airspace restrictions for UAS operations surrounding MSP International airport. LAANC airspace grids provide maximum operating elevations surrounding the airport and allow for real time approval of operational requests below the identified grid elevation and within the airport-controlled airspace. The elevation values are designed to minimize the potential for an UAS/Manned Aircraft interaction.*

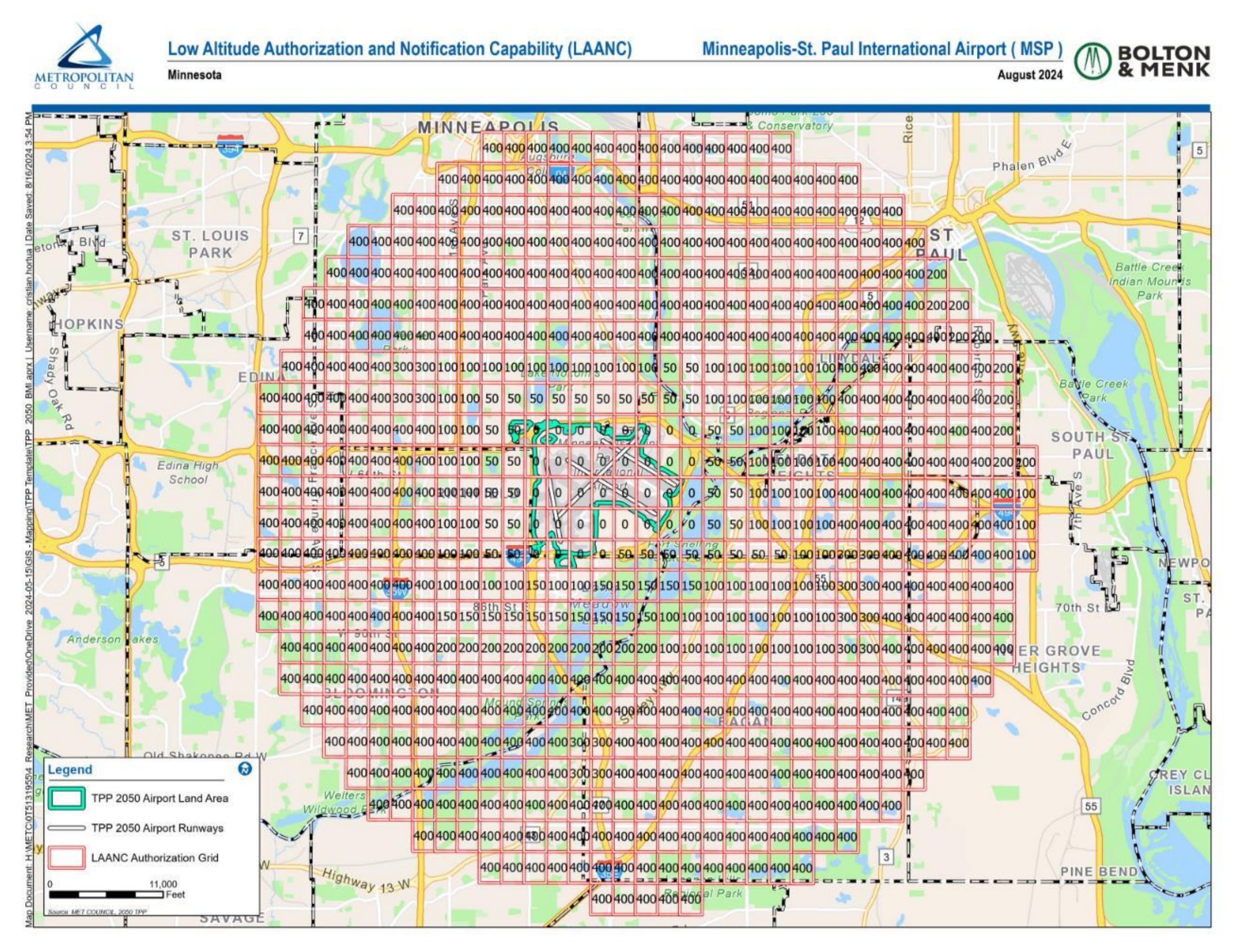


Figure 3. LAANC airspace restrictions for UAS operations surrounding ANE airport. LAANC airspace grids provide maximum operating elevations surrounding the airport and allow for real time approval of operational requests below the identified grid elevation and within the airport-controlled airspace. The elevation values are designed to minimize the potential for an UAS/Manned Aircraft interaction.

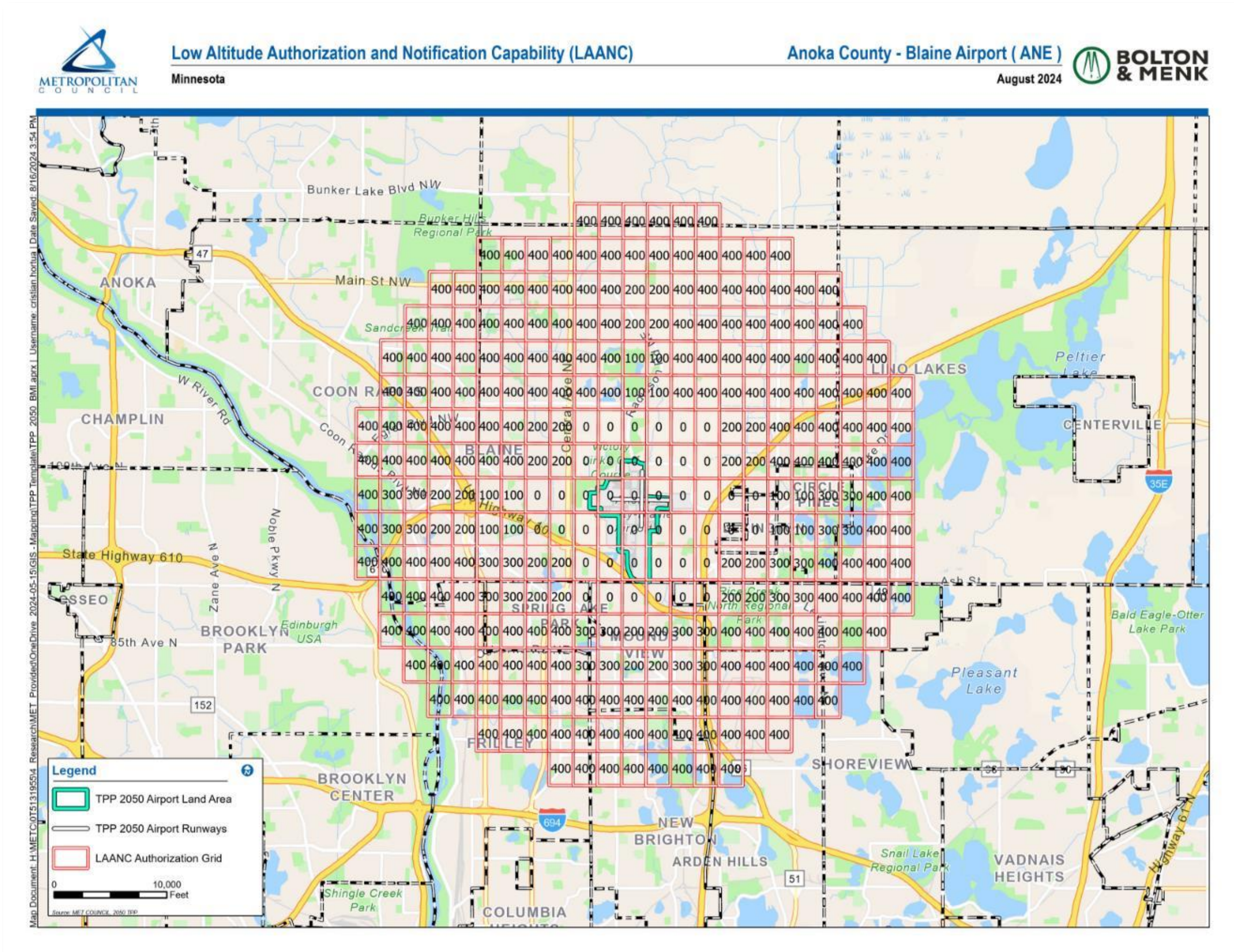


***Figure 4**. LAANC airspace restrictions for UAS operations surrounding FCM airport. LAANC airspace grids provide maximum operating elevations surrounding the airport and allow for real time approval of operational requests below the identified grid elevation and within the airport-controlled airspace. The elevation values are designed to minimize the potential for an UAS/Manned Aircraft interaction.*

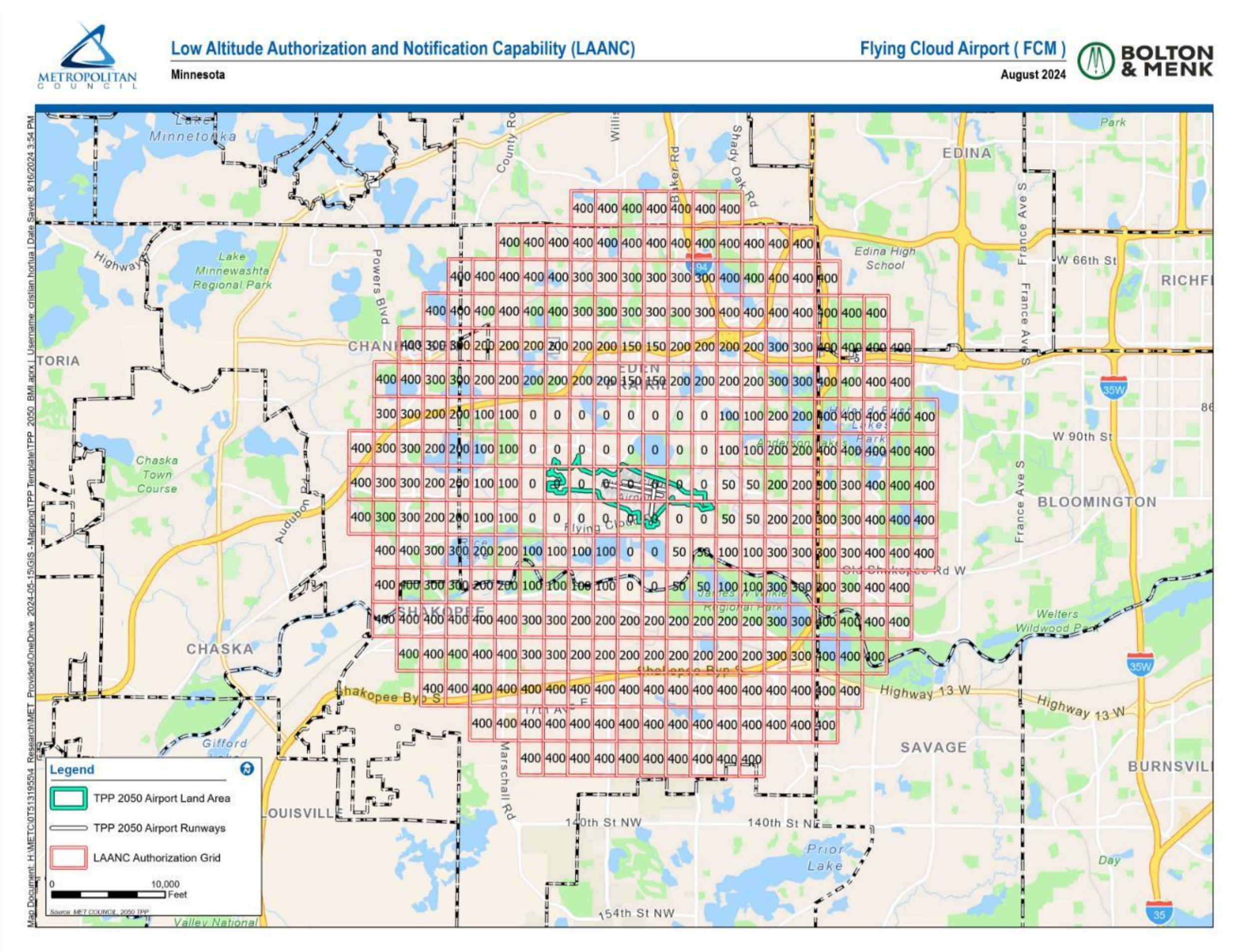


__Figure 5__. LAANC airspace restrictions for UAS operations surrounding MIC airport. LAANC airspace grids provide maximum operating elevations surrounding the airport and allow for real time approval of operational requests below the identified grid elevation and within the airport-controlled airspace. The elevation values are designed to minimize the potential for an UAS/Manned Aircraft interaction.

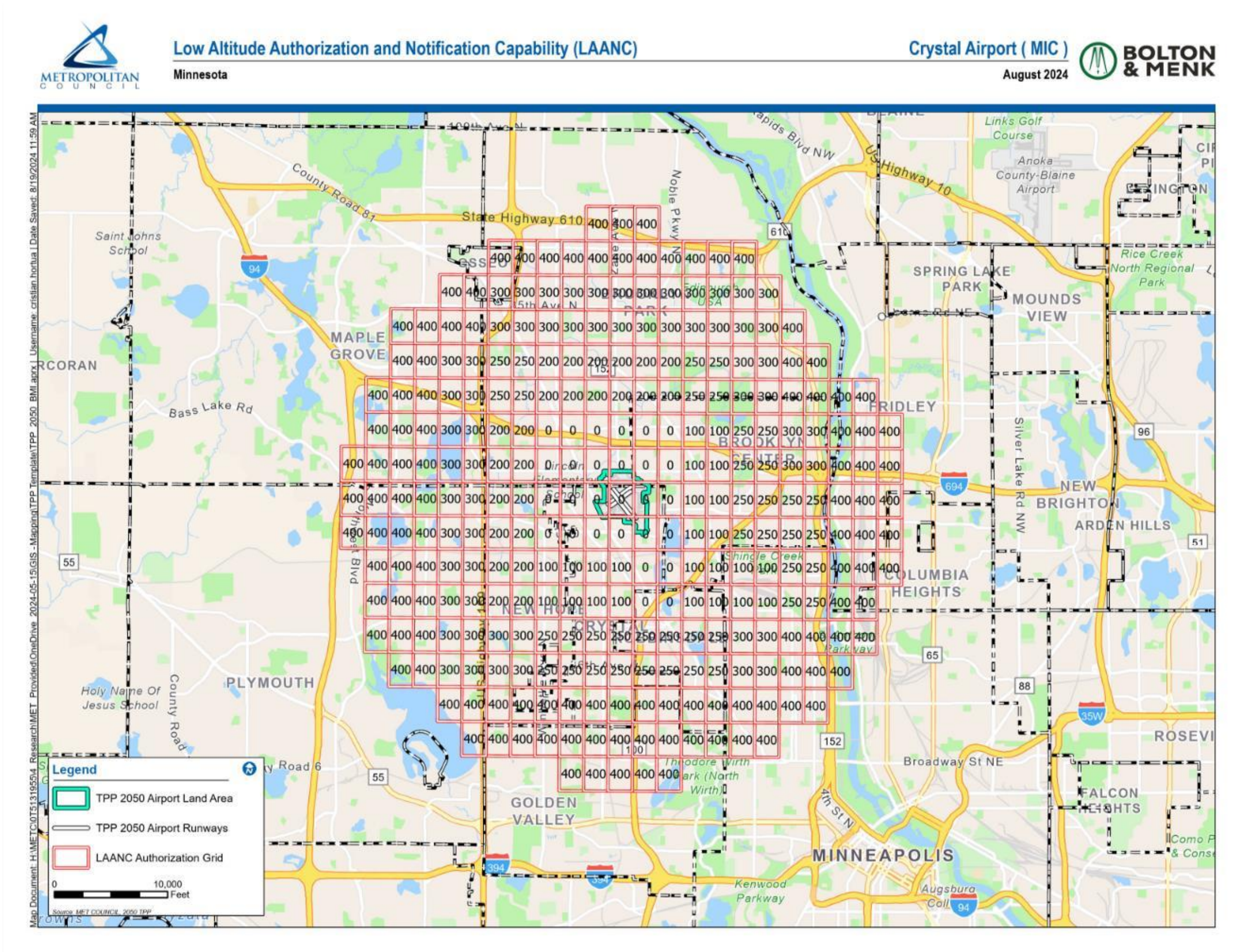


***Figure 6**. LAANC airspace restrictions for UAS operations surrounding SGS airport. LAANC airspace grids provide maximum operating elevations surrounding the airport and allow for real time approval of operational requests below the identified grid elevation and within the airport-controlled airspace. The elevation values are designed to minimize the potential for an UAS/Manned Aircraft interaction.*

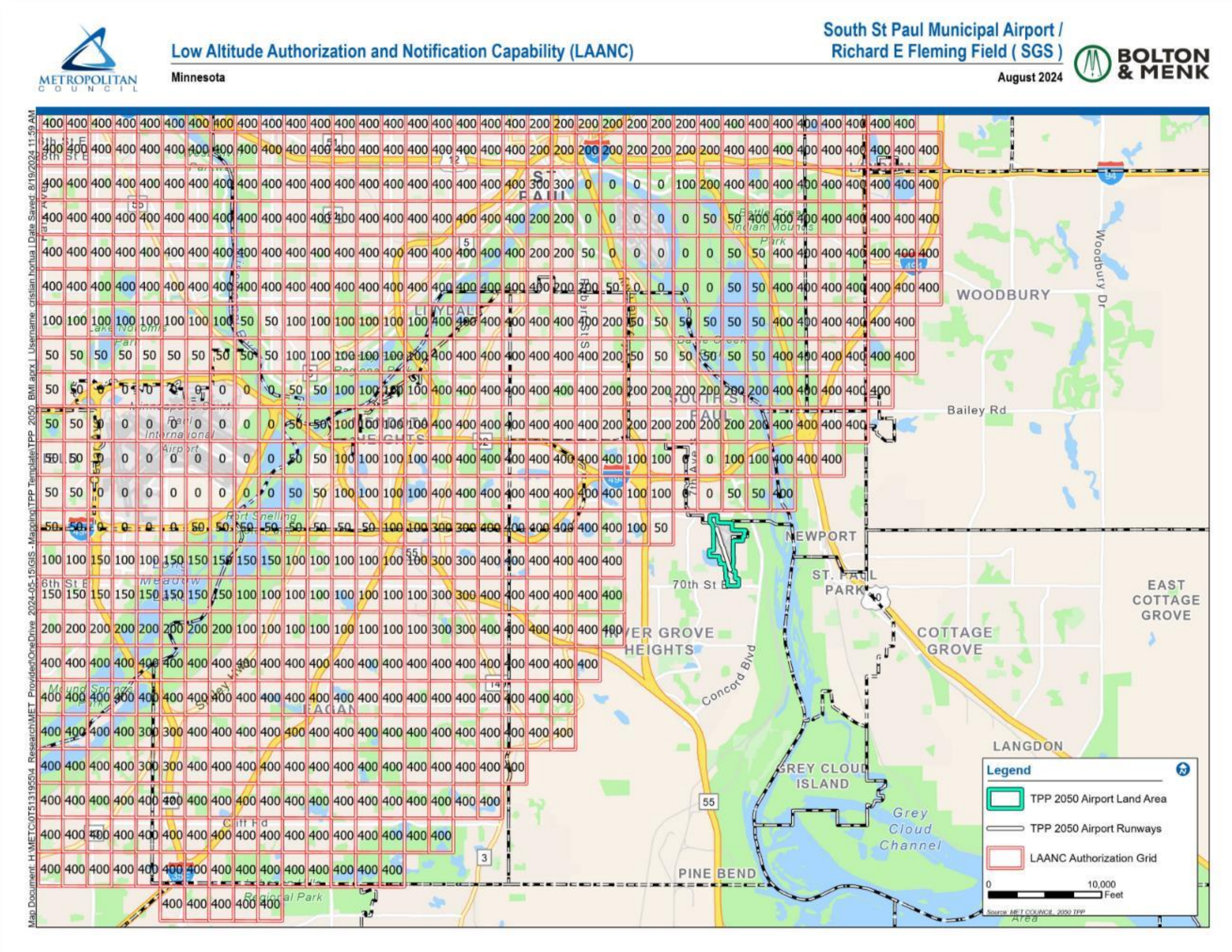
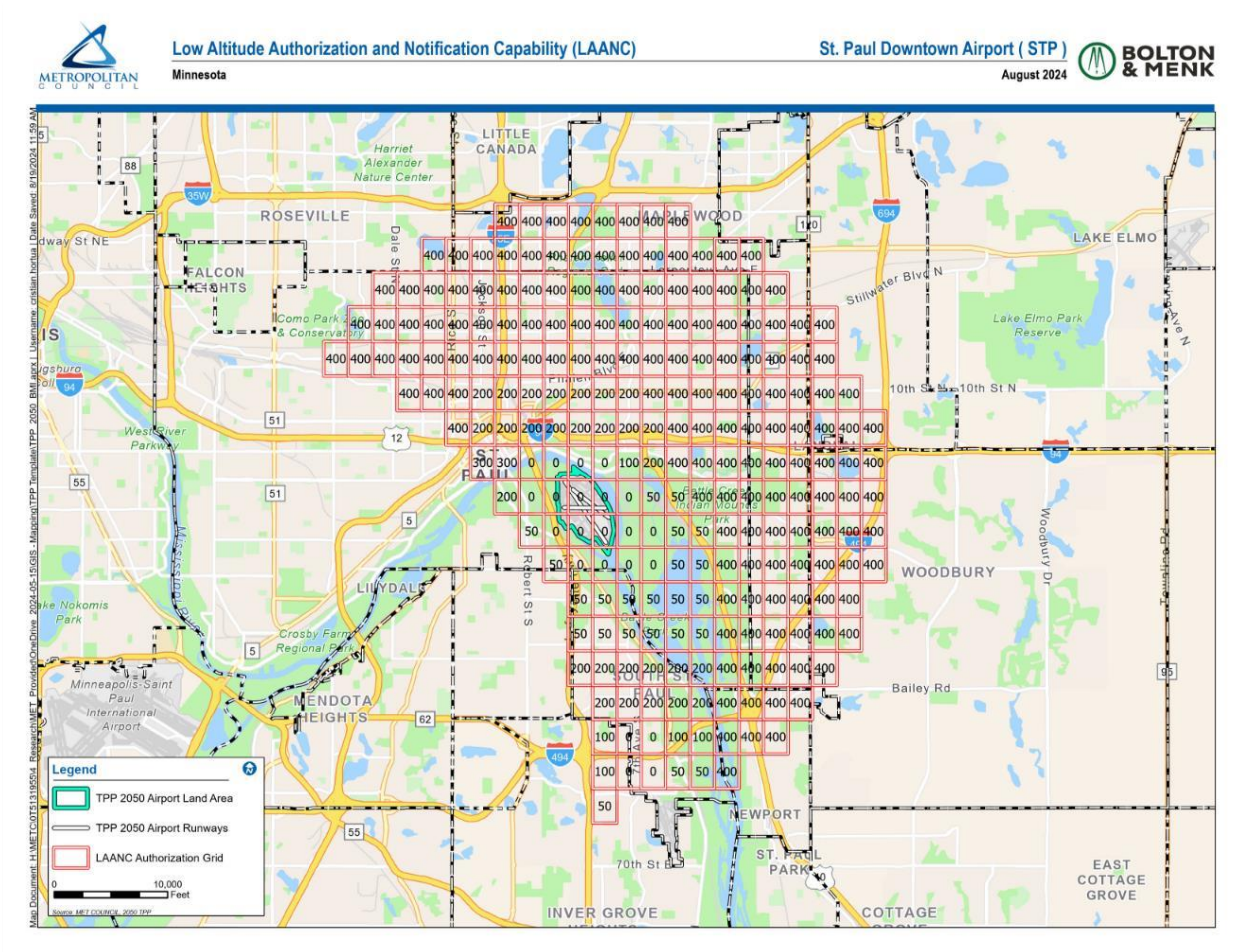


Figure 7*. LAANC airspace restrictions for UAS operations surrounding STP airport. LAANC airspace grids provide maximum operating elevations surrounding the airport and allow for real time approval of operational requests below the identified grid elevation and within the airport-controlled airspace. The elevation values are designed to minimize the potential for an UAS/Manned Aircraft interaction.*


Low Altitude Authorization and Notification Capability (LAANC)
Minnesota
St. Paul Downtown Airport (STP)
August 2024
METROPOLITAN COUNCIL
BOLTON & MENK
LITTLE CANADA
ROSEVILLE
FALCON HEIGHTS
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LAKE ELMO
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WOODBURY
LILYDALE
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West River Parkway
NEWPORT
ST. PAUL PARK
INVER GROVE
COTTAGE GROVE
EAST COTTAGE GROVE
Stillwater Blvd N
10th St N
Bailey Rd
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Legend
TPP 2050 Airport Land Area
TPP 2050 Airport Runways
LAANC Authorization Grid
10,000 Feet