Chapter 4. Airspace Integration

4.1. Introduction

As urbanization continues to expand and technological advancements accelerate, the demand for innovative transportation solutions becomes increasingly essential. One such solution is Regional Air Mobility (RAM), which aims to transform the way people and goods move, both through metropolitan and rural areas. This chapter delves into the intricacies of AAM and its interaction with the National Airspace System (NAS), with a specific focus on RAM and its potential role in and around the Chicago and St. Louis Metro area.

RAM, like Urban Air Mobility (UAM), is a subset of AAM and is a critical component of the next generation system of transportation. Unlike UAM however, RAM is primarily focused on the transportation of passengers and cargo between geographic locations. More specifically, RAM places a much greater emphasis on the geographic connection between adjacent or isolated communities rather than only in urban settings. RAM demand is most likely to begin in highly populated areas, such as Chicago, Illinois or St. Louis, Missouri, where it would generally bridge the gap between suburban and urban areas. The goals of RAM are to connect geographically separated regions, reduce travel/commute times, reduce road congestion, and offer more efficient and sustainable solutions to personal and business travel. However, there are a multitude of challenges the industry must overcome before RAM is realized in Chicago or in other markets in the US.

To understand the potential impact and integration of RAM, it is crucial to first examine the existing airspace structures that govern the NAS. These structures include controlled airspace, where air traffic control (ATC) manages aircraft operations; uncontrolled airspace, where pilots operate without direct ATC guidance; and special use airspace, designated for specific activities such as military operations and restricted zones.

Beyond these traditional categories, other airspace structures play a significant role in facilitating air travel. Helicopter routes provide dedicated pathways for rotorcraft while Unmanned Aircraft System Traffic Management (UTM) and Beyond Visual Line of Sight (BVLOS) operations enable the safe and efficient use of drones, albeit in an extremely limited capacity. As the aviation landscape evolves, future AAM corridors will emerge, designed to accommodate the needs of electric Vertical Takeoff and Landing (eVTOL) aircraft.

Through a series of case studies and illustrative demonstrations, this chapter explores the various benefits and issues of integrating eVTOLs into the NAS, with a focus on safety and land use compatibility. The findings in this chapter will be leveraged for future recommendations as part of **Chapter 5**.

4.2. Airspace Structure Overview

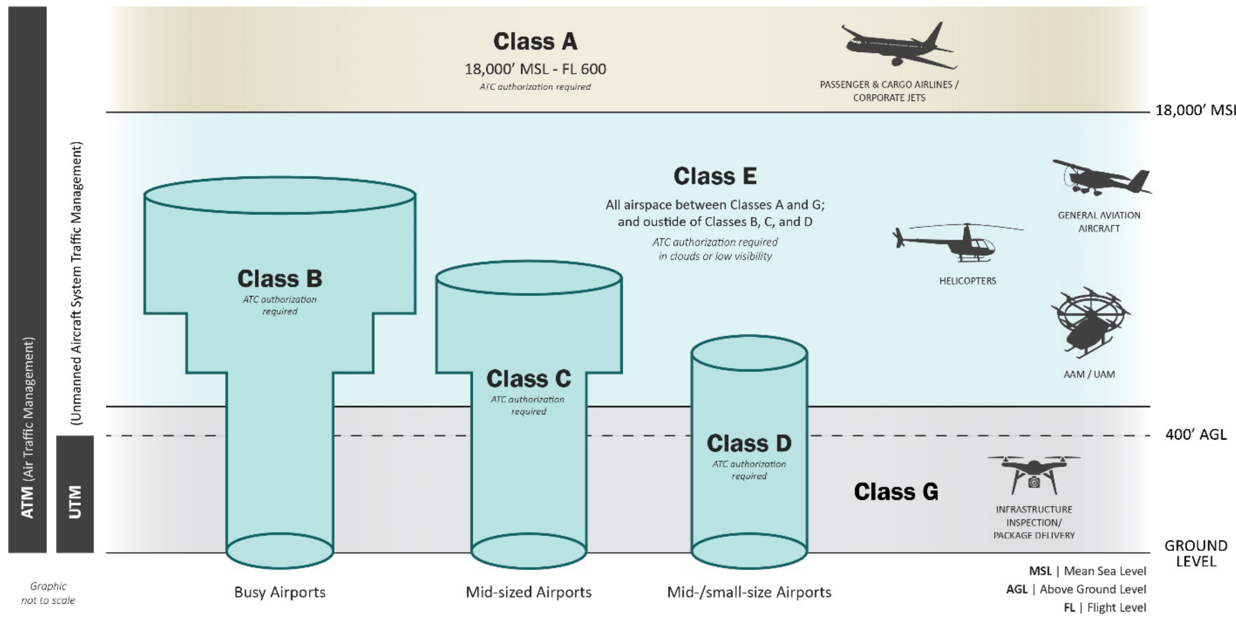
Airspace is structured in three-dimensional volumes, organized and regulated by the Federal Aviation Administration (FAA). The NAS is a network of airspace and aviation facilities connected by a series of navigation systems. ATC assists in upholding the rules and regulations that govern the vast system to promote and ensure safety and efficiency amongst users in the U.S.

Regulations involving specific instrument equipment on board an aircraft, visibility, weather conditions, and communication procedures can govern the type of flight carried out by the pilot-in-command of an aircraft within the NAS. Therefore, pilots are required to operate using either visual flight rules (VFR), when applicable, or instrument flight rules (IFR), which require aircraft be equipped with advanced reporting systems that can communicate obstruction and separational data in low visibility situations.[1]

Airspace includes three primary categorizations: controlled, uncontrolled, and special use. These categories help organize the NAS to operate at maximum levels of safety and efficiency. **Figure 4-1** illustrates the airspace structures within the NAS. Categories of airspace, as well as their order and specific rulings are outlined in the following section.

[1] *The primary difference between VFR flight and IFR flight is the pilots use of visual cues to scan terrain and ultimately remain clear of obstacles during flight. VFR flight can only be carried out when FAA weather minimums are met, and pilots are able to sufficiently operate an aircraft without the assistance of altitude and obstruction reporting equipment. Otherwise, IFR flight is required to ensure the safety of those on board the aircraft. In this case, pilots use necessary instruments in flight to ensure accurate separation from other aircraft and terrain.*

Figure 4-1 – Proposed National Airspace Structure with AAM Corridors



Sources: FAA; Kimley-Horn, 2025

4.2.1. Controlled Airspace

Controlled airspace (Classes A, B, C, D, and E) refers to airspace where ATC services are provided. These “classes” are associated with the airspace above airports and are determined by the frequency and scale of operations taking place at that airport. It is likely that AAM operations will interfere with all classes of airspace except Class A. Classes of controlled airspace are further outlined below.

Class A Airspace – Class A airspace is not shown on aeronautical charts. It begins at 18,000 feet above mean sea level (MSL) and extends up to and including 60,000 feet. Only pilots flying IFR can enter this airspace and prior permission from ATC is required. This airspace is usually controlled by the Air Route Traffic Control Centers (ARTCC) as these controllers handle en route traffic at higher cruising altitudes.[2] It is likely that AAM operations will remain clear of this airspace as eVTOLs and commercial uncrewed aircraft systems (UAS) are not expected to operate at such high altitudes.

[2] *Air Route Traffic Control Centers or ARTCC provide traffic control services to aircraft flying IFR that are in the “en route” phase of flight. There are 22 ARTCC that cover the U.S.*

Class B Airspace – Class B airspace is found around the most highly trafficked airports in the U.S. Pilots must receive permission to enter Class B airspace from the controlling agency, typically the Terminal Radar Approach Control (TRACON) facility associated with the airport and region, as well as have a two-way radio and transponder with altitude reporting capability.[3] Once an aircraft is below a predetermined and designated altitude, the aircraft will be handed off the to the individual airport's tower controller who will clear that aircraft to land.

Starting at the surface, Class B airspace most often resembles a stack of non-uniform, horizontally flattened cylinders. These cylinders, when viewed in concept, get larger in width as the altitude increases, showing an almost inverse conic shape but with noticeable differences between each layer. These airspaces are stacked with no gaps, designed to protect the airport's departure and approach path. Class B airspace in the State of Illinois primarily supports the following airports:

- Chicago O'Hare International (ORD)
- St. Louis Lambert International (STL)

Class C Airspace – Class C airspace usually begins at the surface of the airport and consists of an inner cylinder with a five-mile radius and an outer cylinder with a 10-mile radius that extend from 1,200 feet to 4,000 feet above the airport's elevation. An aircraft must establish two-way radio communication with the controlling agency prior to entering and operating within the airspace. The airspace still handles a substantial volume of incoming and outgoing flights. Class C airspace in the State of Illinois primarily supports the following airports:

- University of Illinois–Willard (CMI)
- Chicago Midway International (MDW)
- Quad Cities International (MLI)
- General Wayne A. Downing Peoria International (PIA)
- Abraham Lincoln Capital (SPI)

[3] *Terminal Radar Approach Control Centers or TRACON facilities are where ATC works to guide aircraft into and out of highly trafficked areas such as airports. These facilities control a radius of roughly 50 nautical miles (nm) from an airport up to 10,000 feet There are roughly 185 TRACON facilities in the United States surrounding the busiest airports.*

Class D Airspace – Class D airspace exists at any airport with an operating air traffic control tower where Class B or Class C airspace does not exist. In turn, the shape of Class D airspace is less standard than Class B or C airspace and is based on the airport reference point (ARP). Pilots must establish two-way radio communication with the controlling agency before entering and operating within the airspace. Class D airports that are towered may have a part time control tower (less than 24-hour coverage) in which case the airspace may revert to Class E or Class G airspace when the tower is not in use. Class D airspace in the State of Illinois primarily supports the following airports:

- St. Louis Regional (ALN)
- MidAmerica St. Louis (BLV)
- Central Illinois Regional Airport at Bloomington-Normal (BMI)
- St. Louis Downtown (CPS)
- Southern Illinois (MDH)
- Waukegan National (UGN)
- Aurora Municipal (ARR)
- Chicago Executive (PWK)
- Dupage (DPA)
- Decatur (DEC)
- Veterans Airport of Southern Illinois (MWA)
- Chicago/Rockford International (RFD)

Class E Airspace – Class E airspace encompasses all other controlled airspace that is not Class A, B, C or D. It allows ATC to manage IFR aircraft outside of an airport's airspace. Class E airspace typically surrounds airports having instrument approaches and encompasses portions of the instrument approach paths. Typically, Class E will start at 1,200 ft above ground level (AGL). However, different circumstances, such as a control tower closing at night, will result in Class E airspace reaching the surface. Additionally, airports without a control tower may have a "transition area" surrounding them that begins at 700 ft AGL to offer ATC services to aircraft arriving or departing. In other cases, such as operating over a military operations area (MOA), Class E airspace will begin at 14,500 MSL. All Class E airspace extends up to but does not include Class A airspace. When the ceiling of Class A airspace ends at 60,000 ft MSL, Class E resumes and extends up to the edge of the atmosphere.

4.2.2. Uncontrolled Airspace

Uncontrolled airspace, also called Class G airspace, encompasses all airspace that is otherwise not a part of Class A, B, C, D, or E. It is possible that as AAM aircraft are integrated into the NAS, previously uncontrolled airspace may require control by different centers or technologies to ensure the safety of passengers of AAM aircraft.

Class G Airspace – Within Class G airspace, sometimes referred to as "ground airspace," ATC services are not offered and there are no entry requirements. However, if you are transitioning from Class G to any form of controlled airspace, the appropriate contact and requirements must be met prior to entering. You will not find class G depicted on sectional charts as it exists at the ground and extends upward until it meets controlled airspace.

4.2.3. Special Use Airspace

Special use airspace designates airspace for specific operations where limitations must be imposed to ensure the safety of other aircraft. Individual special use airspace can involve controlled and uncontrolled airspace. In most cases, it is best practice to contact the controlling agency to understand the specifics of each area. The different types of special use airspace are further outlined below.

Restricted Areas – Restricted areas contain operations of aircraft that may be hazardous to other aircraft during hours of operation. This can include military operations such as artillery firing, aerial gunnery, or guided missile testing. Penetration of restricted areas during their hours of operation may be extremely hazardous to the aircraft and its occupants. Hours of operation and specific altitudes can vary by location.

Prohibited Areas – Prohibited areas are sections of airspace that unauthorized aircraft are prohibited from using.

Warning Areas – Warning areas are typically over bodies of water and extend out, away from U.S. coastline. Warning areas are issued when the U.S. does not have full authority over operations, but hazards may be present. Due to Illinois' minimal coastline and inland location, it is unlikely to find Warning Areas within the state.

Alert Areas – Alert areas are depicted on aeronautical charts to inform pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area shall be conducted in accordance with the Code of Federal Regulations (CFRs), without waiver, and pilots of participating aircraft as well as pilots transiting the areas shall be equally responsible for collision avoidance.

Military Operation Areas - Military operation areas (MOAs) consist of airspace established for the purpose of separating certain military training activities from other aviation traffic. Whenever a MOA is in use, civil traffic may be cleared through the MOA if separation can be provided by ATC.

4.3. AAM Airspace

Understanding the intricacies of non-traditional airways is crucial for the future of AAM. This section delves into the definitions and implications of various airspace conditions, including:

- Existing Helicopter Routes in Illinois
- UTM and BVLOS
- AAM Airspace Corridors

These non-traditional airways could be leveraged to support and enhance AAM initiatives. Through a comprehensive examination, this document seeks to identify opportunities for integrating these airspace conditions into a cohesive framework that ensures safe, efficient, and scalable AAM operations.

4.3.1. Existing Helicopter Routes in Illinois

Helicopter routes, as defined by the FAA, are specific airspace pathways designed to facilitate helicopter navigation in areas with high concentrations of helicopter activity. These routes are depicted on the FAA's Helicopter Route Charts, which provide essential aeronautical information, including routes, heliports, navigational aids (NAVAIDs), and obstructions. Key features of these routes include designated pathways to help helicopters navigate safely through busy airspace, information on heliports and their communication frequencies, and marked obstructions and landmarks to aid visual navigation. While adherence to charted routes and recommended altitudes is generally voluntary, controllers may assign specific routes and altitudes when necessary for safety or traffic management. These routes can pass through various airspace classes, including controlled (Class B, C, D, E) and uncontrolled (Class G), and are designed to avoid restricted or military airspace that requires prior authorization. In some cases, local law enforcement may request restrictions within designated operating zones, which controllers can enforce if it does not adversely affect other aircraft operations. These regulations ensure that helicopter operations are conducted safely and efficiently, minimizing the risk of mid-air collisions and other hazards.

There may be an opportunity for AAM aircraft to utilize a variety of existing helicopter routes, procedures (Part 91 VFR), and infrastructure (helicopter routes, helipads, ATC services). Part 91 VFR, for example, could provide a baseline for requirements and guidelines on how future AAM pilots would operate aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going. While challenges are expected in adapting helicopter VFR routes to function also as AAM routes, such as increased congestion of existing helicopter routes, these routes could serve as a foundation for AAM corridors, especially during the initial stages of implementation.

In the U.S. there are currently eight published helicopter charts. Chicago, as a major metropolitan area, has FAA charts that include primary helicopter routes. These routes align with the outer portions of the controlled airspace around ORD and MDW. Additionally, there are transition routes connecting the primary helicopter routes to the airports' centers. Most of these routes follow existing roadway infrastructure or water features (river/canal) for visual reference and to minimize impact on non-participants and routes over residential areas.

Figure 4-2 presents an overlay of primary helicopter routes in Chicago. As AAM corridors are developed, it is important to evaluate the potential confluence of traditional helicopter routes and any new AAM routes that could be established.

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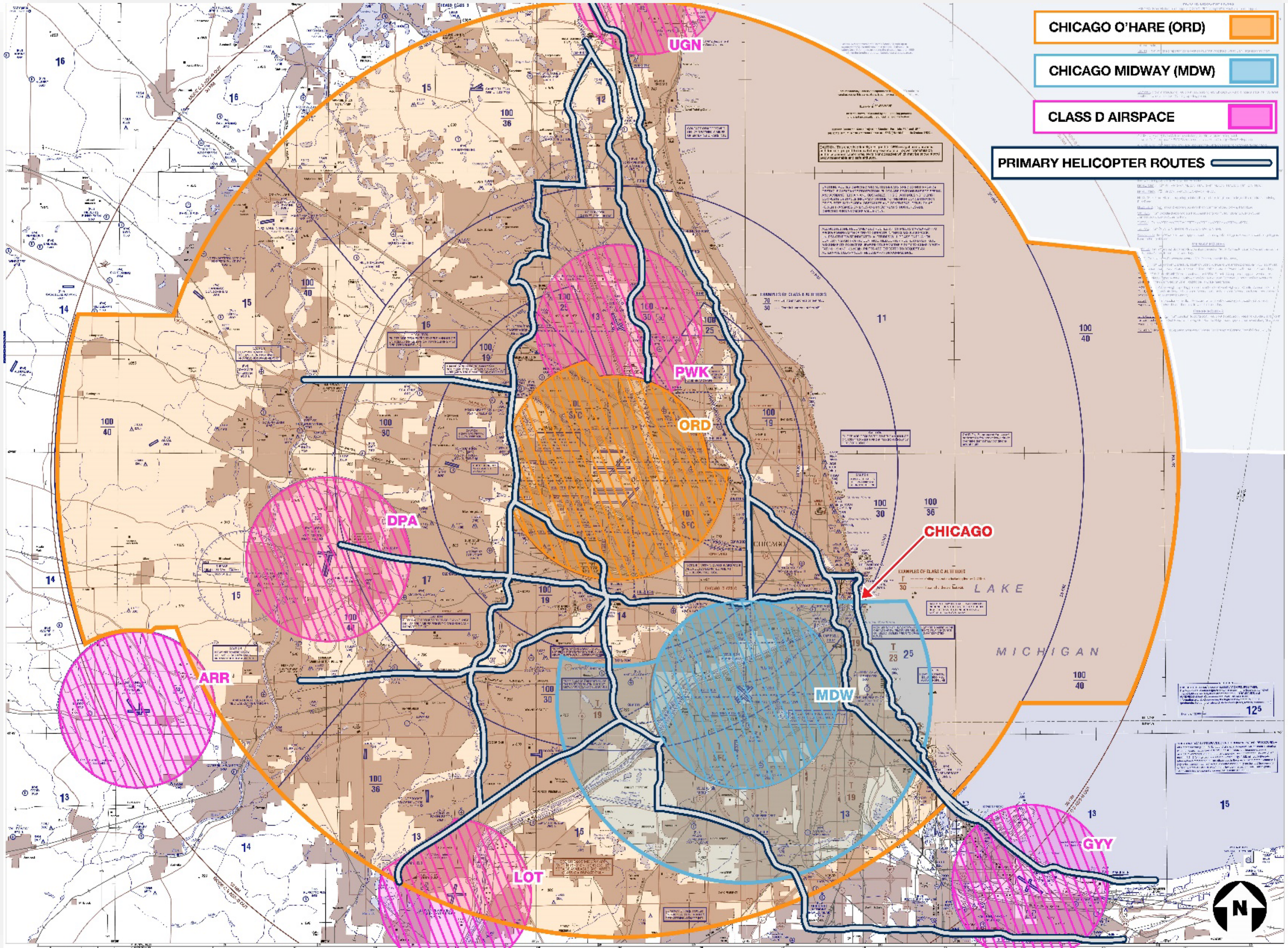
Figure 4-2 – Overlay of Primary Helicopter Routes in Chicago



Sources: FAA, Kimley-Horn

4.3.2. Unmanned Aircraft System Traffic Management (UTM)

UTM is a system designed to manage the traffic of drones (or UAS) flying at low altitudes, typically below 400 feet above ground level (AGL). The goal of UTM is to safely integrate drones into the airspace without interfering with crewed aircraft, helicopters, or other drones. It involves a cooperative interaction between drone operators, service providers, and the FAA. The system uses digital communication and automated systems to share flight details and ensure real-time situational awareness for all airspace users. UTM is designed for UAS use cases such as lightweight cargo delivery, agriculture, and infrastructure inspection. The operations within UTM airspace often referred to as "low altitude airspace" and could also exist in controlled airspace, including Class B, C, D, or E airspace, or in uncontrolled Class G airspace.

4.3.2.1. Beyond Visual Line of Sight (BVLOS)

A crucial aspect of UTM is the ability to conduct BVLOS operations. BVLOS allows drones to fly beyond the direct line of sight of the pilot, enabling a wide range of commercial and public safety applications, including package delivery, infrastructure inspection, and search and rescue missions.

For BVLOS operations to be successful within the UTM framework, several advanced technologies and systems are required:

- **Automated Systems:** These systems facilitate the sharing of flight details and maintain real-time situational awareness.
- **Data Exchange:** Digital communication protocols enable drone operators to share their planned flight routes and receive real-time updates on airspace status.
- **Detection and Avoidance:** Technologies that detect and avoid other aircraft, obstacles, and hazards are critical for the safety of BVLOS operations.
- **Regulatory Framework:** Regulatory bodies, such as the Federal Aviation Administration (FAA), are working to establish rules and standards that authorize and ensure the safety of BVLOS operations.

By integrating BVLOS capabilities into UTM, the goal is to create a safe, scalable, and efficient environment for routine drone operations in low-altitude airspace. The combination of UTM and BVLOS is expected to revolutionize industries and enhance public safety, paving the way for a future where drones coexist harmoniously with crewed aircraft.

UTM is still under development for BVLOS operations of uncrewed aerial systems (UAS) by the FAA, the National Aeronautics and Space Administration (NASA), other federal partner agencies, and industry professionals.

4.3.3. AAM Airspace Corridors

Air traffic in the US, specifically around major metropolitan areas, is extremely congested. Due to increased air traffic demand, ATC staffing shortages, and a projected increase in air traffic operations by AAM vehicles, the NAS may be updated to include specific conditions for controlling AAM aircraft. This includes developing specific routes for AAM operations that would relieve workload from ATC and assist in standardizing operations across the NAS. The AAM corridors would primarily be used as an airway to accommodate safe RAM operations.

An AAM corridor is a specific airspace route designed for eVTOL aircraft. These corridors aim to facilitate the transportation of people and cargo in locations with varying amounts of population. As of February 2025, no AAM corridors are fully operational. According to the FAA, the development of AAM corridors will progress alongside the growth of the AAM industry, with eVTOLs expected to use existing helicopter routes and follow traditional VFR and IFR operations like conventional aircraft in the near term. These corridors will function as procedural routes without ATC separation services, operating with defined vertical and lateral dimensions. The AAM corridors will feature directional tracks that can be spaced laterally and/or stacked vertically, depending on the corridor's dimensions and procedural designs.

Although AAM corridors may pass through various FAA airspace classes, they are considered performance-based airspace structures with their own rules for access and operations.[4] However, traditional cruising altitude rules may still apply. These rules require that VFR aircraft flying above 3,000 ft above the surface fly specific altitudes based on their magnetic course. Additionally, IFR aircraft below 18,000 feet MSL must fly at odd thousand-foot altitudes when flying a heading of 0 to 179 degrees and even thousand-foot altitudes when flying a heading of 180 to 359 degrees. How these AAM flights, if automated in the future, will navigate around existing traffic, rules, and controlled airspaces in the NAS remains to be determined.

It is assumed that cruising AAM aircraft will operate within these corridors above 4,000 feet.[5] These AAM airspace corridors will have specific rules and requirements, with typical flight distances ranging from a few miles to several dozen miles. As technology and deployment advances, aircraft operations are expected to become more precise, quieter, and more weather-tolerant, allowing for denser corridor operations in populated areas. Consequently, the density of AAM corridors, the number of vertiports, and the frequency of AAM flights are expected to increase.

4.3.4. Airspace Integration Challenges

Integrating AAM traffic into Illinois presents several challenges. While these challenges are not immediately pressing when eVTOLs adhere to existing flight rules and airspace regulations, they become more pronounced as AAM operations scale and incorporate autonomous technology. Although autonomy is the end goal for AAM operations, early stages of these operations will be crewed. The exact timeline for full-scale implementation remains uncertain, in the near term, the number of AAM operations and the technology itself likely won't strain Illinois'

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[4] Performance-based airspace structures are designed to manage airspace based on the performance capabilities of aircraft and their systems, rather than strictly on predefined routes or fixed airspace boundaries.

[5] Federal Aviation Administration, "FAA Issues Implementation Plan Outlining Steps to Usher in Advance Air Mobility," 18 July 2023.

existing airspace. However, as AAM matures in Illinois, many challenges may present themselves, including:

1. **Limited Airspace Capacity**: The existing NAS has restrictions on how many aircraft can operate within a given sector at a time.[6] While the goal is to ensure safety, it limits the ability to accommodate additional demand such as AAM. Congested airspaces near major airports, such as ORD and MDW, exacerbate this challenge.
2. **Lack of Modernization**: NAS relies on outdated ground-based navigation systems. To integrate AAM effectively, the NAS needs both technological updates and an overhaul of regulations to enable simultaneous autonomous AAM operations.[7]
3. **Regional Variation**: Different airspace rules exist based on geographical characteristics, air traffic density, and technology. AAM systems must be equipped to navigate the variations of controlled airspace, such as transitioning from Class E to Class B in and around Chicago.
4. **ATC Workforce**: A shortage of qualified controllers affects the ability to accommodate increased demand. Expanding the ATC workforce is crucial for safe AAM operations.
5. **Communication with Autonomous Vehicles**: AAM systems will require new communication methods beyond voice commands, potentially involving AI or text-based instructions. Developing and certifying these technologies will take time, delaying large scale AAM deployments.
6. **Ground Impacts:** Existing AAM technologies strive to produce less noise than traditional aircraft however the impacts to areas located below AAM corridors is still a critical issue. To safeguard vulnerable communities of noise generation from low flying aircraft, communities may consider developing zoning restrictions to reduce flight over residential areas.

4.4. AAM Corridor Modeling – Case Studies

This section details two case studies within the Chicago region, focusing on developing a conceptual AAM corridor. The purpose is to demonstrate what RAM may look like in an area of Illinois that is most ripe for the industry. There are substantive hurdles the industry, both private and public, must overcome to achieve such a goal, especially near Chicago. The case studies detail the reasons behind corridor placement and highlight a variety of challenges that exist, such as airspace conflicts, incompatible land uses, noise concerns, among others. These case studies aim to provide stakeholders with an initial perspective on how an AAM corridor could integrate with the existing airspace early on. It also presents considerations for integration that

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[6] *An airspace sector is a designated area of airspace controlled by air traffic controllers, defined by geographic boundaries and altitudes. They vary in size and shape depending on a variety of factors, including geographic location, traffic volume, and complexity of the airspace.*
[7] *More information on FAA and IDOT policies impacting AAM are provided in Chapter 5.*

could guide future discussions with the FAA, should the development of AAM corridors be warranted.

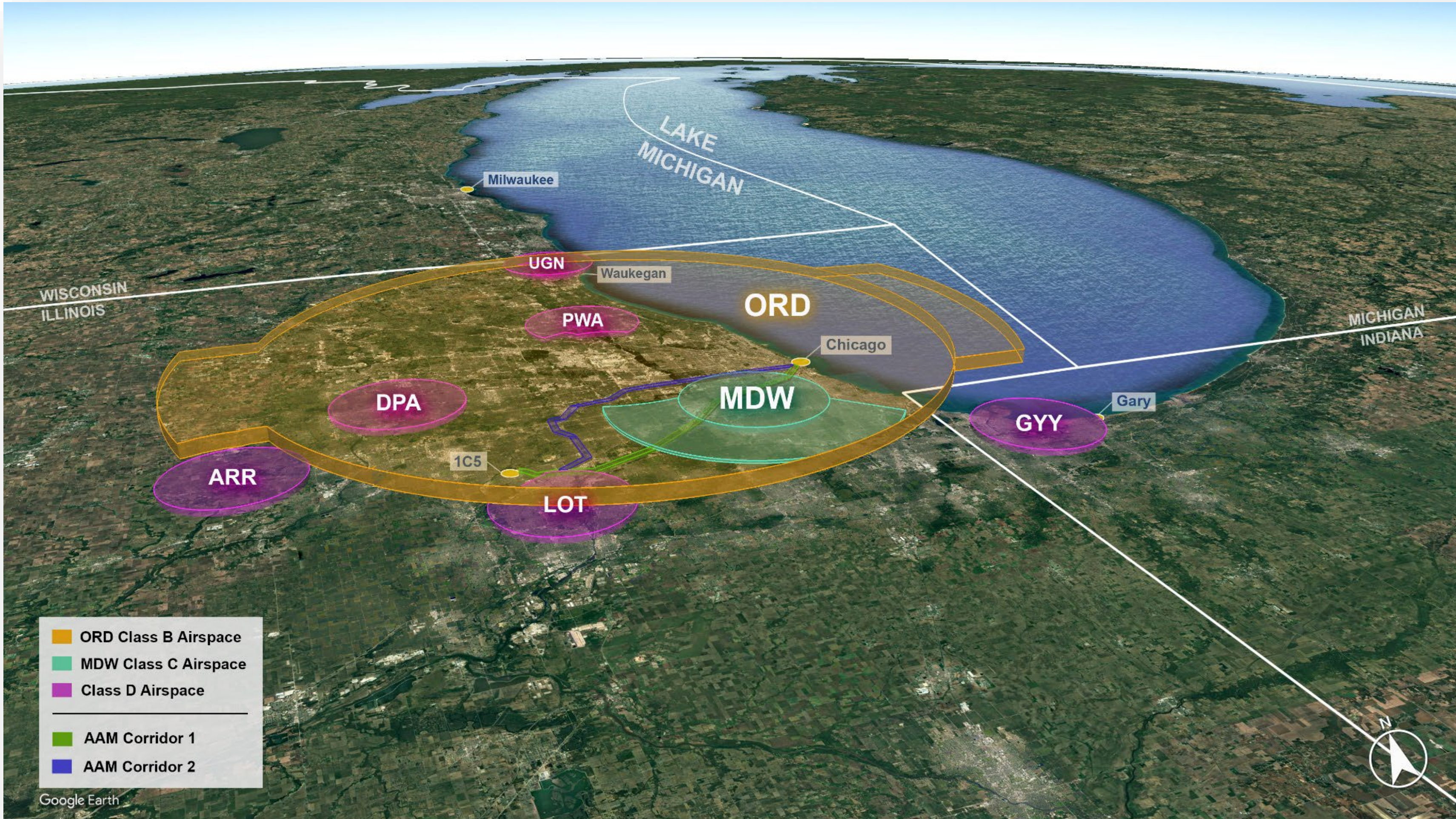
The FAA holds the responsibility and authority to develop AAM corridors, ensuring their safe integration into the NAS. The illustrative corridor design included in these case studies is based on industry-wide recommendations for mitigating AAM impacts on non-participants at ground level, similar to existing helicopter routes. This conceptual visualization effort envisions future AAM corridors, providing a framework for future development and integration of AAM in the Chicago region.

Figure 4-3 presents an overview of the two case study corridors; the first (RAM Airspace Case Study – Scenario 1) is depicted in green and the second (RAM Airspace Case Study – Scenario 2) is depicted in blue.

Both scenarios connect the same two conceptual vertiport locations: Bolingbrook's Clow International Airport (1C5) and downtown Chicago near Union Station. 1C5 was chosen as the origin to showcase the use of an existing airport. Additionally, its suburban location and proximity to downtown Chicago is a realistic opportunity and use case for RAM. The driving distance between 1C5 and downtown Chicago is approximately 31 miles, which can take over 1 hour and 30 minutes during typical commuting hours.

The FAA is solely responsible for the safe and efficient use of the NAS, including the research, analysis, and development of future AAM corridors. The case studies presented below are a conceptual modeling effort for stakeholders to understand the possibilities of a future AAM corridor, including the magnitude of challenges the industry must overcome before RAM becomes a reality. The illustrations below are for conversation purposes only and are not an indication or recommendation from IDOT that they should be developed.

Figure 4-3 – RAM Case Studies Overview

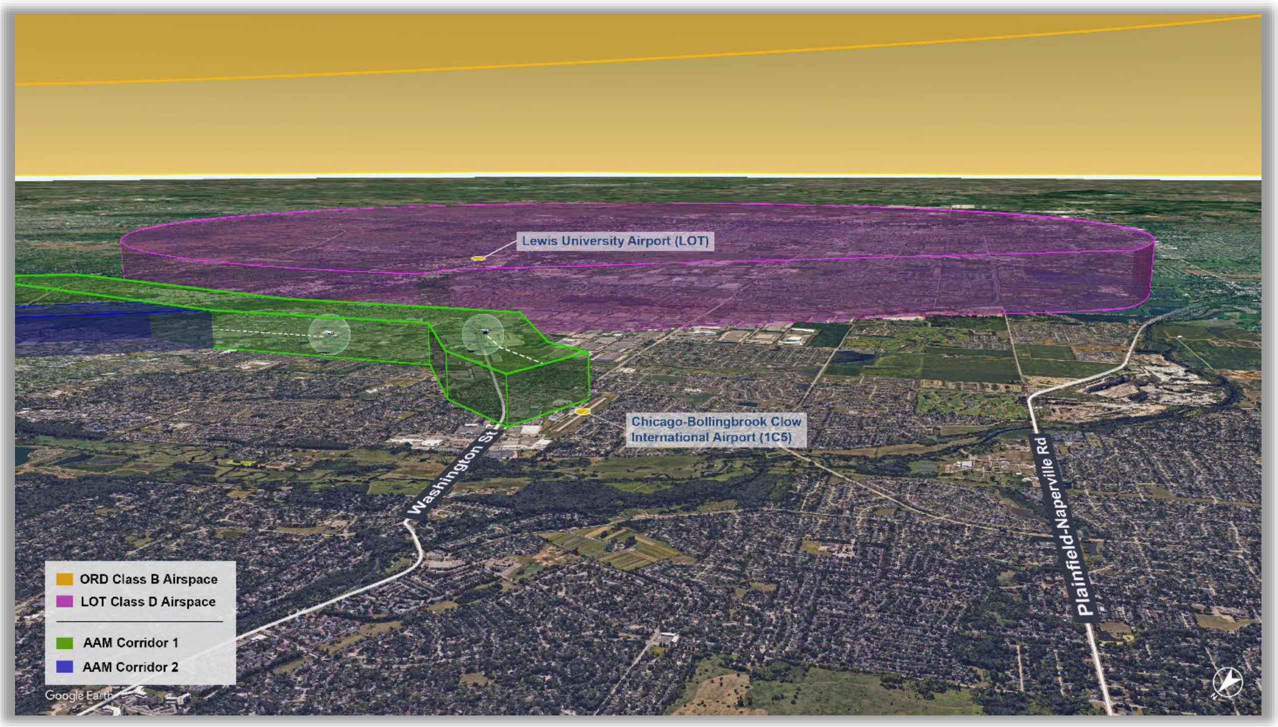


Source: Kimley-Horn, 2024

4.4.1. RAM Corridor Case Study - Scenario 1 (Green Corridor)

Scenario 1 traverses Chicago airspace in a direct, point-to-point route. As shown in Figure 4-4, the route departs from 1C5 and enters the corridor traveling to the east and climbs to and maintains the desired altitude. Class E airspace is present beginning at 700 feet, and ATC services are offered to IFR aircraft. The route purposely avoids Lewis University Airport's (LOT) Class D airspace, a busy area with significant air traffic particularly due to heavy flight training activity. The total length of Scenario 1 is expected to be roughly 27 nautical miles.

Figure 4-4 – RAM Corridor Scenario 1; Section 1



Source: Kimley-Horn, 2024

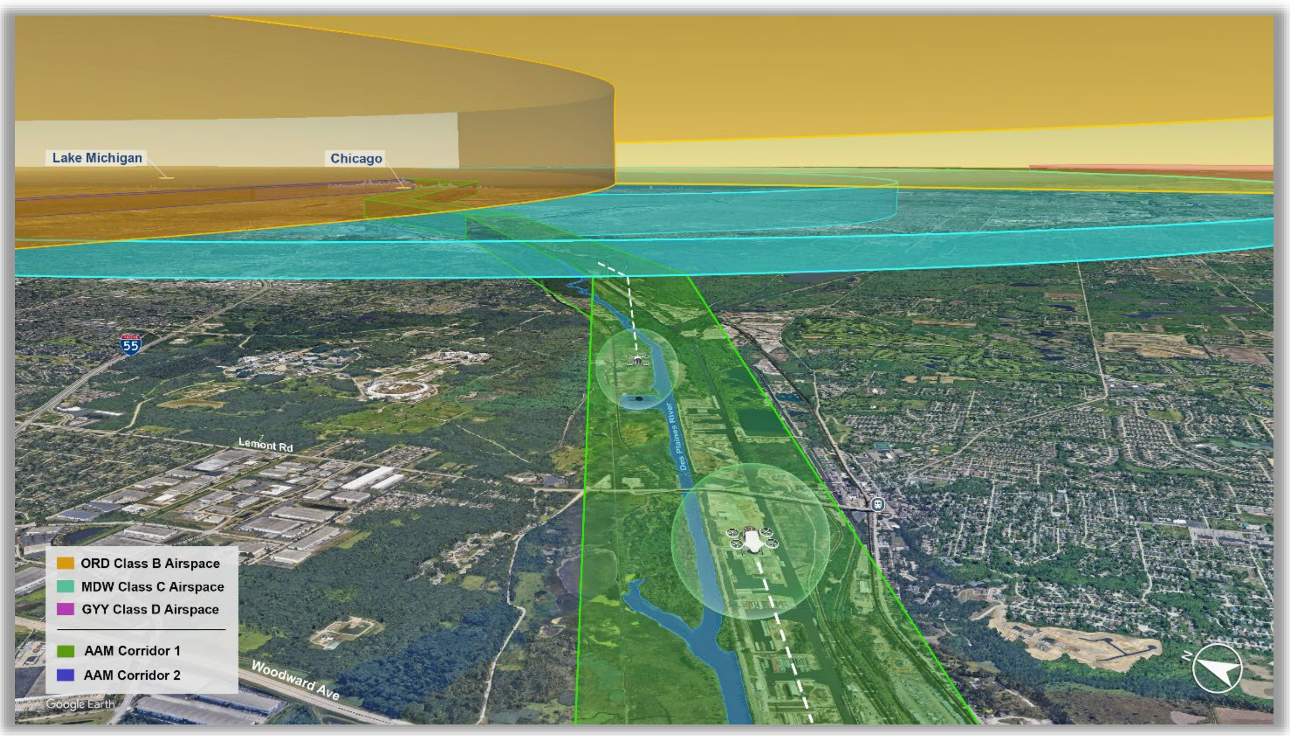
The route continues east, eventually intersecting the Chicago Sanitary and Ship Canal. Some benefits and issues associated with this example include:

- **Benefits**
  - Avoid LOT's Class D airspace.
  - Originates from an existing airport with established airspace protections and support facilities.
  - Primarily travels over Washington Street, a major surface road, avoiding residential and commercial land uses below.
- **Issues**
  - Still within proximity of LOT's Class D airspace, likely causing increased congestion around flight training traffic.

- While mostly over a main arterial roadway, likely creates noise and visual pollution.

Continuing toward downtown Chicago, the route travels east, aligning with the Chicago Sanitary and Shipping Canal, limiting overflight of more sensitive land uses, infrastructure and development. **Figure 4-5** also depicts two AAM aircraft traversing in opposite directions. It is assumed that these aircraft would be vertically separated, traveling at specific altitudes depending on their direction of travel while avoiding ORD's Class B airspace and MDW's Class C airspace. The floor of ORD's Class B airspace begins at 3,600 feet and MDW's Class C airspace, in this case, begins at 1,900 ft MSL. Additionally, **Figure 4-5** shows that the corridor travels under the outer tier of MDW's Class C airspace and then transitions into the Class C airspace. This is a major conflict as MDW handles a substantial volume of incoming and outgoing commercial air travel.

Figure 4-5 – RAM Corridor Scenario 1; Section 2



Source: Kimley-Horn, 2024

- **Benefits**
  - Travels over the Chicago Sanitary and Shipping Canal, avoiding residential land uses, mitigating negative safety and noise impacts.
  - Travels under and avoids ORD's Class B airspace.
  - Initially travels under and avoids the outer tier of MDW's Class C airspace.

- **Issues**
  - Due to the density of the surrounding Class B and Class C airspace, eVTOL's will have limited altitude available for vertical separation of aircraft traveling in opposite directions throughout this section of the corridor.
  - Conflicts with MDW's core Class C airspace, requiring two-way communications before entering - potentially creating congestion in the corridor.

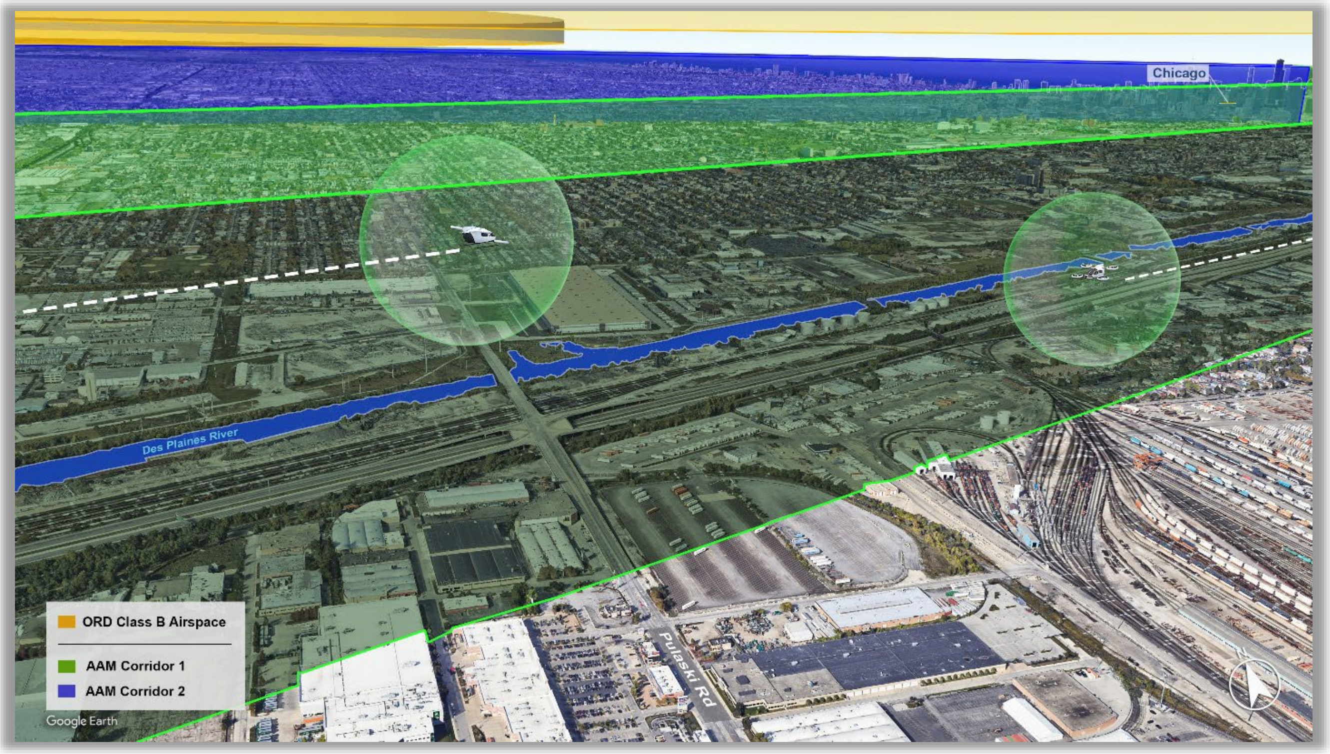
Figure 4-6 depicts two eVTOL aircraft traveling through the AAM corridor within the core of MDW's Class C airspace. Due to the proximity to MDW, prior to entering this airspace, pilots will have had to communicate with MDW ATC. MDW is equipped with four runways, with the longest being Runway 13C/31C. This runway measures 6,522 feet in length and 150 feet in width and can accommodate commercial aircraft such as the Boeing 757. The track of this route over the canal puts the corridor's center roughly 1.5 nautical miles away from the touchdown point of traffic arriving via Runway 13C.

Placing an AAM corridor along the canal provides an effective visual reference point for pilots operating within Class C airspace, enhancing their positional awareness while navigating around the corridor. This approach, similar to the VFR Waypoint Chart Program, could help enhance safety and provide navigation aids for pilots unfamiliar with the area.[8] Although it is likely rare that eVTOL aircraft and aircraft operating in the center of MDW airspace will operate under VFR, operating over the canal could help all reduce pilot deviation and enhance awareness of those operating VFR by providing another positional marker. Additionally, this path is more direct and traverses a shorter distance as opposed to the second corridor.

It should be noted that this analysis is based on existing arrival and departure procedures out of MDW. Arrival and departure procedures are subject to change which could negatively or further constrain the ability of eVTOLs to navigate this airspace.

[8] *The VFR Waypoint Chart Program is a supplemental tool used by VFR pilots to assist in position awareness and navigation in unfamiliar area in or around Class B and Class C airspace.*

Figure 4-6 - RAM Corridor Scenario 1; Section 3



Source: Kimley-Horn, 2024.

- **Benefits**
  - Travel over the Chicago Sanitary and Shipping Canal can provide visual aid to those navigating within busy Class C airspace, reducing pilot deviation and creating spatial awareness.
  - Direct path to downtown Chicago, requiring fewer turns and less power consumption.
- **Issues**
  - Conflicts with MDW's core Class C airspace, putting AAM operations extremely close to MDW operations, necessitating extensive coordination with MDW ATC to ensure safe separation.
  - Increased ATC workload and potential stress on the system.

4.4.1.1. Scenario 1 Summary

RAM Corridor Scenario 1 was developed to demonstrate the most direct route from 1C5 to downtown Chicago. Direct routes are an important factor for RAM as they promote time savings and reduce energy consumption. Scenario 1 navigates primarily over a waterway, which enhances safety for those on the ground and promotes land use compatibility. However, a major conflict arises when an eVTOL traverses MDW airspace, creating significant challenges with ATC and arriving and departing aircraft operations.

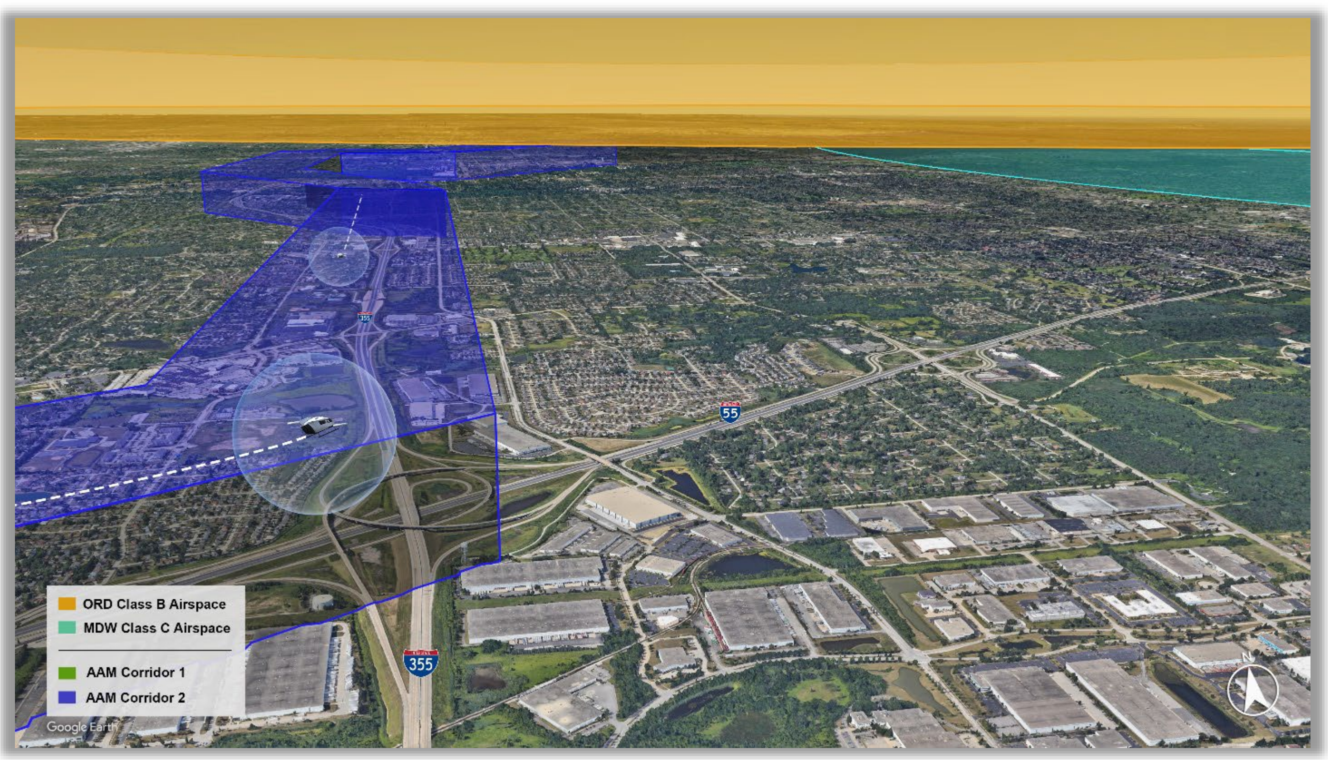
ATC is already at capacity in many ways, from workforce shortages to congested skies, so additional aircraft control and monitoring will likely overly stress the existing system. While the AAM corridor illustrated in Scenario 1 uses best practices for flight corridors, the complexities of this airspace prove the feasibility of Scenario 1 is extremely low.

4.4.2. RAM Airspace Case Study - Scenario 2 (Blue Corridor)

Scenario 2, depicted in blue in **Figure 4-3**, adopts a different strategy by following major arterial roads and highways to minimize impacts. Overall, Scenario 2's route is longer in time and in distance but effectively avoids ORD and MDW airspace.

After taking off from 1C5 using the same initial path as Scenario 1, Scenario 2 then splits to the east along Interstate 55 (I-55) until it intersects I-355. The conceptual corridor utilizes I-355 to shield noise-sensitive areas such as parks, schools, and residential neighborhoods from additional noise exposure. Similar to Scenario 1, the highway also provides a sense of security protecting the airspace above from being interfered with by ground structures. Additionally, this corridor remains clear of all Class B, C, and D airspace in its entirety and remains in Class E airspace throughout. This corridor's route is longer and will result in a longer flight time.

Figure 4-7 - RAM Corridor Scenario 2; Section 1



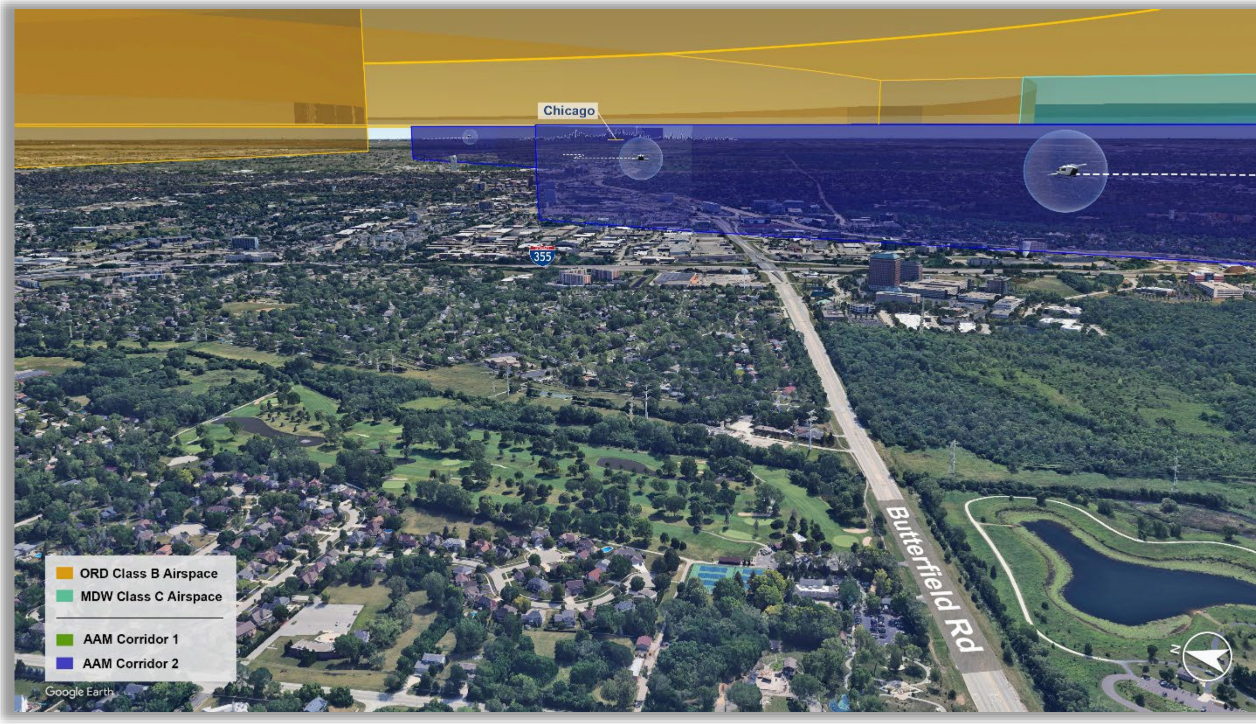
Source: Kimley-Horn, 2024

- **Benefits**
  - Travel over arterial highways can aid in reducing noise impacts to surrounding communities.
  - Avoids Class B, C, and D airspace.
- **Issues**
  - Longer en route flight time.
  - Requires additional turns, increasing power consumption.
  - Comes within proximity to noise-sensitive areas.

Illustrated in **Figure 4-8**, this AAM corridor navigates below ORD Class B airspace as well as between ORD Class B airspace and the core of MDW Class C airspace. As a result, aircraft navigating the corridor will need to change headings roughly 10 times from beginning to end of the corridor. In turn, this route will likely be less efficient in terms of energy conservation and time spent en route. Additionally, this creates more room for pilot deviation or error. The path of the corridor from point A to point B spans roughly 32 NM.

AAM aircraft within this corridor will not be subject to the restrictions or clearances of Class B or C as it does not intersect either of these airspaces and remains in Class E airspace. However, to remain clear of ORD and MDW airspace, an eVTOL will need to travel through the corridor at a height of 1,899 ft MSL or lower. This will allow the aircraft to travel below the second tier of ORD airspace.

Figure 4-8 – RAM Corridor Scenario 2; Section 2

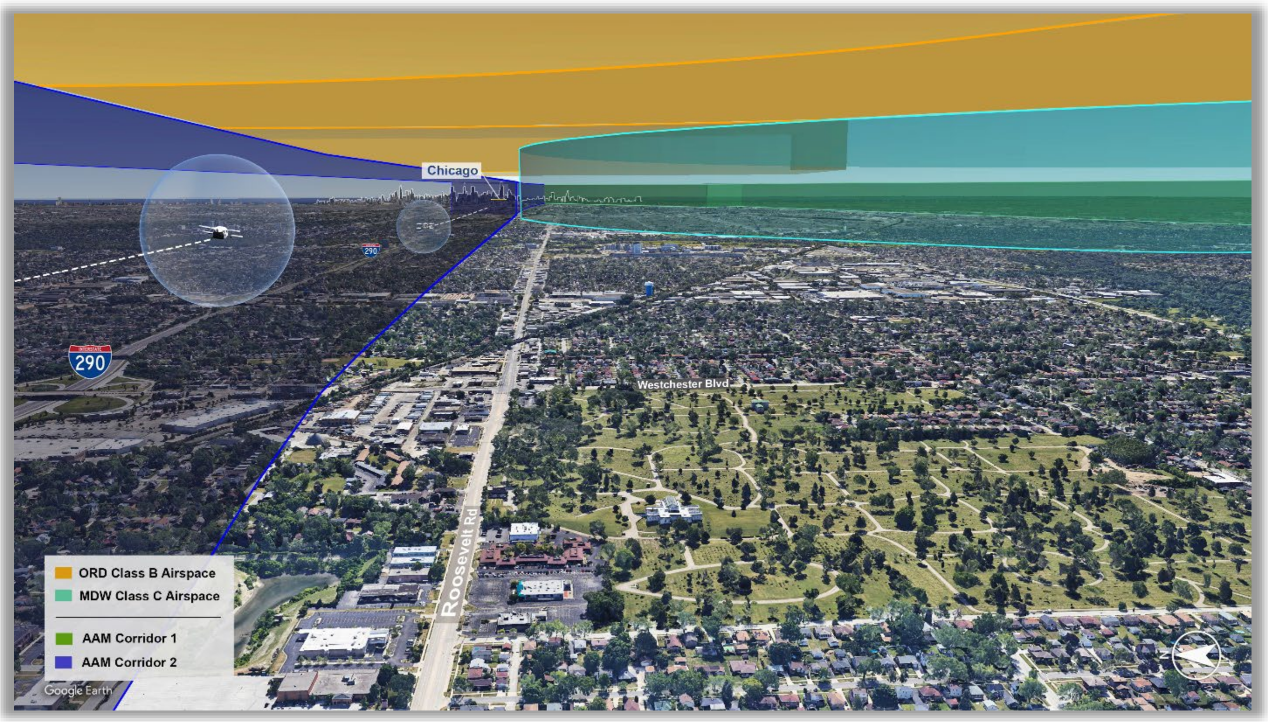


Source: Kimley-Horn, 2024

- **Benefits**
  - Travel over arterial highways can aid in reducing noise impacts to the surrounding communities.
  - Highway naturally protects corridor from future non-compatible development.
  - Avoids conflicts with ORD Class B and MDW Class C airspace.
- **Issues**
  - Changes direction approximately 10 times throughout the corridor, increasing energy consumption.
  - Increased flight duration.
  - Navigational challenges, requiring skilled pilot and/or navigational equipment.
  - Height restrictions of 1,899 feet or lower are in place that will reduce the availability for vertical separation between eVTOL aircraft.

The corridor then intersects with Interstate 290, an auxiliary highway that provides direct access to the city. As illustrated in **Figure 4-9**, the corridor remains just outside of Class C airspace. However, it travels directly over residential and commercial land uses. This proximity could produce a negative public reaction to the corridor resulting in a longer approval process and complexities between the many local jurisdictions and ordinances. It could also lead to significant noise and visual pollution which can typically be mitigated with increased altitudes. However, ORD and MDW airspace limit that ability.

Figure 4-9 - RAM Corridor Scenario 2; Section 3



Source: Kimley-Horn, 2024

- **Benefits**
  - After intersecting Interstate 290, eVTOL would be on a direct path to downtown Chicago.
  - Avoids conflicts with ORD Class B and MDW Class C airspace.
- **Issues**
  - Traverses over residential and commercial land uses.

4.4.2.1. Scenario 2 Summary

RAM Corridor Scenario 2 was developed to demonstrate a route that avoids ORD Class B and MDW Class C airspace. Scenario 2 navigates primarily over main arterials and state highways, which enhances safety for those on the ground and can positively impact land use compatibility. However, to avoid airspace conflicts, the route requires significant navigation to the north and east. This increased navigation requires additional turns and altitude changes compared to Scenario 1, increasing fuel consumption and reducing profitability for the operator. Additionally, the route of Scenario 2 would require a highly skilled pilot familiar with Chicago airspace.

While the AAM corridor illustrated in Scenario 2 uses best practices for flight corridors, the complexities of this airspace prove the feasibility of Scenario 2 is also extremely low.

It should be noted that other routes may exist. The scenarios shown in this chapter highlight a couple of options, and AAM corridors will be developed based on need and demand. A route to the south was also evaluated, navigating over Lake Michigan and avoiding complex airspace and land use concerns. However, the length and time required for this route would increase substantially, which is not ideal due to assumed operator cost concerns.

4.5. Conclusion

The NAS is inherently complex, requiring clear guidelines for operation. The emerging technology of AAM is not yet included in these guidelines, so the integration process is still developing and demands extensive planning to address challenges on local, national, and global scales.

Integrating RAM traffic into Illinois' already busy airspace presents unique challenges, especially with the goal of operations shifting from crewed to autonomous. The case studies in this chapter focused on issues associated with safety and land use, but there are many other crucial aspects that the industry must evaluate, including:

- Limited airspace capacity
- Outdated NAS technology
- Regional variations in airspace rules
- Air Traffic Control (ATC) workload concerns
- Operating in poor weather conditions
- Emergency landing locations
- Local jurisdictions and ordinances on noise, flight times, and frequency
- The need for a robust infrastructure network to handle increased AAM flights, encompassing vertiports, NAVAIDS, and other necessary instruments

RAM is a use case within AAM that has garnered considerable attention and anticipation. However, it is crucial for the industry and IDOT to focus on more tangible use cases in the near term. Emphasizing a "methodical and incremental" approach, it is vital to prioritize decisions that focus on UAS and developing ground infrastructure in the near-term, to support RAM operations in the mid-to-long-term future.

By addressing these foundational elements first, the industry can ensure a solid groundwork is laid for the integration of RAM. This approach will not only help in managing the complexities of the NAS but also provide a smoother transition as new technologies and use cases emerge.

The findings in this chapter, as well as those from previous chapters, provide a springboard into our overall recommendations to support AAM in Illinois.