Kentucky Commission on Military Affairs &
the Commonwealth of Kentucky

The Kentucky Aerospace & Aviation Industry Study

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Kentucky Governor Matt Bevin

"As Governor, my vision is that Kentucky would become the center for engineering and manufacturing excellence in the United States. That's why I am excited about the economic opportunities posed by our state's growing Aerospace and Defense industries. Aerospace manufactured products have quickly become our state's #1 export at $10.85 billion in 2016, a figure that ranks Kentucky second nationally in this category. Kentucky's tremendous logistical capability, our central geographic location, a low cost of living, and our business friendly environment, are contributing factors to this success and give our state great potential for the future. As aerospace companies seek growth opportunities in the Midwest and South, Kentucky is well positioned to see this industry continue to expand throughout the commonwealth."

Kentucky Governor Matt Bevin

Kentucky Lt. Governor Jenean Hampton

"Growing up in the 1960's, I'd often wake up early to watch the rocket launches from Cape Canaveral. NASA and the space program inspired me to dream BIG dreams. Even though I didn't become an astronaut, I've never forgotten the curiosity, optimism and excitement of that period. As Lt. Governor, I'm absolutely thrilled to help Kentucky's aviation and aerospace industry grow. I helped start the Kentucky Aerospace Industry Consortium, support STEM education programs, and promote advanced manufacturing as a rewarding career path. This study is paramount to help us understand Kentucky's aerospace/aviation potential as we become a hub of manufacturing excellence."

Lt. Governor Jenean Hampton

Project Foreword

Over the past five years, aerospace exports in Kentucky have begun to take off. In the early 2000s, aerospace exports hovered slightly over a few billion dollars. By 2013, however, export activity started to change and in 2015, we had generated over $8.7 billion in exports. This surge was enough to push the Commonwealth to #3 nationally in export activity. This sweeping growth was quickly recognized, and in the 2015 legislative session, the General Assembly passed House Joint Resolution 100 to mandate this study of the aviation, aerospace, and defense supply chains. Through intense and thorough research, it has uncovered and highlighted many of the incredible statistics, companies, universities, and research underway throughout our state. By the end of 2016, Kentucky's aerospace exports had grown to $10.85 billion, which makes the Commonwealth #2 in the United States, behind only the state of Washington. This industry is poised to have an enormous and positive impact for all Kentuckians.

Aerospace growth goes way beyond just exports for Kentucky. It has also expanded in the number of companies involved and the individuals looking to make an impact in this arena. For many years, we have had an impact in the automobile industry with large and well-known companies like Toyota, Ford, and Chevrolet. Naturally, this has brought many automobile parts suppliers and manufacturers into the area. As aerospace product manufacturing began to rise regionally many of these companies that made pieces and parts for automobiles, began to use their skills and capabilities to do the same thing within the aerospace industry. At the beginning of this study, the Kentucky Cabinet for Economic Development listed 60 companies involved in aerospace in the state. Through the study, we discovered that Kentucky is home to more than 600 businesses involved in the aerospace and aviation cluster. These companies range from large to small and account for over 17,500 jobs.

While many of these 600+ companies are medium to small in terms of size, some are the larger aerospace and defense companies to include; Raytheon, Lockheed Martin, GE Aviation, Belcan, BAE, and Safran Landing Systems. These companies have relocated and expanded in Kentucky in large part due to a pro-business environment, low-energy costs, and low taxes. Safran has continuously expanded its operations and is currently working on it fifth expansion since 1999. In fact, if you fly commercially there is a high percentage chance that the brakes your aircraft landed on were manufactured at the Safran facility located in Walton, Kentucky.

In addition to the many manufacturers, Kentucky is also home to large logistical operations at the UPS Worldport in Louisville (SDF), and a DHL Hub in the Northern Kentucky Airport (CVG). This has given us a large and unique capability in moving and exporting aerospace products throughout the nation and the world. As the aerospace industry continues to grow and expand throughout the Midwest and South, our incredible logistical strength has the potential to make Kentucky the focal point for the export of aerospace products and parts for the entire region. To add to our already overwhelming logistical capabilities, Amazon Prime announced early in 2017, that it would be investing $1.5 billion in a prime air hub at the Northern Kentucky Airport. This will serve to further increase CVG's already incredible shipping and receiving capabilities. CVG has a daily flight to France that flies whether or not there is even one passenger on board. The reason for this is the value of the aerospace products shipped in the cargo hold. Kentucky proves time and time again that in a world where the ability to reach customers globally is key to success, it can truly deliver.

Global logistics infrastructure is a big reason why many companies are looking to do more business with our Commonwealth. This advantage is not just a positive for the larger companies, but also for the small to medium size businesses in aviation and aerospace cluster. These Kentucky based companies make an incredible array of parts for both military and civilian aircraft. Phoenix Products makes parts for the Blackhawk Helicopter, C-130 and the F-16. Foam Design supplies for the MV-22 Osprey. Meggitt has parts on the E-3A as well as braking systems on many other various aircraft. A.C.E. Compressor builds remanufactured air compressors. Highlands Diversified Services makes armrests and seat parts for commercial airliners. In addition, over 30 Kentucky companies supply Boeing in Charleston, South Carolina. The list of companies in our state contributing to America's aircraft and airpower goes on and on.

Many of these companies are making an impact on the space side of the equation as well. Space Tango, in Lexington, Kentucky, is one of only a handful of companies in the world that has their very own lab on the International Space Station (ISS). They have the capability to deliver to their clients the ability to conduct tests and experiments in micro-gravity. Their lab completes all experiments autonomously, without continuous interaction from ISS astronauts. They can, however, communicate directly with astronauts through a live feed from their Lexington office as they install experiments into the lab on the ISS. Space Tango is pushing into a new frontier in micro-gravity by taking a new approach when looking at space research. Most money spent in space is on looking outward to what is beyond Earth. Space Tango looks at space and micro-gravity and seeks to find how they can use these exotic environments to positively impact our lives on earth. They are completing this mission by finding new ways to use micro-gravity to manufacture products that cannot be built within Earth's gravity, and conducting bio-medical testing through their affiliate, Exomedicine. Until a few years ago the term exomedicine, which seeks to understand better ways to treat illnesses or diseases, did not exist. Now individuals worldwide are making calls to one of Exomedicine's founders, Kris Kimel, to see where they can pursue a Ph.D. on the subject.

Discussing aerospace in Kentucky would not be complete without talking about how our education opportunities are also breaking new ground, and influencing the aviation and aerospace industries worldwide. For many years, we have held the standard for aviation based stem high school education. With 38 schools involved in this program in the past that provided four different pathways for students, Kentucky changed the way our young minds viewed aviation and aerospace. Kentucky officials are continuing to re-work this program so that all schools have the ability to expose their students to possibilities available in aviation and aerospace.

Kentucky universities are also making a huge difference, and each in their own unique way. The University of Louisville (UofL) supports research in micro and nanotechnology, advanced materials, biotechnology, and advanced manufacturing at their Micro/Nano Technology Center. UofL, along with Western Kentucky University are also conducting International Space Station (ISS) experiments to understand colloid material behavior to enhance solar cell performance. In partnership with NASA Kentucky, the University of Kentucky (UK), and Kentucky State University led the development of Next-Generation Entry Thermal Protection. This will be beneficial to both small and large satellites. UK also conducts Unmanned Aerial Systems research in their Mechanical Engineering Department. Eastern Kentucky University is making waves in their aviation department as one of the top pilot training programs in the nation.

Some of the most incredible work in aerospace, however, happens at Morehead State University (MSU) in eastern Kentucky led by Dr. Benjamin Malphrus. MSU not only is one of the leaders in cubesat and other

small satellite technologies, but is also now part of the NASA Deep Space Network (DSN). This makes MSU the only non-NASA asset to have that honor. To date, MSU has launched five satellites into space, and will have their sixth released from the ISS in June 2017. One of their most incredible endeavors comes in 2018, where they will release a satellite mission called "Lunar Ice Cube" from the first launch of the new NASA Space Launch System. The NASA Space Launch System will be the largest rocket ever created. MSU's Lunar Ice Cube mission will be to travel to the moon to look for potential ice formations, a critical building block for future NASA moon missions.

So what is next? As you can see, Kentucky is participating at the forefront of new frontiers, and is pushing the boundaries of technology. The innovation and participation of companies, universities, and individuals will continue to propel our state to the top of the aerospace industry in exports and other categories. The Commonwealth's biggest battle moving forward is perception. Most people in state and out of state are completely unaware of the impact we are having on aerospace. We need to act now to unite, promote, and grow this industry in order to solidify itself as a focal point in a growing aerospace region throughout the Midwest and South. Companies in aerospace continue to relocate in these areas for their business friendly policies, lower taxes, lower energy costs, and lower costs of living. Promotion of the industry will help grow businesses currently in Kentucky, but will also help attract new businesses to relocate. It will also increase awareness of the career opportunities in these thriving industries for our citizens.

As you can see, Kentucky is having a vast impact on the aerospace industry. This, however, is only a small portion of what is happening throughout the Commonwealth. To continue this momentum, state officials need to ensure they make the right steps to continue to strengthen this industry. Great strides have been made in the promotion and unification of the aerospace industry through the creation of the Kentucky Aerospace Industry Consortium by Governor Matt Bevin, and Lt. Governor Jenean Hampton. This organization will be key moving forward to grow the aerospace industry and create a brand for Kentucky Aerospace. The Commonwealth has also shown its commitment to the industry through the recruitment of Braidy Industries to relocate to Kentucky and invest $1.3 billion to build an aluminum mill in Greenup County. Some of the aluminum produced at this facility will be aerospace grade material suitable for many manufacturers and suppliers in the aerospace industries. This proves that our state is serious about aerospace and is poised to continue to make a huge impact.

Fifty years ago, most technological innovations were accomplished by governments, large companies, or major universities. However, we currently live in a world of rapidly growing technological capability. As that capability grows, it also shrinks in physical size. This has allowed smaller companies and individuals to create disruptive technologies or to have an impact on any industry globally. Want proof? Look no further than Kentucky with its robust and growing aerospace industry.

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Project Manager
Kentucky Commission on Military Affairs

Project Overview

Aerospace and Aviation are two industries rising to new prominence in Kentucky. Because of Kentucky's strong military identity with installations such as Ft. Knox, Ft. Campbell, and Bluegrass Army Depot, opportunities for Kentucky to benefit from defense contracting are coming into focus. The nature of national defense and its ties to aerospace and aviation means opportunities in each sector must be considered as well as understanding where they overlap.

In a move to assure Kentucky realizes its full potential to leverage these opportunities, the Kentucky General Assembly passed House Joint Resolution 100 (HJR100) in 2015. The resolution directed the Kentucky Commission on Military Affairs (KCMA), the Kentucky Transportation Cabinet (KyTC), and the Cabinet for Economic Development (CED) to study the economic impact of the overall aerospace/aviation industry in the commonwealth and to report the findings to the Governor and the Legislative Research Commission (LRC).

Following a competitive bidding process, a consulting team led by Thomas P. Miller and Associates (TPMA) was selected to provide the partner agencies listed in the resolution with a study analyzing the Aerospace, Aviation, and Defense industry sectors. TPMA was charged with determining the annual economic impact, potential growth areas, education and workforce development issues, developing recommendations for sustained growth, and creating an online, interactive, data-driven mapping tool. The study and subsequent mapping tool will enable Kentucky companies to understand and participate in the aerospace, aviation, and defense industries. Civic leaders and policy-makers will benefit from an effective, updated source to inform the legislative process and drive increased employment in this sector.

To better understand the aerospace and aviation industries in Kentucky, TPMA utilized several sources of quantitative and qualitative data over the year-long project. In addition to the myriad of data sources accessed for quantitative review, representatives with TPMA hosted several topic-specific focus groups with industry leaders across Kentucky. Targeted interviews further refined the qualitative feedback, ultimately providing a more rich and in-depth analysis of the aerospace, aviation, and defense industries in the state.

In addition, representatives of the TPMA team attended marketing and other public presentation opportunities to provide progress updates and gather additional viewpoints from across the state. Reports and presentations were provided to the project steering committee, legislators, Kentucky's Aviation Day Conference, and the Kentuckians for Better Transportation Conference.

In 2016, Kentucky's total aerospace and aviation exports surpassed those of all but one state. The companies that make up these industries provide good-paying, high-skilled jobs for Kentuckians across the commonwealth and immense state and local economic impact. Leading edge research and development and the resulting innovations is pushing the sector to new heights.

Several common themes, synergies, and obstacles exist in both the civilian aerospace and aviation industries and the defense industry in Kentucky. Each sector also has its own set of dynamic characteristics. In order to provide the most comprehensive analysis at each of the two areas, TPMA and the project team present this report into two distinct sections:

- The Kentucky Aerospace and Aviation Industry Study
- The Kentucky Defense Industry Study

The Kentucky Aerospace & Aviation Industry Study Team

Prime Consultant –

THOMAS P. MILLER & ASSOCIATES

Consulting Team –

Lieutenant General (Ret.) Benjamin Freakley

Fourth Economy Consulting

R.A. Wiedemann & Associates

Business Development Zone

Web and Mobile Visualization –

Heartland Communications Consultants

Executive Summary

Key Findings

The following represent the most high-level findings from the analysis of Kentucky's Aerospace and Aviation industry. Additional and more detailed findings on specific topics are highlighted in the chapters that follow.

- With more than $10.85 billion in goods exported internationally, Kentucky ranks second nationally in aerospace-related exports.
- Kentucky is home to more than 630 businesses in the Aerospace & Aviation cluster.
- There are 1,500 more companies related to this cluster in some way with more than 150 unique industry classifications represented.
- Supply chain potential is significant with Kentucky firms in the Aerospace Products industry spending $316 million annually purchasing products outside Kentucky. Firms in the Aviation Services group spend an estimated $344 to import products from outside the state.
- Among the commonwealth's unique Aerospace & Aviation assets are facilities like the Morehead State Science Center, the Micro/Nano Technology Center at the University of Louisville, research on thermal re-entry systems at the University of Kentucky, organizations such as Space Tango, manufacturers such as Safran Landing systems, and initiatives like the constellation satellites developed in Kentucky.
- Kentucky's Aerospace & Aviation cluster accounts for over 17,500 jobs and around $1 billion in earnings.
- Aerospace and Aviation contribute $3.4 billion in economic activity or 0.8% of the state's annual economic output.
- Of the 53 General Aviation (GA) airports in Kentucky, 28 have runways of 5,000 feet or more. This length is necessary to serve larger civilian aircraft and cargo planes.
- Kentucky is home to three major private-sector logistics hubs: DHL and Amazon in Northern Kentucky and UPS in Louisville.
- Six general aviation airports serve the Aerospace industry with 93 companies located in a close proximity to those facilities.
- To measure Kentucky's progress in realizing opportunities in the Aerospace and Aviation cluster, six states serve as benchmarks for their rankings in employment, research and development, or both. Those are: Alabama, Arizona, Indiana, Kansas, Ohio, and Washington.
- Of the top 15 occupations in Aerospace Products, about 30 percent are in Architecture and Engineering, and almost one-fourth are in the Production occupational group.
- The top three occupations in Kentucky's Aerospace industry are Industrial Engineers, Aircraft Mechanics & Service Technicians, and Team Assemblers.
- The occupations with the most potential for growth in Aerospace are Industrial Engineers and Aircraft Structure, Surfaces, Rigging, & Systems Assemblers.
- Of the top 15 occupations in Aviation Services, more than 60 percent are in the Installation, Maintenance, and Repair occupational group, with more than 20 percent in the Transportation and Material Moving group.

- The top three occupations in Kentucky's Aviation Services sector are Aircraft Mechanics & Service Technicians, Commercial Pilots, and Airfield Operations Specialists.
- The occupations with the greatest potential for growth in Aviation Services are Commercial Pilots, Aircraft Mechanics & Service Technicians, and General & Operations Managers.
- Kentucky's high school and postsecondary programs appear to offer an ample potential talent supply to meet the needs of the talent demand in Aerospace & Aviation key occupations.

Key Recommendations

The following is a preview of the recommendations for maximizing the economic potential of Kentucky's Aerospace and Aviation industries. These recommendations are described in detail in the following chapters.

Capitalizing on Military Installations

- Utilize Airspace for Public-Private Partnerships
- Develop Mission Tracking Capabilities
- Include Military Human Resources and Recruiting Personnel in Aerospace & Aviation Sector Consortium
- Create and Promote Apprenticeships and Related Programs, Focusing on Military Installations in the State
- Explore the Creation of a Research and Technological Hub at Fort Knox
- Explore a Communications and Contracting Framework to Facilitate Defense Contracting
- Explore Becoming a Leader in Crash Investigation and Search and Rescue
- Explore Becoming a National/Regional Maintenance Hub for Military Fixed Wing and Rotary Aircraft

Leveraging Opportunities for Development

- Create an Aerospace and Aviation Consortium
- Establish a "Blue Ribbon Panel" for UAS
- Invest in University R&D
- Stimulate Connections with the Private Sector
- Conduct Efficiency Audits and Training
- Explore Preferred Vendor Certifications
- Create an Innovation Center
- Build a Culture of Commercialization
- Extend the Manufacturing Region Designation
- Create an Embedded Lab

Enhancing Workforce

- Establish Sector Partnerships
- Expand Apprenticeships
- Partner with Community Colleges

Promoting Policy

- Re-align Tax Policies and Incentives
- Expand and Target Advertising Capacity
- Leverage Appropriate Legislation
- Explore Human Capital Centered Incentives
- Develop an Advanced Manufacturing Tax Credit

Table of Contents

Chapter 1: The Aerospace & Aviation Cluster

Chapter 2: Business Costs & Opportunities

Chapter 3: Education & Workforce Analysis

Chapter 4: Kentucky's Unmanned Aircraft System (UAS) Industry Study

Chapter 5: Airport & Air Freight Optimization

Chapter 6: General Aviation Airport Evacuation Plans

Chapter 7: Capitalizing on Military Installations

Chapter 8: Opportunities for Growth & Development

Appendices

Kentucky Commission on Military Affairs &
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Chapter 1: The Aerospace & Aviation Cluster

Key Findings

The Aerospace & Aviation (A&A) Cluster is the initial chapter of the Kentucky Aerospace & Aviation Industry Study. In Chapter 8 of the study, the Research Team provides a more robust summary of recommendations for enhancing this cluster. For this component of our analysis, TPMA primarily utilized research from secondary sources (as opposed to direct soliciting of information from stakeholders). As such, the executive summary details significant findings from that research.

One of the ever-present challenges in economic research is aligning industry information with specific businesses. To confront that challenge, TPMA conducted two parallel analyses of the Aerospace & Aviation cluster in the state. This included an analysis of the businesses that discernably compose the cluster and an analysis of the industries that represent the core of the cluster. The strength of business-level information is that it provides a specific business name and a physical location; however, to obtain more accurate information on other significant economic metrics such as jobs, earnings, sales, and supply-chains, it is necessary to use industry-level information. The following are the key points TPMA has uncovered related to businesses and industries in the state:

- There are 633 establishments in Kentucky in the Aerospace & Aviation cluster, and there are 1,549 active establishments that may or may not be in this cluster. The greatest concentration of businesses is in the Air Operations or Manufacturing industries, but there are greater than 150 unique industry classifications represented on the list.
- The Louisville and Lexington regions lead the state in Aerospace & Aviation establishments. Jefferson County is particularly dense in assets, as it hosts about one out of every four Aerospace & Aviation companies in the state. Jefferson County also leads in company employment in the cluster, followed by Fayette and Boone County.
- The fourteen core Aerospace & Aviation industries in Kentucky currently employ greater than 7,500 workers. Employment in Aviation Services dropped significantly between 2004 and 2016, primarily due to a mass layoff of Delta employees in 2005. However, the Aerospace Products industry is on the upswing over the past ten years, increasing employment by almost 30%.
- The Aerospace industry is a common target industry for many states and geographies across the nation. According to a 2016 Price Waterhouse Cooper study, Kentucky ranks in the 30's among states for most Aerospace metrics, but strong recent growth in this industry group combined with highly competitive wages could position the commonwealth well to increase its ranking. Furthermore, increased awareness of the cluster within the state, coupled with implementation of TPMA's recommendations, could increase Kentucky's rankings in subsequent years.
- The Aerospace & Aviation cluster requires an array of inputs, and the opportunities to plug supply chain gaps by growing or recruiting suppliers to the state are abundant. It is estimated that companies in the Aerospace Products industries spend $316 million annually purchasing products outside of state boundaries. Likewise, in the Aviation Services group, businesses import an estimated $344 million worth of products from outside the state.
- TPMA estimates the Aerospace & Aviation cluster to account for over 17,500 jobs and around $1 billion in earnings. The $3.4 billion in economic activity attributable to the industry accounts for 0.8% of the state's annual economic output.

Introduction

The Kentucky Commission on Military Affairs has contracted TPMA and its partners to conduct a study on the Aerospace, Aviation, and Defense industries and to develop an on-line tool that visualizes the results of the studies. This chapter provides a literature review with background on the Aerospace & Aviation cluster at the international, national, and state of Kentucky levels. Further, the chapter identifies and analyzes core industries in the Aerospace & Aviation cluster, including number of jobs (current and projected); information on the concentration of core industries in Kentucky and any competitive advantages that the state has; and employment demographics. In addition, TPMA utilized a comprehensive methodology to identify numbers, types, and locations of establishments in core Aerospace & Aviation industries that are represented throughout the state. The chapter also includes an analysis of Kentucky's Aerospace exports, as well as a supply chain analysis to identify leakages and opportunities in the Aerospace & Aviation supply chain. Finally, this chapter analyzes the economic impact of the Aerospace & Aviation cluster on the state of Kentucky.

Aerospace & Aviation Cluster

Literature Review

To further support TPMA's research on the Aerospace & Aviation cluster in Kentucky, it is helpful to review existing literature on the sector, both in the state of Kentucky and elsewhere. Though prior company identification work has been completed by the Kentucky Commission on Military Affairs and the Cabinet for Economic Development, and an economic impact analysis recently has been completed related to the Defense industry in Kentucky, no large-scale analysis has been produced that outlines the industry structure, economic impact, and supply chain of Aerospace & Aviation individually. TPMA identified and reviewed several national studies of the Aerospace & Aviation cluster.

2016 Aerospace Manufacturing Attractiveness Rankings

The most comprehensive study found was the 2016 Aerospace Manufacturing Attractiveness Rankings by Price Waterhouse Cooper (PWC). The study reviewed four areas: tax, costs, industry, and education. The tax category included corporate, unemployment, and property taxes. The costs category reviewed electricity, average hourly wage for Aerospace, and average hourly wage for occupations. The industry category examined total Aerospace employment, industry growth, and Aerospace companies. Finally, the education category looked at the number of people in the state with just bachelor's degrees, just master's degrees, and just doctoral degrees, as well as a combination of bachelor's or higher degrees and graduate or professional degrees. Based on the PWC review, states were ranked in each category and overall. Kentucky had a weak overall ranking of 41 out of the 50 states. The highest ranked category was costs, at 21st, and the lowest ranked categories were tax and education, both at 36th.[1]

1 Price Waterhouse Cooper. (2016). 2016 Aerospace Manufacturing Attractiveness Rankings. Retrieved from http://www.pwc.com/us/en/industrial-products/publications/assets/pwc-aerospace-manufacturing-attractiveness-rankings-2016.pdf

Policy Solutions for a Stronger Technical Workforce

The College of William and Mary produced a study in 2014, Policy Solutions for a Stronger Technical Workforce, which specifically focused on Aviation Maintenance. In the discussion of the Southern region, which includes Kentucky, the report noted that the region had the largest employment growth from 2003-2013 within the Aviation Maintenance industry, but had some of the lowest degree completion statistics, as well as lower wages than the national average. However, the study also noted that Kentucky (along with Tennessee) represented a fairly large proportion of FAA certificates held in the region. At a national level, the study was unable to conclude whether there were labor shortages in any region, but did posit a potential skills gap for future needs within the industry nationwide. This finding was due primarily to the decline in FAA certifications between 2008-2013. The researchers surmised that the decline may be based on an increasing number of retirements in the FAA certified workforce, with not enough younger individuals completing certifications to replace the retirees. Further, although it is beneficial that students in Aviation Maintenance programs gain transferable skills, graduates may be obtaining jobs in other industries with larger salaries or more opportunities.[2]

Unmanned Aircraft Systems (UAS) Industry Study

In addition to the previously discussed studies, TPMA reviewed three industry analyses. The first industry analysis was a study in early 2016 sponsored by the Kentucky Commission on Military Affairs on the economic impact of unmanned aircraft systems (UAS). The study focused on commercial UAS use and not manufacturing because there is only one manufacturer in Kentucky producing UAS. Using RIMSII multipliers the study produced an economic impact of UAS use within Kentucky. The current economic impact is $4.6 million and is projected to reach $19.1 million by 2025. The study split the economic impacts between agricultural and non-agricultural industry use. Construction and Insurance were the two largest industries outside of Agriculture to utilize unmanned systems. The study recommends forming a blue ribbon panel that will focus on UAS legislation that emphasizes tax breaks for UAS use by industry and limits the anti-UAS legislation that is being created at the local and state level.[3]

Space Economy Census Report: A National, State, and Regional Space Industry Census

The second industry analysis looked at the space economy within Kentucky. In 2013, the Kentucky Innovation and Commercialization Center commissioned a Space Economy Census Report. This report was created to compose an industry plan to inventory and catalogue businesses that are part of the space economy or that have the potential to enter the economy, and any infrastructure that could be used to create business and growth in the economy. A total of 41 businesses were located in Kentucky that were directly involved in the Aerospace industry across 71 identified categories that are part of the space economy. There are an additional 140 companies that are in industries that are related to Aerospace. These companies either currently supply the cluster or could easily have their production or services modified to produce Aerospace components as part of their product lines. In addition to the review of Aerospace and potential Aerospace industries, the report performed an overall assessment of the research facilities in Kentucky that are either part of a higher education institution or a nonprofit

2 Ban, M., Jones, C., & Uselton, E. (2015). Policy Solutions for a Stronger Technical Workforce. The Thomas Jefferson Program in Public Policy at the College of William and Mary. Retrieved from https://www.wm.edu/as/publicpolicy/documents/prs/tech.pdf
3 Alaris. (2016). Unmanned Aircraft Systems (UAS) Industry Study.

organization. The report identified several facilities that can be used in all phases of product research and development (R&D) throughout the state. Some of the facilities with the greatest potential for the space economy according to this study are:

- Lutz Micro-Nano Technology Center at the University of Louisville
- Space Systems Development Laboratory at the University of Kentucky
- Space Science Center at Morehead State University
- Kentucky Space, LLC
- Coldstream Research Campus Facility
- Rapid Prototyping Center at the University of Louisville
- The Center for Research and Development at Western Kentucky University

Additionally, a review of all high-tech small business centers, accelerators, and incubators was done to look at their potential for space economy product research and development. The report emphasized the potential in the following business areas:

- Nanosatellite technologies
- Micro-nano systems for space applications
- Precision metalworking for space applications
- Rapid Prototyping for space applications
- PCB systems for the space environment
- Nano-UAVs and UASs
- Adaptive Intelligent Systems for space assets

The report emphasized that this was an initial analysis of the current environment and stressed the need for a concerted effort to invest in R&D in order to build up the industry potential and attract businesses from outside Kentucky by highlighting the potential of the state.[4]

One East Kentucky Aviation Assessment and Recruiting Strategy

The final report covered the potential to attract Aerospace companies to One East Kentucky, a nine-county economic development region in Eastern Kentucky. The assessment looked at the current industry, workforce, and educational programming available to attract these businesses. In addition, there was an assessment of all current assets in the form of regional airports, industrial parks, research centers, and other industry components that are strong allies to the communities. While the region itself does not have related educational programming, there is a nearby FAA-certified maintenance school at Somerset Community College in Somerset, KY. Further, the report identified enough assets and growth potential that the region received the AEROready™ designation from Common Sense Economic Development, LLC and Tucson Atlantic Consulting.[5]

4 Malphrus, B. & Kruth, J. (2013). Space Economy Census Report: A National, State, and Regional Space Industry Census.

5 Common Sense Economic Development and Tucson/Atlantic Consulting. (2016). One East Kentucky Aviation Assessment and Recruiting Strategy.

IBISWorld Industry Reports

In providing a background analysis of the Aerospace and Aviation cluster, it is also important to look at the key industries in the cluster and how they are performing economically, on both a domestic and global scale. TPMA collected and analyzed data from IBISWorld to perform this task.[6] The Aircraft, Engine, and Parts Manufacturing industry is one of two key manufacturing industries for the Aerospace & Aviation cluster. The industry has an annual revenue of $241.2 billion across 1,363 businesses in the United States. The industry has seen an annual growth of 6.9% from 2011-2016 and is projected to grow by 4.2% annually from 2016-2021. The largest company within the industry is The Boeing Company with 32.0% of the market share. Aircraft, the primary product of the industry, makes up 61.3% of products.

The other key industry in the Aerospace & Aviation cluster is the Space Vehicle and Missile Manufacturing industry. The industry has an annual revenue of $27.7 billion across 90 businesses in the United States. The industry has seen an average annual growth of 1.6% from 2011-2016 and is projected to have an annual compound growth of 2.1% from 2016-2021. The largest company in the industry is Lockheed Martin Corporation at 31.4% of the market share, followed by Raytheon Company at 25.7%. Missile systems are the largest product, making up 42.6% of all production. Space systems are the second largest product at 35%. For both the Aircraft, Engine, and Parts Manufacturing and Space Vehicle and Missile Manufacturing industries, the key external drivers are federal defense funding and non-NATO defense spending. In addition, for Space Vehicle and Missile Manufacturing, a key driver is the demand from satellite telecommunications providers.

The global Military Aircraft and Aerospace Manufacturing industry have seen a decline in demand from western countries as defense budgets have been cut. This has slowed the industry's average annual growth to 0.6% from 2011-2016, but expanded defense spending demand outside of western countries and the development of new products are expected to increase average industry growth to 3.1% annually from 2016-2021. On the other hand, the global Commercial Aircraft Manufacturing industry has seen large growth, as rapid economic and income growth in emerging markets has fueled a demand for air travel. The average annual growth from 2011-2016 was 7.4% and the annual compound growth is projected to be 4.1% from 2016-2021.

The United States Airport Operations industry operates and supports airports, including refueling, parking, cargo handling, and air traffic control services. This industry has an annual revenue of $25.4 billion with 1,220 businesses primarily providing fixed-base operations. While the industry has seen an annual growth of 4% from 2011-2016, the growth is expected to slow slightly to 2.3% from 2016-2021. The key economic drivers are the demand from domestic and global airlines and domestic trips by residents. Globally, the industry has seen a large amount of expansion with an annual rate of growth of 6.4%. With the increase in demand from developing economies and the expansion of large international hubs, annual compound growth is expected to continue at 2% from 2016-2021. Additionally, the world price of crude oil is a key driver for the industry both domestically and globally, with current lower prices adding to expansion.

The Aircraft Maintenance, Repair, and Overhaul industry provide support services to all air operations, both civil and military. The industry has an annual revenue of $16.6 billion with 2,905 businesses. The

6 TPMA aggregated data from IBISWorld Industry Reports, one of the world's leading publishers of business intelligence reports. The IBISWorld reports are at the five-digit NAICS level so the industry data may cover a broader range of companies than those assigned at specific six-digit NAICS.

industry has seen an average annual growth of 1.5% from 2011-2016 and is projected to have a similar growth pattern of 1.7% annually from 2016-2021. The key external drivers for the industry are domestic and international trips by residents and federal defense funding. The majority of the industry is concerned with the civil sector (97.5%), but 6.5% of the industry provides maintenance and repair to military aircraft.

There are three industries within air travel and transport services, namely, Domestic Airlines, International Airlines, and Charter Flights. Some of the dominant external drivers for all three of these industries include domestic per capita disposable income and world crude oil prices.

The largest of these industries is the Domestic Airline industry which provides regularly scheduled and routed air transportation services in the United States. The industry has an annual revenue of $152.3 billion from 330 businesses. The industry has seen an average annual growth of 1.3% from 2011-2016, which is projected to increase slightly to 2% annual compound growth from 2016-2021. There are several businesses that represent 10-20% of the market share, including American Airlines Group Inc., Delta Air Lines Inc., and United Continental Holdings Inc.

The International Airlines industry provides air transportation with regular routes and schedules that either originate or end internationally. The industry is smaller than the Domestic Airlines industry, with annual revenues of $64.8 billion across 138 businesses. The industry's largest companies are the same as domestic airlines, but United Continental Holdings Inc. has a larger share at 23.7%. While the average annual growth rate has been higher than the Domestic Airlines industry over the last five years, at 1.6%, it is projected to flatten out with a 0.2% annual compound growth from 2016-2021.

The final industry within air travel is the Charter Flight industry. This is the smallest industry, with an annual revenue of $19.8 billion produced by 21,177 businesses. The industry provides air transportation on an irregular basis. The industry has seen the largest average annual growth within air travel and transport services, at 1.8% over the last five years, and it is projected to grow at a steady 1.5% annually from 2016-2021. The largest business within the industry holds slightly over 4% of the market share, indicating that Charter Flight is a much more diverse industry than the regularly-scheduled airlines.

The air transportation industry at a global level is split between Global Airlines and Global Cargo Airlines industries. The Global Airlines industry has grown at a slower pace than the Domestic Airlines industry with an average annual growth rate of 0.6% from 2011-2016. The Global Airlines industry revenue is $709 billion, and it is expected to see large growth, with an annual compound growth rate of 5.8% from 2016-2021. The Global Cargo Airlines industry has seen a large decline in revenue over the last five years, with an annual decrease in revenue of 6% from 2011-2016 to $77.6 billion. The industry is projected to rebound and see an annual compound growth rate of 3.5% from 2016-2021. This is based on demand from emerging markets, decrease in energy costs, and creation of more fuel-efficient aircraft. The largest drivers for both industries are the world price of crude oil and the GDP and trade of the global economy.

Cluster Analysis Introduction

According to Harvard University's Michael Porter, "a cluster is a geographic concentration of related companies, organizations, and institutions in a particular field."[7] Businesses and other organizations within a cluster share a symbiotic relationship that increases productivity due to shared labor pools, trade relationships, networks, and common interests. The Aerospace & Aviation cluster is one that the Kentucky Cabinet for Economic Development has set out to market via the Think Kentucky website.[8] The state currently has a number of businesses in the cluster, to greater and lesser degrees within the geographic sub-regions of the state.

Identifying the existence of a cluster, however, is only the beginning of the process of becoming an international leader in that cluster. As such, the state should seek to understand the unique contours of the cluster within its own boundaries so that it may understand its greatest competitive advantages. This is particularly important for a cluster such as Aerospace & Aviation, which is commonly referenced as a significant cluster in numerous other states. To augment the literature and data review in the previous section and to define Kentucky's Aerospace & Aviation cluster, TPMA analyzed employment statistics from the labor market data provider Economic Modeling Specialists, Inc. (Emsi). In reviewing a combined group of six Aerospace production industries that are commonly utilized to quantify the Aerospace & Aviation Cluster, the following results appear. The state of Kentucky ranks:

- 31st among states and the District of Columbia for employment in 2016;
- 33rd in terms of location quotient (a metric quantifying the concentration of employment); and
- 33rd in terms of the number of establishments.

Though the array of competitors in the United States is considerable, states that rank in the top ten for all three of these metrics are California, Washington, Arizona, Kansas, and Connecticut.[9] Thus, although the Aerospace & Aviation cluster is a strong contributor to the state's economy, the state should consider ways in which it might bolster its assets to become a greater national and international competitor.

Our Approach: Using Both Company Data and Industry Data

One of the tasks of this analysis is to identify and provide information on companies focused on Aerospace & Aviation. Ideally, all analyses would be based completely at a company level, rather than at the industry level, but there are several problems with that approach. First, due to data limitations, it is difficult to determine precisely which companies are performing Aerospace & Aviation work. Second, even when companies can be identified, the question remains *how much* of their efforts (and therefore the attribution of earnings, jobs, and revenue) are focused on Aerospace & Aviation as opposed to other

7 Porter, M. (n.d.). What are Clusters? Harvard Business School. Institute for Strategy & Competitiveness. Retrieved from http://www.isc.hbs.edu/competitiveness-economic-development/frameworks-and-key-concepts/pages/clusters.aspx

8 Others included on the list are the following: Automotive; Primary Metals, Food & Beverage; Logistics/Distribution; Manufacturing; Chemicals; Plastics & Rubber; and Healthcare. Retrieved from http://www.thinkkentucky.com/

9 Emsi 2016.3. Based on 6-digit NAICS codes. For the sake of simplicity in comparison, only the Aerospace Products industries were used in this comparison. Doing such a comparison using Aviation Services would be inappropriate because existence of these industries is much more correlated with population. Places with large populations tend to have more workers in commercial air transportation.

industries. Third, once companies are identified, getting precise data on those businesses can be challenging.

After an extensive review of multiple data sources, TPMA's conclusion is that it is best to use company-level data for determining the number of firms, their industry categorization, and (where available) employment, revenue, federal contract activity, and mobility. For other facets of the analysis, including total economic impact, employment trends, earnings, and supply chains, it is best to rely on industry-level data sources.

Company Identification Process

TPMA utilized three secondary data sources and three primary data sources to identify companies in the Aerospace & Aviation cluster. Secondary data sources come from free or for-purchase websites that classify companies according to characteristics such as product codes and industry codes. Primary sources are lists compiled by Kentucky-based partners who, due to personal and professional networks, can identify particular companies that are known as doing Aerospace & Aviation work. First, establishments were included if they met stringent Aerospace & Aviation criteria among their eight-digit Standard Industry Classification (SIC) codes found in the National Employment Time Series (NETS) database. Next, establishments were added based on their product and service classifications in the DIBBS Navigator database of prime government contractors, from Business Development Zone. Similarly, establishments with Aerospace & Aviation-specific NAICS codes were added from the USASpending.gov subcontractor database. Lastly, the core cluster list was augmented by lists compiled by the Kentucky Cabinet for Economic Development, the Kentucky Aviation Association, and researchers at Morehead State University. As expected, there was a large degree of overlap between the six sources, yet each provided valuable information that was not present via other sources. A comprehensive and detailed description of the methods used to select the companies is contained in Appendix A of this chapter.

The final cluster of Aerospace & Aviation in Kentucky encompasses all establishments where Aerospace and Aviation-related production, administration, government contracting, or research and development is *known to be* performed. For the main list, the motivation was to strike a balance between setting a high bar of evidence, so as to not include a large number of firms that are not actually in the cluster, but at the same time not systematically exclude firms that actually do belong in the cluster. The process created a much larger list of companies that *may* be in the Aerospace & Aviation cluster but there is reason to be less confident *are* in the Aerospace & Aviation cluster. More precisely, there are 633 establishments in Kentucky that are in the cluster, and there are 1,549 active establishments that may or may not be in this cluster. The list of businesses is a cluster in the truest sense. The majority of businesses are in the Aviation Services or Aerospace Products and Parts industries, but there are a host of businesses from numerous other sectors as well.

Core Industries

To arrive at a list of core Aerospace & Aviation industries, TPMA reviewed cluster definitions from the US Cluster Mapping site and several other states that have conducted similar analyses. This gave a starting point, but naturally the industry composition varies significantly from region to region. Some states and regions that produce clothing articles (such as space suits) for the Aerospace industry included certain

parts of the textiles industry in their cluster, but if that is not a part of the cluster in Kentucky it would be in error to include it for this analysis.

Following this, TPMA verified that selected industries were relevant based on the company identification process, which indicates the businesses that are highly likely to be in the Aerospace & Aviation industries. Though industries from across the spectrum could be included, it is not accurate to include the totality of businesses represented by those industry groups in the list of "core" industries. For example, one company on the list is classified as NAICS 327312: "Other Pressed and Blown Glass and Glassware Manufacturing," due to its presence on the Kentucky Cabinet for Economic Development's Aerospace Related Facilities list. According to Emsi, there are roughly five such businesses in the state in 2016. However, TPMA does not feel there is sufficient evidence to say that all five of those companies, and the over 350 employees they support, should be considered in the "core" of Aerospace & Aviation. Hence, TPMA settled on the list of 17 NAICS industry codes presented below (nine in Aviation Services and eight in Aerospace Products) that both matched well with past research on this topic and represented the bulk of businesses that were identified. Not surprisingly, the two methods comported fairly well (67% of all businesses on TPMA's list are classified with a primary NAICS code represented in the core list).

Table 1 below shows the list of businesses in the "core" Aerospace & Aviation cluster. Please note that not all industries on the list actually have employment in the state currently, but it is still important to have a full record of all such industries so that supply chain leakages can be identified where those industries are not present in the state.

Table 1: "Core" NAICS Codes for the Aerospace & Aviation Cluster

NAICS	Description
Aerospace Products	
333314	Optical Instrument and Lens Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
336411	Aircraft Manufacturing
336412	Aircraft Engine and Engine Parts Manufacturing
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
Aviation Services	
481111	Scheduled Passenger Air Transportation
481112	Scheduled Freight Air Transportation
481211	Nonscheduled Chartered Passenger Air Transportation
481212	Nonscheduled Chartered Freight Air Transportation
481219	Other Nonscheduled Air Transportation
488111	Air Traffic Control
488119	Other Airport Operations
488190	Other Support Activities for Air Transportation
611512	Flight Training

Peripheral Industries & Economic Impact

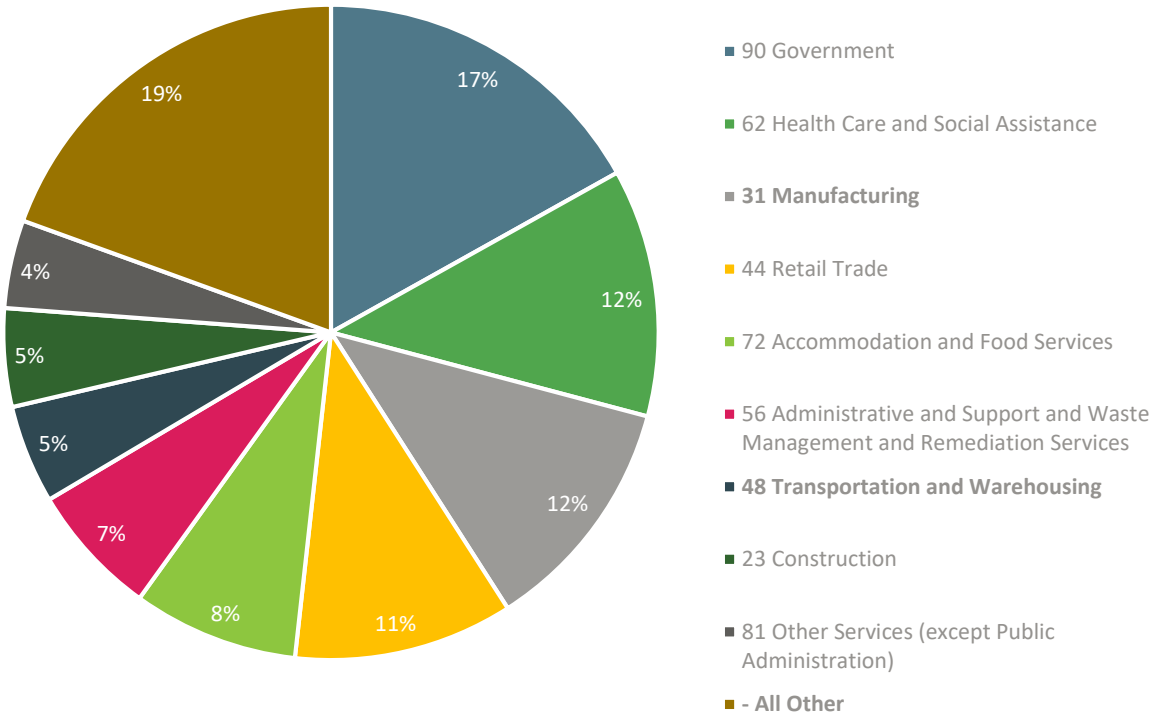
As with any cluster or industry, the total impact does not stop with the companies in a particular sector, but extends to other sectors due to companies' purchases of goods and services required to keep their businesses running, as well as employee spending within the region. Groups of businesses typically have a ripple effect on the economy. Some types of impacts are fairly easy to identify—for example, aircraft manufacturers are required to purchase inputs from semiconductor manufacturers and electronics manufacturers. Other impacts are harder to see, but are no less present. Even seemingly unrelated industries such as healthcare and real estate are supported by industries in Aerospace & Aviation, because without the paychecks that support the workforce of these industries, there would be less need for these services. These concepts are further developed in the economic impact section of this analysis.

Kentucky Aerospace & Aviation Cluster Analysis

Industry Overview

At first glance, it may seem like Aerospace & Aviation activities make up a relatively small percentage of Kentucky's economy. For example, of the 17 core 6-digit NAICS codes identified as consisting of Aerospace Products and Aviation Services, eight are manufacturing industries, eight are transportation and warehousing industries, and one is an educational services industry. These categories rank third, seventh, and thirteenth in total employment for the state. Overall, the 17 industries provide 7,584 of Kentucky's 2,106,407 jobs—just 0.34% of Kentucky's workforce, but they contribute $939,151,681 to Kentucky's GRP—0.53% of the state's total.

Figure 1: Kentucky 2016 Employment by 2-Digit NAICS Code[10]



Bolded Categories Include A&A Industries

Aerospace & Aviation activities are not spread evenly throughout the state. The majority of Kentucky's Aerospace & Aviation jobs are in just three regions: Northern Kentucky, Lexington, and Louisville, which combine to employ 6,283 of the 7,584 people (83%) working in Aerospace & Aviation throughout the state. Graphical depictions of Kentucky's Aerospace & Aviation employment distribution are shown on the next page. It is important to note that while every region of the state contains at least one A&A job, two regions—Ashland and Paducah-Purchase—employ fewer than fifty people in these industries.

10 Emsi 2016.3. These occupations are by 2-digit NAICS code.

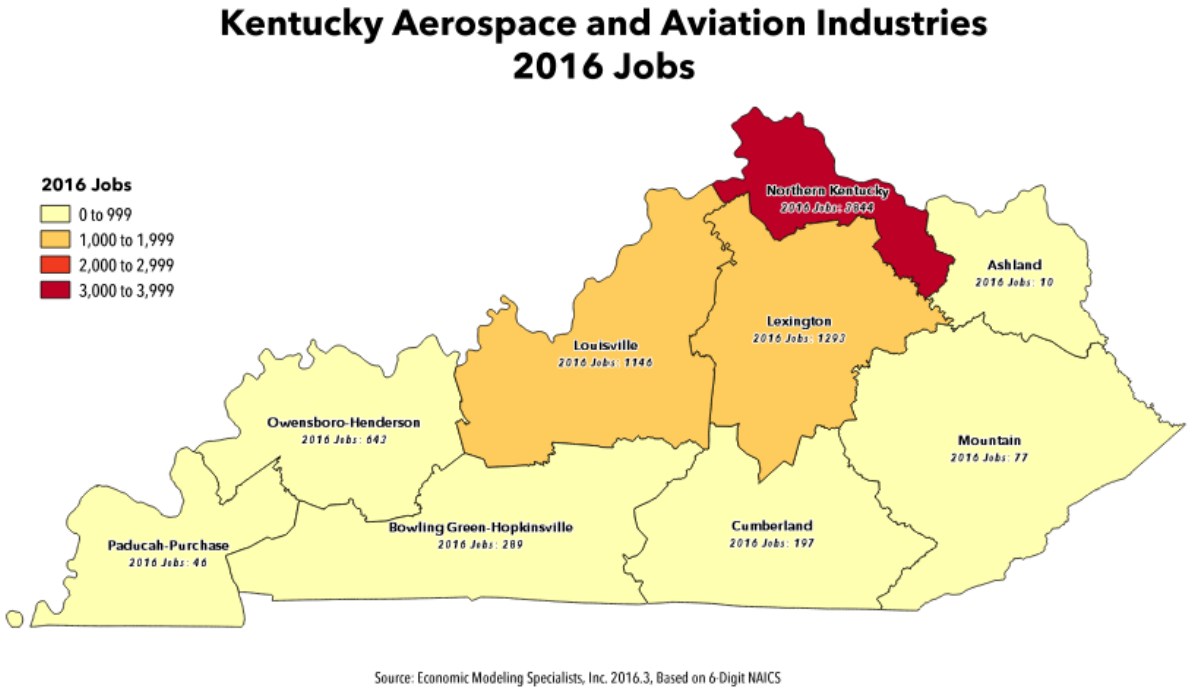
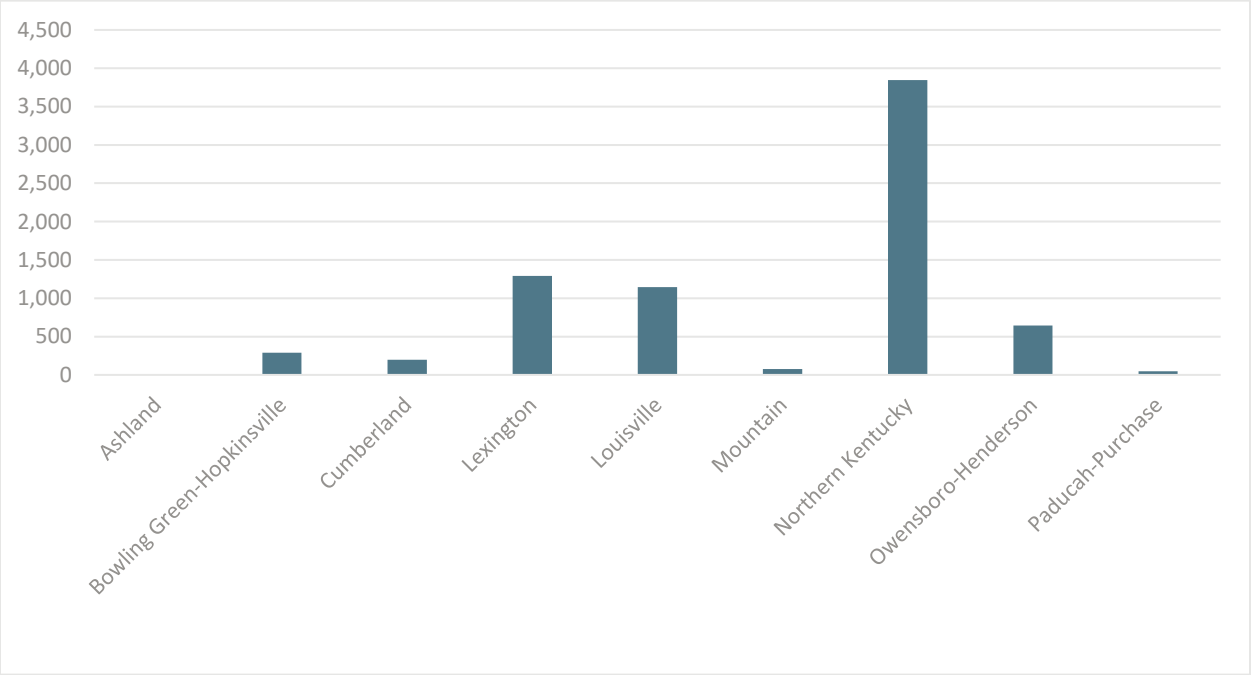


Figure 2: 2016 Aerospace & Aviation Employment by Region[11]

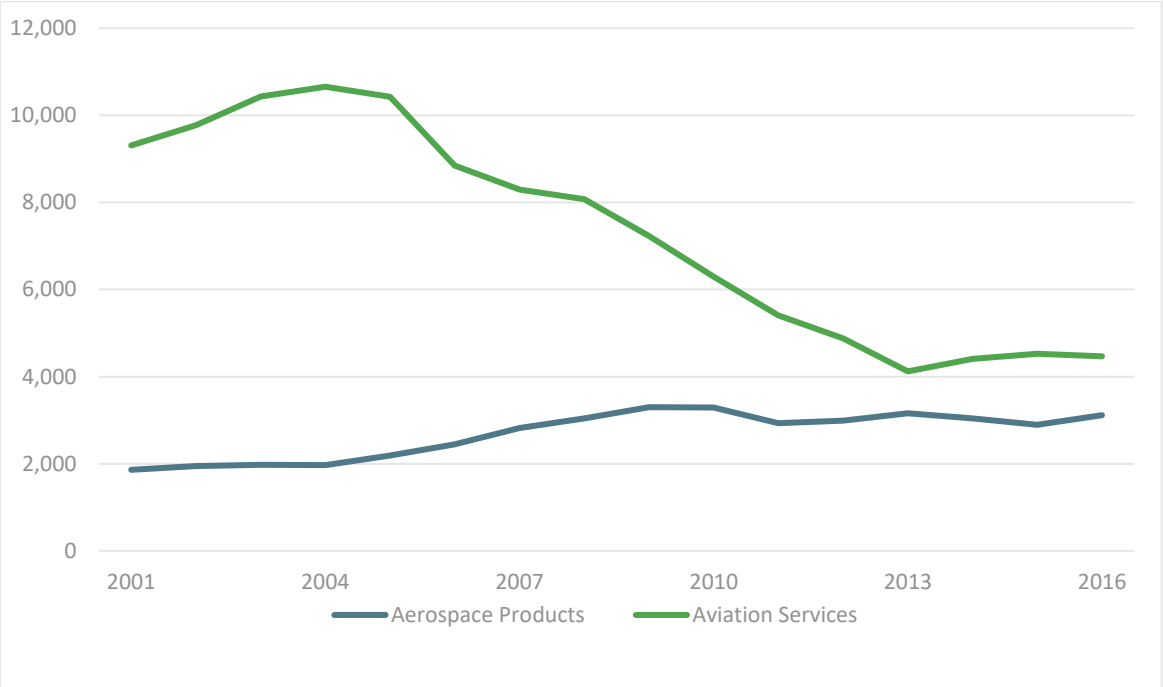


Employment in the nine industries identified as Aviation Services has been dropping in Kentucky over the last 15 years—as demonstrated by the line chart on the following page. In 2001, these industries employed 9,311 people, but they currently employ just 4,467. The majority of this job loss has come from

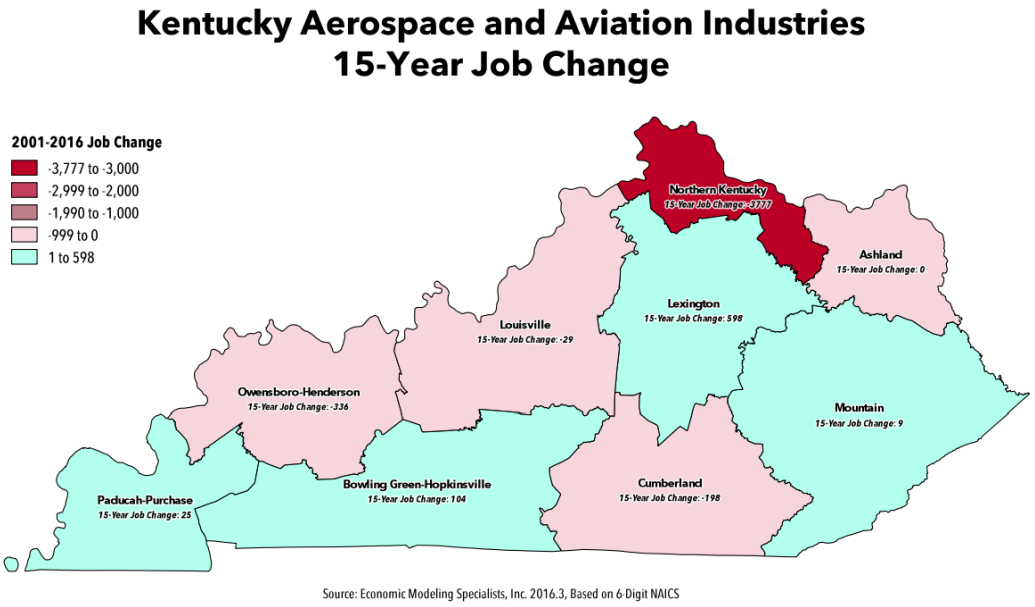
11 Emsi 2016.3. Jobs are for workers in 6-digit NAICS industries. Employment includes only the targeted Aviation Services industries.

the Northern Kentucky region, where employment in Aerospace & Aviation industries together dropped by 3,774 over the same time. Meanwhile, employment in Aerospace Products industries has risen from 1,861 to 3,177 over the past fifteen years. The rise in Aerospace Products employment, coupled with the fall in Aviation Services employment, has meant that Aerospace Products' share of total Aerospace & Aviation employment in Kentucky has risen dramatically. In 2001, Aerospace Products industries provided just 16.7% of Kentucky Aerospace & Aviation jobs; in 2016, they provide 41.1% of Kentucky's Aerospace & Aviation jobs.

Figure 3: Kentucky Employment by Aerospace & Aviation Grouping, 2001-2016[12]

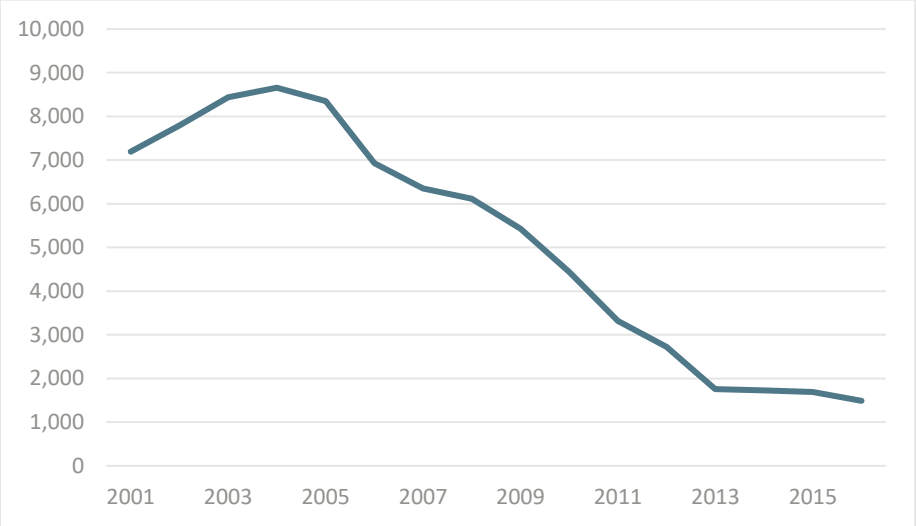


12 Emsi 2016.3. Jobs are for workers in 6-digit NAICS industries. Employment includes only the targeted Aviation Services industries.



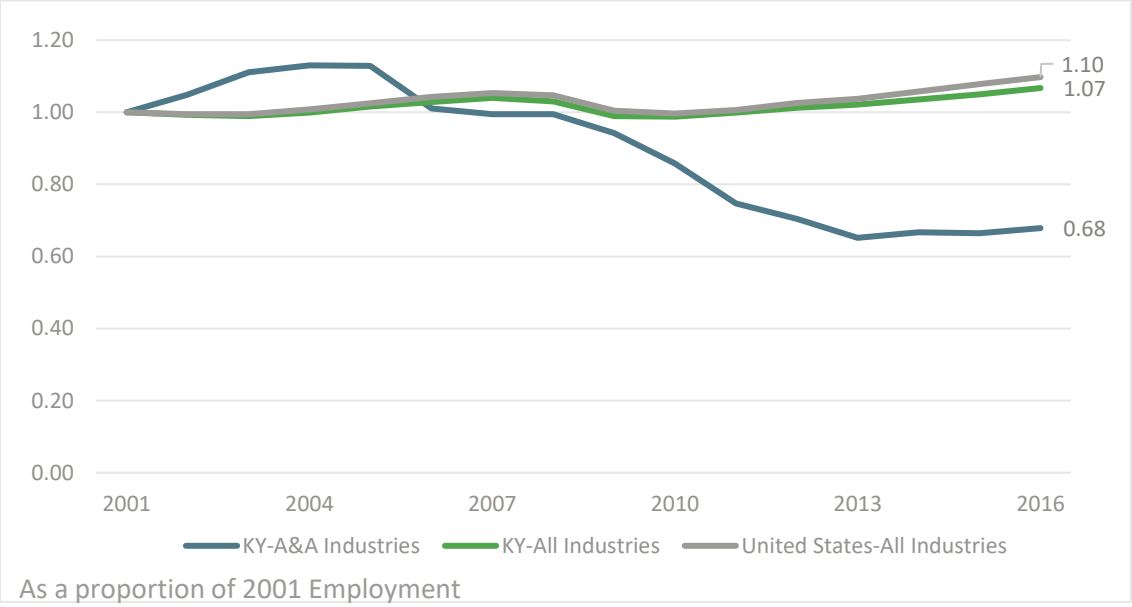
As previously noted, the majority of the job losses in Aerospace & Aviation have been borne by the Northern Kentucky region. Though this region of the state still holds the most Aerospace & Aviation jobs, it has lost 3,777 Aerospace & Aviation jobs since 2001—cutting its Aerospace & Aviation employment in half. As shown by the line graph below, Northern Kentucky's job losses in one subset of Aviation Services—Scheduled Air Transportation—have actually been even greater. The industry has lost over 7,000 jobs since the region's peak in 2004. However, such significant losses in the region have been marginally offset by growth in other Aviation Service industries. Around the rest of the state, the Lexington Region has seen the highest job growth—598 jobs—and the Owensboro-Henderson Region has seen the most job losses—336. Most regions of the state have not seen significant 15-Year job change.

Figure 4: Northern Kentucky 15-Year Job Trend: Scheduled Passenger Air Transportation[13]



13 Emsi 2016.3. Jobs are for NAICS Code 481111.

Figure 5: Aerospace & Aviation Employment Compared to All Kentucky and U.S. Industries[14]



It is helpful to compare Aerospace & Aviation job changes to those in Kentucky and the United States as a whole. As demonstrated by the graph above, jobs in all industries have risen in both Kentucky and the United States since 2001—despite the impacts of the recession. Kentucky Aerospace & Aviation employment in 2016, however, is at just 68% of its 2001 level. Another way to analyze local employment in comparison to the U.S. Economy is by looking at location quotients and competitive effect. Location quotients compare a region's job concentration in each industry with the distribution of jobs in the U.S. economy as a whole. If the location quotient is greater than 1.0 for a particular industry, the region employs a higher than average concentration of people in that industry. For both Aerospace Products and Aviation Services, Kentucky's location quotients are less than 0.5. This means that Aerospace & Aviation jobs are less than half as common in Kentucky as they are in the U.S. economy.

Looking at the competitive effect, however, provides some encouraging news for the industries in the Aerospace Products category. Competitive effect measures job changes in a particular region compared to job trends in the U.S. as a whole. As Table 2 (on the following page) demonstrates, the competitive effect for Kentucky Aerospace Products over the last ten years was 667, meaning that Kentucky gained 667 more jobs than was expected based on trends in the U.S. economy. A competitive effect such as this suggests that there may be factors that are particularly appealing about Kentucky for businesses in the Aerospace Products cluster. If Aerospace Product trends are encouraging, however, Aviation Services trends are the opposite. As shown in Table 3 (on the following page), while the U.S. economy experienced 4% job growth in these industries over the last ten years, Kentucky lost almost 50% of its jobs. This resulted in a competitive effect of -4,403. Combined, Kentucky's Aerospace & Aviation industries have experienced a 33% 10-year job loss, while these industries have experienced no change over time nationally.

One final way that these industries can be analyzed is by the wages they provide. In this regard, Kentucky's Aviation Services jobs are keeping up with the U.S. economy better than those in the Aerospace Products cluster. Though both groups lag behind the U.S. in total earnings per worker, the difference is only $4,308

14 Emsi 2016.3. Jobs are based on number of workers in 6-digit NAICS industries.

in Aviation Services. In comparison, total earnings per worker for Kentucky Aerospace Products is $32,189 lower than the U.S. average.

Table 2: Kentucky to U.S. Aerospace Product Job Comparison[15]

Industry	2006-2016 Job Growth	2016 Location Quotient	Competitive Effect, 2006-2016	2016 Total Earnings Per Worker
Kentucky Aerospace Products	27%	0.37	667	$89,647
U.S. Aerospace Products	(4%)	1.00	--	$121,836

Table 3: Kentucky to U.S. Aviation Services Job Comparison[16]

Industry	2006-2016 Job Growth	2016 Location Quotient	Competitive Effect, 2006-2016	2016 Total Earnings Per Worker
Kentucky Aviation Services	(49%)	0.49	(4,403)	$81,491
U.S. Aviation Services	4%	1.00	--	$85,799

Table 4: Kentucky to U.S. A&A Job Comparison[17]

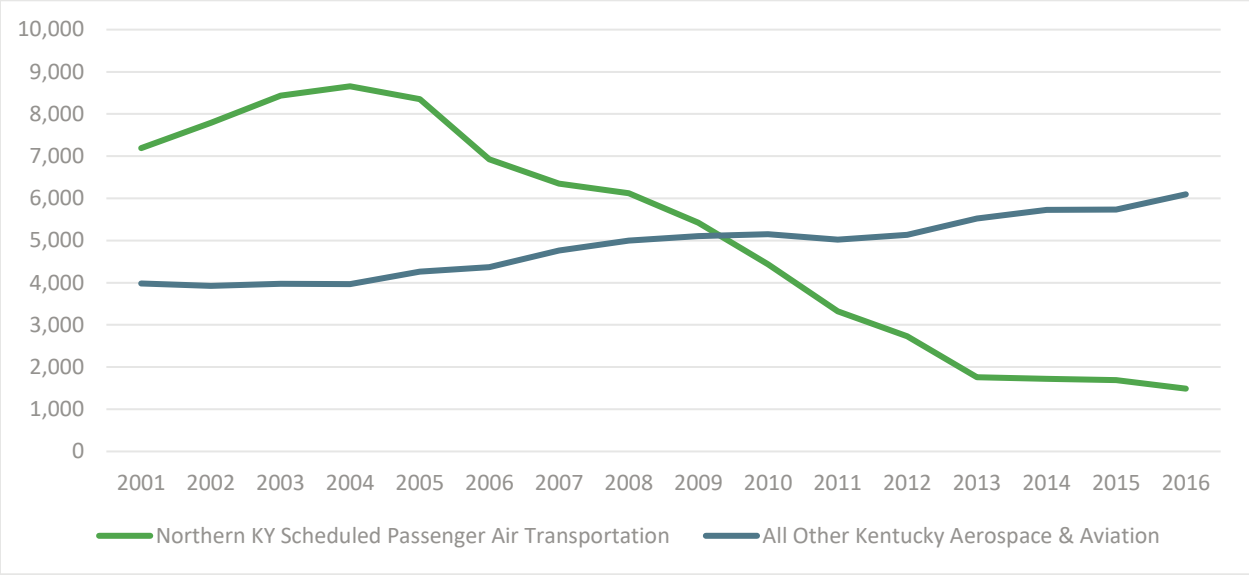
Industry	2006-2016 Job Growth	2016 Location Quotient	Competitive Effect, 2006-2016	2016 Total Earnings Per Worker
KY, All Aerospace & Aviation	(33%)	0.44	(3,736)	$84,843
U.S., All Aerospace & Aviation	0%	1.00	--	$103,042

Aerospace & Aviation Detailed Industry Trends

High-level analysis of the industries in Kentucky's Aerospace & Aviation cluster does not capture all of the important trends in the state. An example of this is shown in Figure 6; though the state has seen Aerospace & Aviation job losses over the past 15 years, the losses have not applied to all industries or regions. In fact, if the trends for Northern Kentucky's Scheduled Passenger Air Transportation industry are isolated from the rest of the state, Aerospace & Aviation activities have seen moderate growth. Therefore, a detailed industry-level analysis can be useful to identify more precise trends throughout the state.

15 Emsi 2016.3. This data was analyzed by TPMA.
16 Emsi 2016.3. This data was analyzed by TPMA.
17 Emsi 2016.3. This data was analyzed by TPMA.

Figure 6: Kentucky Aerospace & Aviation Job Change: Contrasting Trends[18]



Analyzing jobs and job growth by detailed industry reveals dramatic trends. Table 5 presents jobs, actual job growth, forecasted growth, and total earnings per worker in detailed industries, sorted by the total number of statewide jobs in that industry. As previously mentioned, NAICS 481111—Scheduled Passenger Air Transportation has seen a dramatic decline in jobs over the past ten years, and it is forecasted to continue losing jobs over the next five years. Overall, three of the five Aerospace & Aviation industries with employment over 500 have seen 10-year job losses, but the other two have grown quite significantly. NAICS 488190—Other Support Activities for Air Transportation and NAICS 336413—Other Aircraft Parts and Auxiliary Equipment Manufacturing are projected to continue their job growth over the next five years. Overall, if Scheduled Passenger Air Transportation is not considered, Kentucky is expected to add Aerospace & Aviation jobs in the near future; thus, if job losses in this industry can be stabilized, Kentucky could see Aerospace & Aviation employment growth.

While earnings vary significantly by industry, every Aerospace & Aviation industry cluster with sufficient data in Kentucky provides worker earnings that are higher than the state average of $51,669. However, the two highest-paying industries, NAICS 336412—Aircraft Engine and Engine Parts Manufacturing and NAICS 488111—Air Traffic Control have seen job losses over the past ten years. Furthermore, Aircraft Engine and Engine Parts Manufacturing is expected to see its job losses continue over the next five years, further diminishing high-paying jobs.

18 Emsi 2016.3. Jobs are based on 6-Digit NAICS industries.

Table 5: Detailed Industry Jobs and Growth[19]

NAICS	Description	2016 Jobs	2006-2016 Growth	2016 – 2021 Forecasted Growth	2016 Total Earnings Per Worker
481111	Scheduled Passenger Air Transportation	1,870	(5,776)	(1,798)	$82,422
488190	Other Support Activities for Air Transportation	1,729	1,090	392	$85,713
336411	Aircraft Manufacturing	1,302	(97)	(18)	$83,903
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	886	734	192	$76,431
336412	Aircraft Engine and Engine Parts Manufacturing	835	(16)	(130)	$114,161
488119	Other Airport Operations	427	194	63	$62,615
481212	Nonscheduled Chartered Freight Air Transportation	282	212	315	$81,969
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	93	68	29	$75,378
481211	Nonscheduled Chartered Passenger Air Transportation	89	(86)	(38)	$69,759
481112	Scheduled Freight Air Transportation	40	Insf. Data	35	$71,152
488111	Air Traffic Control	15	(1)	0	$123,853
611512	Flight Training	14	(44)	Insf. Data	$68,163
333314	Optical Instrument and Lens Manufacturing	<10	Insf. Data	Insf. Data	Insf. Data
481219	Other Nonscheduled Air Transportation	<10	Insf. Data	Insf. Data	Insf. Data
336414	Guided Missile and Space Vehicle Manufacturing	0	0	0	$0
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	0	0	0	$0
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	0	0	0	$0
Total		**7,584**	**(3,711)**	**(969)**	**$84,843**

Table 6 analyzes industries based on location quotients and competitive effects; it is sorted by each industry's location quotient. As explained above, location quotient provides a measure of each region's concentration of jobs in specific industries. Of the 17 industries included in Kentucky's Aerospace & Aviation cluster, only two have location quotients higher than 1.0. This means that Kentucky has a lower

19 Emsi 2016.3. Jobs are based on 6-Digit NAICS industries.

concentration of jobs than the U.S. average in most Aerospace & Aviation industries. The two exceptions are NAICS 481212—Nonscheduled Chartered Freight Air Transportation and NAICS 488190—Other Support Activities for Air Transportation, with location quotients of 2.46 and 1.22, respectively. These industries also have positive figures for competitive effect, meaning that they have added jobs at a higher rate in Kentucky than elsewhere in the U.S. This contrasts with statewide Aerospace & Aviation trends over the past 5 years, during which competitive effect has been negative.

Table 6: KY Job Concentration by Detailed Industry[20]

NAICS	Description	2016 Location Quotient	Competitive Effect, 2001-2016	Competitive Effect, 2011-2016	2001 Jobs	2016 Jobs
481212	Nonscheduled Chartered Freight Air Transportation	2.46	169	192	119	282
488190	Other Support Activities for Air Transportation	1.22	983	718	544	1,729
336412	Aircraft Engine and Engine Parts Manufacturing	0.81	(264)	(226)	1,341	835
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	0.62	885	508	<10	886
336411	Aircraft Manufacturing	0.43	872	(88)	446	1,302
488111	Air Traffic Control	0.41	11	(6)	<10	15
488119	Other Airport Operations	0.39	48	7	276	427
481111	Scheduled Passenger Air Transportation	0.34	(4,061)	(2,165)	7,856	1,870
481112	Scheduled Freight Air Transportation	0.24	22	25	22	40
481211	Nonscheduled Chartered Passenger Air Transportation	0.22	(104)	(22)	220	89
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	0.06	83	0	12	93
611512	Flight Training	0.06	(137)	(12)	178	14
481219	Other Nonscheduled Air Transportation	0.03	(107)	(6)	87	<10
333314	Optical Instrument and Lens Manufacturing	0.00	(41)	1	60	<10
336414	Guided Missile and Space Vehicle Manufacturing	0.00	0	0	0	0
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	0.00	0	0	0	0
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	0.00	0	0	0	0
Total			**(1,641)**	**(1,076)**	**11,171**	**7,584**

20 Emsi 2016.3. Jobs are based on 6-Digit NAICS industries.

As Table 7 demonstrates, 84% of Kentucky's 2013 Aerospace & Aviation Gross Regional Product (GRP) came from just four industries. Aircraft Manufacturing and Air Transportation contribute heavily to Aerospace & Aviation GRP, and the Scheduled Passenger Air Transportation industry alone contributes over two-thirds of Kentucky's Aerospace & Aviation-based tax revenues—a cause for concern if this industry continues to decline. Air Transportation-related industries, on the other hand, are the only industries in the Aerospace & Aviation cluster that use subsidies; however, these subsidies are minimal compared to Air Transportation contributions to GRP. On the whole, it should be noted that Aerospace Products and Aviation Services industries account for only 0.53% of Kentucky's GRP; in comparison, these industries comprise 1.36% of U.S. GDP.[21]

Table 7: Industry Contribution to KY Gross Regional Product, 2013 (In millions) [22]

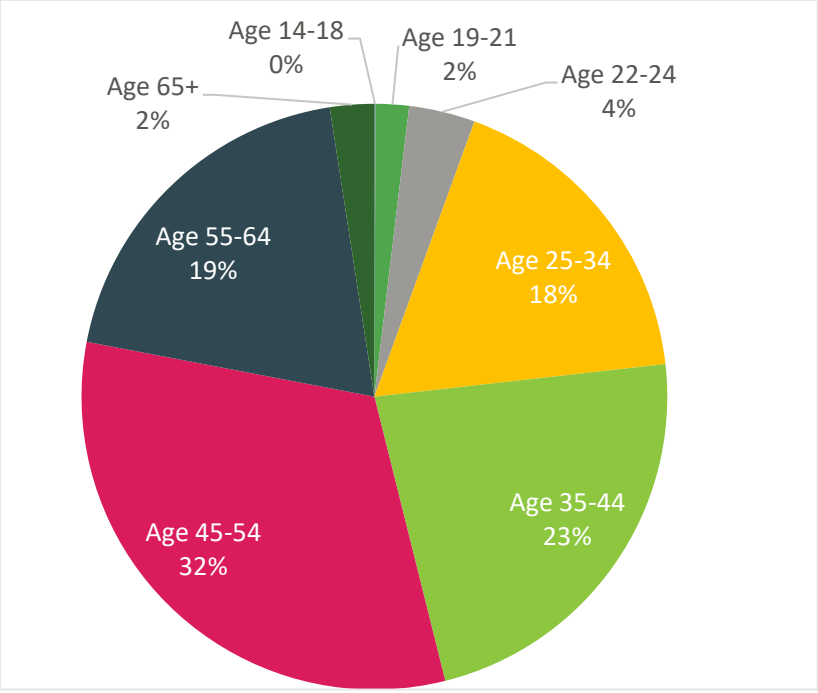
NAICS	Industry	Earnings	Property Income	Taxes	Subsidies	GRP
481111	Scheduled Passenger Air Transportation	$180.2	$64.4	$69.9	($2.2)	$312.4
336411	Aircraft Manufacturing	$123.8	$63.9	$1.7	$0.0	$189.5
336412	Aircraft Engine and Engine Parts Manufacturing	$98.2	$55.5	$3.5	$0.0	$157.2
488190	Other Support Activities for Air Transportation	$103.3	$23.9	$3.1	$0.0	$130.3
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	$33.5	$25.8	$1.4	$0.0	$60.7
488119	Other Airport Operations	$21.8	$4.8	$0.6	$0.0	$27.2
481212	Nonscheduled Chartered Freight Air Transportation	$14.2	$4.7	$5.2	($0.2)	$23.9
481211	Nonscheduled Chartered Passenger Air Transportation	$12.0	$4.2	$4.5	($0.0)	$20.6
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	$4.2	$2.7	$0.1	$0.0	$7.1
481112	Scheduled Freight Air Transportation	$2.9	$1.0	$0.9	($0.0)	$4.8
488111	Air Traffic Control	$2.4	$0.4	$0.1	$0.0	$2.8
611512	Flight Training	$1.6	$0.1	$0.0	$0.0	$1.7
333314	Optical Instrument and Lens Manufacturing	$0.6	$0.0	$0.0	$0.0	$0.6

21 Emsi 2016.3. Jobs are for workers in 6-digit NAICS industries. Employment includes only the targeted Aviation Services industries.
22 Ibid.

NAICS	Industry	Earnings	Property Income	Taxes	Subsidies	GRP
481219	Other Nonscheduled Air Transportation	$0.3	$0.1	$0.1	($0.0)	$0.5
336414	Guided Missile and Space Vehicle Manufacturing	$0.0	$0.0	$0.0	$0.0	$0.0
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	$0.0	$0.0	$0.0	$0.0	$0.0
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	$0.0	$0.0	$0.0	$0.0	$0.0
Total		**$598.9**	**$251.5**	**$91.2**	**($2.5)**	**$939.2**

Aerospace & Aviation Employment Characteristics

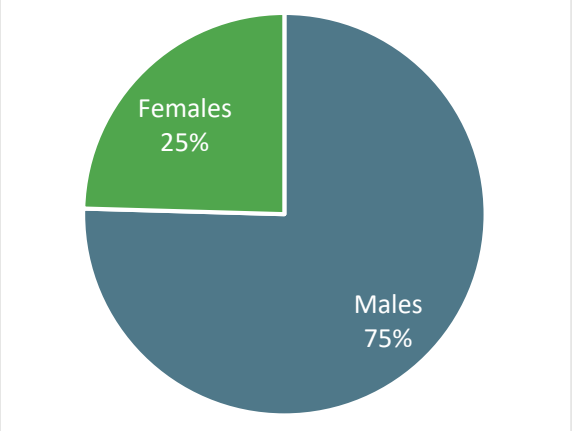
Figure 7: Kentucky Aerospace & Aviation Employment by Age[23]



Kentucky's Aerospace Products and Aviation Services workers differ from Kentucky's total workforce in two ways. First, there is a particularly large concentration of 45 to 64 year olds—51% of Aerospace & Aviation workers are in this age group, but just 38% of Kentucky's total workforce is in this group.[24] This means that a large percentage of workers may be aging out of the Aerospace & Aviation workforce over the next 10 to 15 years.

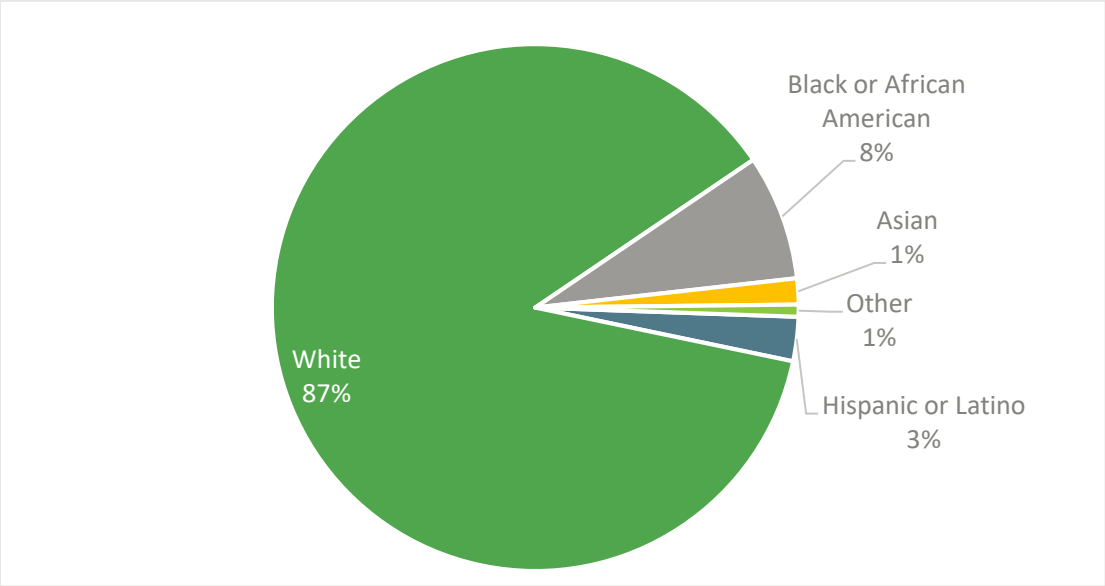
23 Emsi 2016.3. Jobs are for workers in 6-digit NAICS industries. Industry Overview.
24 Ibid.

Figure 8: Kentucky Aerospace & Aviation Industry Employee Gender Distribution[25]



Second, Kentucky's Aerospace & Aviation workers are 75% male. This is a significantly higher proportion of male workers than Kentucky's ratio for all industries, 52.5%. This is also higher than the national average for these industries, as 70% of Aerospace & Aviation workers nationwide are male.[26] Where Aerospace & Aviation workers do not differ from the rest of the state is by race and ethnicity. In Aerospace & Aviation industries, 87% of workers are white, while 86% of workers across all Kentucky industries are white.[27]

Figure 9: Kentucky A&A Employees by Race and Ethnicity[28]



Exports for Aerospace Industries

While Kentucky is not typically associated with the traditional leaders in Aerospace & Aviation, it ranks among the top three in total Aerospace exports. This export data was compiled by analyzing U.S. Census data at the four-digit NAICS level. The four-digit NAICS code that this data is based on is 3364, which covers

25 Emsi 2016.3. Jobs are for workers in 6-digit NAICS industries. Industry Overview
26 Ibid.
27 Ibid.
28 Ibid.

all industries that are producing Aerospace exports. There are three main industries in Kentucky under the 3364 NAICS code that produce almost all of the state's Aerospace exports. These industries are Aircraft Manufacturing, Aircraft Engines and Engine Parts Manufacturing, and Other Aircraft Parts and Auxiliary Equipment Manufacturing. In Kentucky, these industries' total exports combined sum to $10,846,337,959. This puts Kentucky second, behind only Washington, which is impressive considering Washington's large export figure primarily can be attributed to Boeing. Kentucky ranks higher than California, which is known as a perennial leader in Aerospace manufacturing. This export data helps illustrate that Kentucky currently plays a large role in the Aerospace industry.

Table 8: Aerospace Export Ranking by State[29]

State	Rank	Amount Exported (USD)
Washington	1	$46,616,178,788
Kentucky	**2**	**$10,846,337,959**
California	3	$10,036,253,532
Texas	4	$8,384,079,734
Georgia	5	$6,634,332,638
Connecticut	6	$6,059,745,131
Florida	7	$5,956,875,834
South Carolina	8	$5,665,740,530
Ohio	9	$4,981,777,077
Arizona	10	$3,977,042,056
North Carolina	11	$2,621,446,316
Kansas	12	$2,060,359,907

Aerospace Products export data can be further analyzed to illustrate where the majority of Kentucky's Aerospace exports are going. More than half of Kentucky's Aerospace exports go to Europe, while 25% go to Asia. In comparison, the destination of U.S. exports is nearly the opposite. 46% of U.S. Aerospace exports go to Asia, and only 35% go to Europe. Further, the percentage of Kentucky's exports going to South and Central America is twice that of the U.S. (17% vs. 7%). These data suggest that Kentucky should focus in particular on Europe, as the state is capitalizing on their demand for Aerospace products.

Table 9: Export Location by Continent (Kentucky Compared to the U.S.)[30]

Export Location	Kentucky	United States
Europe	53%	35%
Asia	25%	46%
South/Central America	17%	7%
North America	5%	8%
Australia and Oceania	<1%	2%
Africa	<1%	2%

The data from Table 9 is illustrated graphically in Figure 10.

29 U.S. Census Bureau, Economic Indicators Division. (2016) State Exports by NAICS Commodities: NAICS 3364. Retrieved from USA Trade Online.
30 Ibid.

Figure 10: Export Location by Continent (Kentucky Compared to the U.S.)[31]

Kentucky's Aerospace Product export data can be even more deeply analyzed in terms of the countries where the state is exporting. Table 10 lists the countries that make up the top 15 in terms of exports for Kentucky. Compared to the United States, Kentucky's exports are more concentrated in a few countries: 24% of Kentucky's exports go to the United Kingdom (U.K.), 22% to France, 17% to Brazil, 9% to China, and 5% to Singapore. This means that 74% of Kentucky's exports are concentrated in the top five countries of export. In contrast, the distribution of countries receiving exports from the U.S. is much broader. The top five countries of export for the U.S. (China, UK, France, Canada, and Japan) make up only 38% of the nation's total exports.

Table 10: Location of Export by Country (Kentucky Compared to the U.S.)[32]

Location of Export	Kentucky	United States
France	23.9%	8.1%
United Kingdom	21.5%	8.2%
Brazil	16.5%	3.3%
China	7.4%	10.7%
Singapore	5.1%	3.3%
Germany	4.3%	4.5%
Canada	4.2%	5.4%
Malaysia	3.3%	0.7%
Japan	3.2%	5.9%
Netherlands	2.3%	1.9%
Hong Kong	2.2%	1.0%

31 U.S. Census Bureau, Economic Indicators Division. (2016) State Exports by NAICS Commodities: NAICS 3364. Retrieved from USA Trade Online.
32 Ibid.

Location of Export	Kentucky	United States
Korea, South	1.1%	4.2%
Taiwan	0.7%	2.8%
Mexico	0.6%	2.4%
Italy	0.6%	0.9%
All Other Countries	3.1%	36.8%

Company-Based Metrics on Aerospace & Aviation Industries

As described in the introduction, identification of individual establishments that are part of Kentucky's core Aerospace & Aviation cluster was a separate, but parallel, process from that of the industry-level analysis. A thorough overview of the methodology for creating the list of Aerospace & Aviation establishments is provided in Appendix A. This process revealed that 633 establishments throughout the state perform Aerospace Product and/or Aviation Services activities. Each of these establishments is shown on the first map in Appendix B. Notably, company-based metrics discussed in this section do not include the 1,549 establishments that may or may not perform Aerospace & Aviation activities. The map of "maybe" cluster establishments is also shown in Appendix B. In both maps, establishments are broken out into eight Aerospace & Aviation categories, based on their industry characteristics.

These categories are as follows:

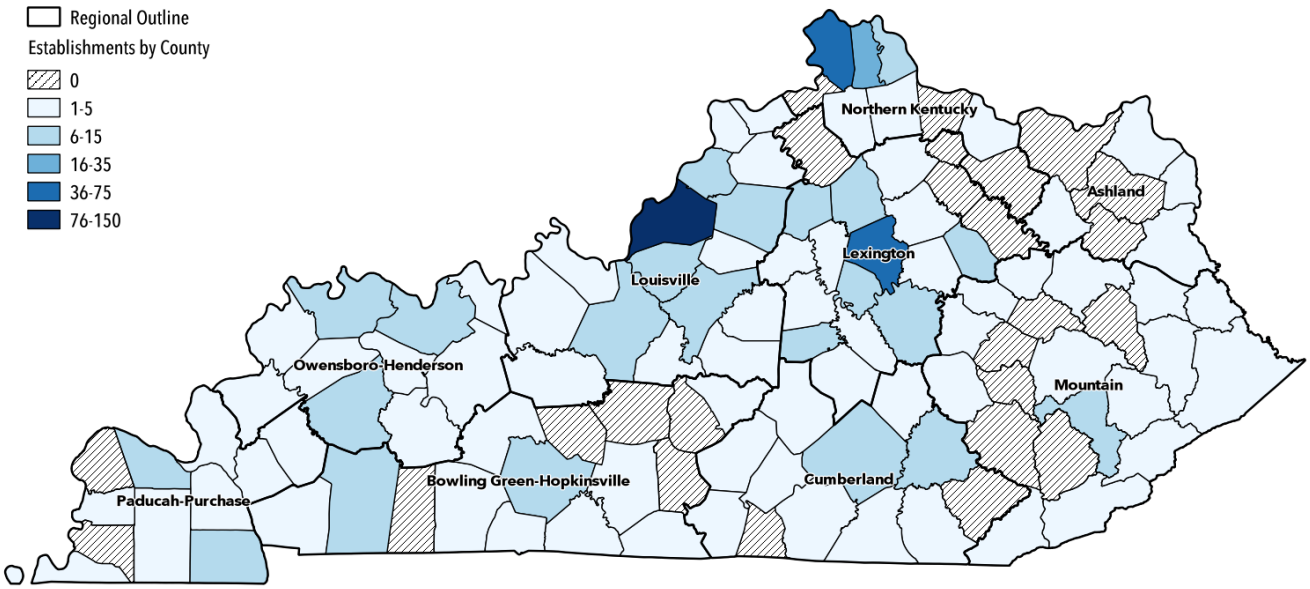
- A&A Services
  - Aerospace & Aviation-specific business service and education providers
- Air Operations
  - Airline and airport operations or administration
- Business Services
  - Business services that are not A&A specific (but the company has still been linked to A&A)
- Engineering & R&D
  - Engineering, Research, and Development related to A&A
- Manufacturing
  - Manufacturing of A&A parts or products
- Suppliers & Maintenance
  - Suppliers: wholesale/retail trade of A&A parts
  - Maintenance: aircraft-related maintenance
- Transportation & Logistics
  - Transportation that is external to administration of the airport itself (does not include passenger planes), and shipping of all forms
- All Other
  - Miscellaneous construction, extraction, or environmental industries

Businesses in each of these categories are spread throughout the state, but they are most heavily concentrated in the Northern Kentucky Region and the population centers of Louisville and Lexington.

The county-level maps that follow make even clearer the concentration of Aerospace & Aviation activities in specific geographic regions. These maps display establishment-level statistics from the Aerospace &

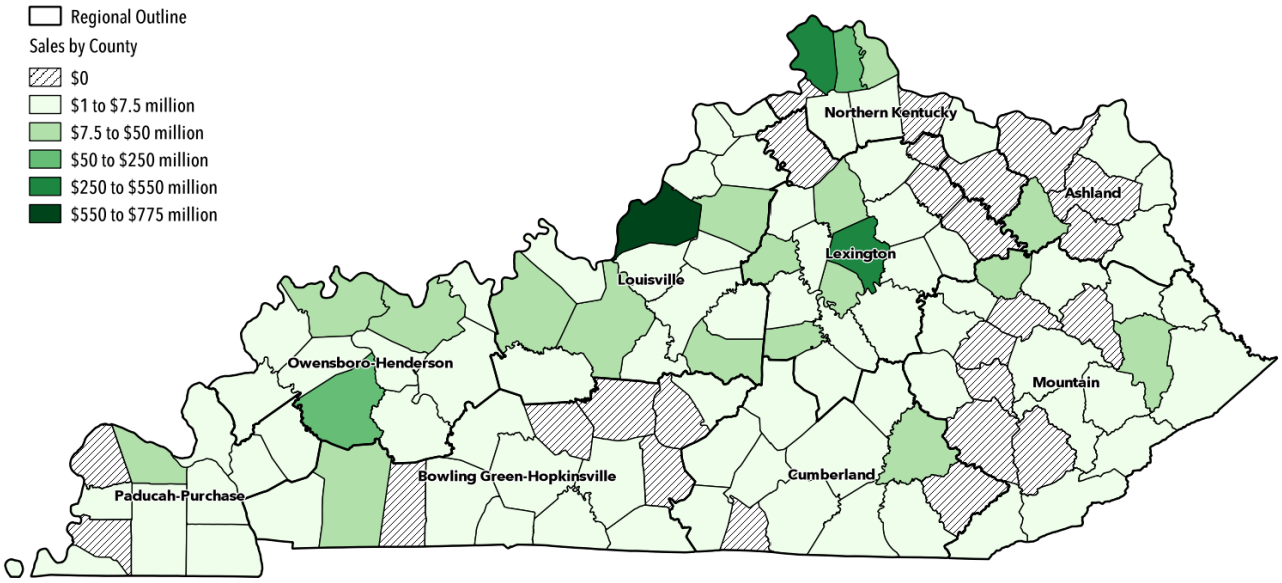
Aviation cluster, aggregated for each county in Kentucky. As the first map demonstrates, 95 of Kentucky's 120 counties contain at least one Aerospace & Aviation-related firm. However, Jefferson County (Louisville) leads with 150 establishments in the cluster or 23.7% of the cluster's establishments. Conversely, Aerospace & Aviation establishments in the Ashland and Mountain Regions are sparse, with only one county between the two regions, Perry County, having more than 5 establishments.[33]

Kentucky Aerospace and Aviation Cluster
Number of Establishments by County



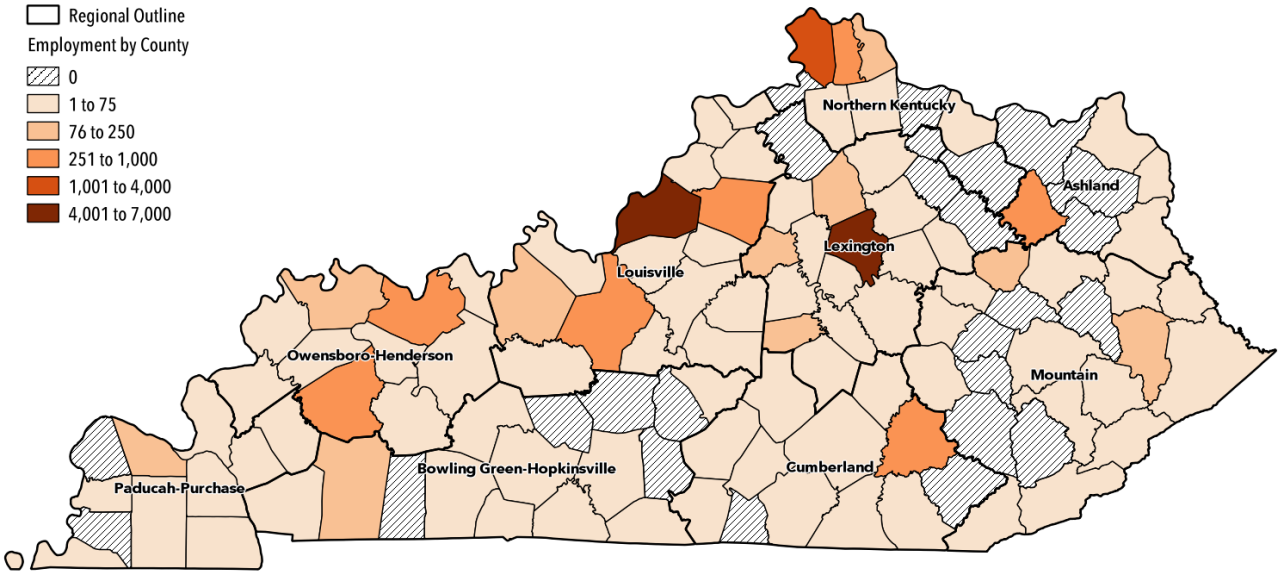
[33] All maps in this section are from TPMA analysis of BDZ and USA Spending data.

Kentucky Aerospace and Aviation Cluster
2013 Establishment-Level Sales by County



A similar picture is painted by the establishment-level sales map. Once again, the Louisville, Lexington, and Northern Kentucky regions lead in Aerospace & Aviation establishment sales. However, there is also a reasonably large concentration of high-sales establishments in the Owensboro-Henderson Region, with three counties having more than $35 million in aggregate sales. Conversely, only three counties in the Paducah-Purchase, Cumberland, and Ashland regions have more than $7.5 million in aggregate A&A sales.

Kentucky Aerospace and Aviation Cluster
2013 Establishment-Level Employment



Lastly, the county-level Aerospace & Aviation cluster employment map looks very similar to the county-level sales map. Once again, Jefferson County leads with 6,929 people employed at firms in the Aerospace & Aviation cluster. Fayette County and Boone County are close behind with 5,258 and 3,077 employees, respectively. Other than these three counties, no Kentucky county has more than 1,000 employees in the Aerospace & Aviation cluster.

Another way to analyze the firms in the Aerospace & Aviation cluster is by their industry characteristics. For each of the establishments identified in the cluster, the most reliable and precise industry information comes from their 8-digit SIC code. Analyzing the distribution of these codes can reveal which collections of companies are having the biggest impact on Kentucky's economy through their Aerospace & Aviation activities.

Employment for the cluster is visualized by SIC code in the tree map in Appendix B. Most of the top employers are in the Air Operations or Manufacturing sectors. Aircraft Electrical Equipment Repair, with just five establishments in the cluster, leads in employment by providing 2,043 jobs. This industry is closely followed by Airports, Business Services, Aircraft Manufacturing, and a collection of aircraft parts, technology, and other manufacturers. As the tree map demonstrates, the cluster's employment is fairly well distributed between the 183 SIC codes associated with the cluster's establishments. It is important to note, however, that for industries that are not exclusively Aerospace & Aviation, the figures shown here only pertain to those firms that *do* perform Aerospace & Aviation production or services. For that reason, an establishment such as a university, which is likely to have high levels of employment across the state, will be confined to just those university establishments that perform Aerospace & Aviation-related R&D.

These breakdowns appear more clearly in the 8-digit SIC table (Table 11) that spans the following pages. This table (sorted by total employment) includes, for every SIC code associated with an establishment in the cluster, the number of establishments in the cluster, their total 2013 sales, and their total 2013 employment. Additionally, it lists the category of Aerospace & Aviation activities that each industry pertains to. By analyzing this table, one can see which industries support the Kentucky Aerospace & Aviation economy through the influence of just a few large firms, and which industries are made up of many smaller establishments. For example, there are 150 establishments listed as Airports, Flying Fields, and Services (sometimes many parties contribute to the operation of an airport), but they contribute less in total sales than the one establishment from the cluster in the Airfoils and Aircraft Engine industry.

Lastly, this table only includes the industries with 50 or more employees in the cluster. Data for industries with less than 50 employees have been aggregated in the final row of the table. The aggregate statistics here are telling: 190 establishments from the cluster are in the industries with fewer than 50 employees, and they combined to bring in $180 million in sales in 2013. This is almost as much as any other single industry in the cluster. Once again, this demonstrates that the Aerospace & Aviation cluster in Kentucky includes a wide variety of industries and firms, providing significant economic value to the state even if activities may be low-employing or obscure.

Table 11: Aerospace & Aviation Cluster Statistics by 8-Digit SIC[34]

SIC8	Industry Name	Total Sales	Total Employment	Total Establishments	A&A Category
76299901	Aircraft electrical equipment repair	$190,266,700	2,043	5	Suppliers & Maintenance
45810301	Airport	$181,938,669	1,392	100	Air Operations
45810000	Airports, flying fields, and services	$77,738,892	1,085	150	Air Operations
73890000	Business services, nec	Unknown	1001	2	Business Services
37210000	Aircraft	$85,830,000	907	7	Manufacturing
37249902	Airfoils, aircraft engine	$121,212,100	800	1	Manufacturing
47310103	Customhouse brokers	$63,000,000	735	1	Transportation & Logistics
35310604	Cranes, nec	$86,000,000	688	1	Manufacturing
37240000	Aircraft engines and engine parts	$101,953,100	662	3	Manufacturing
96210101	Air traffic control operations, government	$0	626	15	Air Operations
38120000	Search and navigation equipment	$78,436,700	555	5	Manufacturing
38120307	Sonar systems and equipment	$77,230,800	502	2	Manufacturing
50820300	General construction machinery and equipment	$116,666,700	500	1	Suppliers & Maintenance
35419910	Numerically controlled metal cutting machine tools	$45,715,000	450	1	Manufacturing
87110000	Engineering services	$19,672,070	401	11	Engineering & R&D
34890000	Ordnance and accessories, nec	$38,000,000	400	1	Manufacturing
35990303	Machine shop, jobbing and repair	$40,288,510	365	6	Manufacturing
28220101	Butadiene rubbers, polybutadiene	$69,300,000	335	1	Manufacturing
73230000	Credit reporting services	$29,450,000	310	1	Business Services
45129903	Helicopter carrier, scheduled	$43,935,200	301	1	Air Operations
36710000	Electron tubes	$30,250,000	275	2	Manufacturing
34410000	Fabricated structural metal	$47,565,116	270	2	Manufacturing

[34] National Employment Time Series Database. (2015). Analysis by Thomas P. Miller & Associates.

16110201	Airport runway construction	$50,149,621	263	2	A&A Services
37280304	Brakes, aircraft	$31,774,959	251	3	Manufacturing
36990000	Electrical equipment and supplies, nec	$38,300,000	250	1	Manufacturing
34440000	Sheet metalwork	$34,751,780	208	4	Manufacturing
34490000	Fabricated structural metal	$24,180,000	204	1	Manufacturing
34620301	Automotive forgings, ferrous: crankshaft, engine, axle, etc.	$33,500,000	200	1	Manufacturing
35590300	Automotive related machinery	$29,166,700	200	1	Manufacturing
45129902	Air passenger carrier, scheduled	$28,348,100	198	10	Air Operations
50750102	Air filters	$43,400,000	155	1	Suppliers & Maintenance
42250000	General warehousing and storage	$11,875,000	150	1	Transportation & Logistics
39650303	Fasteners, hooks and eyes	$33,075,000	147	1	Manufacturing
30890611	Molding primary plastics	$14,576,600	145	3	Manufacturing
87110402	Civil engineering	$12,328,900	135	2	Engineering & R&D
87119903	Consulting engineer	$9,138,241	122	7	Engineering & R&D
51699907	Industrial chemicals	$29,602,300	120	1	Suppliers & Maintenance
45810202	Aircraft servicing and repairing	$42,547,900	108	12	Air Operations
73891700	Brokers' services	$6,250,000	100	1	Business Services
35699912	Jacks, hydraulic	$21,280,000	100	1	Manufacturing
35350000	Conveyors and conveying equipment	$19,022,364	100	1	Manufacturing
17310203	Environmental system control installation	$9,900,000	99	1	All Other
45810200	Aircraft maintenance and repair services	$9,577,600	97	15	Suppliers & Maintenance
30869905	Packaging and shipping materials, foamed plastics	$11,083,300	95	1	Manufacturing
45220102	Flying charter service	$3,933,300	93	7	Air Operations
83310000	Job training and related services	$9,656,500	92	1	Business Services
50120208	Trucks, commercial	$18,000,000	90	1	Transportation & Logistics

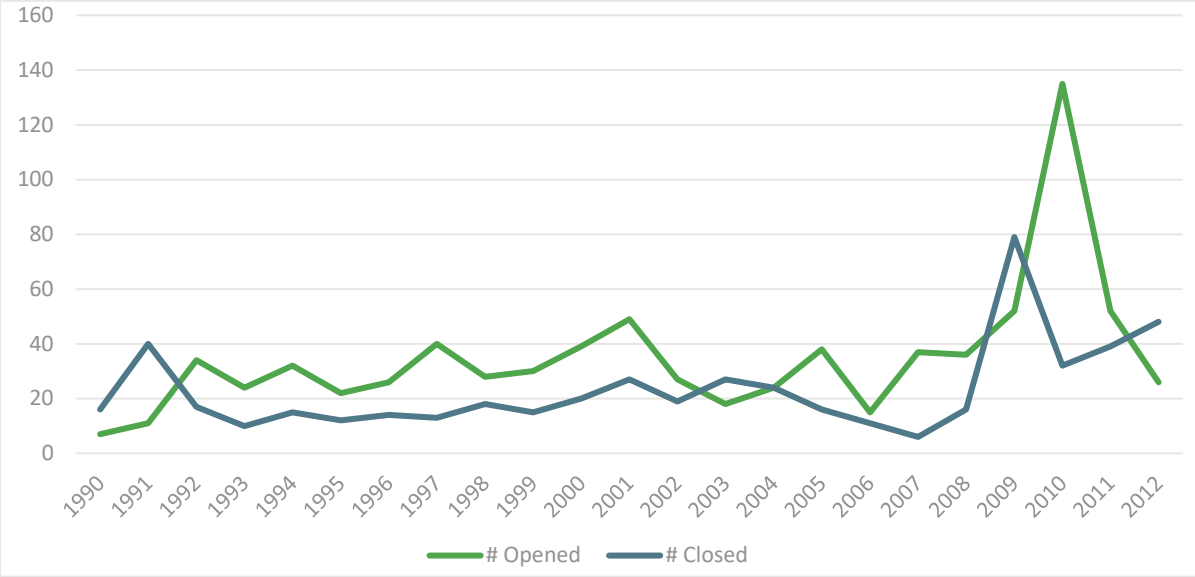
50880303	Aircraft engines and engine parts	$30,342,100	89	3	Suppliers & Maintenance
76992200	Aircraft and heavy equipment repair services	$10,441,700	89	10	Suppliers & Maintenance
30870000	Chemical Manufacturing	$233,749	82	1	Manufacturing
34699904	Electronic enclosures, stamped or pressed metal	$11,378,824	78	1	Manufacturing
45810201	Aircraft cleaning and janitorial service	$3,387,500	75	3	Air Operations
45229901	Charter & Other Nonscheduled Air Transportation Services	$85,255,199	74	2	Air Operations
37619904	Rockets, space and military, complete	$9,800,000	70	1	Manufacturing
34790200	Painting, coating, and hot dipping	$5,600,000	70	1	Manufacturing
73359901	Aerial photography, except mapmaking	$4,300,000	70	1	A&A Services
45819905	Airfreight loading and unloading services	$6,120,000	68	2	Air Operations
50630304	Electronic wire and cable	$14,950,000	65	1	Suppliers & Maintenance
16110200	Surfacing and paving	$10,130,162	60	1	A&A Services
82210102	University	$6,461,400	55	1	Engineering & R&D
76992300	Tool repair services	$6,359,900	53	1	Suppliers & Maintenance
45129901	Air cargo carrier, scheduled	$2,246,400	51	9	Air Operations
34510000	Screw machine products	$11,757,206	51	2	Manufacturing
22980302	Cargo nets	$5,263,200	50	1	Manufacturing
35310814	Winches	$6,900,000	50	1	Manufacturing
50840201	Sewing machines, industrial	$11,842,100	50	1	Suppliers & Maintenance
30890608	Injection molded finished plastics products, nec	Unknown	50	1	Manufacturing
All Other	N/A	$181,462,834	1,586	190	All Other

Company Expansions and Contractions

Establishment-level data can also be used to analyze trends for openings, closings, and expansions in Aerospace & Aviation industries. Figure 11 shows the total number of Kentucky businesses in these industries that have closed and opened each year between 1990 and 2012. Overall, more businesses have opened each year in the past 15 years than have closed. Additionally, despite a spike in closures during the Great Recession in 2009, creation of new Aerospace & Aviation establishments has risen in Kentucky

in recent years. Though some of this may be due to increased data about firm changes for more recent years, it is still an encouraging sign for the state.

Figure 11: Annual Openings and Closings Among Establishments in Aerospace & Aviation Industries, 1990-2012[35]



Company expansions can also provide details about the growth of the Aerospace & Aviation industries in Kentucky in recent years. According to information collected by the Kentucky Cabinet for Economic Development, 30 Aerospace or Aviation companies have chosen to expand over the last three years, and two have chosen to open new locations. Altogether, these decisions were expected to result in 1,183 new jobs and $461,622,044 in new investments in the state. Though estimates have not been made for the number of companies choosing to contract or close their operations during the same time, each of these expansion announcements represent a positive change for Kentucky.

Aerospace & Aviation Supply Chain Analysis

Businesses within clusters typically buy and sell products and services from one another. This is one of the characteristics that defines a cluster. However, the degree of that interconnectedness can vary by the type of cluster and the geography. Instances such as the entertainment cluster in Los Angeles and the Bioscience cluster in the Research Triangle Region of North Carolina are classic examples of strong clusters because there are many contributors and there are few cluster components that do not exist within those regions. Alternatively, a cluster could consist of three companies in a particular region that all produce similar types of automotive parts, and yet the region lacks any automotive assembly companies. Though characteristics of a cluster exist in this situation, the full economic impact of the cluster is muted because of the lack of depth and diversity of businesses. Even the most robust cluster will have gaps or "leakages" due to companies making purchases outside of the state or region. The process of plugging missing gaps in existing supply chains has been dubbed as "import substitution" by economists. This process can include

[35] National Employment Time Series Database. (2015). Analysis by Thomas P. Miller & Associates.

growing or recruiting two kinds of companies: those that provide inputs for existing businesses (upstream suppliers), or those that purchase inputs from existing businesses (downstream purchasers).

For this stage of the analysis, TPMA analyzed the supply chains of the Aerospace & Aviation cluster to determine its current level of interconnectedness and the greatest industry opportunities for reducing leakage by recruiting or growing companies. This analysis is performed using data from the Input-Output Model from Economic Modeling Specialists, International (Emsi). This tool estimates industry inter-connections based on data from the Bureau of Economic Analysis (BEA) on industry production functions, regional employment concentration data, and some transportation immediacy data. The topic of opportunities for increasing economic impact by plugging leakages in the supply chain will be further developed in a separate report, in particular Chapter 7 of the Defense report. For the purposes of this analysis, it is most illuminating to separate the Aerospace Products and Aviation Services groups.

Aerospace Products Supply Chain Leakage Analysis

The Aerospace Products subgroup includes seven 6-digit NAICS categories, five of which have some level of presence in Kentucky in 2016. The Aerospace Products industries spent an estimated $540 million purchasing products and services from other companies; of that amount, 58% were imported from outside of the state, which is equivalent to $316 million dollars-worth of purchases to companies outside of the commonwealth each year.

One fascinating aspect of the Aerospace Products group is that it is heavily dependent on producing inputs for itself. This does not mean that individual companies are selling products to themselves; rather, it means that within a relatively aggregated industry category, there can be multiple companies that sell products to one another. All industries considered, almost 40% of all inputs for the Aerospace Products group are sourced by other companies within the Aerospace Products group. When reflected upon, it is clear how Aerospace companies tend to congregate in certain geographic areas and develop deep supply chains. Businesses that produce highly specialized aircraft parts, such as airfoils and sonar systems, have few other markets to sell their products, outside of the Aerospace sector. This single data point provides strong justification for the state to pursue growing the Aerospace Products group.

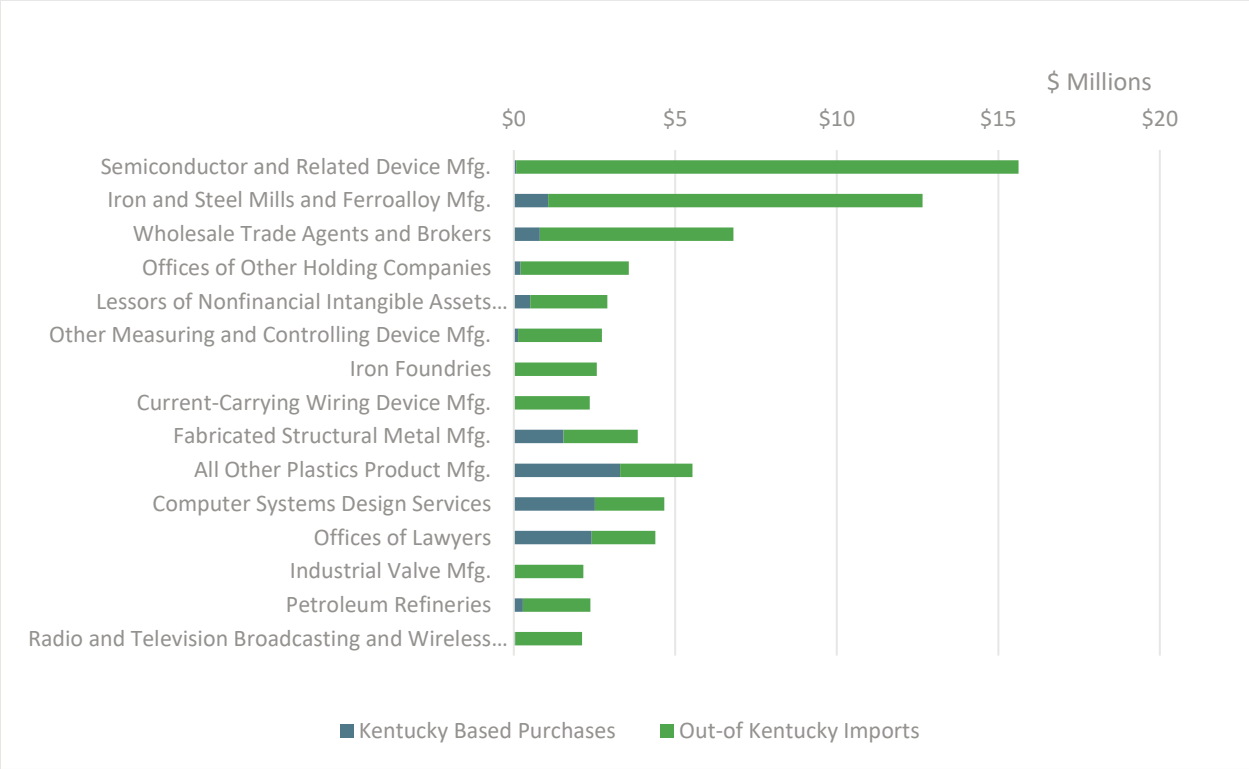
There are other critical industries supporting the Aerospace Products group. Figure 12 shows the top 15 industries from which Aerospace companies in Kentucky are importing products and services from out of state. In some cases, an industry presence actually exists in Kentucky (indicated by the blue bar in the chart), but it is not sufficient to satisfy the demand of the Aerospace Products group. The most notable areas of leakage where the state could have the greatest impact by connecting businesses and possibly expanding operations include a mixture of manufacturing and services, including:

- Iron and Steel Mills and Ferroalloy Mfg.; $11.6 million in imports;
- Wholesale Trade Agents & Brokers; $6.0 million;
- Offices of Other Holding Companies; $3.3 million;
- Lessors of Nonfinancial Intangible Assets (except Copyrighted Works); $2.4 million;
- Fabricated Structural Metal Mfg.; $2.3 million;
- All Other Plastics Product Mfg.; $2.2 million; and
- Computer Systems Design Services; $2.1 million.

Fields where Kentucky has very little or no presence and would have to grow through recruiting businesses include the following:

- Semiconductor and Related Device Mfg.; $15.6 million;
- Other Measuring and Controlling Device Mfg.; $2.6 million;
- Iron Foundries; $2.5 million;
- Current-Carrying Wiring Device Mfg.; $2.3 million;
- Industrial Valve Mfg.; $2.2 million;
- Radio and Television Broadcasting and Wireless Communications Equipment Mfg.; $2.1 million.

Figure 12: Purchases by Aerospace Products Companies in Kentucky[36]



Aviation Services Supply Chain Leakage Analysis

The Aviation Services subgroup includes seven 6-digit NAICS categories, all of which have some level of activity in the state. The Aviation Services industries spent an estimated $568 million purchasing products and services from other companies. The majority of those purchases (62%) are to companies outside of the state, equivalent to an annual loss of $344 million in revenue. Unlike the Aerospace Products group, the Aviation Services group is not highly self-dependent for generating inputs and suppliers. The majority of purchases are from companies in oil, transportation & warehousing, and leasing.

Figure 13 shows the top 15 industries from which Aviation Services industries in Kentucky are importing products and services from out of state. As with the prior chart, industries with some portion of Kentucky-based purchases are illustrated by the blue bars in the chart. The amount of leakage due to imports from

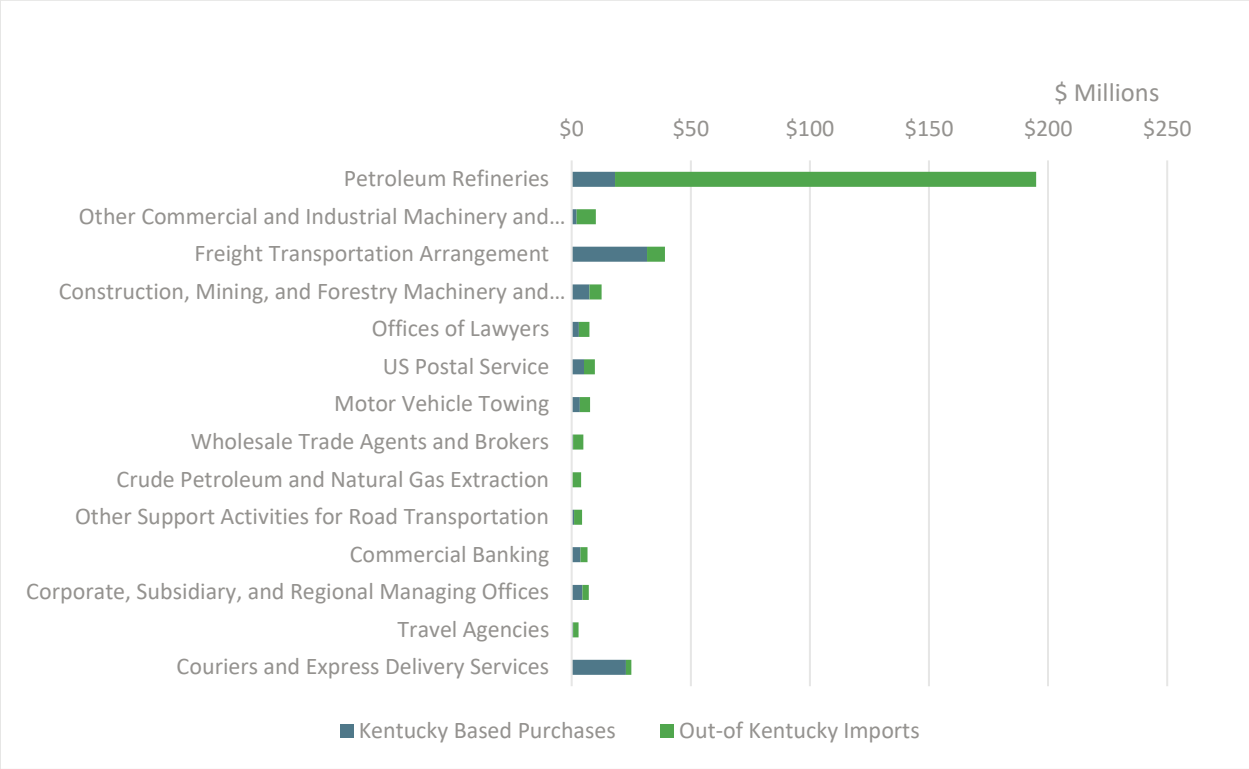
[36] Emsi 2016.3. Industry Purchases Table.

outside of Kentucky is signified by the green bars. Industries where the state could have the greatest impact by connecting existing businesses and possibly expanding operations include:

- Petroleum Refineries; $176.8 million in imports;
- Other Commercial and Industrial Machinery and Equipment Rental and Leasing; $8.1 million;
- Freight Transportation Arrangement; $7.5 million;
- Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing; $5.2 million; and
- Offices of Lawyers, $4.5 million.

Fields where Kentucky has very little or no presence are small enough or inconclusive enough to not be worthy of noting.

Figure 13: Purchases by Aviation Services Companies in Kentucky[37]



[37] Emsi 2016.3. Industry Purchases Table.

Aerospace & Aviation Economic Impact

Industries with strong export orientation, such as Aerospace Products and Aviation Services, have a deep economic impact on their communities. When products are shipped out of the region, whether to other places within the United States or internationally, dollars are brought into the region which allows residents the resources to sustain local-serving industries, such as retail, healthcare, and entertainment. Similarly, strong Aviation Services allows people from outside of Kentucky to visit, bringing in their business and leisure spending. In short, the purpose of economic impact analysis is to show the extent to which a given group of industries has an *impact* on a region, outside of the jobs and earnings that exist within that industry alone.

The impact analysis that follows displays the economic impact and the fiscal (or tax) impact of Aerospace & Aviation on the state of Kentucky. Metrics used to demonstrate that impact include total economic output (or sales), jobs, earnings (or payroll), and taxes on production & imports. Table 12 is broken into several sections for each subgroup, as follows:

- **Direct impact** - these values are the same as those shown elsewhere in this chapter and are placed here to emphasize the magnitude of total impact.
- **Multiplier impact** – these values are the added impact appreciated in Kentucky due to the presence of Aerospace Products & Aviation Services.
- **Total impact** – these values are the total of the direct and multiplier effects.
- **Multipliers** – multipliers indicate the degree of impact by dividing total impact by direct impact. They provide a helpful tool for interpreting the magnitude of impact attributable to each subgroup.

The Aerospace & Aviation cluster is responsible for $3.4 billion in economic impact, or 0.8% of the state's economic activity. Aerospace & Aviation supports 17,518 jobs and over $1 billion in employee compensation. The state's economy is highly reliant on these industries to create jobs in other fields outside of Aerospace & Aviation, as indicated by the combined jobs multiplier of 2.19.[38] This means that every one job in Aerospace & Aviation registers an additional 1.19 jobs within the state's economy. These industries do not just create a benefit to those directly working with and for the industries; there are roughly $131 million in federal, state and local taxes attributable to Aerospace & Aviation support services that benefit all members of society. In particular, the state and local component, which totals $109 million, directly benefits the people of Kentucky.

As indicated in the section on exports of Aerospace Products and Aviation Services, the estimated international exports of Aerospace Products from Kentucky in 2015 was over $8.7 billion. The reason the estimated sales value is lower than the value of exports ($3.4 billion compared to $8.7 billion) is that some materials can be exported out of Kentucky without actually being manufactured within the state. The U.S. Census Bureau, which tracks the volume and value of exports by geographic location, attempts to attribute exports to their original point of origin. However, the Census Bureau also grants that this is not

38 For Aerospace products and Aviation services, the jobs multipliers are 2.23 and 2.16, respectively.

an exact science and that in some cases the estimated value of exports could include products that were manufactured elsewhere.[39]

Table 12: Aerospace & Aviation Cluster Economic Impact Statistics[40]

Industry Classification	Jobs	Sales or Economic Output ($ Millions)	Earnings ($ Millions)
----------Direct Impact---------			
Aerospace Products	2,938	$1,160.32	$264.81
Aviation Services	5,078	$1,243.71	$399.80
Cluster Total	8,016	$2,404.04	$664.60
----------Multiplier Impact---------			
Aerospace Products	3,602	$393.84	$157.65
Aviation Services	5,900	$625.13	$247.56
Cluster Total	9,502	$1,018.97	$405.21
----------Total Impact---------			
Aerospace Products	6,540	$1,554.16	$422.46
Aviation Services	10,978	$1,868.84	$647.36
Cluster Total	17,518	$3,423.01	$1,069.82
----------Multipliers---------			
Aerospace Products	2.23	1.34	1.60
Aviation Services	2.16	1.50	1.62
Cluster Total	2.19	1.42	1.61

Table 13: Fiscal Impact of Aerospace & Aviation Cluster[41]

Industry Classification	Local	State	Federal	Total Taxes on Production & Imports ($ Millions)
Aerospace Products	$7.60	$7.24	$5.52	$20.36
Aviation Services	$50.49	$43.72	$16.58	$110.79
Cluster Total	$58.09	$50.95	$22.10	$131.14

39 The source for export data, the US Census Bureau's Foreign Trade Statistics, lists the limitations of these data at their website: http://www.census.gov/foreign-trade/guide/sec2.html#state_limitation.

40 Emsi 2016.3. For tables 12 and 13, totals may not precisely match if the listed metrics are summed. This is due to rounding to the nearest 10,000 for display within this table.

41 Emsi 2016.3. For tables 12 and 13, totals may not precisely match if the listed metrics are summed. This is due to rounding to the nearest 10,000 for display within this table.

Kentucky Commission on Military Affairs &
the Commonwealth of Kentucky

Chapter 2: Business Costs & Opportunities

Key Findings

This chapter analyzes Kentucky's opportunities to meet the needs of businesses in the Aerospace & Aviation cluster. Six states against which Kentucky can be benchmarked are identified, and the chapter then provides an analysis of cost context benchmarks, including infrastructure, workforce quality, labor costs, research and development access, and business costs. The following are key findings:

- Arizona, Ohio, Alabama, Kansas, Washington, and Indiana were identified as benchmark states for Kentucky, due in part to these states' rankings in employment and/or research and development.
- Infrastructure quality and quantity is important in that it is directly related to business costs. In terms of infrastructure in Kentucky, as compared to competitor states:
    - Kentucky fares well in overall road quality (roads rated as both acceptable and good) among competitor states. In terms of road quantity (road mileage per 1,000 square miles), Kentucky is in the middle of competitor states, trailing Ohio and Indiana.
    - For total freight railroad mileage, Kentucky ranks near the bottom of competitor states, with less total railroad mileage than all but Arizona. However, Kentucky is competitive in Class 1 freight mileage, which is the most profitable type of rail.
    - Among competitor states, Kentucky has the most miles of navigable waterways, at 1,590 miles. Shipping by waterways costs the least of any shipping method, and barge transportation is more energy efficient than other methods. As such, this may be considered a competitive advantage for Kentucky.
    - Bridge condition is an important measure of infrastructure, as poor quality bridges create economic costs by decreasing efficiency. Three competitor states have higher percentages than Kentucky in bridges that are structurally deficient, but Kentucky has the highest percentage of functionally obsolete bridges among competitor states.
    - Kentucky has nine intermodal rail facilities, primarily concentrated in Louisville. Due to this concentration, Louisville has been recognized as one of the top 50 cities in the U.S. for logistics.
- One component of workforce quality and the availability of a skilled workforce is the level of education of the population and the education pipeline. In Kentucky:
    - In terms of overall educational attainment for adults 25 and older, 82% of Kentucky's adults have a high school diploma or higher, which is lower than all other competitor states. The percentage of Kentucky adults with a bachelor's degree or higher is also the lowest of all competitor states.
    - Kentucky's four-year adjusted cohort graduation rate, which measures the percentage of high school students who graduate within four years, compares favorably to competitor states. In 2013, Kentucky's rate was 86%, trailing only Indiana (87%).
    - In terms of postsecondary degrees awarded by Kentucky's institutions of higher education, the state lags most competitor states. Kentucky tended to be in the bottom three among competitor states for associate, bachelor's, master's, and doctoral degrees awarded between 2012 and 2014.
    - Many occupations associated with Aerospace & Aviation industries may require degrees in science, technology, engineering, and math (STEM). In terms of higher education

degrees in STEM fields conferred by Kentucky postsecondary institutions, Kentucky awarded far more undergraduate certificates than competitor states.
    - Kentucky offers a number of registered apprenticeships. While the state is far outpaced in active apprenticeship offerings by Ohio, Washington, and Indiana, Kentucky is on par with Arizona, Kansas, and Alabama.
- Labor costs and opportunities are an important consideration for potential employers. Kentucky has the 9th lowest average annual salary ($40,880) among all 50 states and Washington, D.C. Focusing specifically on the Aerospace & Aviation cluster, Kentucky ranks 40th in Aerospace Products ($88,572) and 15th in Aviation Services ($84,985).
- A strong science and engineering (S&E) enterprise is crucial for the long-term health of the Aerospace & Aviation cluster. However, overall Kentucky does not have a robust S&E enterprise, although there are opportunities to improve. To illustrate:
    - Kentucky has had $84 million in A&A research and development (R&D) from FY12-FY15, ranking 26th among all states.
    - Kentucky has a small pipeline of NASA R&D contracts, but the state's universities are growing in R&D activity. Over the past six years, Kentucky universities have averaged $2.1 million in NASA R&D, compared to $6.2 million in Indiana and $8.7 million in Ohio. Kentucky universities reached a high point in 2016 with $4.3 million in NASA R&D.
    - Kentucky does not have a strong base of private R&D activity in the state. Most A&A-related research in Kentucky is conducted by Lockheed Martin in Lexington.
    - Kentucky could leverage more of its EPSCoR (Experimental Program to Stimulate Competitive Research) funding for A&A research to boost state activities.
- In terms of cost components, Kentucky is in a relatively advantaged position for labor costs. While the state has some disadvantages in certain business or regulatory costs, it is competitive when it comes to the major costs of running a business. The state has the following advantages and disadvantages:
    - Kentucky's electricity prices are lower than the U.S. average and are among the lowest of the six benchmark states. Among benchmark states, Kentucky has one of the lower prices for industrial customers.
    - For the most part, Kentucky enjoys moderate tax rates—the state is ranked 34th nationally in terms of the overall business-friendliness of its tax systems.
    - Kentucky ranks favorably in sales tax (13th in the nation), a higher ranking than all competitor states other than Indiana (10th).
    - Kentucky ranks unfavorably in unemployment insurance tax (48th in the nation) and property taxes (36th in the nation), below all benchmark states. Unlike many states, Kentucky taxes both equipment and inventory, one of only nine states to do so. The inventory tax has a negative impact on the state's A&A industries, particularly in the Aviation Services sector.
    - Kentucky ranks 22nd among all states in the nation in terms of how burdensome its start-up and annual filing regulations are, which is important to new business attraction. Among competitor states, Indiana, Washington, and Alabama rank higher.
    - Kentucky has nearly 10,000 acres that are shovel-ready and build-ready, meaning these sites could be occupied quickly.

- While residential real estate in Kentucky is less expensive than the U.S. as a whole, Kentucky has lower household incomes than the U.S., which may create issues with affordability. Kentucky has 63 counties where home values are more than 2.5 times annual income, indicating potential affordability challenges.
- In terms of key regulatory costs, Kentucky ranks 25th among all states in the nation. Among competitor states, Kentucky ranks fifth, trailing Indiana, Kansas, Alabama, and Arizona. Regulatory costs include workers' compensation insurance; unemployment insurance; short-term disability insurance; effective state minimum wage; state family leave mandates; right-to-work laws; occupational licensing and certification regulations; economic efficiency of state energy regulations; and tort liability.
    - Indiana, Kansas, and Alabama outperformed Kentucky across more than half of the indices used to describe the state regulatory environment.
    - Ohio and Washington had a worse overall regulatory environment ranking, but outperformed Kentucky in areas like occupational licensing and certification requirements and state tort liability environment.
    - In 2017 the Kentucky General Assembly passed Right to Work legislation with the intention of improve the commonwealth's competitiveness and regulatory environment.

Introduction

This chapter provides an overview of Kentucky's opportunities to meet the needs of businesses in the Aerospace & Aviation cluster. First, the chapter identifies six competitor states against which Kentucky can benchmark its assets. The chapter then provides an overview of cost context benchmarks, including infrastructure, workforce quality, labor costs, research and development access, and business costs as compared to these six competitor states.

The analysis focuses first on Kentucky's infrastructure. This section includes information on a variety of components, including road quality, road mileage, freight railroad miles, waterways, bridge conditions, and intermodal facilities. It also links the quality of these assets in a state directly to business costs.

To examine the quality and potential of Kentucky's workforce, the chapter then analyzes Kentucky's talent supply with a review of the state's overall educational attainment and public high school graduation rate as compared to competitor states. Further, this section provides a more in-depth analysis of Kentucky's overall postsecondary completion and STEM degree completion data. These data also are benchmarked against competitor states. Finally, this section provides an analysis of the current education levels of the Aerospace & Aviation workforce in Kentucky. This section complements the analysis that Thomas P. Miller and Associates (TPMA) completed in Chapter 3 of this study, which focuses on the talent demand and supply relative to 30 key occupations in Aerospace & Aviation in Kentucky.

Next, the chapter reviews the overall cost of labor in Kentucky as compared to all other states in the nation, examining average and median wages for all workers. This section also provides an overview of the average and median wages of workers in the Aerospace Products and Aviation Services clusters, both in Kentucky and in competitor states.

As a robust science and engineering enterprise is vital for Aerospace & Aviation growth in Kentucky, the chapter also examines Kentucky's research and development (R&D) status. This section identifies current R&D contracts in Kentucky that are related to Aerospace & Aviation, as well as identifying potential opportunities for expanding R&D funding in this cluster.

Finally, the chapter analyzes direct business costs in the state of Kentucky and benchmarks those against the six competitor states. Specifically, this section reviews utility costs, tax rates, real estate costs, and key regulatory costs associated with doing business in Kentucky as compared to these other states.

Identification of Competitor States

The list of states to compare Kentucky against is based on three factors: the states' employment in Aerospace & Aviation; the states' base of research and development (R&D); and the states' proximity to Kentucky either geographically or roughly in terms of size (i.e., the analysis excludes states such as California or Connecticut that may not be relatable benchmarks).

The goal is to select a set of benchmark states that are ranked highly in either or both employment or R&D, so that the benchmarks can begin to guide the strategic goal of building up Kentucky's employment base or enabling greater investments in R&D. Benchmarking allows for analysis of the differences in policies or conditions that may drive a state's performance in employment or R&D, which in turn contributes to strategic recommendations for Kentucky.

Table 1 identifies the comparison states that were selected for this study, as well as each state's ranking in Aerospace & Aviation employment, research and development, and the reasons why each state was selected as a comparison state. Comparison states are also referenced in other chapters of the study.

Table 1: Competitor States

State	Employment Ranking	R&D Ranking	Justification for Selection
Kentucky	33	32	-
		Competitor States	
Arizona	7	10	Highly-ranked for employment and R&D; Good to have a "best in class"
Ohio	10	11	Highly-ranked for R&D and employment; has geographical proximity to Kentucky
Alabama	22	5	High rank for R&D; lower for employment
Kansas	4	38	Top for employment, not for R&D
Washington	1	16	Top for employment; good for R&D; possible substitute for Kansas
Indiana	16	29	Mid-level rankings; geographical proximity to Kentucky

Comparative Cost Context Benchmarking

Infrastructure

The quality of infrastructure has a direct relation to business costs. Lesser quality and quantity of infrastructure can constrain existing businesses and hinder new business relocation. There are several reasons why infrastructure is important:

- **Network effects**—linking more locations exponentially increases the value and effectiveness of transport.
- **Performance improvements**—reducing cost and time for existing passenger and freight movements increases transport's contribution to economic growth.
- **Reliability**—improves time performance and reduces loss and damage, thus reducing economic drag.
- **Market size**—access to wider markets adds to economies of scale in production, distribution, and consumption, thereby increasing economic growth.
- **Productivity**—transport increases productivity gained from access to a larger and more diverse base of inputs such as raw materials, parts, energy, labor, and broader markets for more diverse outputs.[1]

Road Quality

Road quality impacts the amount of time it takes to deliver goods outside of a region, as well as to ship in needed components and materials. Poor quality roads increase costs, as potholes and rough roads can damage vehicles, leading to higher maintenance costs. Poor quality roads also increase the time and cost

1 The World Bank. (2011). PPIAF Railway Reform: A Toolkit for Improving Rail Sector Performance. Retrieved from https://ppiaf.org/sites/ppiaf.org/files/documents/toolkits/railways_toolkit/ch1_1_3.html

of moving people—whether employees or visitors. Therefore, understanding how Kentucky's roads compare to competitor states is an important part of the value proposition.

Road quality is measured by the International Roughness Index (IRI). The less rough a road is, the higher the quality. According to the pavement condition criteria used in the Highway Performance Monitoring System, an IRI rating of less than 95 indicates "good" ride quality. An IRI rating of less than or equal to 170 indicates "acceptable" ride quality. Table 2 has been simplified from U.S. Department of Transportation data to show, for each state, the percentage of roads rated "good" and the percentage rated "acceptable," with an overall metric for the percentage of roads that rated "acceptable or above."

Of all states in the U.S., New Jersey rated lowest, with 51% of roads rated "acceptable or above." Nevada and South Dakota both had 96% of roads that were "acceptable or above," although Nevada had more roads that were in the category of "good."

Table 2: Road Quality in the United States[2]

State	Acceptable (<170 IRI)	Good (<95 IRI)	IRI of 170 or Less
Alabama	33%	56%	90%
Alaska	36%	38%	75%
Arizona	30%	61%	92%
Arkansas	47%	33%	80%
California	44%	16%	60%
Colorado	43%	35%	79%
Connecticut	41%	16%	58%
Delaware	35%	48%	84%
Florida	20%	74%	94%
Georgia	33%	55%	88%
Hawaii	43%	14%	57%
Idaho	31%	63%	93%
Illinois	40%	40%	79%
Indiana	34%	49%	83%
Iowa	32%	54%	86%
Kansas	20%	71%	91%
Kentucky	45%	46%	91%
Louisiana	37%	38%	75%
Maine	48%	25%	73%
Maryland	34%	42%	76%
Massachusetts	42%	28%	70%
Michigan	24%	65%	89%
Minnesota	31%	58%	90%
Mississippi	41%	34%	75%
Missouri	45%	34%	80%

2 U.S. Department of Transportation, Federal Highway Administration. (2015). Highway Statistics, HM-63 and HM-64. Retrieved from www.fhwa.dot.gov/policyinformation/statistics.cfm

State	Acceptable (<170 IRI)	Good (<95 IRI)	IRI of 170 or Less
Montana	36%	55%	91%
Nebraska	39%	56%	95%
Nevada	32%	64%	96%
New Hampshire	27%	46%	74%
New Jersey	35%	16%	51%
New Mexico	33%	42%	75%
New York	44%	28%	72%
North Carolina	40%	49%	89%
North Dakota	22%	73%	95%
Ohio	38%	48%	87%
Oklahoma	42%	28%	70%
Oregon	37%	52%	89%
Pennsylvania	48%	30%	77%
Rhode Island	48%	12%	60%
South Carolina	51%	37%	88%
South Dakota	36%	60%	96%
Tennessee	30%	63%	93%
Texas	35%	56%	91%
Utah	49%	33%	82%
Vermont	34%	41%	76%
Virginia	50%	30%	79%
Washington	46%	21%	67%
West Virginia	54%	17%	71%
Wisconsin	35%	39%	74%
Wyoming	32%	60%	92%

Table 3 narrows the analysis to Kentucky and its competitor states. Kentucky has 45% "acceptable" roads and 46% "good" roads, for a total of 91% of roads "acceptable or above." Kentucky fares well in overall road quality among competitor states and is on par with Arizona and Kansas. However, when analyzing only the percentage of roads that are "good" quality, Kentucky's 46% is lower than all competitor states except Washington, at 21%.

Table 3: Road Quality in Kentucky and Competitor States[3]

State	Acceptable (<170 IRI)	Good (<95 IRI)	Acceptable or Above
Arizona	30%	61%	92%
Kentucky	45%	46%	91%
Kansas	20%	71%	91%
Ohio	38%	48%	87%
Indiana	34%	49%	83%

3 U.S. Department of Transportation, Federal Highway Administration. (2015). Highway Statistics, HM-63 and HM-64. Retrieved from www.fhwa.dot.gov/policyinformation/statistics.cfm; Analyzed by Fourth Economy Consulting

State	Acceptable (<170 IRI)	Good (<95 IRI)	Acceptable or Above
Washington	46%	21%	67%

Miles of Roads

Just as the square mileage of states varies, so do the miles of road in each state. Table 4 shows the total miles of road in each state, including interstate, principal and minor arterials, major and minor collectors, and local roads.

Table 4: Total Road Mileage in All States[4]

State	Interstate	Other principal and minor arterials	Major and minor collectors	Local	Total
Texas	3,415	33,280	65,154	211,378	313,228
California	2,451	30,002	32,223	110,313	174,989
Illinois	2,185	14,771	22,169	106,583	145,708
Kansas	874	9,688	33,698	96,427	140,687
Minnesota	914	13,686	30,408	93,759	138,767
Missouri	1,379	10,487	25,109	94,925	131,900
Georgia	1,247	14,329	23,037	90,006	128,620
Ohio	1,574	11,253	22,869	87,602	123,297
Michigan	1,244	15,008	24,458	81,431	122,141
Florida	1,495	13,590	14,560	92,442	122,088
Pennsylvania	1,857	13,762	19,847	84,470	119,936
Wisconsin	743	12,910	23,501	77,990	115,145
New York	1,724	14,601	20,737	77,666	114,728
Iowa	782	9,778	31,629	72,240	114,429
Oklahoma	933	8,417	25,490	78,100	112,940
North Carolina	1,255	10,018	17,351	77,579	106,202
Alabama	1,002	9,716	22,386	68,733	101,837
Arkansas	656	7,441	21,061	72,499	101,656
Indiana	1,188	8,758	22,523	65,084	97,553
Tennessee	1,104	9,305	17,994	67,132	95,536
Nebraska	482	8,144	20,772	64,371	93,770
Colorado	952	9,259	16,245	62,109	88,565
North Dakota	571	5,941	11,929	68,637	87,078
South Dakota	679	6,430	19,004	56,446	82,558
Washington	764	8,412	17,292	55,980	82,448
Kentucky	801	6,169	16,562	56,066	79,598

4 U.S. Department of Transportation, Federal Highway Administration. (2015). Highway Statistics, HM-20. Retrieved from www.fhwa.dot.gov/policyinformation/statistics.cfm

State	Interstate	Other principal and minor arterials	Major and minor collectors	Local	Total
Mississippi	700	7,740	15,892	50,784	75,116
Montana	1,192	6,088	16,245	51,408	74,933
Virginia	1,119	8,764	14,394	50,472	74,748
Oregon	730	7,112	18,589	44,798	71,228
New Mexico	1,000	4,963	9,188	55,620	70,772
Arizona	1,168	6,021	8,072	51,178	66,441
South Carolina	851	7,233	15,089	43,059	66,232
Louisiana	926	5,685	9,972	44,844	61,427
Idaho	612	4,249	10,611	32,611	48,082
Utah	937	3,772	8,162	33,384	46,254
Nevada	596	3,471	5,612	30,460	40,139
New Jersey	431	6,391	4,437	28,034	39,293
West Virginia	555	3,498	8,635	26,063	38,750
Massachusetts	575	6,768	4,550	24,478	36,370
Maryland	481	4,110	5,059	22,772	32,422
Wyoming	914	3,671	10,279	14,161	29,024
Maine	367	2,199	5,914	14,401	22,882
Connecticut	346	3,004	3,206	14,918	21,474
New Hampshire	225	1,745	2,642	11,485	16,098
Alaska	1,081	1,571	3,300	9,727	15,680
Vermont	320	1,320	3,119	9,506	14,266
Delaware	41	680	1,039	4,633	6,393
Rhode Island	70	914	887	4,235	6,106
Hawaii	55	824	752	2,800	4,430
District of Columbia	12	286	157	1,047	1,501

Unsurprisingly, Texas has the highest quantity of roads, with 313,228 total miles. The District of Columbia has the least, with Hawaii having the second least. Kentucky is solidly in the middle, with 79,598 miles of road. However, these numbers must be normalized by the total geographic area of the state to determine how well the road network covers the state. Table 5 does this for Kentucky and competitor states by analyzing road mileage per 1,000 square miles.

Table 5: Road Mileage per 1,000 Square Miles in Kentucky and Competitor States[5]

State	Interstate	Other principal and minor arterials	Major and minor collectors	Local	Total
Kentucky	20	153	410	1,387	1,970
Arizona	10	53	71	449	583

5 U.S. Department of Transportation, Federal Highway Administration. (2015). Highway Statistics, HM-20. Retrieved from www.fhwa.dot.gov/policyinformation/statistics.cfm

State	Interstate	Other principal and minor arterials	Major and minor collectors	Local	Total
Ohio	35	251	510	1,954	2,751
Alabama	19	185	427	1,311	1,943
Kansas	11	118	410	1,172	1,710
Washington	11	118	243	785	1,156
Indiana	33	240	618	1,787	2,679

Of the competitor states, Ohio and Indiana have the best coverage in terms of interstates, with 35 miles of interstate per 1,000 square miles in Ohio and 33 miles in Indiana. Kentucky has 20 miles of interstate per 1,000 square miles of territory, comparable to Alabama. Kansas and Washington both have 11 miles, and Arizona has the least developed interstate network. The rankings are similar when considering the total miles of road network coverage, where Kentucky has 1,970 miles of roads per 1,000 square miles.

Freight Railroad Miles

Railways are important to industrial development because they are often a more efficient transportation mode than roads or air. Using rail cuts costs—in the U.S., rail freight is on average 63% more fuel efficient than road transportation.[6] Only water transportation is more fuel efficient, but because rail is less circuitous, shipping via rail is more cost and energy effective. Furthermore, rail can achieve significant economies of scale, especially compared to road transportation, because it can move many tons of freight or passengers at once.

Tables 6 and 7 separate rail by classes and types. Class 1, which includes the majority of rail mileage in the U.S., is defined as having annual carrier operating revenues of $250 million or more in 1991 dollars, according to the Surface Transportation Board.[7] The Association of American Railroads divides non-Class 1 companies into three other categories represented in Tables 6 and 7:

- Regional railroads (those that operate at least 350 miles or make at least $40 million per year).
- Local railroads, which are not regional but engage in line haul service.
- Switching and terminal railroad, which mainly switch cars between other railroads or provide service from other lines to a common terminal.[8]

6 The World Bank. (2011). PPIAF Railway Reform: A Toolkit for Improving Rail Sector Performance. Retrieved from https://ppiaf.org/sites/ppiaf.org/files/documents/toolkits/railways_toolkit/ch1_1_4.html
7 Surface Transportation Board. (n.d.). FAQs. Retrieved from https://www.stb.gov/stb/faqs.html
8 Association of American Railroads. (n.d.). Types of Railrodes. Retrieved from https://www.aar.org/todays-railroads/our-network?t=typesofrailroads.

Table 6: Freight Railroad Mileage (All States)[9]

State	Class I	Regional	Linehaul	Switching and Terminal	Canadian	Total
Alabama	2,255	236	635	68	0	3,194
Alaska	0	506	0	0	0	506
Arizona	1,235	0	259	149	0	1,643
Arkansas	1,677	0	895	126	0	2,698
California	3,919	0	999	377	0	5,295
Colorado	2,018	198	368	78	0	2,662
Connecticut	6	210	148	0	0	364
Delaware	183	0	47	20	0	250
District of Columbia	15	0	0	5	0	20
Florida	1,693	431	774	2	0	2,900
Georgia	3,251	0	1,384	18	0	4,653
Hawaii	0	0	0	0	0	0
Idaho	962	33	481	147	0	1,623
Illinois	5,851	148	649	338	0	6,986
Indiana	2,510	304	1,076	185	0	4,075
Iowa	3,189	364	271	45	0	3,869
Kansas	2,816	1,429	367	243	0	4,855
Kentucky	2,117	270	221	0	0	2,608
Louisiana	2,354	0	515	58	0	2,927
Maine	0	621	493	2	0	1,116
Maryland	557	0	172	29	0	758
Massachusetts	261	529	159	24	0	973
Michigan	1,557	0	1,751	233	1	3,542
Minnesota	3,625	3	651	127	44	4,450
Mississippi	1,614	8	716	114	0	2,452
Missouri	3,399	0	419	139	0	3,957
Montana	2,061	865	274	0	0	3,200
Nebraska	2,567	324	469	15	0	3,375
Nevada	1,192	0	0	0	0	1,192
New Hampshire	0	174	170	0	0	344
New Jersey	189	91	176	525	0	981
New Mexico	1,431	0	96	310	0	1,837
New York	1,758	328	1,231	128	2	3,447
North Carolina	2,335	0	709	214	0	3,258
North Dakota	2,182	766	382	0	0	3,330
Ohio	3,240	433	1,265	350	0	5,288
Oklahoma	2,009	0	968	296	0	3,273
Oregon	1,103	321	843	129	0	2,396
Pennsylvania	2,428	772	1,374	577	0	5,151
Rhode Island	0	19	0	0	0	19
South Carolina	1,948	0	266	97	0	2,311
South Dakota	1,494	74	98	87	0	1,753
Tennessee	1,836	0	751	62	0	2,649
Texas	8,369	0	1,236	864	0	10,469

9 Association of American Railroads. (2015). Railroad Ten-Year Trends. Retrieved from www.aar.org

State	Class I	Regional	Linehaul	Switching and Terminal	Canadian	Total
Utah	1,249	0	59	35	0	1,343
Vermont	0	224	366	0	0	590
Virginia	2,773	0	438	4	0	3,215
Washington	1,735	0	1,272	185	0	3,192
West Virginia	1,855	0	365	6	0	2,226
Wisconsin	2,595	674	180	0	0	3,449
Wyoming	1,851	0	0	9	0	1,860
United States, total	**95,264**	**10,355**	**26,438**	**6,420**	**47**	**138,524**

Due to the sheer size of the state, it is no surprise that Texas has the most miles of rail, with 10,469 miles. The next two states, Illinois and California, each have nearly one half of that amount. Of the entire United States, Kentucky is 28th in the ranking of miles of rail, with 2,608 miles. As with roads, those states that are the smallest in land area also have the least amount of rail; Rhode Island and Hawaii have 19 miles and 0 miles, respectively.

Table 7: Freight Railroad Mileage Kentucky and Competitor States[10]

State	Class I	Regional	Linehaul	Switching and terminal	Canadian	Total
Ohio	3,240	433	1,265	350	0	5,288
Kansas	2,816	1,429	367	243	0	4,855
Indiana	2,510	304	1,076	185	0	4,075
Alabama	2,255	236	635	68	0	3,194
Washington	1,735	0	1,272	185	0	3,192
Kentucky	2,117	270	221	0	0	2,608
Arizona	1,235	0	259	149	0	1,643

Amongst competitor states, Ohio has the most freight rail miles at 5,288. In total mileage, Kentucky is below all competitor states other than Arizona. However, Kentucky is in a similar class as Kansas, Indiana, and Alabama for Class 1 freight miles. Since this type of rail is most profitable, it can be inferred that Kentucky is competitive in the amount of rail within the state.

Waterways

Besides rail, the most efficient way to move freight is via barge on navigable waterways. Shipping by waterways costs the least of any shipping method, and approximately 15% of all freight in the U.S. is shipped by barge.[11]

Barge transportation is also more energy efficient. The measure of energy efficiency in transportation is the amount of energy expended to move a certain weight of load over a given distance, expressed as BTUs

10 Association of American Railroads. (2015). Railroad Ten-Year Trends. Retrieved from www.aar.org
11 U.S. Department of Transportation. Maritime Administration. (1994). Environmental Advantages of Inland Barge Transportation. Retrieved from http://www.port.pittsburgh.pa.us/Modules/ShowDocument.aspx?documentid=345

required to move one ton one mile (a ton-mile). Water transport expends 433 BTU per ton-mile versus 696 for rail.[12]

Table 8 shows the 39 states and the District of Columbia with inland waterways. Overall, there are approximately 25,000 miles of navigable inland waterways in the U.S. Alaska has the most, with 5,500 miles, followed by Louisiana, with 2,820, and third is Arkansas with 1,860. Kentucky follows, with 1,590 miles of waterway. New Hampshire and the District of Columbia are tied for the least with 10 miles each, while Rhode Island has the third least with 40.

Table 8: Inland Waterways in the United States[13]

State	Miles
Alabama	1,270
Alaska	5,500
Arkansas	1,860
California	290
Connecticut	120
Delaware	100
District of Columbia	10
Florida	1,540
Georgia	720
Idaho	110
Illinois	1,100
Indiana	350
Iowa	490
Kansas	120
Kentucky	1,590
Louisiana	2,820
Maine	70
Maryland	530
Massachusetts	90
Minnesota	260
Mississippi	870
Missouri	1,030
Nebraska	320
New Hampshire	10
New Jersey	360
New York	390
North Carolina	1,150
Ohio	440
Oklahoma	150
Oregon	680
Pennsylvania	260
Rhode Island	40

12 U.S. Department of Transportation. Maritime Administration. (1994). Environmental Advantages of Inland Barge Transportation. Retrieved from http://www.port.pittsburgh.pa.us/Modules/ShowDocument.aspx?documentid=345

13 U.S. Army Corps of Engineers. Waterborne Commerce Statistics Center. National Waterway Network. Personal communication. Data as of July 2015.

State	Miles
South Carolina	480
South Dakota	80
Tennessee	950
Texas	830
Virginia	670
Washington	1,060
West Virginia	680
Wisconsin	230
United States, total	**25,000**

Among the competitor states, Kentucky has the most miles of navigable waterways, with 1,590 miles. Alabama is close behind, with 1,270, and Washington rounds out the top three with 1,060. Arizona has the least, with 0, preceded by Kansas, with 120.

Table 9: Inland Waterways in Kentucky and Competitor States[14]

State	Miles
Kentucky	1,590
Alabama	1,270
Washington	1,060
Ohio	440
Indiana	350
Kansas	120
Arizona	0

Bridge Conditions

In the United States, 61,030 bridges out of the 607,013 bridges are currently rated as structurally deficient. This equates to 10.1 percent of the bridge stock in the nation.[15] Structurally deficient bridges create economic costs because restrictions that limit lanes traveled or weight carried may be imposed upon them, thereby decreasing efficiency and lowering costs. At the most extreme, structurally deficient bridges may collapse, leading to loss of human life, property destruction, and lost efficiencies in traffic patterns during the time of rebuilding.

Table 10 shows the number and percentage of bridges in each state that are functionally obsolete and structurally deficient. There is an important distinction between the two; functionally obsolete is a status used to describe a bridge that is no longer, by design, functionally adequate for its task, such as not having enough lanes to accommodate traffic flow. A functionally obsolete bridge may be safe to use, and structurally sound, but may cause traffic jams or prohibit oversized vehicles; therefore, it is not functioning as effectively. Structurally deficient is a status used to describe a bridge that has one or more structural

14 U.S. Army Corps of Engineers. Waterborne Commerce Statistics Center. National Waterway Network. Personal communication. Data as of July 2015.
15 U.S. Department of Transportation. Federal Highway Administration. Office of Bridge Technology. (2015). National Bridge Inventory. Functional Classification of Bridges by Highway System. Retrieved from www.fhwa.dot.gov/bridge/nbi.cfm

defects that require attention. This status does not indicate the severity of the defect but rather that a defect is present.[16]

In the U.S. 10.1% of bridges are structurally deficient, while 13.8% are functionally obsolete. Rhode Island had the highest rate of structurally deficient bridges, at 23.1%, and Pennsylvania had the second highest, with 22.5%. Nevada had the lowest rate of structurally deficient bridges, with 1.8% and Florida had the second lowest with 2%. The District of Columbia had the highest rate of functionally obsolete bridges, with 64.8%. Massachusetts had the second highest rate of functionally obsolete bridges with 43.3%. Kentucky's bridges are 8.4% structurally deficient and 22.9% functionally obsolete.

Table 10: Bridge Condition in the United States[17]

State	All Bridges	Structurally Deficient	Functionally Obsolete	Structurally Deficient	Functionally Obsolete
Alabama	16,057	1,388	2,144	8.6%	13.4%
Alaska	1,526	153	198	10.0%	13.0%
Arizona	8,031	256	684	3.2%	8.5%
Arkansas	12,805	861	1,994	6.7%	15.6%
California	25,315	2,501	4,306	9.9%	17.0%
Colorado	8,666	529	859	6.1%	9.9%
Connecticut	4,071	373	975	9.2%	23.9%
Delaware	863	48	123	5.6%	14.3%
District of Columbia	253	14	164	5.5%	64.8%
Florida	12,012	243	1,760	2.0%	14.7%
Georgia	14,777	785	1,623	5.3%	11.0%
Hawaii	1,137	61	422	5.4%	37.1%
Idaho	4,427	405	471	9.1%	10.6%
Illinois	26,535	2,216	1,971	8.4%	7.4%
Indiana	19,017	1,902	2,201	10.0%	11.6%
Iowa	24,293	5,022	1,183	20.7%	4.9%
Kansas	25,046	2,416	1,813	9.6%	7.2%
Kentucky	14,189	1,191	3,253	8.4%	22.9%
Louisiana	12,959	1,837	1,944	14.2%	15.0%
Maine	2,419	364	432	15.0%	17.9%
Maryland	5,289	317	1,104	6.0%	20.9%
Massachusetts	5,137	459	2,224	8.9%	43.3%
Michigan	11,064	1,295	1,754	11.7%	15.9%
Minnesota	12,884	830	363	6.4%	2.8%
Mississippi	17,088	2,275	1,290	13.3%	7.5%
Missouri	24,375	3,310	3,145	13.6%	12.9%
Montana	5,251	400	514	7.6%	9.8%
Nebraska	15,373	2,653	986	17.3%	6.4%
Nevada	1,896	34	215	1.8%	11.3%
New Hampshire	2,463	324	451	13.2%	18.3%

16 National Bridges. (n.d.) A Guide to Important National Bridge Inventory Terms. Retrieved from http://nationalbridges.com/guide-to-ratings

17 U.S. Department of Transportation. Federal Highway Administration. Office of Bridge Technology. (2015). National Bridge Inventory. Functional Classification of Bridges by Highway System. Retrieved from www.fhwa.dot.gov/bridge/nbi.cfm

State	All Bridges	Structurally Deficient	Functionally Obsolete	Structurally Deficient	Functionally Obsolete
New Jersey	6,490	595	1,673	9.2%	25.8%
New Mexico	3,951	284	359	7.2%	9.1%
New York	17,332	2,012	4,733	11.6%	27.3%
North Carolina	18,097	2,199	3,135	12.2%	17.3%
North Dakota	4,424	701	243	15.8%	5.5%
Ohio	26,972	2,080	4,452	7.7%	16.5%
Oklahoma	23,132	4,216	1,575	18.2%	6.8%
Oregon	8,011	439	1,419	5.5%	17.7%
Pennsylvania	22,430	5,049	4,388	22.5%	19.6%
Rhode Island	753	174	255	23.1%	33.9%
South Carolina	9,336	1,031	891	11.0%	9.5%
South Dakota	5,872	1,174	238	20.0%	4.1%
Tennessee	20,035	1,083	2,863	5.4%	14.3%
Texas	52,898	1,127	8,867	2.1%	16.8%
Utah	3,014	102	317	3.4%	10.5%
Vermont	2,745	206	676	7.5%	24.6%
Virginia	13,800	1,120	2,454	8.1%	17.8%
Washington	8,107	382	1,711	4.7%	21.1%
West Virginia	7,163	960	1,541	13.4%	21.5%
Wisconsin	14,109	1,212	759	8.6%	5.4%
Wyoming	3,124	422	284	13.5%	9.1%
United States, total	**607,013**	**61,030**	**83,399**	**10.1%**	**13.7%**

Of the competitor states, Ohio has the most total bridges, with Kentucky ranking 5th. Kentucky is 4th in the percentage of structurally deficient bridges, but is highest among comparison states in the percentage of functionally obsolete bridges.

Table 7: Bridge Condition in Kentucky and Competitor States[18]

State	All bridges	Structurally deficient	Functionally obsolete	Structurally deficient	Functionally obsolete
Ohio	26,972	2,080	4,452	7.7	16.5
Kansas	25,046	2,416	1,813	9.6	7.2
Indiana	19,017	1,902	2,201	10.0	11.6
Alabama	16,057	1,388	2,144	8.6	13.4
Kentucky	14,189	1,191	3,253	8.4	22.9
Washington	8,107	382	1,711	4.7	21.1
Arizona	8,031	256	684	3.2	8.5

[18] U.S. Department of Transportation. Federal Highway Administration. Office of Bridge Technology. (2015). National Bridge Inventory. Functional Classification of Bridges by Highway System. Retrieved from www.fhwa.dot.gov/bridge/nbi.cfm

Intermodal Facilities

Intermodal freight transport involves the transportation of freight in a container or vehicle that allows for use by several modes of transportation. Intermodal containers can be transported by multiple modes, from rail to ship to truck, without handling the actual cargo. This method reduces handling, improves security, reduces damage and loss, and allows freight to be transported faster. According to the Freight Analysis Framework (FAF), domestic freight transportation grew by approximately 20% over the past decade and is expected to increase another 65-70% by 2020.[19]

Some intermodal facilities in Kentucky are roads that provide access between major intermodal facilities and the other four subsystems making up the National Highway System. Others are connected primarily to the subsystems, i.e. rail or airport facilities.

Table 12: Intermodal Facilities in Kentucky[20]

Facility	Type	Connector Description
Amtrak Station - Catlettsburg	AMTRAK Station	CS 2551 (15th St East in Ashland to Amtrak Station Entrance)
Amtrak Station - Fulton	AMTRAK Station	US 51 (South limits of Purchase Pkwy Interchange to Newton Rd.), Newton Rd (US 51 to Terminal Entrance)
Bells Lane Petroleum/Chemical Pipeline	Truck/Pipeline Terminal	KY 2056 from I-264 W to the Louisville-Ohio river Floodwall
Bells Lane Petroleum/Chemical Port	Port Terminal	KY 2056 - Louisville-Ohio Floodwall to I-264- Same as KY 6L
Campground Rd Petroleum Pipeline	Truck/Pipeline Terminal	Campground Rd (Cane Run to Ralph), Kramers Ln (Cane Run to Campground), Ralph Ave (Cane Run to Campground Rd)
Campground Rd Petroleum Port	Port Terminal	Same as 5L
Cincinnati/N KY International Airport	Airport	KY 212 from I-275 S to the Airport Roadway System
CCI Energy Slones Branch Terminal	Truck/Rail Facility	KY 1441 (US 460 to Clark Elkhorn Tipple #1 Ent), KY 1789 (US 460 to KY 1441)
Golden Oak Mining CO.	Truck/Rail Facility	KY 7 (KY 15 to KY 931), KY 931 (KY 7 to Facility)
Greyhound Bus Station - Louisville	Intercity Bus Terminal	FS 8829 (Roy Wilkens to Ali Blvd), FS 8806 (Ali Blvd to Facility)
Ivel Coal Tipple	Truck/Rail Facility	County Rd 1020 - US 23 to Facility
Lexington Bluegrass Field	Airport	FS 8550 - US 60 to Facility
Louisville International Airport	Airport	Grade Ln (I-264 to UPS Feeder Truck Entrance), FS 8879 (I-264 to Facility)

19 Kentucky Transportation Cabinet. Division of Planning. (2007). 2016 Kentucky Statewide Intermodal Freight Plan. Retrieved from http://transportation.ky.gov/Planning/Documents/Freight%20Plan%20Extended%208%202007.pdf

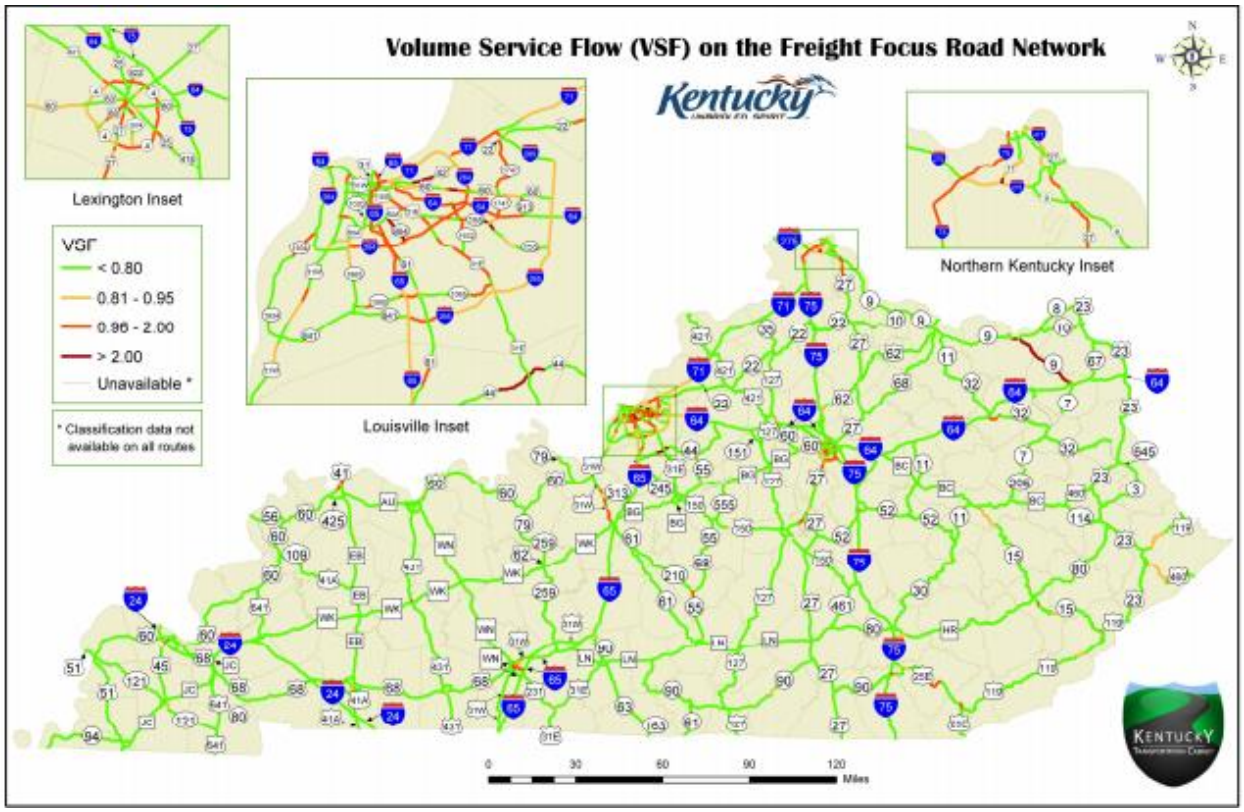
20 U.S. Department of Transportation. Federal Highway Administration. (n.d.) National Highway System, Intermodal Connectors, Kentucky. Retrieved from https://www.fhwa.dot.gov/planning/national_highway_system/intermodal_connectors/kentucky.cfm

Facility	Type	Connector Description
Louisville/Ashland Oil/Chevron Dist. Center	Truck/Pipeline Terminal	KY 1681 - KY 4 Interchange to Facility
McCoy Elkhorn Coal Corp	Truck/Rail Facility	KY 194 - US 119 to Facility
Norfolk Southern Intermodal - Georgetown	Truck/Rail Facility	KY 620 - Facility to I-75 Interchange
Norfolk Southern Intermodal - Louisville	Truck/Rail Facility	Newburg Rd (I-264 to Bishop), Bishop Ln (Newburg to Jennings), Jennings Ln (Bishop to Facility)
Owensboro Riverport	Port Terminal	KY 331 (US 60 to Harbor Rd), Harbor Rd (KY 331 to Facility)
Apex Energy/Cambrian Coal Corp. Tipple	Truck/Rail Facility	KY 80 from US 460 to Facility
Truck to Barge Coal Dock Cluster, Boyd County	Port Terminal	KY 757 from US 23 near Lockwood to 2.3 Miles North

According to the Kentucky Statewide Intermodal State Plan, the state is overburdened by freight being shipped by intermodal means. Therefore, the Kentucky Freight Focus Network (KFFN) was formed to "focus limited state resources on the most significant transportation facilities and to eliminate bottlenecks that impede safe, efficient, and reliable transportation. Kentucky's Freight Focus Network includes airports, highways, rail, intermodal connectors, public riverports, and navigable waterways with public riverports."[21] As shown in Figures 1 and 2, on the following pages, there are several places where this network is overburdened.

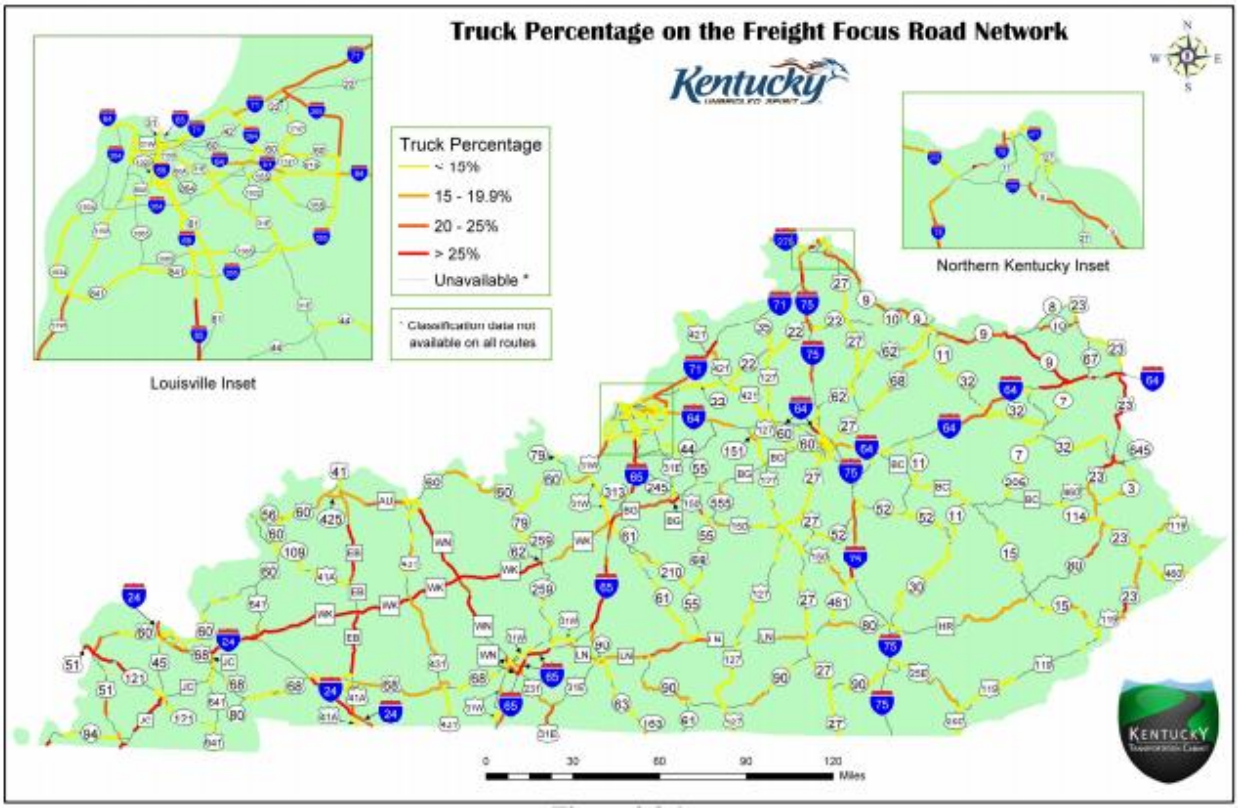
21 Kentucky Transportation Cabinet. Bluegrass Area Development District. (2016). Regional Transportation Asset Review. Retrieved from http://bgadd.org/wp-content/uploads/2014/07/2016-Asset-Review.pdf

Figure 1: Kentucky Freight Focus Network[22]



[22] Kentucky Transportation Cabinet. Bluegrass Area Development District. (2016). Regional Transportation Asset Review. Retrieved from http://bgadd.org/wp-content/uploads/2014/07/2016-Asset-Review.pdf

Figure 2: Truck Percentage on the Freight Focus Network[23]



Rail is an essential component of intermodal systems. Kentucky has nine intermodal rail facilities. Four facilitate transfer of containers. These terminals are transfer points between truck and rail modes. Norfolk Southern (NS) operates three terminals, two in Louisville and one in Georgetown. CSX Transportation (CSX) opened a terminal in Louisville in 2012. The others are equipment depots. The rail intermodal facilities are concentrated in Louisville and Georgetown, with the majority in Louisville.

Table 13: Intermodal Rail Facilities[24]

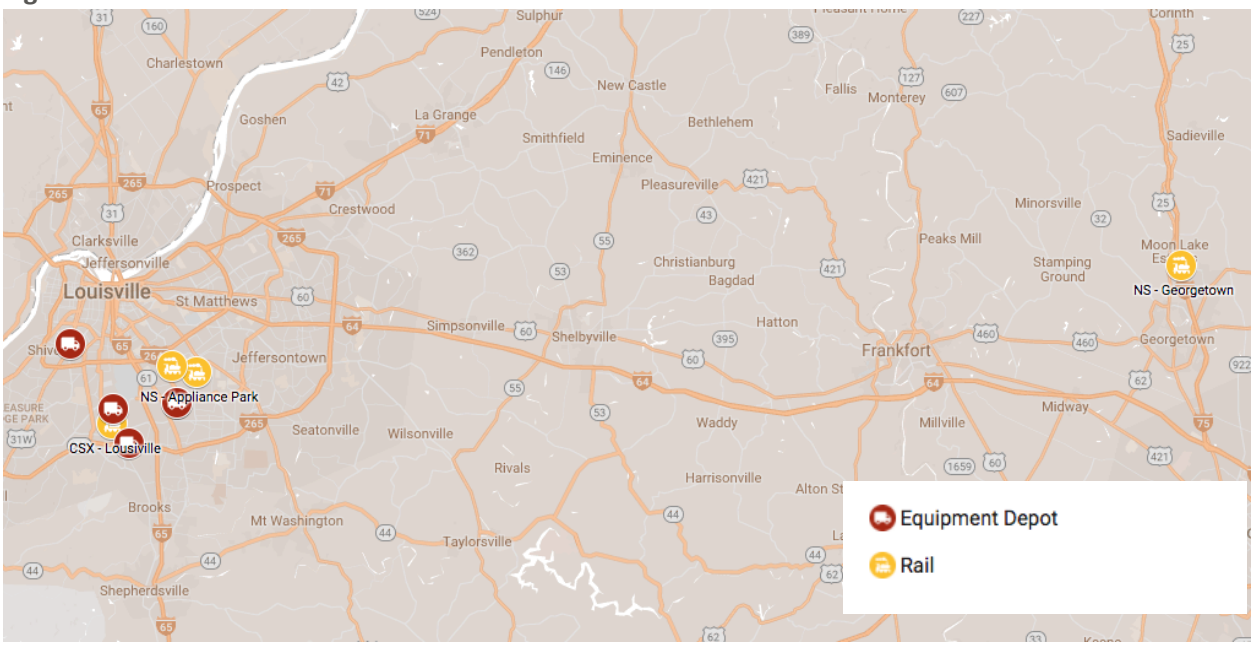
Type	Facility	Street	City	State	ZIP
Rail	CSX - Lousiville	8021 National Turnpike Rd	Louisville	KY	40214
Rail	NS - Appliance Park	4913 Heller Street	Louisville	KY	40218
Rail	NS - Buechel	4705 Jennings Lane	Louisville	KY	40218
Rail	NS - Georgetown	601 Cherry Blossom Way	Georgetown	KY	40324

[23] Kentucky Transportation Cabinet. Bluegrass Area Development District. (2016). Regional Transportation Asset Review. Retrieved from http://bgadd.org/wp-content/uploads/2014/07/2016-Asset-Review.pdf

24 Kentucky Transportation Cabinet. (2015). Kentucky Statewide Rail Plan. Chapter 2: Freight and Intermodal. Retrieved from http://transportation.ky.gov/Railroads/Documents/2015%20Rail%20Plan/Chapters/Chapter%202%20-%20Freight%20and%20Intermodal.pdf

Type	Facility	Street	City	State	ZIP
Equipment Depot	ContainerPort Group	1803 South Park Rd.	Louisville	KY	40219
Equipment Depot	Kentucky Container Service	6301 Geil Lane	Louisville	KY	40219
Equipment Depot	Louisville Cartage Co., Inc.	3101 Dixie Highway	Louisville	KY	40216
Equipment Depot	XPO Drayage	6901 Recovery Road	Louisville	KY	40214

Figure 3: Intermodal Rail Facilities



Due to the concentration in intermodal rail facilities, Louisville has been recognized as one of the top 50 cities in the U.S. for logistics by industry magazine MH&L (Material Handling & Logistics). The city scored high in workforce cost, air cargo capacity, and taxes and fees.[25]

Workforce Quality

When assessing workforce quality, the level of education of the population is the most accessible and the most pertinent to retaining and attracting companies to the state. While important qualities in a workforce such as loyalty or innovation are more difficult to track, education levels—including degrees conferred, and in what fields—offer a proxy metric for gauging human capital.

The following section moves from a very broad assessment of education to a more specific analysis, first looking at overall educational attainment for the state and the total number of degrees conferred by Kentucky institutions of higher education and comparison states. The section then provides an analysis of

25 King, B. & Keating, M. (2006). The Top 50 Logistics Cities in the United States. Material Handling & Logistics. Retrieved from http://mhlnews.com/transportation-amp-distribution/top-50-logistics-cities-united-states

the number of STEM-specific degrees awarded by Kentucky and comparison states. Degrees in STEM fields particularly may be applicable to the Aerospace & Aviation cluster.

Educational Attainment

Overall, Kentucky's educational attainment lags the U.S. overall, as well as competitor states. In the U.S., 88% of adults 25 and older have a high school diploma or equivalent, while in Kentucky, that percentage is 82%--a difference of 6 percentage points. All other competitor states rank higher than Kentucky in this regard. Kentucky also falls behind significantly in terms of adults with bachelor's degrees or more—22% vs. a U.S. rate of 33%. The percentage of Kentuckians with a bachelor's degree or more is the lowest of all competitor states. In terms of adults with advanced degrees, Kentucky falls behind the U.S. percentage of 12%, but is on par with Alabama, Indiana, and Ohio.

Table 14: Adult Educational Attainment[26]

	Percent of adults with high school diploma or equivalent	Percent of adults with bachelor's degree or more	Percent of adults with advanced degree
United States	88%	33%	12%
Kentucky	82%	22%	9%
Alabama	84%	23%	9%
Arizona	86%	27%	10%
Indiana	88%	24%	9%
Kansas	90%	31%	11%
Ohio	89%	26%	9%
Washington	90%	33%	12%

Public High School Graduation Rate

Table 15 shows the public high school 4-year adjusted cohort graduation rate for the United States and the District of Columbia for years 2011-2013. The 4-year ACGR is the number of students who graduate in four years with a regular high school diploma divided by the number of students who form the adjusted cohort for the graduating class. Those states with missing information were granted an extension to begin reporting this data; therefore, information is not available for all states for all years.

The overall 4-year graduation rate in the United States increased from 79% to 81% from 2011 to 2013. Iowa remained consistently in the lead in this metric, with 88% in 2011, 89% in 2012, and 90% in 2013. The District of Columbia rates were lowest – 59%, 59%, and 62%. Kentucky did not report on the first two years tracked, but indicated a rate of 86% in 2013.

26 U.S. Census Bureau. (2016). Educational Attainment in The United States: 2015. Current Population Reports. Retrieved from http://www.census.gov/content/dam/Census/library/publications/2016/demo/p20-578.pdf, and U.S. Census Bureau. (2016). Educational Attainment. Retrieved from https://www.census.gov/topics/education/educational-attainment.html

Table 15: Adjusted Cohort High School Graduation Rate in the United States[27]

State	2010-11	2011-12	2012-13
United States	**79**	**80**	**81**
Alabama	72	75	80
Alaska	68	70	72
Arizona	78	76	75
Arkansas	81	84	85
California	76	79	80
Colorado	74	75	77
Connecticut	83	85	86
Delaware	78	80	80
District of Columbia	59	59	62
Florida	71	75	76
Georgia	67	70	72
Hawaii	80	81	82
Idaho	—	—	—
Illinois	84	82	83
Indiana	86	86	87
Iowa	88	89	90
Kansas	83	85	86
Kentucky	—	—	86
Louisiana	71	72	74
Maine	84	85	86
Maryland	83	84	85
Massachusetts	83	85	85
Michigan	74	76	77
Minnesota	77	78	80
Mississippi	75	75	76
Missouri	81	84	86
Montana	82	84	84
Nebraska	86	88	88
Nevada	62	63	71
New Hampshire	86	86	87

27 U.S. Department of Education. (2017). Consolidated State Performance Report, School Years 2010-11, 2011-12, and 2012-13. Retrieved from http://www2.ed.gov/admins/lead/account/consolidated/index.html

State	2010-11	2011-12	2012-13
New Jersey	83	86	88
New Mexico	63	70	70
New York	77	77	77
North Carolina	78	80	83
North Dakota	86	87	88
Ohio	80	81	82
Oklahoma	—	—	85
Oregon	68	68	69
Pennsylvania	83	84	86
Rhode Island	77	77	80
South Carolina	74	75	78
South Dakota	83	83	83
Tennessee	86	87	86
Texas	86	88	88
Utah	76	80	83
Vermont	87	88	87
Virginia	82	83	84
Washington	76	77	76
West Virginia	78	79	81
Wisconsin	87	88	88
Wyoming	80	79	77

Table 16: Adjusted Cohort High School Graduation Rate in Kentucky and Competitor States[28]

	2010-11	2011-12	2012-13
Indiana	86	86	87
Kentucky	—	—	86
Kansas	83	85	86
Ohio	80	81	82
Alabama	72	75	80
Washington	76	77	76
Arizona	78	76	75

As shown in Table 16, Kentucky's adjusted cohort graduation rate of 86% in 2012-2013 was on par with or better than competitor states. Kentucky's graduation rate is not available for 2011 and 2012, due to

28 U.S. Department of Education. (2017). Consolidated State Performance Report, School Years 2010-11, 2011-12, and 2012-13. Retrieved from http://www2.ed.gov/admins/lead/account/consolidated/index.html

the Department of Education's Office of Elementary and Secondary Education approving an extended timeline for the state.

Postsecondary Degree Completion

The following tables (Tables 17-20) show the number of associate, bachelor's, master's, and doctoral degrees awarded by higher education institutions in Kentucky and competitor states between 2012 and 2014. The number of these degrees granted in the United States is also shown. These are presented to gauge overall potential workforce quality and postsecondary completions in Kentucky and each of the competitor states. Note that these are not the number of degrees held by the entire population of Kentucky or other states. These data show a snapshot of degrees conferred by institutions of higher education in each state, indicating possible trends, and they are one indicator of the potential workforce pipeline in the states.

Associate Degrees

In terms of completions for associate degrees, Arizona was consistently in the lead, outpacing most other states by at least 10,000 degrees in each year. Kentucky was in the bottom three of the competitor states each year, with more associate degrees conferred than Kansas or Alabama.

Table 17: Associate Degrees Conferred in Kentucky and Competitor States[29]

	2011-2012	2012-2013	2013-2014
United States	1,021,718	1,007,427	1,003,364
Kentucky	14,680	13,853	13,621
Arizona	62,994	48,911	41,846
Ohio	35,871	33,570	33,473
Alabama	14,197	13,758	13,303
Kansas	10,218	10,647	11,799
Washington	28,977	29,281	29,064
Indiana	19,430	18,838	17,730

Bachelor's Degrees

For bachelor's degrees, Kentucky was also in the bottom three among competitor states, with 22,268 degrees conferred in 2013-2014, exceeding only Kansas (20,274 bachelor's degrees conferred). Ohio conferred the most bachelor's degrees in 2014 with 68,288. Arizona and Ohio were consistently highest by far in bachelor's degrees conferred for each year (2012-2014).

Table 18: Bachelor's Degrees Conferred in Kentucky and Competitor States[30]

	2011-2012	2012-2013	2013-2014
United States	1,792,163	1,840,381	1,869,814
Kentucky	21,531	21,872	22,268
Arizona	64,707	66,304	61,280
Ohio	66,736	66,193	68,288

29 U.S. Department of Education. National Center for Education Statistics. (n.d.). Completions Component. Integrated Postsecondary Education Data System (IPEDS), 2012-2014.
30 Ibid.

	2011-2012	2012-2013	2013-2014
Alabama	28,277	29,876	29,516
Kansas	18,999	19,622	20,274
Washington	32,376	32,689	32,506
Indiana	45,534	46,551	46,986

Master's Degrees

Kentucky and Washington are comparable in number of master's degrees conferred; Washington had a larger number of master's degrees conferred in 2011-2012, but was eclipsed by Kentucky in subsequent years. However, both states were near the bottom in the number of master's degrees conferred, compared to their competitors. Arizona had the highest number of master's degrees conferred in 2014, with 28,829, followed by Ohio. However, both states saw their numbers decrease from 2012-2014.

Table 19: Master's Degrees Conferred in Kentucky and Competitor States[31]

	2011-2012	2012-2013	2013-2014
United States	755,967	751,718	754,475
Kentucky	9,411	9,860	9,507
Arizona	36,178	30,579	28,829
Ohio	24,148	22,994	22,780
Alabama	11,539	11,670	11,346
Kansas	7,021	6,625	7,387
Washington	9,595	9,519	9,292
Indiana	14,230	14,663	14,357

Doctoral Degrees

In terms of doctoral degrees conferred, Kentucky is on par with Alabama and Washington, and Kentucky's doctoral degrees conferred consistently exceeded Kansas. Ohio performs best in this category, with numbers around 6,000 in each year, at a rate that continues to grow.

Table 20: Doctoral Degrees Conferred in Kentucky and Competitor States[32]

	2011-2012	2012-2013	2013-2014
United States	170,217	175,026	177,580
Kentucky	1,935	1,951	2,026
Arizona	3,533	3,771	3,904
Ohio	5,992	6,117	6,149
Alabama	2,256	2,297	2,286
Kansas	1,452	1,474	1,460
Washington	2,561	2,601	2,558

31 U.S. Department of Education. National Center for Education Statistics. Completions Component. Integrated Postsecondary Education Data System (IPEDS), 2012-2014.
32 Ibid.

STEM

Table 21 shows science, technology, engineering, and math (STEM) completions in 2015 across the academic degree spectrum. Generally, STEM programs fall under the U.S. Department of Education's Classification of Instructional Programs (CIP) taxonomy in the two-digit series including engineering, biological sciences, mathematics, and physical sciences. However, degrees in STEM can also fall under a related field, which generally include fields involving research, innovation, or development of new technologies that use engineering, mathematics, computer science, or natural sciences.[33] Some examples of related fields include agroecology and sustainable agriculture, livestock management, and wood science and wood products/pulp and paper technology. Therefore, not all STEM degrees are necessarily directly related to Aerospace & Aviation fields. However, an analysis of STEM degrees conferred by Kentucky and competitor states provides an overview of the state's potential workforce pipeline in some areas that may be of value to Aerospace Products and Aviation Services.

Looking over the table, some trends emerged. Kentucky had the second lowest number of STEM bachelor's degree conferrals and the lowest number of master's degree conferrals among the competitor states. Kentucky had the third lowest number of STEM associate degree conferrals. In considering doctoral STEM degrees, Kentucky exceeds only Kansas. However, Kentucky conferred the most STEM undergraduate certificates of all competitor states, by a fairly large number. Overall, Kentucky institutions of higher education conferred 11,174 STEM degrees in 2015. This is more than Alabama and Kansas, but fewer than all other competitor states.

Table 21: STEM Degree Conferrals in Kentucky and Competitor States[34]

State	Associate	Bachelor's	Master's	Doctoral	Undergrad Certificate	Graduate Certificate	TOTAL
Alabama	749	5,272	1,417	365	959	85	8,847
Arizona	2,722	5,809	2,387	526	2,515	74	14,033
Indiana	1,571	10,375	2,678	906	1,102	119	16,751
Kentucky	800	4,028	1,005	270	4,969	102	11,174
Kansas	674	3,534	1,079	265	529	84	6,165
Ohio	3,151	13,306	4,537	1,102	1,965	250	24,311
Washington	2,794	8,585	1,722	556	3,025	71	16,753

Distribution of Degrees in the Aerospace and Aviation Industry

Using Public Use Microdata Samples from the American Community Survey, it is possible to break down the distribution of degrees in the Aerospace & Aviation industry in Kentucky. Interestingly, 32% of the

33 U.S. Immegration and Customs Enforcement. (2016). STEM Designated Degree Program List. Effective May 10,2016. Retrieved from https://www.ice.gov/sites/default/files/documents/Document/2016/stem-list.pdf, Programs identified as STEM are those that are on the STEM Designated Degree Program list, which is a list of fields that Department of Homeland Security considers to be STEM for purposes of the 24-month STEM optional practice training extension.

34 U.S. Department of Education. National Center for Education Statistics. (2015). Completions Component. Integrated Postsecondary Education Data System (IPEDS), 2012-2014.

Aerospace workforce has only a high school degree. The next most common educational level in the industry is "some college," which could indicate that these jobs are low skill, or, alternatively, are accessible to those with certifications. The amount of the workforce that has a bachelor's degree or above is also 32%. This indicates that these jobs are likely high paying. In Aviation, the workforce is solidly made up of high school graduates and those with "some college" (58% of the workforce) Those with a bachelor's degrees or above make up only 25% of this workforce.

Table 22: Distribution of Degrees Across the Aviation and Aerospace Industries of Kentucky[35]

Industry	No High School	HS grad	Some College	Assoc.	Bach.	Grad Degree
Aerospace	3%	32%	24%	9%	18%	14%
Aviation	9%	33%	25%	9%	20%	5%

Apprenticeships

Apprenticeships are an important part of workforce development. By partaking in apprenticeships, it is possible for workers to learn new skills and earn wages at the same time. For businesses, apprenticeships help train the next generation of workers without the commitment of full-time hire.

Kentucky has a robust apprenticeship program. Tech Ready Apprentices for Careers in Kentucky (TRACK) is a youth pre-apprenticeship program providing secondary students with career pathway opportunities into Registered Apprenticeship programs. At the time of publication, the four established TRACK programs include carpentry, electrical, manufacturing, and welding. In September 2016, the Kentucky Labor Cabinet formed the Division of Apprenticeship as part of the "Kentucky Trained. Kentucky Built." Initiative. New efforts and resources (including coordinators) will provide technical and marketing expertise in the aim of growing the role of registered apprenticeships in the state.

The apprenticeships below are those that are registered with the federal government's Department of Labor. An individual employer, group of employers, or an industry association can sponsor a Registered Apprenticeship program, sometimes in partnership with a labor organization. Registered Apprenticeship program sponsors make significant investments to design and execute apprenticeship programs, provide jobs to apprentices, oversee training development, and provide hands-on learning and technical instruction for apprentices. The programs are operated on a voluntary basis and are often supported by partnerships consisting of community-based organizations, educational institutions, the workforce system, and other stakeholders.[36]

Table 23: Registered Apprenticeships in Kentucky and Competitor States[37]

State Name	Active Apprentices	New Apprentices	Completers	Active Programs	New Programs
Kentucky	3,310	1,307	420	154	11
Alabama	4,225	1,387	430	96	26
Arizona	2,784	1,519	379	128	5

35 U.S. Census Bureau, American Community Survey. Public Use Microdata Samples (PUMS).
36 U.S. Department of Labor, Employment and Training Administration. (2014). What is Registered Apprenticeship. ApprenticeshipUSA. Retrieved from https://www.doleta.gov/oa/apprenticeship.cfm
37 U.S. Department of Labor, Employment and Training Administration. (2017). Registered Apprenticeship National Results, FY 2016. ApprenticeshipUSA. Retrieved from https://www.doleta.gov/oa/data_statistics.cfm

State Name	Active Apprentices	New Apprentices	Completers	Active Programs	New Programs
Indiana	12,406	7,178	2,891	880	58
Kansas	2,920	663	326	234	10
Ohio	16,237	6,781	2,132	926	25
Washington	13,682	574	1,117	258	6

In terms of the number of active apprenticeships, Kentucky is on par with Arizona, Kansas, and Alabama. However, Indiana, Ohio, and Washington have many more active apprenticeships. Kentucky matches several states in terms of new apprenticeships, with Indiana and Ohio offering far more than other states. Kentucky ranks in the bottom three in terms of active programs with 154, and again Indiana and Ohio outpace all states with numbers close to 1,000.

Labor Costs

Occupational Wages

Table 24 ranks states by their average annual salary across all occupations. Each state's median annual salary is also included. The District of Columbia has both the highest average and median salaries. Kentucky has the 9th lowest average annual salary with $40,880.

Table 24: Average and Median Annual Salaries (All States)[38]

State	Average Annual Salary	Median Annual Salary
District of Columbia	$80,150	$66,040
Massachusetts	$59,010	$45,580
New York	$57,030	$41,600
Connecticut	$56,280	$43,830
Alaska	$55,760	$46,420
California	$55,260	$39,830
New Jersey	$54,950	$41,320
Maryland	$54,630	$41,860
Washington	$54,010	$42,190
Virginia	$51,670	$38,180
Colorado	$51,180	$38,800
Rhode Island	$50,780	$39,050
Delaware	$50,300	$37,750
Illinois	$49,970	$37,320
Minnesota	$49,740	$38,870
New Hampshire	$48,710	$37,280
Oregon	$48,100	$37,080
Hawaii	$47,740	$38,750
Texas	$46,560	$34,550
Pennsylvania	$46,550	$36,150
Michigan	$46,310	$35,400
Vermont	$46,060	$37,040
Wyoming	$45,850	$38,280
North Dakota	$45,660	$38,170
Georgia	$45,420	$33,430

38 Bureau of Labor Statistics. (2015). Occupational Employment Statistics: State Occupational Employment and Wage Estimates, May.

State	Average Annual Salary	Median Annual Salary
Arizona	$45,310	$34,680
Ohio	$44,750	$35,030
North Carolina	$44,170	$33,100
Utah	$44,130	$33,990
Wisconsin	$43,930	$35,110
Missouri	$43,640	$33,380
Maine	$43,260	$34,710
New Mexico	$43,170	$32,320
Kansas	$42,930	$33,700
Florida	$42,860	$31,810
Nevada	$42,800	$33,700
Nebraska	$42,630	$33,840
Indiana	$42,070	$32,910
Alabama	$41,920	$31,550
Iowa	$41,840	$33,650
Oklahoma	$41,820	$32,430
Tennessee	$41,300	$31,820
Kentucky	$40,880	$32,340
Idaho	$40,810	$31,860
Louisiana	$40,810	$31,980
Montana	$40,620	$31,970
South Carolina	$40,580	$31,280
West Virginia	$39,100	$30,240
South Dakota	$38,820	$30,780
Arkansas	$38,540	$29,420
Mississippi	$37,620	$29,000

Earnings in Aerospace & Aviation Cluster

This section looks at labor costs within the Aerospace & Aviation cluster. Table 25 shows current total earnings in core industries of the Aerospace & Aviation cluster. Current total earnings, also called average total earnings, is the total industry earnings for a state in 2016 divided by number of jobs. Earnings include wages, salaries, supplements, and proprietor income.

Virginia has the highest current total earnings in Aerospace Products, while the District of Columbia has the highest in Aviation Services. Kentucky is ranked 40th in Aerospace Products at $88,572 and 15th in Aviation Services at $84,985.

Table 25: Current Total Earnings in Aerospace Products and Aviation Services[39]

State Name	Aerospace Products- Current Total Earnings	Aerospace Products - Earnings Rank	Aviation Services - Current Total Earnings	Aviation Services - Earnings Rank
Alabama	$105,482	24	$76,853	26
Alaska	$72,647	47	$70,737	30
Arizona	$124,149	13	$81,441	19
Arkansas	$75,814	46	$65,011	35

39 Emsi 2016.3. These occupations are by 6-digit SOC. Employment includes only the targeted Aviation Services industries.

State Name	Aerospace Products- Current Total Earnings	Aerospace Products - Earnings Rank	Aviation Services - Current Total Earnings	Aviation Services - Earnings Rank
California	$128,317	10	$85,233	14
Colorado	$158,475	2	$84,544	17
Connecticut	$131,634	7	$80,108	21
Delaware	$89,005	39	$99,964	5
District of Columbia	$0	51	$235,625	1
Florida	$109,906	20	$76,985	24
Georgia	$110,341	19	$115,765	2
Hawaii	$91,038	36	$76,961	25
Idaho	$60,074	49	$60,131	40
Illinois	$107,450	23	$95,960	7
Indiana	$109,011	21	$64,382	36
Iowa	$119,917	14	$45,739	49
Kansas	$93,968	33	$67,812	32
Kentucky	$88,572	40	$84,985	15
Louisiana	$100,610	28	$73,194	28
Maine	$87,922	41	$41,481	51
Maryland	$140,838	4	$94,084	9
Massachusetts	$144,938	3	$79,378	22
Michigan	$97,606	29	$95,851	8
Minnesota	$91,692	34	$93,690	10
Mississippi	$85,223	43	$61,373	39
Missouri	$130,474	8	$66,562	34
Montana	$79,826	44	$46,261	48
Nebraska	$77,493	45	$62,480	38
Nevada	$91,430	35	$81,270	20
New Hampshire	$125,294	11	$70,907	29
New Jersey	$135,027	6	$103,157	4
New Mexico	$96,805	30	$70,623	31
New York	$115,308	17	$85,783	12
North Carolina	$116,057	16	$75,036	27
North Dakota	$66,199	48	$42,180	50
Ohio	$119,862	15	$97,396	6
Oklahoma	$94,261	31	$84,812	16
Oregon	$103,298	25	$67,694	33
Pennsylvania	$112,829	18	$81,731	18
Rhode Island	$136,265	5	$50,117	47
South Carolina	$107,538	22	$63,306	37
South Dakota	$90,225	37	$54,668	43
Tennessee	$89,101	38	$59,593	41
Texas	$124,631	12	$104,302	3
Utah	$101,144	27	$85,494	13
Vermont	$102,527	26	$51,361	46
Virginia	$171,779	1	$78,975	23
Washington	$129,859	9	$91,330	11

State Name	Aerospace Products- Current Total Earnings	Aerospace Products - Earnings Rank	Aviation Services - Current Total Earnings	Aviation Services - Earnings Rank
West Virginia	$94,228	32	$58,510	42
Wisconsin	$85,841	42	$53,915	44
Wyoming	$53,185	50	$53,606	45
United States	**$121,101**		**$88,165**	

Research & Development Access

Aerospace & Aviation are research and innovation intensive industries. According to the National Science Foundation (NSF), 53% of aircraft companies have innovation activities for goods and services, second only to communications equipment (55%). However, 52% of aircraft companies are also engaged in process-related innovations, which is far higher than the other industries surveyed. Given the importance of innovation, a strong science and engineering (S&E) enterprise is critical for the long-term health of A&A in Kentucky.

Table 26: Share of U.S. Manufacturing Companies Reporting Innovation Activities, by Selected Industry: 2008–10[40]

Industry	Any good or service	Any process
All manufacturing industries	23.3%	21.1%
Communications equipment	55.2%	21.1%
Aircraft	53.1%	52.3%
Testing, measuring, and control instruments	52.8%	29.9%
Pharmaceuticals	49.4%	30.1%
Computers and peripheral equipment	48.4%	33.0%
Soap, cleaning compound, and toilet preparation	46.0%	30.5%

Overall, the state of Kentucky has a limited, but growing S&E enterprise. The National Science Foundation (NSF) created the **Experimental Program to Stimulate Competitive Research (EPSCoR)** to expand and de-concentrate the infrastructure for R&D in the United States. EPSCoR works with less research-intensive states to encourage local action to develop long-term improvements in the science and engineering enterprise in that state. EPSCoR programs also operate in the Department of Energy (DOE), Department of Agriculture (USDA), National Aeronautics and Space Administration (NASA), and the National Institutes of Health (NIH). The Department of Defense (DOD) and Environmental Protection Agency (EPA) EPSCoR programs are currently inactive due to budget reductions.

Kentucky joined EPSCoR in 1985. Kentucky's EPSCoR/IDeA Coalition Goals for FY2017 total more than $546 million. This includes several agencies that have funding that could support aerospace and aviation R&D: $170 million from the NSF, $25 million from NASA, and $20 million from the DOE. Kentucky could leverage more of its EPSCoR funding to A&A research to boost the state's activities.

Between FY12 and FY15, Kentucky had $84.0 million in prime A&A R&D contracts from federal agencies, which is less than 1% of the U.S. total. Kentucky ranked 26th overall in A&A RD contracts, while Indiana

40 National Science Foundation. (2010). Business R&D and Innovation Survey. National Center for Science and Engineering Statistics. The survey asked companies to identify innovations introduced from 2008 to 2010.

ranked 14th and Ohio ranked 11th. Ohio had $12.5 of A&A R&D for every dollar in Kentucky, a total of $1.1 billion in A&A research and development over the four fiscal years.

Table 27: A&A Research & Development Contracts[41]

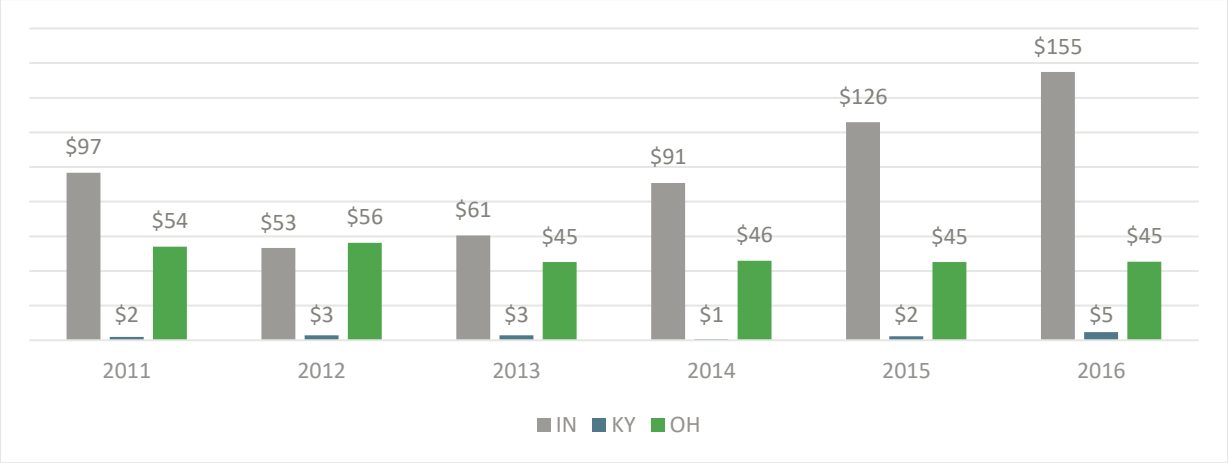
Rank	State	Total FY 2012-2015 ($1 millions)
	U.S. Total	$67,178.9
1	California	$22,451.2
2	Texas	$8,339.3
3	Colorado	$6,606.5
11	Ohio	$1,056.0
14	Indiana	$456.0
26	Kentucky	$84.0

Kentucky may be able to leverage its EPSCoR status into more collaborative research in A&A projects through the NSF. While the NSF is an overall small player in A&A innovation, they tend to fund early stage, basic research that can lead to downstream S&E projects and contracts. The DoD EPSCoR program may not have a budget, but Kentucky could leverage the NSF, DOE, and NASA EPSCoR programs to increase the level of A&A research in Kentucky.

NASA and Academic R&D

In terms of R&D awards from NASA, Kentucky also lags far behind its neighbors in Indiana and Ohio. From 2011 to 2016, the state averaged $2.5 million in NASA R&D contracts, compared to $48.7 million for Ohio and $97.0 million for Indiana. Considering all NASA contracts, both R&D and otherwise, Kentucky averaged $4.9 million for those six years. However, contracts in recent years have shown some signs of improvement: Kentucky's total contracts and R&D contracts from NASA both peaked in 2016. The state received $6.7 million in total NASA contracts and $4.6 million in R&D NASA contracts that year. Meanwhile, Indiana's R&D contracting has risen from $96.7 million in 2011 to $154.9 million in 2016.

Figure 3: NASA R&D Contracts by State, 2011-2016 ($1 millions)[42]

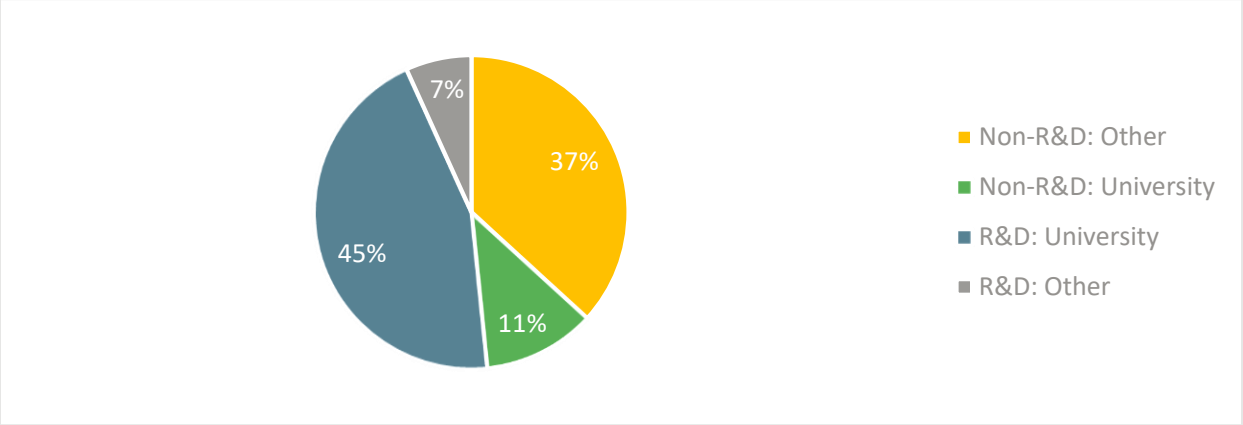


41 Federal Procurement Data System – Next Generation. (FY2012-FY2015). Ad-Hoc Reporting Tool. Prime Contracts in Aircraft and Aerospace R&D: Defined as PSC Codes AC10-27 & AR10-97.

42 Federal Procurement Data System – Next Generation. (2011-2016). Advanced Search Tool. Prime Contracts from NASA by state and PSC code—Research & Development PSC codes only.

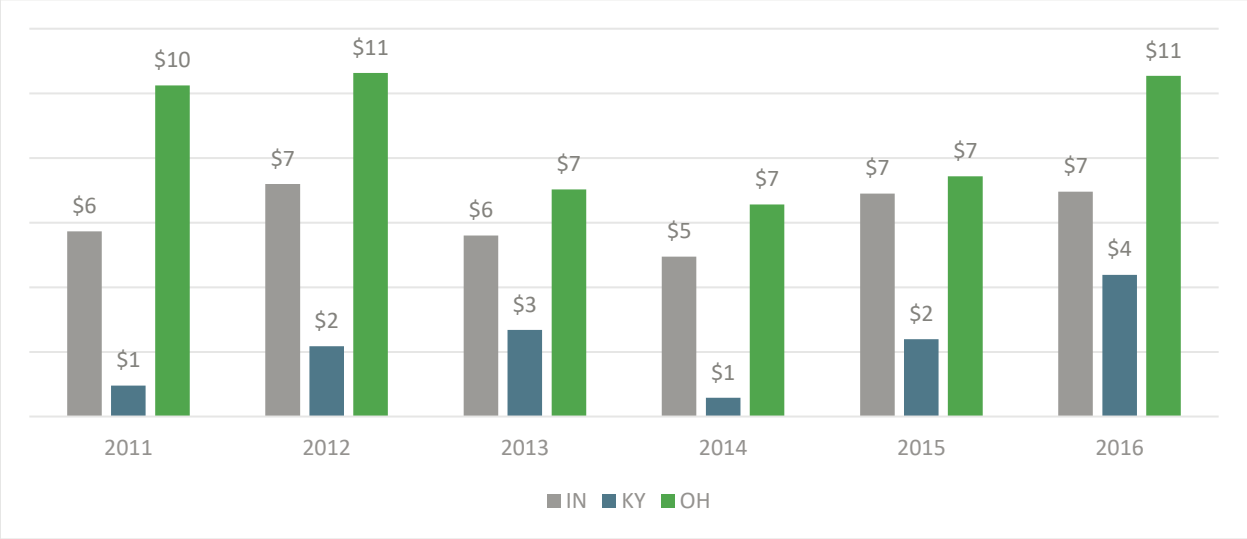
Unlike Indiana and Ohio, the majority of Kentucky's NASA R&D contracts are obtained by universities. In fact, while university R&D contracts make up 44.8% of Kentucky's six-year NASA total, non-university R&D is only 6.8%. In Indiana, non-university entities obtain 93.6% of the state's NASA R&D contracts; in Ohio, the figure is 82.0%.

Figure 4: KY 2011-2016 NASA Grants, by Activity and Recipient[43]



Because of this difference, Kentucky is much more comparable to Indiana and Ohio in university R&D. Over the past six years, Kentucky universities have averaged $2.1 million in NASA R&D, which compares more favorably to Indiana ($6.2 million) and Ohio ($8.7 million). As Figure 5 demonstrates, Kentucky universities have also experienced growth in NASA R&D, gaining ground on their Indiana and Ohio peers.

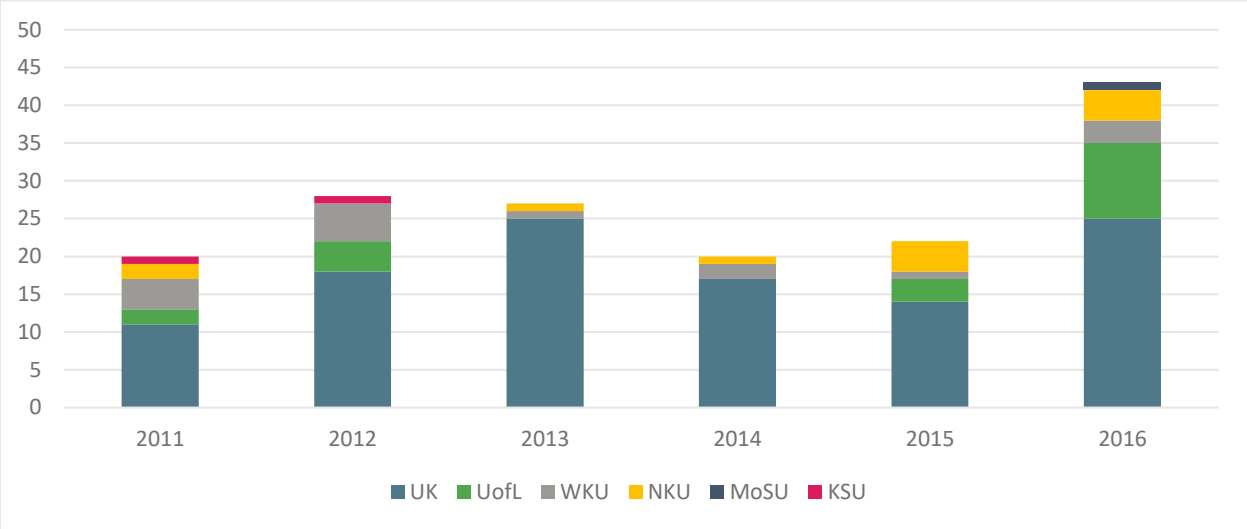
Figure 5: NASA R&D Contracts to Universities, 2011-2016 ($1 millions)[44]



[43] Ibid.
[44] Ibid.

Similar growth can be seen in the annual number of NASA grants received by Kentucky Universities. The number of grants received has risen from 20 in 2011 to 43 in 2016. Led by the University of Kentucky, Kentucky schools obtained 160 NASA grants from 2011 to 2016.

Figure 6: # of NASA Grants to KY Universities, 2011-2016[45]



The data reported by NASA and the Federal Procurement Data System (FPDS), have the benefit of being uniformly administered across all divisions of the federal government. However, there is reason to believe that these data under-report certain critical activity occurring within Kentucky. Most notably, Morehead State's Space Science Center is responsible for greater than $10 million in NASA contracts between 2011 and 2015, whereas FPDS reports that the University was only awarded $1.8 million between 2011 and 2016, and NASA reports that the University only received one grant during that time. Similarly, the National Science Foundation conducts an annual survey—the Higher Education Research and Development Survey (HERD)—that asks each school to report its institution-wide expenditures on research for each academic discipline. From 2012 through 2015, Kentucky institutions reported only $1.3 million in Aerospace Engineering R&D expenditures.[46] In comparison, Indiana institutions reported $147.1 million expenditures, and Ohio institutions reported $136.7 million.

These discrepancies are significant enough that they warrant the attention of faculty and administrators at Kentucky's research universities. Though university staff may not be able to improve data quality for data systems that are internal to the federal government—such as NASA and FPDS—they can improve the quality of HERD survey responses and statewide data systems. Kentucky could benefit from a concerted effort to standardize university research expenditure recording and reporting. By doing so, Kentucky would be better positioned to voice its progress in A&A research and better equipped to respond accurately to national surveys. The end result would be more favorable comparisons of Kentucky's expertise on the national stage—helping the state to attract additional research investment and talent.

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[45] NASA Shared Services Center. (2011-2016). Grants Status Search. Total Grants by Institution.

46 National Science Foundation. (2016). Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey. November.

Firm-Level A&A Research

Kentucky does not have a strong base of private R&D activity in the state. Most of the A&A-related research in Kentucky is conducted by Lockheed Martin at their location in Lexington. The remaining firms are relatively small in terms of their research activity. Only Lockheed Martin registers among the top research organizations in Kentucky, Indiana, and Ohio.

Table 28: A&A Research Firms in Kentucky[47]

Organization	City	Amount
Lockheed Martin Corporation	Lexington	$44,668,835
NGIMAT, LLC	Lexington	$2,393,070
Tier 1 Performance Solutions, LLC	Covington	$2,356,899
BMAR & Associates, LLC	Hopkinsville	$1,384,734
Minerva Systems & Technologies, LLC	Lexington	$1,202,501
Directed Energy Incorporated	Lexington	$1,000,000
Mercury Data Systems, Inc.	Lexington	$972,758
Infobeyond Technology, LLC	Louisville	$669,999
Enomalies	Mount Vernon	$400,000
Theta Tech Solutions LLC	Louisville	$150,000
Fundo Science Corporation	Lexington	$105,000
Unmanned Services Inc.	Versailles	$24,329
Definitive Infotech Services And Solutions, LLC	Louisville	$2,501
Innovative Technical Solutions, LLC	Paducah	$2,501
Strategic Communications, LLC	Louisville	$2,501
E10/Space Tango	Lexington	Unknown

Table 29: Largest A&A Research Organizations in the Tri-State Area[48]

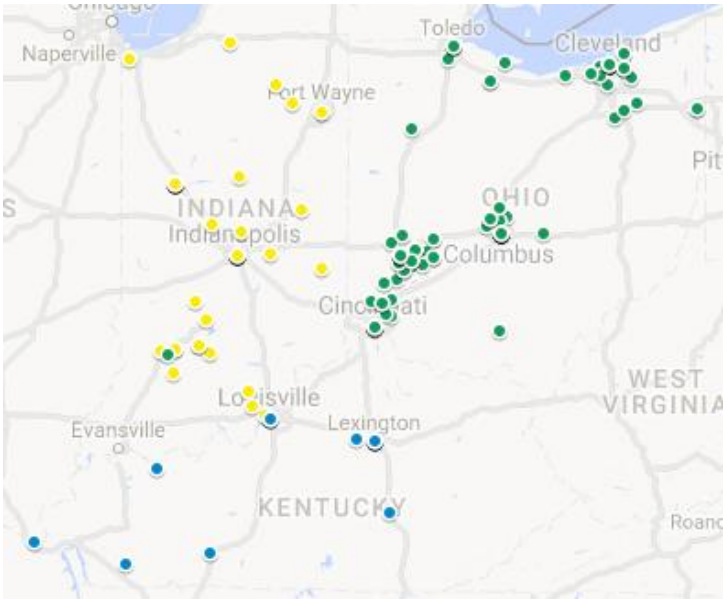
Organization	City	State	Amount
Babcock & Wilcox Conversion Services	Piketon	OH	$260,055,152
General Electric Company	Cincinnati	OH	$257,757,456
Universal Technology Corporation	Dayton	OH	$116,215,703
University Of Dayton	Dayton	OH	$96,606,982
UES Inc	Dayton	OH	$95,707,384
Infoscitex Corporation	Dayton	OH	$52,557,732
Battelle Memorial Institute	Columbus	OH	$51,506,619
Lockheed Martin Corporation	Lexington	KY	$44,668,835
Innovative Scientific Solutions, Inc	Dayton	OH	$41,178,343
L-3 Communications Corporation	Mason	OH	$26,415,548
Rolls Royce North American Technologies Inc	Indianapolis	IN	$20,644,290
Azimuth Corporation	Beavercreek	OH	$20,196,761

47 These organizations have contracts that are categorized in areas related to Aerospace Engineering R&D or related systems, materials, or electronics.

48 These organizations have contracts that are categorized in areas related to Aerospace Engineering R&D or related systems, materials, or electronics.

While research organizations are geographically distributed across the state, in terms of the dollar volume of research, 90% percent is conducted in Lexington. A significant amount of the A&A research conducted in Ohio is located in the Cincinnati and Dayton areas.

Figure 7: Map of Tri-State A&A Research Organizations



Kentucky also has a limited portfolio of patenting activity in technology classes related to Aerospace & Aviation. From 2011 to 2015, Kentucky received five patents in Patent Class 244 Aeronautics and Astronautics. Two of these patents have not been assigned to a company and one has been assigned an out-of-state firm – PPG Industries.

Table 30: Kentucky Patents for Aeronautics and Astronautics[49]

Patent #	Patent Title and Assignee
8,981,265	Electric circuit and sensor for detecting arcing and a transparency having the circuit and sensor. Assigned to: PPG industries Ohio, Inc. (Cleveland, OH)
8,322,649	Saucer-shaped gyroscopically stabilized vertical take-off and landing aircraft Assigned to: Unassigned
8,096,496 and 8,317,127	Helicopter drip pan Assigned to: Phoenix Products, Inc. (McKee, KY)
8,991,769	Two-dimensional morphing structure for wing Assigned to: Toyota Motor Engineering & Manufacturing North America, Inc. (Erlanger, KY)
7,971,823	Saucer shaped gyroscopically stabilized vertical take-off and landing aircraft Assigned to: Unassigned

[49] U.S. Patent and Trademark Office. (n.d.). Calendar Year Patent Statistics by Geography and Industry Classification.

Examining related technologies and patent classes, Kentucky has some innovation in computing and data processing as well as coatings, chemistry, and bonding. The overall level of patenting activity for all of these technologies averages less than 50 patents per year.

Table 31: Kentucky Patents Related to Aerospace & Aviation[50]

Class	Class Title	Total 2011-2015
709	Multicomputer Data Transferring (Electrical Computers and Digital Processing Systems)	24
106	Compositions: Coating or Plastic	19
427	Coating Processes	18
174	Electricity: Conductors and Insulators	17
318	Electricity: Motive Power Systems	14
415	Rotary Kinetic Fluid Motors or Pumps	12
530	Chemistry: Natural Resins or Derivatives; Peptides or Proteins; Lignins or Reaction Products Thereof	11
33	Geometrical Instruments	9
156	Adhesive Bonding and Miscellaneous Chemical Manufacture	9
431	Combustion	8
16	Miscellaneous Hardware (e.g., Bushing, Carpet Fastener, Caster, Door Closer, Panel Hanger, Attachable or Adjunct Handle, Hinge, Window Sash Balance, Etc.)	7
180	Motor Vehicles	7
392	Electric Resistance Heating Devices	7
701	DP: Vehicles, Navigation, and Relative Location (Data Processing)	7
200	Electricity: Circuit Makers and Breakers	6
320	Electricity: Battery or Capacitor Charging or Discharging	6
429	Chemistry: Electrical Current Producing Apparatus, Product, and Process	6
704	DP: Speech Signal Processing, Linguistics, Language Translation, and Audio Compression/Decompression (Data Processing)	6
102	Ammunition and Explosives	5
244	Aeronautics and Astronautics	5
251	Valves and Valve Actuation	5
257	Active Solid-State Devices (e.g., Transistors, Solid-State Diodes)	5
303	Fluid-Pressure and Analogous Brake Systems	5
356	Optics: Measuring and Testing	5
714	Error Detection/Correction and Fault Detection/Recovery	5

Business Costs

Table 32 presents an overview of the cost components for Aerospace industries. The relative importance of each cost is represented by share of its total (by a percentage). The largest costs components are the cost of materials (42%) and payroll and labor costs (23%).

Kentucky is in an advantaged position in terms of labor costs. Materials costs are not entirely in the control of any state economic policy or program tools. The other cost components that relate to real estate, utility costs, and taxes account for a small portion of the overall cost picture. It is important to explain the proportionality importance of these costs because, as detailed later in this section, certain business or

50 U.S. Patent and Trademark Office. (n.d.). Calendar Year Patent Statistics by Geography and Technology.

regulatory costs that might seem to disadvantage the state of Kentucky are insignificant compared to the major costs of running a business in Kentucky.

Table 32: Overview of Cost Components in Aerospace[51]

	Share of Total Cost
Annual payroll	22.9%
Total fringe benefits	7.9%
Total cost of materials	42.0%
Cost of purchased fuels consumed	0.2%
Cost of purchased electricity	0.8%
Capital expenditures on buildings and other structures	0.6%
Capital expenditures on machinery and equipment	1.9%
Capital expenditures on all other machinery and equipment	1.6%
Rental or lease payments for buildings	0.6%
Taxes and license fees	0.3%

Utility Costs

For electricity prices that affect Aerospace & Aviation, Kentucky is in a generally favorable cost position. Its electricity prices are lower than the U.S. average and are among the lowest of the six benchmark states.

Table 33: Average Price of Electricity by End-Use Sector, August 2016 (Cents per Kilowatt hour)[52]

State	Commercial	Industrial	Transportation	All Sectors
Arizona	15.36	12.80	12.25	16.70
Alabama	11.33	5.99	--	9.86
Ohio	9.78	6.80	7.89	9.89
Kansas	10.41	7.43	--	10.76
Indiana	10.36	7.53	9.24	8.83
Kentucky	9.21	5.66	--	8.46
Washington	8.27	4.64	8.99	7.64
U.S. Total	10.70	7.23	9.94	10.83

In terms of natural gas prices, Kentucky has one of the lower prices for industrial customers. Kentucky is the 17th most expensive state for natural gas for commercial users and six of the top ten states have lower prices for commercial natural gas.

51 2013 Annual Survey of Manufacturing. Operating Costs for core aerospace industries.
52 U.S. Energy Information Administration. (2016). Form EIA-826, "Monthly Electric Sales and Revenue Report with State Distributions Report." October.

Table 34: Natural Gas Prices (Dollars per thousand cubic feet)[53]

State	Industrial	Commercial
Alabama	$4.08	$11.26
Arizona	$6.78	$10.53
Indiana	$6.36	$7.61
Kansas	$4.24	$8.87
Kentucky	$4.45	$8.75
Ohio	$6.35	$6.39
Washington	$8.91	$9.77

Tax Rates

According to the *2017 State Business Tax Climate Index*, published by the Tax Foundation, Kentucky is lagging somewhat behind the other benchmark states in terms of the burden tax rates; but by most measures, the state enjoys moderate tax rates, which are reflected in the state's ranking at 34th nationally in terms of the overall business-friendliness of its tax systems.

Table 35: Kentucky and Benchmark State Rankings: The Burdensomeness of Tax Rates[54]

State	Overall Rank	Corporate Tax Rank	Individual Income Tax Rank	Sales Tax Rank	Unemployment Insurance Tax Rank	Property Tax Rank
Indiana	8	23	11	10	10	4
Washington	17	48	6	49	18	27
Arizona	21	19	19	47	13	6
Kansas	22	39	18	30	11	19
Alabama	32	14	22	48	14	16
Kentucky	34	28	30	13	48	36
Ohio	45	45	47	29	4	11

Kentucky's unemployment insurance tax ranking is lower than all comparison states and among the worst in the nation. According to the Tax Foundation's report, states with high unemployment insurance tax rankings "tend to feature more complicated experience formulas and charging methods, and have added benefits and surtaxes to their systems."

Additionally, the Tax Foundation's rankings show Kentucky as having the poorest property tax rankings among the benchmark states (at 36). In fact, Kentucky enjoys a very low Effective Property Tax rate of 0.82%; the actual rates vary based on the county in which the property is located, with Campbell County's being the highest in the state at 1.15%. Kentucky's property tax collections per capita are among the nation's lowest, with $732 collected in property tax per Kentuckian per year. But there's another story behind Kentucky's property tax rankings: unlike many states, Kentucky taxes both equipment and inventory (Kentucky is one of only nine states to tax inventory).

53 U.S. Energy Information Administration. (2016). Form EIA-857, "Monthly Report of Natural Gas Purchases and Deliveries to Consumers"; Form EIA-910, "Monthly Natural Gas Marketer Survey." October.
54 The Tax Foundation. (2017). State Business Tax Climate Index.

This inventory tax has a negative impact on Kentucky's Aerospace & Aviation industries. Kentucky's burgeoning cargo Aviation sector, and its Aviation sector in general, may be negatively impacted by the fact that the inventory tax makes it relatively more expensive for Maintenance, Repair, and Overhaul (MRO) to service aircraft. This is because the parts they keep in stock for repairs are subject to this inventory tax, which in turn make it more expensive for customers (e.g., airlines or freight shipping companies like UPS or Amazon) to purchase MRO services in Kentucky. This should be seen as a potential threat to cargo aviation in Kentucky.

According to 2014 *Location Matters: The State Cost of Doing Business* report from the Tax Foundation, the total effective tax rates for different types of businesses reflect some potential misalignments between investments the state may be looking to make in Aerospace & Aviation and the total taxes affecting those types of businesses. As the Location Matters report states, Kentucky's lack of a tax credit for R&D operations means that R&D firms pay among the highest-taxes categories firms within the state. Additionally, distribution centers are taxed at a 22.7% total effective tax rate, which does not align with the anticipated continued expansion for Kentucky's cargo aviation operations.

Table 36: Effective Tax Rates for Different Facility Types within Kentucky[55]

	Corporate Headquarters	R&D Facility	Distribution Center	Labor-Intensive Manufacturer
Total effective tax rate for mature facilities	11.2%	13.3%	22.7%	8.0%
Total effective tax rate for new facilities	7.1%	7.5%	24.7%	6.5%

Kentucky's corporate income tax ranking (a 6% top tax rate) puts it in the middle of the pack, both in terms of the rest of the country and the six benchmark states; its individual income tax ranking (also a 6% top tax rate) is better than the median; and its 6% sales tax rate (which equally affects corporations and individually) ranks 13th nationally.

Table 37: State Start-up and Annual Filing Regulatory Burdens[56]

State	Ranking
Indiana	9
Washington	18
Alabama	21
Kentucky	22
Arizona	25
Ohio	32
Kansas	34

On the matter of new facilities and new firms, according to another ranking of business costs, *The 50-State Small Business Regulation Index* published by the Pacific Research Institute, Kentucky ranks near the middle, both nationally and in terms of the benchmark states, in terms of how burdensome its start-up

55 The Tax Foundation. (2014). Location Matters: The State Cost of Doing Business.
56 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

and annual filing regulations are currently. It would be expected that states with high start-up and annual filing costs, or particularly onerous processes for starting a new business, would see fewer new business starts, because start-up businesses would have to be relatively larger or well-capitalized.

Real Estate Costs

Commercial and industrial real estate conditions vary widely across the state. The community conditions, the location of the site, and the infrastructure and amenities on the site all impact the real estate costs. In order to gain some insight into the commercial and industrial real estate conditions, Fourth Economy identified shovel-ready and build-ready sites in Kentucky. While these sites still vary in terms of their locations and amenities, using the shovel-ready and build-ready designation enables us to compare sites that could be occupied quickly versus vacant land or greenfields that require infrastructure and significant development.

Kentucky has nearly 10,000 acres that are shovel-ready across 64 sites in 26 counties. The lowest price per acre observed across the 64 sites was $8,000 at the Henderson Corporate Park in Henderson County (the average price per acre = $16,000 for Henderson County). The highest price was $354,795 per acre at the Melcon Lane Commerce Park in Laurel County.

Table 38: Shovel-Ready and Build-Ready Sites in Kentucky[57]

County	Total Acres	Average Price per Acre	Average Distance to an Airport	Number of Sites
Anderson	115.4	$22,900	17.0	1
Ballard	72.0	$15,000	22.0	1
Boone	571.0	$82,818	11.3	11
Boyd	368.6	$25,000	13.0	1
Bullitt	496.0	$102,210	17.3	4
Campbell	52.5	$82,000	12.5	2
Daviess	164.4	$35,000	1.0	1
Fayette	375.6	$93,833	7.0	3
Franklin	98.7	$34,798	16.7	3
Grant	37.6	$35,000	21.0	1
Graves	2,199.8	$18,125	23.0	2
Greenup	203.5	$25,000	16.5	2
Hancock	141.8	$15,000	20.0	1
Hardin	457.8	$36,250	7.0	2
Henderson	1,169.3	$16,000	11.4	5
Jefferson	601.9	$108,750	12.0	4
Jessamine	27.9	$30,000	18.0	1
Kenton	498.5	$82,400	10.0	5
Laurel	11.3	$354,795	5.0	1
Marshall	1,180.0	$65,000	21.0	1

57 Kentucky Cabinet for Economic Development. Think Kentucky. (n.d.). Select Kentucky. Retrieved from http://www.thinkkentucky.com/selectkentucky/

County	Total Acres	Average Price per Acre	Average Distance to an Airport	Number of Sites
Mason	25.0	$10,000	12.0	1
McCracken	510.1	$29,667	7.0	3
Oldham	18.4	$50,000	25.0	1
Pendleton	68.3	$15,000	7.0	1
Scott	410.0	$53,700	19.0	5
Woodford	80.5	$87,500	18.0	1
Grand Total	**9,955.9**	**$63,643**	**13.3**	**64**

Home values provide another reflection on real estate costs. It impacts the workforce directly, but higher residential values generally indicate higher real estate values in general. Home values in Kentucky are generally lower than the United States. The statewide median home value in 2015 was $123,200 for Kentucky, compared to $178,600 for the United States. There are two counties in Kentucky with higher median home values, but they also tend to have higher incomes.

Table 39: Counties with Home Values Higher than the U.S.[58]

County	Median Income	Median Home Value	County to US Income	County to US Home Value
Oldham County	$85,452	$247,500	1.59	1.39
Woodford County	$58,750	$181,300	1.09	1.02

Household incomes in Kentucky also tend to be lower than the United States. The median household income for Kentucky in 2015 was $43,740, compared to $53,889 for the United States. Ten counties had higher median household incomes than the United States and all but two of these had lower median home values.

Table 40: Counties with Household Incomes Greater than the U.S.[59]

County	Median Household	Median Home Value	County to U.S. Income	County to U.S. Home Value
Oldham County	$85,452	$247,500	1.59	1.39
Boone County	$66,730	$175,100	1.24	0.98
Spencer County	$63,000	$176,900	1.17	0.99
Scott County	$63,027	$164,600	1.17	0.92
Shelby County	$60,324	$175,700	1.12	0.98
Woodford County	$58,750	$181,300	1.09	1.02
Bullitt County	$55,975	$144,700	1.04	0.81
Campbell County	$54,621	$150,400	1.01	0.84
Kenton County	$54,296	$145,200	1.01	0.81
Anderson County	$53,974	$136,800	1.00	0.77

58 U.S. Census Bureau, 2011-2015 American Community Survey, 5-year Estimates. (2016). Tables B25077: Median Value (Dollars) - Universe: Owner-Occupied Housing Units; S1903: Median Income In The Past 12 Months (In 2015 Inflation-Adjusted Dollars).
59 Ibid.

Even though residential real estate is relatively less expensive in Kentucky than in the United States, the lower household incomes can create issues with affordability. Generally, home values that are less than 2.2 times annual income are considered affordable, and home values that are greater than 2.5 times annual income are not affordable. Kentucky has 28 counties where the median home value is less than 2.2 times annual income.

Table 41: Counties with the Most Affordable Housing[60]

County	Median Household Income	Median Home Value	Home Value to Income
Hickman County	$41,218	$68,400	1.66
Leslie County	$25,872	$45,500	1.76
Breathitt County	$25,817	$47,500	1.84
Letcher County	$30,333	$56,300	1.86
Magoffin County	$28,500	$53,100	1.86
Knott County	$30,411	$57,900	1.90
Webster County	$38,917	$74,600	1.92
Cumberland County	$32,019	$63,500	1.98
Carlisle County	$38,829	$77,200	1.99
Muhlenberg County	$38,961	$77,800	2.00
Harlan County	$25,814	$52,000	2.01
Breckinridge County	$43,479	$88,000	2.02
Livingston County	$42,171	$86,900	2.06
Hancock County	$50,476	$104,200	2.06
Ohio County	$40,189	$83,700	2.08
Union County	$40,120	$84,100	2.10
Carter County	$36,696	$77,100	2.10
Hopkins County	$42,346	$89,500	2.11
Green County	$34,982	$74,200	2.12
Pike County	$33,183	$70,400	2.12
Edmonson County	$41,710	$88,800	2.13
Fulton County	$28,359	$61,000	2.15
Crittenden County	$35,316	$76,000	2.15
Greenup County	$45,370	$97,700	2.15
Todd County	$40,497	$87,300	2.16
Pendleton County	$48,353	$104,800	2.17
Perry County	$32,667	$71,200	2.18
Bath County	$33,483	$73,500	2.20

60 U.S. Census Bureau, 2011-2015 American Community Survey, 5-year Estimates. (2016). Tables B25077: Median Value (Dollars) - Universe: Owner-Occupied Housing Units; S1903: Median Income In The Past 12 Months (In 2015 Inflation-Adjusted Dollars).

Kentucky has 29 counties where the ratio of home values to annual income is between 2.2 and 2.5. These counties are not yet facing an affordability issue, but real estate development within these counties could increase real estate prices. Any real estate development needs to be balanced with development of higher wage jobs.

Table 42: Counties with Somewhat Affordable Housing[61]

County	Median Household Income	Median Home Value	Home Value to Income
Jackson County	$29,826	$65,900	2.21
Gallatin County	$48,370	$107,500	2.22
Johnson County	$35,570	$79,200	2.23
McLean County	$40,770	$91,700	2.25
Lawrence County	$35,935	$81,400	2.27
Caldwell County	$42,537	$96,700	2.27
Monroe County	$31,045	$70,600	2.27
Allen County	$41,326	$95,500	2.31
Nicholas County	$36,097	$83,900	2.32
Clinton County	$28,025	$65,300	2.33
Owen County	$41,934	$98,000	2.34
Rockcastle County	$31,555	$73,900	2.34
Elliott County	$28,224	$66,100	2.34
Lewis County	$28,630	$67,100	2.34
Floyd County	$30,096	$70,600	2.35
Graves County	$39,530	$92,900	2.35
Boyd County	$42,319	$99,700	2.36
Trimble County	$47,409	$112,000	2.36
Casey County	$32,341	$76,500	2.37
Carroll County	$41,439	$99,200	2.39
Washington County	$40,976	$98,100	2.39
Estill County	$29,770	$71,400	2.40
Hart County	$34,774	$83,600	2.40
Ballard County	$42,244	$101,800	2.41
Fleming County	$35,469	$86,700	2.44
Logan County	$38,570	$94,600	2.45
Marshall County	$45,212	$111,600	2.47
Adair County	$33,362	$82,400	2.47
Menifee County	$31,503	$78,100	2.48

61 U.S. Census Bureau, 2011-2015 American Community Survey, 5-year Estimates. (2016). Tables B25077: Median Value (Dollars) - Universe: Owner-Occupied Housing Units; S1903: Median Income In The Past 12 Months (In 2015 Inflation-Adjusted Dollars).

Unfortunately, Kentucky has 63 counties where the home values are more than 2.5 times annual income. Even though many of these counties have home values that are well below the median for the United States, and the real estate may therefore be considered inexpensive, it is not necessarily affordable for local residents.

Table 43: Counties with the Least Affordable Housing[62]

County	Median Household Income	Median Home Value	Home Value to Income
Daviess County	$45,989	$115,400	2.51
Whitley County	$31,014	$77,900	2.51
Lincoln County	$37,139	$93,600	2.52
Meade County	$49,884	$126,100	2.53
Marion County	$38,826	$98,200	2.53
Anderson County	$53,974	$136,800	2.53
Morgan County	$29,707	$75,500	2.54
Metcalfe County	$32,294	$82,600	2.56
Wolfe County	$20,504	$52,700	2.57
Henderson County	$41,036	$105,500	2.57
Powell County	$29,736	$76,600	2.58
Bullitt County	$55,975	$144,700	2.59
Trigg County	$44,083	$114,100	2.59
Mason County	$38,824	$101,100	2.60
Henry County	$46,495	$121,300	2.61
Scott County	$63,027	$164,600	2.61
Clay County	$21,549	$56,300	2.61
Laurel County	$36,020	$94,400	2.62
Boone County	$66,730	$175,100	2.62
Bracken County	$36,327	$95,800	2.64
Martin County	$25,795	$68,200	2.64
Kenton County	$54,296	$145,200	2.67
Bell County	$22,443	$60,400	2.69
Butler County	$33,536	$90,800	2.71
Nelson County	$49,298	$133,600	2.71
Grayson County	$35,030	$95,500	2.73
Christian County	$39,521	$108,500	2.75
Campbell County	$54,621	$150,400	2.75
Barren County	$38,370	$105,800	2.76
Grant County	$44,824	$124,900	2.79
Spencer County	$63,000	$176,900	2.81
Wayne County	$28,573	$80,300	2.81

62 U.S. Census Bureau, 2011-2015 American Community Survey, 5-year Estimates. (2016). Tables B25077: Median Value (Dollars) - Universe: Owner-Occupied Housing Units; S1903: Median Income In The Past 12 Months (In 2015 Inflation-Adjusted Dollars).

County	Median Household Income	Median Home Value	Home Value to Income
Taylor County	$33,340	$93,700	2.81
Hardin County	$50,765	$143,100	2.82
McCracken County	$44,067	$124,400	2.82
Larue County	$38,578	$110,100	2.85
Russell County	$30,720	$88,000	2.86
Franklin County	$47,964	$137,500	2.87
Oldham County	$85,452	$247,500	2.90
Montgomery County	$39,275	$114,000	2.90
Garrard County	$44,243	$128,500	2.90
Shelby County	$60,324	$175,700	2.91
Simpson County	$39,679	$116,800	2.94
Knox County	$26,599	$78,400	2.95
Clark County	$47,959	$142,700	2.98
Lee County	$22,698	$67,700	2.98
Lyon County	$46,931	$141,000	3.00
Pulaski County	$34,790	$106,800	3.07
Woodford County	$58,750	$181,300	3.09
Bourbon County	$45,208	$139,600	3.09
Jefferson County	$48,695	$150,400	3.09
Rowan County	$36,860	$115,300	3.13
Warren County	$44,911	$141,500	3.15
Harrison County	$35,681	$113,000	3.17
Jessamine County	$50,558	$160,400	3.17
Mercer County	$42,083	$133,600	3.17
McCreary County	$19,328	$62,300	3.22
Calloway County	$37,034	$119,900	3.24
Robertson County	$31,741	$104,000	3.28
Owsley County	$20,985	$69,800	3.33
Boyle County	$39,704	$132,500	3.34
Fayette County	$49,778	$168,100	3.38
Madison County	$42,390	$144,800	3.42

Another type of real estate cost, which is ranked on a state level rather than a county-by-county level like the affordability of housing, is the burden of land use regulations, including the legal, legislative, and executive actions that a state takes with regard to land use, as well as local zoning regulations. For businesses looking to locate or expand in Kentucky, these regulations might result in relatively more application procedures for variances, permits, and amendments.

According to the rankings in the 2017 State Business Tax Climate Index, Kentucky is 4th among benchmark states in terms of its land use regulations, and it is ranked 17th overall in the nation.

Table 44: Kentucky and Benchmark State Rankings: Land Use Regulations[63]

State	Ranking
Kansas	1
Indiana	6
Alabama	8
Kentucky	17
Ohio	22
Arizona	41
Washington	44

Key Regulatory Costs

As noted earlier in this section, the Pacific Research Institute publishes an index where it ranks states in terms of how burdensome their regulations are to business creation and development, *The 50-State Small Business Regulation Index*.

In their overall rankings, Kentucky ranked 25th among the 50 states, and 5th when compared with the six benchmark states. The Pacific Research Institute creates this overall ranking by averaging a number of other comparative indices. Several of those indices will be discussed in this section to understand where Kentucky falls against the other benchmarking states, and against the rest of the country.

Table 45: 50-State Ranking of the Burdens from State Regulatory Structures[64]

State	Ranking
Indiana	1
Kansas	4
Alabama	15
Arizona	18
Kentucky	25
Ohio	27
Washington	42

Workers Compensation Insurance

Workers compensation insurance programs are state-designed programs that benefit workers injured on the job. These state-level mandates vary from state-to-state, both in terms of their benefit levels and in terms of the type of insurer. These mandates mandate set the amounts and terms of insurance payouts, unlike other types of insurance, which vary based on the specific needs of employers and employees. It is therefore debated on—and varies by—the state level whether this benefit ought to be mandated by the state government or reflected, for example, in higher overall wages.

Kentucky is among the states with the least burdensome workers' compensation programs, out-ranked only by Indiana, which has the second least burdensome program in the nation.

63 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.
64 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

Table 46: State Workers Compensation Insurance Programs[65]

State	Ranking
Indiana	2
Kentucky	11
Kansas	12
Arizona	14
Ohio	18
Alabama	22
Washington	34

Unemployment Insurance

Unemployment benefits are funded by jointly by federal and state governments. The benefit is funded by a tax paid by employers; an employer's taxable wage base, and the tax rate an employer is subject to, varies by state.

Table 47: State Unemployment Insurance Programs[66]

State	Ranking
Arizona	3
Alabama	9
Ohio	13
Indiana	19
Kansas	25
Kentucky	29
Washington	48

Kentucky ranks 29th nationwide in terms of how burdensome the state costs of its unemployment insurance program is, which is likely to be ameliorated by an action by Governor Bevin in late 2016, rolling back a 0.21% surcharge of the taxable wage base of $10,200 per employee that had been instituted since 2012 to pay back the federal government for unpaid interest on unemployment insurance benefits.

Short-term Disability Insurance

All six of the benchmark states, like Kentucky, do not require short-term disability insurance.

Effective State Minimum Wage

The federal government requires a $7.25 minimum wage, on top of which cities and state impose their own minimum wage rules. Like three of the benchmark states, Kentucky's minimum wage is $7.25.

Table 48: Ranking of Effective State Minimum Wage[67]

State	Ranking
Alabama	1
Indiana	1
Kansas	1

65 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.
66 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.
67 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

State	Ranking
Kentucky	1
Arizona	33
Ohio	36
Washington	50

Workers in Aerospace & Aviation are part of the large skilled labor force who earn above the minimum wage; however, Kentucky's low state minimum wage may be an incentive for businesses in adjacent industries (for example, Logistics or Food Service, which are both tied into airports and therefore to Aviation) that pay workers at minimum wage.

State Family Leave Mandates

The federal Family Medical Leave Act (FMLA) mandates that private employers with at least 50 employees provide their employees with at least 12 weeks of unpaid leave per year for reasons including managing a medical condition, taking care of a newborn or newly-adopted child, and caring for a family member. In addition to the federal regulation, some states require additional, more generous protections for employees (for example, by decreasing the threshold of the number of employees in a business that are needed to be eligible for FMLA leave). Opponents of family medical leave requirements say that they disproportionally affect small businesses, making it costlier to run a business and take on additional staff. Kentucky does not have any additional family leave legislation, putting it on par with Alabama, Arizona, Kansas, and Ohio.

Table 49: Ranking of State Family Leave Mandates[68]

State	Ranking
Alabama	1
Arizona	1
Kansas	1
Kentucky	1
Ohio	1
Indiana	25
Washington	47

Right-to-Work Laws

As of January 2017, Kentucky is a Right-to-Work state, placing it in a group of states (including four of the benchmark states: Arizona, Alabama, Indiana, and Kansas) with right-to-work legislation. These laws enable employees to decide whether to join a union and are now on the books in 27 states. Proponents of right-to-work laws say that without them, unions have an unfair advantage, which they exercise by negotiating "excessively high" rates for their members, which limits opportunities for unemployed workers. Right-to-work laws have been changing the landscape of Aerospace manufacturing; for example, in late 2016, GKN Aerospace announced that they would lay off 300 union workers (members of the International Association of Machinists & Aerospace Workers) involved in the manufacture of fighter jets

68 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

and move those jobs to a facility in Alabama, a right-to-work state.[69] In Aviation, there are a number of airline and aviation trade unions. Because no airlines are headquartered in Kentucky, it is unclear how right-to-work will affect aviation. Kentucky lawmakers credited the recent right-to-work legislation with enabling Amazon's announced $1.5 billion investment, announced in late January 2017.[70]

Occupational Licensing and Certification Regulations

Occupational licenses, which are a more stringent requirement, and certificates, a less stringent requirement, are established by governments to create qualifications for receiving payment for work done in certain occupations. The Pacific Research Institute's rankings are based on the number of job categories that require a license or certificate, the share of the workforce that is licensed, and the share of the workforce that is certified.

Table 50: Ranking Occupational Licensing and Certification Regulations[71]

State	Ranking
Kansas	2
Alabama	15
Ohio	19
Indiana	19
Washington	26
Arizona	31
Kentucky	49

In the PRI rankings, South Carolina requires the least in terms of workforce licensing and certification, and Connecticut requires the most. Kentucky is ranked 49th in the nation, its lowest ranking in the *Small Business Regulation Index*. The relevance of this ranking to Aerospace & Aviation is not entirely clear; however, many of the certifications required to work in A&A are mandated by the FAA (for example, Aviation maintenance workers are required to take certification exams, but because they are federally-mandated, Kentucky does not face a competitive disadvantage).

The Economic Efficiency of State Energy Regulations

According to the PRI 50-State Small Business Index, states with regulations that "restrict the supply of energy, impose direct mandates and costs on the production of energy, or make energy consumption more difficult, will make it more difficult for small businesses to thrive." Energy regulations may include renewable portfolio standards, regulations on electricity transmission, and revenue decoupling regulations, which guarantee utilities to earn a set level of revenue even if customers fall short of their consumption by having customers pay a higher rate on their bills.

69 International Association of Machinists and Aerospace Workers. (2016). Machinists Union Condemns GKN Plan to Ship 300 St. Louis Jobs to Alabama. Retrieved from https://www.goiam.org/press-releases/machinists-union-condemns-gkn-plan-ship-300-st-louis-jobs-alabama/

70 Monk, D. (2017). Amazon Expansion: First Big Win for Kentucky's Right-to-Work Law?. WCPO Cincinnati. Retrieved from http://www.wcpo.com/news/insider/amazon-expansion-first-big-win-for-kentuckys-right-to-work-law

71 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

Table 51: Ranking of the Economic Efficiency of State Energy Regulations[72]

State	Ranking
Alabama	1
Kansas	7
Ohio	14
Arizona	20
Indiana	29
Kentucky	32
Washington	44

Kentucky's regulatory environment about energy ranks 32nd-best in the nation, putting it behind all of the other benchmark states besides Washington. Alabama is ranked as having the most economically efficient energy regulations.

Tort Liability

The statewide legal environment for civil proceedings can be an important factor in deciding where to locate or do business; according to the PRI report, 70% of companies surveyed cite a state's tort liability as a key factor in important business decisions. The relative expense and efficiency of the system through which lawsuits are filed and resolved has very real consequences for small businesses, for which a single lawsuit can have a catastrophic impact.

Table 52: Ranking of the State Tort Liability Environment[73]

State	Ranking
Kansas	5
Indiana	14
Arizona	17
Washington	22
Ohio	30
Kentucky	39
Alabama	43

Kentucky ranks 39th in terms of its state tort liability environment, which places it at a competitive disadvantage to the benchmark states, with the exception of Alabama, which is 43rd in the PRI ranking.

Benchmarking the Benchmarks

Compared to the six benchmark states that Kentucky's regulatory environment was measured against, this section identifies the states that regularly ranked higher than Kentucky, and in which areas. Indiana, Kansas, and Alabama outperformed Kentucky across more than half of the ten indices used to describe the state regulatory environment. Ohio and Washington had a worse overall regulatory environment ranking, but outperformed Kentucky in areas like Occupational Licensing and Certification Regulations and State Tort Liability Environment. Indiana, Kansas, and Alabama may be worth examining in terms of their relative lack of regulatory burden. It is recommended that Kentucky pay some additional attention to the

72 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.
73 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

inventory tax issues outlined in the "Tax Rates" section of this chapter, which stands to particularly affect A&A companies.

Table 53: Benchmark State Rankings compared to Kentucky[74]

State	Times Ranked Higher than Kentucky (Across 10 Indices)	Where it Ranked Higher
Indiana	9	State Workers Compensation Programs; State Unemployment Insurance Programs; Effective State Minimum Wage; State Family Leave Mandates; Occupational Licensing and Certification Regulations; Land Use Regulations; Economic Efficiency of State Energy Regulations; State Tort Liability Environment; State Start-up and Annual Filing Regulatory Burdens
Kansas	8	State Workers Compensation Programs; Effective State Minimum Wage; State Family Leave Mandates; Occupational Licensing and Certification Regulations; Land Use Regulations; Economic Efficiency of State Energy Regulations; State Tort Liability Environment
Alabama	7	State Unemployment Insurance Programs; Effective State Minimum Wage; Occupational Licensing and Certification Regulations; Land Use Regulations; Economic Efficiency of State Energy Regulations; State Start-up and Annual Filing Regulatory Burdens
Arizona	5	State Unemployment Insurance Programs; State Family Leave Mandates; Occupational Licensing and Certification Regulations; Economic Efficiency of State Energy Regulations; State Tort Liability Environment
Ohio	4	State Unemployment Insurance Programs; Occupational Licensing and Certification Regulations; Economic Efficiency of State Energy Regulations; State Tort Liability Environment
Washington	3	Occupational Licensing and Certification Regulations; State Tort Liability Environment; State Start-up and Annual Filing Regulatory Burdens

74 Pacific Research Institute. (2015). The 50-State Small Business Regulation Index.

Kentucky Commission on Military Affairs &
the Commonwealth of Kentucky

Chapter 3: Education & Workforce Analysis

Key Findings

This chapter focuses on two areas: talent supply and talent demand for Aerospace & Aviation. On the talent demand side, the chapter identifies the top 15 key occupations in Aerospace Products and Aviation Services. These are the occupations that a) are projected to grow over the next five years; b) provide median hourly earnings of at least 80% of the median earnings for all occupations in the state; and (for those that meet criteria a and b), c) have the most employment in Kentucky as of 2016. Talent demand focuses solely on these key occupations and provides data on current employment in each of these key occupations, median hourly earnings, and the number of net-new jobs that are projected in the next five years. The demand side also identifies projected training and education needs for each of the key occupations. On the talent supply side, the chapter identifies overall educational attainment for the state of Kentucky and overall postsecondary completions and information on out-migration for Kentucky postsecondary institution graduates. The talent supply side section then drills down into postsecondary completions in majors related to the identified key occupations in Aerospace & Aviation, as well as high school programs and apprenticeships related to the key occupations.

A fuller version of workforce and education implications and recommendations will be provided in Chapter 8 of this study. The intent of this executive summary is to identify key takeaways related to this topic. The following takeaways are separated into 3 topics: Aerospace Products, Aviation Services, and Commonalities between Aerospace Products & Aviation Services.

Aerospace Products

- Roughly, 30% of jobs in the top 15 key occupations identified for Aerospace Products are in the Architecture and Engineering broad occupational group, and 23% are in the Production occupational group.
- At the more detailed level, among the top 15 key occupations, Industrial Engineers comprise the largest share of total sector jobs in 2016 (227 jobs, 7.3% of the sector), followed by Aircraft Mechanics & Service Technicians (155 jobs, 5.0%) and Team Assemblers (112 jobs, 3.6%).
- Industrial Engineers is the key occupation that is projected to grow by the most jobs (+14, 6% growth), followed by Aircraft Structure, Surfaces, Rigging, & Systems Assemblers (+10, 10% growth).
- With a large number of undergraduate Industrial Mechanics and Maintenance Technology certificates (837) and associate degrees (137) conferred in 2015, the state is well-positioned to fill key occupations related to Installation, Maintenance, and Repair. Additionally, with 449 bachelor's degrees awarded by Kentucky institutions in programs related to Computer and Math, the state likely has a solid supply of graduates for key occupations such as Computer Systems Analysis and Software Development (Applications and Systems Software).
- Retaining Kentucky graduates in Mechanical and Industrial Engineering (bachelor's degree level); encouraging more students to enroll in Aerospace Engineering and related programs at Kentucky institutions of higher education; and recruiting Aerospace Engineering graduates from other states is necessary to fill the growing demand for Industrial, Mechanical and Aerospace Engineers in the Aerospace Products sector.

Aviation Services

- The majority (62%) of jobs in the top 15 key occupations in Aviation Services are in the Installation, Maintenance, and Repair broad occupational group, followed by the Transportation and Material Moving occupational group (22%).
- At a more detailed level, among the top 15 key occupations in this sector, Aircraft Mechanics & Service Technicians comprise the largest share of total Aviation Services jobs in 2016 (560 jobs, or 12.5% of the sector), followed by Commercial Pilots (138 jobs, 3.1%) and Airfield Operations Specialists (67 jobs, 1.5%).
- Among the top 15 key occupations in Aviation Services, Commercial Pilots are projected to gain the most jobs over the next 5 years (+97 jobs), followed by Aircraft Mechanics & Service Technicians (+82 jobs) and General & Operations Managers (+12 jobs).
- There are opportunities to retain certificate and Career and Technical Education (CTE) completers for occupations in the Aviation Services sector, where 90% of key occupations identified require less than an associate degree.
- Currently Kentucky does not have high school or postsecondary programs directly related to the Airfield Operations Specialists key occupation. The state may want to pursue opportunities to create high school CTE or apprenticeship programs in this area.

Commonalities between Aerospace Products & Aviation Services

- Overall, Kentucky's high school and postsecondary programs appear to offer an ample potential talent supply to meet the needs of its talent demand in Aerospace & Aviation key occupations.
- Three key occupations are common among both Aerospace Products and Aviation Services:
    - ***Aircraft Mechanics & Service Technicians*** (representing 12.5% of the Aerospace Products sector vs. 5.0% of the Aviation Services Sector in 2016; totaling 715 workers in 2016)
    - ***Purchasing Agents, Except Wholesale, Retail, & Farm Products*** (2.1% of the Aviation Services sector vs. 0.4% of the Aerospace Products sector, for a total of 83)
    - ***Production, Planning, & Expediting Clerks*** (1.7% of Aviation Services vs. 0.6% of Aerospace Products, totaling 79 workers in 2016).
- Kentucky's institutions of higher education provide diverse postsecondary programs related to Aerospace & Aviation key occupations. Further, stakeholders indicate that research & development conducted by each institution may be an asset for recruiting and retaining students in Aerospace & Aviation-related programs.
- Kentucky's high schools offer a variety of career pathways in Career and Technical Education related to key occupations in Aerospace & Aviation. Completers of these programs may be well-positioned to enter occupations that require only high school diplomas or higher, particularly in Aviation Services. Further, completers of CTE programs in areas that directly connect to postsecondary programs related to A&A key occupations may offer a pipeline to increase enrollments and completions in postsecondary degree programs, particularly those related to Aerospace Products.
- Kentucky may benefit from increasing its apprenticeship offerings in areas specifically related to Aerospace & Aviation.

Introduction

Companies and site selectors are placing increased emphasis on the availability of a qualified workforce and the availability of education and workforce programs can sway business location decisions. According to a recent survey of corporate executives, 9 out of 10 consider the availability of skilled labor to be "important" or "very important," and nearly 7 out of 10 agree that training programs are "important" or "very important" when deciding to locate in a particular community.[1]

Chapter 1 of this study established the size and scope of the Aerospace & Aviation industries in the state of Kentucky. These industries play a significant role in the state's economy, but if that role is to remain strong and grow in the future, a system for training and retaining talented workers for key in-demand occupations in these sectors must be in place. Further, it is important for the state to have an understanding of current, high demand occupations in Aerospace & Aviation, as well as the potential earnings, education, and training levels needed to fill these positions. It is also vital to establish an understanding of Kentucky's supply of workers—both current and potential.

To address these needs, this chapter begins by looking at the demand side of Aerospace Products & Aviation Services industries, with an identification and analysis of the top 15 key occupations in these two sectors, the projected education and training needs in these occupations over the next five years, and relevant knowledge, skills, and abilities associated with these occupations. It should be noted when discussing demand that employment forecasts contained in this chapter are based on a fairly conservative view of the future, in which the state does not significantly enhance its number of Aerospace & Aviation companies. If the state improves its national image in the cluster and expands employment, employment demand would also increase.

The demand analysis is followed by an analysis of Kentucky's potential "supply" for these key occupations. The supply side includes an overview of the most current adult educational attainment levels (ages 25 and older) and total completions for programs offered by postsecondary institutions in Kentucky that are related to the key occupations in Aerospace & Aviation. The chapter also addresses current Career and Technical Education (CTE) and Aerospace & Aviation-related programs in secondary schools in the state. Finally, the chapter identifies apprenticeship programs in the state, and the ways in which apprenticeship programs may augment the potential supply of workers from CTE and postsecondary programs and further meet the needs of the state in Aerospace & Aviation.

Comparison of the "supply" side against the "demand" side allows for identification of areas in which the current supply of working adults may be able to meet the demands, both current and future, of key occupations in the Aerospace & Aviation cluster. Chapter 8 of this report, focused on recommendations, will touch on areas where the state may want to consider expanding its education and training offerings to ensure that the occupational demands of the cluster are met.

1 Area Development. (2016). 30th Annual Survey of Corporate Executives: Cautious Optimism Reflected. Retrieved from http://www.areadevelopment.com/Corporate-Consultants-Survey-Results/Q1-2016/corporate-executive-site-selection-facility-plans-441729.shtml

Talent Demand: Aerospace & Aviation

Aerospace & Aviation Key Industries

In Chapter 1 of this study, TPMA identified key industries at the 6-digit NAICS level within the Aerospace & Aviation cluster in Kentucky. For reference, Table 1 lists those industries. The key occupations identified in subsequent sections of this chapter fall into these key industries:

Table 1: Key Industries within Aerospace & Aviation

Aerospace Products – Key Industries	
NAICS	*Industries*
333314	Optical Instrument and Lens Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
336411	Aircraft Manufacturing
336412	Aircraft Engine and Engine Parts Manufacturing
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
Aviation Services – Key Industries	
481111	Scheduled Passenger Air Transportation
481112	Scheduled Freight Air Transportation
481211	Nonscheduled Chartered Passenger Air Transportation
481212	Nonscheduled Chartered Freight Air Transportation
481219	Other Nonscheduled Air Transportation
488111	Air Traffic Control
488119	Other Airport Operations
488190	Other Support Activities for Air Transportation
611512	Flight Training

Top 15 Key Occupations in Aerospace & Aviation

An examination of occupational demand is separate and distinct from industry analysis, because industries require a mix of occupations to function. For example, industries in the Aviation Services group employ occupations that may be more obviously identified as "aviation occupations," such as Commercial Pilots or Airfield Operations Specialists. However, in order to function, this group must also employ managers, accountants, maintenance and repair personnel, administrative support staff, and many other occupational categories.

While there are many varied occupations in Kentucky's Aerospace & Aviation cluster, this chapter focuses on the top 15 occupations in each of the Aerospace Products and Aviation Services groups. The top 15 key occupations were identified using the following methodology.

Key occupations are those that fall into the Aerospace Products and/or Aviation Services key industries and:

- Are projected to grow over the next 5 years; [2]
- Provide median hourly earnings of at least 80% of the median earnings for all occupations in the state;[3] and
- Have the most employment in Kentucky as of 2016.

The chapter chooses to focus on these key occupations because they represent occupational growth within the Aerospace & Aviation cluster, and they pay relatively high wages. Further, focusing on these key occupations allows the supply side to target the specific education and training needs of these occupations and better identify whether the state is poised to meet the needs of the growing occupations.

Aerospace Products

Top 15 Key Occupations

Table 2 identifies the top 15 key occupations in Aerospace Products at the detailed occupation level[4] (5-digit Standard Occupational Classification). Top 15 key occupations in Aerospace Products represent 1,181 jobs as of 2016 and are projected to increase to 1,253 by 2021. Industrial Engineers makes up the largest share of sector jobs in 2016 (227 jobs, 7.3% of the sector), followed by Aircraft Mechanics & Service Technicians (155 jobs, 5.0%), and Team Assemblers (112 jobs, 3.6%). In addition to making up the largest share of sector jobs in 2016, Industrial Engineers is also projected to grow by the most jobs (+14, 6% growth), followed by Aircraft Structure, Surfaces, Rigging, & Systems Assemblers (+10, 10% growth). The remainder of the key occupations in this sector are projected to grow by fewer than 10 jobs. The greatest proportional gain in jobs is anticipated for Aerospace Engineers, projected to add nine new jobs over the next five years, or a 29% growth rate, the highest growth rate within this sector.

The key occupations at the detailed occupation level in Aerospace Products represent 6 broader occupational groups. The occupational groups and the individual occupations include:

Architecture & Engineering

- Aerospace Engineers
- Industrial Engineers
- Mechanical Engineers

2016 Industry Employment
359

5-Year Projected Aerospace Growth
31 jobs

Production

- Team Assemblers
- Aircraft Structure, Surfaces, Rigging, & Systems Assemblers
- Computer-Controlled Machine (CNC) Tool Operators, Metal & Plastic

2016 Industry Employment
271

5-Year Projected Aerospace Growth
17 jobs

2 Emsi 2016.3.
3 Emsi 2016.3. The median hourly earnings for Kentucky is $18.38/hour.
4 Emsi 2016.3. These occupations are by 5-digit SOC codes.

Installation, Maintenance, & Repair

- Aircraft Mechanics & Service Technicians
- Industrial Machinery Mechanics

2016 Industry Employment
216

5-Year Projected Aerospace Growth
4 jobs

Computer & Mathematical

- Computer Systems Analysts
- Software Developers, Applications
- Software Developers, Systems Software

2016 Industry Employment
110

5-Year Projected Aerospace Growth
10 jobs

Business & Financial Operations

- Logisticians
- Purchasing agents, except Wholesale, Retail & Farm Products
- Business Operations Specialists, All Other

2016 Industry Employment
171

5-Year Projected Aerospace Growth
7 jobs

Office & Administrative Support

- Production, Planning, & Expediting Clerks

2016 Industry Employment
54

5-Year Projected Aerospace Growth
3 jobs

About 30% of key occupations identified are in the Architecture and Engineering occupational group, and 23% are in Production occupations. These groups are also projected to show the most growth.

Table 2 lists in further detail each top 15 key occupation's employment and share of the Aerospace Sector in 2016, anticipated job change over the next 5 years, median hourly earnings, and typical entry-level job training and educational requirements.

Table 2: Top 15 Key Occupations (Aerospace Products) by 2016 Employment, 6-digit SOC[5]

Key Aerospace Products Occupations	2016 Employment	Change 2016-2021 #	Change 2016-2021 %	2016 Share of Sector Jobs	Median Hourly Earnings	Typical Entry On-The-Job Training	Typical Entry Level Education
Industrial Engineers	227	14	6%	7.3%	$37.86	None	Bachelor's Degree
Aircraft Mechanics & Service Technicians	155	1	1%	5.0%	$41.93	None	Postsecondary non-degree award
Team Assemblers	112	2	2%	3.6%	$16.62	Moderate-term	HS diploma or equivalent
Mechanical Engineers	101	8	8%	3.2%	$37.08	None	Bachelor's degree
Aircraft Structure, Surfaces, Rigging, & Systems Assemblers	99	10	10%	3.2%	$21.24	Moderate-term	HS diploma or equivalent
Logisticians	69	3	4%	2.2%	$34.15	None	Bachelor's degree
Purchasing Agents, Except Wholesale, Retail, & Farm Products	66	1	2%	2.1%	$26.02	Long-term	Bachelor's degree
Industrial Machinery Mechanics	61	3	5%	2.0%	$23.75	Long-term	HS diploma or equivalent
Computer-Controlled Machine Tool Operators, Metal & Plastic	60	5	8%	1.9%	$17.54	Moderate-term	HS diploma or equivalent
Production, Planning, & Expediting Clerks	54	3	6%	1.7%	$21.06	Moderate-term	HS diploma or equivalent
Software Developers, Applications	46	2	4%	1.5%	$34.98	None	Bachelor's degree
Software Developers, Systems Software	45	5	11%	1.5%	$40.69	None	Bachelor's degree
Business Operations Specialists, All Other	36	3	8%	1.2%	$29.13	None	Bachelor's degree
Aerospace Engineers	31	9	29%	1.0%	$41.80	None	Bachelor's degree
Computer Systems Analysts	19	3	16%	0.6%	$34.22	None	Bachelor's degree

Hourly Wages

Key occupations in Aerospace Products industries offer fairly high wages; 67% (10 of 15) offer median hourly earnings of $25.00 or higher, and 53% (8 of 15) offer median hourly earnings of $30.00 or higher. By comparison, overall average wages in the state of Kentucky are $18.38/hour. Of the key detailed occupations, Aircraft Mechanics and Service Technicians pays the highest median wage at $41.93/hr. and

5 Emsi 2016.3. These occupations are by 6-digit SOC. Employment includes only the target Aerospace Products industries.

Aerospace Engineers has the 2nd highest median wage at $41.80/hr. Comparatively, Team Assemblers have the lowest wage at $16.62/hr.

On average, Aerospace Products occupations offer higher median wages than Aviation Services. While 67% (10 of 15) of Aerospace Products occupations offer median hourly wages of $25.00 or higher, only 47% (7 of 15) of Aviation Services jobs exceed $25.00/hr. Further, 53% (8 of 15) Aerospace Products occupations offer median hourly wages of $30.00 or higher, compared to only 20% (3 of 15) of Aviation Services occupations.

Typical Education and Training Requirements

More than half (55%, or 688 jobs) of jobs in key Aerospace occupations require a 4-year degree, and an additional 12% require a postsecondary non-degree award. The remaining one-third of jobs require a high school diploma. Most (62%) of projected jobs in the key occupations do not require on-the-job training, although many of the jobs that do not require training (about 80%) require a bachelor's degree, which may in part explain why training is not required for them. Over 300 projected jobs (28%) require moderate on-the-job training, and 131 jobs (10%) require long-term training.[6] [7]

Figure 1: Education Requirements (Key Aerospace)

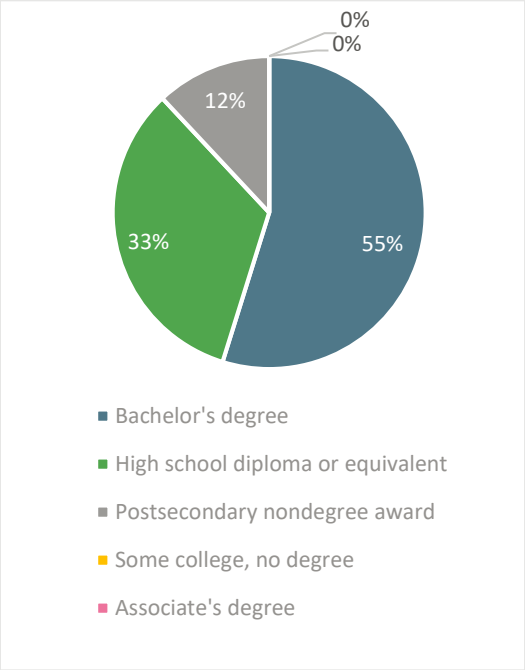
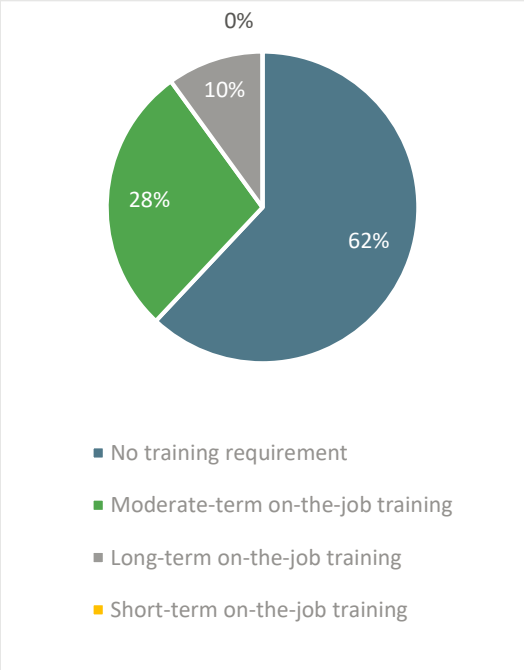


Figure 2: Training Requirements (Key Aerospace)



Aviation Services

Top 15 Key Occupations

Table 3 identifies the top 15 key occupations at the detailed occupation level (6-digit SOC) in Aviation Services. These occupations represent 1,124 jobs in the sector, a figure that is expected to grow to 1,375 jobs by 2021. The majority of the top 15 detailed key occupations are in the Installation, Maintenance,

6 Emsi 2016.3

7 Bureau of Labor Statistics defines short-term OJT as one month of less; moderate OJT as more than one month and up to 12 months; and long term as more than 12 months.

and Repair occupations group (62%), followed by the Transportation and Material Moving occupations group (22%). These 2 occupational groups are also projected to show the most growth over the next 5 years.

The key Aviation Services occupations at the detailed occupation level represent 7 broader occupational groups. The occupational groups and the individual occupations include:

Installation, Maintenance, & Repair

- Aircraft Mechanics & Service Technicians
- First-Line Supervisors of Mechanics, Installers & Repairers
- Maintenance & Repair Workers, General
- Maintenance Workers, Machinery
- Avionics Technicians

2016 Industry Employment
693

5-Year Projected Aviation Growth
110 jobs

Transportation and Material Moving

- Commercial Pilots
- Airfield Operations Specialists
- First-Line Supervisors of Helpers, Laborers, & Material Movers, Hand
- First-Line Supervisors of Transportation & Material-Moving Machine & Vehicle Operators

2016 Industry Employment
248

5-Year Projected Aviation Growth
108 jobs

Management

- General & Operations Managers

2016 Industry Employment
53

5-Year Projected Aviation Growth
12 jobs

Production

- Inspectors, Testers, Sorters, Samplers & Weighers

2016 Industry Employment
40

5-Year Projected Aviation Growth
9 jobs

Office & Administrative Support

- Bookkeeping, Accounting, & Auditing Clerks
- Production, Planning & Expediting Clerks

2016 Industry Employment
50

5-Year Projected Aviation Growth
7 jobs

Business & Financial Operations

- Purchasing Agents, Except Wholesale, Retail, & Farm Products

2016 Industry Employment
17

5-Year Projected Aviation Growth
2 jobs

Sales & Related

- Sales Representatives, Services, All Other

2016 Industry Employment
23

5-Year Projected Aviation Growth
3 jobs

Aircraft Mechanics & Service Technicians makes up the largest share of sector jobs (560 jobs, 12.5% of the sector), followed by Commercial Pilots (138 jobs, 3.1%) and Airfield Operations Specialists (67 jobs, 1.5%). Commercial Pilots represents the largest projected job growth over the next 5 years (+97 jobs), followed by Aircraft Mechanics & Service Technicians (+82 jobs) and General & Operations Managers (+12 jobs). The remaining key occupations are projected to add fewer than 10 jobs each over the next 5 years.

Note that 3 occupations are common among ***both Aerospace Products and Aviation Service***s:

- Aircraft Mechanics & Service Technicians (12.5% of the Aviation Services sector vs. 5.0% of the Aerospace Products Sector)
- Purchasing Agents, Except Wholesale, Retail, & Farm Products (2.1% of the Aviation Services sector vs. 0.4% of the Aerospace Products sector)
- Production, Planning, & Expediting Clerks (1.7% of Aviation Services vs. 0.6% of Aerospace Products).

Table 3 lists in further detail each top 15 key occupation's employment and share of the Aviation Sector in 2016, anticipated job change over the next 5 years, median hourly earnings, and typical job training and entry-level education.

Table 3: Top 15 Key Occupations (Aviation Services) by 2016 Employment, 6-digit SOC[8]

Key Aviation Services Occupations	2016 Employment	Change 2016-2021 #	Change 2016-2021 %	2016 Share of Sector Jobs	Median Hourly Earnings	Typical On-the-Job Training	Typical Entry Level Education
Aircraft Mechanics & Service Technicians	560	82	15%	12.5%	$41.93	None	Postsecondary non-degree award
Commercial Pilots	138	97	70%	3.1%	$34.72	Moderate-term	HS diploma or equivalent
Airfield Operations Specialists	67	4	6%	1.5%	$28.76	Long-term	HS diploma or equivalent
First-Line Supervisors of Mechanics, Installers, & Repairers	61	9	15%	1.4%	$26.66	None	HS diploma or equivalent
General & Operations Managers	53	12	23%	1.2%	$36.66	None	Bachelor's degree
Inspectors, Testers, Sorters, Samplers, & Weighers	40	9	23%	0.9%	$16.44	Moderate-term	HS diploma or equivalent
Maintenance and Repair Workers, General	34	4	12%	0.8%	$16.83	Long-term	HS diploma or equivalent
Bookkeeping, Accounting, & Auditing Clerks	25	4	16%	0.6%	$16.39	Moderate-term	Some college, no degree
Production, Planning, & Expediting Clerks	25	3	12%	0.6%	$21.06	Moderate-term	HS diploma or equivalent
Maintenance Workers, Machinery	23	6	26%	0.5%	$21.62	Moderate-term	HS diploma or equivalent
Sales Representatives, Services, All Other	23	3	13%	0.5%	$20.81	Moderate-term	HS diploma or equivalent
First-Line Supervisors of Helpers, Laborers, & Material Movers, Hand	22	3	14%	0.5%	$21.75	None	HS diploma or equivalent
First-Line Supervisors of Transportation & Material-Moving Machine & Vehicle Operators	21	4	19%	0.5%	$24.76	None	HS diploma or equivalent
Purchasing Agents, Except Wholesale, Retail, & Farm Products	17	2	12%	0.4%	$26.02	Long-term	Bachelor's degree
Avionics Technicians	15	9	60%	0.3%	$27.05	None	Associate degree

8 Emsi 2016.3. These occupations are by 6-digit SOC. Employment includes only the targeted Aviation Services industries.

Wages

In general, occupations in the Aviation Services group have lower median hourly earnings than those in the Aerospace Products group, although some Aviation Services occupations offer high earnings. In addition to being the largest key Aviation Services occupation by employment, Aircraft Mechanics & Service Technicians also pay the highest median wage, at $41.93/hr. Commercial Pilots, the occupation projected to add the most jobs over the next 5 years, also represents fairly high median hourly earnings ($34.72/hr., 3rd highest of the key occupations). Avionics Technicians, which is projected to grow by 60% over the next 5 years (+9 jobs), has the 5th highest median hourly earnings in the group. Of the key positions identified, the lowest median wage is for Bookkeeping, Accounting, & Auditing Clerks at $16.39 per hour.

It is important to note that positive wage impacts are noticeable for non-degree awards and certificates, where short-term certificates generally require six to 29 credits and long-term certificates more than 29 credits but less than an associate degree. A 2014 study analyzing student data from the Kentucky Community and Technical College System and Unemployment Insurance wage records found an associate degree had a positive quarterly wage impact of nearly $1,500 for men and $2,400 for women, while certificates returned approximately $300 per quarter for both men and women.[9]

By and large, the labor market rewards career and technical education, especially engineering and industrial technology credentials and certificates. Recent research shows statistically significant gains to wages (+11%) for these credentials earned through California's community college system – including short term and long-term certificates and associates degrees.[10] A follow-on paper in 2016 found approximately $1,600 annual wage return for just six credit hours in engineering and industrial technology programs.[11]

9 Jepsen, et. al. (2014). The Labor-Market Returns to Community College Degrees, Diplomas, and Certificates. Retrieved from http://www.journals.uchicago.edu/doi/10.1086/671809
10 Bahr, P.R. (2014). The Labor Market Return in Earnings to Community College Credits and Credentials in California. Retrieved from https://umich.app.box.com/v/bahr-2014-earnings1
11 Bahr, P.R. (2016). The Earnings of Community College Graduates in California. Retrieved from https://umich.app.box.com/v/Bahr-2016-earnings-complete

Typical Education and Training Requirements

The figures below identify the education and training requirements for the top 15 key occupations that are projected to exist in 2021.

Figure 3: Education Requirements (Key Aviation)

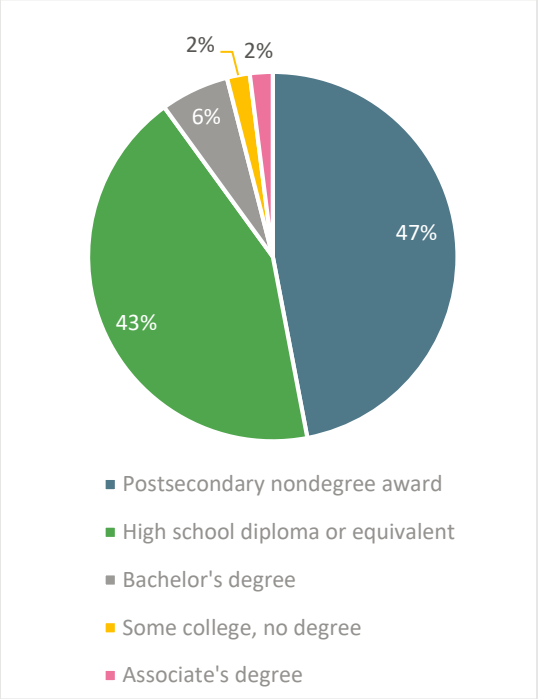
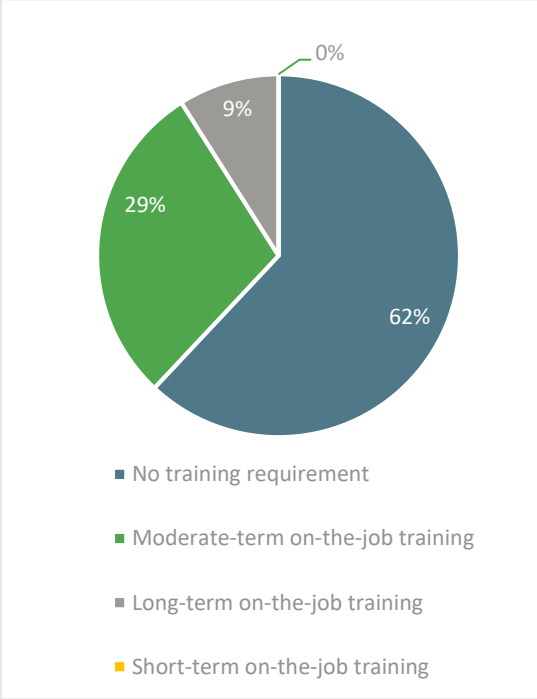


Figure 4: Training Requirements (Key Aviation)



Of the 15 key growing occupations in Aviation Services, the vast majority (90%) require less than an associate degree. However, 47% of the projected jobs (642) in key occupations in 2021 will require a postsecondary non-degree award, which is usually a shorter-term certification requiring 2 years or less education. Approximately 8% of projected jobs (108) in key Aviation Services industries will require an associate or bachelor's degree. In terms of training and experience requirements, the majority of jobs (62%, or 851 jobs that are projected to exist in 2021) will require no training; 29% will require moderate on-the-job training and 9% will require long-term training.[12]

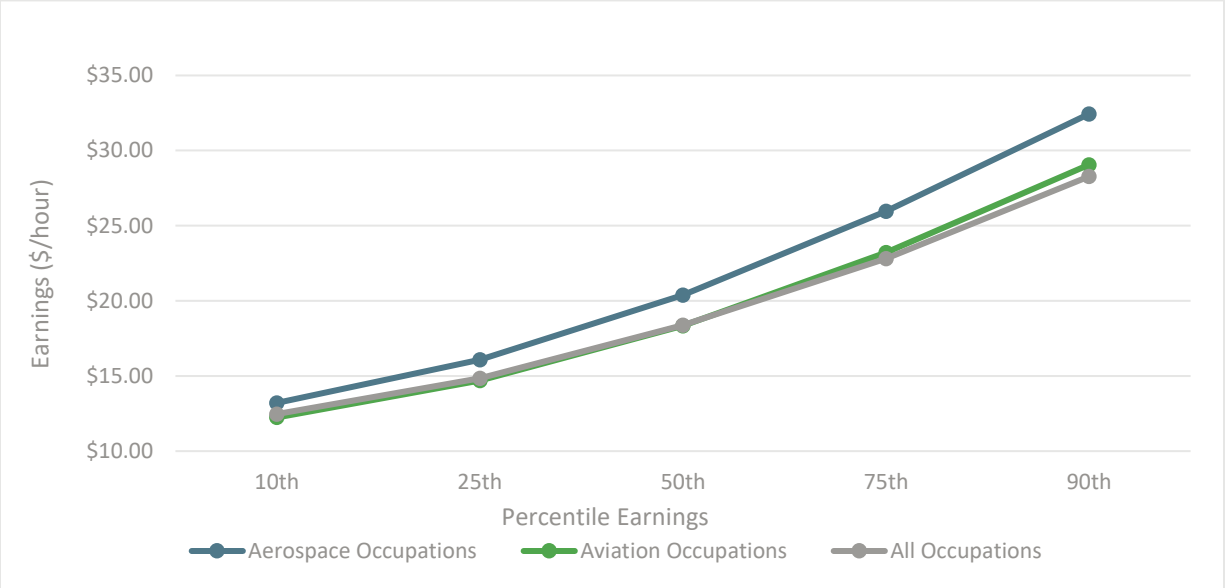
12 Emsi 2016.3. These occupations are by 6-digit SOC. Employment includes only the target Aviation Services industries.

Earnings Scales for Key Aerospace & Aviation Occupations

To further expand on hourly earnings shown in Tables 2 and 3, Figure 5 displays hourly earnings for the key occupations in the Aviation Services and Aerospace Products sectors, as compared to hourly earnings for all occupations in the state. The horizontal axis shows the earnings at various percentile[13] levels between 10th and 90th. Typically, earnings at the 10th percentile are considered "entry-level", while those at the 90th percentile are considered "advanced-level."

Aerospace Products occupations have higher earnings at every percentile (entry to advanced) than percentile earnings for all occupations in the state, while Aviation Service occupations earn nearly the same as other occupations at most levels, other than at the more advanced levels (75th and 90th percentile), where earnings are slightly higher. Earnings in Aviation Services are lower than Aerospace Products at all percentiles, entry to advanced. As discussed in the next section, jobs in key occupations in Aerospace Products typically require higher levels of education than jobs in Aviation Services, which may partially explain the higher earnings in Aerospace Products.

Figure 5: Percentile hourly earnings for Key Aviation & Aerospace Occupations Compared to All Occupations[14]



13 Percentiles are a statistical tool for determining the distribution of a number across an entire group of people—where the 10th percentile indicates 10 percent of workers earn that wage level or less and the 90th percentile indicates that 90% of workers earn that wage level or less.
14 Emsi 2016.3

Knowledge, Skills, and Abilities of Key Occupations

Though specific certifications and post-secondary degrees are frequently sought out by employers, they are also looking for evidence of certain knowledge, skills, and abilities (or KSAs). KSA attributes span across occupational categories and are broader and more foundational in nature. In this section on KSAs, the key occupations in Aerospace Products and Aviation Services are grouped together at the broad occupational group level (2-digit SOC).[15]

Knowledge

Within the key occupational groups[16] in the Aerospace Products and Aviation Services sectors, the most common knowledge aptitudes are technical, including engineering, technology, computers, mathematics, electronics, design, English language proficiency, and production and processing. The most common knowledge aptitudes in more supportive roles are administrative, management, customer and personal service, and personnel and human resources.

Installation, Maintenance, & Repair

Aircraft Mechanics & Service Technicians; Industrial Machinery Mechanics; Avionics Technicians; Machinery Maintenance Workers; General Maintenance & Repair Workers; First-Line Supervisors of Mechanics, Installers & Repairers

- ***KNOWLEDGE***: Mechancial; Engineering & Technology; Computers & Electronics; Mathematics; Production & Processing; Design; English Language; Building & Construction; Customer & Personal Service; Administration & Management

Transportation & Material Moving

Commercial Pilots, Airfield Operations Specialists, and First Line Supervisors of 1) Helpers, Laborers, & Material Movers, Hand, and 2) Transportation & Material-Moving Machine & Vehicle Operators

- ***KNOWLEDGE***: Transportation; Customer & Personal Service; Geography; Public Safety & Security; Administration & Management

Production

Inspectors, Testers, Sorters, Samplers & Weighers, Team Assemblers; Aircraft Structure, Surfaces, Rigging, & Systems Assemblers; CNC Tool Operators, Metal & Plastic

- ***KNOWLEDGE***: Production & Processing, Mathematics, English Language; Mechanical; Education & Training; Design

15 Emsi 2016.3

16 Due to data limitations, KSA (knowledge, skills and abilities) summary information is not available for Business Operations Specialists, All Other (SOC 13-1199), and Sales Representatives, Services, All Other (SOC 41-3099).

Architecture & Engineering

Aerospace, Industrial, and Mechanical Engineers

•***KNOWLEDGE***: Engineering & Technology; Mathematics; Production & Processing; Design

Computer & Mathematical

Computer Systems Analysts, and Software Developers of 1) Applications and 2) Systems Software

•***KNOWLEDGE***: Computers & Electronics; Engineering & Technology; Mathematics; English Language

Management

General & Operations Managers

•***KNOWLEDGE***: Administration & Management; Customer & Personal Service; Personnel & Human Resources

Office & Administrative

Production, Planning, & Expediting Clerks; Bookkeeping, Accounting, & Auditing Clerks

•***KNOWLEDGE***: Production & Processing; Adminisration & Management; Clerical; Mathematics; English Language

Business & Financial

Purchasing agents, except Wholesale, Retail & Farm Products; Logisticians

•***KNOWLEDGE***: Transportation; English Language; Administration & Management; Law & Government

Skills

Skills demonstrate proficiency, expertise, or competence in an area and the use of knowledge in an applied fashion. The most common skills applicable to the key Aerospace Products and Aviation Services occupations are reading comprehension, active listening, speaking, critical thinking, equipment maintenance, monitoring (of operations and more generally), and coordination.

Installation, Maintenance, & Repair

Aircraft Mechanics & Service Technicians; Industrial Machinery Mechanics; Avionics Technicians; Machinery Maintenance Workers; General Maintenance & Repair Workers; First-Line Supervisors of Mechanics, Installers & Repairers

- ***SKILLS***: Critical Thinking; Operation Monitoring; Troubleshooting; Equipment Maintenace; Repairing; Monitoring; Management of Personnel Resources

Transportation & Material Moving

Commercial Pilots, Airfield Operations Specialists, and First Line Supervisors of 1) Helpers, Laborers, & Material Movers, Hand, and 2) Transportation & Material-Moving Machine & Vehicle Operators

- ***SKILLS***: Operation & Control; Operation Monitoring; Critical Thinking; Active Listening; Reading Comprehension; Speaking; Time Management; Coordination

Production

Inspectors, Testers, Sorters, Samplers & Weighers, Team Assemblers; Aircraft Structure, Surfaces, Rigging, & Systems Assemblers; CNC Tool Operators, Metal & Plastic

- ***SKILLS***: Active Listening; Critical Thinking; Coordination; Monitoring; Operation Monitoring; Quality Control Analysis

Architecture & Engineering

Aerospace, Industrial, & Mechanical Engineers

•***SKILLS***: Reading Comprehension; Writing; Critical Thinking; Science; Mathematics

Computer & Mathematical

Computer Systems Analysts, & Software Developers of Systems Software & Applications

•***SKILLS***: Critical Thinking; Reading Comprehension; Systems Analysis; Active Listening; Programming; Systems Evaluaion

Management

General & Operations Managers

•***SKILLS***: Active Listening; Speaking; Social Perceptiveness

Office & Administrative

Production, Planning, & Expediting Clerks; Bookkeeping, Accounting, & Auditing Clerks

•***SKILLS***: Reading Comprehension; Active Listening; Speaking

Business & Financial

Purchasing Agents, except Wholesale, Retail & Farm Products; Logisticians

•***SKILLS***: Reading Comprehension; Active Listening; Speaking; Critical Thining; Monitoring; Coordination

Abilities

Lastly, abilities are the demonstrated application of a person's knowledge and/or skills. Within the key occupations identified, the most common abilities revolve around communication (oral and written comprehension and oral expression), physical attributes (especially arm-hand steadiness and finger or manual dexterity), and intellectual qualities (including problem sensitivity, information ordering, and inductive and deductive reasoning).

Installation, Maintenance, & Repair

Aircraft Mechanics & Service Technicians; Industrial Machinery Mechanics; Avionics Technicians; Machinery Maintenance Workers; General Maintenance & Repair Workers; First-Line Supervisors of Mechanics, Installers & Repairers

- ***ABILITIES***: Oral Comprehension; Oral Expression; Near Vision; Finger Dexterity; Written Comprehension; Information Ordering; Arm-Hand Steadiness; Manual Dexterity; Reaction Time; Problem Sensitivity

Transportation & Material Moving

Commercial Pilots, Airfield Operations Specialists, and First Line Supervisors of 1) Helpers, Laborers, & Material Movers, Hand, and 2) Transportation & Material-Moving Machine & Vehicle Operators

- ***ABILITIES***: Oral Expression; Oral Comprehension; Far Vision; Control Precision; Problem Sensitivity; Deductive Reasoning; Written Comprehension

Production

Inspectors, Testers, Sorters, Samplers & Weighers, Team Assemblers; Aircraft Structure, Surfaces, Rigging, & Systems Assemblers; CNC Tool Operators, Metal & Plastic

- ***ABILITIES***: Oral Expression; Oral Comprehension; Near Vision; Finger Dexterity; Hearing Sensitivity; Arm-Hand Steadiness; Manual Dexterity; Problem Sensitivity

Architecture & Engineering

Aerospace, Industrial, & Mechanical Engineers

- ***ABILITIES***: Oral Comprehension; Oral Expression; Written Comprehension; Deductive Reasoning; Inductive Reasoning; Information Ordering

Computer & Mathematical

Computer Systems Analysts, & Software Developers of Systems Software & Applications

- ***ABILITIES***: Oral Comprehension; Oral Expression; Written Comprehension; Problem Sensitivity; Information Ordering; Inductive Reasoning; Deductive Reasoning

Management

General & Operations Managers

- ***ABILITIES***: Oral Comprehension; Oral Expression; Written Comprehension

Office & Administrative

Production, Planning, & Expediting Clerks; Bookkeeping, Accounting, & Auditing Clerks

- ***ABILITIES***: Oral Comprehension; Oral Expression; Written Comprehension; Written Expression

Business & Financial

Purchasing Agents, except Wholesale, Retail & Farm Products; Logisticians

- ***ABILITIES***: Oral Comprehension; Oral Expression; Written Comprehension; Deductive Reasoning; Problem Sensitivity

Talent Supply: Aerospace & Aviation

A key ingredient to the success of any industry sector is a workforce with the appropriate level of education. The goal is not to exclusively generate or attract highly educated individuals, but to build a workforce with the right level and type of educational credentials. The previous section discussed the talent demand for the top 30 key Aerospace & Aviation occupations. Many of these occupations, especially in Aerospace, offer relatively high median wages and may provide good opportunities for workers. While 33% of Aviation Services and 43% of Aerospace Products jobs will require a high school diploma or less, a relatively large percentage of jobs in key occupations that are projected to exist in 2021 will require at least some college, including a postsecondary non-degree certificate or a bachelor's degree. Further, a sizeable percentage of jobs will require moderate- or long-term on-the-job training.

This section of the chapter provides state-level statistics on the educational attainment levels of adults, including where Kentucky ranks compared to the United States and comparison states. In addition, supply data in terms of number of graduates from Kentucky's postsecondary education programs, including those that are related to the key Aerospace & Aviation occupations, are provided. Appendix C offers detailed information on postsecondary degree production in areas related to key A&A occupations by institution type and for each four-year public institution in Kentucky. Further, the chapter includes information on enrollments and industry certifications earned in Career and Technical Education (CTE) pathways related to key occupations in Aerospace & Aviation. Finally, the chapter provides information on apprenticeship programs available in the state that may relate to key occupations in Aerospace & Aviation. Supply information allows the state to identify the extent to which it is in position to meet the needs for key occupations identified in the demand section of the chapter.

Educational Attainment

Kentucky's educational attainment for postsecondary degrees (associate or higher) trails the United States as a whole (29% for the state vs. 37% for the nation). Only 13% of Kentucky's adults have bachelor's degrees, compared to 18% nationally, and 9% hold graduate or professional degrees, compared to 11% nationally. This indicates that overall, Kentucky's adult population has completed less education than the U.S. as a whole.

Table 4: Educational Attainment—Kentucky and Comparison States[17]

Education Level	USA	KY	OH	IN	AL	AZ	KS	WA
Less than 9th grade	5.8%	7.0%	3.2%	4.1%	5.4%	6.3%	4.0%	4.1%
9th to 12th grade, no diploma	7.8%	9.5%	8.0%	8.3%	10.9%	7.8%	6.0%	5.8%
HS diploma, or equivalent	28.0%	33.7%	34.5%	35.0%	31.1%	24.5%	27.2%	23.3%
Some college, no degree	21.2%	20.7%	20.7%	21.0%	22.0%	25.9%	24.3%	24.9%
Associate degree	7.9%	7.3%	8.1%	8.1%	7.6%	8.4%	7.8%	9.7%
Bachelor's degree	18.3%	12.9%	16.1%	15.1%	14.5%	17.1%	19.9%	20.6%
Graduate or professional degree	11.0%	8.9%	9.5%	8.5%	8.6%	10.0%	10.8%	11.7%

Kentucky's percentage of adults with an associate degree or higher (29%) is less than comparison states. The 13% of Kentucky adults with a bachelor's degree is 2-8% below neighboring comparison states. On a

17 U.S. Census Bureau, 2010-2014 American Community Survey 5-Year Estimates. (2016).

positive note, Kentucky has a slightly larger percentage of adults with graduate or professional degrees than Indiana and Alabama.

As discussed in the previous supply section of this chapter, Key Occupations, in 2021, more than half of the jobs in key Aviation Services and Aerospace Products occupations are projected to require a postsecondary credential or degree. Based purely on these current educational attainment levels, Kentucky's Aviation & Aerospace companies may have difficulty filling these positions, particularly if demand increases more than is currently projected, or may need to look to neighboring states to locate new or expanded operations if talent attraction becomes a barrier to business growth. However, Kentucky's adults with graduate or professional degrees may be especially competitive for some of the Aerospace positions that require higher education degrees. Further, as shown in the next sections, Kentucky's institutions of postsecondary institutions and its CTE programs have been producing an ample supply of completers in areas specifically related to key occupations in Aerospace & Aviation. If Kentucky can retain these completers, it may be well-suited to meet the talent demand in the cluster.

Postsecondary Completions

Of the undergraduate credentials awarded by Title IV postsecondary institutions[18] in Kentucky, 31% were for certificates requiring less than one year of education, much larger than the national rate of 12%. The number of conferred bachelor's and doctoral degrees has steadily increased since 2011-2012.

Table 5: Postsecondary Completions (Kentucky Institutions vs. all US)[19]

	All Credentials Total	< 1 Year Certificate	More than 1 Year Certificate	Associate Degree	Bachelor's Degree
KY	58,524	31%	8%	24%	37%
US	**3,813,324**	**12%**	**13%**	**26%**	**48%**

Table 6: Postsecondary Completions by Degree Level (Associate and Higher)[20]

Conferred Degrees - KY	AY 2011-12	AY 2012-13	AY 2013-14
Associate	14,680	13,853	13,621
Bachelor's	21,531	21,872	22,268
Master's	9,411	9,860	9,507
Doctoral	1,935	1,951	2,026

The fact that a relatively large percentage of postsecondary completions from Kentucky institutions are undergraduate certificates may be promising for the state in terms of talent retention for Aerospace & Aviation. Based on data from the Kentucky Center for Education & Workforce Statistics (KCEWS), a

18 Institutions of higher education that participate in federal student financial aid programs (e.g., Pell grants and federal student loans) authorized by Title IV of the Higher Education Act of 1965.
19 U.S. Department of Education, National Center for Education Statistics. (2013). Institutional Characteristics (IC) and Completions components. Integrated Postsecondary Education Data System (IPEDS).
20 U.S. Department of Education, National Center for Education Statistics. (2014). Fall 2012 through Fall 2014 Completions. Integrated Postsecondary Education Data System (IPEDS).

relatively large percentage of certificate earners who graduate from Kentucky's postsecondary institution were employed in the state within five years of completion.

To illustrate, 86.6% of 2008 certificate earners from Kentucky two-year institutions were employed in the state within five years of completion.[21] Since nearly half of the key occupations in Aviation Services will require a postsecondary non-degree certificate, there may be opportunities for the state to look to retain certificate completers from Kentucky institutions to staff these positions.

As shown in the next section, many academic programs related to Aerospace & Aviation fall into Science, Technology, Engineering, and Math (STEM) areas or Trades areas. Most jobs in key occupations in Aerospace & Aviation that are associated with STEM majors (including Computer and Math and Architecture and Engineering occupational groups) require bachelor's degrees, and many that are associated with Trades majors require some postsecondary training, especially a postsecondary non-degree certificate.

According to KCEWS, for the six two-year institutions in Kentucky for which data were available,[22] 4 had more than 70% of STEM certificate completers from 2008 still employed in Kentucky in fiscal year 2012-2013. These percentages were somewhat smaller for graduates of Trades-related areas (which includes majors associated with occupations that fall into the Production or Installation Maintenance and Repair occupational groups). Of the 14 institutions for which data were reported, only three had more than 70% of their Trades certificate completers from 2008 still employed in the state in 2013, while six had 60% employed in the state in 2013.[23]

The Aerospace Products sector in Kentucky will require a large percentage of individuals that hold bachelor's degrees. While 37% of the postsecondary completions from Kentucky institutions were bachelor's degrees, this proportion is lower than that of the United States (48%). However, it is heartening that the number of bachelor's degrees awarded by Kentucky postsecondary institutions has steadily increased over the past three years.

In addition, although smaller than certificate completers, a fairly large percentage of bachelor's degree graduates from Kentucky postsecondary institutions have remained in the state to work after graduation. According to KCEWS, for 2008 bachelor's degree completers from Kentucky's postsecondary institutions, 73.5% of graduates from four-year independent institutions; 73.9% of graduates from four-year public comprehensive institutions; and 79.4% of graduates from four-year public research institutions were employed in the state within five years.[24] However, smaller percentages of 2008 STEM bachelor's degree recipients were employed in Kentucky as of fiscal year 2013. For the 19 institutions for which data were reported, nine had less than half their STEM bachelor's degree recipients employed in the state in 2013. Only one had over 70% of STEM bachelor's recipients employed in the state in 2013, while five had over 60% and four had over half.[25] Participants in stakeholder interviews and focus groups expressed concern that the state may not be doing everything it can to retain its graduates in relevant STEM programs that are related to Aerospace & Aviation. Some stakeholders indicated that while Kentucky institutions are

21 Kentucky Center for Education & Workforce Statistics. (2014).
22 Employment data for some institutions were suppressed due to small sample sizes and/or to protect privacy.
23 Kentucky Center for Education & Workforce Statistics. (2014).
24 Ibid.
25 Ibid.

clearly graduating engineers, these graduates might go elsewhere for jobs, or these students may not be earning degrees in the "right" type of engineering for Aerospace & Aviation. Some indicated a lack of connection between employers and graduates of these programs, and that stronger connections may result in more graduates staying in state. Because these graduates will be in high demand for key occupations in Aerospace Products, the state may look to identify ways to better retain these types of graduates and attract them to high-paying occupations in the sector.

Completions Related to Key Aerospace & Aviation Occupations[26]

While the Talent Demand section of this chapter identified that a slight majority of the top 15 key occupations in Aerospace Products require a bachelor's degree, and just under half of the top 15 key occupations in Aviation Services require some type of postsecondary certificate, it is important to consider whether graduates are earning degrees in majors that are appropriate to fill the key occupations.

Tables 7 and 8 provide information on postsecondary completions in programs related to the Aerospace & Aviation key occupations, based on institutions of higher education in Kentucky in 2015, and each award level is detailed. A "0" value indicates at least one or more institutions in Kentucky awards that type or level of degree, but there were no completions in 2015. If no value is reported (--), a program at that degree level does not exist in postsecondary institutions in the state.[27] Note that although an academic program has been identified as related to Aerospace & Aviation occupations, graduates of these programs are not necessarily employed in the cluster.

For both Aviation Services and Aerospace Products, the largest proportion of completions were certificates of either <1 year or 1-2 years: 42% in Aviation Services and 63% in Aerospace Products. In Aviation Services, the most common majors were business-related, with 3,614 completers in Business Administration and Management, General; and 1,662 completers in Business/Commerce, General. In contrast, more completers in majors related to Aerospace Products were in STEM or Trades areas—the largest was Computer and Information Sciences, General, with 2,076 completers, followed by Industrial Mechanics and Maintenance Technology, with 974 completers.

Of the key occupations identified, five post-secondary programs are common between both the Aerospace Products and Aviation Services sectors, including Industrial Mechanics and Maintenance Technology; Aircraft Powerplant Technology/Technician; Operations Management and Supervision; Sales, Distribution, and Marketing Operations, General; and Business, Management, Marketing, and Related Support Services, Other.

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26 Emsi 2016.3. Emsi uses data from the national Integrated Postsecondary Education Data System (IPEDS) database, which is published by the U.S. Department of Education's National Center for Education Statistics. IPEDS organizes this data into a taxonomy called the Classification of Instructional Programs (CIP) system. Emsi uses the CIP system to create program-to-occupation crosswalks. There are limitations to the IPEDS data. The most recent completion data available is 2015. The National Center for Education Statistics collects data from postsecondary education institutions. Thus, the data and this analysis do not account for training programs provided by non-postsecondary education institutions.

27 Reporting on the existence of programs is based on a combination of the IPEDS database and the Kentucky Academic Program Inventory (dataportal.cpe.ky.gov/KYAcademicProgInventory.aspx) that is maintained by the Kentucky Council on Postsecondary Education.

As discussed in the Talent Demand section of this chapter, key occupations in Aerospace & Aviation represent several broader occupational groups (2-digit SOC), mainly: Installation, Maintenance, and Repair, which is projected to represent over 1,000 total jobs in Aerospace & Aviation by 2021; Production (337 jobs); Business and Financial (197 jobs); and Office and Administrative Support (114 jobs).

Although a small percentage of the jobs in Installation, Maintenance, and Repair require less than postsecondary education or training, the majority (over 80%) require at least some training beyond high school, mainly a postsecondary certification – with many of these jobs in the Aviation Services sector. In 2015, Kentucky higher education institutions awarded 837 undergraduate certificates and 137 Associate degrees to Industrial Mechanics and Maintenance Technology majors. This is encouraging for the Aerospace & Aviation cluster, as these graduates may be well positioned to fill key occupations in this group.

State institutions also awarded 489 undergraduate certificates in Machine Shop Technology/Assistant majors, and 43 associate degrees, as well as 69 undergraduate certificates in Aircraft Powerplant Technology/Technician, and 14 associate degrees. These majors may also be qualified to fill jobs in this occupational group.

While jobs in the Production and Office and Administrative Support occupational groups typically require a high school diploma, jobs in the Business and Financial occupational group typically require a bachelor's degree. Kentucky institutions of higher education awarded 688 bachelor's degrees in Business Administration and Management, General in 2015, and 852 bachelor's degrees in Business/Commerce, General. Graduates with these majors may be appropriate for jobs in this occupational group.

The Aerospace Products & Aviation Services also include a number of occupations unique to each sector. To illustrate, in Aviation Services, the Transportation occupational group is projected to have 356 jobs by 2021, with 108 net-new jobs, particularly in the Commercial Pilots key occupation. While the typical entry-level education required for Transportation jobs is a high school diploma, Kentucky institutions of higher education awarded 27 bachelor's degrees in Airline/Commercial/Professional Pilot and Flight Crew majors. These graduates may be highly competitive for jobs in this occupation.

In Aerospace Products, 390 jobs are projected to exist in the Architecture and Engineering occupational group in 2021, and 120 are projected in the Computer and Mathematical occupational group. All of the key occupations in both of these groups typically require at least a bachelor's degree. In majors related to key occupations in the Architecture and Engineering group, Kentucky institutions of higher education awarded 197 bachelor's degrees in Mechanical Engineering and 118 bachelor's degrees in Manufacturing Engineering Technology/Technician. Further, 70 graduate degrees were awarded in Mechanical Engineering. If Kentucky can retain graduates such as these, the state may be well-positioned to meet key occupational needs for Industrial Engineers and Mechanical Engineers, which are projected to have 241 and 109 total jobs, and 14 and 8 net-new jobs, respectively, by 2021.

While a number of degrees were conferred in majors related to Mechanical and Industrial Engineering, per IPEDS, only one public or private (not-for-profit) institution in Kentucky offers a degree directly related to Aerospace Engineering—Morehead State University, which offers a Master's in Space Systems Engineering degree. However, according to IPEDS data, no degrees were conferred in this major in 2015 or years prior. As such, the state may need to look to recruit graduates from other states for occupations

in Aerospace Engineering or find ways to increase the pipeline of enrollments to this and related programs.

In the Computer and Math occupational group, there are projected to be 120 jobs in 2021, with ten net-new jobs. Higher education institutions in Kentucky awarded 205 bachelor's degrees in Computer and Information Sciences, General; 148 degrees in Information Technology; 69 degrees in Computer Engineering, general; and 27 degrees in Computer Science. Graduates with these degrees may be suited to fill positions in key occupations such as Computer Systems Analysis and Software Development (Software Developers, Applications and Software Developers, Systems Software).

Table 7: 2015 Completions in Programs Related to Key Occupations in Aerospace Products[28]

Program Title[29]	<1 Year Award	1-2 Year Award	Associate Degree	Bachelor's Degree	Post-Bachelors[30]	Total
Computer and Information Sciences, General	1,581	--	253	205	37	2,076
Industrial Mechanics and Maintenance Technology	711	126	137	--	--	974
Machine Shop Technology/Assistant	390	99	43	--	--	532
Information Technology	--	--	10	148	173	331
Mechanical Engineering	--	--	--	197	70	267
Manufacturing Engineering Technology/Technician	19	--	22	118	--	159
Computer Engineering, General	--	--	--	69	36	105
Aircraft Powerplant Technology/Technician	68	1	14	--	--	83
Industrial Engineering	7	--	--	35	28	70
Information Science/Studies	0	0	0	45	10	55
Computer Science	--	--	--	27	16	43
Medical Informatics	0	--	--	--	42	42
Logistics, Materials, and Supply Chain Management	5	--	16	1	0	22
Meeting and Event Planning	--	--	14	--	--	14
Sales, Distribution, and Marketing Operations, General	1	--	11	--	--	12
Business, Management, Marketing, and Related Support Services, Other	1	0	0	0	0	1

28 Zero value indicates at least one or more institutions in Kentucky awards that type or level of degree, but there were no completions reported to IPEDS in 2015. If no value is reported (--), a program at that degree level does not exist in postsecondary institutions in the state that report data to IPEDS.

29 Additional programs related to Aerospace Products but for which, according to IPEDS, public or non-public institutions in Kentucky do not offer degrees at any level are: Agricultural Mechanics and Equipment/Machine Technology; Artificial Intelligence; Modeling, Virtual Environments and Simulation; Computer Software Engineering; Electromechanical Engineering; Packaging Science; Bioinformatics; Heavy/Industrial Equipment Maintenance Technologies, Other; Airframe Mechanics and Aircraft Maintenance Technology/Technician; Avionics Maintenance Technology/Technician; CNC Machinist Technology/CNC Machinist; and Parts, Warehousing, and Inventory Management Operations.

30 Includes post-baccalaureate certificates, master's degrees, and doctoral degrees

Program Title[29]	<1 Year Award	1-2 Year Award	Associate Degree	Bachelor's Degree	Post-Bachelors[30]	Total
Computer Programming/Programmer, General	0	--	1	0	--	1
Computer Systems Analysis/Analyst	--	--	--	1	--	1
Computer Programming, Specific Applications	--	--	--	--	0	0
Informatics	--	--	--	--	0	0
Computer Software Technology/Technician	--	--	0	--	--	0
Computer Systems Networking and Telecommunications	--	--	0	--	--	0
Operations Management and Supervision	--	--	0	0	--	0
Aerospace, Aeronautical and Astronautical/Space Engineering	---	---	---	---	0	0
TOTAL	**2,783**	**226**	**521**	**846**	**412**	**4,788**

Table 8: 2015 Completions in Programs for Key Occupations in Aviation Services[31]

Program Title[32]	<1 Year Award	1-2 Year Award	Associate Degree	Bachelor's Degree	Post-Bachelors[33]	Total
Business Administration and Management, General	1,781	97	588	688	460	3,614
Business/Commerce, General	3	0	124	852	683	1,662
Industrial Mechanics and Maintenance Technology	711	126	137	--	--	974
Public Administration	--	--	--	12	150	162
Accounting Technology/Technician and Bookkeeping	3	13	67	--	--	83
Aircraft Powerplant Technology/Technician	68	1	14	--	--	83
International Business/Trade/Commerce	0	--	--	40	--	40
Airline/Commercial/	--	--	--	27	--	27

31 Zero value indicates at least one or more institutions in Kentucky awards that type or level of degree, but there were no completions reported to IPEDS in 2015. If no value is reported (--), a program at that degree level does not exist in postsecondary institutions in the state that report data to IPEDS.

32 Additional programs related to Aviation Services but for which, according to IPEDS, public or non-public institutions in Kentucky do not offer degrees are: Agricultural Mechanics and Equipment/Machine Technology; Parks, Recreation, and Leisure Facilities Management, Other; Heavy/Industrial Equipment Maintenance Technologies, Other; Vehicle Maintenance and Repair Technologies, General; Airframe Mechanics and Aircraft Maintenance Technology/Technician; Avionics Maintenance Technology/Technician; High Performance and Custom Engine Technician/Mechanic; Recreation Vehicle (RV) Service Technician; Air Traffic Controller; Flight Instructor; Railroad and Railway Transportation; Transportation/Mobility Management; Parts, Warehousing, and Inventory Management Operations; and Selling Skills and Sales Operations.

33 Includes Post baccalaureate certificates, Masters degrees, and Doctors degrees

Program Title[32]	<1 Year Award	1-2 Year Award	Associate Degree	Bachelor's Degree	Post-Bachelors[33]	Total
Professional Pilot and Flight Crew						
Entrepreneurship/ Entrepreneurial Studies	--	--	--	20	5	25
Building/Property Maintenance	0	18	--	--	--	18
Quality Control Technology/Technician	12	1	2	--	3	18
Sales, Distribution, and Marketing Operations, General	1	--	11	--	--	12
Business, Management, Marketing, and Related Support Services, Other	1	0	0	0	0	1
Accounting and Related Services, Other	--	0	0	--	--	0
Operations Management and Supervision	--	--	0	--	--	0
Retail Management	0	--	--	--	--	0
Retailing and Retail Operations	0	0	--	--	--	0
TOTAL	**2,580**	**256**	**943**	**1,639**	**1,301**	**6,719**

Completions in Programs Related to Key Occupations vs. Comparison States

Although the top 30 key occupations identified in this chapter are specific to Kentucky, for frame of reference, the number of degrees conferred in programs related to the 30 key occupations are provided for comparison states. Kentucky awarded far more <1 year undergraduate certificates in programs related to key occupations in Aerospace & Aviation than all other comparison states. However, in comparison to competitor states, Kentucky awarded the 2nd fewest number of associate degrees, the fewest bachelor's degrees, and the 2nd fewest post-bachelor's degrees. In total, Kentucky institutions of higher education awarded the 2nd fewest total degrees in programs related to key Aerospace & Aviation occupations, exceeding only Kansas.

Table 9: Completions in Programs Related to A&A Key Occupations: Kentucky and Comparison States[34]

	<1 Year Award	1-2 Year Award	Associate Degree	Bachelor's Degree	Post-Bachelors	Total Completions
Alabama	472	244	1,640	5,481	2,866	10,703
Arizona	1,512	1,275	7,580	10,132	8,278	28,777
Indiana	820	1,866	3,174	9,663	4,999	20,522
Kansas	411	351	1,155	3,810	1,389	7,116
Ohio	1,269	798	3,982	8,580	5,019	19,648
Washington	3,298	772	3,269	4,275	2,411	14,025
Kentucky	4,582	355	1,302	2,485	1,713	10,437

34 Emsi 2016.3. Note that Arizona's program completions include University of Phoenix, a large online university, which represents 53.3% of Arizona's total completions.

Completions in Programs Related to Key Occupations by Institution Type

Kentucky has a wide variety of higher education institutions, including two- and four-year public institutions, four-year private (not-for-profit) institutions, and 2- and 4-year proprietary (for-profit) institutions. Each type of institution offers at least one degree program in at least one major related to Aerospace Products and Aviation Services. As shown in Table 10, the vast majority of degrees at the bachelor's level and above in programs related to key Aerospace Products occupations were awarded by four-year public institutions, with this type of institution awarding 92% of the bachelor's degrees and 62% of the post-bachelor's degrees. Further, nearly all certificates and associate degrees in programs related to key occupations in Aerospace Products were awarded by public two-year institutions (99.5% of less than one year certificates; 100% of 1-2 year certificates; and 86% of associate degrees).

In contrast to key Aerospace Products occupations, the distribution of bachelor's degrees in programs related to key Aviation Services occupations was more evenly split across four-year public and four-year private (not-for-profit) institutions. Slightly less than half (48%) of bachelor's degrees in programs related to key Aviation Services occupations were awarded by four-year public institutions, compared to 38% awarded by four-year private (not-for-profit) institutions and 14% by proprietary (for-profit) institutions. This more even split is primarily due to more programs in Aviation Services key occupations being business-related, which private and proprietary institutions are more likely to offer. In addition, a somewhat larger proportion of Associate degrees were awarded by four-year proprietary institutions (27%), although the majority were still awarded by two-year public institutions (60%). While over half of the post-bachelor's degrees were awarded by four-year public institutions (57%), the remaining post-bachelor's degrees were split roughly evenly between four-year private and four-year proprietary institutions (22% vs. 20.5%, respectively).

Table 10: Programs Related to Key A&A Occupations: Degrees Awarded by Institution Type[35]

Institution Type	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Programs Related to Key Aerospace Products Occupations						
Four-year public	13	--	3	779	254	1,049
Four-year private (not-for-profit)	--	--	6	61	1	68
Four-year proprietary (for-profit)	1	--	63	6	157	227
Two-year public	2,769	226	449	--	--	3,444
Two-year proprietary (for-profit)	--	--	--	--	--	--
Programs Related to Key Aviation Services Occupations						
Four-year public	1	--	33	783	745	1,562
Four-year private (not-for-profit)	--	--	71	630	289	990
Four-year proprietary (for-profit)	5	35	256	226	267	789
Two-year public	2,574	221	569	--	--	3,364
Two-year proprietary (for-profit)	0	--	14	--	--	14

35 Institution type is based on IPEDS classification. If a degree level is listed as 0, that indicates that programs are offered at that degree level by the type of institution, but no degrees were reported to IPEDS as conferred in 2015.

Programs Offered and Characteristics of Kentucky Higher Education Institutions

Some programs related to key occupations in Aerospace Products are offered only at certain institution types, and some are unique to particular institutions.[36] To illustrate, there are six engineering programs related to key Aerospace Products occupations, and four of these are offered at institutions in Kentucky. As indicated previously, Morehead State University (MSU) is the only public or private not-for-profit institution in the state that offers a degree in the Aerospace, Aeronautical, and Astronautical/Space Engineering area (a master's degree in Space Systems Engineering). MSU also offers a bachelor's degree program in Space Science, combining elements of astronautical engineering and space physics, which is one of only five space science programs in the U.S.[37] Additionally, the University of Kentucky offers an aerospace certificate that can be added to an undergraduate program.

University of Kentucky and University of Louisville are the only institutions in the state to offer Industrial Engineering programs. These two institutions, along with Bellarmine University (a private not-for-profit institution) are also the only in the state that offer degrees in Computer Engineering. University of Kentucky, University of Louisville, and Western Kentucky University are the only institutions in Kentucky that offer degrees in Mechanical Engineering.

Outside of engineering, some programs related to key Aerospace Products occupations are offered at only one or a few institutions. For example, Northern Kentucky University is the only institution in the state to offer programs in Medical Informatics. Murray State University and University of Louisville are the only four-year public institutions that offer programs in Logistics, Materials, and Supply Chain Management (along with several public two-year institutions and four-year proprietary institutions).

While programs in key occupations related to Aviation Services tend to be offered by a larger number of institutions in Kentucky than those in Aerospace Products, there are still several programs that are unique to a few institutions. To illustrate, Western Kentucky University is the only four-year public institution that offers a program in Quality Control Technology/Technician (a graduate certificate), in addition to two public 2-year institutions offering an associate degree program and undergraduate certificate programs. Further, Eastern Kentucky University is the only institution in the state that offers a bachelor's degree in Airline/Commercial/Professional Pilot and Flight Crew (a Bachelor of Science with concentrations in Professional Flight, Aerospace Management, or Aerospace Technology).

Based on interviews and focus groups conducted by TPMA, many of Kentucky's stakeholders underscore what the completions data demonstrate: that Kentucky's higher education system offers a diverse array of programs related to key Aerospace & Aviation occupations. According to local employers, one of the state's main strengths related to Aerospace & Aviation is the number of engineers that institutions such as University of Kentucky (UK) and University of Louisville (UL) produce in a given year. According to IPEDS, in 2015, these two institutions combined conferred over 1,000 degrees and certificates in all Engineering-

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36 Degree program offerings are based on a combination of a review of the Kentucky Academic Program Inventory provided by the Kentucky Council on Postsecondary Education retrieved from dataportal.cpe.ky.gov/KYAcademicProgInventory.aspx as well as data reported to the Integrated Postsecondary Education Data System (IPEDS).

37 Morehead State University. (n.d.). Space Science. Retrieved from http://www.moreheadstate.edu/study/spacescience/

related programs, and over 400 degrees in engineering programs directly related to key Aerospace & Aviation occupations.[38]

Further, although Chapter 2 of this study identified that overall, Kentucky does not have a large science and engineering enterprise, it is worth noting that Kentucky's public institutions of higher education are involved in a variety of R&D efforts in Aerospace & Aviation. Stakeholders mentioned the value of the diversity of R&D focuses across Kentucky's higher education institutions. As stakeholders suggested, broader sharing of R&D efforts that are being undertaken in the state may be a catalyst for encouraging students to enroll in programs related to Aerospace & Aviation key occupations, as well as to stay in the state after earning degrees.

According to key informant interviews and focus groups, the R&D areas of each institution are diverse. Further, Kentucky's institutions of higher education have partnered with NASA Kentucky to provide researchers and students opportunities to participate in cutting edge R&D related to Aerospace & Aviation. To illustrate, the Micro/Nano Technology Center at the University of Louisville supports research related to areas such as micro and nanotechnology, advanced materials, biotechnology, and advanced manufacturing. Among many disciplines, the facility is used for research in areas directly related to A&A key occupations, including computer engineering and mechanical engineering.[39] UL and Western Kentucky University are conducting International Space Station (ISS) experiments to create a better understanding of colloid material behavior, which will enhance solar cell performance.[40] In partnership with NASA Kentucky, researchers at UK and Kentucky State led the development of Next-Generation Entry Thermal Protection, which will be beneficial to both small and large satellites.[41] Morehead State University has led research on nano satellite technology, including a focus on miniaturization of satellites. Funding from NASA Kentucky led to one of the first NASA CubeSats launched in 2010 and the first ISS CubeLab installed in the same year.[42]

The Space Grant Consortium, a program designed to support valuable STEM areas in the state, emphasizes networking and collaboration among education, businesses, and government agencies.[43] Kentucky's space grant programs include graduate fellowships, undergraduate scholarships, NASA and industry internships, undergraduate team projects, course and curriculum development, faculty research initiation awards, and mini-grants for STEM recruitment, retention, and teacher training.[44] Several grants support activities at Kentucky's community and technical colleges, including projects in drone surveying, robotics and mechatronics, biofuels, atmospheric chemistry, and near-space ballooning. As of late 2016, 67 students had participated in the projects, with six subsequently employed in STEM fields; 30 completing

38 Integrated Postsecondary Education Data System (IPEDS).
39 University of Louisville. (n.d.). About Us. Micro/Nano Technology Center. Retrieved from http://louisville.edu/micronano/about-us.
40 Impact of Kentucky's Higher Education Partnership with NASA. Presentation to Lt. Governor Hampton by Suzanne Weaver Smith. Presented October 27, 2016.
41 Ibid.
42 Ibid
43 NASA Kentucky Space Grant Consortium and EPSCoR Programs. (n.d.). NASA Kentucky Space Grant programs. Retrieved from http://nasa.engr.uky.edu/space-grant/#.WKWuFTsrK01.
44 NASA Kentucky Space Grant Consortium and EPSCoR Programs. (2016).

degrees; and 24 transitioning to four-year degree programs.[45] NASA Kentucky also offers the NASA EPSCoR (Experimental Program to Stimulate Competitive Research) program. This program awards competitive start-up grants to higher education faculty at Kentucky institutions. The grants are designed to strengthen research capabilities in Kentucky, especially in areas of importance to NASA and the state. They promote the development of research infrastructure and aim to improve the abilities of researchers to obtain funding support outside of EPSCoR, as well as to develop further partnerships with NASA.[46]

Along with its programs designed around space science, the University of Kentucky is a premier leader in research of unmanned aircraft systems (UAS). In 2016, UK received FAA authorization to conduct UAS (drones) research, one of the first universities in the U.S. to receive this permission.[47] Similarly, Morehead State University has taken measures to implement a UAS-focused training program through its recently created drone flight training school.[48]

Higher education institutions in many of Kentucky's aerospace and aviation competitor states – defined in greater detail in Chapter 2 of this study – have taken similar efforts to engage the UAS industry. Kansas State Polytechnic University Salina[49] and Indiana State University[50] both offer a Bachelor of Science degree in Unmanned Systems. In Ohio, community colleges similarly have been deliberate in integrating their students into the UAS industry. One such example is Sinclair Community College in Dayton, which provides specific training related to UAS, in addition to its more traditional offerings associated with advanced manufacturing, IT, and cybersecurity.[51]

As the UAS industry expands, Kentucky should continue to explore efforts to deliberately develop the industry, particularly with respect to institutions of higher education and through STEM programming. Many recommendations to do so are presented in the Unmanned Aircraft Systems (UAS) Industry Study prepared by Alaris in 2016 and presented in Chapter 4 of this study. For example, Eastern Kentucky University (EKU) is positioned to offer training relevant to the UAS industry by integrating UAS focused courses into its current Aviation program. In addition, the Kentucky Community and Technical College System (KCTCS), could offer certificate programs and degrees that would open opportunities for students enter the UAS industry workforce.

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45 Impact of Kentucky's Higher Education Partnership with NASA. Presentation to Lt. Governor Hampton by Suzanne Weaver Smith. Presented October 27, 2016.
46 KY EPSCoR Research Innovation Education. (n.d.). NASA KY Program. Retrieved from http://www.kyepscor.org/index.php/programs/nasa-ky-epscor-space-grant.
47 University of Kentucky. (2016). Research Education 2016. Kentucky Engineering Journal. Retrieved from https://www.engr.uky.edu/kej/research2016/
48 Claxton, C. (2016). Drone School to Aid Public Agencies. The Morehead News. Retrieved from http://www.themoreheadnews.com/news/local_news/drone-school-to-aid-public-agencies/article_9337b706-348d-11e6-bee9-9b4d4fbadc4a.html.
49 Kansas State Polytechnic. (2017). Unmanned Aircraft Systems Flight and Operations. Retrieved from http://polytechnic.k-state.edu/aviation/uas/
50 Indiana State University. (2017). Unmanned Systems (UMS). Retrieved from https://www.indstate.edu/technology/ums
51 Sinclair College News. (2015). Sinclair National UAS Training and Certification Center Unveils Leading-Edge Capabilities for Unmanned Aerial Systems. Retrieved from https://www.sinclair.edu/news/article/sinclair-national-uas-training-and-certification-center-unveils-leading-edge-capabilities-for-unmanned-aerial-systems/

Appendix C provides a detailed breakdown of degrees conferred in programs related to key A&A occupations by each type of higher education institution, as well as a breakdown by institution for Kentucky's 4-year public institutions.

Career and Technical Education Pathways

Postsecondary completions are one aspect of Kentucky's talent supply, but the state's high schools also offer a number of Career and Technical Education (CTE) programs in areas related to key occupations in Aerospace & Aviation. According to the Kentucky Department of Education's 2015-2016 school report card, there were over 205,000 students enrolled in any CTE pathway in 2016, and over 29,000 Kentucky Occupational Skills Standards Assessments (KOSSA) and Industry Certifications were earned in the same year.[52] While Kentucky offers many career pathways, this section of the chapter focuses on those pathways that are related to the top 30 key occupations in Aerospace & Aviation.

As of the 2015-2016 school year, Kentucky CTE programs offer career pathways in 14 broad academic program areas that are related to Aerospace & Aviation key occupations, with a total of 24 related career pathways (some career pathways fall under the same program area). Each career pathway related to the A&A key occupations is detailed in Table 11, along with the related program area (CIP code), related key occupation(s) in Aerospace & Aviation, and number of enrollments and KOSSA and certification attainments in 2015-2016.

Table 11: CTE Pathways in Programs Related to Key A&A Occupations[53]

CTE Pathway Name	Total Enrollments	Total KOSSA and Industry Certs. Earned	Related Key A&A Occupation(s)
Informatics	185	5	Software Developers, Applications Software Developers, Systems Software
Computer Programming	724	110	Software Developers, Applications Software Developers, Systems Software
Computer Science	1,083	133	Software Developers, Applications Software Developers, Systems Software
Network Administration	733	117	Computer Systems Analysts
Aeronautical Engineering	292	4	Aerospace Engineers
Space Systems Engineering	27	0	Aerospace Engineers
Manufacturing Engineering Tech.	531	45	Industrial Engineers
Bricklayer Assistant	151	30	Maintenance & Repair Workers, General
Res. Maintenance Carpenter Asst.	82	0	Maintenance & Repair Workers, General
Fluid Power Mechanic	21	3	Industrial Machinery Mechanics

52 Kentucky Department of Education. (2017). School Report Card (School Year 2015-2016), Career and Technical Education. Retrieved from http://applications.education.ky.gov/SRC/CareerTechEducationByState.aspx

53 Pathways obtained from the Kentucky Department of Education (KDE). (20170. Career and Technical Education. Retrieved from education.ky.gov/CTE/Pages/default.aspx. Program enrollments/completions from KDE. (2017). School Report Card (School Year 2015-2016), Career and Technical Education. Retrieved from http://applications.education.ky.gov/SRC/CareerTechEducationByState.aspx.

CTE Pathway Name	Total Enrollments	Total KOSSA and Industry Certs. Earned	Related Key A&A Occupation(s)
			Maintenance Workers, Machinery
Industrial Maintenance Electrical Technician	467	72	Industrial Machinery Mechanics Maintenance Workers, Machinery
Industrial Maintenance Welding Technician	87	10	Industrial Machinery Mechanics Maintenance Workers, Machinery
Maintenance Machinist	85	33	Industrial Machinery Mechanics Maintenance Workers, Machinery
Maintenance Mechanic	546	153	Industrial Machinery Mechanics Maintenance Workers, Machinery
Refrigeration Technician	55	19	Industrial Machinery Mechanics Maintenance Workers, Machinery
Aircraft Maintenance Technician	20	0	Aircraft Mechanics & Service Technicians Aircraft Str., Surface, Rigging, & Systems Assemblers Airframe Mech. & Aircraft Maintenance Technology/Technician
Computer Numerical Control (CNC) Operator	147	32	Comp. Controlled Machine Shop Operators, Metal and Plastic
Computer Numerical Control (CNC) Programmer	6	5	Computer Controlled Machine Shop Operators, Metal and Plastic
Machinist Operator	519	100	Computer Controlled Machine Shop Operators, Metal and Plastic
Machinist Technician	551	103	Computer Controlled Machine Shop Operators, Metal and Plastic
Flight and Aeronautics	295	12	Commercial Pilots
Business Management	11,739	871	General & Operations Managers
Management Entrepreneurship	799	57	General & Operations Managers
Retail/Wholesaling	751	220	Sales Representatives, Services, All Other
TOTAL	**19,896**	**2,134**	

In addition to the programs listed in Table 11, according to the 2017-2018 program of studies for Engineering,[54] Kentucky CTE programs will add three pathways in programs related to key occupations in Aerospace Products and Aviation Services – Fabrication Engineering (14.1901, related to Mechanical Engineers occupation); Industrial/Mechanical Engineering (14.3501, related to Industrial Engineers); and Industrial Maintenance/Electrical Engineering (14.4101), related to Mechanical Engineers.

While a number of the key occupations related to CTE pathways require some college education (such as a postsecondary certificate or bachelor's degree), some of the related occupations require only a high school diploma but still pay relatively high wages. Completers of CTE pathways in these areas may be well positioned to obtain jobs in related in-demand, key occupations. Additionally, because of receiving

54 Kentucky Department of Education. (n.d.). Engineering Program of Studies 2017-2018. Office of Career and Technical Education. http://education.ky.gov/CTE/ctepa/Documents/Engineer--2017-2018.pdf

relevant training in CTE programs, these students may require less or shorter-term on the job training, potentially cutting costs for employers.

For example, Industrial Machinery Mechanics, a key Aerospace Products occupation with median hourly earnings of $23.75, typically requires a high school diploma. Kentucky's CTE programs had 1,261 students enrolled in related CTE pathways in 2015-2016, with 290 KOSSA and industry certifications earned. These pathways are also related to the key Aviation Services occupation Maintenance Workers, Machinery, with median hourly earnings of $21.62. In another key occupation related to Aerospace Products, CTE programs had 153 individuals enrolled in pathways related to the Computer-Controlled Machine Tool Operators, Metal & Plastic key occupation, with 37 KOSSA and industry certifications earned. In Aviation Services, there were 233 individuals enrolled in pathways related to Maintenance and Repair Workers occupations, with 30 KOSSA and industry certifications earned.

Students participating in CTE pathways for key occupations that typically require a bachelor's degree, such as Computer Science, Computer Programming, Aeronautical and Space Systems Engineering, and Manufacturing Engineering Technology may matriculate into Kentucky's postsecondary programs in these areas, thus further providing a strong pipeline to fill key occupational needs in Aerospace & Aviation.

One key occupation in Aviation Services that is not directly represented by programming in Kentucky's CTE or higher education programming is Airfield Operations Specialists. This occupation represents 67 jobs in 2016 and is projected to add four net-new jobs over the next five years. Further, the occupation offers relatively high median hourly earnings, at $28.76. This job typically requires a high school diploma and long-term OJT. According to Emsi, the program CIP code most closely related to the occupation is 49.0105, Air Traffic Controller.[55] Because there may be opportunities for CTE completers to fill this demand, as well as to potentially require less OJT than those without training, it may be beneficial for the state to pursue opportunities to offer CTE programs in this area, or to expand existing CTE programs related to flight and aviation to include this area.

Although not listed in Table 11, it is notable that Kentucky CTE programs saw 5,214 enrollments and 830 KOSSA and industry certification completions in Project Lead the Way (PLTW) Engineering programs. While general PLTW Engineering pathways are not listed in the table because they cover many types of engineering, PLTW Engineering programs do provide courses that are relevant to some key Aerospace Products occupations, particularly Aerospace Engineering and Computer Engineering. PLTW courses also include introductory engineering courses and elective courses in areas such as Computer Integrated Manufacturing, Engineering Design & Development, and Software Engineering. Kentucky also offers hybrid pathways, which combine PLTW Engineering courses with CTE-specific programs.

Further, Kentucky's CTE programs offer Junior Reserve Officers Training Corps (JROTC) programs in multiple branches of the armed services (Air Force, Army, Marine Corps, and Navy). Programs in Air Force JROTC and Navy JROTC may particularly prepare students for postsecondary opportunities or careers in Aerospace & Aviation. In 2015-2016, there were 1,476 students enrolled in Air Force JROTC CTE pathways (with 188 KOSSA and Industry Certifications earned), and 1,312 students enrolled in Navy JROTC (with 268 KOSSA and Industry Certifications earned).

55Emsi 2016.3.

Aerospace and Aviation Programs in Middle and High Schools

Career and Technical Education (CTE) programs are offered in high schools throughout Kentucky, including some programs that are specific to Aerospace & Aviation. Efforts are currently underway to identify or develop a curriculum that is designed specifically for aerospace and aviation studies.

One magnet school in the Jefferson County Public School District specifically dedicated to Aerospace & Aviation. The Academy @ Shawnee serves grades 6-12 and offers programs in Aerospace-Flight, Aerospace-Maintenance, Aerospace-Travel & Tourism, Aerospace Engineering, and the Navy Junior Reserve Officers Training Corps (NJROTC). In 2015-2016, there were 666 students enrolled in the school.[56] The campus shares space with the Jefferson Community Technical College Aviation Maintenance Campus, as well as a Challenger Learning Center (CLC). The CLC offers space simulation experiences for all schools in the area (including schools in southern Indiana and southern Ohio). As part of its programming, the Academy offers a private pilot's license program that meets the Federal Aviation Administration's FAR Part 141 requirements.[57]

The Challenger Learning Centers of Kentucky are examples of additional programs providing students in the Commonwealth with exposure to Aerospace and Aviation related programing as well as other STEM programing. With Kentucky Challenger Learning Centers located in Paducah, Louisville and Hazard, the program serves approximately 8,000 students from Kentucky and surrounding states. In addition to simulated, real world space missions, each center offers their own unique STEM programming that is tailored to their communities and educational needs. The Challenger Learning Center program was created in remembrance of the 1986 Space Shuttle explosion and provides a space science education center where teachers and students can use state-of-the-art technology and simulation while applying mathematics, science and technology in the workplace of the future.

In focus groups conducted by TPMA, a number of participants indicated that more Aerospace & Aviation-related programs should be offered at early ages. While most participants suggested providing more offerings at the middle school level, some participants even suggested starting as early as the elementary level. Currently, Kentucky is looking to offer more programs to middle school students, in an effort to bolster the pipeline from middle to high school to postsecondary programs or careers in Aerospace & Aviation. For example, in 2016, through a grant from NASA, a project was conducted for four middle schools called Aerospace Motivates Kids – A Context for STEM. A total of 78 students participated in the program (along with 19 teachers and parents). The project offered a STEM-based program that was conducted at the Aviation Museum of Kentucky. Students and teachers participated in sessions that were focused on areas such as aerospace technology, navigation, and flight simulation.[58]

While all participants in focus groups and key informant interviews noted that the array of programming in Aerospace & Engineering at the high school level is an asset to the state, many suggested that it would be beneficial to continue to increase partnerships between A&A-related businesses and A&A-related secondary programming. Some stakeholders suggested that students, especially at the secondary level,

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56 Kentucky Department of Education. (2017). School Report Card (School Year 2015-2016), Career and Technical Education. Retrieved from http://applications.education.ky.gov/SRC/CareerTechEducationByState.aspx
57 The Academy @ Shawnee. (n.d.). Aerospace & Flight. Retrieved from http://academy.lbibuzz.com/aviation-flight.html
58 Murphy, Ed. (2017). Summary Results of UK NASA project SG-16-001.

might have difficulty understanding how to translate what they learn in CTE or secondary-related programs into selecting appropriately linked postsecondary programs or careers. Stakeholders noted that continuing to build close relationships between middle and high schools and A&A-related industries would assist in helping students translate their skills more appropriately. Further, stakeholders suggested that although there are a number of STEM-related programs in K-12, it could be beneficial to create a comprehensive vision and direction, including goals and outcomes, for these programs.

Apprenticeships

Apprenticeships combine on-the-job training and postsecondary learning to provide 'earn-and-learn' opportunities. Apprenticeships are quite flexible and can be time-based, competency-based, or a hybrid of the two. Although community colleges are a primary provider of career and technical education, classroom instruction can also be provided by training centers, technical schools, or through distance learning. Offered in over 1,000 career areas, credentials are often stackable and transferable, providing opportunities to earn higher wages as skill levels increase. The Department of Labor states the average starting wage of a registered Apprentice as $15.00 per hour – more than double the federal minimum of $7.25 per hour.

A 2016 report from Case Western Reserve University and the U.S. Department of Commerce presents a deeper dive into the costs and benefits of registered apprenticeships in a wide variety of companies. Due to the flexible nature of registered apprenticeships, costs varied from less than $25,000 to $250,000 per apprentice (not considering startup costs). The most common factors affecting program costs included program length, apprenticeship wages, training equipment and program management, as well as if the company worked alone or in partnership with other businesses, educational institutions, unions, or non-profits. Program start-up, tuition and educational materials, mentor time, and overhead were additional factors affecting costs.

According to data provided by the Kentucky Labor Cabinet's Department of Workplace Standards, Kentucky offers approximately 215 apprenticeship programs, serving over 10,000 participants. In 2016 alone, the state had over 3,300 active Registered Apprentices including 1,300 new Apprentices that year. Historically, apprenticeships in Electrician occupations represent the most participants (3,180), followed by Construction Craft Labor (1,179) and Structural Steel/Ironworker (991). While Kentucky offers a fairly wide variety of apprenticeship programs, representing over 50 occupations, only one on the list – Machinist (with five participants) – is directly related to the key industries identified for Aerospace & Aviation, and no programs are directly related to the identified key occupations.

Kentucky may benefit from increasing its apprenticeship offerings in areas specifically related to Aerospace & Aviation. Recent data indicate that 91% of apprentices are employed after completing the program, and the average starting wage for these participants is $60,000. Apprenticeships may benefit companies by reducing or eliminating the need for on-the-job training, as journeymen bring in specialized occupational knowledge. Qualitative data from the study suggest that firms using apprenticeships believe that the programs improved their overall company performance and offered them a competitive advantage by having workers that are more skilled.[59] Given that 38% of in-demand jobs in both Aviation

59 Case Western Reserve University and U.S. Department of Commerce. (2016). The benefits and costs of apprenticeships: A business perspective.

Services and Aerospace Products will require moderate- to long-term on-the-job training, expanded apprenticeship opportunities throughout the state may offer opportunities to bring in workers that already have the skills needed, potentially cutting down on the amount of training needed after they are hired. What is more, companies offering apprenticeship opportunities often are able to "grow their own" talent from within the organization.

Conclusion

On the talent demand side, key occupations in the Aerospace & Aviation cluster in Kentucky are projected to add 72 net-new jobs in Aerospace Products and 251 net-new jobs in Aviation Services, representing 1,253 and 1,375 total jobs, respectively, in the state by 2021. Jobs in these key occupations offer relatively high earnings, particularly in the Aerospace Products group. In Aviation Services, key occupations projected to add the most jobs are Commercial Pilots (+97) and Aircraft Mechanics & Service Technicians (+82). In Aerospace Products, Industrial Engineers is projected to add 14 jobs, followed by Aircraft Structure, Surfaces, Rigging, & Systems Assemblers (+10).

When looking at talent supply, although the overall educational attainment of adults in Kentucky tends to lag the United States and neighboring states, recent postsecondary completions from Kentucky higher education institutions suggest the state is relatively well-positioned to meet its key occupational demands in most areas. However, the state must ensure that mechanisms are in place to retain graduates of relevant programs with appropriate degrees. While migration data indicate that a fairly large majority of certificate recipients remain in the state after graduation, smaller percentages of certificate recipients in Trades areas stay in the state. Further, while overall bachelor's degree recipients are relatively likely to be employed in the state within five years of graduation, fewer STEM degree recipients are employed within five years. The state may consider ways in which it can further publicize the multiple and diverse research and development opportunities that are occurring at its institutions of higher education to recruit students into higher education programs and retain them after graduation.

At the high school level, Kentucky has a number of Career and Technical Education pathways that are related to key Aerospace & Aviation occupations. It may be beneficial for the state to examine ways to create pipelines for CTE students to move directly into related occupations, potentially reducing the need for longer-term on the job training. Further, CTE students who have studied A&A-related pathways who stay in state may create an additional supply of students to enroll in the broad array of A&A-related programs at the state's institutions of higher education. The state may also consider adding Apprenticeship programs to augment its supply of qualified workers in areas related to Aerospace & Aviation.

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Chapter 4: Kentucky's *Unmanned Aircraft Systems (UAS) Industry Study*

Key Findings

This chapter provides a detailed overview of the Unmanned Aircraft Systems (UAS) Industry Study prepared by Alaris in 2016. It also includes background information on UAS relative to the differentiation between Unmanned Aerial Vehicles (UAV's) and on both UAS research in Kentucky and at the national level.

- Industry and most regulators have now adopted UAS rather than UAV as the preferred term for Unmanned Aircraft or Aerial Systems.
- In 2016, the University of Kentucky became one of the first universities in the country to receive permission from the Federal Aviation Administration (FAA) to conduct research with UAS.
- In 2016, Maysville Community and Technical College (MCTC) received a $1,290,000 Appalachian Regional Commission POWER grant for the KY-WV Regional Drone Technology Workforce Project.
- In 2016, the Kentucky Innovation Network at Morehead State University and Unmanned Services Inc. collaborated to create a drone flight training school.
- The economic impact of UAS in KY is estimated at $4.6M and projected to reach $19.1M in 2025.
- The Norwegian company ProxDynamics is the only UAS manufacturer operating in Kentucky.
- Legislation of UAS at both the federal and local levels is subject to change.
- There is very active UAS education in Kentucky that should aid UAS growth in the state.

Introduction

The purpose of this chapter is to present key findings from the Unmanned Aircraft Systems (UAS) Industry Study sponsored by the Kentucky Commission on Military Affairs (KCMA) Office of the Governor and prepared by Alaris in 2016.[1] Following the Alaris study's structure, this chapter explores:

- Economic impact of the UAS industry in the state of Kentucky;
- Legislative arena surrounding this industry;
- Economic incentives to expand UAS in Kentucky;
- Educational opportunities in the industry; and
- Infrastructure needs of the industry.

The following sections present background information and a description of the Alaris study's methodology and findings associated with the UAS industry in the state of Kentucky.

Data Sources

To complete the UAS Industry Study, Alaris utilized data from the Census Bureau, the Bureau of Labor Statistics (BLS), the United States Department of Agriculture (USDA), and the Kentucky Cabinet for Economic Development. Alaris also used RIMSII I/O multipliers.

Background

Unmanned Aircraft Systems (UAS)

UAS are one of the most rapidly developing and revolutionary technologies currently explored in the aircraft, engine, and parts manufacturing industry.

> *"Today's UAVs range in size, weight, speed and operating altitudes that vary from the four-pound Raven that flies for about one hour at 50 knots and normally below 1000 feet, to the largest operational UAV, the Global Hawk, which weighs about 15,000 pounds, and flies at 400 knots for more than 30 hours at 65,000 feet."*[2]

The capabilities of these systems also span military, commercial, and personal usage. It is important to note that industry and most regulators have now adopted UAS rather than UAV as the preferred term for Unmanned Aircraft or Aerial Systems. This is because the UAS acronym encompasses *all* aspects of deploying these platforms and not just the platforms themselves.

1 Alaris (2016). Unmanned Aircraft Systems (UAS) Industry Study.
2 Soshkin, M. (2017). Aircraft, Engine & Parts Manufacturing in the US. IBIS World Industry Report 33641a.

UAS Research and Training in the State of Kentucky

In January 2016, TPMA asked key stakeholders representing R&D and educational institutions in the state to provide insight on the role of UAS in Kentucky. These informants included premier researchers in the UAS field such as:

- **Dr. Benjamin Malphrus** – Chair, Department of Earth and Space Sciences at Morehead State University
- **Dr. Suzanne Smith** – Director, Kentucky Space Grant Consortium and NASA EPSCoR and Director of the Unmanned Systems Research Consortium at the University of Kentucky

They supported main findings from the Alaris study and reiterated the importance and potential impact of UAS on precision agriculture in the state. Feedback also indicated a renewed interest in deployable wing UAS in the state. In 2018, Kentucky will host a conference for UAS flights to study lower atmosphere, which could provide an increased opportunity to test these vehicles and systems.

In 2016, educational institutions in Kentucky made great strides in the UAS field. As noted previously, the University of Kentucky became one of the first universities in the country to receive permission from the Federal Aviation Administration (FAA) to conduct research with unmanned aerial systems, or drones, nationwide, following FAA regulations.[3] This helps to solve a large concern in the state surrounding readily available airspace for testing and development of these platforms.

In addition, Maysville Community and Technical College (MCTC) in Maysville, KY received a $1,290,000 Appalachian Regional Commission (ARC) POWER grant for the *KY- WV Regional Drone Technology Workforce Project*:

> *"MCTC will partner with Southern West Virginia Community and Technical College to deliver comprehensive training courses in small-air drone operation to a seven-county area in southern West Virginia and a 13-county area in northeastern Kentucky. Specific training activities will enable graduates to operate drones and drone sensors to provide in-demand commercial services—such as the close-up inspection of fixed structures like power lines, utility poles, and cell phone towers. The project will serve 100 trainees over the two-year life of the award, will leverage $14,000,000 in private investment, and will, in conjunction with a previous ARC POWER award, further strengthen the emerging drone industry cluster in the West Virginia-Kentucky- Virginia tri-state area."*[4]

In 2016, the Kentucky Innovation Network at Morehead State University and Unmanned Services Inc. also collaborated to create a drone flight training school. The flight school provides technical unmanned aircraft systems education and instruction to public and private entities at a low cost and hopes to expand

3 University of Kentucky (2016). Kentucky Engineering Journal, Research Education 2016. Retrieved from https://www.engr.uky.edu/kej/research2016/.
4 Appalachian Regional Commission (2017). POWER Award Summaries by State. Retrieved from https://www.arc.gov/images/grantsandfunding/POWER2017/ARCPOWERAwardSummariesbyState1-25-2017.pdf.

offerings and curriculum across the state to include topics specific to agriculture, search and rescue, mapping, etc.[5]

This momentum builds on the expectation of rapid growth in the UAS industry. Kentucky's key assets in the industry are naturally exploring programs to give themselves and Kentucky's workforce an edge over future development and regional operation. To expand national research and discover the direct impact and growth of the industry in Kentucky, the KCMA contracted Alaris to prepare the Unmanned Aircraft Systems (UAS) Industry Study.

AUVSI Study

The Association for Unmanned Vehicle Systems International (AUVSI) is the world's largest nonprofit organization focused solely on advancing the unmanned systems and robotics community. In 2013, the group released "The Economic Impact of Unmanned Aircraft Systems Integration in the United States" which utilized a national top-down approach to revenue analysis in the industry.

In the study reviewed below, Alaris builds from the AUVSI report but uses a bottom-up approach specific to the state of Kentucky. The Alaris study retains two key parameters from the AUVSI study:

1) "there will be a net-zero impact of job creation in the application of these systems."
2) "economic impact is based on the theory that a dollar flowing into a local economy from the outside is a benefit to the regional economy."[6]

It is important to note that the Alaris study also provides a key differentiation not found in the AUVSI report. That differentiation is the separation of manufacturers and users.

Unmanned Aircraft Systems (UAS) Industry Study prepared by Alaris in 2016

This study covers the economic impact of unmanned aircraft systems in the state of Kentucky. The primary focus of this study is on commercial UAS. In addition, the study focuses predominantly on the impact of UAS *use* rather than manufacturing, as there is little to no UAS manufacturing presence in the state.

Overview and Study Approach

The study focuses on addressing 11 key questions or actions pertaining to assessing the economic impact of UAS manufacturers and users in Kentucky:

- ***"Question/Action 1*** - What is the economic impact if Kentucky does nothing or retains the status quo? What can the economic impact be if Kentucky enables this industry through legislation, incentives, and other growth initiatives?

5 Claxon, C. (2016, June 17). Drone School to Aid Public Agencies. Retrieved from http://www.themoreheadnews.com/news/local_news/drone-school-to-aid-public-agencies/article_9337b706-348d-11e6-bee9-9b4d4fbadc4a.html.
6 Jenkins, D., Vasigh, B. (2013, March). The Economic Impact of Unmanned Aircraft Systems Integration in the United States. Retrieved from https://higherlogicdownload.s3.amazonaws.com/AUVSI/958c920a-7f9b-4ad2-9807-f9a4e95d1ef1/UploadedImages/New_Economic%20Report%202013%20Full.pdf

- ***Question/Action 2*** - What are the UAS jobs or career profiles and what are the compensation rates for occupations in this field?
- ***Question/Action 3*** - Fully develop and describe the enabling legislation needed at the state level to complement federal progress on UAS integration.
- ***Question/Action 4*** - Recommend state level economic growth incentives that will spur investment, business relocation to Kentucky, and entrepreneurial activity in the UAS sector.
- ***Question/Action 5*** - What strategic investments are required by the Commonwealth?
- ***Question/Action 6*** - How does Kentucky advance the development of this part of the economy while protecting the privacy of citizens?
- ***Question/Action 7*** - What are the infrastructure needs in Kentucky as related to the UAS industry? Do the military installations in the state have a role? If so, how is that potential developed? Fully analyze the military assets and infrastructure available in the Commonwealth of Kentucky and develop recommendations for leveraging these assets to grow the economic impact of UAS in Kentucky.
- ***Question/Action 8*** - Analyze the educational opportunities available in public institutions in Kentucky that enable graduates to participate in the UAS industry. Make recommendations for development of additional degree-granting programs and/or certifications.
- ***Question/Action 9*** - How can Kentucky impact workforce migration (gain) to the Commonwealth as this industry continues to develop?
- ***Question/Action 10*** - What are the specific uses of UAS that are best suited for Kentucky and why?
- ***Question/Action 11*** - Develop action steps and a timeline for growing the economic impact of the UAS industry in Kentucky. Include recommendations covering legislation, education and workforce, investment and infrastructure, licensing and regulation, military partnerships, economic incentives, and any other recommendations developed in the course of the study."[7]

The study addresses legislative environment, economic growth incentives, infrastructure, and educational opportunities in the state, and it discusses possible mechanisms for leveraging the industry in the state. The study also provides a high-level action plan to help Kentucky capitalize on the integration of UAS into national airspace.

This review does not include all findings from the Alaris study. Key points and an explanation of the economic impact methodology are provided. Strategic recommendations that overlap the broader Aerospace & Aviation study – i.e. in legislation, economic incentives, infrastructure, and educational opportunities – are explored in more detail.

Key Points

The methodology utilized involved gathering data on industries that use UAS from the Census Bureau, the Bureau of Labor Statistics (BLS), and the United States Department of Agriculture (USDA). Alaris also produced an economic impact model specific to UAS usage for this study. The impact model uses RIMSII I/O multipliers, and it breaks out impacts by agricultural and non-agricultural users.

7 Alaris. (2016). Unmanned Aircraft Systems (UAS) Industry Study.

Additional information in the study comes from interviews with companies and government representatives. Key findings include:

- "The economic impact of UAS in KY is currently estimated at $4.6M and projected to reach $19.1M in 2025.
- The Norwegian company ProxDynamics is the only UAS manufacturer operating in Kentucky.
- Multiple companies in Kentucky support aerospace sub-component work but it is difficult to transition their complex assembly lines for UAS production.
- Agriculture is currently the largest economic area that may benefit from UAS growth.
- The economic impact of UAS users (agriculture and non-agriculture) may generate considerable revenue; however, the funding impact is considered revenue-neutral since it comes from existing budgets.
- Legislation of UAS at both the federal and local levels is subject to change. Kentucky is currently reviewing proposed "Anti-UAS" legislation that overlaps existing laws.
- There is very active UAS education in Kentucky that should aid UAS growth in the state."[8]

The chief recommendation of this study is to establish a Blue Ribbon Panel to create a centralized forum for relevant stakeholders to aid the development of the UAS industry in Kentucky. The Panel's charter should allow it to form a comprehensive plan for the growth of Kentucky's UAS industry. The panel should be tasked with making Kentucky a "Pro-UAS state" by creating incentives, legislation, and investments that capitalize on the emerging UAS industry.

Economic Impact Model

As mentioned, the study's economic impact model focused on the *use* of UAS technology, rather than production due to the lack of UAS manufacturing in Kentucky. The authors of this model identified 12 NAICS industry-areas where UAS technology could be useful. They are represented in the figure below.[9]

8 Alaris (2016). *Unmanned Aircraft Systems (UAS) Industry Study.*
9 Ibid.

Potential Uses of UAS in Kentucky

Agriculture
UAS can monitor crop health more effectively than conventional methods.

Construction
Crews can provide efficient site management, surveys, and topography analysis more easily with UAS.

Real Estate
UAS have already expanded the use of aerial photography and videography due to their affordability.

Insurance
Using UAS, adjusters can safely and more affordably provide routine and post-catastrophe damage assessments.

Utilities
Utility companies can use UAS for infrastructure monitoring and damage detection/assessment.

Public Safety/Emergency Management
Search and Rescue, remote chemical/bio analysis, and accident investigations.

Event Coverage/Leisure Activities
News outlets are already relying on UAS for Media coverage, breaking news, and event advertising.

Entertainment
The film industry was the first to get commercial approval to operate UAS for TV and movie filming.

Telecommunications
UAS are improving safety in the areas of tower maintenance inspections and emissions monitoring

Extractive Industries
UAS are ideal candidates for stockpile surveying, soil sampling, and open-cast mining.

Environmental Monitoring
UAS present an affordable way to conduct weather and environmental monitoring and air sampling.

Wildlife Management and Forestry
Wildlife counting/monitoring and forest fire fighting are just a few ways environmentalists are using UAS.

These 12 industry codes were split between Agricultural (one code) and Non-Agricultural (11 codes) for analysis and comparison. Using Census Bureau data, Alaris then assembled a list of companies that participate in these industries and sorted those companies into subsectors. Utilization rates were applied to illustrate the percent of an industry subsector that would use UAS. Some examples of these utilization rates are: UAS would likely be used by 90% of companies that maintain telecommunication lines, but by only 10% of residential construction companies. Using these rates, Alaris produced an estimated number of companies that utilize UAS technology. With Standard Occupation Classification (SOC) codes, Alaris then factored in the number of employees attributed to these companies.

This data fed into the Alaris economic impact model that utilized the average estimated users as calculated above, growth profiles for UAS sales as defined in the 2013 AUVSI study, multipliers from the RIMS-II model, and local/state tax multipliers available from the Kentucky Cabinet for Economic Development. It also assumed 10% conversion rate of estimated UAS users to full-time operators. The combined results for UAS users in the state are estimated in Table 1.

Table 1: Combined Non-Agricultural and Agricultural User Economic Impact for UAS in Kentucky from 2015-2025[10]

Year	Total Jobs (Direct, Indirect, and Induced)	Total Value Added	Total Local and State Taxes
2015	1,483	$ 97,334,261.00	$ 4,583,498.00
2016	2,780	$ 182,498,214.00	$ 8,590,533.00
2017	4,077	$ 267,662,168.00	$ 12,597,569.00
2018	4,342	$ 285,042,567.00	$ 13,415,333.00
2019	4,607	$ 302,422,968.00	$ 14,233,097.00
2020	4,872	$ 319,803,368.00	$ 15,050,861.00
2021	5,136	$ 337,183,768.00	$ 15,868,625.00
2022	5,401	$ 354,564,168.00	$ 16,686,389.00
2023	5,666	$ 371,944,569.00	$ 17,504,154.00
2024	5,930	$ 389,324,969.00	$ 18,321,917.00
2025	6,195	$ 406,705,369.00	$ 19,139,681.00

Strategic Recommendations

The Alaris study did not find major U.S. Department of Defense (DoD) UAS manufacturers in Kentucky. While the 2013 DoD Report "Unmanned Systems Integrated Roadmap 2013-2038" indicates that U.S. defense budgets for UAS are likely to decline, the current national political environment could actually result in spending increases.

Such spending increases could take years to be felt throughout the defense Aerospace supply chain. Explored in more detail in Chapter 6 of this study, future investments made in defense Aerospace may fund a new set of programs, like UAS. As UAS play an increasingly prominent role in defense Aviation, it is likely that they will create demand for entirely new categories of defense spending, like counter-drone devices and technologies.[11] To capitalize on these opportunities, Kentucky should explore the strategic recommendations provided by Alaris – particularly those highlighted in the following sections.

Legislative Arena

Technological advancements in the UAS industry have widely enabled usage, thus spiking demand. To accommodate this demand, the federal government created the "333 Exemption Process" to permit commercial UAS. As of September 28, 2016, there have been over 5,500 Section 333 petitions granted

10 Alaris (2016). Unmanned Aircraft Systems (UAS) Industry Study.
11 U.S. Department of Defense (2017, January 7). Department of Defense Announces Successful Micro-Drone Demonstration. Retrieved from https://www.defense.gov/News/News-Releases/News-Release-View/Article/1044811/department-of-defense-announces-successful-micro-drone-demonstration?source=GovDelivery.

across the U.S.[12] This growth has resulted in legislative responses across states that have been divided between some states enacting "UAS-friendly" legislation to attract businesses and others enacting "anti-UAS" legislation in the name of privacy.

Three bills were originally introduced in Kentucky's 2016 legislative session that addressed UAS in the state: HB 22 (Drone Surveillance), HB 67 (Drone Harassment), and HB 120 (Drone Definition). HB 22 and 67 were withdrawn and their issues added to HB 120, which died in the Senate.[13] Much of this was in response to the fact that in 2016, Kentucky also saw the first lawsuit regarding the rights of UAS operators versus the rights of property owners filed in a federal court in the state.[14] In the current legislative session, HB 540, an ACT that would which would require drone operators to clear their plans with GA airport secretaries when operating within a certain radius of a GA airport, was recently passed out of committee.[15]

Strategic Recommendations

Since legislation such as the bills proposed above can create the negative effect of an "anti-UAS" culture, the state should avoid similar bills in future sessions. Efforts should instead be directed towards embracing the UAS industry in a responsible and proactive way to make Kentucky "UAS-friendly".

Economic Incentives

Incentives can be used to encourage and support growth ranging from business attraction, retention, and expansion to entrepreneurism. Because there is only one identified UAS manufacturer in Kentucky, the state should explore tax incentives targeted both at manufacturers and agricultural users.

Strategic Recommendations

Kentucky should explore tax incentives: 1) for established UAS manufacturers moving into Kentucky and 2) that encourage the use of UAS. In addition, these should include R&D credits that could also be tradeable.

Educational Environment

Kentucky now needs to create an environment to produce and attract the talent needed to grow this industry. Explored further in Chapters 2 and 3 of this report, Kentucky has the opportunity to expand its educational pipeline relative to Aerospace & Aviation to make a tangible impact on its workforce. These opportunities begin with the K-8 Science, Technology, Engineering and Mathematics (STEM) programs that prepare students for Kentucky's High School Science Standards.

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12 Federal Aviation Administration (2017, February 10). Retrieved from https://www.faa.gov/uas/beyond_the_basics/section_333/.

13 Kentucky Legislative Research Commission (2016). Retrieved from http://www.lrc.ky.gov/record/16RS/record.htm.

14 Lexis Legal News (2016, March 30). Drone Owner Argues for Federal Jurisdiction Over Trespass, Declaratory Complaint. Retrieved from http://www.lexislegalnews.com/articles/7204/drone-owner-argues-for-federal-jurisdiction-over-trespass-declaratory-complaint

15 Kentucky Legislative Research Commission (2016). Retrieved from http://www.lrc.ky.gov/record/17RS/HB540.htm.

The state should also pursue paths into career and technical education, including certification programs to both standardize skills and market to companies interested in collaborating with Kentucky students and faculty members on their UAS projects, such as Valmie Resources.[16] By collaborating with industry and academia in higher education, Kentucky has created an incubation environment for UAS research and development embodied by the Unmanned Systems Research Consortium launched in 2013 and spearheaded by the University of Kentucky.[17] Additional courses are available across the state, including through the Kentucky Transportation Research Center Technology Transfer Program on UAS. These assets should be focal points for increasing UAS awareness across the state, and expansion of course offerings should continue.

Strategic Recommendations

Kentucky should champion a UAS educational pipeline. Best practices to do so include:

- *Increase awareness of current UAS educational avenues*
- *Increase university and college UAS Opportunities*
- *Participate in STEM UAS Programs*
- *Create Kentucky-sponsored UAS competitions*
- *Sponsor internships for students with Kentucky businesses*
- *Create a leadership program for rising Kentucky business people, politicians, and citizens*
- *Market and attract UAS Conferences to Kentucky*

Infrastructure

As noted in Chapter 5 of this study, Kentucky does not have a strong base of private R&D activity. Most of the A&A-related research in Kentucky is conducted by Lockheed Martin in Lexington, and the remaining firms – including Unmanned Services, Inc. – are relatively small in terms of their research activity. Stakeholders suggest that this is due to a lack of readily available airspace for testing. The University of Kentucky USRC has now received a COA for UAS study by the FAA that should help solve this problem. The state should continue to utilize this asset for research to enable this industry.

TPMA has also heard multiple suggestions that the state explore the usage of military airspace, particularly Fort Knox, to form public-private partnerships for the testing of UAS equipment. Addressed directly in Chapter 8 of this study, military airspace is not regularly accessible for this type of R&D.

Strategic Recommendations

To become a leader in the UAS field, Kentucky should leverage its University of Kentucky asset and participate in FAA pilot programs. The state should also complete a detailed airspace analysis as part of an educational program to improve safety and reduce violations by UAS operators.

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[16] Business Wire. (2016, November 30). Valmie (VMRI) Visits University of Kentucky Regarding Collaboration on Upcoming UAS Projects. Retrieved from http://www.businesswire.com/news/home/20161130005458/en/Valmie-VMRI-Visits-University-Kentucky-Collaboration-Upcoming.

[17] Hautala, K. (2013, December 18). Kentucky Launches Unmanned Systems Research Consortium. Retrieved from https://uknow.uky.edu/campus-news/kentucky-launches-unmanned-systems-research-consortium.

Conclusion

Kentucky has some basic assets to build upon and carve out its niche in the UAS sector. A snapshot of these assets include:

- Ongoing UAS research at the University of Kentucky,
- A newly awarded Appalachian Regional Commission (ARC) drone workforce project awarded to Maysville Community and Technical College and a community college in West Virginia, and
- Morehead State University and the Kentucky Innovation Network partnership to create a drone flight training school.

The above projects are just a few examples of how this new technology can impact the commonwealth. There is currently only one UAS manufacturer in the state and no major DoD suppliers for these systems, coupled with estimates of more than $19 million in economic impact from this industry in Kentucky by 2025, means there is ample opportunity to grow this industry, its suppliers and a highly qualified workforce.

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Chapter 5: Airport & Air Freight Optimization

Key Findings

This chapter examines airport and freight optimization within Kentucky's general aviation system, consisting of 53 General Aviation (GA) airports. In October 2016, Kentucky's general aviation airports were surveyed to determine capabilities for air freight and executive transport of aerospace manufacturing industry products and personnel. Of these, 52 airports provided meaningful feedback over a phone interview or by completing a written survey. Results from this study and the Aerospace and Aviation Industry Study, overall, should be utilized in conjunction with ongoing the Kentucky Statewide Aviation Systems planning efforts conducted by CDM Smith and the KY Department of Aviation and the Transportation Cabinet.[1]

- Of the 53 General Aviation (GA) airports in Kentucky that were evaluated for the study:
    - From the 52 airports respondents, there were eight that reported use by a local Aerospace Products manufacturer.
    - Five airports indicated that they did not currently support use by the aerospace manufacturing industry but that they had been approached in some capacity by the Aerospace Products industry.
    - 31 of the 44 airports not currently supporting use by the Aerospace Products industry responded that they would be interested in supporting air freight service or forwarding should the opportunity present itself.
    - Seven of the eight airports that reported use by an Aerospace Products manufacturer indicated that those companies also use their airport for executive transport.
    - On average, there are 12 Aerospace Products businesses within proximity of an airport that reported supporting the industry.
    - 21 airports share characteristics with the eight airports that are currently serving Aerospace Products companies, but only 16 of the 21 indicated that they would be interested in supporting use by the industry.
    - Survey respondents that indicated their airports are currently conducting air cargo service have an average runway length of 5,239 feet.

- General aviation airports interested in improving or exploring relationships with Aerospace Products Manufacturers could do so by following these recommendations:
    - For general aviation airports desiring to enter the air cargo market, the most important first step is identifying local demand.
    - If an airport desires to enter the air cargo business, it should contact area freight forwarders and any of the manufacturers in the area it wants to serve.
    - If demand exists, improvements to airports such as convenient ground transportation, convenient meeting locations at the airport, food catering for the aircraft and for the flight crew, etc. may increase the usage of executive transport.
    - Another way airports may increase executive transport usage is to engage fractional aircraft ownership operators such as NetJets, FlightOptions, Flexjet, Jet Alliance, etc.

1 CDM Smith. (2017). KY Statewide Aviation System Plan. Retrieved from http://www.kyaviationsystem.com/about-the-plan.html

Introduction

The purpose of this chapter is to identify airport and air freight optimization within the overall Kentucky general aviation system, with the majority of research and analysis performed by Randal A. Wiedemann & Associates Inc. The report consists primarily of data obtained from a survey of 53 General Aviation (GA) airports within the Kentucky System Plan. The survey and subsequent research conducted to augment the survey aimed to answer the following questions:

- Identify local Kentucky General Aviation (GA) airports and how they are utilized in the supply chain.
- How are local Kentucky airports utilized and how can they be improved to increase opportunities for Kentucky companies?
- How often do Aerospace Products businesses utilize GA airports?
- How are GA airports utilized for business purposes? (e.g., executive visits, freight shipping, parts delivery, etc.)

Underlying the above core questions, there was a desire to determine the proximity of Aerospace Products companies to Kentucky airports, freight capabilities relative to the airports, and how these airports should be optimized or improved to attract more economic activity. To augment survey results and further answer these questions, the report also includes information gleaned through Thomas P. Miller & Associate's (TPMA) analysis of Aerospace Products companies and these companies' needs. The following sections present documentation of the survey efforts and findings associated with airport and air freight optimization.

Summary of General Aviation Airports Survey

In October 2016, 53 general aviation (GA) airports identified within the Kentucky System Plan were surveyed to determine capabilities for air freight and executive transport of aerospace manufacturing industry products and personnel. Of these, 52 airports were able to provide meaningful feedback over a phone interview or by completing a written survey to determine their involvement with aerospace and aviation product industries. One airport was unavailable to provide feedback for this survey effort. Information on the amount of freight shipped through GA airports in Kentucky was not available through the survey. This section provides a high-level summary of survey results. A copy of the survey is included on page 159, and detailed findings are provided later in the report. In addition, a summary of the responses is included in Appendix D of this document.

Airport Survey

1. Do you know of any use of your airport by Aerospace or Aviation Parts manufacturers?

Of the 52 airports with respondents, a large majority (71%, 37 airports) reported a high level of certainty that no Aerospace Products manufacturer was utilizing their airport. There were eight that reported use by a local Aerospace Products manufacturer. The use of each airport ranged from infrequent shipping of prototype parts to regularly scheduled cargo shipments from multiple manufacturers. Two respondents reported Aerospace part sales that take place at the airport.

Of the 44 airports not currently serving the Aerospace Products industry, seven reported air cargo activity for local manufacturers but did not believe those had any involvement with the Aerospace Products industry. This activity involved automotive parts, custom gears from aluminum plants, etc.

2. Have you ever been approached by one of these businesses inquiring about air freight service or forwarding?

One-fifth of the respondents (11 airports) indicated they had been approached in some capacity by the Aerospace Products industry. Of those airports, five did not currently support use by the aerospace manufacturing industry. These respondents reported that they were in consideration, but in each case, the company decided to use a different airport. In one instance, the respondent identified the reason for not being used as not having enough space for the inquiring party to move forward.

3. Does your airport have any facilities or services available to accommodate specialized air freight (forklift, pallets, etc.)?

One key to providing air cargo service is the availability of one or more forklifts. Of the 52 respondents, 12 (23%) reported having a forklift on the field. Of these, four reported having more than one forklift. For those airports without a forklift, three reported using a forklift service that could be made available with enough notice. The remaining 37 airports did not report having a forklift available.

Other items mentioned by the airports that would support specialized air freight included ample land space available, ramp space, solid infrastructure, hangar space, ground transport capabilities, controlled entry gate, and fuel services.

There were 24 airports (46%) that reported not having any equipment or facilities to accommodate air freight shipments.

4. If the opportunity presented itself, would you or your airport desire specialized air freight service or forwarding?

Of the 44 airports that were not currently supporting activity from the Aerospace manufacturing industry, 70% (31 airports) responded that they would be interested in supporting air freight service or forwarding should the opportunity present itself. However, two of these airports also added that they did not really consider it a possibility – one because the airport was unmanned and another because of the lack of any nearby industry.

Seven airports indicated they would not be interested in any air freight service activity, citing the airport's inability to handle such activity. One airport noted that they were simply too busy doing other things.

5. What airport improvements, if any, would be needed to attract more of this economic activity?

Survey respondents noted improvements that would increase activity at their airport for specialized freight services.

They included the following:

- Fourteen airports reported that runway improvements would help attract more air cargo. These improvements included increased runway length, greater weight capacity, and additional runway lighting.
- Fourteen respondents indicated that additional cargo handling equipment was needed for their airports to attract more activity.
- Eleven airports cited the need for better facilities or hangars. These included buildings that could be dedicated for storing part shipments and additional hangars that could accommodate larger aircraft.
- Six airports reported that the biggest obstacle they faced was location. This included a close geographic proximity to an economically depressed area or one that did not support manufacturing.
- Three airports mentioned general infrastructure as a needed improvement.
- Two airports indicated that additional staffing would be needed for them to support air freight activity.
- Two airports listed a loading dock for tractor trailers as a needed improvement.
- Additional improvements discussed included better access to and from the airport, increased ramp space, and an airport traffic control tower.

In addition to these responses, there were two airports that currently do not handle any air freight, but indicated that their airport already had everything it could need to support such activity and that no improvements were necessary.

6. Does your airport receive any executive transport to and from any local aviation manufacturing companies?

Seven of the eight airports that reported use by an Aerospace Products manufacturer indicated that those companies also use their airport for executive transport. For the remaining 44 airports that did not support Aerospace manufacturing, nine reported a high amount of charter service but could not pinpoint whether those charter flights had anything to do with the Aerospace manufacturing industry.

Figure 1: Airport Survey

Kentucky UNBRIDLED SPIRIT

Commonwealth of Kentucky Aerospace, Aviation & Defense Industry Study – Airport Survey

1) **Do you know of any use of your airport by aerospace or aviation parts manufacturers?**

2) **Have you ever been approached by one of these businesses inquiring about air freight service or forwarding?**

3) **Does your airport have any facilities or services available to accommodate specialize air freight (fork lift, pallets, etc.)?**

4) **If the opportunity presented itself, would you or your airport desire specialized air freight service or forwarding?**

5) **What airport improvements, if any, would be needed to attract more of this economic activity?**

6) **Does your airport receive any executive transport to and from any local aviation manufacturing companies?**

"This project is contracted with the Commonwealth of Kentucky, with financial support from the Office of Economic Adjustment, Department of Defense. The content does not necessarily reflect the views of the Office of Economic Adjustment."

THOMAS P. MILLER & ASSOCIATES FOURTH economy R.A. Wiedemann & Associates, Inc. BDZ hcc

Detailed Findings of General Aviation Airports Survey

This section drills down into the results of the airport survey, combining survey responses with additional research on components such as airport size, proximity to manufacturers, and other airport characteristics. In examining which factors are common across airports that participate in executive transport and air cargo service for the Aerospace Products industry in Kentucky, several components emerge. Specifically, the following characteristics are shared across the airports that serve the Aerospace Products industry in the state:

- Airport Size and Runway Length
- Geographic Proximity to Aerospace Products Manufacturers
- Service Equipment on Hand
- Amenities for Executive Transport

Several of these findings are developed further in the recommendations portion of this section.

Airport Size and Runway Length

Table 1 shows all eight of the airports that currently serve Aerospace Products and executive transport. Runway lengths and airport acreage are included in the table. Of the eight, only two airports with runways under 5,000 feet indicated use by an Aerospace Products company. For these airports, respondents noted that utilization was seldom and very limited. For instance, Breckinridge County Airport reported no major use, but that infrequently a specialty part from a local manufacturer might be shipped from their airport.

The six airports that reported more consistent and regular usage by the Aerospace manufacturing industry all have runway lengths greater than 5,000 feet. The average runway length of the six airports providing air cargo service is 5,239 feet. In general, larger aircraft require longer runways. As such, longer runways (those that are 5,000 feet or longer) may be an asset for these six airports. Airports with runways shorter than 5,000 feet may have difficulty attracting specialized air cargo service, even if they are near an Aerospace manufacturer. While airports with less than 5,000-foot runways may be able to provide limited and infrequent air cargo service, the primary targets of future air cargo marketing efforts should be directed at airports with runways of 5,000 feet or more.

The airports with more consistent and regular usage also tended to have larger acreage. The average acreage of all eight airports that reported currently serving Aerospace Products industries is 180.4. However, when including only the six that reported more consistent and regular usage, the average acreage is 208.5.

It should be noted that all air cargo carriers may use airports that do not have FAR Part 139 Operating Certificates. However, if the carrier has an FAR Part 121 Certificate (scheduled airline) or an FAR Part 380 Certificate (scheduled charter), it must use airports that have FAR Part 139 Operating Certificates if:

- Scheduled passenger-carrying operations are conducted in aircraft designed for more than 9 passenger seats, and
- Unscheduled passenger-carrying operations are conducted in aircraft designed for at least 31 passenger seats.

In Kentucky, there are only six FAR Part 139 Certificated airports: Bowling Green-Warren County Regional, Cincinnati-Northern Kentucky International, Bluegrass Airport (Lexington), Owensboro-Davies County, Barkley Regional (Paducah), and Louisville International. None of these are strictly general aviation airports. All of them have some type of scheduled airline service. The average primary runway length at these airports is 8,648 feet.

Geographic Proximity to Aerospace Product Manufacturers

Table 1 also shows the geographic proximity to the nearest companies involved with Aerospace & Aviation industries for the eight airports currently conducting air cargo and executive transport operations. To determine proximity requirements, the geographical area is defined by the first three-digits of the zip code associated with a given airport. On average, there are 12 Aerospace Products businesses within proximity of an airport that reported supporting the industry. Appendix E shows a detailed list of Aerospace Products companies located near the airports that responded to this survey.[2] Appendix F presents a list of air freight forwarders near Kentucky airports.

Table 1: KY GA Airports Utilized by Aerospace Products Companies

Airport	Primary Runway	Based Jets	Acreage	Zip Code	Companies in Zip Code
Lebanon-Springfield Airport	5,001 x 75	0	112	40069	30
Breckinridge County Airport	4,000 x 75	0	87	40143	11
Capital City Airport	5,506 x 100	1	375	40601	9
London-Corbin Airport (Magee Field)	6,100 x 150	2	186	40744	6
Hancock County Airport (Ron Lewis Field)	4,000 x 75	0	105	42351	13
Henderson City-County Airport	5,504 x 100	3	80	42420	13
Lake Cumberland Regional Airport (was Somerset-Pulaski County Airport)	5,801 x 100	0	288	42501	6
Elizabethtown Regional Airport (Addington Field)	6,001 x 100	0	210	42701	5

In total, there were 93 companies located within a close geographical proximity to an airport that actively supports the Aerospace Products industry. It should be noted that it is unknown whether companies in the geographical proximities of the airports actually use those airports, or whether they use airports outside of their zip code designation. In addition, it is likely that most of these companies already use commercial airline airports, which were not surveyed in this analysis.

Executive Transport

Each of the eight airports that support Aerospace Products also reported supporting executive transport for those industries. Because executive transport is often tied to business jet activity, runway length requirements are a primary consideration. For business jet operations, a key threshold for airport runway

2 The companies counted in Table 1 and noted in Appendix E were identified through TPMA's Aerospace & Aviation company identification process, outlined in chapter 1, entitled Aerospace & Aviation Cluster.

lengths is 5,000 feet, which meets the significant common criterion for corporate flight departments and their insurance requirements for airfield use.[3,4]

Larger, heavier corporate aircraft require additional runway length to safely conduct operations. This becomes even more critical during summer months when heat reduces the density of the atmosphere. The reduced density diminishes the ability of the aircraft's wings to generate lift and increases the necessary speed and required runway length needed for the takeoff roll. A safety margin must also be added to provide an option to stop on the runway in the event of a rejected takeoff. Thus, flight crews operating larger aircraft will often opt for airports with more than the minimum required runway length.

For the surveyed Kentucky GA airports, the existence of based jets can be one indication of executive transport activities taking place at that airport. Table 1 shows that three of these airports have at least one based jet on the field. We know that all eight have executive transport, so the based jet indicator is only one facet of the overall capability.

Airports with Potential for Utilization by Aerospace Products Companies

There are 21 GA airports that share characteristics with the eight airports that are currently serving Aerospace Products companies. The 21 airports listed in Table 2 all have runways longer than 5,000 feet. In addition, most have at least one of the following: large acreage, proximity to Aerospace Products manufacturers, and/or the existence of based jets. Because these airports share at least one characteristic with the airports that are currently serving Aerospace Products, they may have potential to provide these services. Although all 21 on this list may have the capacity to serve, it is important to note that only 16 of the 21 indicated that they would be interested.

Table 2 lists the 21 survey respondents with runways that meet the 5,000-foot-or-more guideline that is a preferred benchmark for handling cargo shipments. Many of the airports in Table 2 also have a large number of companies with geographic proximity to Aerospace Products manufacturers. Further, many have large acreage, and several have the existence of based jets. These airports indicated that they are not currently supporting the Aerospace Products industry.

3 These operating limitations may be waived if the insurance company has a long safety record with an aviation company using an airport with shorter runways.
4 Bradley Brandt, Director of Aviation with the Louisiana State Department of Transportation and Development, Insurance Journal, "Louisiana Runway Extension to Increase Traffic, Satisfy Insurance Requirements" March 2014.

Table 2: KY GA Airports with Potential for Utilization by Aerospace Products Companies

Airport	Primary Runway	Based Jets	Acreage	Zip Code	Companies in Zip Code
Samuels Field	5,003 x 75	1	110	40004	30
Morehead-Rowan County Clyde A. Thomas Regional Airport	5,500 x 100	0	325	40313	32
Georgetown-Scott County Airport (Marshall Field)	5,498 x 100	2	285	40379	
Mount Sterling-Montgomery County Airport	5000 x 75	3	53	40353	
Central Kentucky Regional	5,001 x 100	0	197	40475	9
Stuart Powell Field	5,000 x 75	1	170	40484	
Williamsburg-Whitley County Airport	5,498 x 100	0	500	40769	6
Ashland Regional Airport	5,602 x 100	0	170	41183	2
Big Sandy Regional Airport	5,000 x 100	2	136	41214	2
Wendell H. Ford Airport	5,499 x 100	6	37	41367	0
Pike County Airport (Hatcher Field)	5,356 x 100	0	46	41501	4
Mayfield Graves County Airport	5,002 x 100	0	113	42066	18
Murray-Calloway County Airport (Kyle-Oakley Field)	6,203 x 100	1	300	42071	
Glasgow Municipal Airport	5,302 x 100	1	326	42141	12
Hopkinsville-Christian County Airport	5,505 x 100	0	180	42240	10
Ohio County Airport	5,000 x 75	0	201	42320	13
Muhlenberg County Airport	5,000 x 75	0	92	42345	
Madisonville Municipal Airport	6,050 x 100	1	215	42431	13
Sturgis Municipal Airport	5,000 x 75	2	1,307	42459	
Russell County Airport	5,010 x 78	1	165	42629	4
Taylor County Airport	5,003 x 75	0	106	42718	5

The average acreage for the 21 airports in Table 2 is 239.7, with median acreage of 170. Eight of the 21 have acreage over 200. In addition, 11 of the 21 have based jets. The far right column shows there are a total of 160 companies in proximity to airports that are not currently utilized by Aerospace Products companies.[5]

If Table 2 is overlaid on Table 1, it narrows further the 160 companies that are located within the three-digit zip code of an airport listed as not currently supporting the Aerospace Products industry. These overlapping companies were removed, leaving a remainder of 93 companies involved with Aerospace Products that are located within the geographical proximity of a GA airport with at least 5,000 feet of runway length that is not currently supporting the aerospace manufacturing industry. These are the

5 To avoid duplication, companies associated with airports that share a three-digit ZIP code identifier were listed only once.

potential sites for new air cargo carrier service for the Aerospace Products companies. Some of these airports, such as Georgetown-Scott County Regional Airport already have a significant air cargo operation. However, their business is focused on the Automotive Manufacturing industry.

Recommendations

Recommendations for GA airports are divided into two categories:

1) Air Cargo Facilities and Services
2) Executive Transport

Because general aviation airports are usually more limited in the size and weight of aircraft using their facilities, heavy and steady air cargo volumes are typically shipped through airline airports. Thus, the primary market for GA airports is specialty shipments and just-in-time parts or freight.

Air Cargo Facilities, Equipment, and Services

From the survey responses and discussions with airport operators, several minimum requirements for air cargo facilities and services were identified. These needs apply to any GA airport that desires to enter the air cargo business and has identified local demand.

Identification of Demand

For GA airports desiring to enter the air cargo market, the most important first step is identifying local demand. Even with the best facilities and services, the success of an airport cargo operation depends upon the need for the service.

Methods of determining demand vary based upon local circumstances. For airport sponsors that have their own fixed-base operators (FBOs), the following methods may be helpful:

- Monitor phone calls for air cargo services. When a call comes in requesting service, conduct follow up to determine the scope of demand.
- If air cargo operators are already serving clients in the area, conduct discussions with them to determine potential partnering on facilities or services.

For airports with independent FBOs, communication with the FBO management concerning the recording of any air cargo operations or requests is crucial. From this information, there may be additional facilities or equipment needed to adequately serve demand or increase existing service.

Airport Facilities and Equipment

Survey respondents that indicated their airports are currently conducting air cargo service have an average runway length of 5,239 feet. While there are two airports with only 4,000 feet of runway on the list, they represent exceptions to the general rule of 5,000 feet or more for high performance aircraft. Many insurance companies will not write policies for jet aircraft operators for airports with less than 5,000 feet of runway length. While waivers are given, those are based upon interviews with the pilots and their safety records. In some cases, the pilots use these facilities at their own risk.

In addition to runway length, hangar space is needed for interim storage. The amount of area required depends upon the volume of air cargo handled. This space is mostly for weather protection rather than long-term storage. Other facilities and equipment necessary to conduct air cargo services include, but are not limited to:

- Truck access to the airport flight line.
- Minimum of one forklift (can be a manual lift if volumes are very low).
- Pallets for movement and storage of air cargo.

Air Cargo Services

At Kentucky GA airports, either the airport sponsor acting as the airport's fixed-base operator (FBO) provides the air cargo loading/unloading services, or that is provided by a private FBO at the airport. GA airports that offer air cargo services usually include the following items:

- Published List of Costs:
    - Loading and unloading aircraft
    - Fork lift costs
    - Storage costs
- On-call service, with after hours, as needed

If an airport desires to enter the air cargo business, it should contact area freight forwarders and any of the manufacturers in the area it wants to serve. Given that Kentucky has a large Automotive Manufacturing base, the success of an air cargo operation at a GA airport could depend upon the business generated from both the Automotive and Aerospace Products industries. Therefore, all avenues of potential demand should be examined before entering the market.

In addition, GA airports and Aerospace Products manufacturers in Kentucky should implement better communication strategies. This would involve airports that currently offer air cargo service (either to the Aerospace Products industry or to the Automotive industry). More exposure and greater knowledge of the convenience offered by these airports to Kentucky-based Aerospace Products industry manufacturers could help increase their usage. Such a program could be initiated on an upper level, statewide basis. Alternatively, it could originate with each airport currently offering air cargo service. It is likely that the upper level program will fare better in publicizing these facilities and services.

Executive Transport

To attract executive transport activity, each airport must consider what is desired by executives and their specific aircraft needs. The primary reason for GA executive transport is to save time. Therefore, all convenience items relative to a trip should be considered.

Airport Improvements in Facilities and Services

If demand exists, improvements to airports that may increase usage include, but are not limited to:

- Convenient ground transportation at the airport in the form of ready rental cars or courtesy cars.
- Convenient meeting locations at the airport, primarily in the form of boardrooms or conference rooms in the terminal building.
- Food catering for the aircraft and for the flight crew.

- Ground power units (GPU), de-icing, overnight hangar storage.
- Package deals with business class hotels and restaurants.

Engagement of Fractional Aircraft Ownership Operators

The gold standard of executive transport is exemplified in a company like NetJets. This company has a rigorous vetting process for their client airports and safety is their top priority. The process by which airports are approved for use is instructive for any Kentucky airport desiring greater utilization for executive transport. This process involves the following steps:

Survey is initiated by owner request:

- NetJets staff then places a call to the Airport Manager
- NetJets reviews previous communications with the airport as well as airport changes since the last call by NetJets
- Focal issues of the survey include:
    - General Airport Information
        - Runway length
        - Taxiway dimensions and lighting
        - PAPI angles
        - Fuel delivery and future Prist requirements
        - Accurate diagrams specifying dimensions (ALP)
        - Weight bearing and occasional usage
    - Safety and Security
        - Camera coverage – aprons, hangars
        - Fencing – restrict non-aviation interests
        - Badging – identify who belongs near aircraft
        - NATA Safety First program
    - Fuel Branding
        - Training
        - Fuel quality

For all GA airports desiring to increase their executive transport market, it is recommended that they certify their airport for usage by fractional jet companies such as NetJets, FlightOptions, Flexjet, Jet Alliance, etc. Such action will assure any private operator of the safety associated with using that airport.

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Kentucky Commission on Military Affairs &
the Commonwealth of Kentucky

Chapter 6: General Aviation Airport Evacuation Plans

Key Findings

This chapter examines the capabilities of 53 General Aviation (GA) airports in Kentucky to support evacuation operations. The evaluation includes an analysis of the extent to which each airport is suitable to support requirements for natural disaster response and other emergency operations. The chapter analyzes runway length and width to determine the largest civilian and military aircraft that can access the airport, as well as providing maps for evacuation routes and emergency staging areas.

- There are 53 General Aviation (GA) airports in Kentucky that were evaluated for the study.
    - 28 have runways of 5,000 feet or more. This length is necessary to serve larger civilian aircraft, such as the ATR-72 (66 passengers); Bombardier CRJ-200 (50 passengers); Bombardier CRJ-700 (78 passengers); Boeing 737-500 (122 passengers); Embraer 170 (80 passengers); and Boeing 737-700 (143 passengers).
    - 14 airports could support dual-wheel aircraft, and an additional 36 could support single-wheel aircraft.
    - 14 airports could support relatively large civilian aircraft (Boeing 757-200, holding 200 passengers; Boeing 737-700, holding 143 passengers; or Boeing 737-500, holding 122 passengers).
    - 31 airports could support medium-size civilian aircraft (Embraer 170, holding 80 passengers; ATR-72, holding 66 passengers; or ATR-42, holding 48 passengers).
    - The Lockheed C-130 (92 passengers) is the most common largest military aircraft that the GA airports could support, with 28 airports capable of supporting this aircraft.
    - The evaluation identified that 18 of the 53 airports likely could serve as civilian evacuation bases, with another 25 identified as possible, and 10 identified as unlikely or very unlikely to serve as evacuation bases.
- General aviation airports could further improve emergency relief efforts by following these recommendations:
    - Have local emergency operations centers review the airport's plans.
    - Conduct an onsite inspection of the airport to determine necessary changes to area boundaries (to increase potential overflow parking options, etc.).
    - Ensure that emergency plans are available to emergency personnel, dispatchers, and administrators.
    - Include airport briefings and graphics as part of desktop emergency exercises, drills, or simulations.

Introduction

Airports are natural staging areas for evacuation operations. Depending upon the emergency and its associated response level, Kentucky's airports can be used to evacuate injured or disabled persons from the path of an impending deadly storm, terror event, HAZMAT or biological incident, or from weapons of mass destruction. Any situation that requires the evacuation of most or all people from an area or region may require the use of aerial transportation. This would include the injured, hospitalized, immobile sick or elderly, nursing home patients, and others.

This chapter inventories 53 public-use General Aviation (GA) airports in Kentucky and identifies the extent to which they are suitable to support requirements generated by natural disaster response and other emergency operations. For each airport, runway length and width is utilized to determine the largest civilian and military aircraft that can access the airport. In addition, maps of preferred evacuation routes and emergency staging areas have been developed for each airport. The chapter also makes general recommendations for improving emergency relief efforts through the inclusion of GA airports.

Airport Capabilities

In the event of an emergency, the system of public-use airports in Kentucky can serve as staging and aerial evacuation points for an area. The different capabilities of the airports will dictate what types of staging and evacuation are possible. Tables 1 and 2 present guidelines for each of the public-use airports regarding their capabilities for both civilian and military transport aircraft.

Table 3 identifies the 53 public-use airports included in this study. In addition, their three-character identification code is shown, along with their primary runway length and strength. The runway strength is presented in terms of either Single wheel, Dual wheel, or Dual Tandem wheels, along with a load bearing weight limitation. It should be noted that this limitation is for regular usage by aircraft of that weight. Emergency situations allow for landings and takeoffs by aircraft over those weight limitations.

The largest civilian aircraft capable of using each airport is included in the table to provide an idea for emergency planners to understand the passenger capacity limitations of aircraft using the airport. These aircraft were matched to each of the Kentucky airports based upon their required runway lengths and operating characteristics. That is, there are other aircraft types with passenger capacities higher than those listed, but their runway length requirements were greater. The premium trade-off for general aviation airports is runway length and strength against aircraft passenger capacity. Aircraft selected for these airports were taken from the compiled list in Tables 1 and 2.

Table 1: Civilian Aircraft Characteristics

Aircraft	Passengers	Runway Length	Max Weight
Pilatus PC-12	9	2,300’	9,900 lbs.
De Havilland Dash-7	50	2,700’	21,300 lbs.
ATR-42	48	3,600’	37,300 lbs.
ATR-72	66	5,000’	50,300 lbs.
Bombardier CRJ-200	50	5,000’	53,000 lbs.
Bombardier CRJ-700	78	5,100’	75,000 lbs.
Boeing 737-500	122	5,400’	115,500 lbs.
Embraer 170	80	5,500’	75,900 lbs.
Boeing 737-700	143	5,600’	130,000 lbs.

There are many other aircraft with similar operating characteristics; however, with the exception of the Dash-7, these aircraft are fairly common in the U.S. fleet. For many of the smaller airports, the Dash-7 would be the aircraft of choice. However, because of its relative scarcity, it is not included in Table 3.

Table 2: Military Aircraft Characteristics

Aircraft	Passengers	Runway Length	Weight
Lockheed C-130	92	2,300’	155,000 lbs.
UH-60 Black Hawk	14	VTOL	22,000 lbs.
V-22 Osprey	24	VTOL	52,600 lbs.
CH-47 Chinook	36	VTOL	50,000 lbs.

Of the military aircraft, the most versatile fixed wing version is the C-130 Transport. This aircraft can carry more than 90 passengers, and it has a very short runway length requirement. Other than this aircraft, the military has vertical take-off and landing (VTOL) aircraft such as the Black Hawk, the Osprey, and the Chinook that can be called into action. Of these, the Osprey has the longest stage length service range, thanks to its tilt-rotor design. After vertical takeoff, the rotors swivel to forward position, and the aircraft flies like a fixed wing plane. These efficiencies increase the speed and lengthen the distance the Osprey can fly before refueling. Of course, the aircraft actually used during an emergency will be the ones most available to the area. That is why both the civil aircraft and military aircraft lists were expanded to include multiple aircraft.

Table 3: Airport Evacuation Staging Capabilities

Airport Name	Airport Code	Longest Runway	Load Bearing	Largest Civilian Aircraft*	Largest Military Aircraft*	Parking & Staging Area Available (Acres)
Addington Field	EKX	6,001' x 100'	S-30	B-737-700 (143 Pax)	Lockheed C-130 (92 Pax)	17.5
Ashland Regional	DWU	5,602' x 100'	D-65, DT-105	B-737-700 (143 Pax)	Lockheed C-130 (92 Pax)	9.6
Big Sandy Regional	SJS	5,000' x 100'	S-30	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	13.4
Bowman Field	LOU	4,358' x 75'	S-30	ATR-42 (48 Pax)	Lockheed C-130 (92 Pax)	72.4
Breckinridge County	I93	4,000' x 75'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	9.4
Capital City	FFT	5,506' x 100'	D-51, DT-82	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	27.7
Central Kentucky Regional	RGA	5,001' x 100'	S-12.5	ATR-72 (66 Pax)	CH-47 (36 Pax)	8.5
Columbia-Adair County	I96	2,600' x 60'	S-12	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	10.6
Cynthiana-Harrison County	0I8	3,850' x 75'	D-25	ATR-42 (48 Pax)	Lockheed C-130 (92 Pax)	4.2
Fleming-Mason	FGX	5,001' x 100'	D-50	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	15.2
Fulton	1M7	4,001' x 75'	S-12	ATR-42 (48 Pax)	CH-47 (36 Pax)	6.3
Gene Snyder	K62	3,994' x 75'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	2.4
Georgetown Scott County - Marshall Field	27K	5,498' x 100'	S-30	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	30.1
Glasgow Municipal	GLW	5,302' x 100'	S-30	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	17.3
Grayson County	M20	4,000' x 60'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	6.9
Hancock Co-Ron Lewis Field	KY8	4,000' x 75'	D-40	ATR-42 (48 Pax)	Lockheed C-130 (92 Pax)	5.2
Henderson City-County	EHR	5,504' x 100'	D-60, DT-130	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	29.0
Hopkinsville-Christian County	HVC	5,505' x 100'	S-14	EMB-170 (80 Pax)	CH-47 (36 Pax)	11.8
Julian Carroll	JKL	4,400' x 75'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	4.8
Kentucky Dam State Park	M34	4,000' x 100'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	6.1
Kyle-Oakley Field	CEY	6,203' x 100'	S-30	B-737-700 (143 Pax)	Lockheed C-130 (92 Pax)	16.6
Lake Barkley State Park	1M9	4,800' x 100'	S-30	ATR-42 (48 Pax)	Lockheed C-130 (92 Pax)	3.7

Airport Name	Airport Code	Longest Runway	Load Bearing	Largest Civilian Aircraft*	Largest Military Aircraft*	Parking & Staging Area Available (Acres)
Lake Cumberland Regional	SME	5,801' x 100'	D-70, DT-125	B-737-700 (143 Pax)	Lockheed C-130 (92 Pax)	32.9
Lebanon-Springfield	6I2	5,001' x 75'	S-10	ATR-72 (66 Pax)	CH-47 (36 Pax)	7.0
Liberty-Casey County	I53	3,000' x 60'	--	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	1.0
London-Corbin Airport-Magee Field	LOZ	5,751' x 150'	D-95, DT-151	B-737-700 (143 Pax)	Lockheed C-130 (92 Pax)	45.4
Madisonville Municipal	2I0	6,050' x 100'	D-130	B-757-200 (200 Pax)	Lockheed C-130 (92 Pax)	6.1
Marion-Crittenden County	5M9	4,400' x 75'	--	ATR-42 (48 Pax)	CH-47 (36 Pax)	7.3
Mayfield Graves County	M25	5,002' x 100'	S-30	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	10.3
McCreary County	18I	2,999' x 75'	S-8	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	6.7
Middlesboro-Bell County	1A6	3,631' x 75'	S-19	ATR-42 (48 Pax)	CH-47 (36 Pax)	12.0
Morehead-Rowan County Clyde A. Thomas Regional	SYM	5,500' x 100'	S-30	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	9.3
Mount Sterling-Montgomery County	IOB	5,000' x 75'	S-20	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	21.4
Muhlenberg County	M21	5,000' x 75'	D-30	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	12.1
Ohio County	JQD	5,000' x 75'	D-50	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	8.8
Pike County-Hatcher Field	PBX	5,356' x 100'	S-30	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	13.3
Princeton-Caldwell County	2M0	4,099' x 76'	S-12	ATR-42 (48 Pax)	CH-47 (36 Pax)	3.8
Providence-Webster County	8M9	3,800' x 70'	S-7.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	2.5
Rough River State Park	2I3	3,200' x 75'	S-8	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	3.5
Russell County	K24	5,010' x 78'	D-70	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	8.5
Russellville-Logan County	4M7	4,000' x 75'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	4.9
Samuels Field	BRY	5,003' x 75'	S-18	ATR-72 (66 Pax)	CH-47 (36 Pax)	13.4
Stanton	I50	2,996' x 70'	S-8	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	4.9
Stuart Powell Field	DVK	5,000' x 75'	S-30	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	14.5
Sturgis Municipal	TWT	5,000' x 75'	D-50	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	11.7
Taylor County	AAS	5,003' x 75'	S-30	ATR-72 (66 Pax)	Lockheed C-130 (92 Pax)	10.6
Tompkinsville-Monroe County	TZV	4,000' x 75'	S-12	ATR-42 (48 Pax)	CH-47 (36 Pax)	8.5

Airport Name	Airport Code	Longest Runway	Load Bearing	Largest Civilian Aircraft*	Largest Military Aircraft*	Parking & Staging Area Available (Acres)
Tradewater	8M7	2,875 x 80'	Turf	Use Military VTOL	CH-47 (36 Pax)	1.0
Tucker-Guthrie Memorial	I35	3,460' x 75'	S-24	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	4.7
Wayne County	EKQ	4,000' x 75'	S-12.5	ATR-42 (48 Pax)	CH-47 (36 Pax)	9.5
Wendell H Ford	CPF	5,499' x 100'	S-30	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	10.7
West Liberty	9I3	2,400' x 60'	S-9	Pilatus PC-12 (9 Pax)	CH-47 (36 Pax)	3.2
Williamsburg-Whitley County	BYL	5,498' x 100'	D-45	B-737-500 (122 Pax)	Lockheed C-130 (92 Pax)	14.1

* Airport runway load-bearing capacity may bar some aircraft from use, even though runway lengths are adequate.

LEGEND: S=Single Wheel; D=Dual Wheel; Number (8, 30, 50, 12.5, etc.) = Pavement load bearing capacity in thousands of pounds.

Airport-Specific Plans

For mass evacuations, airport-specific plans were developed to show the on-airport locations for staging, parking, aircraft operations, etc. These plans focus on airport management response, communications, and protocols between the airport and responding agencies. The specific plans, shown below, identify the proposed staging locations for both aircraft and evacuees, along with the ingress/egress routes for ground traffic.

Although there are federal guidelines for emergency operations at airports, there are no specific guidelines for assigning areas for use during an evacuation emergency. Generally, air operations areas provide space for landing, takeoff, or surface maneuvering of aircraft and are separated from ground operations. For this analysis, general guidelines for assigning areas included the following:

- Air Operations areas were assigned to runways and taxiways.
- Air Staging areas were located on the apron or ramp area nearest the accessing taxiways to the runway. These are areas of loading and unloading passengers from ground to air and vice versa.
- Ground Staging areas were located behind the Air Staging areas and could include ramp or hangar areas. These areas are transition locations for evacuees from ground transportation to be readied for air transport.
- Parking areas were located on airport property and mostly on paved surfaces.
- Overflow Parking areas were located both on and off airport property and could include paved or grassy surfaces.

On-ground inspections may show some parking areas as inaccessible due to lack of terrain visibility in mapping programs. Presented below is each Kentucky system airport, showing evacuation routes, along with staging and parking areas graphically depicted.

Recommendations for Improving Emergency Relief

The recommendations for improving emergency relief efforts by including use of general aviation airports include the following:

- Have local emergency operations centers review their airport's specific plans.
- Conduct an on-site inspection of the airport to determine which area boundaries should be changed, if necessary. For example, the presence of a fence or drainage ditch that removes an overflow parking area from potential use needs to be identified.
- Ensure that all emergency plans are available to emergency personnel, dispatchers, and administrators. This could be in the form of digital downloads of the plans to emergency officials. These should be available for viewing on smart phones, tablets, etc.
- Include airport briefings and graphics as a part of any desktop emergency exercises, drills, or simulations.

While no plan is foolproof and situations may require adjustments, it is important to have emergency personnel familiarized with the potential use of the local airport as an evacuation center.

Addington Field Airport - EKX

Elizabethtown, Kentucky

With a paved runway 6,001 feet by 100 feet, Addington Field Airport is the largest among three other alternative airports within a 30-mile radius. The airport has good ground transportation access. As such, it is likely that Addington Field Airport would be utilized for evacuation of civilians from the Elizabethtown area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-700 (143 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. As with many airports of this size, paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas near the terminal. The large, level grassy area inside the fence west of the terminal and T-hangars could be safely roped-off for additional parking areas.

Largest Civilian Aircraft

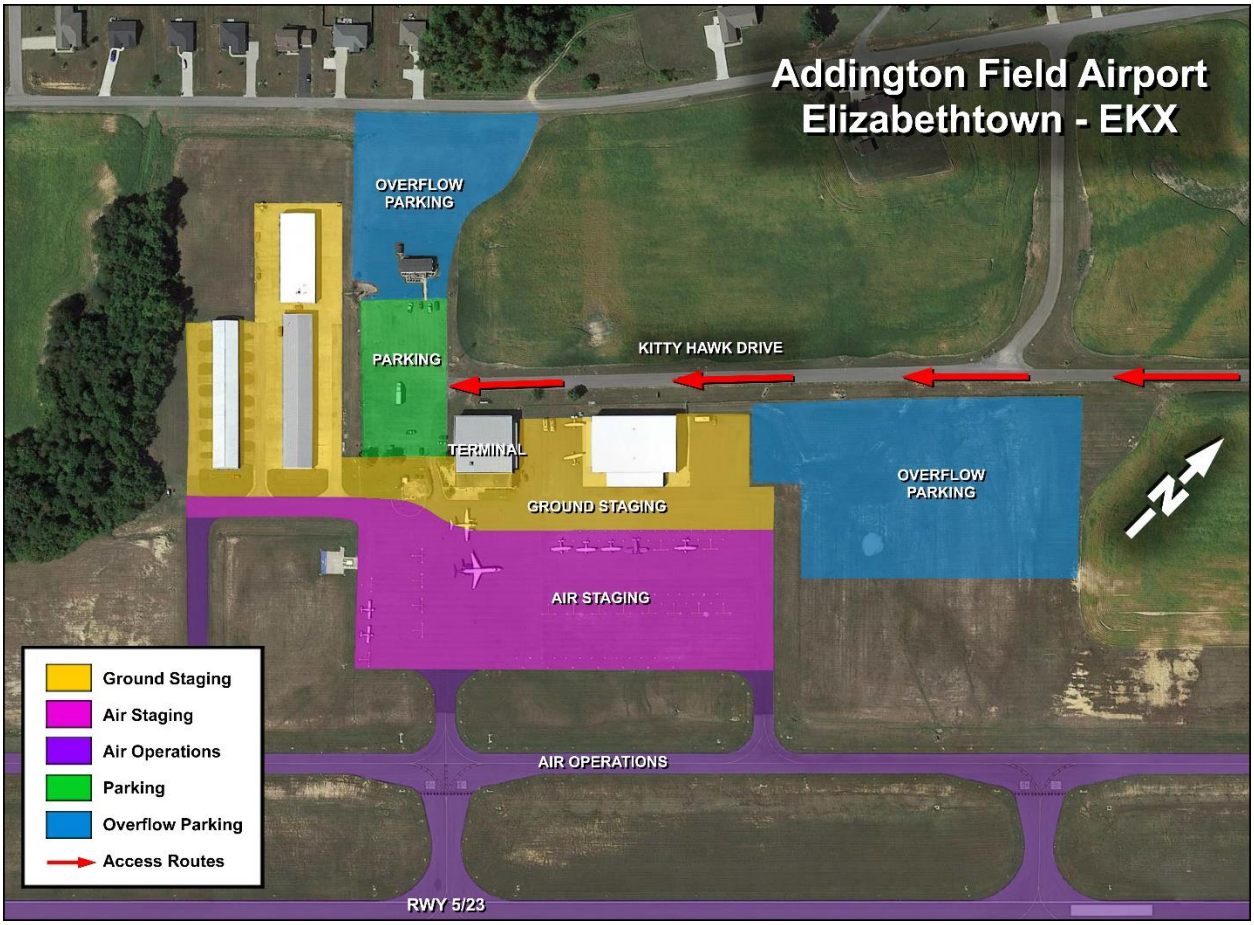
Boeing 737-700 (143 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Kitty Hawk Drive, which connects to Ring Road approximately 0.9 miles east of the Airport. Ring Road North leads to St. John Road connecting with US Highway 31, and West Elizabethtown is approximately 4 miles to the east. Ring Road South leads to US Highway 62 and accesses Interstate 65. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Addington Field Airport - EKX
TERMINAL AREA
KITTY HAWK DRIVE
To 31W
RING ROAD
To Elizabethtown
To 62
N


Addington Field Airport
Elizabethtown - EKX
OVERFLOW PARKING
PARKING
KITTY HAWK DRIVE
TERMINAL
GROUND STAGING
OVERFLOW PARKING
AIR STAGING
AIR OPERATIONS
RWY 5/23
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Ashland Regional Airport - DWU

Ashland, Kentucky

With a paved runway 5,602 feet by 100 feet and as the only Kentucky airport within a 30-mile radius, it is likely that Ashland Regional Airport would be utilized for evacuation of civilians from the area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737–700 (143 passengers) and military Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is available. Overflow parking is limited, and may be accommodated on reasonably level grassy areas near the terminal and along the edges of Scott Street. Additional overflow parking may be possible across Scott Street south of the terminal, or inside the fence west of the terminal and within the hangar area.

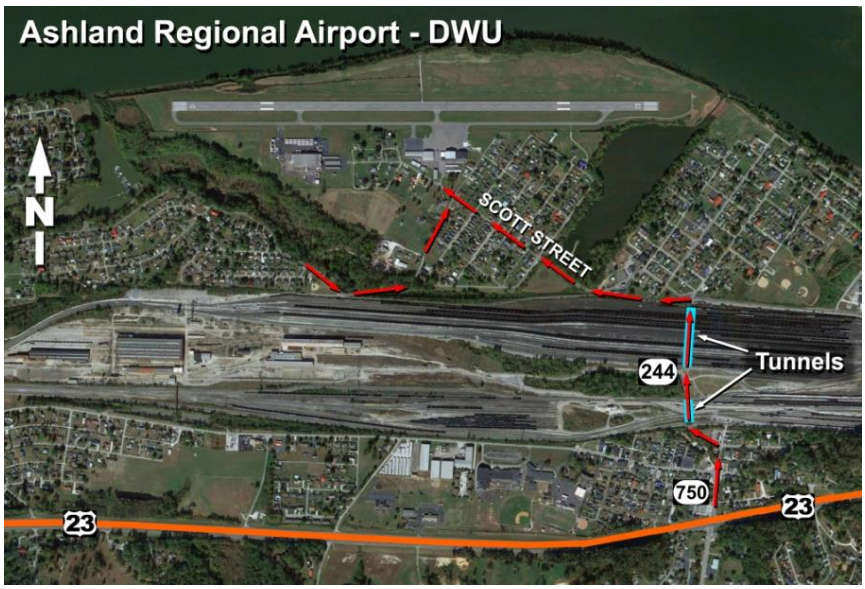
Largest Civilian Aircraft

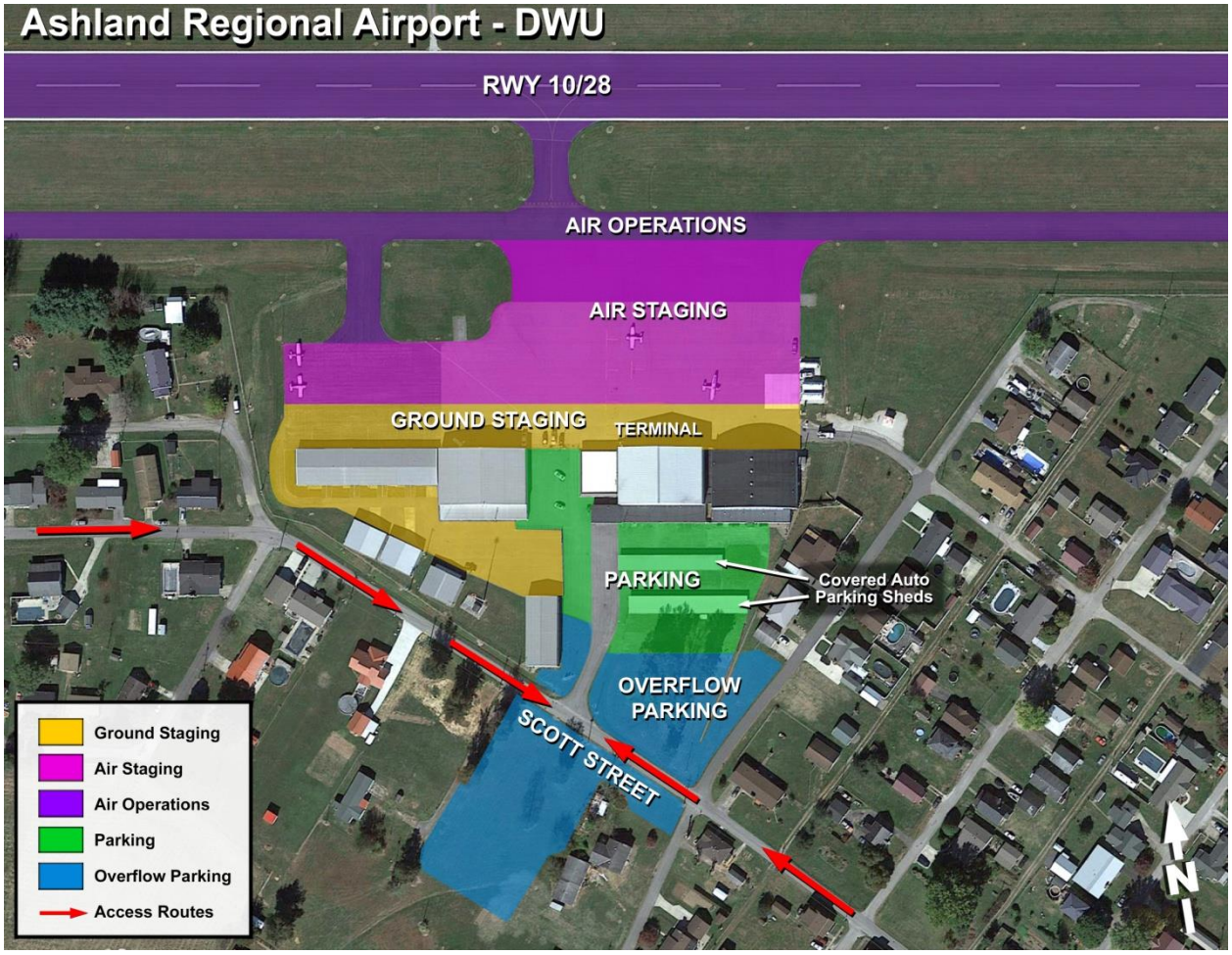
Boeing 737-700 (143 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Scott St., 0.4 miles east to Center Street, then south on Kentucky 244 which connects to US Highway 23 approximately 1.2 miles southeast of the Airport. Highway 23 leads to the city of Ashland approximately 6.9 miles to the southeast. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Ashland Regional Airport - DWU
N
SCOTT STREET
Tunnels
244
750
23
23


Ashland Regional Airport - DWU
RWY 10/28
AIR OPERATIONS
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
Covered Auto Parking Sheds
OVERFLOW PARKING
SCOTT STREET
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Big Sandy Regional Airport - SJS

Prestonsburg, Kentucky

With a paved runway 5,000 feet by 100 feet and only one other alternative airport within a 30-mile radius, it is likely that Big Sandy Regional Airport would be utilized for evacuation of civilians from the Prestonsburg area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. As with many airports of this size, paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas near the terminal. Parking for airport personnel, emergency responders, and law enforcement may be staged inside the fence near the terminal.

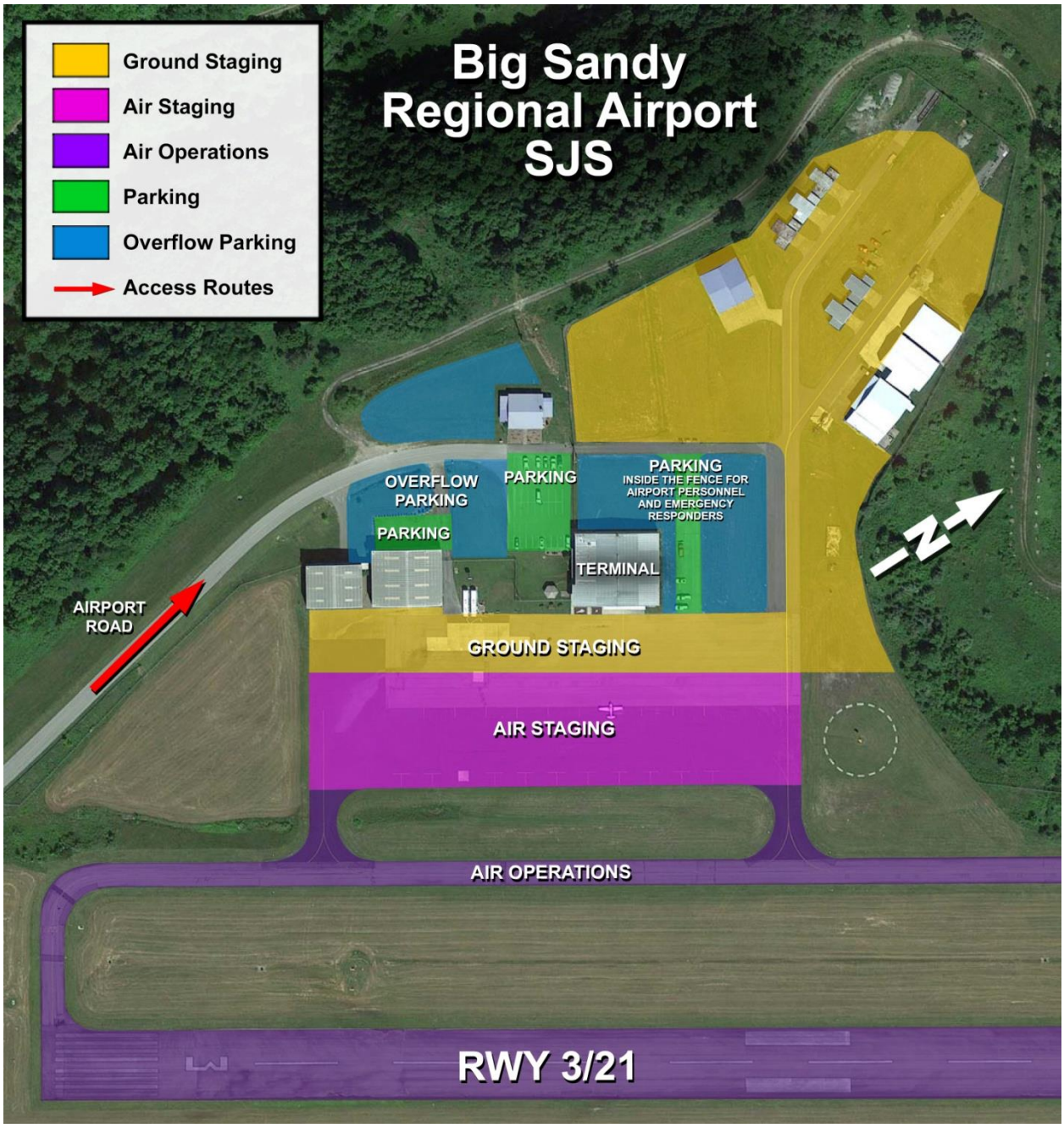
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Route 3 approximately three miles north of the Airport. Kentucky Route 3 leads to US 23 approximately nine miles to the west. US 23 connects with the towns of Paintsville, approximately 7 miles to the north, and Prestonsburg, approximately 5 miles to the south. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
Big Sandy Regional Airport SJS
OVERFLOW PARKING
PARKING
PARKING
PARKING INSIDE THE FENCE FOR AIRPORT PERSONNEL AND EMERGENCY RESPONDERS
TERMINAL
AIRPORT ROAD
GROUND STAGING
AIR STAGING
AIR OPERATIONS
RWY 3/21
N

Bowman Field - LOU

Louisville, Kentucky

With a paved primary runway 4,358 feet by 75 feet and two alternative airports within a 30-mile radius, it is likely that Bowman Field would be utilized for evacuation of civilians from the Louisville area under certain threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is more plentiful at Bowman Field than at many other similarly sized airports. Even so, additional overflow parking may be necessary on grassy areas within the terminal hangar complex. Other parking may be possible by opening areas inside the perimeter fence, permitting parking between hangars.

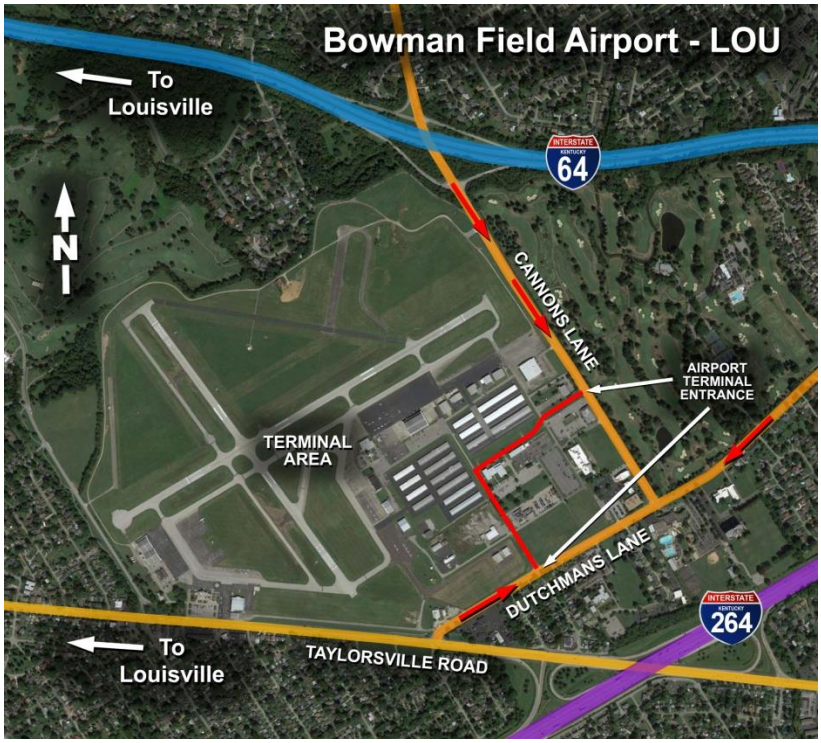
Largest Civilian Aircraft

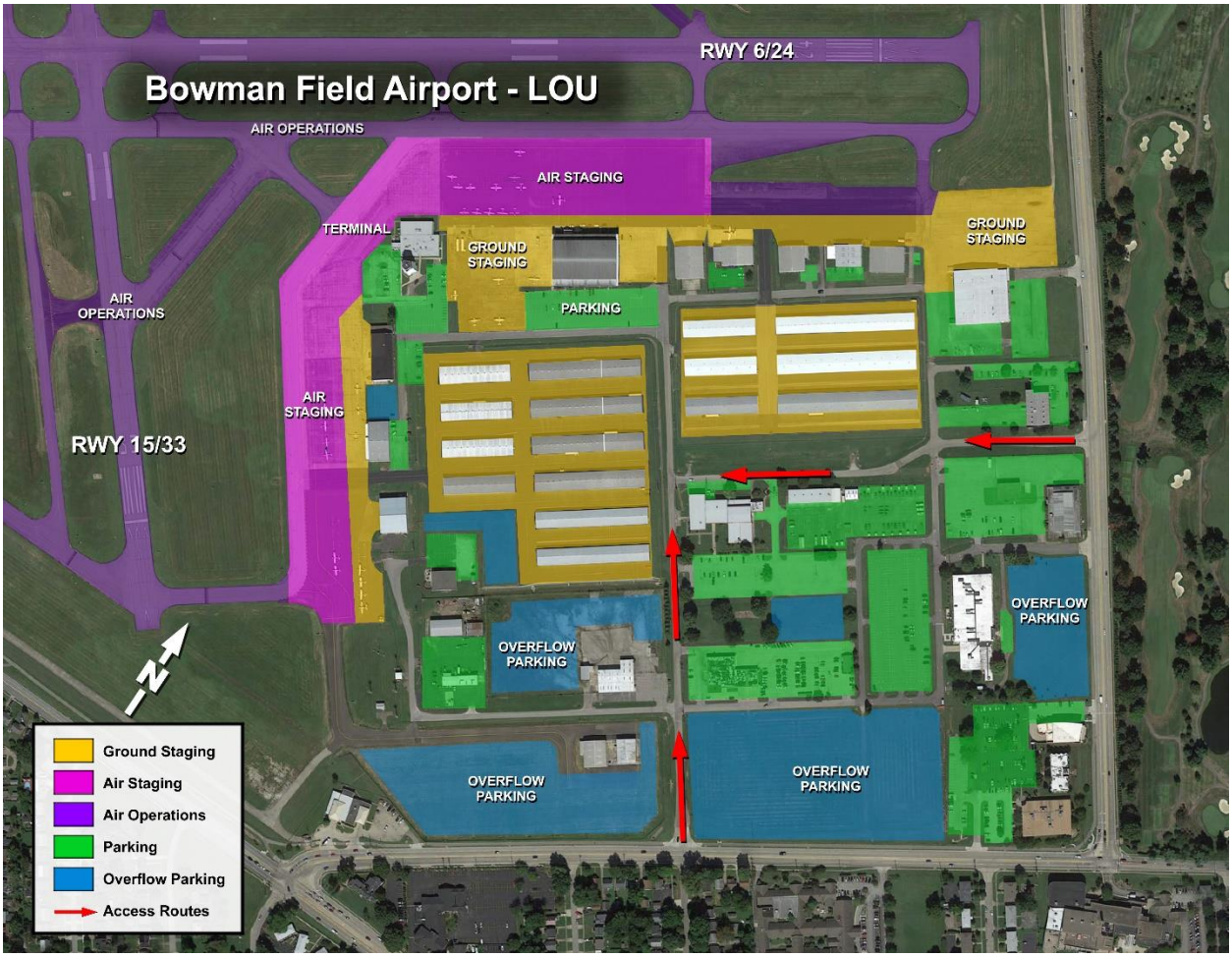
ATR-42 (48 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

There are numerous ground evacuation routes to Bowman Field. Access may be made via Gast Boulevard onto Dutchman's Lane, on the southeast side of the terminal hangar complex. Dutchman's Lane connects with Taylorsville Road, which connects almost immediately with Interstate 264. The terminal hangar complex may be exited on the northeast side onto Cannons Lane, which connects with Interstate 64 approximately 0.6 miles north of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Bowman Field Airport - LOU
RWY 6/24
AIR OPERATIONS
AIR STAGING
TERMINAL
GROUND STAGING
GROUND STAGING
PARKING
AIR OPERATIONS
AIR STAGING
RWY 15/33
OVERFLOW PARKING
OVERFLOW PARKING
OVERFLOW PARKING
OVERFLOW PARKING
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Breckinridge County Airport - I93

Hardinsburg, Kentucky

With a paved runway 4,000 feet by 75 feet and four alternative airports within a 30-mile radius, it is unlikely that Breckinridge County Airport would be required to serve as a base of evacuation for civilians from the Hardinsburg area except under unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is very limited. Overflow parking may be accommodated on reasonably level grassy areas southwest of the operations area.

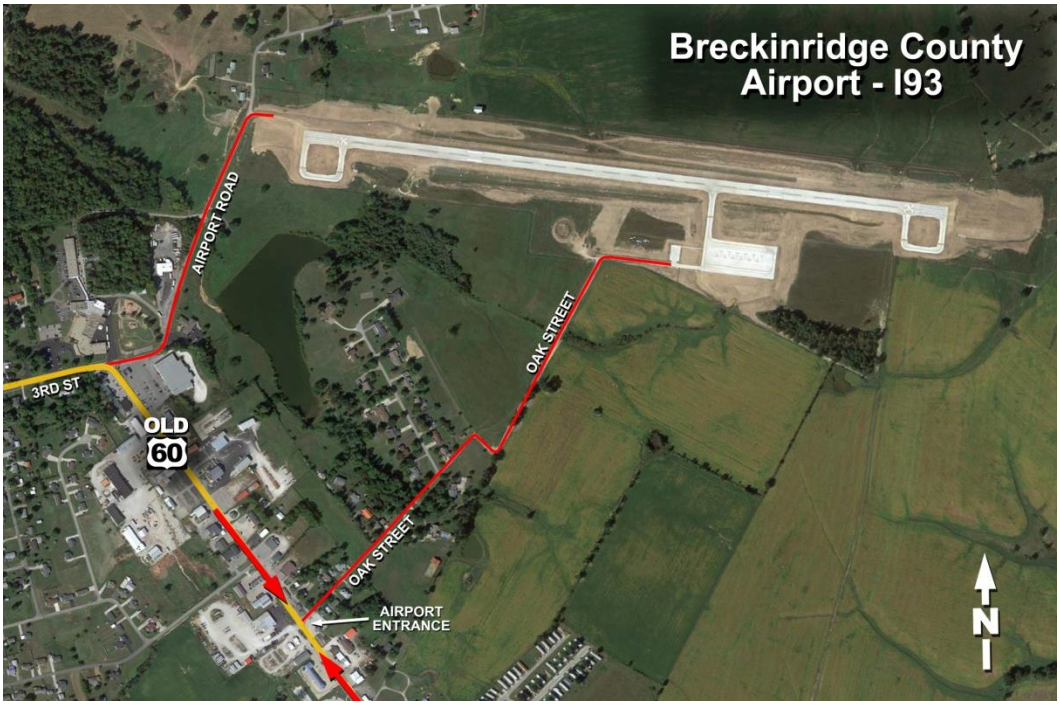
Largest Civilian Aircraft

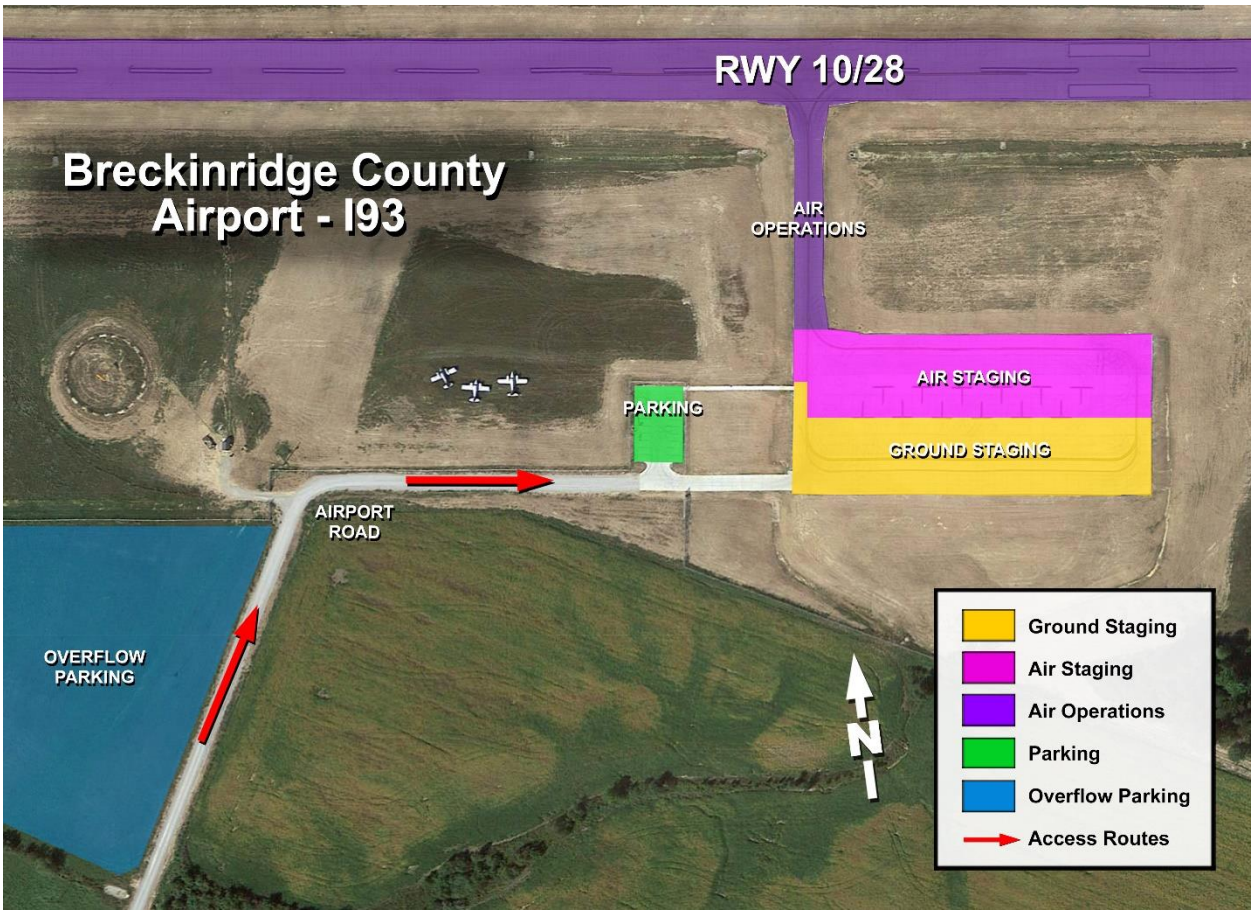
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Oak Street, which connects to Old US 60, approximately 0.7 miles south of the Airport. Old US 60 enters the town of Hardinsburg 0.4 miles north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 10/28
Breckinridge County Airport - I93
AIR OPERATIONS
AIR STAGING
PARKING
GROUND STAGING
AIRPORT ROAD
OVERFLOW PARKING
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Capital City Airport - FFT

Frankfort, Kentucky

With a paved runway 5,506 feet by 100 feet and only two alternative airports within a 30-mile radius, it is likely that Capital City Airport would be utilized for evacuation of civilians and government officials from the Frankfort area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. It is possible that the Air National Guard Base on the opposite side of the field could be opened to civilian evacuation. However, those acreages were not included in Table 1. Civilian Boeing 737-500 (122 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is available, but the need for additional overflow parking may be accommodated on reasonably level grassy areas east of the terminal, as well as paved parking at adjacent facilities.

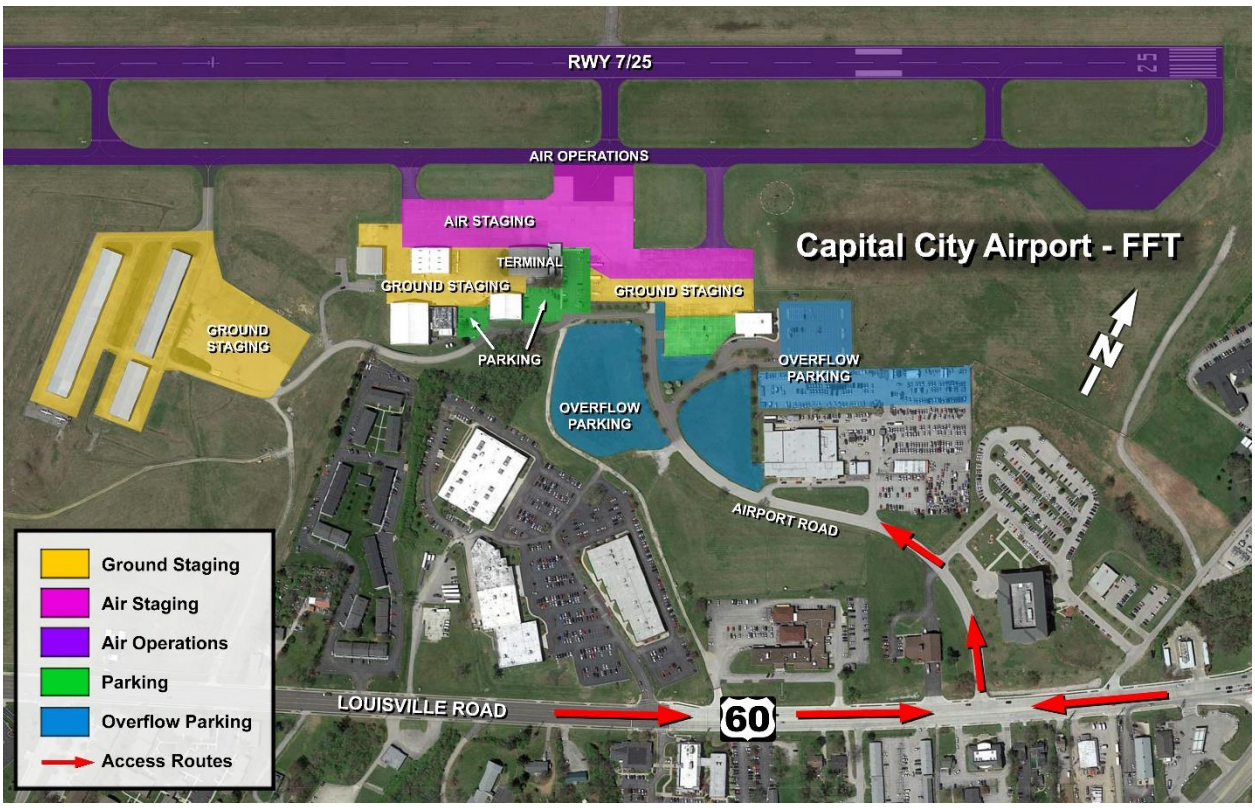
Largest Civilian Aircraft

Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 60, 0.4 miles southeast of the terminal area. US Highway 60 leads to the downtown capital city of Frankfort, approximately 3 miles to the northeast. US Highway 60 crosses US Highway 127, 325 yards from the Airport entrance. Highway 127 connects with Interstate 64, 1.75 miles south of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 7/25
AIR OPERATIONS
AIR STAGING
TERMINAL
GROUND STAGING
GROUND STAGING
GROUND STAGING
PARKING
OVERFLOW PARKING
OVERFLOW PARKING
Capital City Airport - FFT
N
AIRPORT ROAD
LOUISVILLE ROAD
60
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Central Kentucky Regional Airport - RGA

Richmond, Kentucky

With a paved runway 5,001 feet by 100 feet and two other alternative airports within a 30-mile radius, it is possible that Central Kentucky Regional Airport could be utilized for evacuation of civilians from the Richmond area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Runway load-bearing limitations may prevent the use of larger military aircraft such as the C-130. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas northwest of the terminal area.

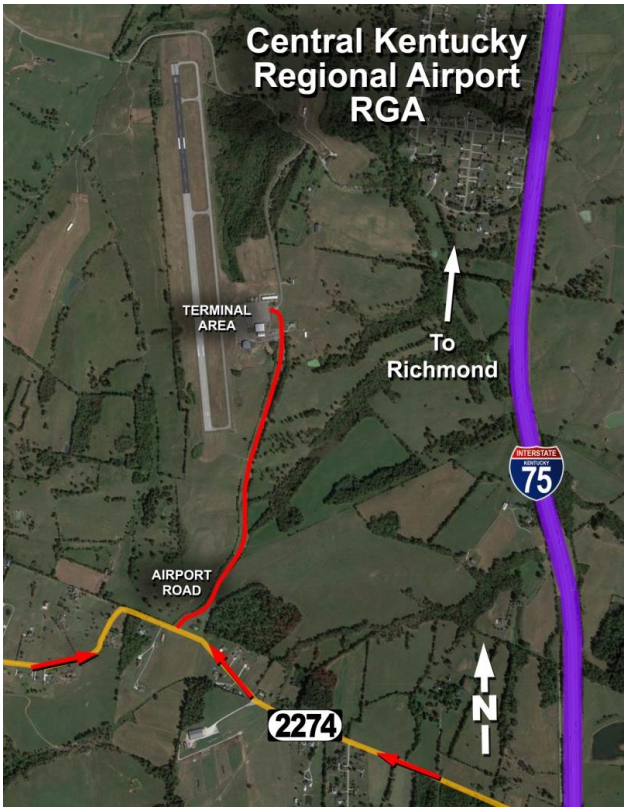
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Peggy Flats Road approximately 0.9 miles south of the Airport. Peggy Flats Road (East) becomes KY 2274, 1.1 miles from Airport Road, where it turns south and parallels Interstate 75 for approximately one mile before intersecting Walnut Meadow Road. A turn east provides access to Interstate 75 North and South. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




AIRPORT ROAD
AIRPORT ROAD
OVERFLOW PARKING
PARKING
GROUND STAGING
AIR STAGING
AIR OPERATIONS
RWY 18/36
Central Kentucky Regional Airport RGA
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N

Columbia-Adair County Airport - I96

Columbia, Kentucky

With a paved runway 2,600 feet by 60 feet and four alternative airports within a 30-mile radius, it is possible that Columbia-Adair County Airport could be utilized for evacuation of civilians from the area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. As with many airports of this size, paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas near the terminal. Parking for airport personnel, emergency responders, and law enforcement may be staged inside the fence near the terminal and hangar areas.

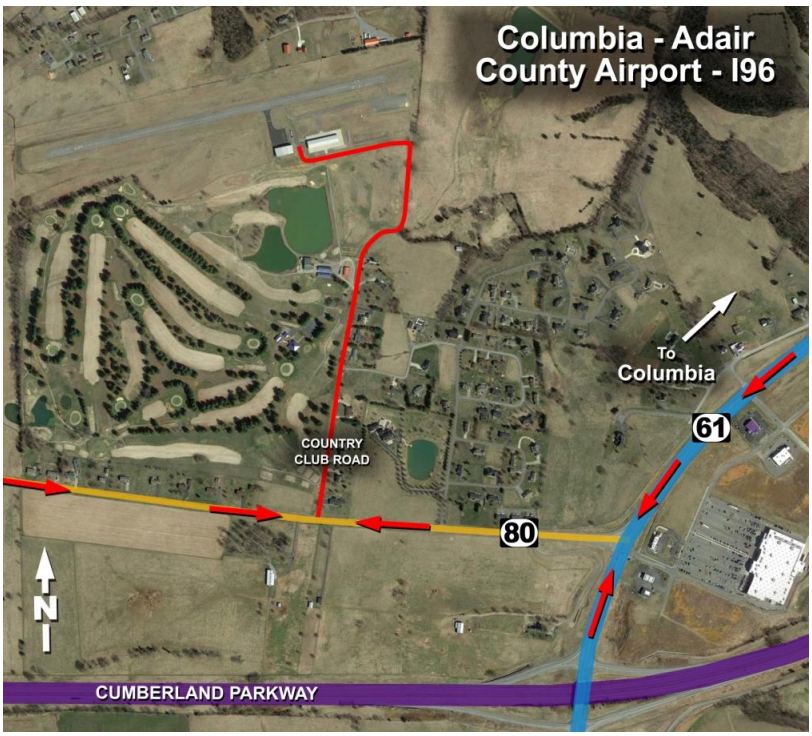
Largest Civilian Aircraft

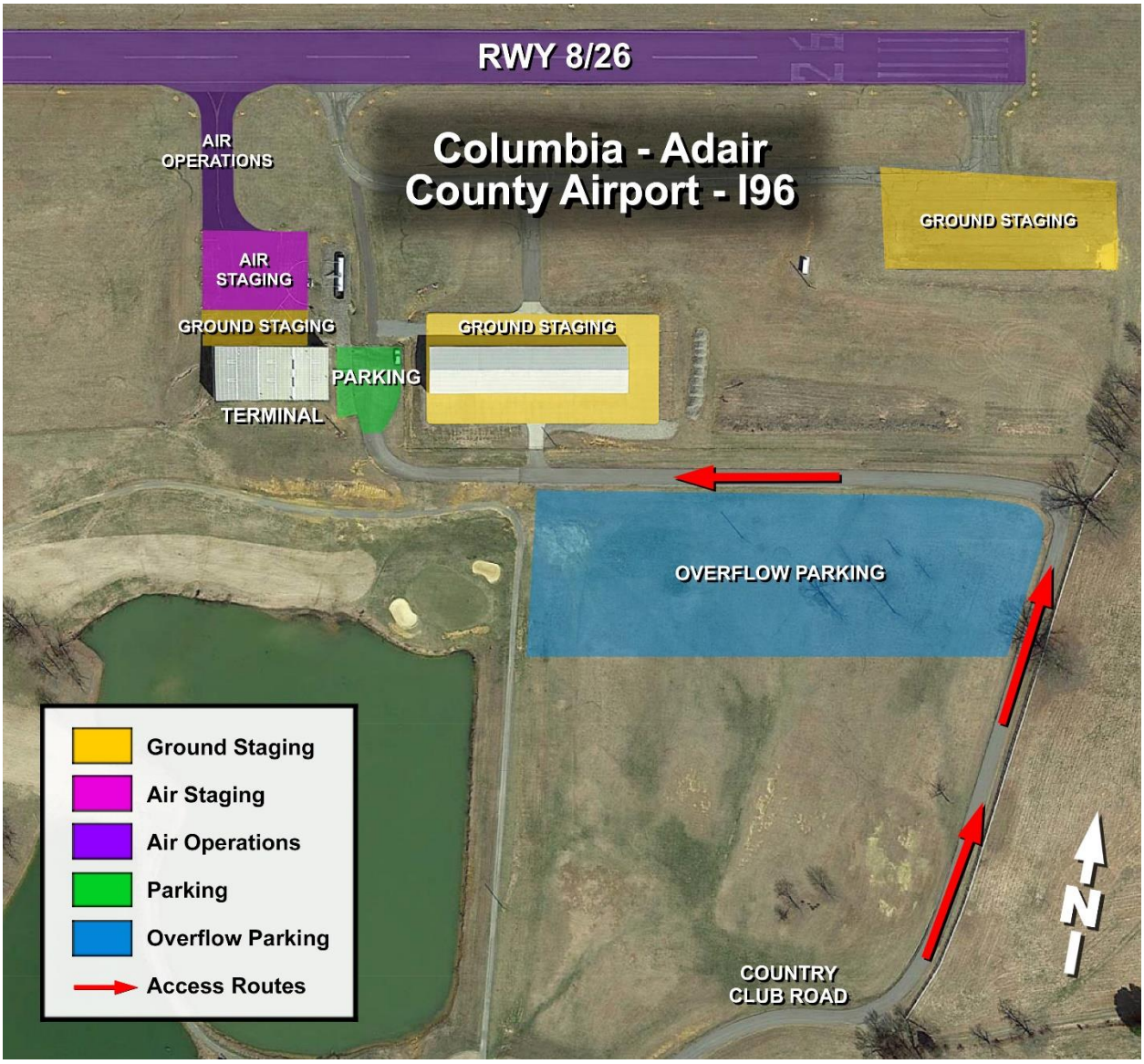
Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Country Club Road, which connects to County Road 80 approximately one half of a mile south of the Airport. County Road 80 connects to County Road 61 approximately 0.4 mile to the East. County Road 61 may then be taken approximately 3 miles northeast to the city of Columbia, or approximately one quarter of a mile south, to access the Cumberland Parkway. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 8/26
Columbia - Adair County Airport - I96
AIR OPERATIONS
AIR STAGING
GROUND STAGING
GROUND STAGING
GROUND STAGING
PARKING
TERMINAL
OVERFLOW PARKING
COUNTRY CLUB ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Cynthiana-Harrison County Airport - 0I8

Cynthiana, Kentucky

With a paved runway 3,850 feet by 75 feet and four alternative airports within a 30-mile radius, it is unlikely that Cynthiana-Harrison County Airport would be utilized for a large-scale evacuation of civilians from the area, except under a unique set of threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas east of the terminal.

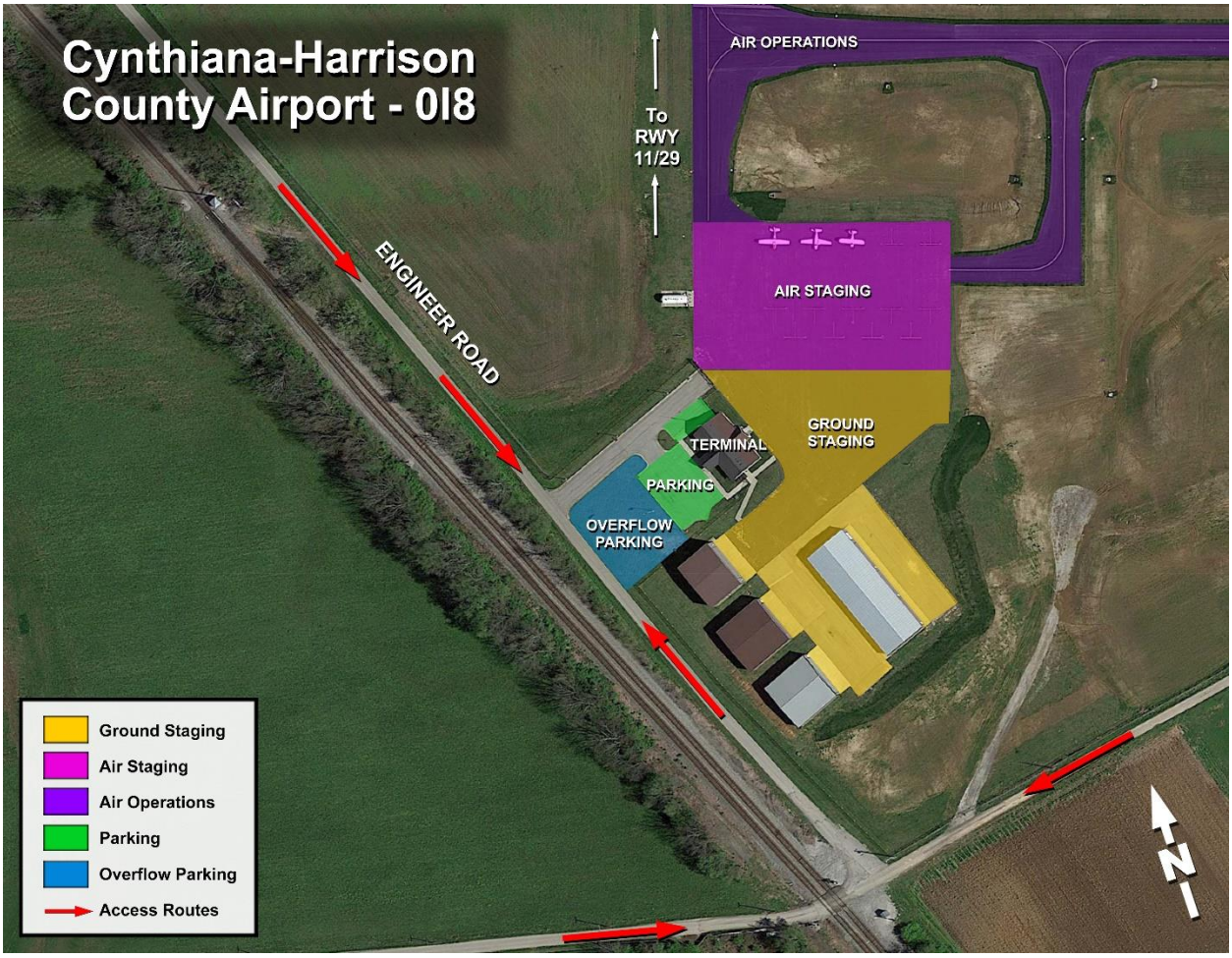
Largest Civilian Aircraft

ATR-42 (48 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Engineer Road 200 yards south to Infirmary Lane, then 400 yards west to 982, also known as New Lair Road. The town of Cynthiana is approximately 1.6 miles north on New Lair Road. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Cynthiana-Harrison County Airport - 0I8
AIR OPERATIONS
To RWY 11/29
ENGINEER ROAD
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW PARKING
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N

Fleming-Mason Airport - FGX

Flemingsburg, Kentucky

With a paved runway 5,001 feet by 100 feet and only one other alternative airport within a 30-mile radius, it is likely that Fleming-Mason Airport would be utilized for evacuation of civilians from the Flemingsburg area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. As with many airports of this size, paved parking is in limited supply. Additional overflow parking may be accommodated on reasonably level grassy areas southeast of the terminal and hangar area.

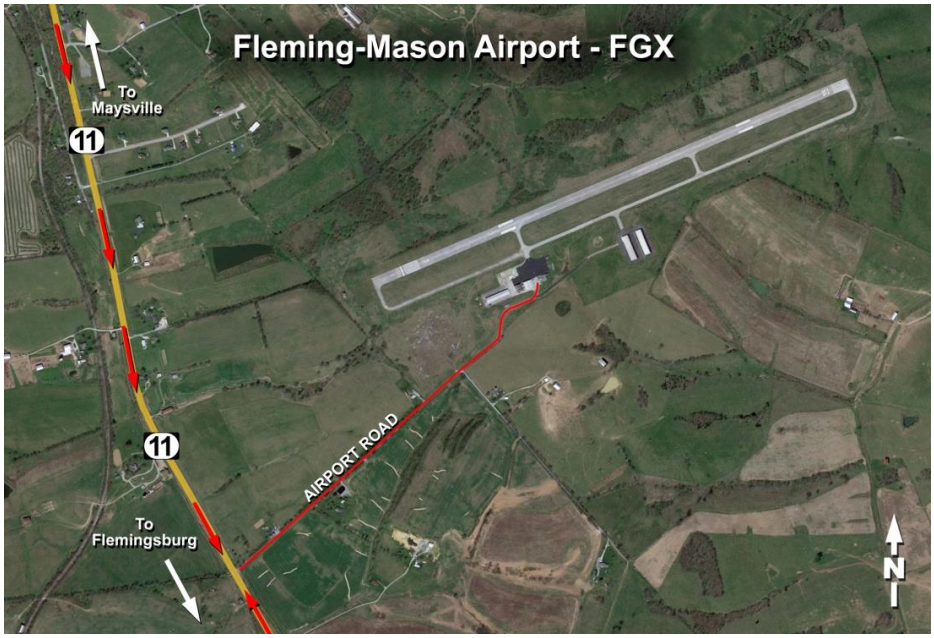
Largest Civilian Aircraft

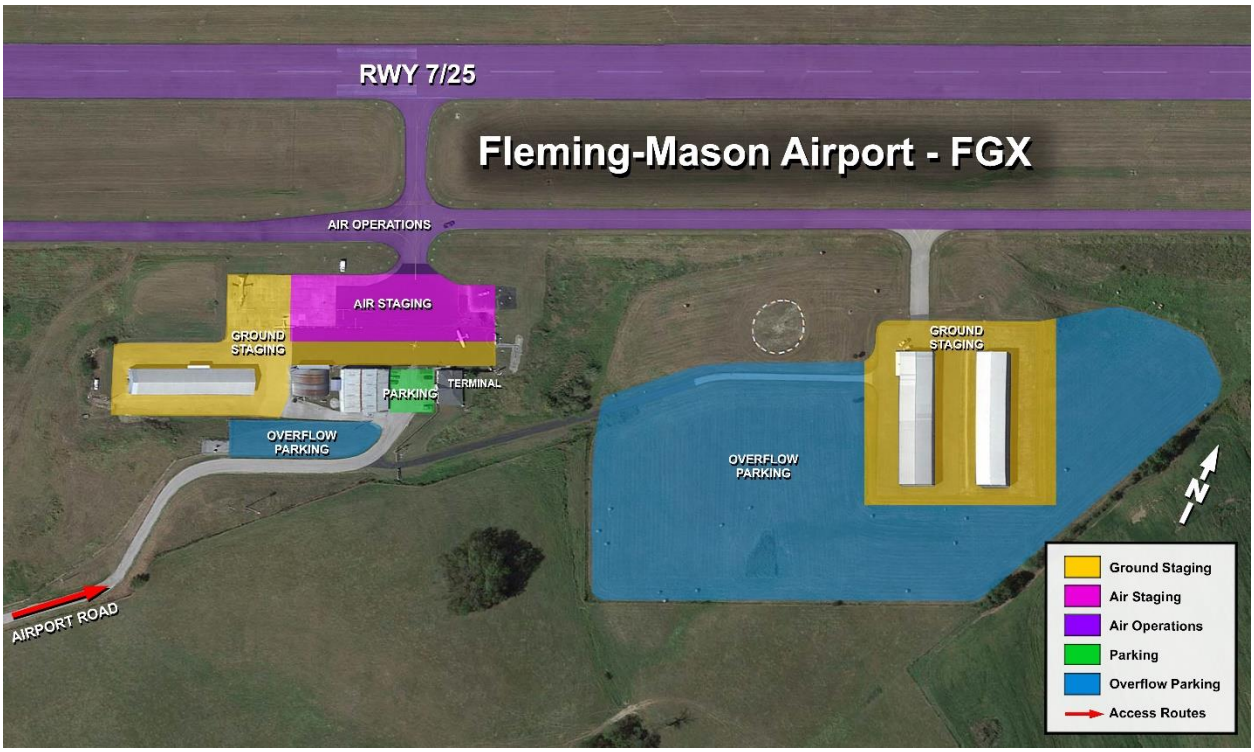
ATR-72 (66 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Route 11 approximately 0.8 miles Southwest of the Airport. Kentucky Route 11 leads to Flemingsburg 8.1 miles south, and to Maysville 9 miles north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Fleming-Mason Airport - FGX
To Maysville
11
11
AIRPORT ROAD
To Flemingsburg
N


RWY 7/25
Fleming-Mason Airport - FGX
AIR OPERATIONS
AIR STAGING
GROUND STAGING
PARKING
TERMINAL
OVERFLOW PARKING
GROUND STAGING
OVERFLOW PARKING
AIRPORT ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Fulton Airport - 1M7

Fulton, Kentucky

With a paved runway 4,001 feet by 75 feet and only one alternative airport within a 30-mile radius, it is possible that Fulton Airport would be utilized for evacuation of civilians from the area in the event of an earthquake or other unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas around the terminal and in the field across Airport Road from the terminal area.

Largest Civilian Aircraft

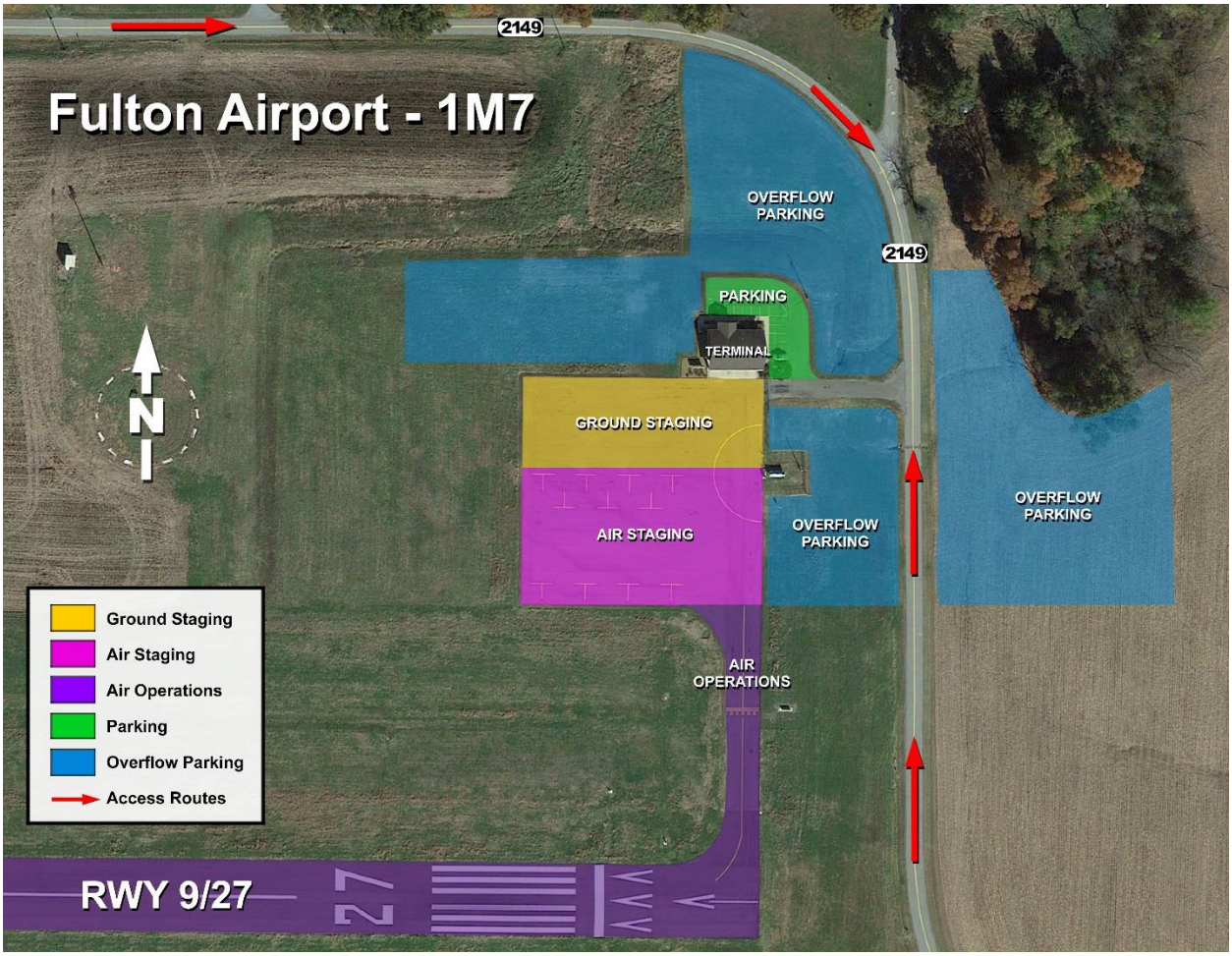
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by State Route 2149, also known as Airport Road, which connects to US Highway 51 approximately 1.4 miles southeast of the Airport. US Highway 51 connects with Purchase Parkway 0.2 miles to the south. The town of Fulton is just south of Purchase Parkway. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


2149
N
TERMINAL AREA
2149
1461
To Fulton
1909
Fulton Airport - 1M7


2149
Fulton Airport - 1M7
OVERFLOW PARKING
2149
PARKING
TERMINAL
N
GROUND STAGING
AIR STAGING
OVERFLOW PARKING
OVERFLOW PARKING
AIR OPERATIONS
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
RWY 9/27
27

Gene Snyder Airport - K62

Falmouth, Kentucky

With a paved runway 3,994 feet by 75 feet and two alternative airports within a 30-mile radius, it is possible that Gene Snyder County Airport could serve as a base for evacuation of civilians from the Falmouth area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited, as are reasonably level grassy areas that may be utilized for overflow parking. A small amount of overflow parking may be accommodated through the fence in the hangar area northwest of the terminal.

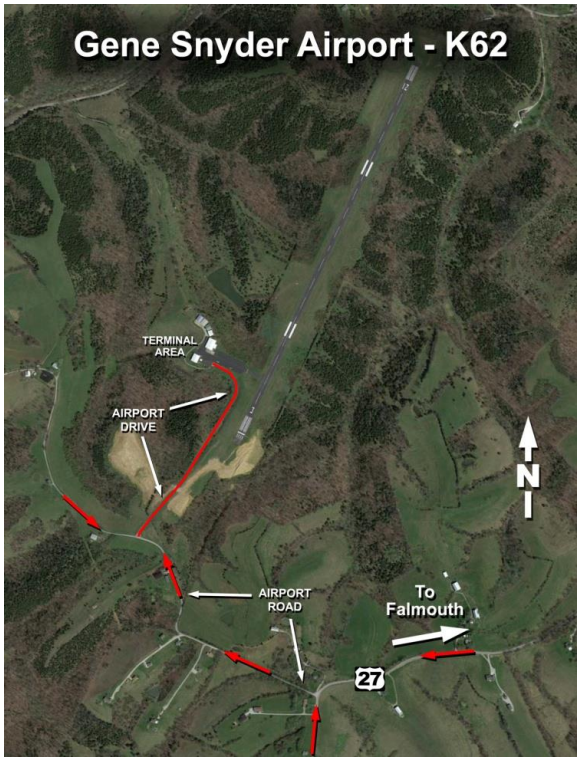
Largest Civilian Aircraft

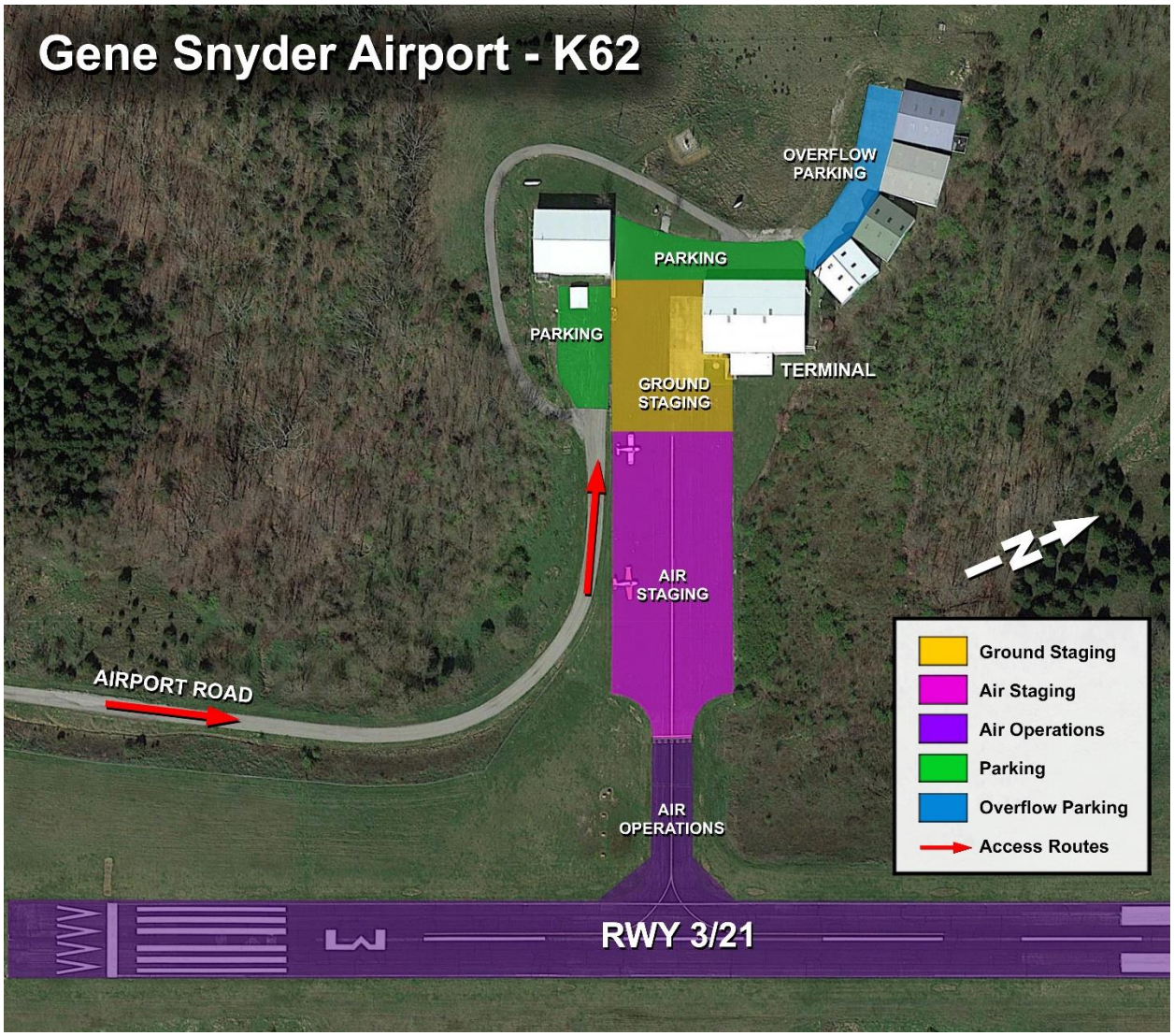
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Highway 22 approximately 0.8 miles south of the Airport. Kentucky Highway 22 connects with US Highway 27 approximately 1.5 miles east, which then leads to the town of Falmouth 2.5 miles southeast of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Gene Snyder Airport - K62
OVERFLOW PARKING
PARKING
PARKING
TERMINAL
GROUND STAGING
AIR STAGING
AIRPORT ROAD
AIR OPERATIONS
RWY 3/21
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Georgetown Scott County-Marshall Field - 27K

Georgetown, Kentucky

With a paved runway 5,498 feet by 100 feet and three alternative airports within a 30-mile radius, it is likely that Georgetown Scott County - Marshall Field would be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-500 (122 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available, but the need for additional parking and overflow parking may be accommodated on reasonably level grassy areas near the terminal and hangar areas.

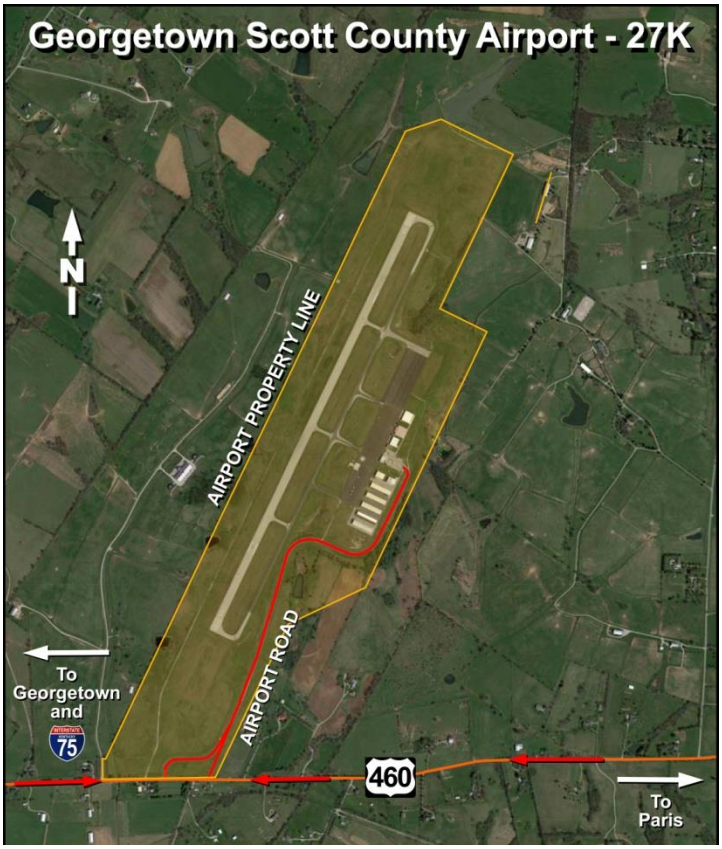
Largest Civilian Aircraft

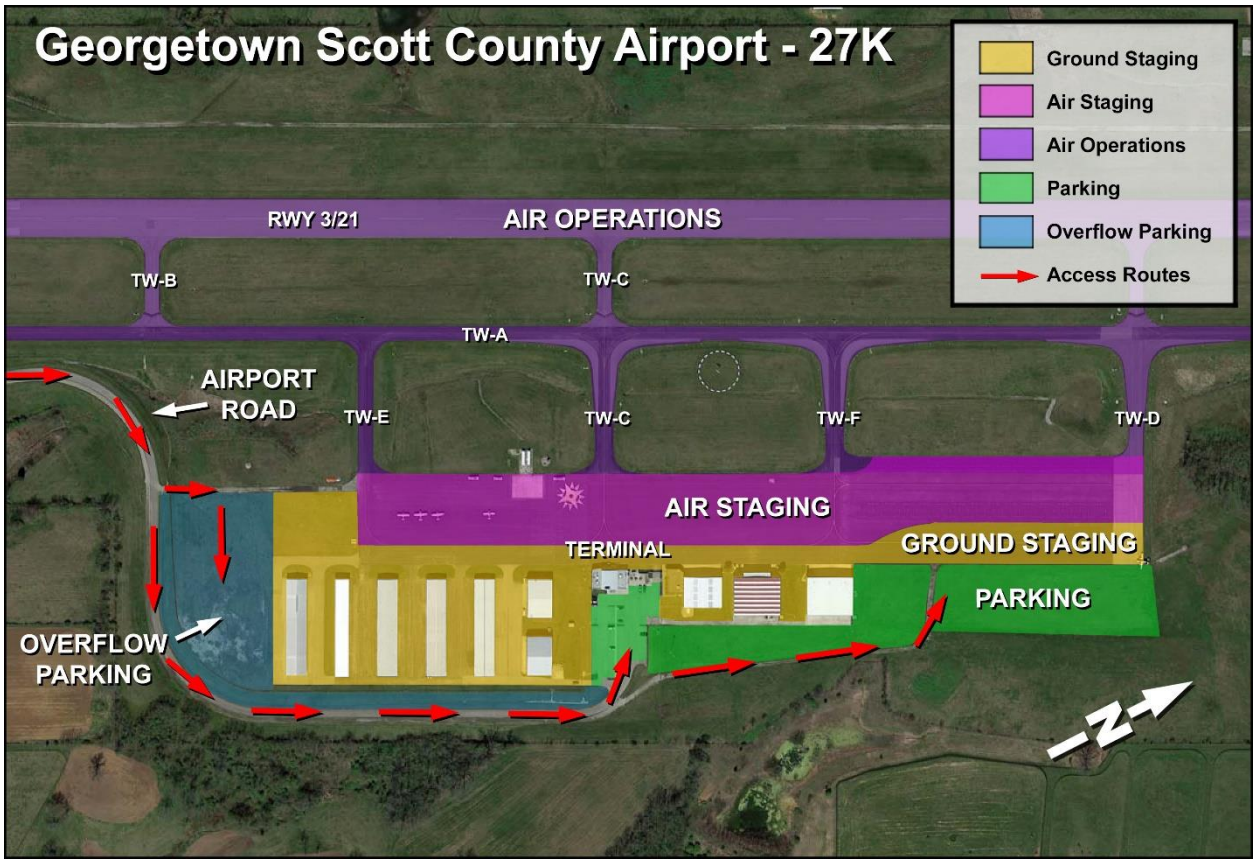
Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Highway 460 approximately 0.9 miles south of the terminal area. Highway 460 leads to Interstate 75 about 5.25 miles west, and to the city of Georgetown just west of Interstate 75. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Georgetown Scott County Airport - 27K
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
RWY 3/21
AIR OPERATIONS
TW-B
TW-C
TW-A
AIRPORT ROAD
TW-E
TW-C
TW-F
TW-D
AIR STAGING
TERMINAL
GROUND STAGING
PARKING
OVERFLOW PARKING
N

Glasgow Municipal Airport - GLW

Glasgow, Kentucky

With a paved runway 5,302 feet by 100 feet and only two alternative airports within a 30-mile radius, it is likely that Glasgow Municipal Airport would be utilized for evacuation of civilians from the area in the event of an earthquake of other unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-500 (122 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available, but the need for additional overflow parking may be accommodated on reasonably level grassy areas southeast of the terminal area.

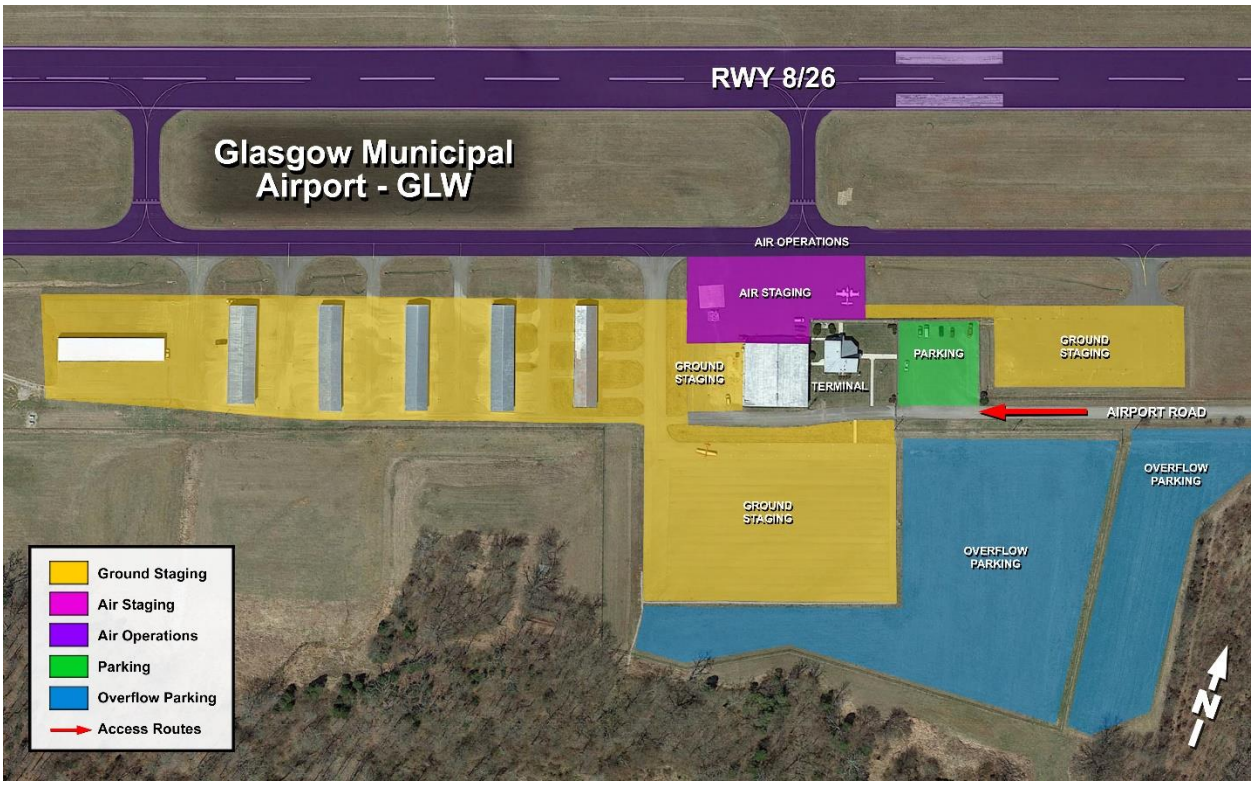
Largest Civilian Aircraft

Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Highway 90, 0.4 miles east of the terminal area. Highway 90 leads to the city of Glasgow approximately 2 miles southeast of the Airport and connects with US Highway 31E. US Highway 31E leads to the Cumberland Parkway approximately 2.4 miles south. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 8/26
Glasgow Municipal Airport - GLW
AIR OPERATIONS
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
GROUND STAGING
AIRPORT ROAD
OVERFLOW PARKING
GROUND STAGING
OVERFLOW PARKING
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N

Grayson County Airport - M20

Leitchfield, Kentucky

With a paved runway 4,000 feet by 60 feet and three alternative airports within a 30-mile radius, it is possible that Grayson County Airport could serve as a base for evacuation of civilians from the Leitchfield area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is limited. Overflow parking may be accommodated on reasonably level grassy areas north of the terminal.

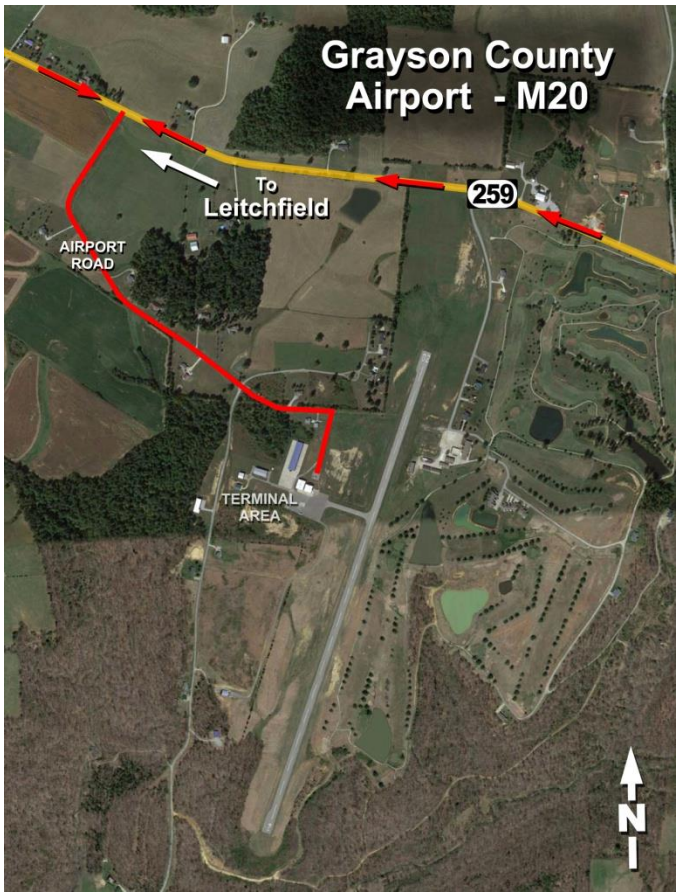
Largest Civilian Aircraft

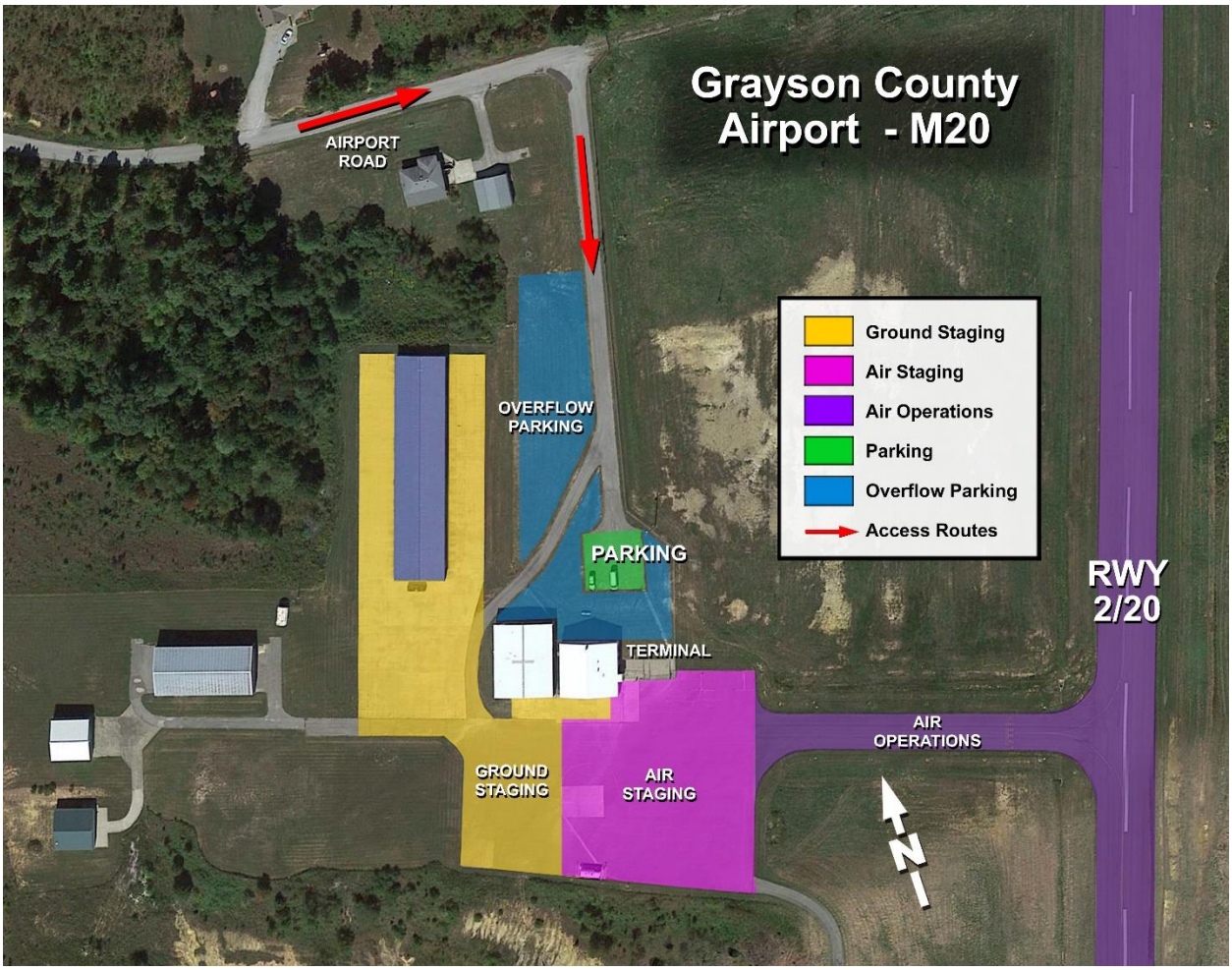
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to State Route 259, also known as Anneta Road, approximately 0.75 miles northwest of the Airport. State Route 259 connects with the Western Kentucky Parkway approximately 4.3 miles north. The town of Leitchfield is just north of the Western Kentucky Parkway. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Grayson County
Airport - M20
AIRPORT
ROAD
OVERFLOW
PARKING
PARKING
TERMINAL
GROUND
STAGING
AIR
STAGING
AIR
OPERATIONS
RWY
2/20
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Hancock County-Ron Lewis Field - KY8

Lewisport, Kentucky

With a paved runway 4,000 feet by 75 feet and two alternative airports within a 30-mile radius, it is possible that Hancock County-Ron Lewis Field could be utilized for evacuation of civilians from the Lewisport area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas north and east of the terminal area.

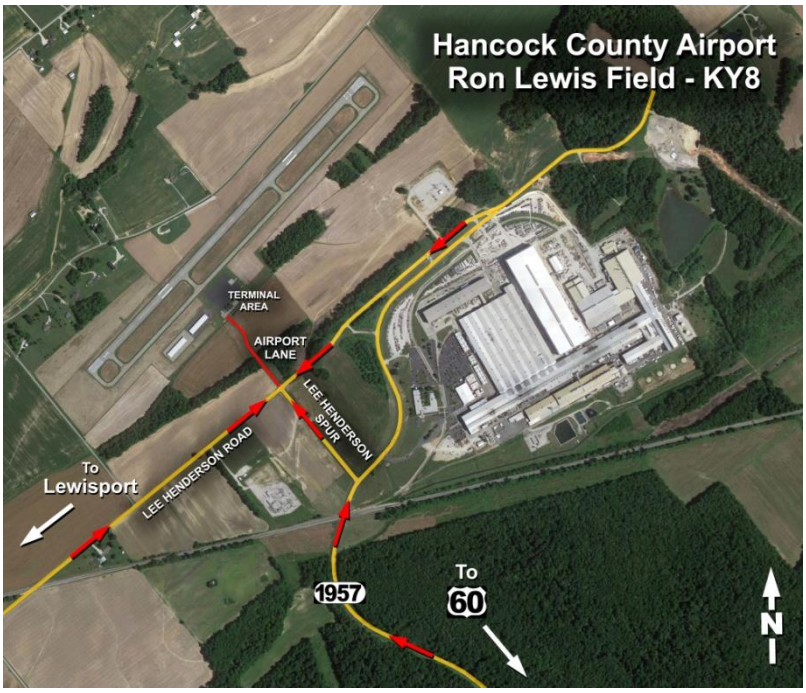
Largest Civilian Aircraft

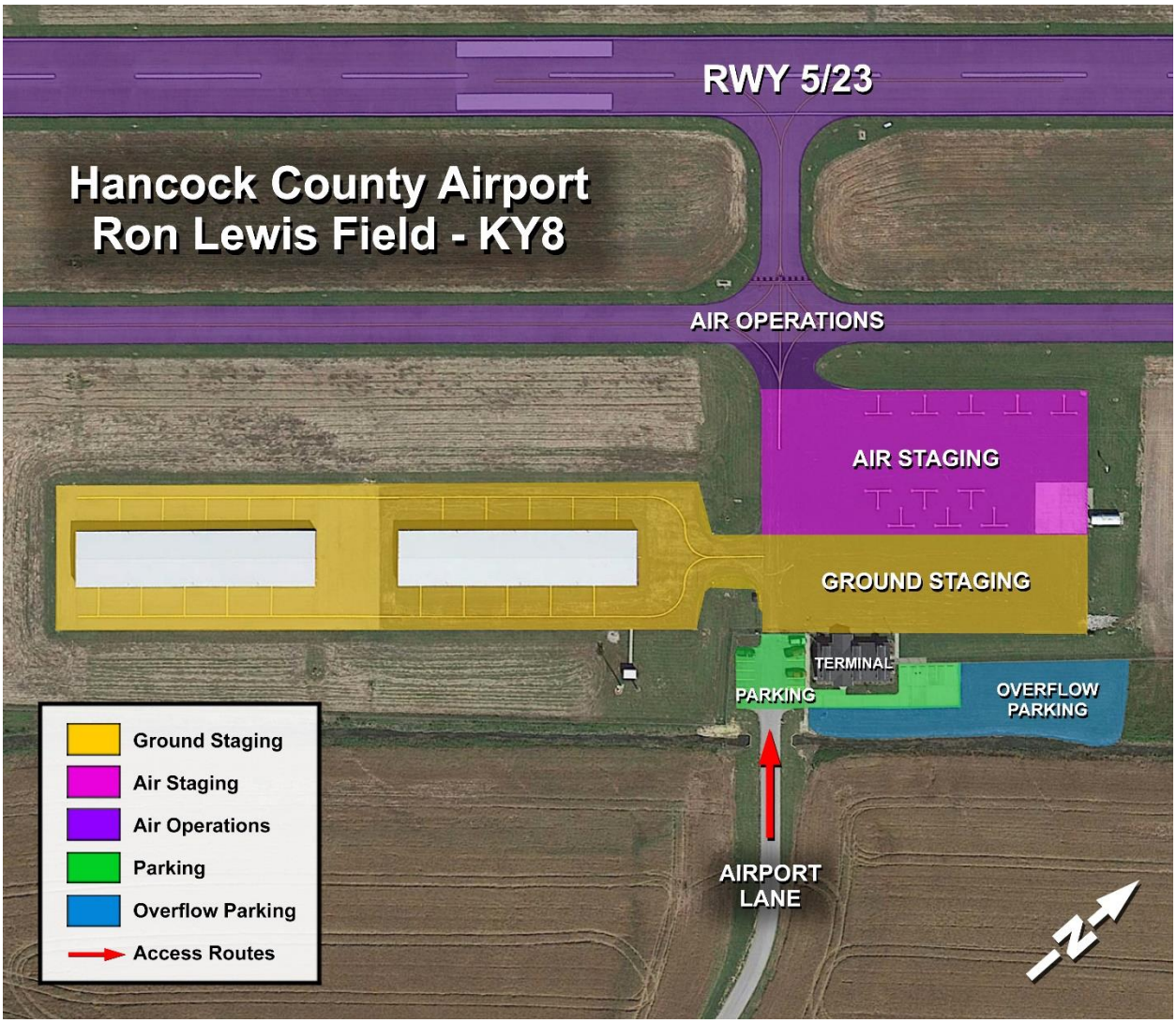
ATR-42 (48 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Lane, which connects to Lee Henderson Spur, and then to State Route 1957, south of the Airport. State Route 1957 connects with US Highway 60, 1.3 miles south of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 5/23
Hancock County Airport
Ron Lewis Field - KY8
AIR OPERATIONS
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW PARKING
AIRPORT LANE
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Henderson City-County Airport - EHR

Henderson, Kentucky

With a paved runway 5,504 feet by 100 feet and only two alternative airports within a 30-mile radius, it is likely that Henderson City-County Airport would be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-500 (122 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas with evacuees using ground staging near the terminal area. Paved parking is available, but the need for additional overflow parking may be accommodated on reasonably level grassy areas west of the terminal area.

Largest Civilian Aircraft

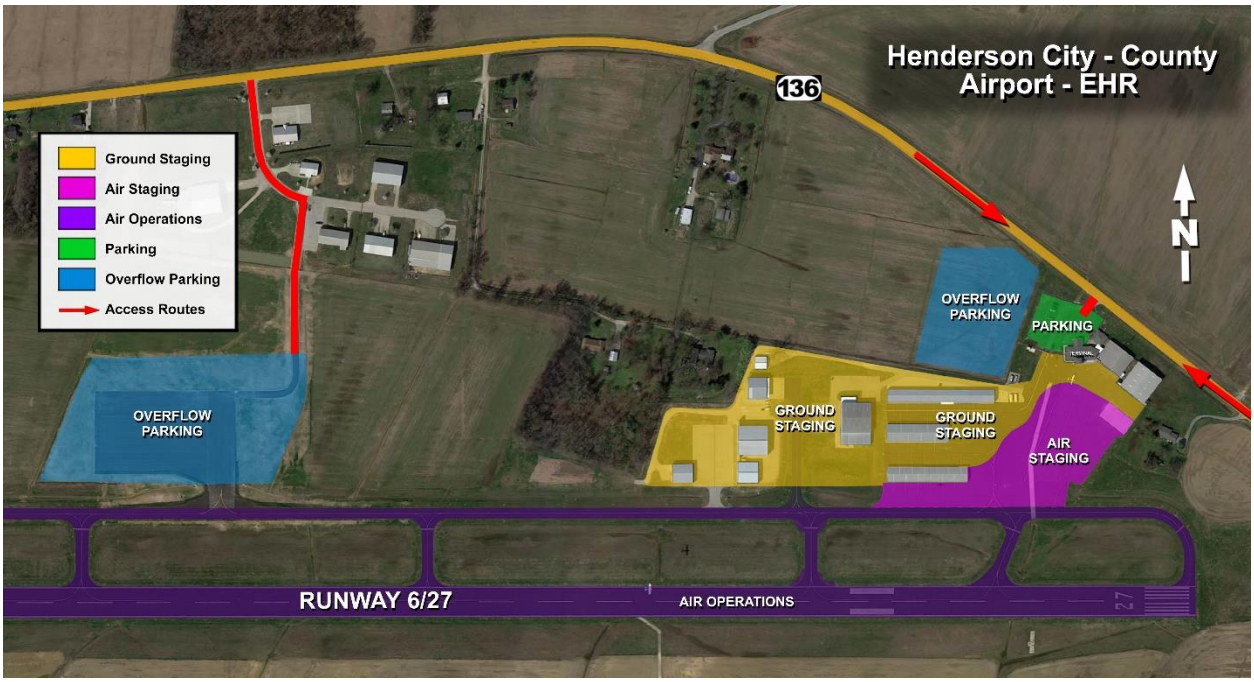
Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by entering Kentucky Highway 136, which connects to US Highway 60, which leads 3 miles northeast to the town of Henderson. The Airport has two entrances, one on Amiet Road and the other directly off State Route 136. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Henderson City-County Airport - EHR
136
AMIET ROAD
To Henderson
MAIN ENTRANCE
TERMINAL AREA
N


Henderson City - County Airport - EHR
136
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
OVERFLOW PARKING
OVERFLOW PARKING
PARKING
GROUND STAGING
GROUND STAGING
AIR STAGING
N
RUNWAY 6/27
AIR OPERATIONS

Hopkinsville-Christian County Airport - HVC

Hopkinsville, Kentucky

With a paved runway 5,505 feet by 100 feet and four alternative airports within a 30-mile radius, it is possible that Hopkinsville-Christian County Airport could be utilized for evacuation of civilians from the area under certain unique threat conditions, such as an earthquake. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Embraer-170 (80 passengers) and military helicopters such as CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved areas designated for auto parking are limited. Additional overflow parking may be accommodated on reasonably level grassy areas, as well as paved areas inside the fence at both ends of the hangar areas, east and west of the terminal.

Largest Civilian Aircraft

EMB-170 (80 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Memorial Field Drive north to US Highway 68. US Highway 68 connects with the Pennyrile Parkway 1.4 miles west and with the city of Hopkinsville just beyond. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Hopkinsville - Christian County Airport - HVC
68
To
Hopkinsville
MEMORIAL
FIELD
DRIVE
TERMINAL
AREA
TRUCK
41
N


Hopkinsville - Christian County Airport - HVC
MEMORIAL
FIELD
DRIVE
PARKING
TERMINAL
OVERFLOW
PARKING
AIR STAGING
GROUND STAGING
OVERFLOW
PARKING
AIR OPERATIONS
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N
RWY 8/26

Julian Carroll Airport - JKL

Jackson, Kentucky

With a paved runway 4,400 feet by 75 feet and only two alternative airports within a 30-mile radius, it is possible that Julian Carroll Airport would be utilized for evacuation of civilians from the Jackson area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas inside the fence and east of the terminal and hangar area.

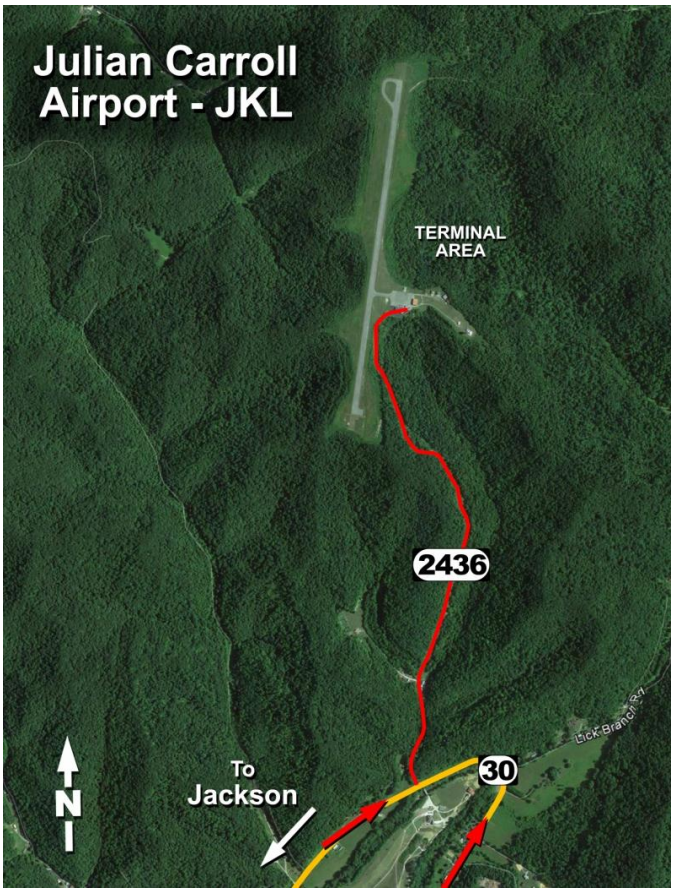
Largest Civilian Aircraft

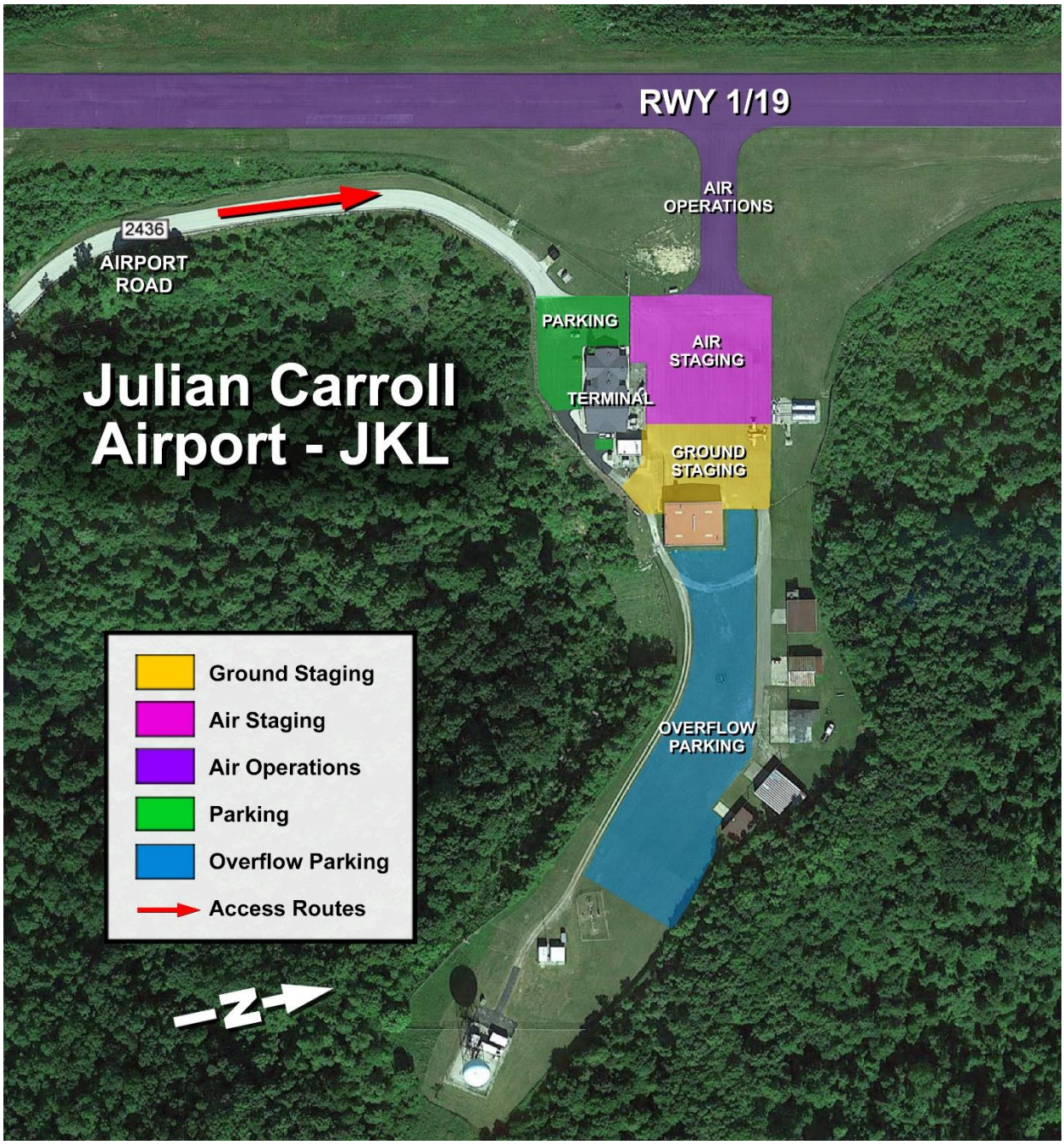
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Highway 30 approximately 1.5 miles south of the Airport. Kentucky Highway 30 connects with State Route 15 4.3 miles to the southeast. The town of Jackson is 2.4 miles further north on Highway 15. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 1/19
AIR OPERATIONS
2436
AIRPORT ROAD
PARKING
AIR STAGING
TERMINAL
GROUND STAGING
Julian Carroll Airport - JKL
OVERFLOW PARKING
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N

Kentucky Dam State Park Airport - M34

Gilbertsville, Kentucky

With a paved runway 4,000 feet by 100 feet and six alternative airports within a 30-mile radius, it is unlikely that Kentucky Dam State Park Airport would be utilized for any significant evacuation of civilians from the area, but could be utilized under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas south of the terminal.

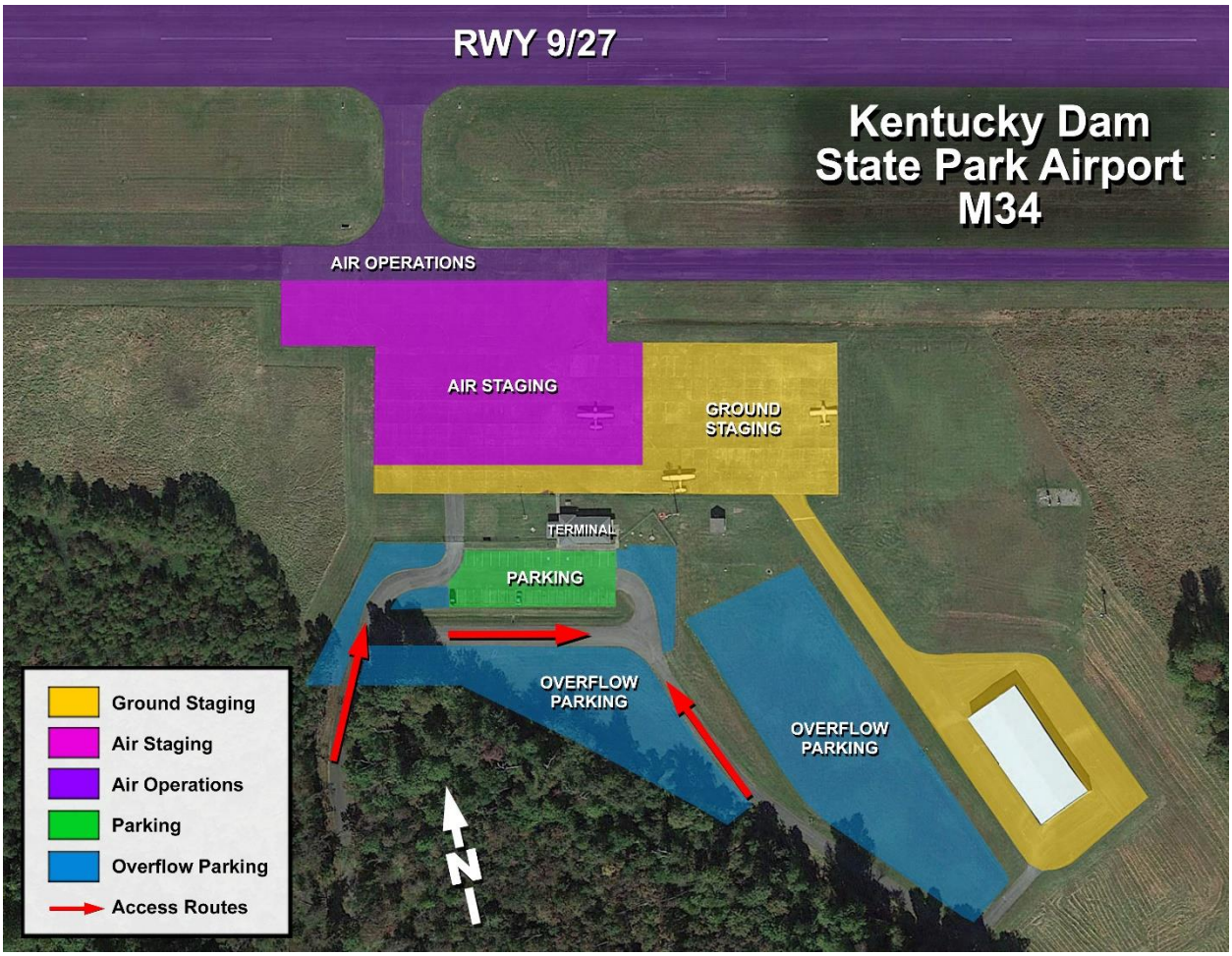
Largest Civilian Aircraft

ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 62 approximately 0.4 miles south of the Airport. US Highway 62 connects with Interstate 24, 1.5 miles to the west. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 9/27
Kentucky Dam
State Park Airport
M34
AIR OPERATIONS
AIR STAGING
GROUND
STAGING
TERMINAL
PARKING
OVERFLOW
PARKING
OVERFLOW
PARKING
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Kyle-Oakley Field Airport - CEY

Murray, Kentucky

With a paved runway 6,203 feet by 100 feet and three smaller alternative airports within a 30-mile radius, it is likely that Kyle-Oakley Field Airport would be utilized for evacuation of civilians from the Murray area in the event of an earthquake or other unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-700 (143 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport (assuming adequate load bearing capacity) to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas east of the terminal area.

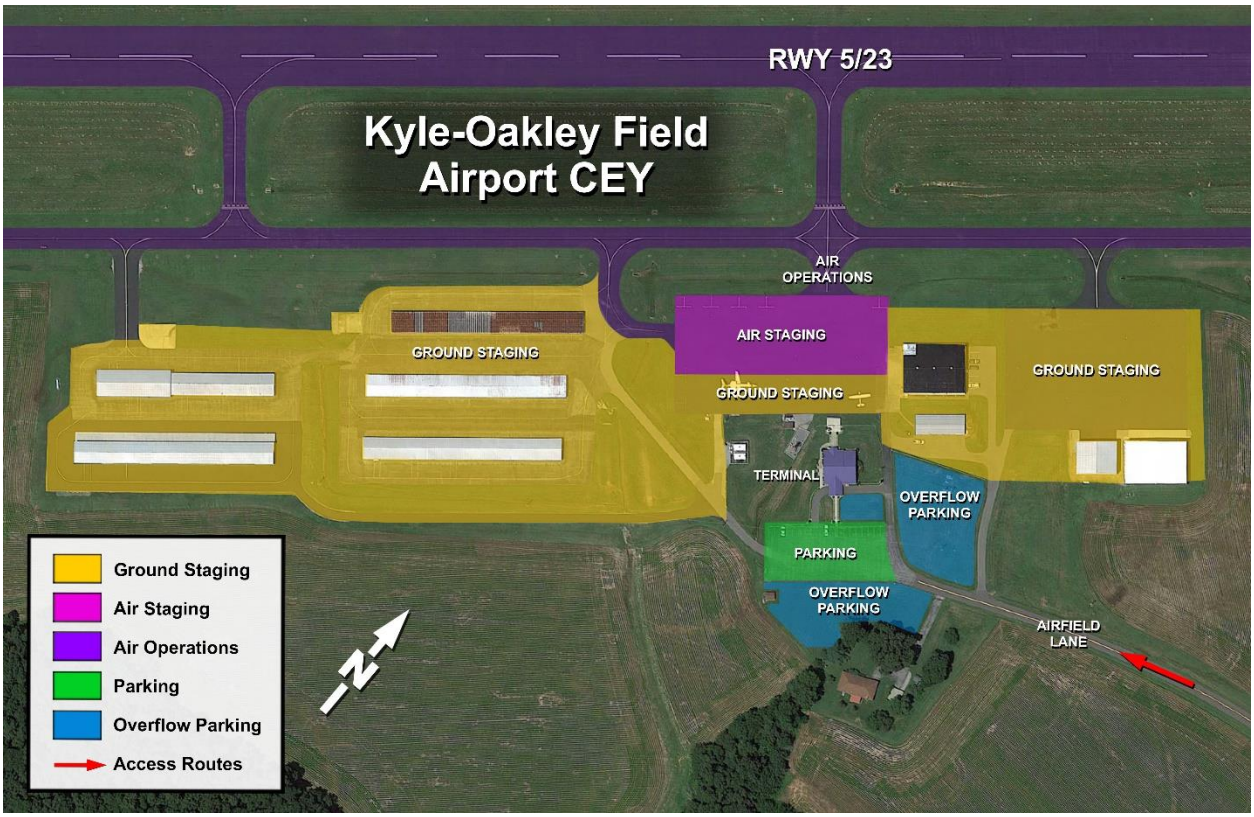
Largest Civilian Aircraft

Boeing 737-700 (143 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Lane, which connects to Airport Road 0.5 miles east of the terminal area. Airport Road connects with Kentucky Highway 80 approximately 0.8 miles south of the Airport. Kentucky Highway 80 leads to Murray approximately 7.5 miles southeast of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 5/23
Kyle-Oakley Field
Airport CEY
AIR OPERATIONS
AIR STAGING
GROUND STAGING
GROUND STAGING
GROUND STAGING
TERMINAL
OVERFLOW PARKING
PARKING
OVERFLOW PARKING
AIRFIELD LANE
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Lake Barkley State Park Airport - 1M9

Cadiz, Kentucky

With a paved runway 4,800 feet by 100 feet and five alternative airports within a 30-mile radius, it is possible that Lake Barkley State Park Airport could be utilized for evacuation of civilians from the area under certain unique threat conditions, such as an earthquake. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas north of the terminal.

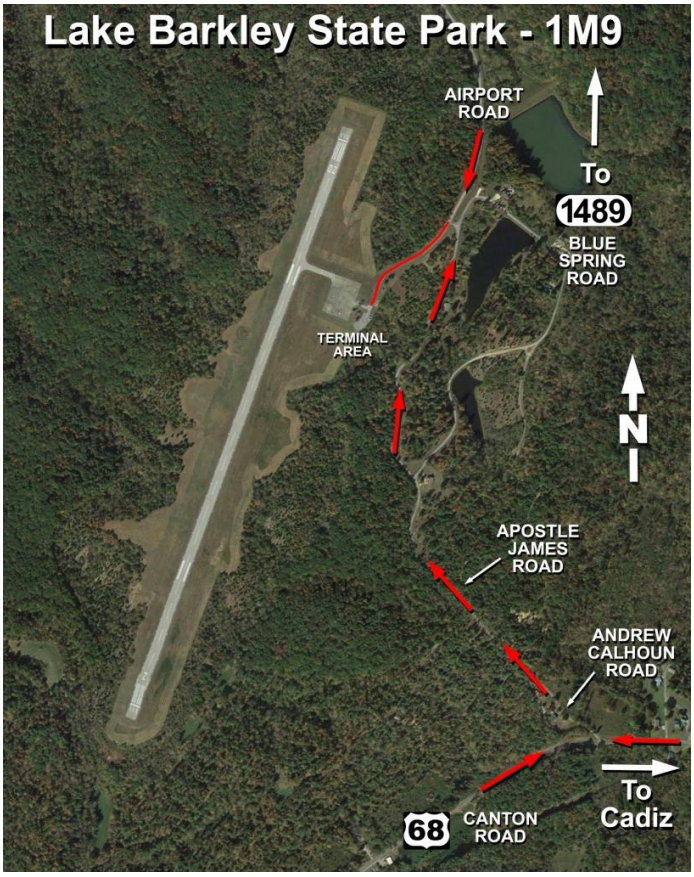
Largest Civilian Aircraft

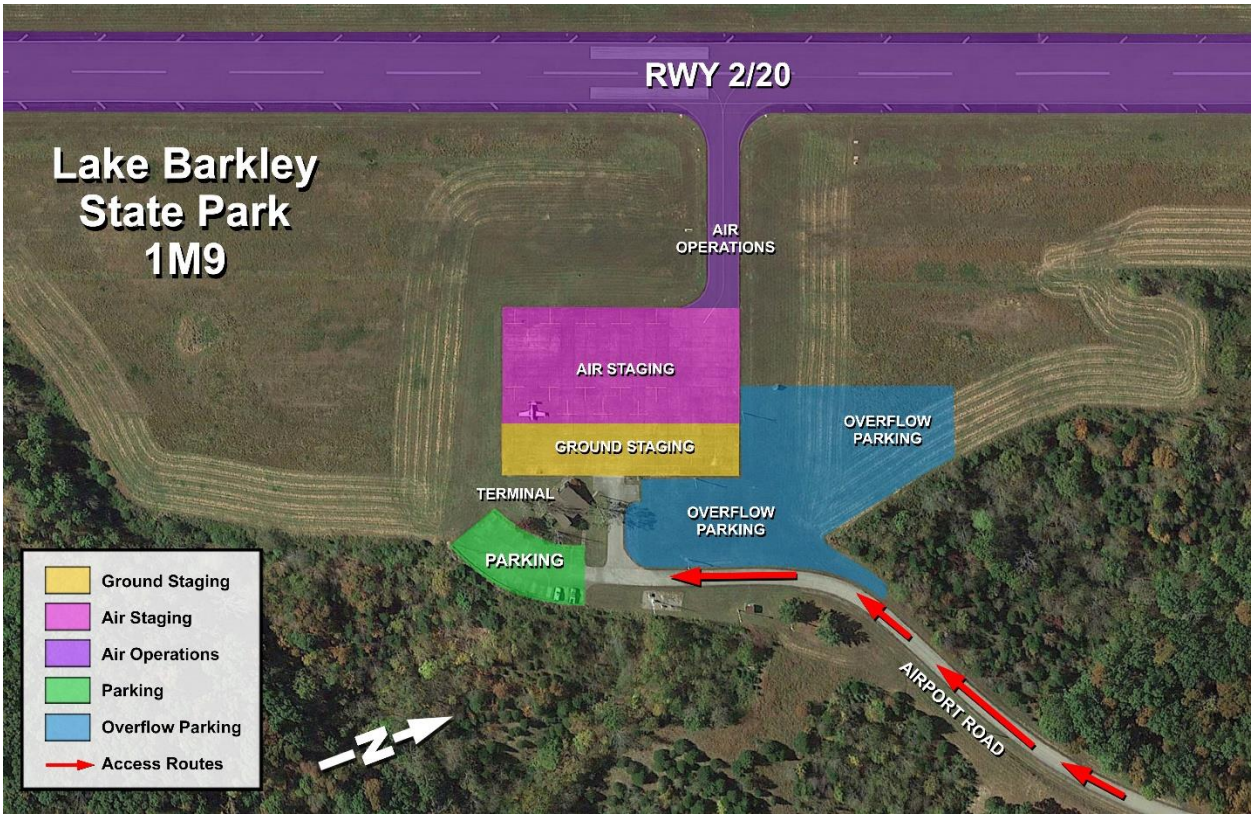
ATR-42 (48 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road 300 yards north to Apostle Paul Loop south, to Apostle James Road south approximately 0.9 miles to US Highway 68. US Highway 68 east connects to the town of Cadiz approximately 5.3 miles northeast of the Airport. US Highway 68 connects with Interstate 24, 11.1 miles northeast of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 2/20
Lake Barkley
State Park
1M9
AIR
OPERATIONS
AIR STAGING
GROUND STAGING
OVERFLOW
PARKING
TERMINAL
OVERFLOW
PARKING
PARKING
AIRPORT ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Lake Cumberland Regional Airport - SME

Somerset, Kentucky

With a paved runway 5,801 feet by 100 feet and six alternative airports within a 30-mile radius, it is likely that Lake Cumberland Regional Airport would be utilized for evacuation of civilians from the Somerset area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. As shown, there are two areas available at the Airport for staging. Civilian Boeing 737-700 (143 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available, but the need for additional overflow parking may be accommodated on reasonably level grassy areas outside and inside the fence.

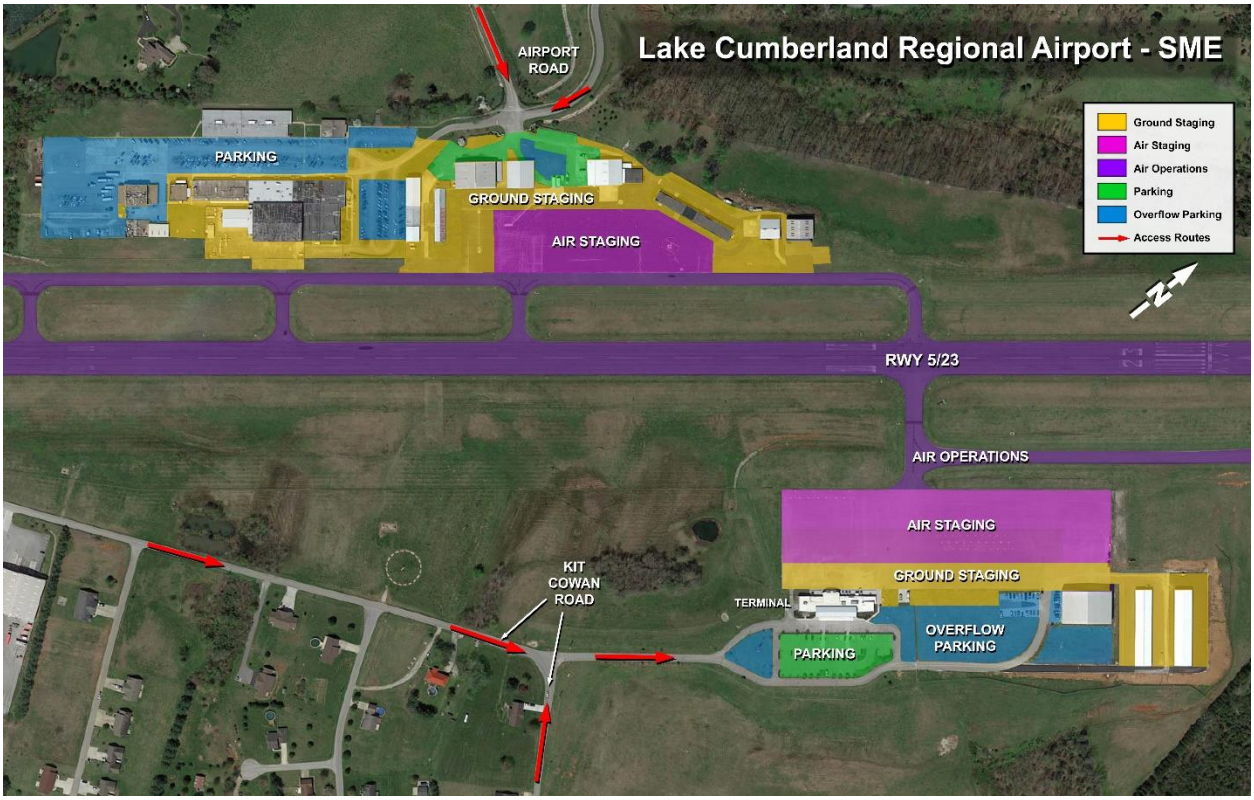
Largest Civilian Aircraft

Boeing 737-700 (143 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Kit Cowan Road, which connects to Highway 27, 1.2 miles southwest of the terminal area. Highway 27 leads to Highway 80, approximately 4 miles north, and the Cumberland Parkway approximately 6 miles north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Lake Cumberland Regional Airport - SME
AIRPORT ROAD
PARKING
GROUND STAGING
AIR STAGING
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N
RWY 5/23
AIR OPERATIONS
AIR STAGING
GROUND STAGING
KIT COWAN ROAD
TERMINAL
OVERFLOW PARKING
PARKING

Lebanon-Springfield Airport-George Hoerter Field - 6I2

Lebanon, Kentucky

With a paved runway 5,001 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Lebanon Springfield Airport-George Hoerter Field could be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area (assuming adequate load bearing capacity). Paved parking is limited. Additional overflow parking may be necessary on reasonably level grassy areas north of the terminal.

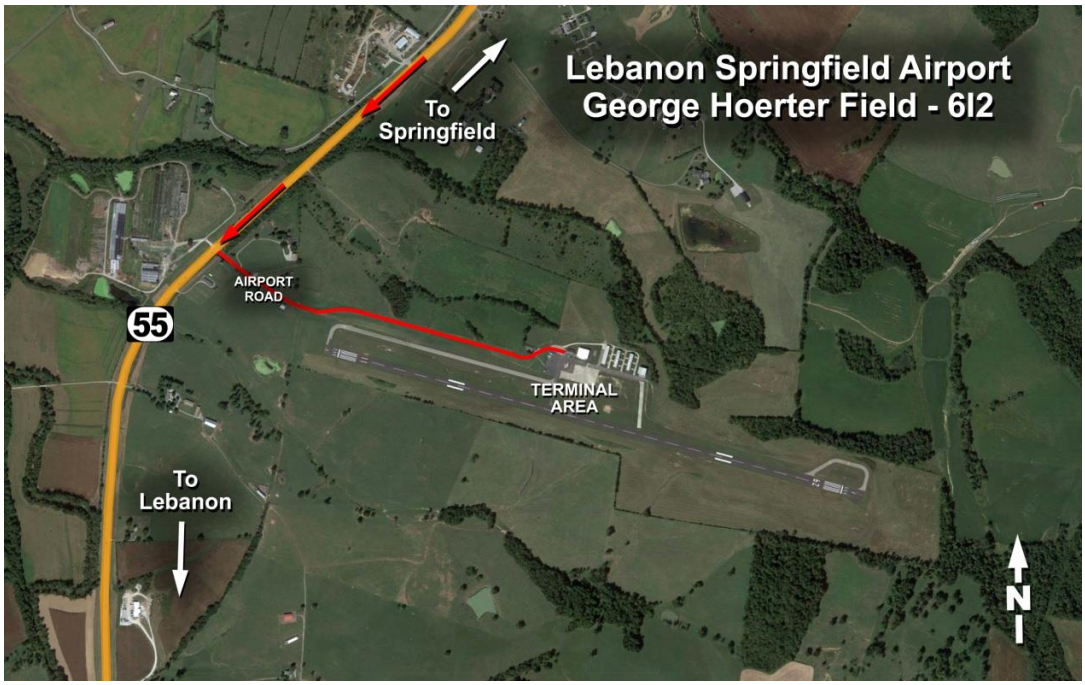
Largest Civilian Aircraft

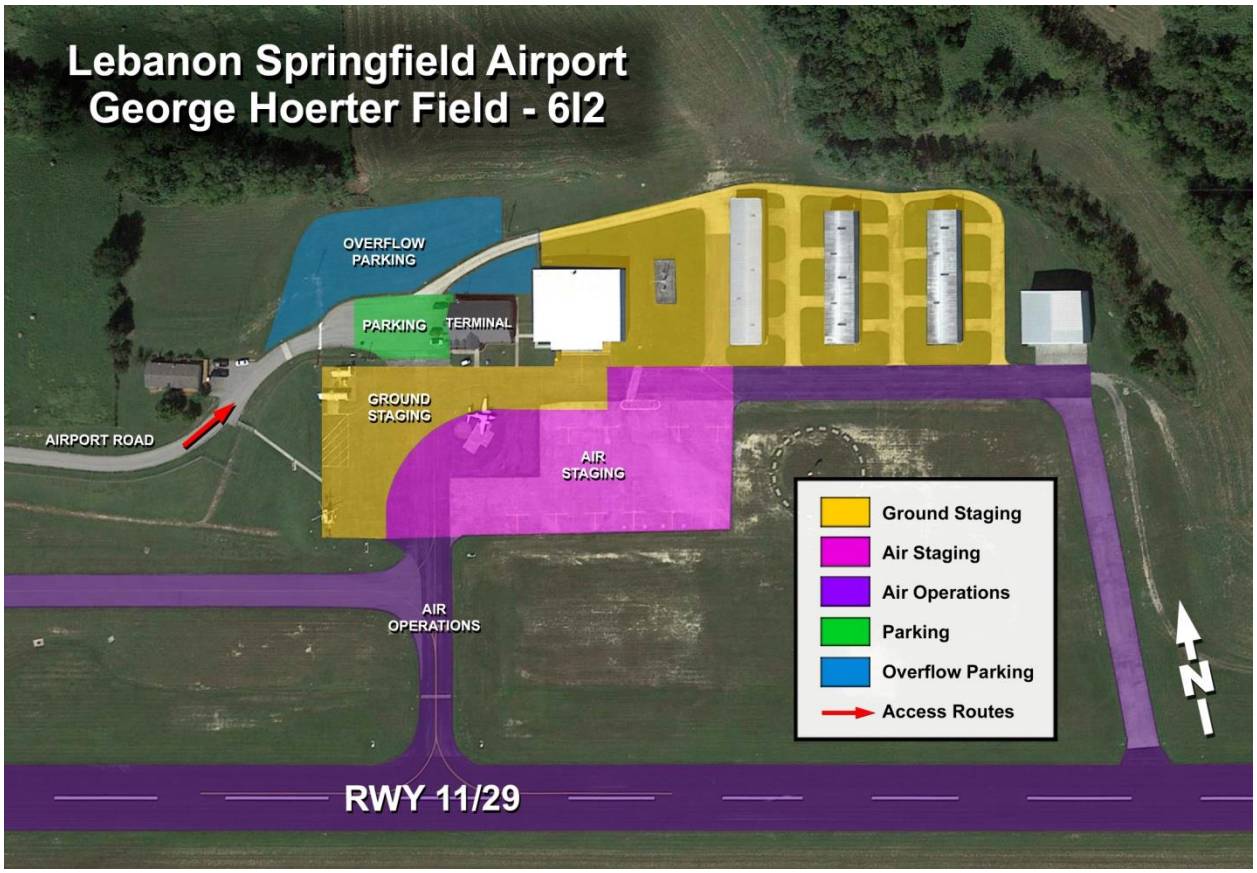
ATR-72 (66 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Lane, which connects to Kentucky Highway 55 approximately 0.7 miles west of the Airport. Kentucky Highway 55 leads to the town of Springfield approximately 4 miles north, and to the town of Lebanon approximately 5 miles south. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Lebanon Springfield Airport
George Hoerter Field - 6I2
To Springfield
AIRPORT ROAD
55
TERMINAL AREA
To Lebanon
N


Lebanon Springfield Airport
George Hoerter Field - 6I2
OVERFLOW PARKING
PARKING
TERMINAL
GROUND STAGING
AIRPORT ROAD
AIR STAGING
AIR OPERATIONS
RWY 11/29
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N

Liberty-Casey County Airport - I53

Liberty, Kentucky

With a paved runway 3,000 feet by 60 feet, minimal facilities, and six alternative airports within a 30-mile radius, it is unlikely that Liberty - Casey County Airport could be utilized for evacuation of civilians from the area, except under the most unique threat conditions. Should that need ever arise, the maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging on and around the paved apron area. There is no paved parking in the immediate vicinity of the existing apron area; therefore, parking on grassy areas near the apron would be necessary.

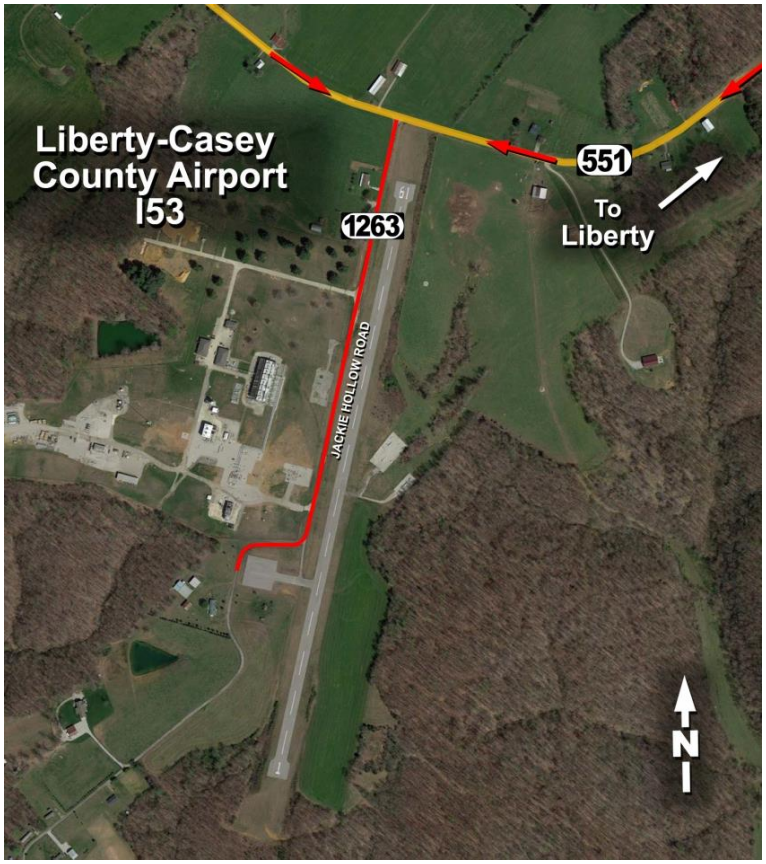
Largest Civilian Aircraft

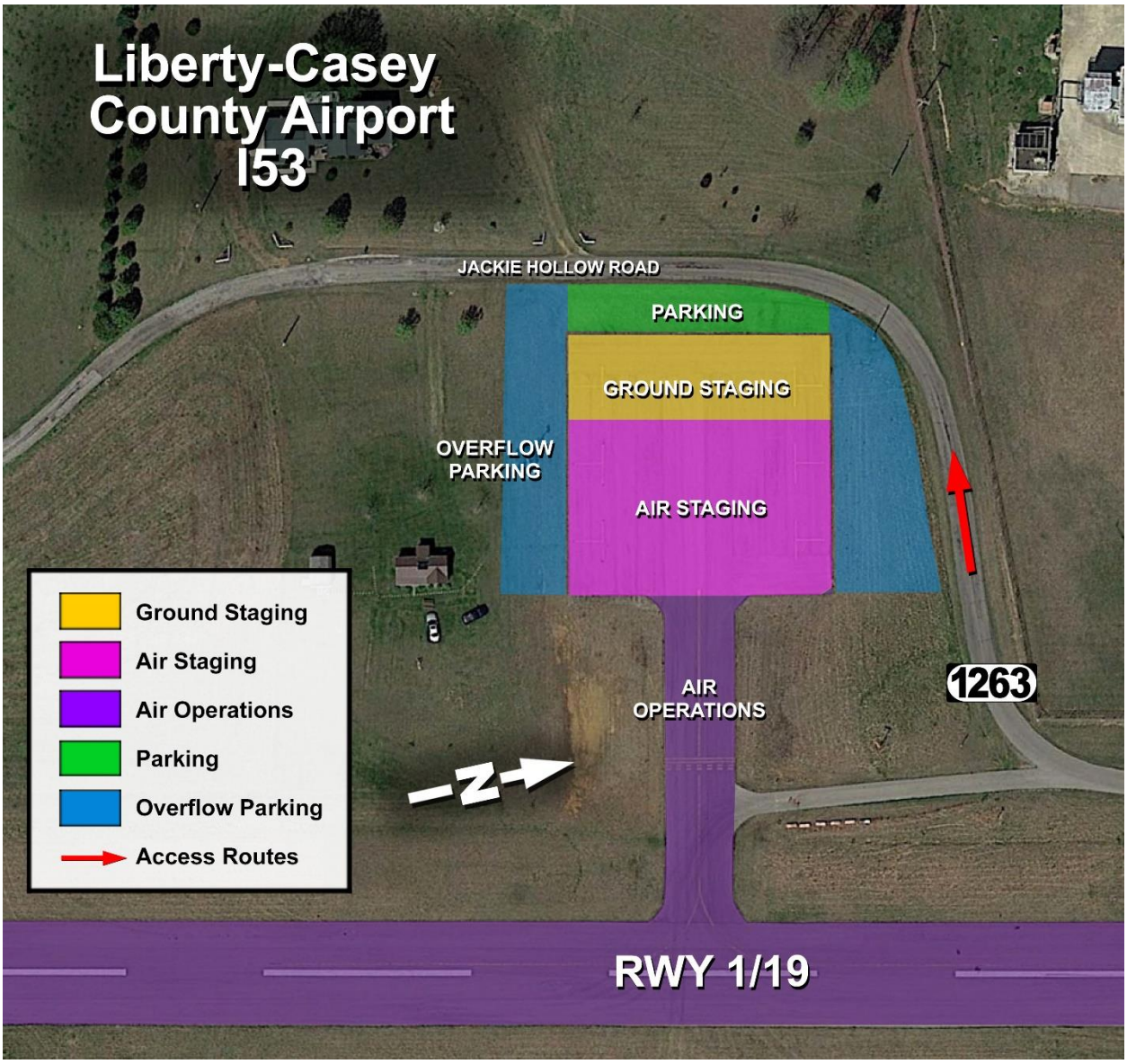
Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by County Road 1263, also known as Jackie Hollow Road, which connects to County Road 551, also known as Possum Trot Road. The town of Clementsville is approximately 3.3 miles southwest of the Airport on County Road 551. Highway 70 then connects with the town of Liberty approximately 11.3 miles east. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Liberty-Casey
County Airport
I53
JACKIE HOLLOW ROAD
PARKING
GROUND STAGING
OVERFLOW
PARKING
AIR STAGING
AIR
OPERATIONS
1263
N
RWY 1/19
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

London-Corbin Airport-Magee Field - LOZ

London, Kentucky

With a paved runway 5,751 feet by 150 feet and only two alternative airports within a 30-mile radius, it is likely that London-Corbin Airport-Magee Field would be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-700 (143 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near terminal areas on both sides of the runway. Paved parking is available, but the need for additional overflow parking may be accommodated on reasonably level grassy areas east of the terminal and hangar areas.

Largest Civilian Aircraft

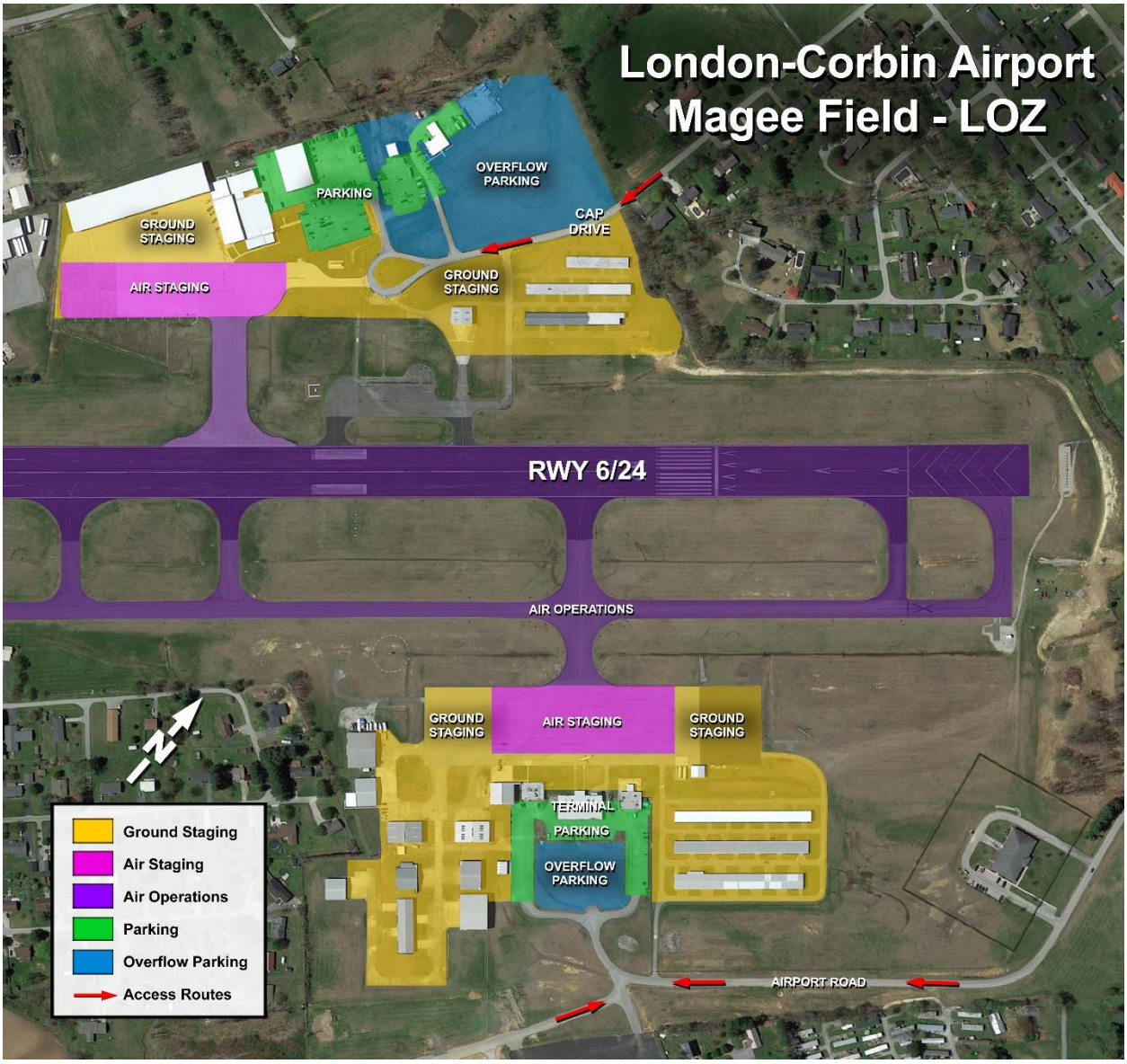
Boeing 737-700 (143 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed on the south side of the Airport by Hal Rogers Drive, which connects to US Highway 25, 0.5 miles east of the terminal area. Ground evacuation routes may be accessed on the north side of the Airport by Cap Drive, 0.4 miles to Middleground Way, which also connects to US Highway 25, 0.4 miles east of the hangar area. US Highway 25 leads to Interstate 75, via Highway 192 west, approximately 2.9 miles north of the Airport, and to the city of London approximately 2 miles north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


London-Corbin Airport
Magee Field - LOZ
MIDDLEGROUND WAY
CAP ROAD
To London
AIRPORT ROAD
TERMINAL
AIRPORT TERMINAL ENTRANCE
INTERSTATE
75
25
N


London-Corbin Airport
Magee Field - LOZ
OVERFLOW PARKING
PARKING
GROUND STAGING
CAP DRIVE
AIR STAGING
GROUND STAGING
RWY 6/24
AIR OPERATIONS
GROUND STAGING
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW PARKING
AIRPORT ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Madisonville Municipal Airport - 2I0

Madisonville, Kentucky

With a paved runway 6,050 feet by 100 feet and four alternative airports within a 30-mile radius, it is likely that Madisonville Municipal Airport would be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 757-200 (200 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. The need for additional overflow parking may be accommodated on reasonably level grassy areas southeast of the terminal area.

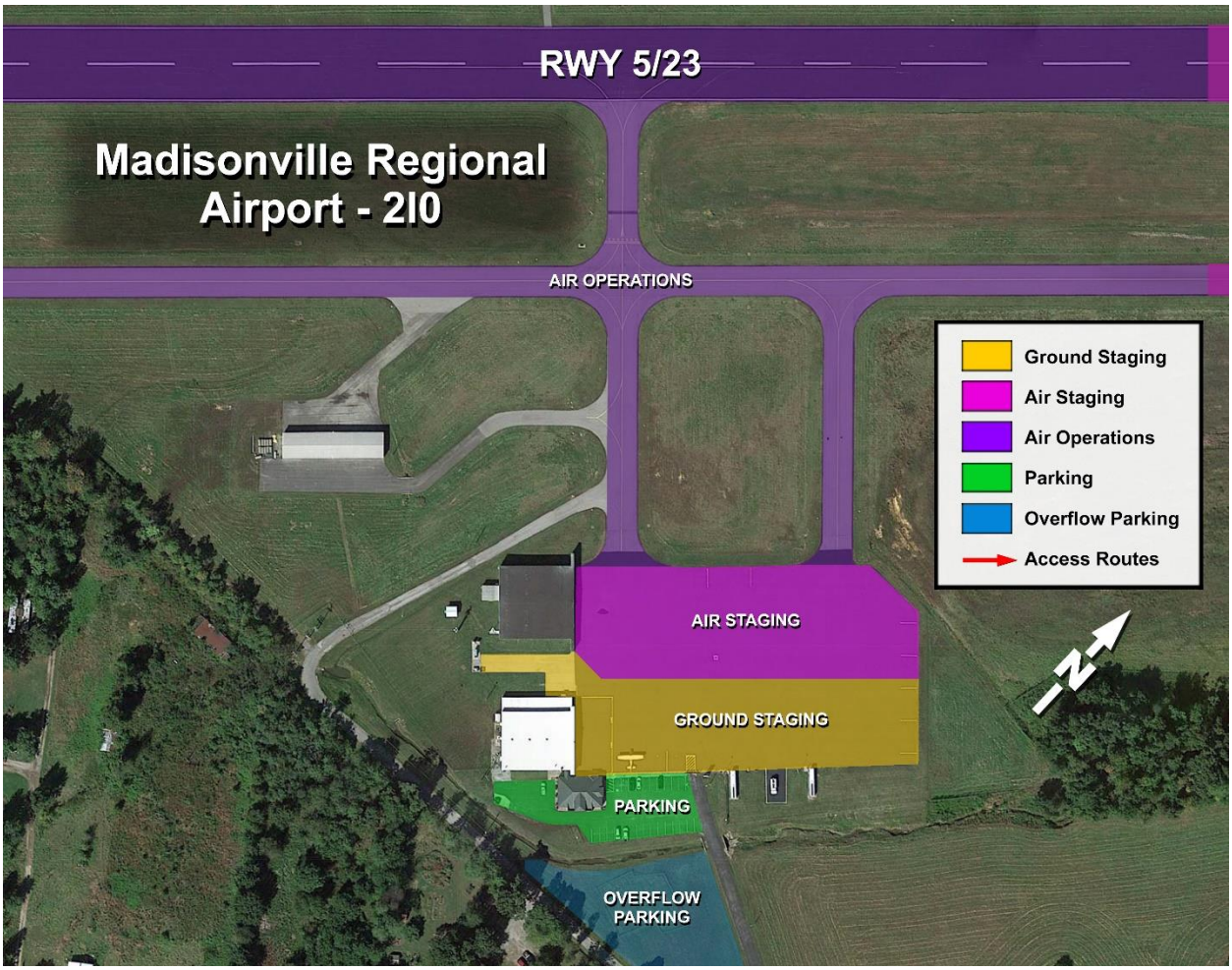
Largest Civilian Aircraft

Boeing 757-200 (200 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by entering Kentucky Highway 85/Anton Road, which connects to the Pennyrile Parkway 5.3 miles southwest of the Airport. The town of Madisonville is just west of the Pennyrile Parkway. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 5/23
Madisonville Regional Airport - 2I0
AIR OPERATIONS
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
AIR STAGING
GROUND STAGING
PARKING
OVERFLOW PARKING
N

Marion-Crittenden County Airport - 5M9

Marion, Kentucky

With a paved runway 4,400 feet by 75 feet and six alternative airports within a 30-mile radius, it is unlikely that Marion-Crittenden County Airport would be heavily utilized for any significant evacuation of civilians from the area, but could be utilized under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas south of the terminal.

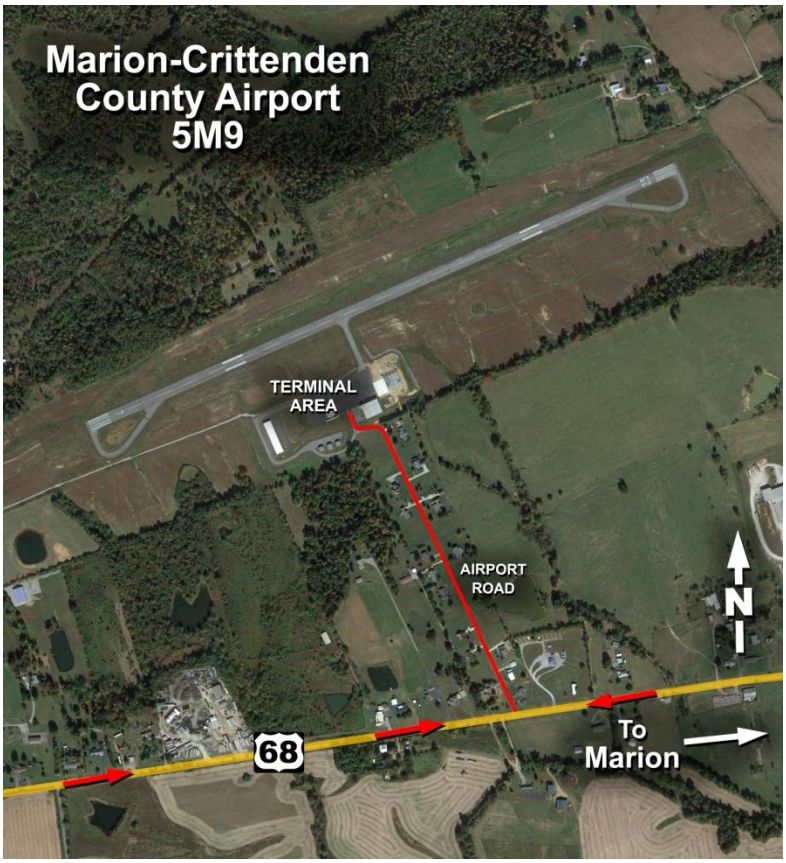
Largest Civilian Aircraft

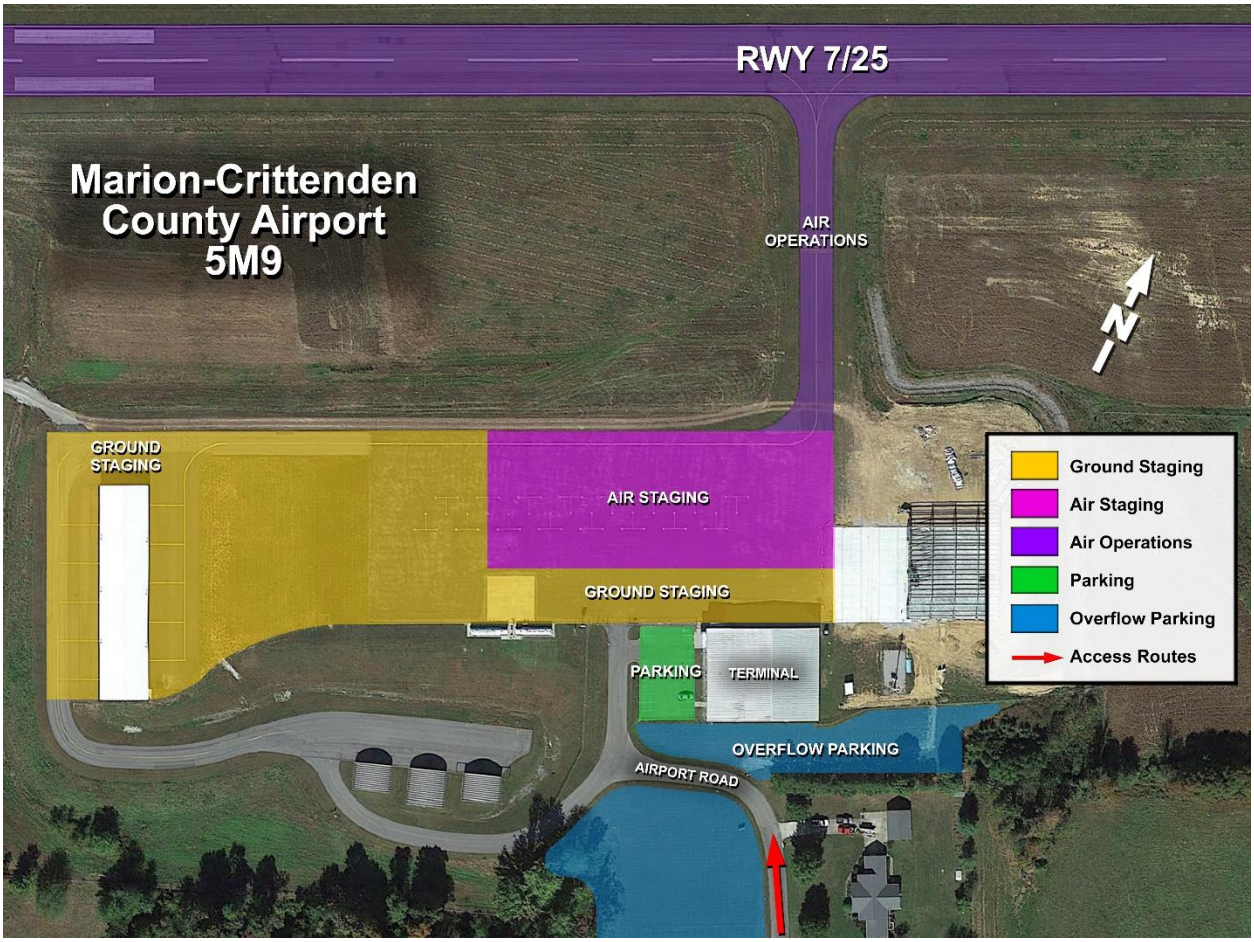
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 68 approximately 0.4 miles south of the Airport. US Highway 68 leads to the town of Marion, 1.4 miles east of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 7/25
Marion-Crittenden
County Airport
5M9
AIR
OPERATIONS
N
GROUND
STAGING
AIR STAGING
GROUND STAGING
PARKING
TERMINAL
OVERFLOW PARKING
AIRPORT ROAD
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Mayfield-Graves County Airport - M25

Mayfield, Kentucky

With a paved runway 5,002 feet by 100 feet and four other alternative airports within a 30-mile radius, it is possible that Mayfield - Graves County Airport could be utilized for evacuation of civilians from the area in the event of an earthquake or other unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas east of the terminal area.

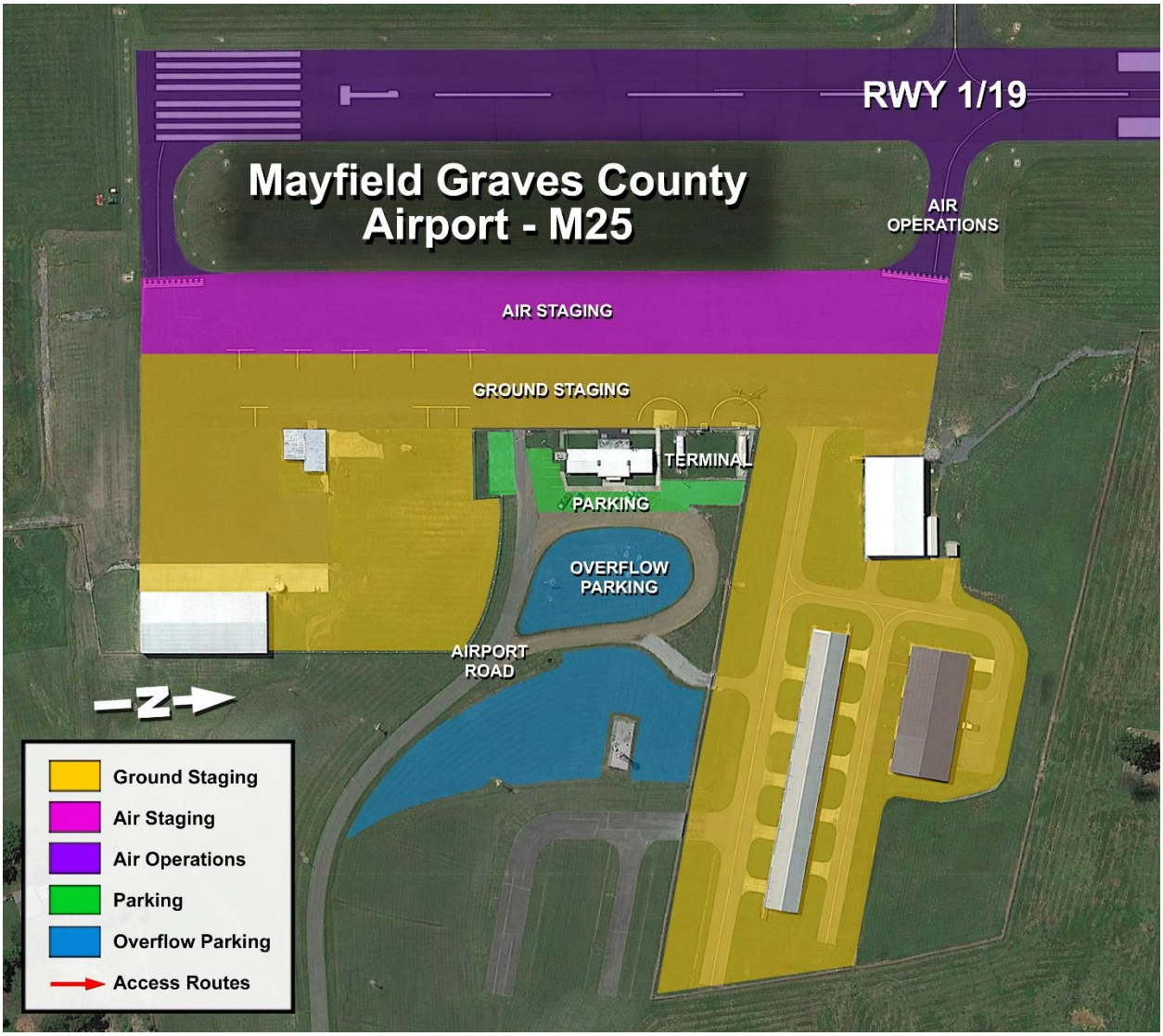
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Route 58 approximately 0.2 miles southeast of the Airport. Kentucky Route 58 leads to Mayfield 3.5 miles west, and to the Purchase Parkway via State Route 131, 2 miles west and north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 1/19
Mayfield Graves County
Airport - M25
AIR
OPERATIONS
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW
PARKING
AIRPORT
ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

McCreary County Airport - 18I

Pine Knot, Kentucky

With a paved runway 2,999 feet by 75 feet and three alternative airports with larger runways within a 30-mile radius, it is possible that McCreary County Airport could be utilized for evacuation of civilians from the Pine Knot area under certain unique threat conditions. With its proximity to United States Penitentiary-McCreary, one of the most likely protocols under a disaster or threat scenario would involve use of the airport as a staging and evacuation base for prisoners and staff of USP McCreary. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area.

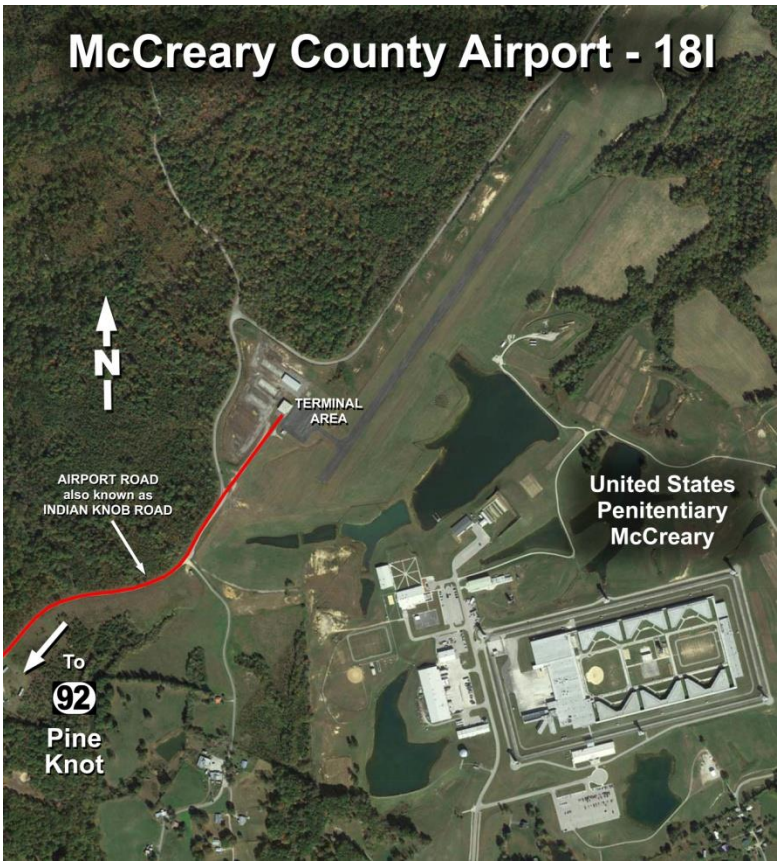
Largest Civilian Aircraft

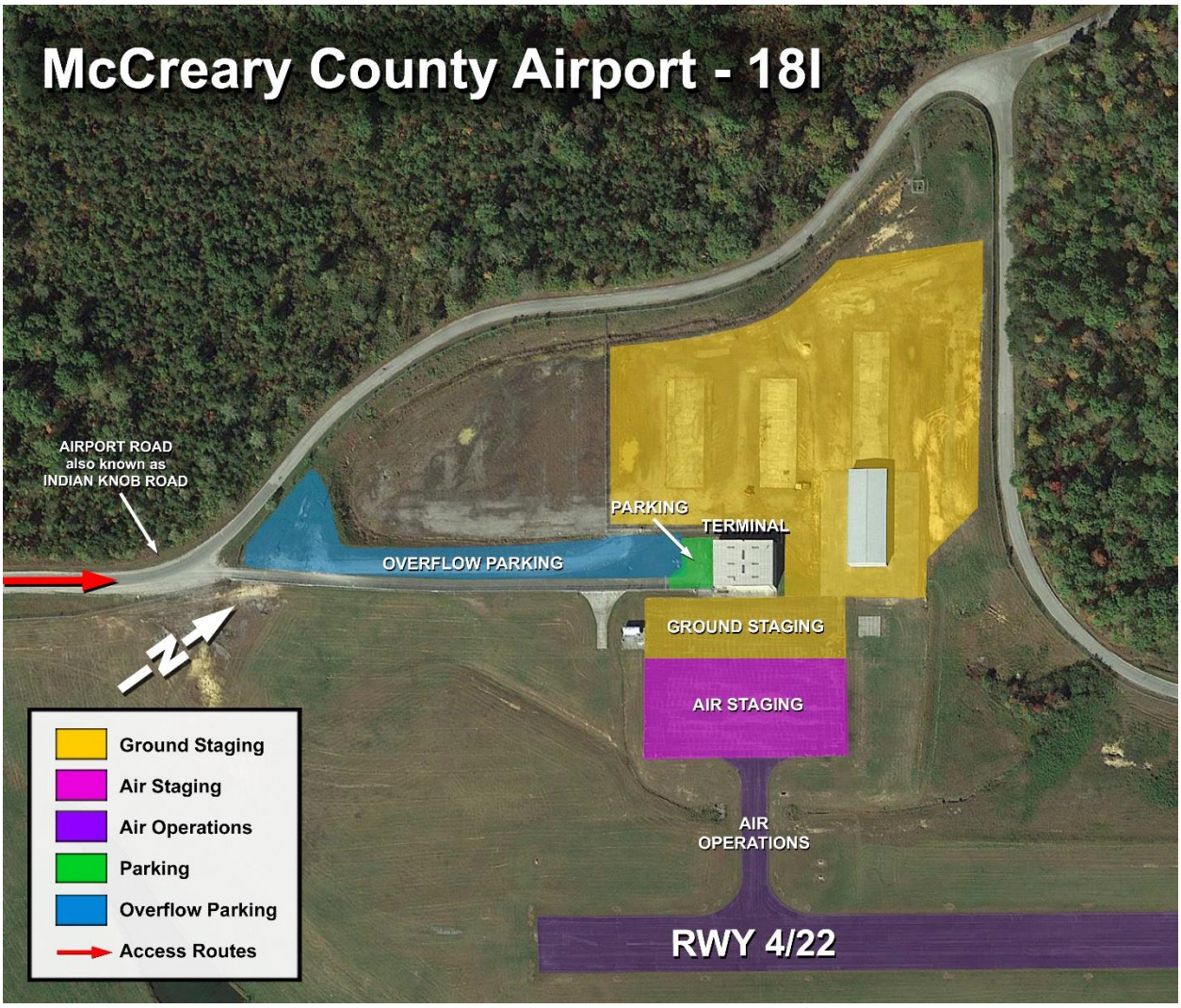
Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, also known at Indian Knob Road, southwest to Kentucky Highway 92, which then connects to US Highway 27 approximately 1.5 miles west, approximately 0.5 miles north of the town of Pine Knot. Traveling east on Highway 92 from Airport Road, it is approximately 18 miles to Interstate 75. Travelers may also turn north from the Airport entrance onto Indian Knob Road, which connects with County Road 478 approximately 2.3 miles north of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




McCreary County Airport - 18I
AIRPORT ROAD
also known as
INDIAN KNOB ROAD
OVERFLOW PARKING
PARKING
TERMINAL
GROUND STAGING
AIR STAGING
AIR
OPERATIONS
RWY 4/22
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Middlesboro-Bell County Airport - 1A6

Middlesboro, Kentucky

With a paved runway 3,631 feet by 75 feet and only two alternative airports within a 30-mile radius, it is possible that Middlesboro-Bell County Airport could be utilized for evacuation of civilians from the area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas near the terminal and hangar area.

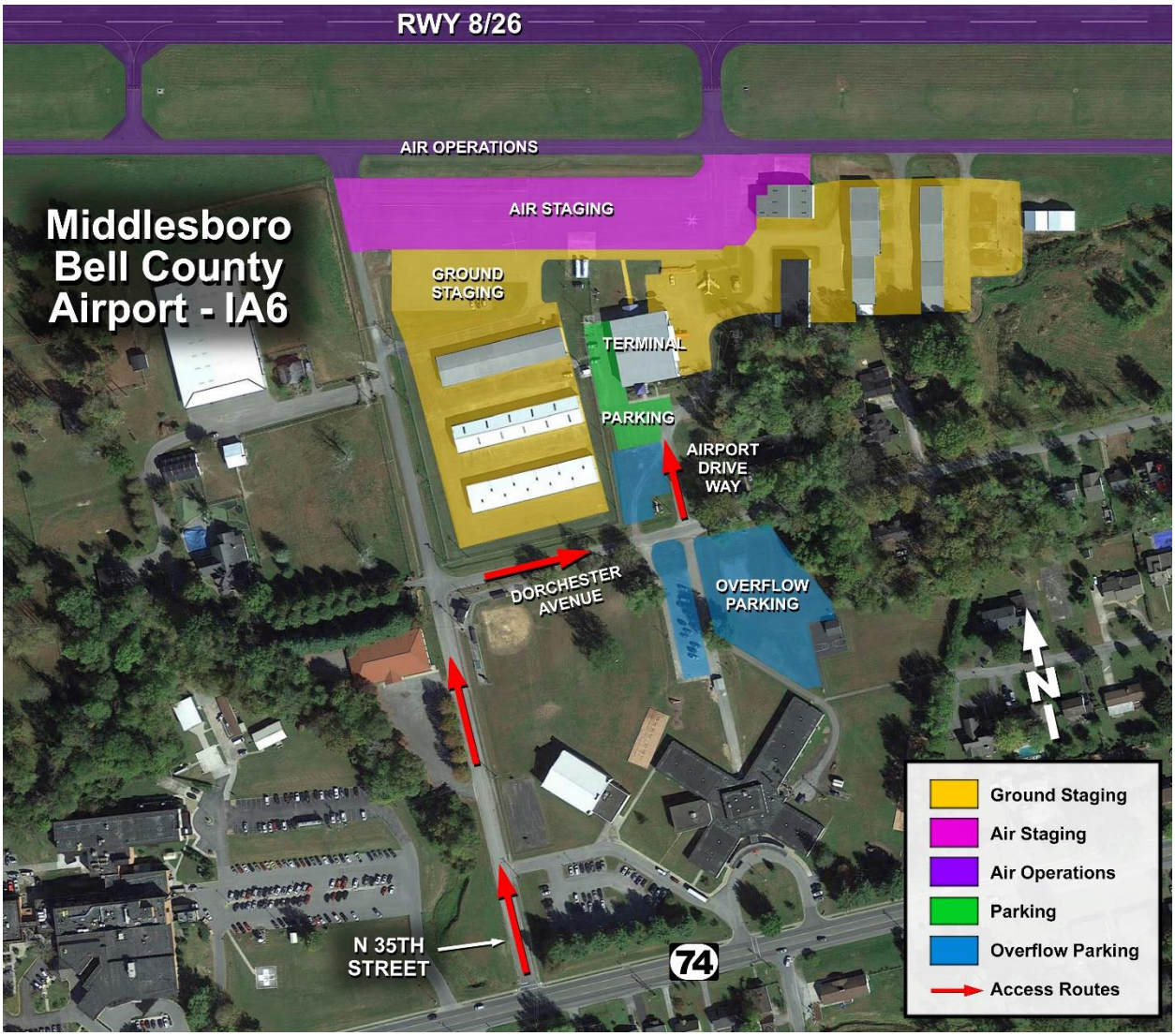
Largest Civilian Aircraft

ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Dorchester Avenue and 35th St. onto Kentucky Highway 74, also known as West Cumberland Avenue. It is approximately 2 miles east on W. Cumberland Ave. through Middlesboro to US 25 E. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


RWY 8/26
AIR OPERATIONS
AIR STAGING
Middlesboro
Bell County
Airport - IA6
GROUND
STAGING
TERMINAL
PARKING
AIRPORT
DRIVE
WAY
DORCHESTER
AVENUE
OVERFLOW
PARKING
N
N 35TH
STREET
74
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Morehead-Rowan County Clyde A Thomas Regional Airport - SYM

Morehead, Kentucky

With a paved runway 5,500 feet by 100 feet and as the largest of four other alternative airports within a 30-mile radius, plus excellent ground transportation access, it is likely that Morehead-Rowan County Regional Airport would be utilized for evacuation of civilians from the area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-700 (143 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. As with many airports of this size, paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas near the terminal. With a large paved area inside the fence near the T-hangars on the west side of the airport, additional supervised parking within a roped-off area could be safely staged.

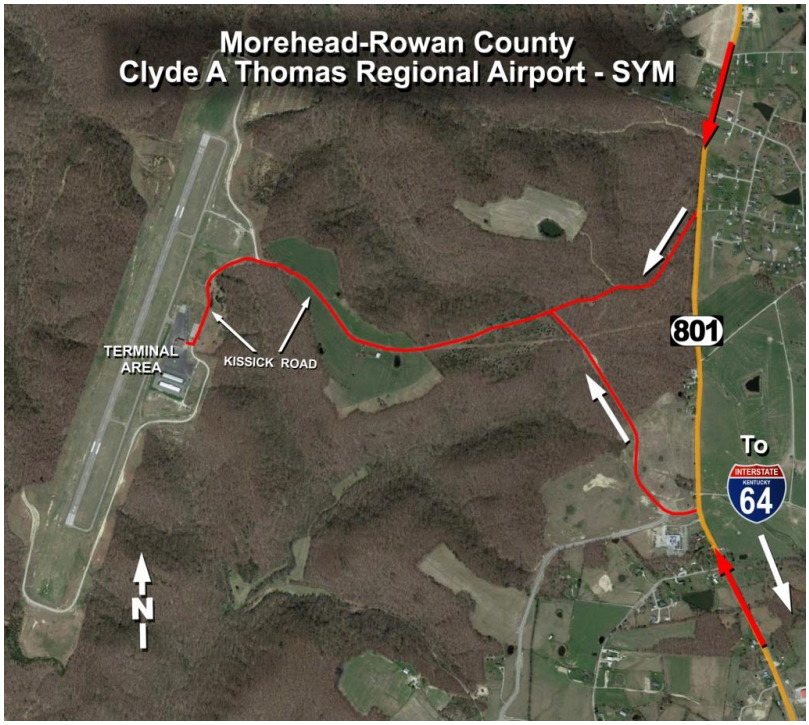
Largest Civilian Aircraft

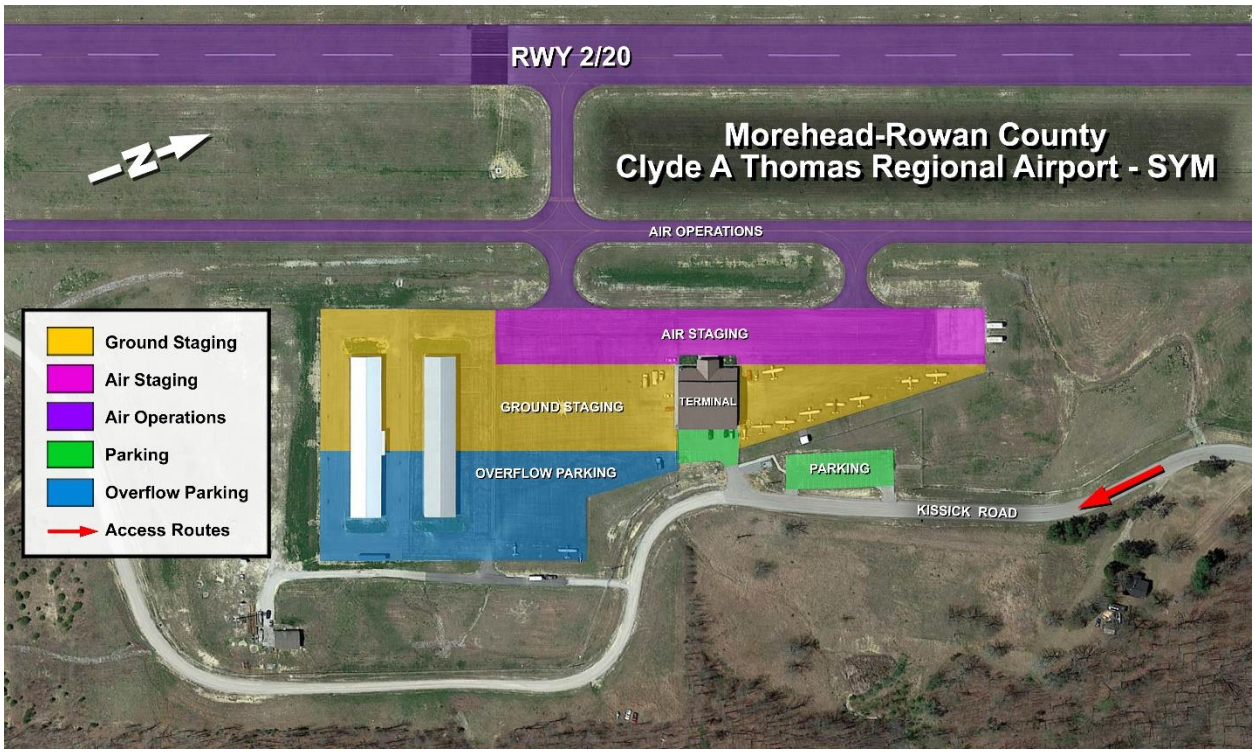
Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Kissick Road, which connects to Kentucky Highway 801 approximately 1.5 miles east of the Airport. State Route 801 leads to Interstate 64 approximately 2 miles to the south. Interstate 64 connects with the towns of Morehead approximately 7 miles to the east, and Owingsville approximately 12 miles to the west. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 2/20
Morehead-Rowan County
Clyde A Thomas Regional Airport - SYM
N
AIR OPERATIONS
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
AIR STAGING
GROUND STAGING
TERMINAL
OVERFLOW PARKING
PARKING
KISSICK ROAD

Mount Sterling-Montgomery County Airport - IOB

Mount Sterling, Kentucky

With a paved runway 5,000 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Mount Sterling-Montgomery County Airport could be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available. Overflow parking will be necessary on reasonably level grassy areas west of the terminal.

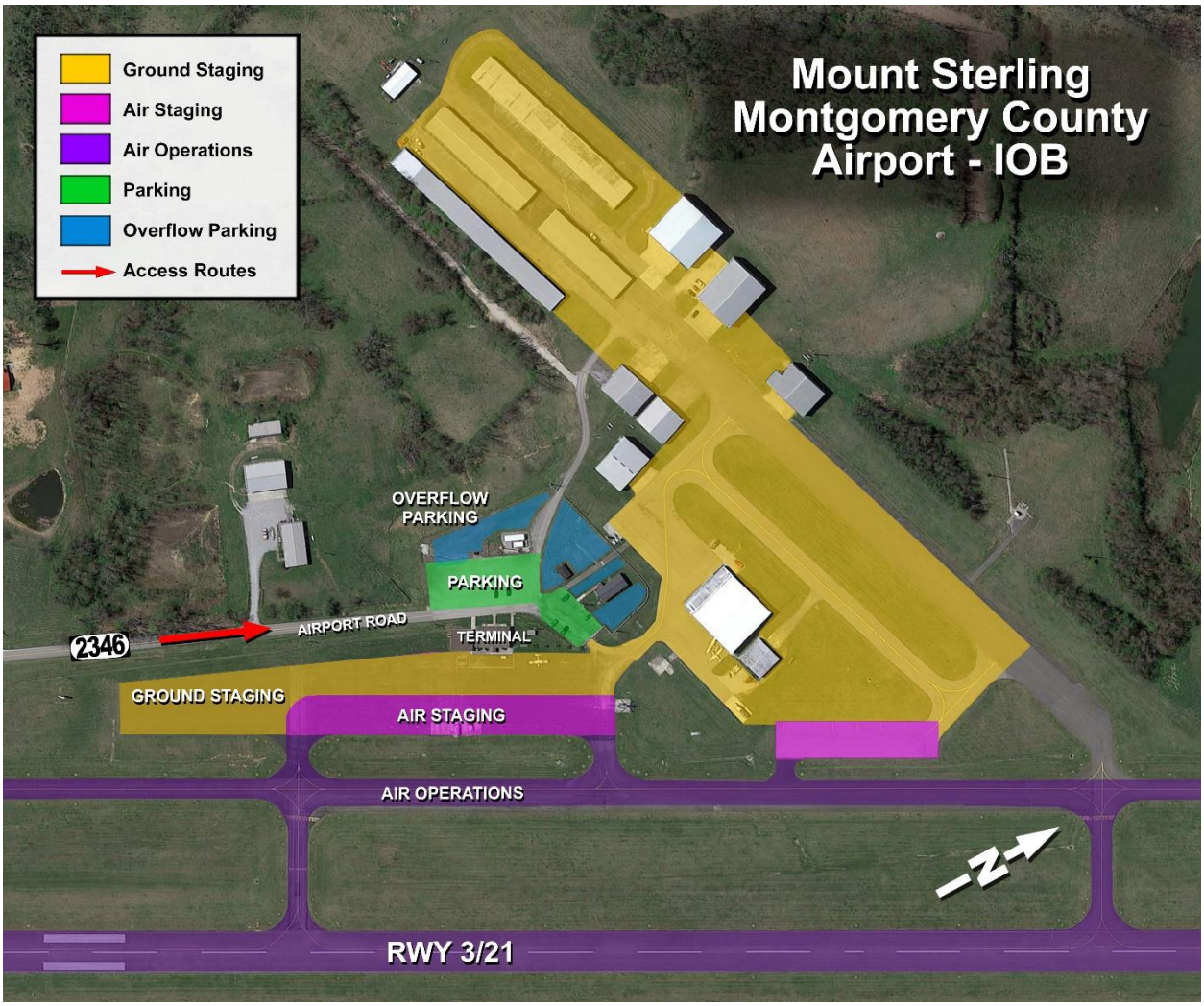
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 60, 0.9 miles southeast of the Airport. US Highway 60 leads to the town of Mount Sterling, approximately 2 miles east of the Airport. Interstate 64 is approximately 1.8 miles north of the Airport, and may be accessed via several routes. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
Mount Sterling
Montgomery County
Airport - IOB
OVERFLOW
PARKING
PARKING
AIRPORT ROAD
TERMINAL
2346
GROUND STAGING
AIR STAGING
AIR OPERATIONS
N
RWY 3/21

Muhlenberg County Airport - M21

Greenville, Kentucky

With a paved runway 5,000 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Muhlenberg County Airport could be utilized for evacuation of civilians from the Greenville area in the event of unique threat conditions, such as an earthquake. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Overflow parking will be necessary on reasonably level grassy areas west of the terminal, and in the parking areas of neighboring properties.

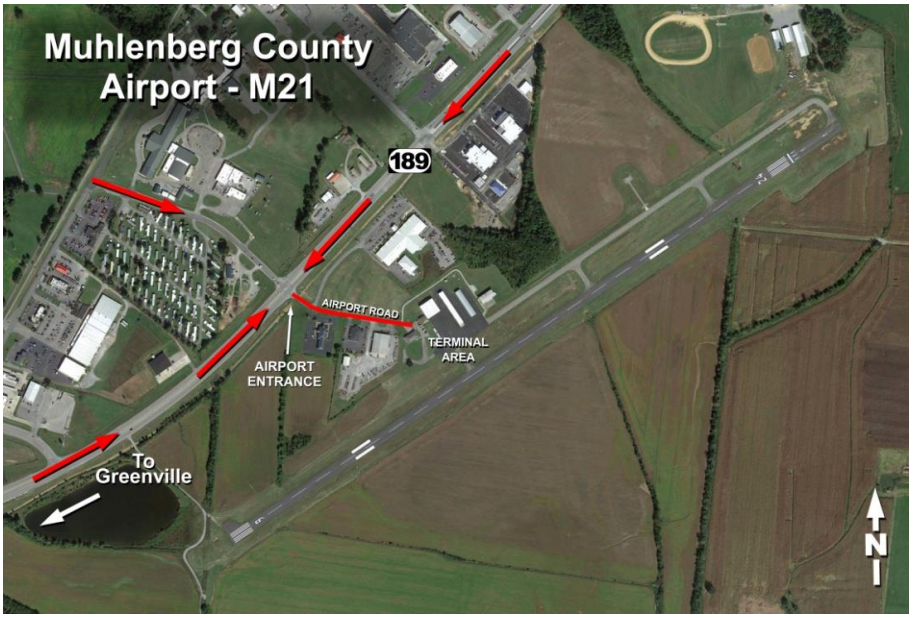
Largest Civilian Aircraft

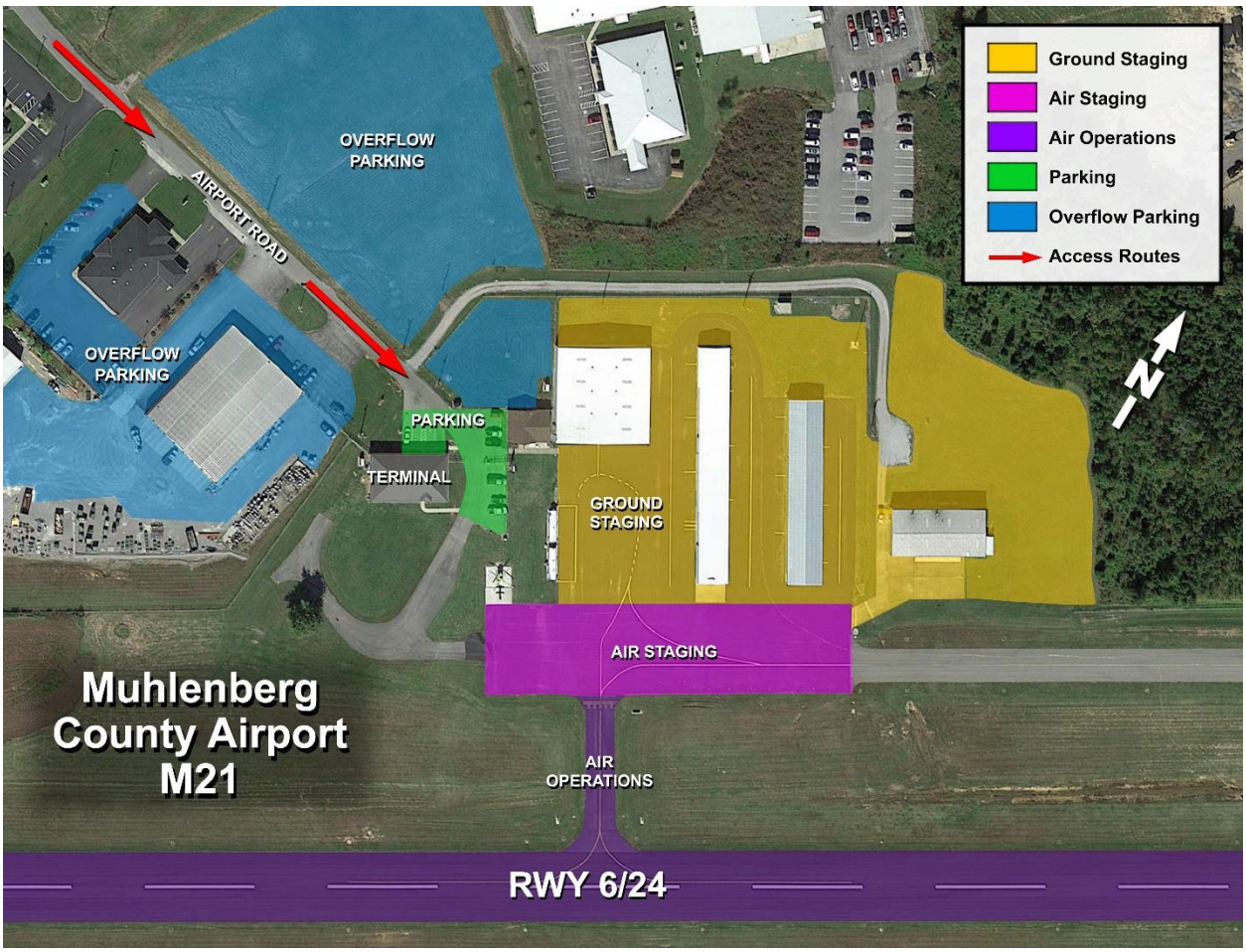
ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Highway 189, also known as Robert L. Draper Way, 350 yards west of the Airport. State Route 189 leads to the town of Greenville approximately 1.3 miles south, and to the Western Kentucky Parkway approximately 3.5 miles north of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
OVERFLOW PARKING
AIRPORT ROAD
OVERFLOW PARKING
PARKING
TERMINAL
GROUND STAGING
AIR STAGING
Muhlenberg County Airport M21
AIR OPERATIONS
RWY 6/24
N

Ohio County Airport - JQD

Hartford, Kentucky

With a paved runway 5,000 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Ohio County Airport could be utilized for evacuation of civilians from the Hartford area in the event of unique threat conditions, such as an earthquake. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Overflow parking will likely be necessary on reasonably level grassy areas southwest of the terminal.

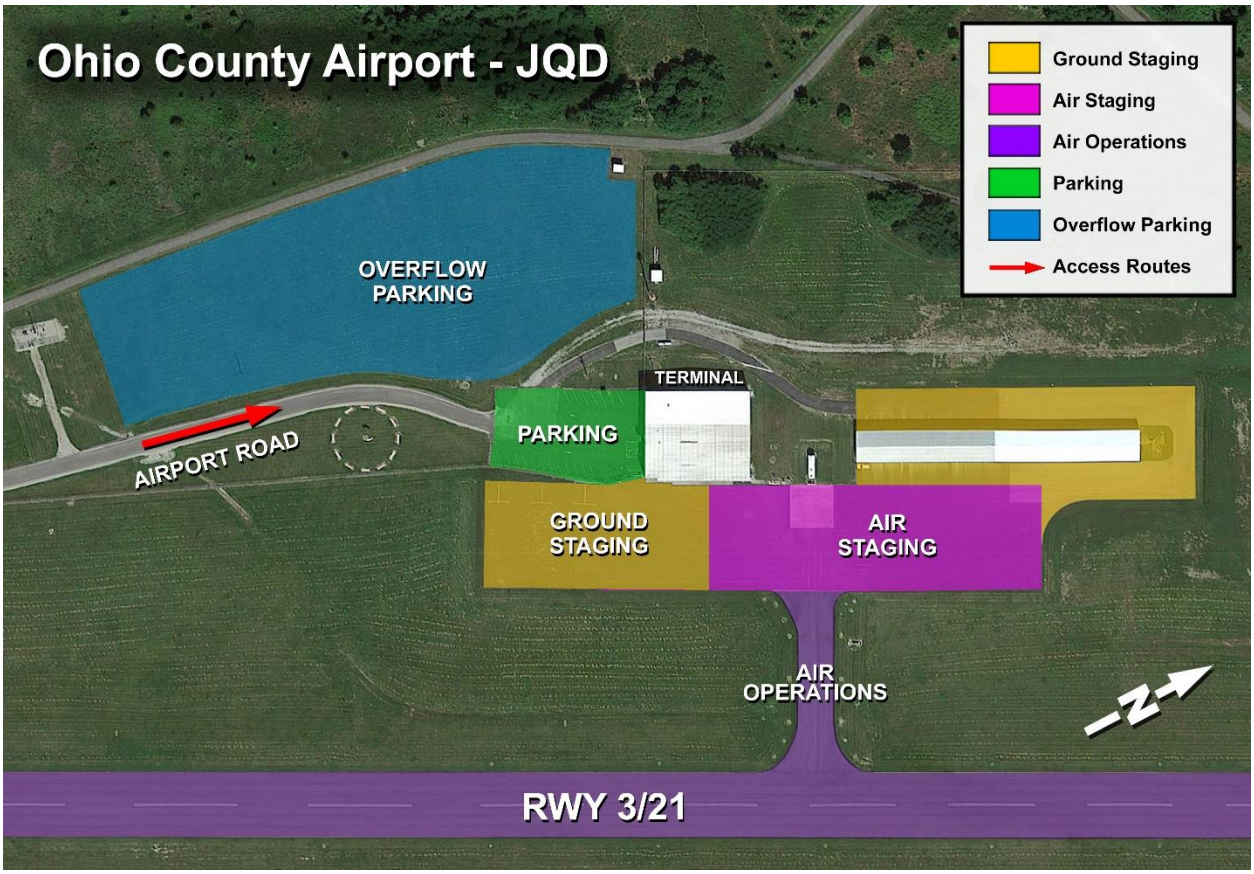
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Wesley C Phelps Memorial Lane approximately 400 yards west of the Airport. Wesley C Phelps Memorial Lane connects with Kentucky Highway 69 approximately one mile west of the Airport. State Route 69 leads to the William H. Natcher Parkway 0.9 miles southwest, and to the town of Hartford approximately 1.5 miles southwest of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Ohio County Airport - JQD
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
OVERFLOW PARKING
TERMINAL
PARKING
AIRPORT ROAD
GROUND STAGING
AIR STAGING
AIR OPERATIONS
N
RWY 3/21

Pike County-Hatcher Field - PBX

Pikeville, Kentucky

With a paved runway 5,356 feet by 100 feet and only one alternative airport within a 30-mile radius, it is likely that Pike County-Hatcher Field would be utilized for evacuation of civilians from the Pikeville area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737–500 (122 passengers) and military Lockheed C-130 (92 passengers) could be staged from the Airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available. Overflow parking is limited and may be accommodated on reasonably level grassy areas near the terminal, and along the edges of Airport Road. Additional overflow parking may be possible inside the fence, west of the terminal and hangar area.

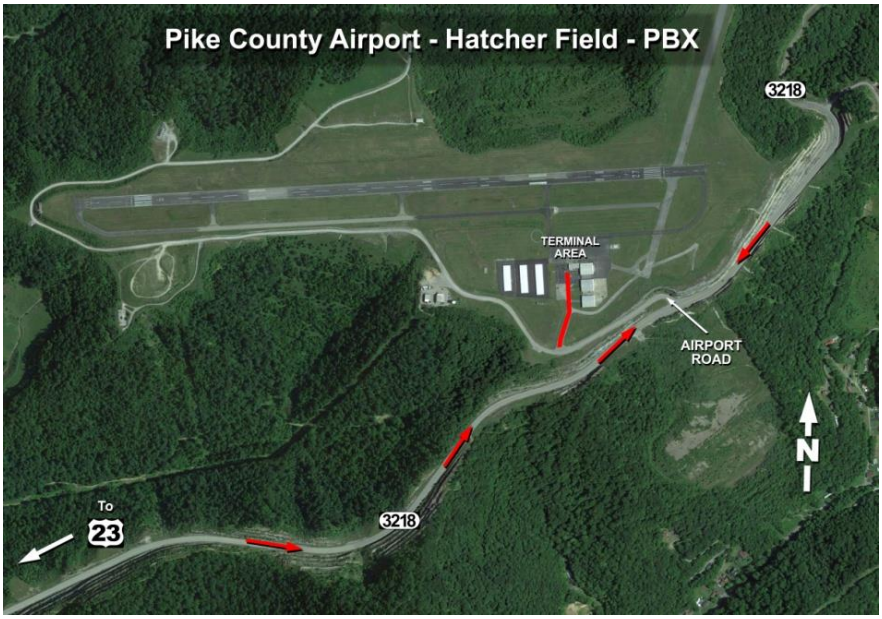
Largest Civilian Aircraft

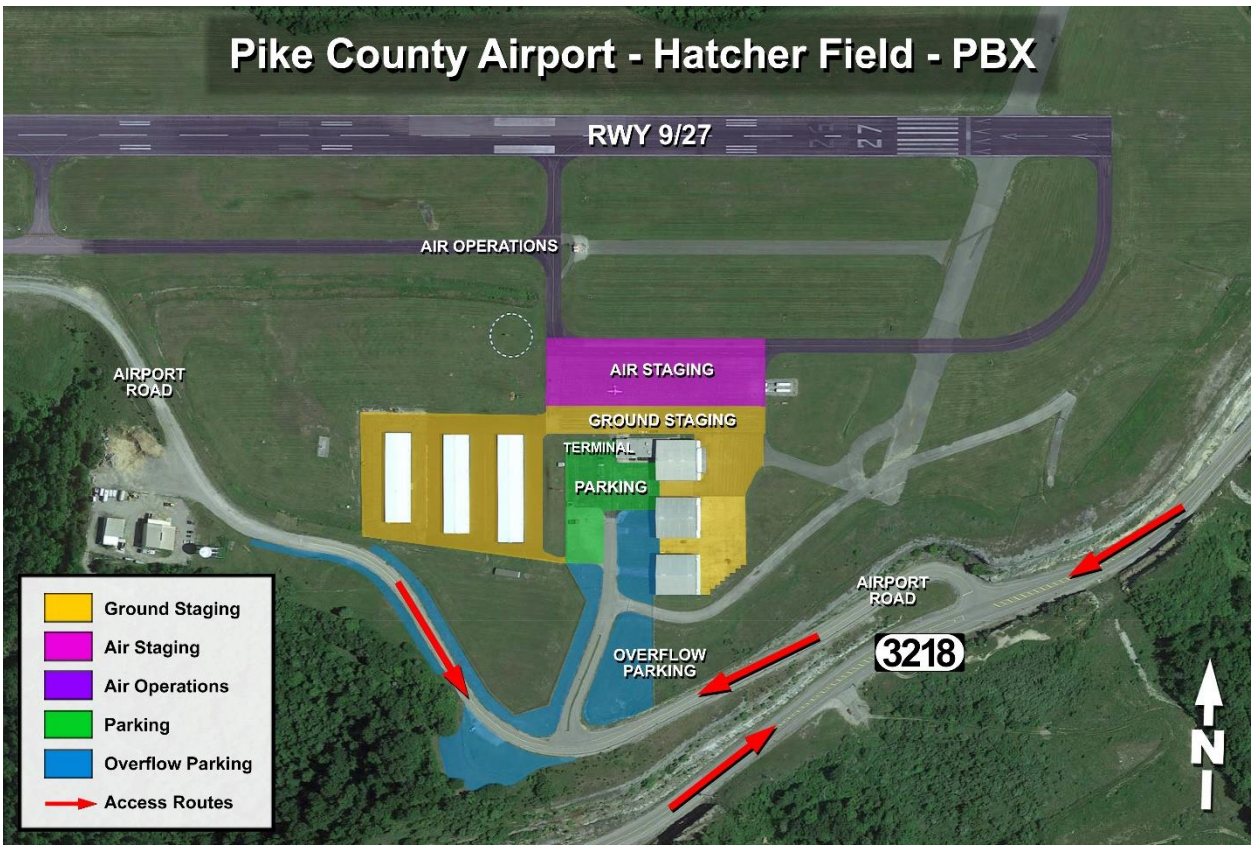
Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 23 approximately 3.1 miles southwest of the Airport. US Highway 23 leads to the cities of Prestonsburg, approximately 18.2 miles to the northwest, and Pikeville, 9.1 miles to the southeast. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Pike County Airport - Hatcher Field - PBX
RWY 9/27
AIR OPERATIONS
AIRPORT ROAD
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW PARKING
AIRPORT ROAD
3218
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Princeton-Caldwell County Airport - 2M0

Princeton, Kentucky

With a paved runway 4,099 feet by 76 feet and six alternative airports within a 30-mile radius, it is unlikely that Princeton-Caldwell County Airport would be utilized for any significant evacuation of civilians from the area, but could be utilized under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas north and west of the terminal.

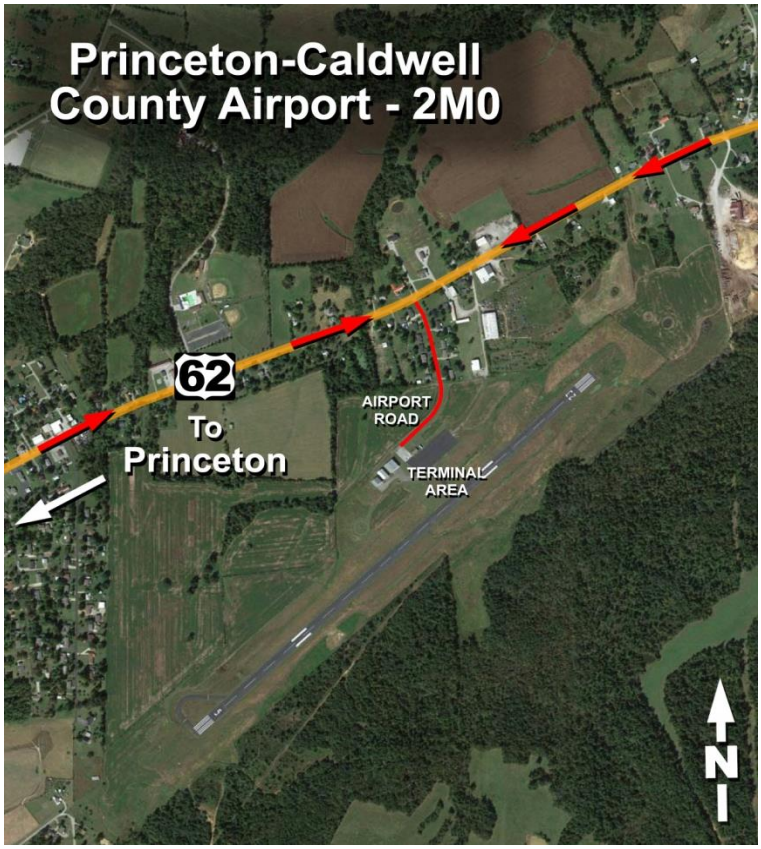
Largest Civilian Aircraft

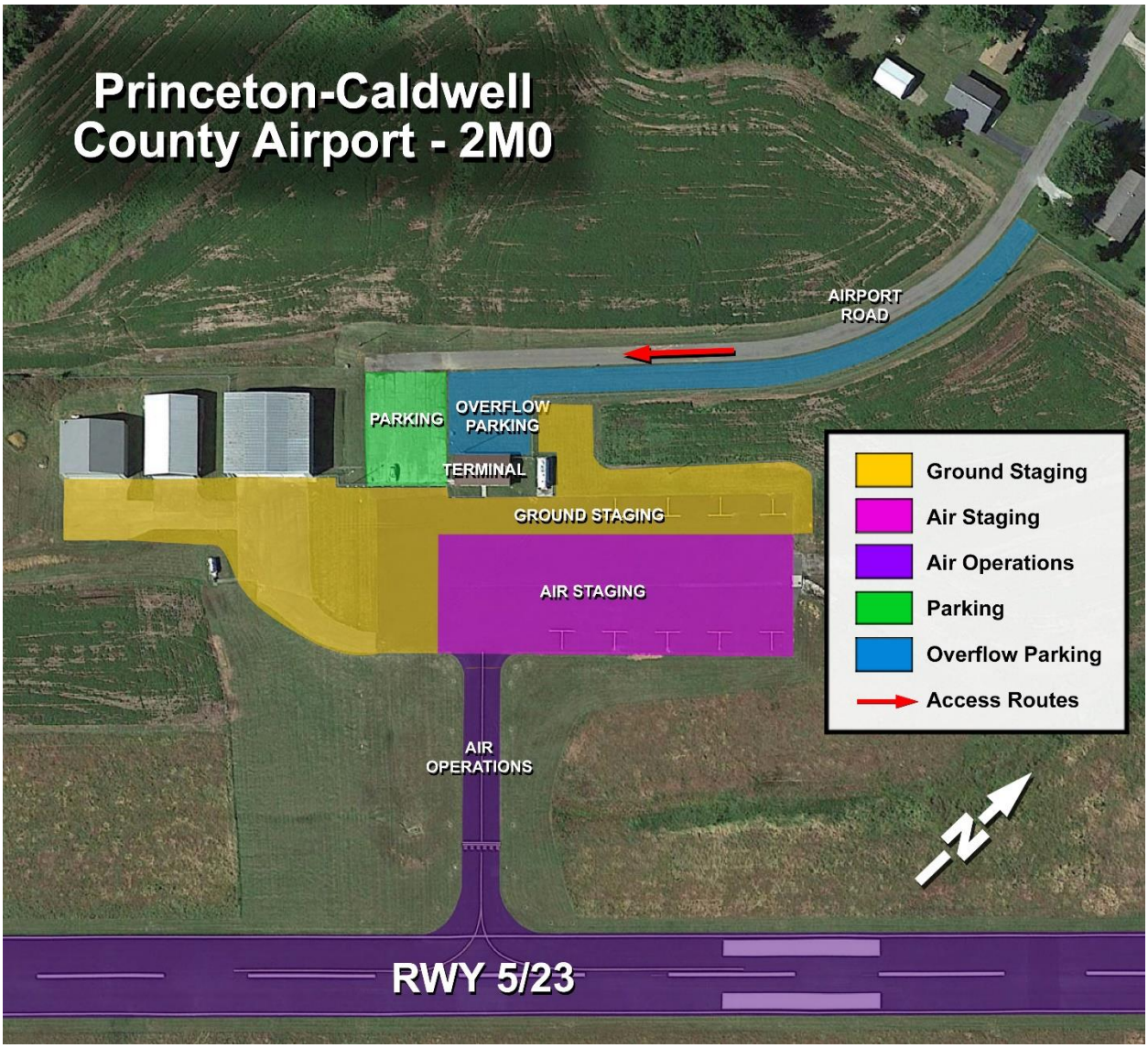
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 62 approximately 0.25 miles north of the Airport. US Highway 62 leads to the town of Princeton 1.5 miles southwest of the Airport. The Western Kentucky Parkway may be accessed via Highway 293, 1.4 miles north of Princeton. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Princeton-Caldwell County Airport - 2M0
AIRPORT ROAD
PARKING
OVERFLOW PARKING
TERMINAL
GROUND STAGING
AIR STAGING
AIR OPERATIONS
RWY 5/23
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N

Providence-Webster County Airport - 8M9

Providence, Kentucky

With a paved runway 3,800 feet by 70 feet and six alternative airports within a 30-mile radius, it is unlikely that Providence-Webster County Airport would serve a substantial role for the evacuation of civilians from the area, except under the most unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy area southwest of the terminal.

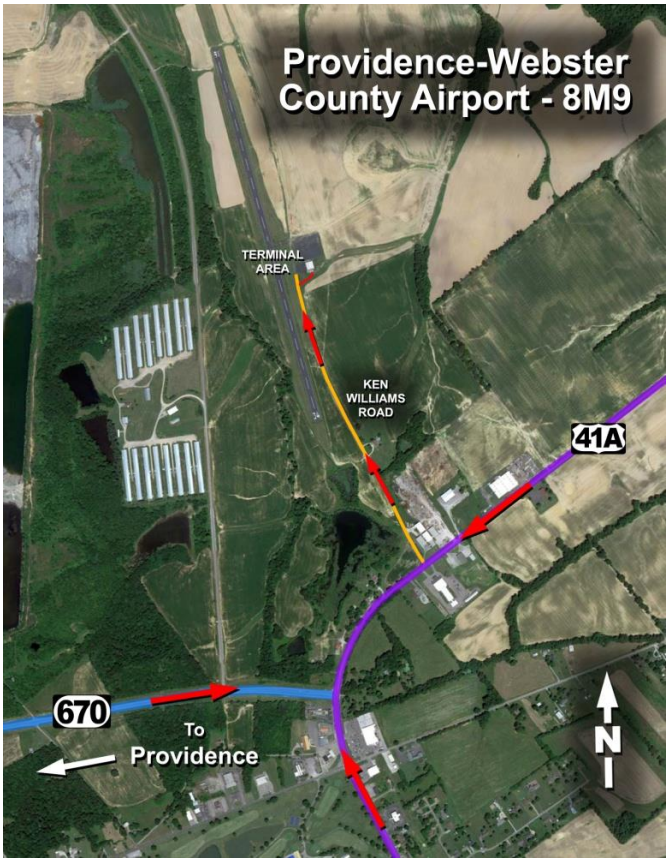
Largest Civilian Aircraft

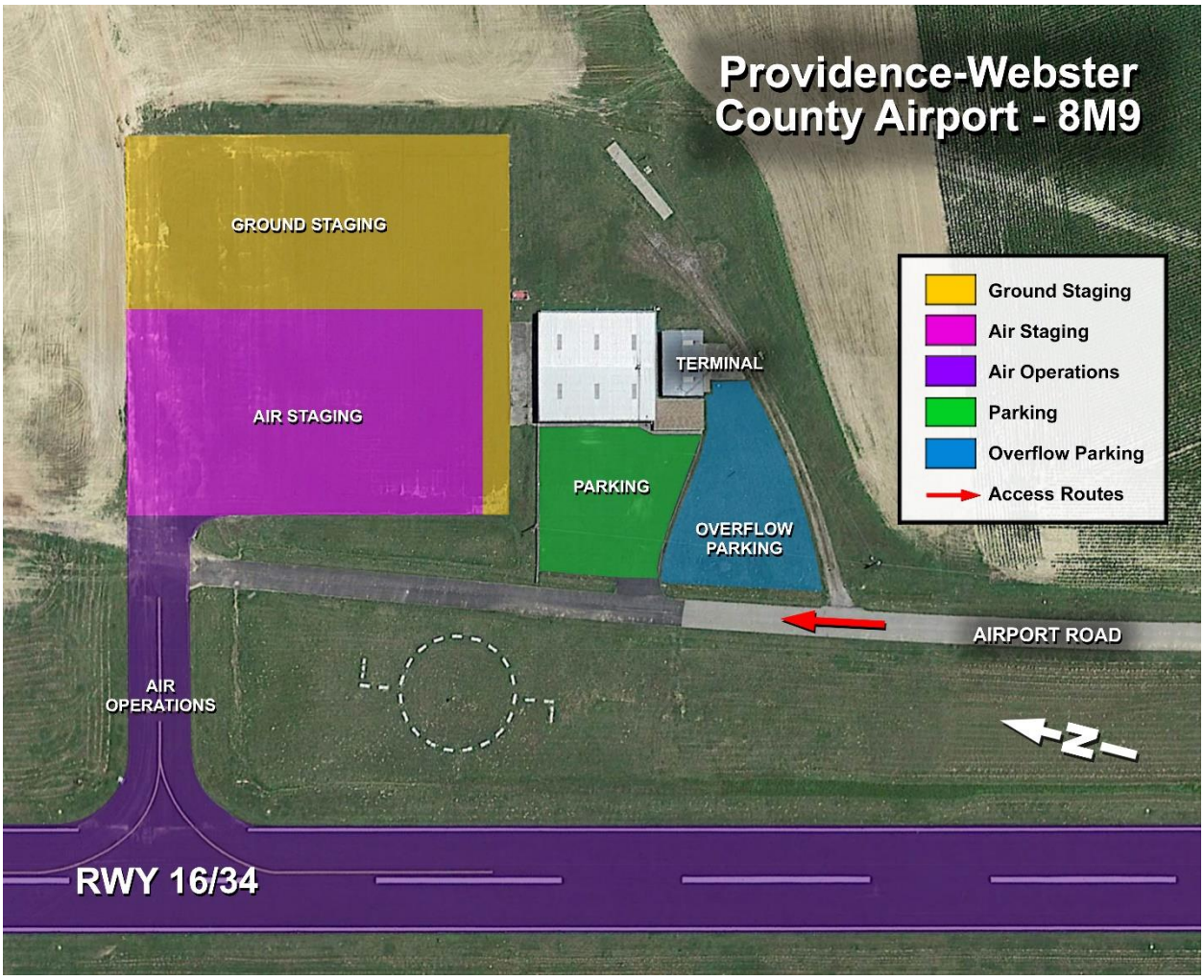
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, also known as Ken Williams Road, which connects to US Highway 41A approximately 0.7 miles south of the Airport. US Highway 41A leads to the town of Providence 1.8 miles southwest of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Providence-Webster County Airport - 8M9
GROUND STAGING
AIR STAGING
TERMINAL
PARKING
OVERFLOW PARKING
AIR OPERATIONS
AIRPORT ROAD
RWY 16/34
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Rough River State Park Airport - 2I3

Falls of Rough, Kentucky

With a paved runway 3,200 feet by 75 feet and three alternative airports within a 30-mile radius, it is possible that Rough River State Park Airport could be utilized for evacuation of civilians from the area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available for approximately three dozen automobiles. Overflow parking is available in grassy areas north, east, and south of the terminal building.

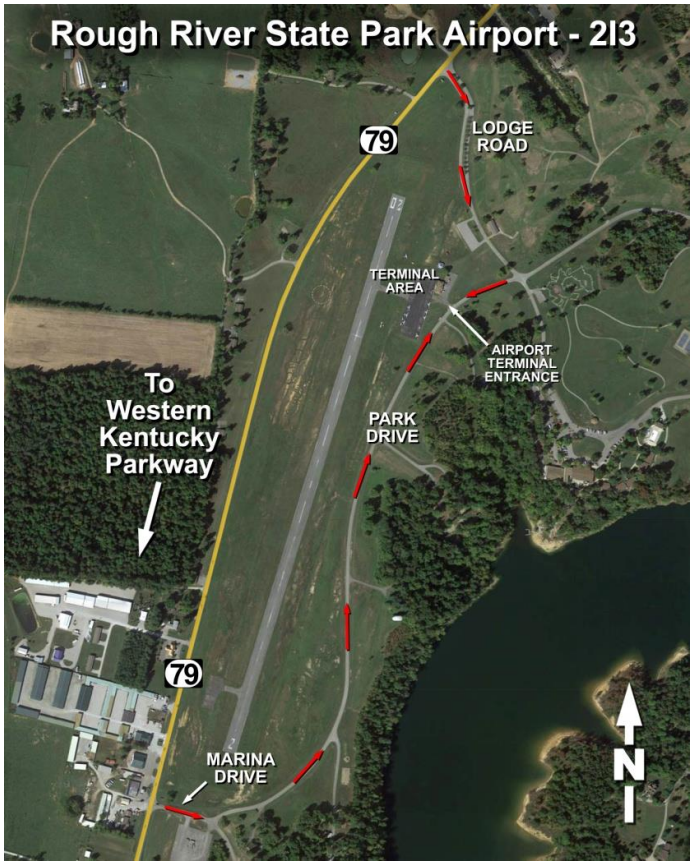
Largest Civilian Aircraft

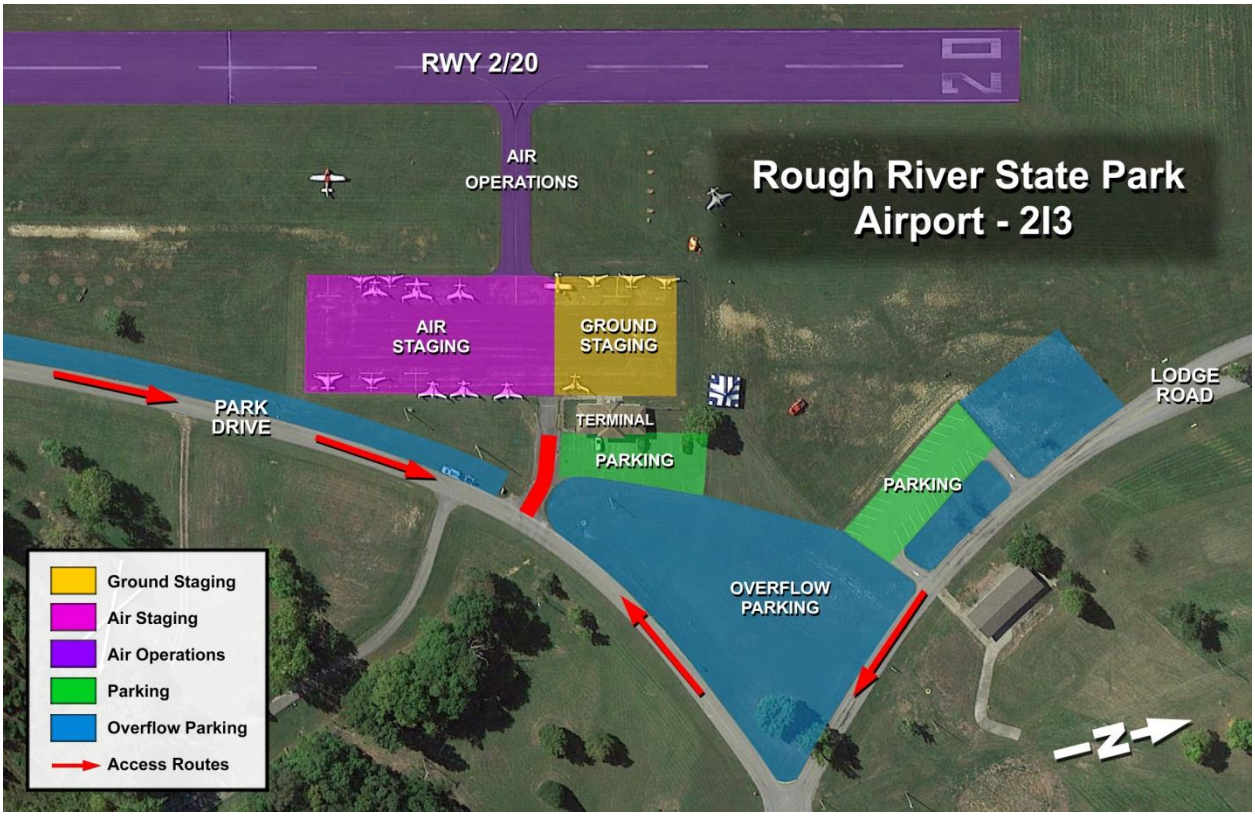
Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Park Drive to Lodge Road. Kentucky Highway 79 is 0.3 miles north on Lodge Road. State Route 79 connects with US Highway 60, 15.3 miles north, and with the Western Kentucky Parkway 15.9 miles south. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 2/20
20
AIR
OPERATIONS
Rough River State Park
Airport - 2I3
AIR
STAGING
GROUND
STAGING
PARK
DRIVE
TERMINAL
PARKING
LODGE
ROAD
PARKING
OVERFLOW
PARKING
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Russell County Airport - K24

Jamestown, Kentucky

With a paved runway 5,010 feet by 78 feet and five other alternative airports within a 30-mile radius, it is possible that Russell County Airport could be utilized for evacuation of civilians from the Jamestown area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available, but it is likely that overflow parking will be necessary on reasonably level grassy areas east of the terminal.

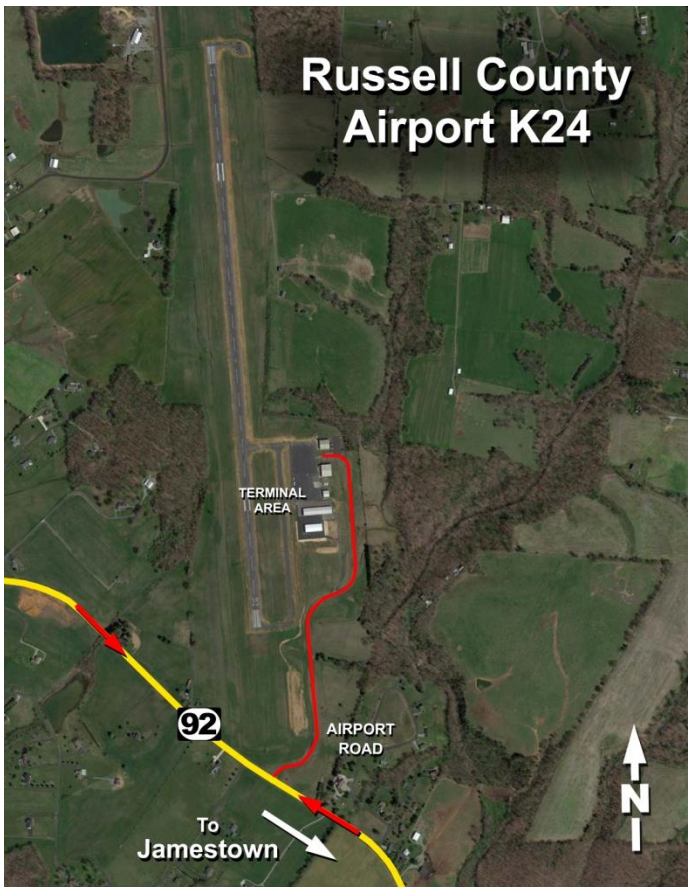
Largest Civilian Aircraft

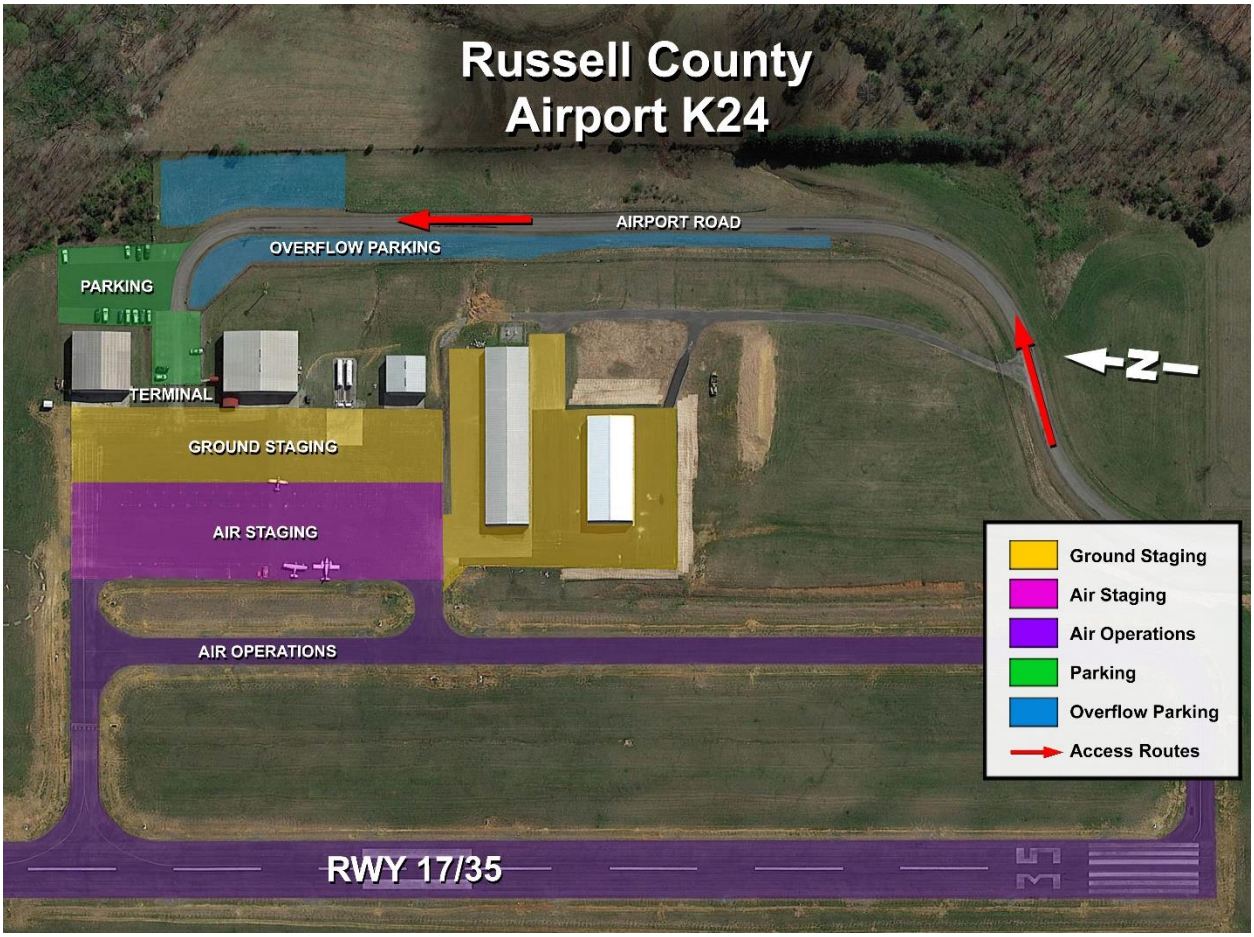
ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by C. Smith Road, which connects to Kentucky Highway 92, approximately 0.6 miles south of the Airport. State Route 92 leads to US Highway 127 approximately 1.2 miles southeast, and to the town of Jamestown approximately 2.3 miles southeast. US Highway 127 connects to the Cumberland Parkway approximately 4.1 miles north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Russell County
Airport K24
AIRPORT ROAD
OVERFLOW PARKING
PARKING
TERMINAL
GROUND STAGING
AIR STAGING
AIR OPERATIONS
RWY 17/35
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Russellville-Logan County Airport - 4M7

Russellville, Kentucky

With a paved runway 4,000 feet by 75 feet and only one alternative airport within a 30-mile radius, it is likely that Russellville-Logan County Airport would be required to serve as a base of evacuation for civilians from the area under unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Overflow parking may be accommodated on reasonably level grassy areas southeast of the terminal.

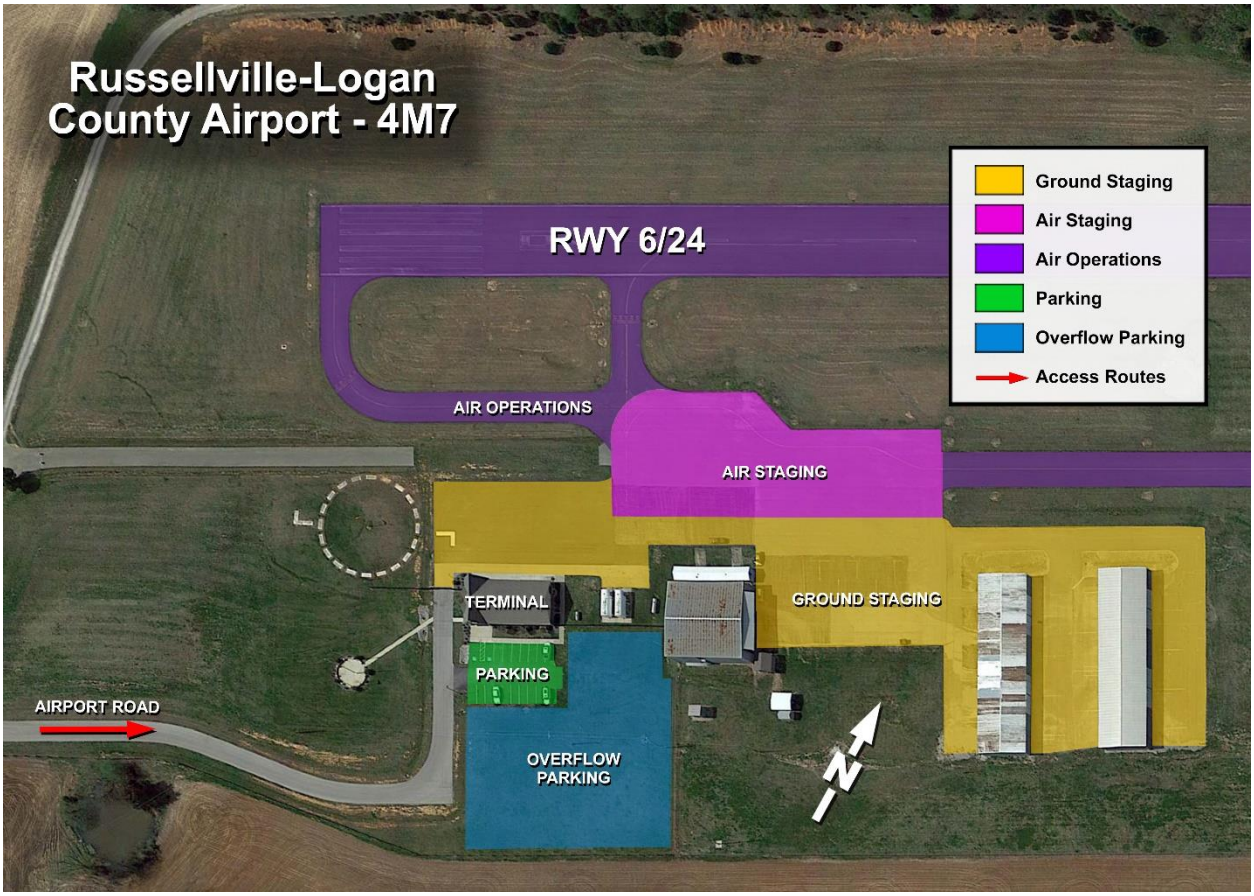
Largest Civilian Aircraft

ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Highway 100, also known as Franklin Road, 0.4 miles south of the terminal area. State Route 100 connects with US Highway 68, approximately 4.9 miles northwest of the Airport. The town of Russellville is just north of US Highway 68, approximately 5 miles northwest of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Russellville-Logan
County Airport - 4M7
RWY 6/24
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
AIR OPERATIONS
AIR STAGING
TERMINAL
GROUND STAGING
PARKING
AIRPORT ROAD
OVERFLOW
PARKING
N

Samuels Field - BRY

Bardstown, Kentucky

With a paved runway 5,003 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Samuels Field could be utilized for evacuation of civilians from the Bardstown area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport (assuming adequate runway load bearing capability) to facilitate evacuations. Paved parking is extremely limited. Additional parking would be necessary on reasonably level grassy areas east of the terminal.

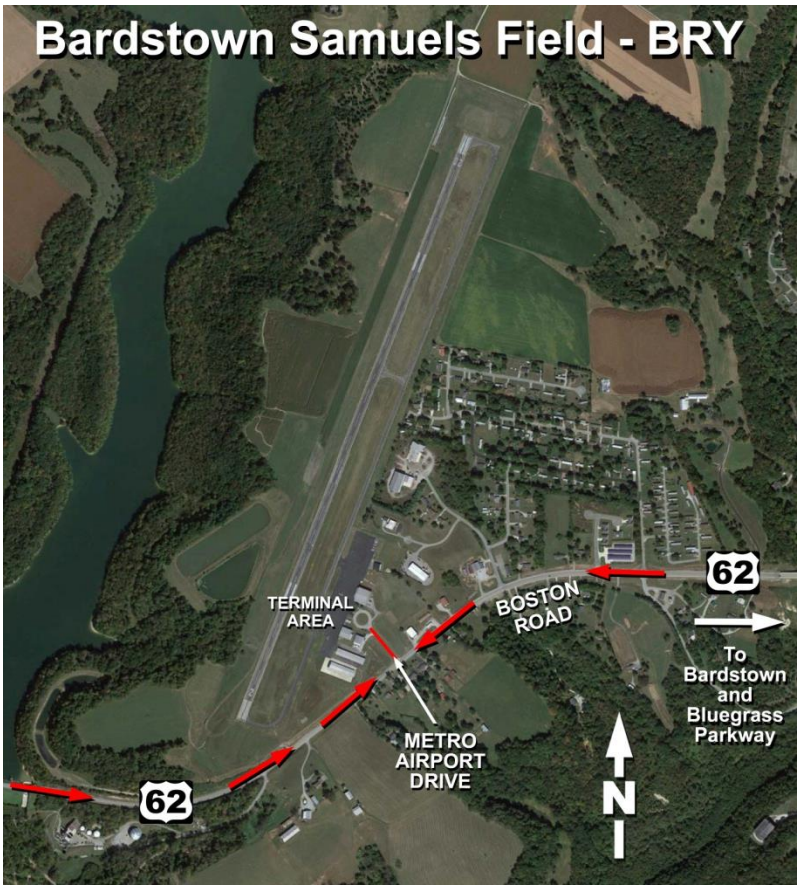
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 62, also known as Boston Road, approximately 150 yards southeast of the Airport. US Highway 62 leads to the town of Bardstown approximately 1.5 miles east of the Airport. The Bluegrass Parkway is approximately 1.8 miles south of the airport, and may be accessed via several routes. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 2/20
Bardstown
Samuels Field
BRY
AIR
OPERATIONS
AIR STAGING
TERMINAL
GROUND STAGING
PARKING
62
OVERFLOW
PARKING
METRO
AIRPORT
DRIVE
CLERMONT
DRIVE
BOSTON ROAD
62
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Stanton Airport - I50

Stanton, Kentucky

With a paved runway 2,996 feet by 70 feet and three alternative airports within a 30-mile radius, it is unlikely that Stanton Airport could be utilized for evacuation of civilians from the area except under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is at a premium. Additional overflow parking may be accommodated on reasonably level grassy areas near the terminal and hangar area. Overflow parking may require supervised areas inside the fence.

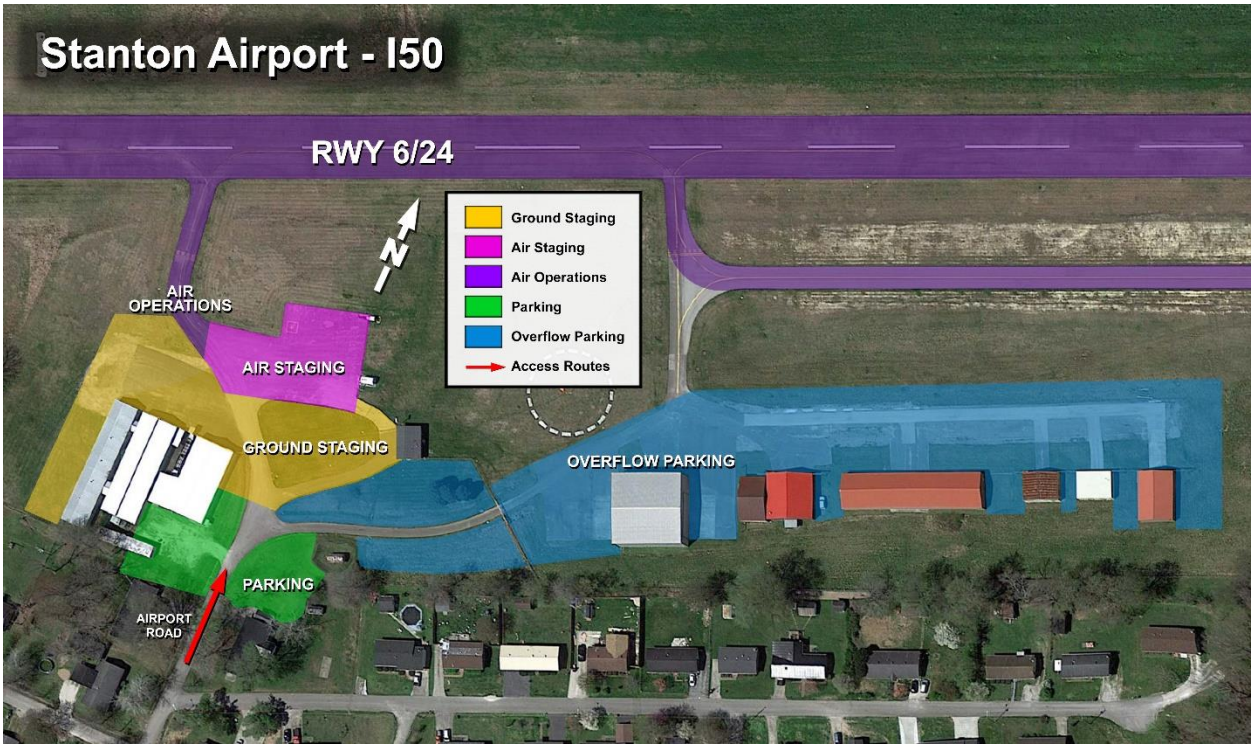
Largest Civilian Aircraft

Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to County Road 11, also known as East College Avenue, approximately one-third of a mile south of the Airport. County Road 11 leads to the town of Stanton and connects with County Road 213 approximately 0.65 miles to the west. County Road 213 connects with Mountain Parkway just south of the city of Stanton. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Stanton Airport - I50
RWY 6/24
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
AIR OPERATIONS
AIR STAGING
GROUND STAGING
OVERFLOW PARKING
PARKING
AIRPORT ROAD

Stuart Powell Field - DVK

Danville, Kentucky

With a paved primary runway 5,000 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Stuart Powell Field could be utilized for evacuation of civilians from the Danville area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available; however, overflow parking will likely be necessary on reasonably level grassy areas north of the terminal.

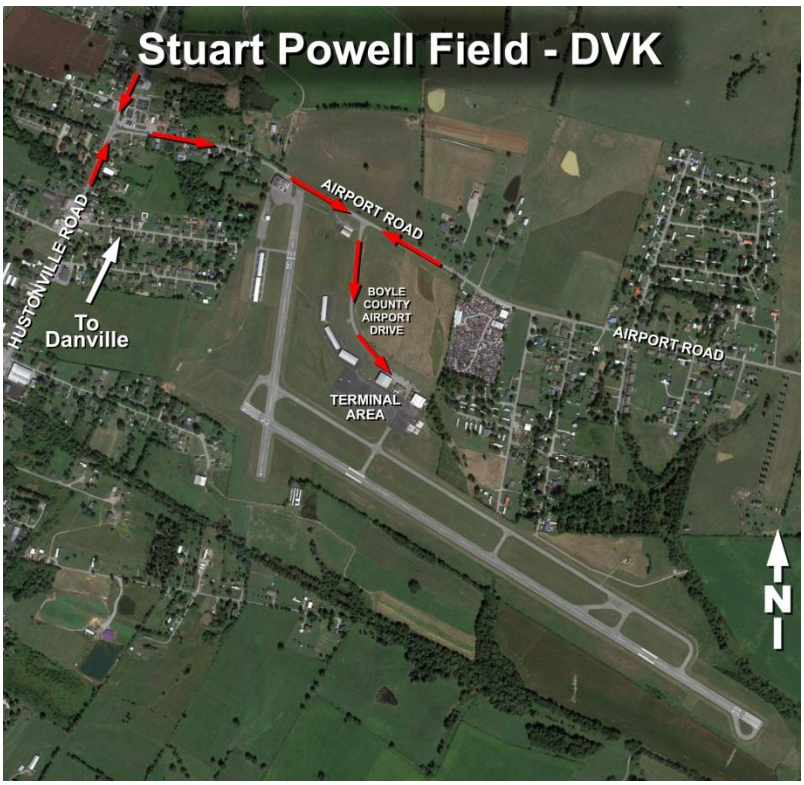
Largest Civilian Aircraft

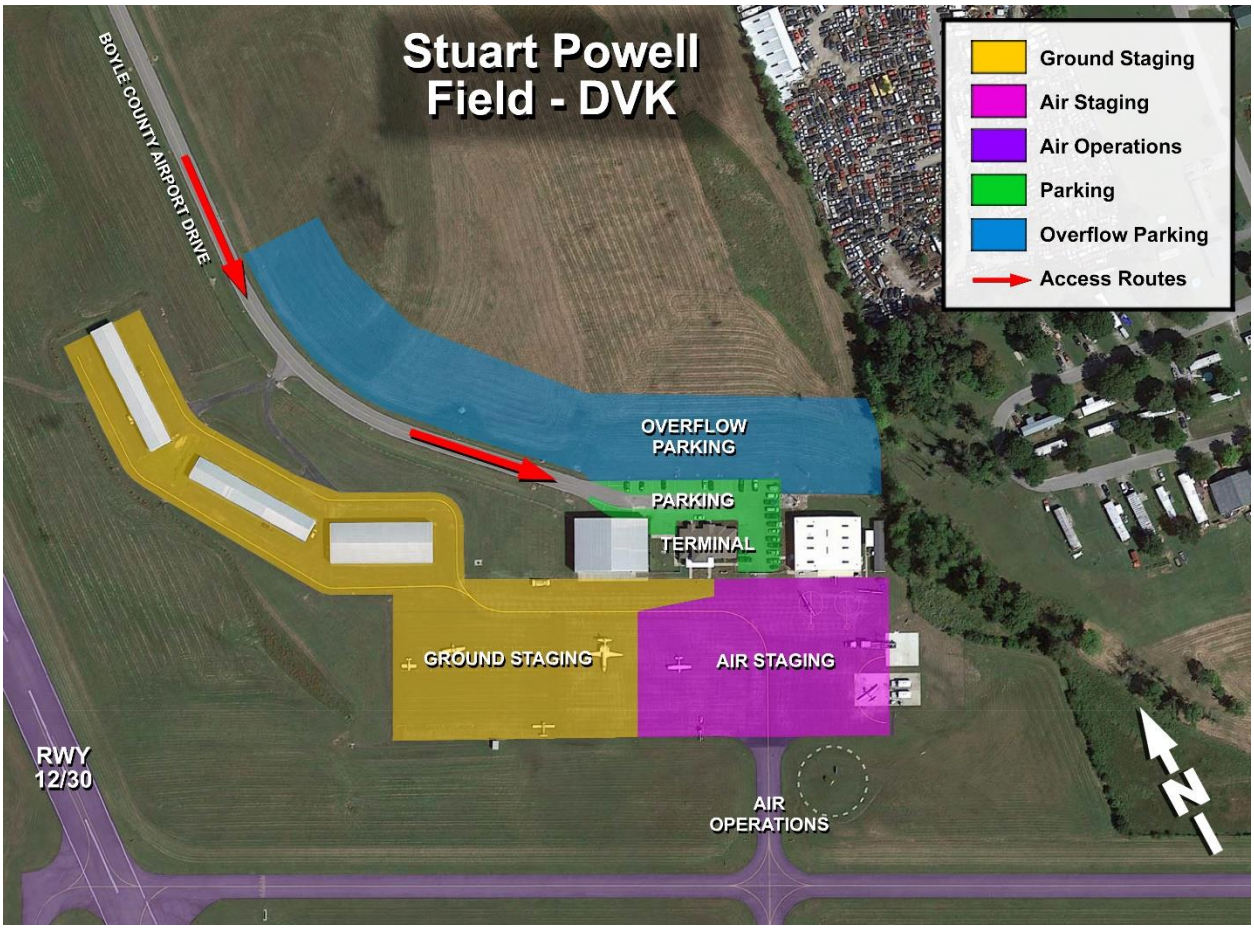
ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Boyle County Airport Drive approximately 0.4 miles to Airport Road, which connects to Hustonville Road approximately 0.5 miles northwest of the Airport. Hustonville Road connects with US Highway 127 approximately 0.8 miles northwest of the Airport. US Highway 127 leads to the town of Danville approximately 3.5 miles north. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Stuart Powell
Field - DVK
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
BOYLE COUNTY AIRPORT DRIVE
OVERFLOW
PARKING
PARKING
TERMINAL
GROUND STAGING
AIR STAGING
RWY
12/30
AIR
OPERATIONS
N

Sturgis Municipal Airport - TWT

Sturgis, Kentucky

With a paved runway 5,000 feet by 75 feet and five other alternative airports within a 30-mile radius, it is possible that Sturgis Municipal Airport could be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Overflow parking would likely be necessary on reasonably level grassy areas west of the terminal.

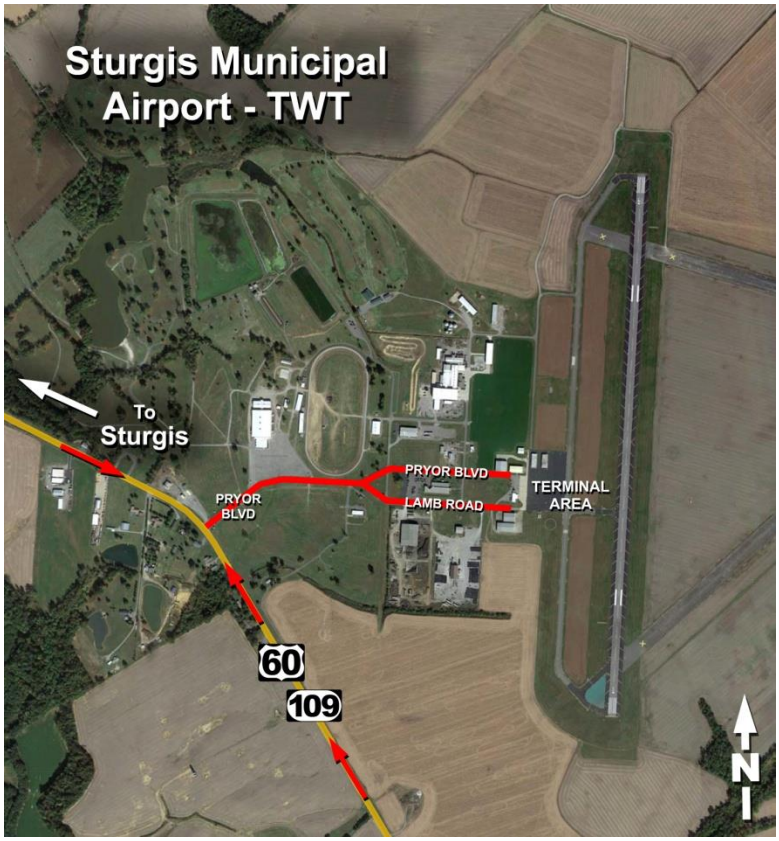
Largest Civilian Aircraft

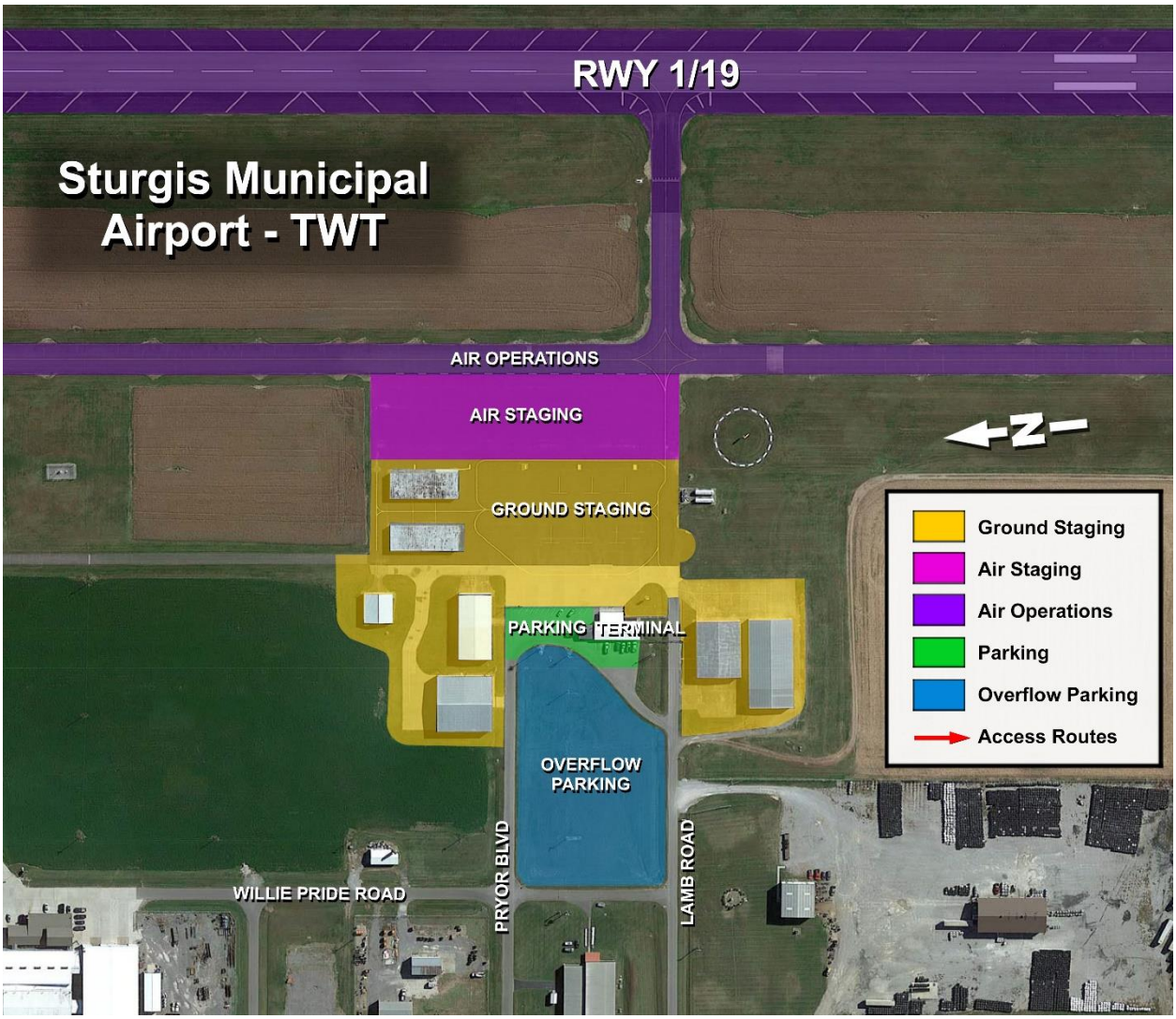
ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Lamb Road and Pryor Boulevard, which connect with US Highway 60 approximately 0.6 miles west of the Airport. One mile further west on US Highway 60 is the town of Sturgis. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 1/19
Sturgis Municipal Airport - TWT
AIR OPERATIONS
AIR STAGING
GROUND STAGING
PARKING
TERMINAL
OVERFLOW PARKING
WILLIE PRIDE ROAD
PRYOR BLVD
LAMB ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Taylor County Airport - AAS

Campbellsville, Kentucky

With a paved runway 5,003 feet by 75 feet and four other alternative airports within a 30-mile radius, it is possible that Taylor County Airport could be utilized for evacuation of civilians from the Campbellsville area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-72 (66 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available for only about 40 automobiles. Overflow parking would be necessary on reasonably level grassy areas west of the terminal.

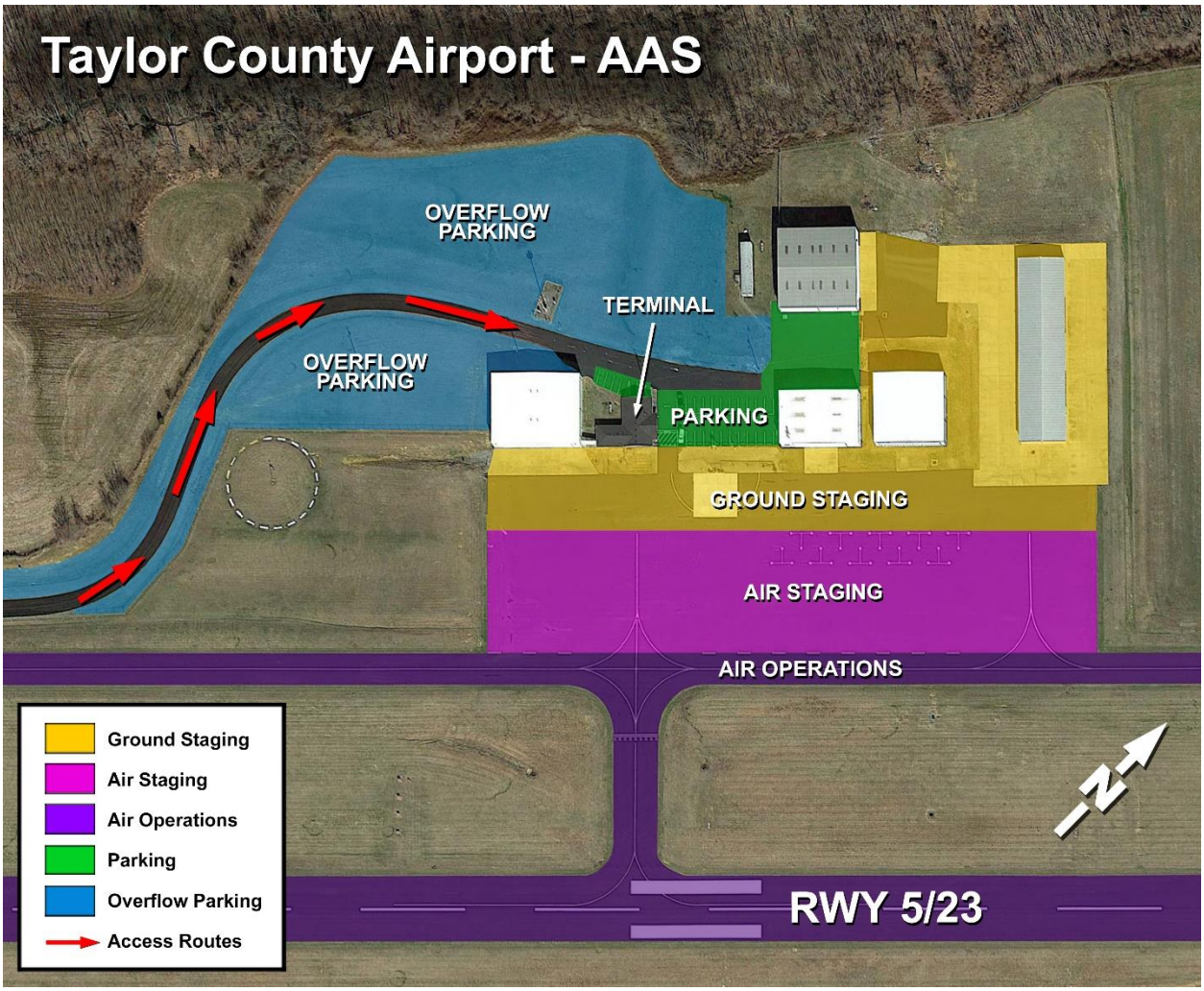
Largest Civilian Aircraft

ATR-72 (66 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to US Highway 68 approximately 0.4 miles west of the Airport. US Highway 68 leads to the town of Campbellsville approximately 1 mile southwest, and eventually to the Cumberland Parkway approximately 30 miles to the southwest. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


Taylor County Airport - AAS
OVERFLOW PARKING
TERMINAL
OVERFLOW PARKING
PARKING
GROUND STAGING
AIR STAGING
AIR OPERATIONS
RWY 5/23
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Tompkinsville-Monroe County Airport - TZV

Tompkinsville, Kentucky

With a paved runway 4,000 feet by 75 feet and two alternative airports within a 30-mile radius, Tompkinsville-Monroe County Airport could be utilized for evacuation of civilians from the area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas southwest of the terminal.

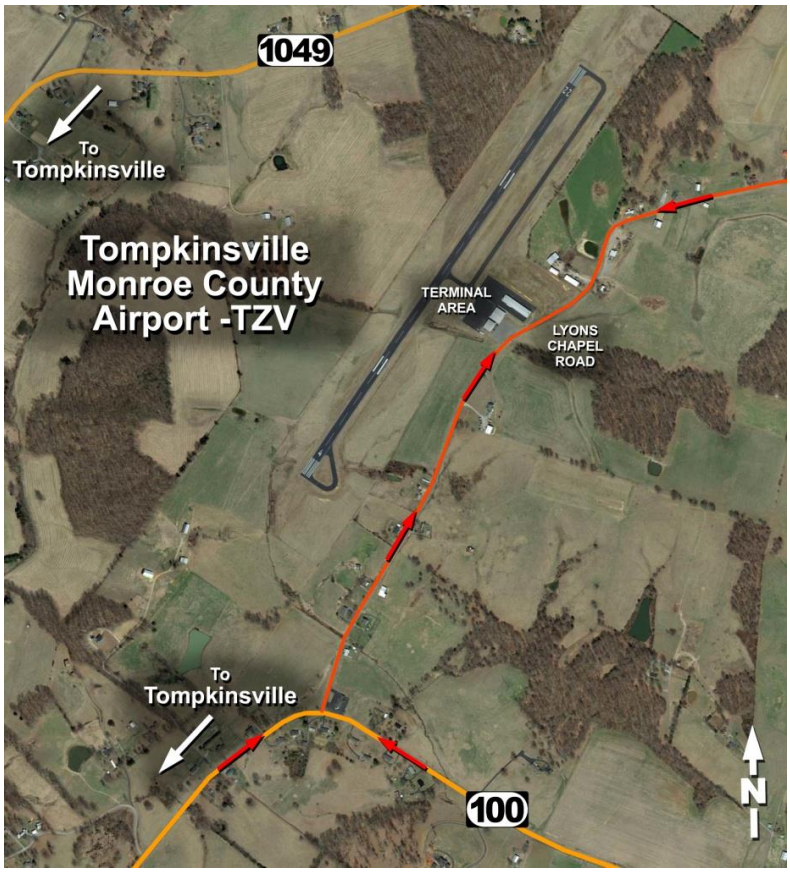
Largest Civilian Aircraft

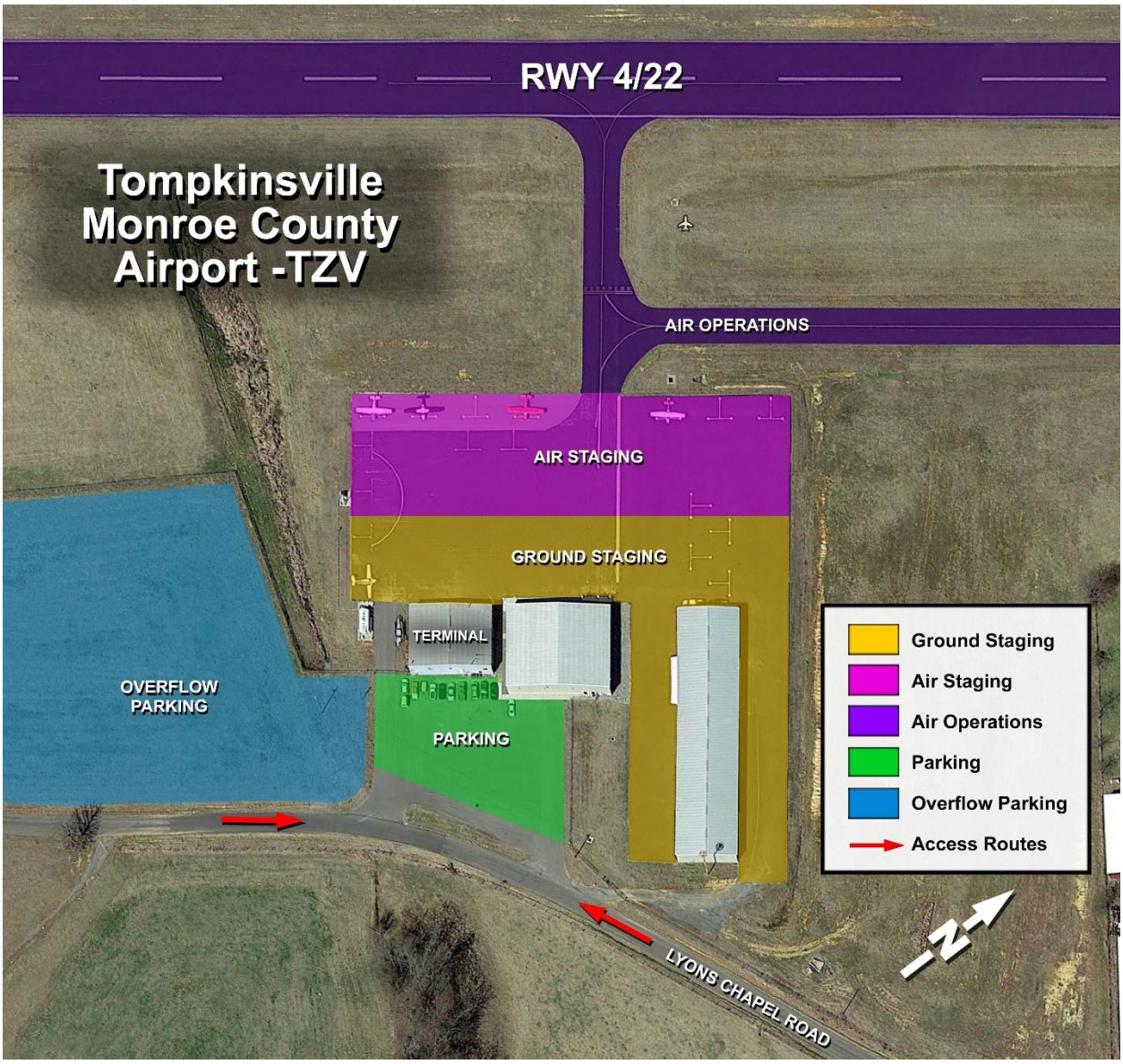
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Lyons Chapel Road, which connects to Kentucky Highway 100, also known as Center Point Road, approximately 0.7 miles south of the Airport. State Route 100 leads to the town of Tompkinsville 2.4 miles southwest of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 4/22
Tompkinsville
Monroe County
Airport -TZV
AIR OPERATIONS
AIR STAGING
GROUND STAGING
TERMINAL
OVERFLOW
PARKING
PARKING
LYONS CHAPEL ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Tradewater Airport - 8M7

Dawson Springs, Kentucky

With a turf runway of less than 2,900 feet and eight alternative airports within a 30-mile radius, it is unlikely that Tradewater Airport would be needed for a large evacuation of civilians from the Dawson Springs area under any level of threat. If, however, an earthquake or other significant disaster impaired the function of other larger airports in the region, it is possible that the facilities at Tradewater may be required. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Military VTOL (vertical takeoff and landing) aircraft and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the hangar area. Paved parking for ground transportation vehicles is virtually nonexistent. Creative use of reasonably level grassy areas near the hangar area would be required to accommodate ground transportation vehicles.

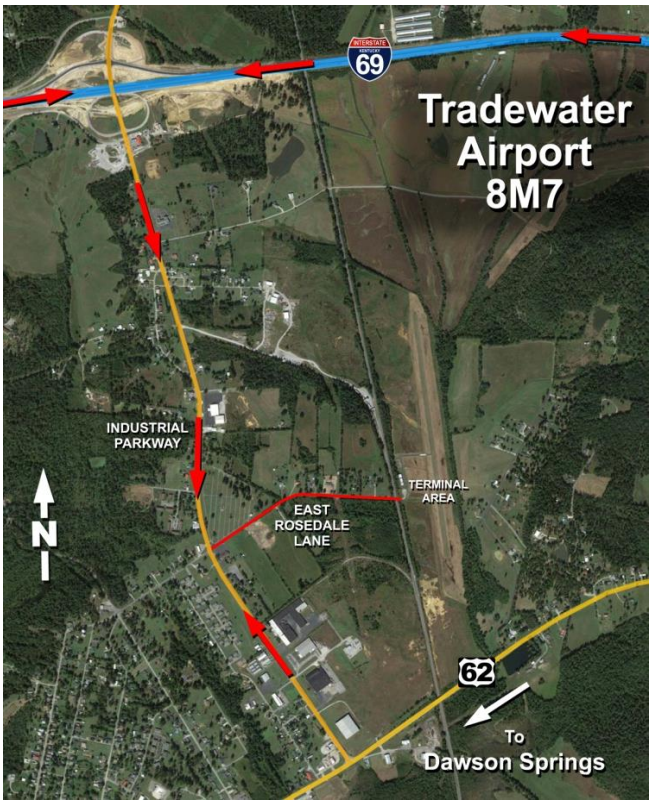
Appropriate Military Aircraft

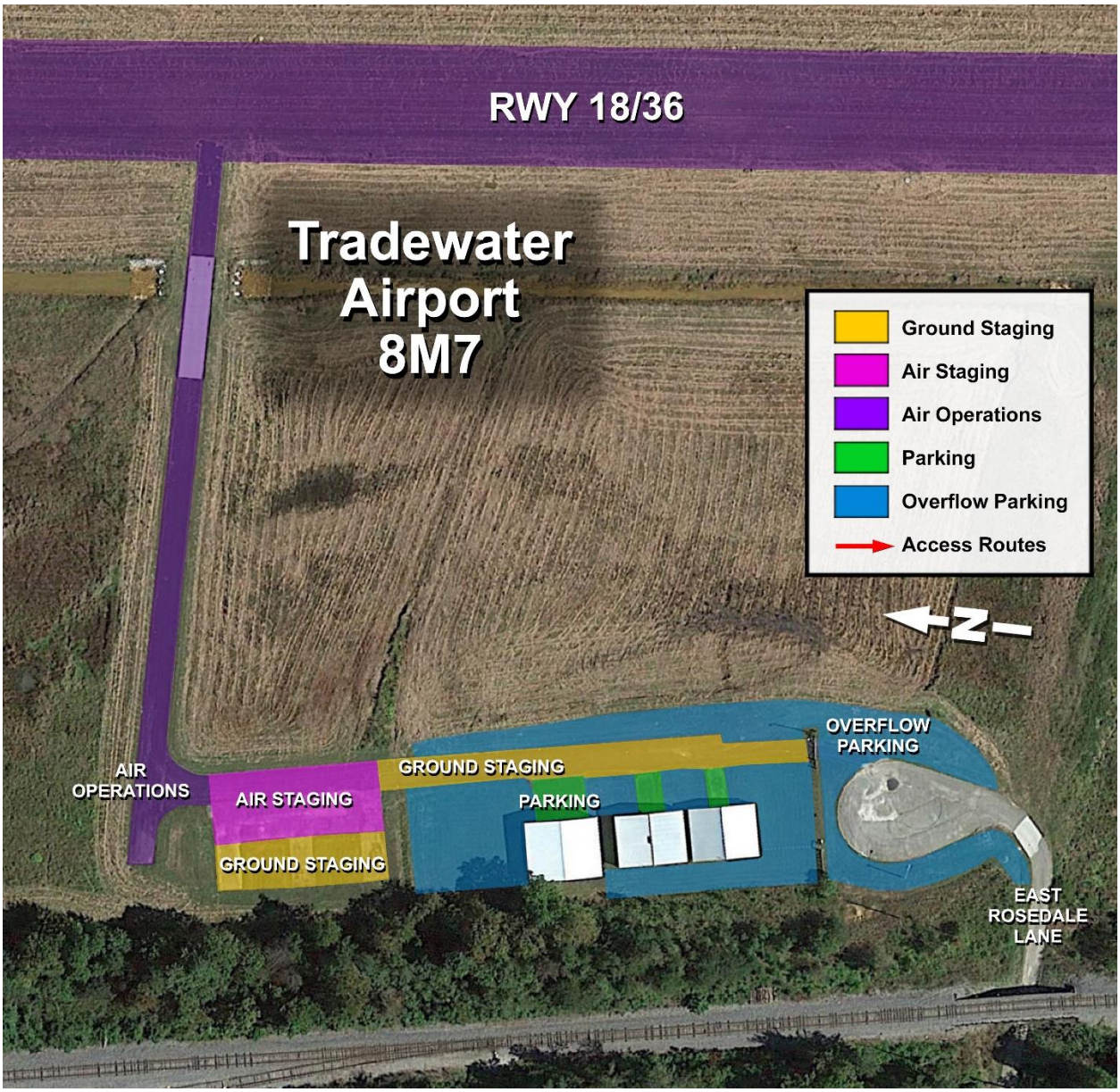
Military Osprey VTOL (24 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by East Rosedale Lane which connects to County Road 109, also known as Industrial Parkway, approximately one half of a mile west of the Airport. Industrial Parkway connects directly to the Western Kentucky Parkway/Interstate 69 approximately 1.25 miles north, and with US Highway 62 approximately 0.6 miles to the south. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 18/36
Tradewater
Airport
8M7
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
N
AIR
OPERATIONS
AIR STAGING
GROUND STAGING
GROUND STAGING
PARKING
OVERFLOW
PARKING
EAST
ROSEDALE
LANE

Tucker-Guthrie Memorial Airport - I35

Harlan, Kentucky

With a paved runway 3,460 feet by 75 feet and only one alternative airport within a 30-mile radius, it is possible that Tucker-Guthrie Memorial Airport could be utilized for evacuation of civilians from the Harlan area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. As with many small airports, paved parking is limited. It may be necessary for officials to permit overflow parking inside the gate, in the hangar area on the south side of the Airport.

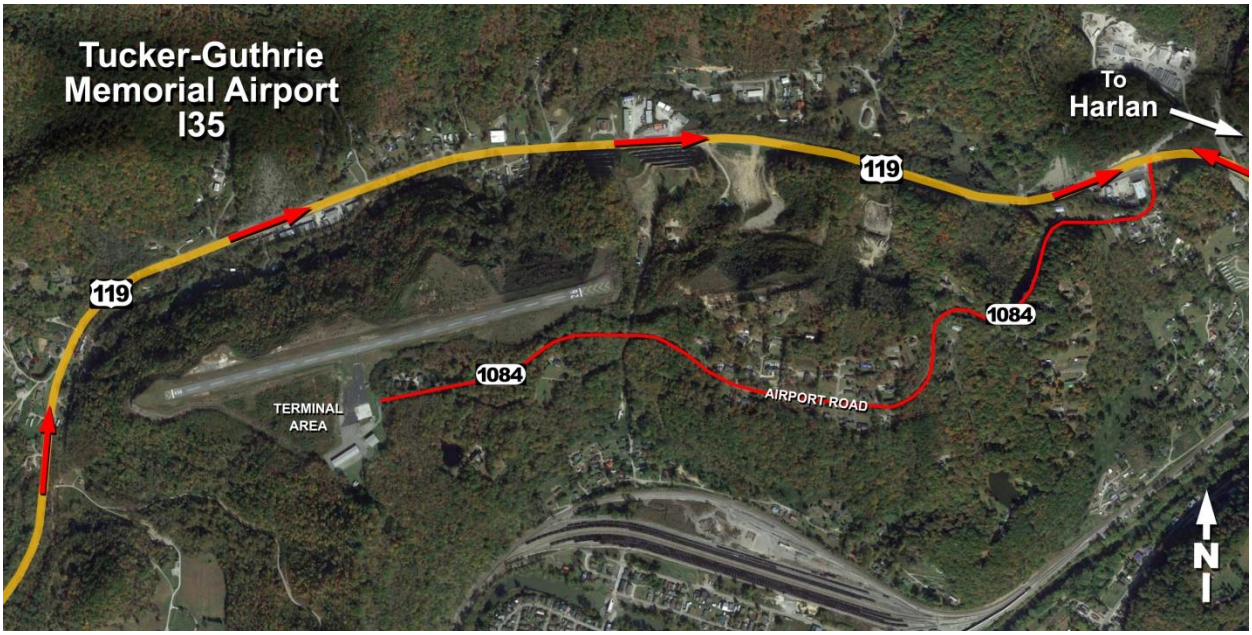
Largest Civilian Aircraft

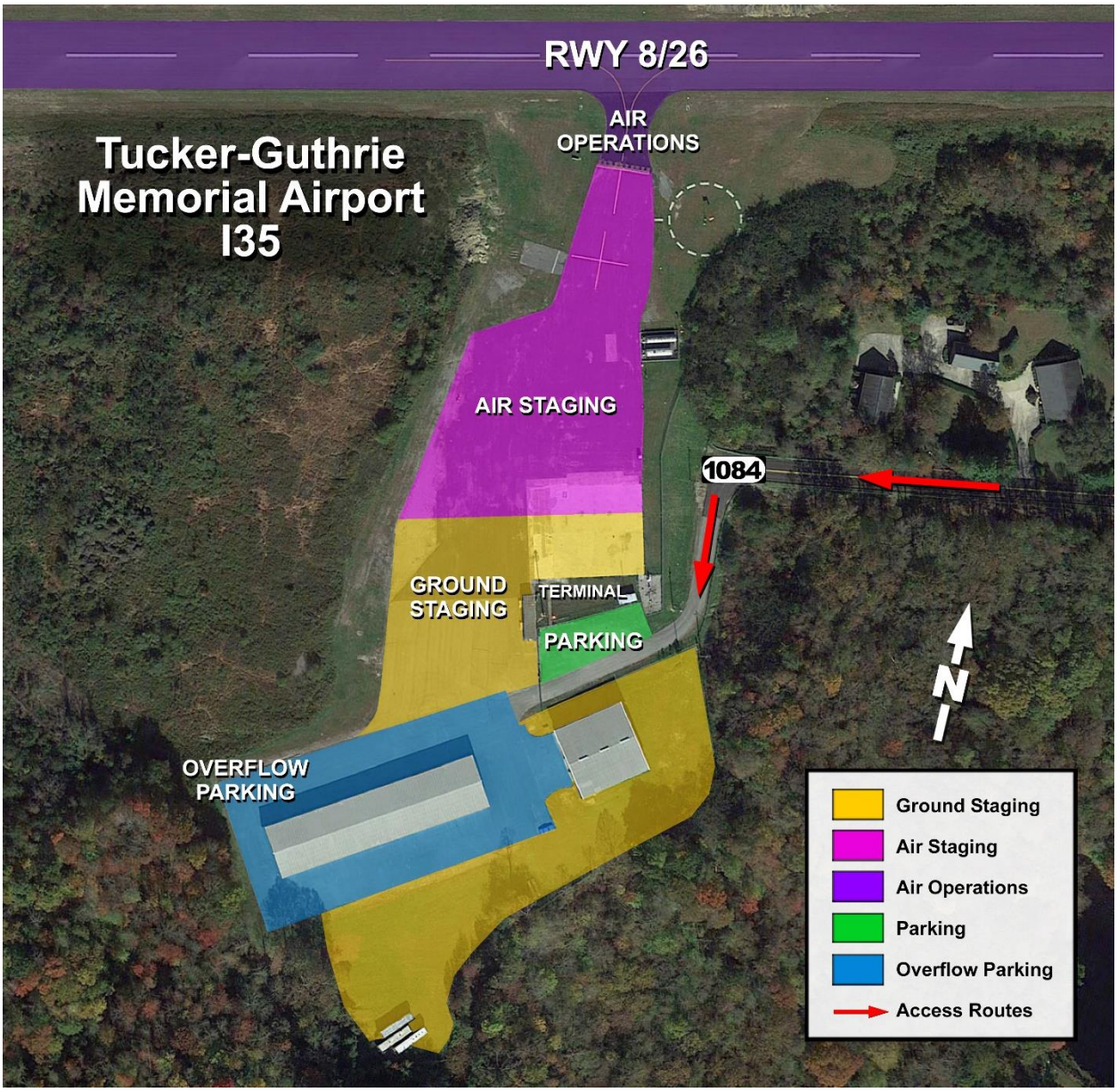
Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by County Road 1084, also known as Airport Road, which connects to US Highway 119 approximately 1.5 miles east of the Airport. US Highway 119 connects US Highway 421 approximately 0.8 miles east. One mile south on US Highway 421 is the city of Harlan. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




RWY 8/26
Tucker-Guthrie
Memorial Airport
I35
AIR
OPERATIONS
AIR STAGING
1084
GROUND
STAGING
TERMINAL
PARKING
OVERFLOW
PARKING
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Wayne County Airport - EKQ

Monticello, Kentucky

With a paved runway 4,000 feet by 75 feet and three alternative airports within a 30-mile radius, Wayne County Airport could be utilized for evacuation of civilians from the Monticello area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian ATR-42 (48 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is limited. Additional overflow parking may be accommodated on reasonably level grassy areas east of the terminal.

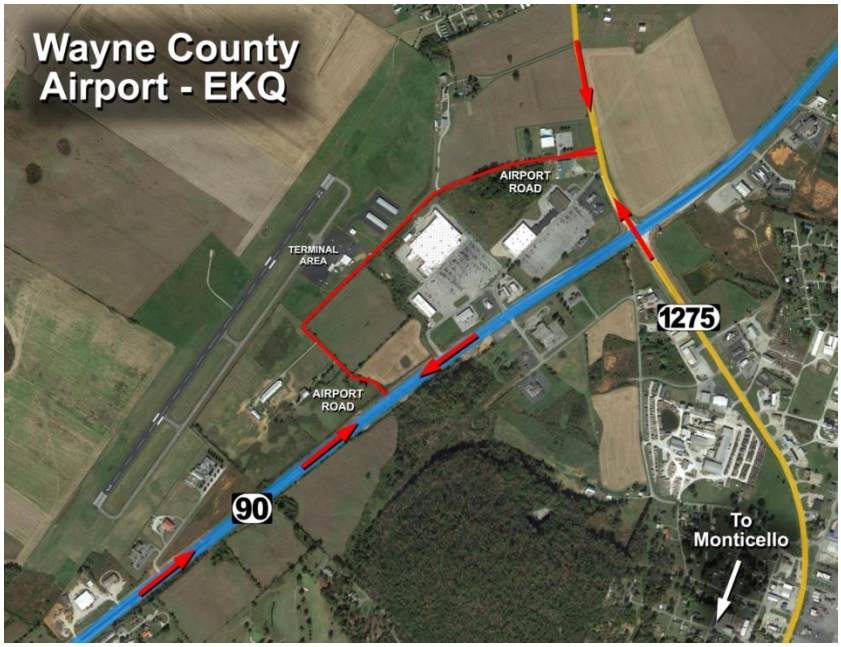
Largest Civilian Aircraft

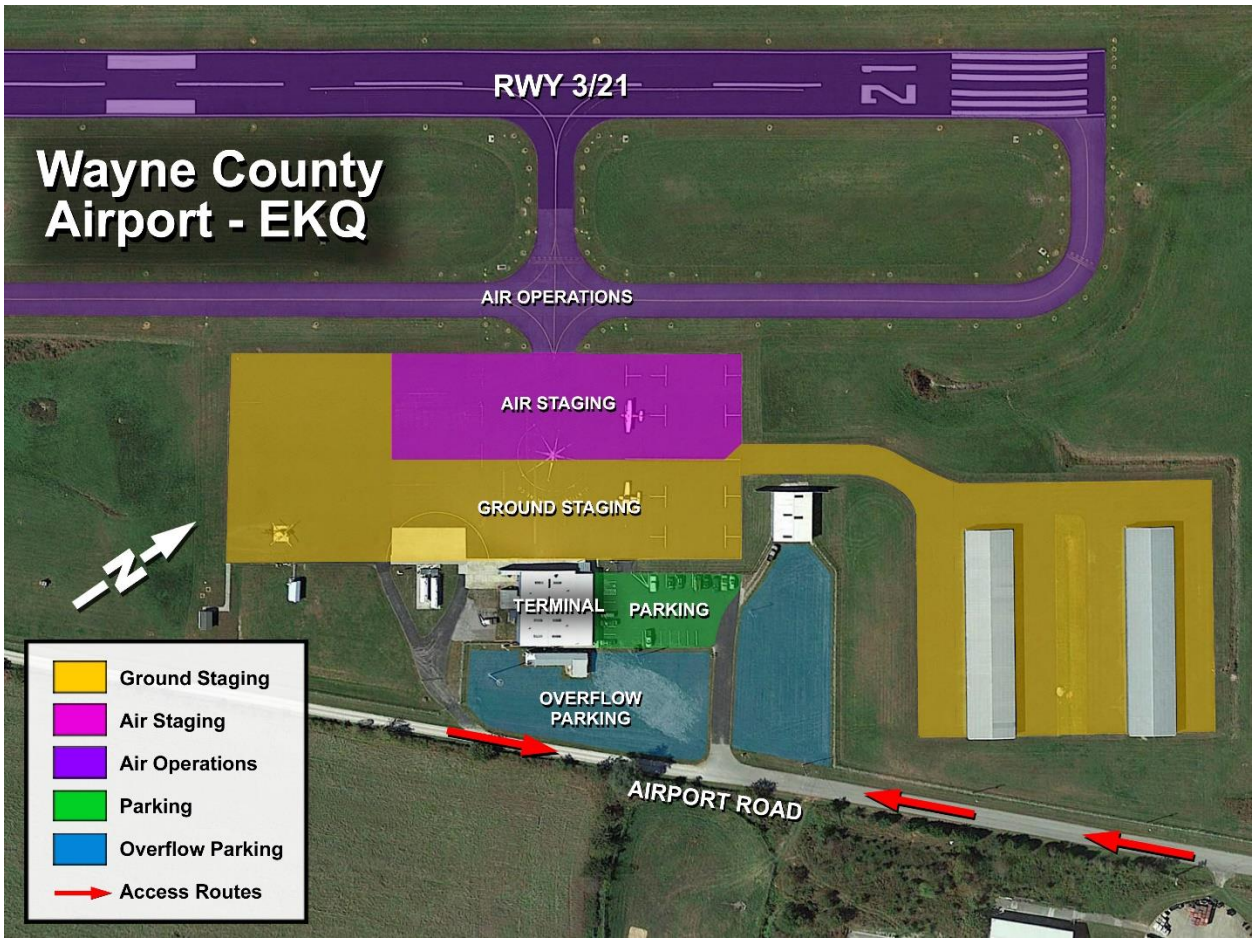
ATR-42 (48 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to both Kentucky Highway 90 and County Highway 1275. Kentucky Highway 90 leads to the town of Monticello to the south and to US Highway 27 approximately 16.5 miles northeast of the Airport. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Wayne County
Airport - EKQ
RWY 3/21
AIR OPERATIONS
AIR STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW
PARKING
AIRPORT ROAD
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

Wendell H Ford Airport - CPF

Hazard, Kentucky

With a paved runway 5,499 feet by 100 feet and only one smaller alternative airport within a 30-mile radius, it is likely that Wendell H Ford Airport would be utilized for evacuation of civilians from the Hazard area under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737–500 (122 passengers) and military Lockheed C-130 (92 passengers) could be staged from the airport (assuming adequate runway load bearing strength) to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is very limited. Overflow parking may be accommodated on reasonably level grassy areas near the terminal, and along the edges of Airport Road. Additional overflow parking may be possible inside the fence west of the terminal and hangar area.

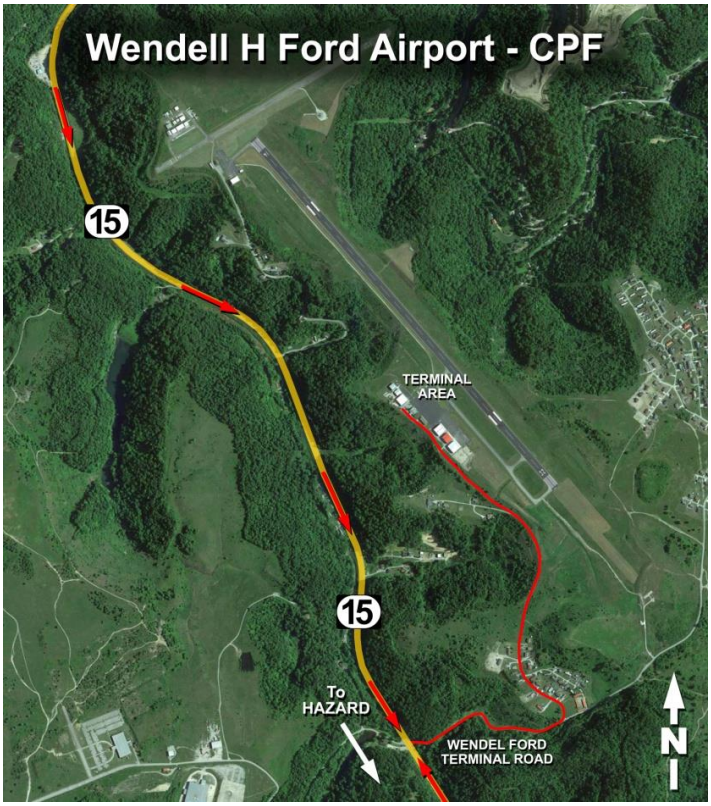
Largest Civilian Aircraft

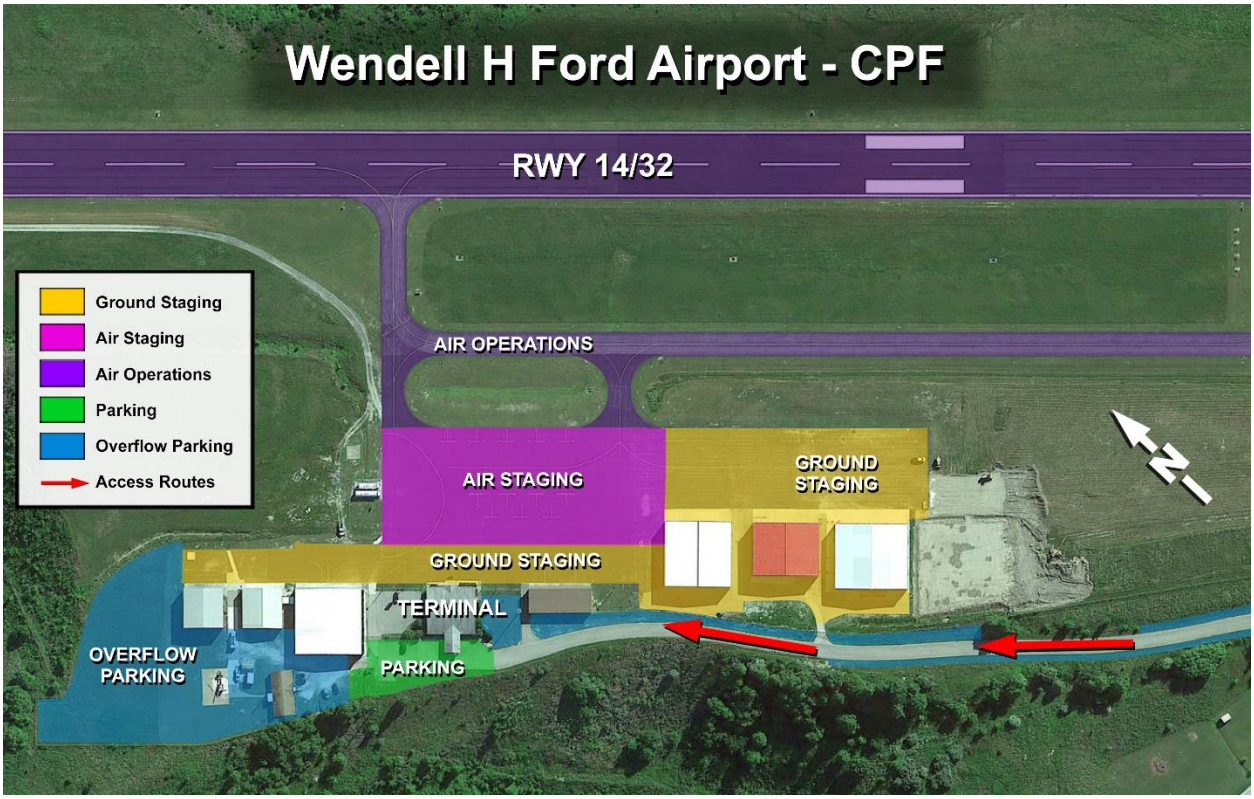
Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Airport Road, which connects to Kentucky Highway 15 approximately 0.7 miles south of the Airport. State Route 15 leads to the city of Hazard approximately 12 miles to the southeast. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Wendell H Ford Airport - CPF
RWY 14/32
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
AIR OPERATIONS
AIR STAGING
GROUND STAGING
GROUND STAGING
TERMINAL
PARKING
OVERFLOW PARKING
N

West Liberty Airport - 9I3

West Liberty, Kentucky

With a paved runway 2,400 feet by 60 feet and only two alternative airports within a 30-mile radius, it is very unlikely that West Liberty Airport could be utilized for evacuation of civilians from the area except under certain unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Pilatus PC-12 (9 passengers) and military helicopters such as the CH-47 (36 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area.

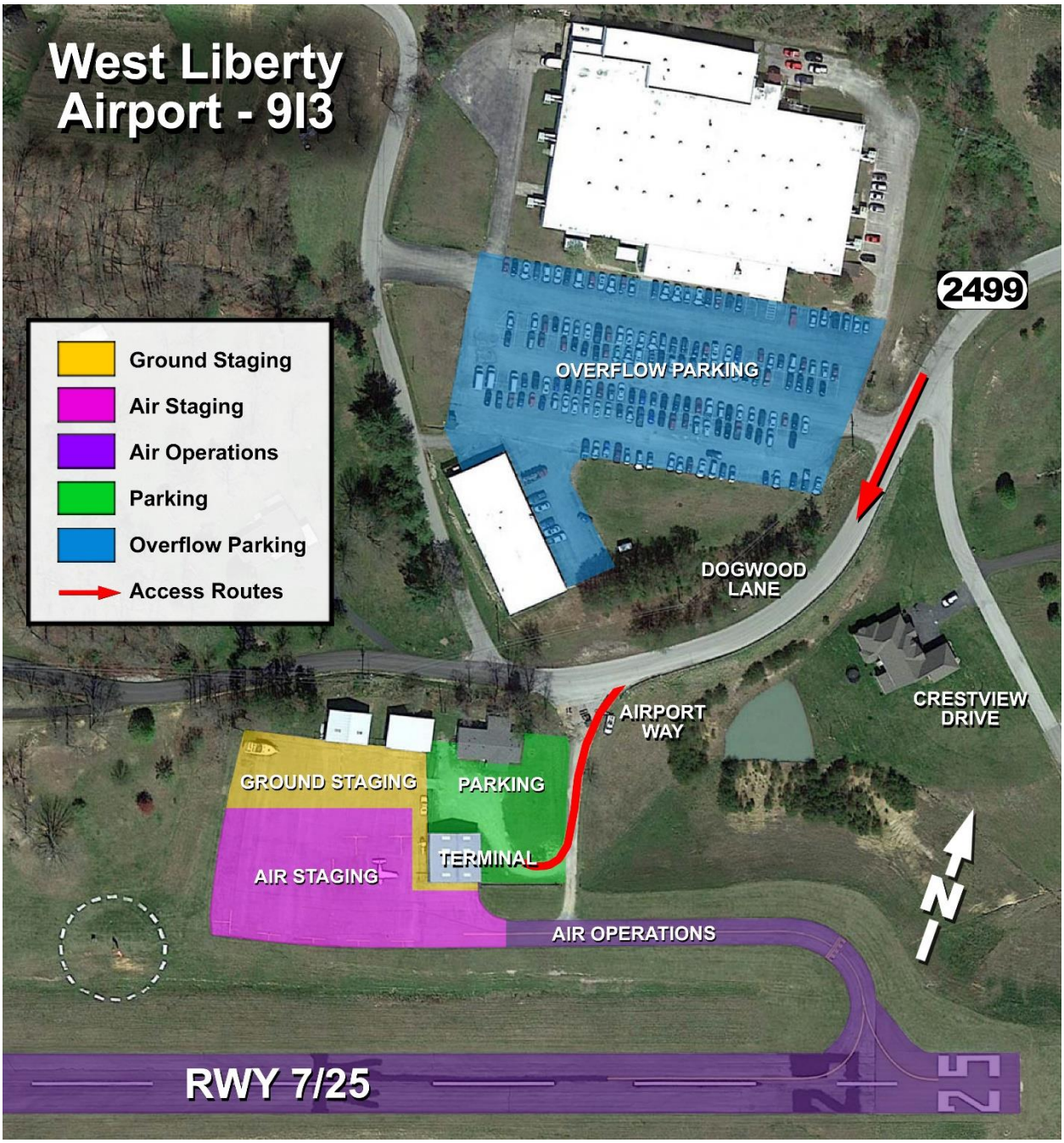
Largest Civilian Aircraft

Pilatus PC-12 (9 passengers)

Largest Military Aircraft

CH-47 (36 passengers)

Ground evacuation routes are accessed from the Airport by County Road 2499, also known as Dogwood Lane, which connects to US Highway 460 approximately one third of a mile northeast of the Airport. US Highway 460 connects State Route 7 approximately 0.9 miles to West. State Route 7 then connects with Interstate 64 approximately 25 miles northwest. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.


West Liberty Airport - 9I3
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes
OVERFLOW PARKING
2499
DOGWOOD LANE
AIRPORT WAY
CRESTVIEW DRIVE
GROUND STAGING
PARKING
TERMINAL
AIR STAGING
AIR OPERATIONS
N
RWY 7/25

Williamsburg-Whitley County- BYL

Williamsburg, Kentucky

With a paved runway 5,498 feet by 100 feet and four alternative airports within a 30-mile radius, it is likely that Williamsburg-Whitley County would be utilized for evacuation of civilians from the area in the event of unique threat conditions. The maps below show both ground evacuation routes and the potential staging areas for both evacuees and aircraft. Civilian Boeing 737-500 (122 passengers) and military aircraft such as the Lockheed C-130 (92 passengers) could be staged from the airport to facilitate evacuations within the designated air operations areas, with evacuees using ground staging near the terminal area. Paved parking is available, but the need for additional overflow parking may be accommodated on reasonably level grassy areas near the terminal and hangar areas.

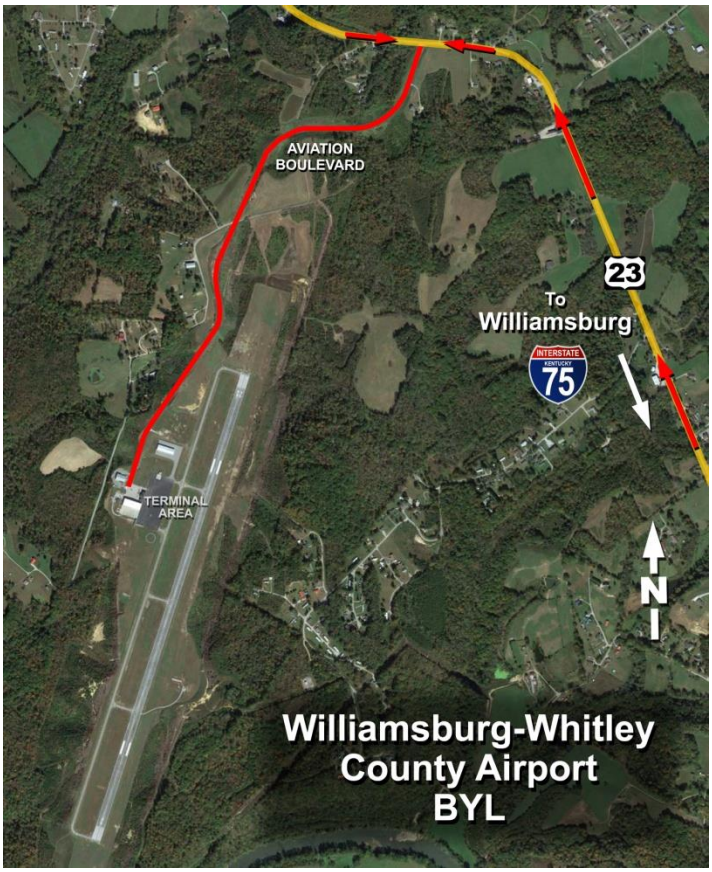
Largest Civilian Aircraft

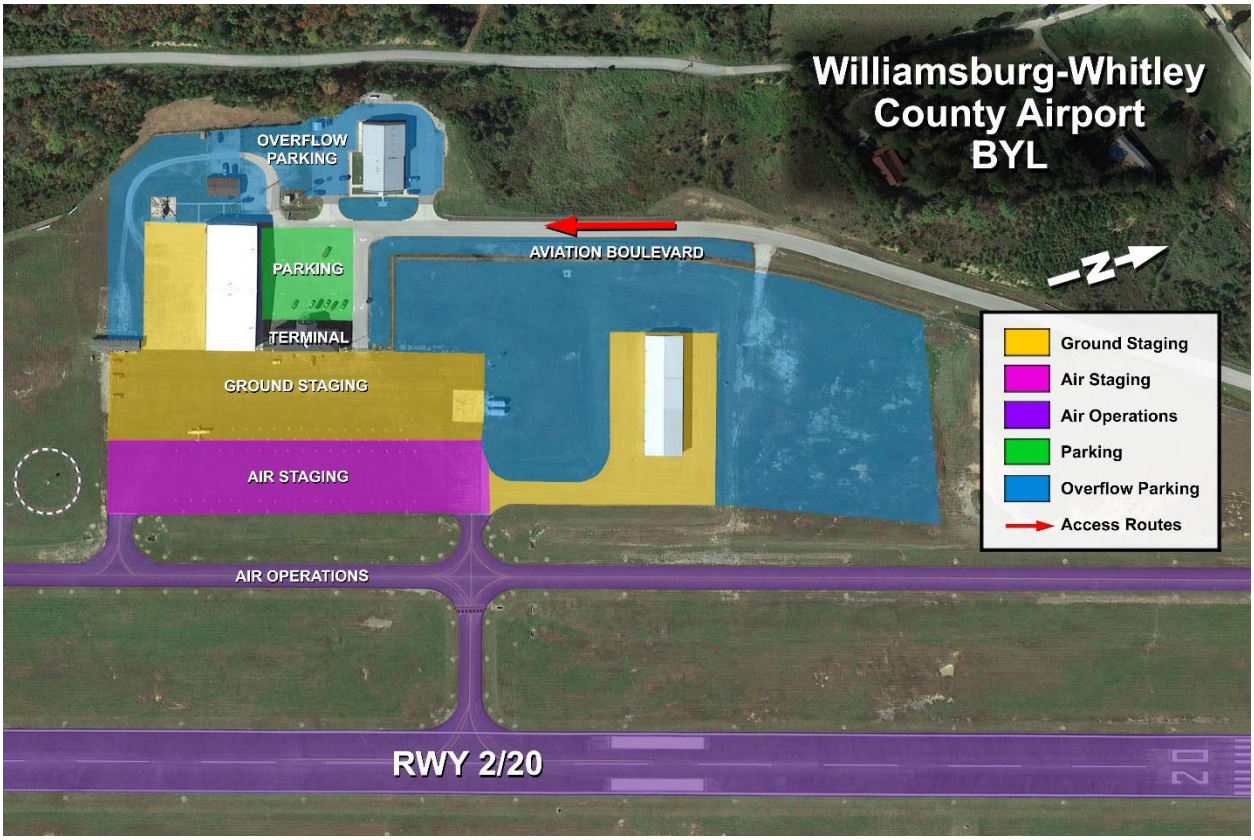
Boeing 737-500 (122 passengers)

Largest Military Aircraft

Lockheed C-130 (92 passengers)

Ground evacuation routes are accessed from the Airport by Aviation Boulevard, which connects to US Highway 25, also known as Cumberland Falls Highway, approximately 1.25 miles north of the terminal area. US Highway 25 leads to Interstate 75 about 1.9 miles east, and to the city of Williamsburg approximately 3.8 miles south. The direction of travel on these evacuation routes is contingent upon instructions from local emergency response and law enforcement officials.




Williamsburg-Whitley
County Airport
BYL
OVERFLOW
PARKING
PARKING
TERMINAL
AVIATION BOULEVARD
GROUND STAGING
AIR STAGING
AIR OPERATIONS
RWY 2/20
N
Ground Staging
Air Staging
Air Operations
Parking
Overflow Parking
Access Routes

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Kentucky Commission on Military Affairs &
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Chapter 7: Capitalizing on Military Installations

Key Findings

This chapter provides an overview of recommendations to capitalize on military installations located in Kentucky to bolster the state's Aerospace & Aviation industry. Kentucky has a wide spectrum of military assets in the state, from large, military installations such as Fort Knox, Fort Campbell, the Bluegrass Army Depot, Army National Guard Armories, and Reserve Units, to recruiting stations located throughout the state. These military assets represent an opportunity for state leadership to collectively harness resources for the economic vitality of the Aerospace & Aviation industries individually, as well as the state of Kentucky, collectively.

This chapter focuses on harnessing Kentucky's military installations for the Aerospace & Aviation industries. These recommendations include:

- Utilize the airspace of Fort Campbell and Fort Knox for Kentucky's Aerospace & Aviation industries for research, development, and testing of new technology and pilots;
- Develop mission tracking capabilities in Kentucky;
- Include military human resource, recruiting personnel, and bridge training in the Aerospace & Aviation sector consortium;
- Utilize the state's military assets as entry points for Aerospace & Aviation apprenticeships and other earn and learn opportunities;
- Explore creating a research and technological hub at Fort Knox to act as an incubator for creative technology and manufactured goods and services for the Aerospace & Aviation industries;
- Explore a communication and contracting framework within the Aerospace & Aviation industry to more effectively facilitate DoD contracting within Kentucky;
- Explore becoming a leader in crash investigations and search and rescue; and
- Explore becoming a national/regional maintenance hub for military fixed wing and rotary aircraft.

Introduction

This chapter provides recommendations to capitalize on the multiple military installations located in Kentucky. These recommendations are specifically linked to leveraging the presence of Fort Campbell, Fort Knox, and National Guard activities to further development of Aerospace & Aviation industries within the state.

Military Installation Recommendations

Within the state of Kentucky, the previously described military assets can be capitalized on to further bolster the Aerospace & Aviation industries in the state specifically, as well as the overall economic impact for the state. This chapter provides recommendations to capitalize on those assets to further the Aerospace & Aviation industry in Kentucky.

Recommendations to Further Aerospace & Aviation

Recommendation 1: Utilize Airspace for Public-Private Partnerships

On the surface, both Fort Knox and Fort Campbell offer immense opportunities for public private partnerships pertaining to the research, development, and testing of aircraft for commercial use. However, numerous military rules and regulations currently control both facilities' airspaces. Historically, commercial testing within DoD-owned airspace has been prohibited but these rules and regulations have recently been somewhat relaxed, specifically pertaining to UAV aircraft. Fort Hood, Texas has historically been used as a best practice for the utilization of airspace, and one of their two large airstrips is for public private partnerships, specifically utilized for air transportation of goods and services. Additionally, interviews with Garrison Commanders from Fort Knox and Fort Campbell revealed that exploring public private partnerships with non-military entities to more efficiently utilize military assets, such as airspace, was not ruled out. Corporate Aerospace & Aviation consortium leaders should, once demand and/or requirements have been identified by the collective consortium, explore specific public private partnerships with both installations to utilize the airspace they own and operate.

While numerous public and private installations offer access to public airspace, Fort Knox and Fort Campbell offer additional benefits to Aerospace & Aviation companies wanting to test new products. These benefits include tightly controlled facilities from a security standpoint, as well as access to unpopulated acreage, making them ideal for testing, research, and development. Additionally, with both installations owning and controlling their own airspace, ideal testing conditions can be safely monitored and controlled. With the development of an Aerospace & Aviation consortium, companies can ascertain demand for access. Once demand and/or requirements have been determined, the consortium should approach the corresponding leadership of both installations to explore the establishment of a public private partnership for the utilization of each installation's airspace. While Fort Campbell's airspace currently is more populated, Fort Knox's airspace capacity represents tremendous opportunity.

Finally, through these partnerships, a workforce component can be derived through training for Aerospace & Aviation-specific careers. Both Fort Knox and Fort Campbell represent the perfect area to train fixed wing and helicopter pilots, UAV operators, air traffic controllers, aviation and crash rescue, material handling/ground operations, mechanics, and others. With Fort Campbell representing the

highest talent pool of helicopter pilots in the world, utilizing this expertise for training would prove valuable. Additionally, with the UAV and drone technology market growing, many postsecondary institutions are looking at establishing operator programs under the mandate of the FAA. Finally, air traffic controllers, ground operations personnel such as fueling and material handling personnel are always in need and represent well paying, highly skilled career positions.

Recommendation 2: Develop Mission Tracking Capabilities

The State of Kentucky has been on the leading edge of the recent trend to commercialize outer space. From private companies such as Space Tango in Lexington, KY to satellite technologies being developed at Morehead State University, Kentucky researchers, engineers, and scientists have been well represented in the growing industry. Ten years ago, only federal governments possessed the ambition, fiscal resources, and available assets to launch, track, and control space vehicles. Today, with the commercialization of space, private companies are entering this realm with mission control capabilities. Given Kentucky's Fort Knox and Fort Campbell military installations, as well as its geographic location and weather, the state would be well suited for mission tracking and control services.

Acting in concert with the previous recommendation, a consortium of Aerospace providers should be established to ascertain the demand for these services. Once fully vetted, consortium leadership should approach the appropriate personnel at both installations to explore public private partnerships for the mission tracking and control of space vehicles.

Recommendation 3: Include Military Human Resources and Recruiting Personnel in the Aerospace & Aviation Sector Consortium

With the creation of a specific Aerospace & Aviation sector consortium to evaluate numerous issues surrounding the cluster, leadership must ensure human resources and recruiting personnel are included in conversations on workforce issues pertaining to the cluster. With the number one issue of concern for Aerospace & Aviation companies revolving around the availability of qualified talent, these individuals will ensure the military and its deep pool of well-trained and educated talent is represented in the form of both military retirees and veterans/transitioning military.

Military human resources and recruiting personnel members of the Aerospace & Aviation consortium can help connect consortium members to retiring and transitioning members of the military. Veterans represent enormous potential for available workforce for Aerospace & Aviation companies in Kentucky. Veterans may possess specific, high-tech skills and experience needed for occupations such as aviation mechanics, air traffic controllers, pilots, and aviation meteorologists. Further, veterans represent a broader pool of talent due to typically having above average soft skills, leadership training, and other highly sought-after attributes. As such, Kentucky's military installations can immediately contribute to any company's workforce and should be tapped.

In addition to veterans leaving the military, another statewide access point to top quality talent is represented in recruiting stations for all branches of the military/guard and reserve. Today, only one in three potential recruits make it into their selected branch of the military. These individuals could be denied for a myriad of reasons, including health and age. Aerospace & Aviation consortium leadership must align their workforce needs with the military recruiting apparatus in Kentucky. Recruits who are not selected for their respective military branches should be directed to the Aerospace & Aviation industry

consortium members who are employers in the industry. ROTC entities should also be considered. Additionally, ensuring workforce needs of the Aerospace and Aviation industry are conveyed to recruiting personnel will ensure a more proactive transition or bridge component to the sector. Those that are not eligible for service can then be provided with information on open and available positons within the sector. Currently, the military is implementing these bridge strategies into other sectors and can easily transition into the Aerospace and Aviation sector.

Huntsville, Alabama provides strong evidence for the value of utilizing military assets to recruit a qualified workforce for the Aerospace & Aviation cluster. With a dedicated focus on research and recruitment of talent for the Aerospace & Aviation sectors, Huntsville has gone from a small rural community to a magnet of talent for Aerospace & Aviation. These talent attraction and retention efforts have resulted in the addition of Aerospace & Aviation businesses and industries that have transformed the community.

Recommendation 4: Create and Promote Apprenticeships and Related Programs, Focusing on Military Installations in the State

Similar to Recommendation 3, Kentucky should create and promote apprenticeships and other earn and learn opportunities to companies in the Aerospace & Aviation industry, with efficient access and entry points emanating from military installations within the state. Apprenticeship training has been demonstrated to be an effective answer for business and industry looking for a well-trained and secure workforce and in September 2016, the Kentucky Labor Cabinet formed the Division of Apprenticeship as part of the "Kentucky Trained. Kentucky Built." initiative. New efforts and resources (including coordinators) will be devoted to providing technical and marketing expertise with the aim of growing the role of registered apprenticeships in the state.

Transitioning soldiers and veterans from Kentucky's military installations represent a higher-skill pool with pre-developed soft skills that should expedite any training or apprenticeship model. Utilizing military installations across the state as entry points into apprenticeships and similar opportunities will enhance these programs, ultimately providing a higher quality workforce for Aerospace & Aviation companies across Kentucky. In addition to transitioning military members, Kentucky should explore attracting military veterans currently residing in other states for the same benefits as stated above.

To more effectively facilitate this career ladder into apprenticeships, Kentucky should consider aligning its programs with the Department of Defense SkillBridge concept. SkillBridge focuses on transitioning service members into civilian jobs utilizing skills and abilities that transfer well from a soldier's MOS to a given civilian job. By easing this transition, apprenticeship recruitment is streamlined by efficiently identifying talent and the subsequent civilian career field. Additionally, by aligning with the DoD SkillBridge, Kentucky will be perceived as more military-friendly than those states that do not align.

Veteran's Apprenticeship Pilot

TPMA recommends the state of Kentucky explore a pilot program built around this recommendation. Below are expected priorities for this pilot and funding expectations.

Priorities for the Pilot

This effort is a high priority for a pilot effort both to meet the needs of veterans in the state as well as filling the talent needs for regional firms.

1. Kentucky Labor Cabinet, Division of Apprenticeship should work with a sub-group of defense suppliers that ideally should be drawn from the Defense Consortium to identify high priority apprenticeship needs and partners.
2. Identify advisors and support services, in addition to the Division of Apprenticeship that can assist these suppliers to develop and implement their apprenticeship activities.
3. Apply for grant funding to support the Apprenticeship program.

Funding for the Pilot

Initial funding of $75,000 would support the planning and development of this targeted apprenticeship program, as well as support at least a part-time grants writer to develop funding for implementation. The planning phase will develop a formal budget, but similar programs in other states range from $1 to $1.5 million to operate. Some funding may be available from an existing Apprenticeship USA grant for Kentucky.

Recommendation 5: Explore the Creation of a Research and Technological Hub at Fort Knox

With additional land available at Fort Knox, Kentucky should explore the creation of a technological hub to act as an incubator for creative technology and manufactured goods and services. Similar to the Polytechnic Campus at Arizona State University (formerly Williams Air Force Base), this technological hub could facilitate the commercialization of several regional university research and development initiatives. With one in five Aerospace & Aviation industry companies located in Louisville/Jefferson County, Kentucky, Fort Knox would represent an ideal location for this research and technological hub.

Project interviews with researchers at Kentucky's universities and other qualitative inputs suggest there is not an established framework for moving from research to commercialized product. The Kentucky Innovation Network and the Innovation and Commercialization Center under the Kentucky Science and Technology Corporation are somewhat engaged in this effort. However, Kentucky lags when comparing the pipeline of technology transfer from universities to the market. A best practice is to create an affiliated, non-profit corporation that handles this bureaucratic burden, such as the Polytechnic Campus at Arizona State University or CalCharge, a partnership between Berkley Lab and the California Clean Energy Fund, which connects California's battery technology cluster with the university and government researchers who are developing new innovations. At the innovation center, an individual with an idea could receive assistance with prototyping, patent, fundraising, and additional research complimenting the efforts towards manufacturing their idea. All public universities could potentially provide assistance with each specializing in a unique field, such as prototyping or legal assistance.

An innovation center would necessarily be connected to the research consortium recommended in Chapter 8 of this study. Ideally, the affiliated non-profit that would run the innovation center would assume the administrative task of convening the research consortium and implementing its ideas. The board of the affiliated non-profit should also include members of major private companies in the Aerospace industry, including Boeing and Amazon, as well as other smaller entities, such as SpaceTango.

Additionally, non-profit and governmental entities should be involved. This engagement between all three sectors would create communication, as well as a network of support for this fledgling industry.

Fort Knox Research and Technology Hub Pilot

TPMA recommends the state of Kentucky explore a pilot program built around this recommendation. Below are expected priorities for this pilot and funding expectations.

Priorities for the Pilot

1. Confirm ability to create a Research and Technology Hub at Fort Knox.
2. Determine ability of KSTC or other entity to manage this activity; if not, create an independent nonprofit that may include these partners.
3. Set up a benchmarking trip / tour of at least three model sites
4. Develop a budget and site plan

Funding for the Pilot

Initial funding of $75,000 would support a feasibility assessment and site selection support for the Research and Technology Hub at Fort Knox. This may include some of the expenses for the benchmarking tours.

Recommendation 6: Explore a Communications and Contracting Framework to Facilitate Defense Contracting

Given Kentucky's significant military presence within the state, consisting of installations such as Fort Knox, Fort Campbell, the Bluegrass Army Depot, and others, state leadership should facilitate more efficient lines of communication and contracting between the state's Aerospace & Aviation companies and these military assets. The Kentucky Aerospace & Aviation consortium should ensure representatives from these installations are included in the eventual consortium and emphasize training for contracting.

There are over 5,000 companies with registered CAGE codes but 400 to 600 are awarded contracts each year. This clearly indicates a need for training for potential contractors to access and filter DoD solicitations. While the KY PTAC organization provides a rudimentary service, more robust software systems exist for identification and filtering of the roughly 2,500 DoD solicitations issued daily.

Additionally, the consortium should work with the state's innovation centers to facilitate the governmental contracting process. Kentucky should work with the defense and Aerospace suppliers to address sector-wide, sector-specific challenges that Aerospace manufacturers are facing with regard to procurement; specific initiatives could then be crafted to get Kentucky suppliers certified or up to speed.

An increasing number of OEMs have preferred supplier/long-term supply programs, such as the United Technologies UTC Supplier Gold program, Boeing's Partnership for Success, and Lockheed Martin's Supplier Excellence Program. In addition, there are industry-wide supplier certifications, like Nadcap accreditation. Once the highest-value programs and certifications have been established, strategic assistance could be given to manufacturers in the relevant supply chains to make it easier for Kentucky Aerospace manufacturers to apply to a program or to successfully pass an audit.

Recommendation 7: Explore Becoming a Leader in Crash Investigation and Search and Rescue

Given Kentucky's Aerospace & Aviation assets, the state should explore becoming a world leader in crash investigation and search and rescue. With the airspace associated with Fort Knox, Eastern Kentucky University's focus on commercial pilot training, Fort Campbell's renowned special operations pilots, and Murray State University's focus on flight simulators, components are in place for Kentucky to excel in this field. Additionally, research and development into new best practices and equipment could be harnessed by Kentucky's universities to better help investigators, first responders, and others with crash investigations. Kentucky should explore identifying and recruiting Task Force 160 Special Forces pilots, consistently known as the best of the best and can fly in all conditions, to capitalize on their expertise to further enhance simulators and crash investigations. While crash scene investigations are normally attributed to the National Transportation Safety Board (NTSB), Kentucky's assets in the form of Fort Knox, Fort Campbell and their availability of land and air-space, in addition to the unmatched population of helicopters represented at both installations, gives Kentucky the majority of the assets to become a world leader in crash simulations, investigations and other associated tasks. Harnessing these assets could lead to an NTSB Center of Excellence in the future.

Recommendation 8: Explore Becoming a National/Regional Maintenance Hub for Military Fixed Wing and Rotary Aircraft

Capitalizing on Kentucky's Aerospace, Aviation and Military assets, both civilian and military, the state should explore becoming a national and/or regional maintenance hub for military fixed wing and rotary aircraft. With military assets such as Fort Campbell, Fort Knox and others, Kentucky has a critical mass of aircraft in the state, especially rotary winged helicopters. No other location on the planet has more helicopters than Fort Campbell, Kentucky. In addition, along with the total number of helicopters at the base, Fort Campbell has the highly-skilled maintenance personnel needed to maintain and operate these aircraft. Kentucky should capitalize on these facts and explore the creation and/or recruitment of an aircraft maintenance hub for the military.

In addition to the military assets, Kentucky is also home to three major distribution hubs of UPS, Amazon and FedEx as well as numerous smaller aviation operations. The creation of a national maintenance hub for aircraft has the potential to benefit the private sector through the increase in the associated workforce pool. Given Kentucky's centralized location, the state should lobby the Department of Defense and other military and political leaders to locate maintenance operations in Kentucky. Once established, the maintenance hub would benefit from Kentucky's focus on automotive and other related industries and their highly skilled workforce to bolster the aircraft maintenance industry.

Kentucky Commission on Military Affairs &
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Chapter 8: Opportunities for Growth & Development

Introduction

This chapter is designed to be a culmination of other chapters in the study. To begin, it reviews market trends in Aerospace and Aviation. For the Aerospace industry, the chapter identifies the industry's structure, as well as providing a brief history of the ways in which the Aerospace supply chain have flattened, including potential implications for smaller suppliers in Kentucky. This section also supplies the outlooks for defense and commercial Aerospace. For Aviation, the chapter identifies trends, particularly related to Maintenance, Repair, and Overhaul (MRO). The chapter further discusses an important investment made very recently in the Aviation space in Kentucky that may begin to change the landscape and may create further opportunities.

Next, the chapter provides recommendations for short-, mid-, and long-term development in Aerospace, Aviation, and Defense. This section begins with an overview of the Aviation, Aerospace, and Defense Manufacturing sectors, as well as an overview of research and innovation opportunities in the state. Next, it provides development recommendations that could be implemented within the next 1-2 years (short-term); 3-5 years (mid-term); and the next ten years (long-term). Further, the chapter offers short-, medium-, and long-term recommendations for workforce initiatives designed to increase the diversity of Kentucky's Aerospace & Aviation workforce, as well as to ensure a robust pipeline of a next generation to meet the needs of the sector. Finally, the chapter offers short-, medium-, and long-term recommendations for policy changes that could be made in the state to facilitate the growth and sustainability of Aerospace & Aviation.

Market Trends

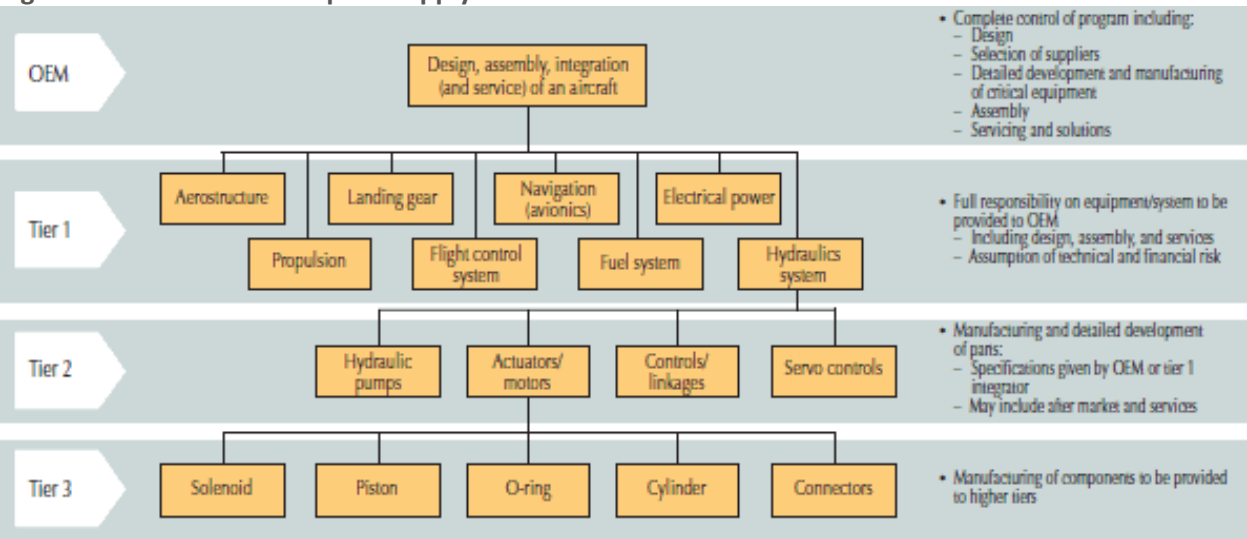
Trends in Aerospace

Structure of the Aerospace Industry

Like the automotive supply chain, the Aerospace supply chain is comprised of tiers, with original equipment manufacturers (like Boeing or Airbus) at the top, supported by Tier 1, 2, and 3 suppliers. OEMs assemble the components of an aircraft and are responsible for the aircraft from its design to its service. Tier 1 suppliers provide complete systems to OEMs, including landing gear, flight control, aerostructures, electrical power, and hydraulic systems. Tier 2 suppliers manufacture and provide Tier 1 suppliers with the parts that make up their systems (for example, motors, pumps, or controls). Tier 3 suppliers manufacture the components that are provided to the higher tiers (for example, pistons to a Tier 2 supplier).[1]

1 Emerson, D., (2012). Beyond the Horizon: Canada's Interests and Future in Aerospace - Aerospace Review Mandated by the Government of Canada. Retrieved from http://aerospacereview.ca/eic/site/060.nsf/eng/00037.html?Open&pv=1

Figure 1: Tiers of the Aerospace Supply Chain[2]



The hierarchy of the Aerospace supply chain has begun to shift as OEMs seek to lower costs and make their manufacturing processes more efficient. The Aerospace supply chain is growing flatter, in ways that may especially impact small suppliers.

The Flattening of the Supply Chain

Since the 1980s, the Aerospace OEMs have applied lean manufacturing principles learned from the automotive sector to reduce their own waste. The gradual application of these efficiency principles, like the Kanban system for managing inventory, in which inventory levels are aligned with actual factory consumption, have consequences for suppliers. Boeing, for example, is "reducing its factory inventory and is relying on suppliers to hold parts instead" — a system called Vendor Managed Inventory.[3] Instead of keeping a surplus of parts in stock, Boeing is relying on close relationships with its vendors to deliver parts just in time. According to *Aviation Week* magazine, OEMs are also changing what they source from Tier 1 suppliers: "Aerospace OEMs are sourcing sub-systems rather than piece parts and thus, reducing the number of suppliers in order to improve their supply chain efficiency."[4] By purchasing larger, more complete assemblies from fewer vendors, OEMs are looking to control more of the variables in the supply chain: it's a way for them to manage the complexity of assembling complicated systems as well as the complexity of interdependent vendor/supplier relationships.

In addition to this trend towards fewer Tier 1 suppliers, the growing technical sophistication of modern aircraft means that OEMs are more involved with — and more discerning about — the vendors that comprise their supply chain. According to an industry analyst, OEMs are helping to share the risk involved in creating innovative new programs by working more closely with their Tier 1 suppliers, even

2 Emerson, D., (2012). Beyond the Horizon: Canada's Interests and Future in Aerospace - Aerospace Review Mandated by the Government of Canada. Retrieved from http://aerospacereview.ca/eic/site/060.nsf/eng/00037.html?Open&pv=1
3 Scott, A., Hepher, T., (2016, July 7). Boeing slows payment to suppliers as it accelerates cost cutting. Retrieved from http://www.reuters.com/article/us-boeing-suppliers-idUSKCN0ZN1GG.
4 Aviation Week. (2015, Dec. 23). Supply Chain Research Insights: Aerospace Industry Trends. Retrieved from http://Aviationweek.com/master-supply-chain/supply-chain-research-insights-Aerospace-industry-trends.

implementing operational improvement programs with Tier 1 suppliers, which those suppliers in turn implement for their vendors on down the supply chain:

"As Tier 1 responsibility shifts to include not only full-system but subsystem specs and integration, OEMs will have to work with those specs and that integration to ensure the OEMs have the sufficient competencies in place. In addition, OEMs will have to continue streamlining their supply chains through restructuring and integration efforts."[5]

According to a recent IBISWorld analysis about aircraft manufacturing, this sense of risk-sharing creates consolidation down the supply chain – a "domino effect" whereby Tier 1 suppliers have become larger in order to take on more responsibilities and have demanded the same of their own suppliers, resulting in merger and acquisition activities on down the supply chain (as illustrated in Figure 2).[6]

All of this is taking place in front of a backdrop of cost cutting. In 2012, Boeing implemented "Partnership for Success," an initiative with the goal of reducing overall supply chain costs by 15%. Partnership for Success aims to help vendors lower their costs by becoming more efficient, and then rewards them with more business, so that the volume of new business offsets the revenue the vendors within the supply chain agree to forego due to the price-cutting.[7] Additionally, in the 2016 rollout of Partnership for Success, Boeing increased the time it takes to pay vendors from 30 to 120 days.

According to an analyst quoted in a November 2016 article in the Charleston *Post and Courier* about Partnership for Success, both the cost structure and the payment terms disproportionally affect small-scale suppliers, whose margins are thinner.[8] As the analyst noted,

> "Partnering for Success and other initiatives have placed a huge burden on the supplier base…It's driving massive cost-cutting initiatives and consolidation. Smaller suppliers are particularly vulnerable, because they're often too small to resist demands, and they often have weaker balance sheets than larger companies."

Smaller companies, like many of Kentucky's Aerospace suppliers, are at risk because it is more difficult for them to achieve the economies of scale that would enable them to meet increased commercial demand at a lower cost. Conversely, Aerospace's "notoriously complex" supply chain poses risks for OEMs because with a distributed and somewhat fragmented supply chain, it's difficult for OEMs to prevent delays and cost overruns.[9]

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5 Alix Partners (2013). The 2013 Aerospace & Defense Industry Outlook. Retrieved from http://legacy.alixpartners.com/en/Publications/AllArticles/tabid/635/articleType/ArticleView/articleId/661/Pockets-of-Turbulence.aspx#sthash.2DdGc9i8.dpuf.

6 Soshkin, M. (2017). Aircraft, Engine & Parts Manufacturing in the US. IBIS World Industry Report 33641a.

7 Broderick, S. (2014, April 2). Boeing Not Relaxing Supply Chain Savings Push. Aviation Week. Retrieved from http://Aviationweek.com/commercial-Aviation/boeing-not-relaxing-supply-chain-savings-push.

8 Wren, D. (2016, Nov. 6). Boeing supplier Impresa Aerospace to shut down Charleston area operations by year's end. The Post and Courier. http://www.postandcourier.com/business/boeing-supplier-impresa-Aerospace-to-shut-down-charleston-area-operations/article_63c458d4-a112-11e6-b1b8-6b662145f8b3.html.

9 Soshkin, M. IBIS World Industry Report 33641a.

Figure 2: Evolution of the Aerospace Supply Chain[10]

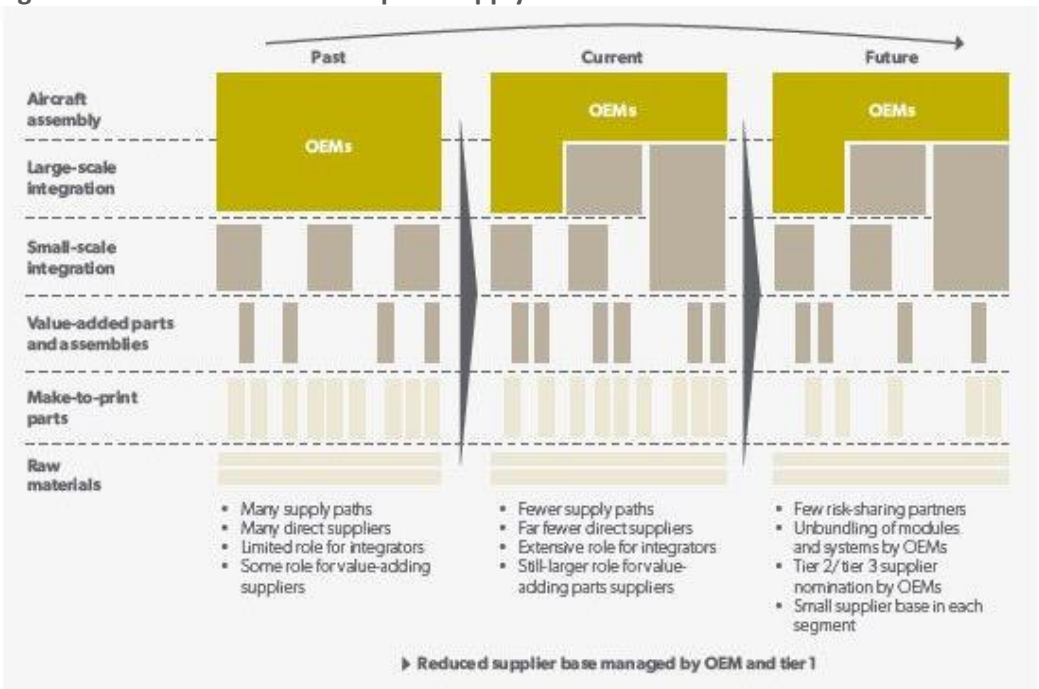

Figure 2 provides some illustrative context about how this increased collaboration between OEMs and Tier 1 suppliers will be echoed throughout the supply chain: in the future, analysts suggest that the Aerospace supply chain will be composed of fewer trusted suppliers working more closely together. The Aerospace supply chain of the future will be more cooperative — but it will also demand more of suppliers. Large suppliers benefit from both the economies of scope – providing a centralized point of purchase for a range of related items – well as economies of scale, which enable larger production runs for a lower per-item cost.

How can small suppliers compete? As noted, means is through mergers and acquisition – that is, by no longer being a small supplier. Efficient internal systems (for example, effective inventory systems) and lower operational costs can also help small suppliers maintain a competitive edge in a changing market.[11]

Outlooks for Defense and Commercial Aerospace

After several years of forecasting declining domestic defense spending and growth in commercial Aerospace, the 2017 Deloitte *Global Aerospace and Defense Sector Outlook* predicts only modest growth for commercial Aviation and notes some new potential opportunities for defense spending in the United States. Commercial Aerospace revenues in the U.S. are predicted to grow by 0.3 percent in 2017 after a slowdown in 2016. Defense revenues may experience a more significant increase in revenue in 2017, according to the report:

> "Defense subsector revenues are likely to grow at a much faster 3.2 percent in 2017 as defense spending in the US has returned to growth, after multi-year declines in defense budgets and

10 Alix Partners. The 2013 Aerospace & Defense Industry Outlook.
11 Soshkin, M. IBIS World Industry Report 33641a.

future growth may be driven by the newly elected US administration's increased focus on strengthening the US military. "[12]

Other sources indicate that the increase in Defense spending may be more drastic, keying off of President Trump's commitment to increase the federal defense budget by $54 billion in FY 2018.[13] Even if this is the case, however, increases in military spending will take a couple of years to be felt throughout the defense Aerospace supply chain.

Additionally, future investments made in defense Aerospace may fund a new set of programs, like unmanned aerial vehicles. Some UAVs resemble traditional aircraft, while others, like "swarming" micro-drones recently tested by the Department of Defense, are functionally and technologically distinct from traditional defense Aerospace (and its supply chain).[14] Additionally, as UAVs play an increasingly prominent role in defense Aviation, they will create demand for entirely new categories of defense spending, like counter-drone devices and technologies.

Commercial Aerospace is being shaped by a different set of market forces. The industry is currently preparing for a slowdown in orders due to rising oil prices and a slowing of the rate of passenger traffic growth. Demand for commercial Aerospace depends directly on demand for commercial Aviation. Demand for commercial Aviation is, in turn, affected by fuel cost; it is estimated that fuel costs account for 30% of an airline operator's costs, so, for example, when crude oil prices peaked at 2011, airlines implemented measures, from price increases to route consolidation, to protect their profit.[15] Cost, along with a number of other factors that affect consumer confidence, affects the rates of passenger traffic (given that roughly 2/3 of commercial flights are taken for leisure, rather than for business).[16] According to the *Financial Times*, the airline industry group IATA is forecasting passenger traffic to slow from 5.9% to 5.1%.[17] Factors like passenger traffic and fuel prices affect demand for commercial Aerospace in that less demand for commercial Aviation (for example, as a result of less passenger traffic) trickles down in terms of lagging profits, and less available capital on the part of airlines to invest in the manufacture of new planes.

Another recent development in Aerospace is likewise the result of a trend in Aviation; low-cost airlines operating domestically and internationally are re-using older planes rather than ordering new planes. These airlines rely more heavily on maintenance, repair, and operations to service their older fleets; aside from the market for parts within MRO, these airlines are bypassing the supply chain that serves OEMs.

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12 Deloitte. (2017). Global Aerospace and defense sector outlook. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/2017-global-ad-outlook-january.pdf.

13 The White House Press Briefings. (2017, Feb. 28). President Trump is Rebuilding America's National Security. Retrieved from https://www.whitehouse.gov/the-press-office/2017/02/28/president-trump-rebuilding-americas-national-security.

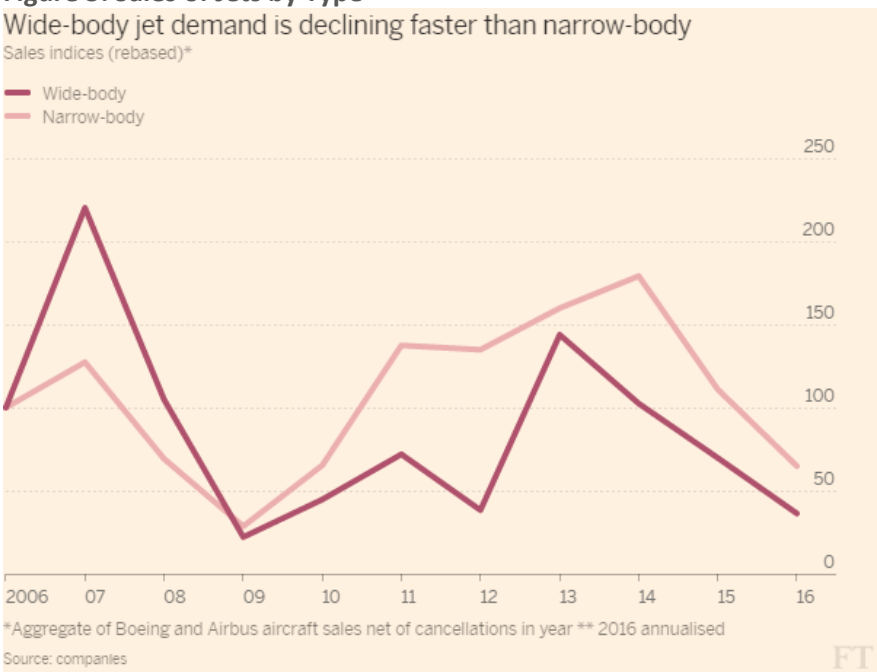
14 Snow, S. (2017, Jan. 9). Pentagon successfully tests world's largest micro-drone swarm. Military Times. Retrieved from http://www.militarytimes.com/articles/pentagon-successfully-tests-worlds-largest-micro-drone-swarm.

15 D'Costa, V. (2016). Domestic Airlines in the U.S. IBISWorld Industry Report 48111b.

16 Ibid, p.13.

17 Financial Times. (2017, Jan. 2). Airbus and Boeing expect turbulence in 2017. Financial Times. Retrieved from https://www.ft.com/content/73d3f166-d0d4-11e6-9341-7393bb2e1b51.

Figure 3: Sales of Jets by Type[18]



This slowdown in passenger traffic is also changing the types of new planes that are being ordered: the long-range passenger jet market is facing some recent pressure. Although airlines will always need larger aircraft for long-haul routes, they are also more challenging to fill and smaller aircraft carry less risk. Consequently, the demand for narrow body jets (with one aisle) has declined less steeply than the demand for wide-body jets (with two aisles).[19]

Smaller airplanes also reflect consumer preferences in Aviation. Even though OEMs have invested heavily in their jumbo-jet programs like the Airbus A380, according to one industry analyst, orders have been slow in part because consumers prefer to take direct flights in smaller planes than make connections through huge hubs.[20]

Trends in Aviation

Maintenance, Repair and Overhaul on the Rise

The Maintenance, Repair, and Overhaul (MRO) function is an important third part of the Aerospace industry. Since the activities associated with MRO, like upkeep, repairs, refurbishment, and equipment upgrades, exist outside of the manufacture of either commercial or defense Aviation, for the purposes of this analysis it will be considered as an aspect of Aviation.

18 Financial Times. (2016, Oct. 2). Long-range passenger jet market under pressure. Financial Times. Retrieved from https://www.ft.com/content/434ffd16-84ba-11e6-a29c-6e7d9515ad15.
19 Ibid.
20 Mouawad, J. (2014, Aug. 9). Oversize Expectations for the Airbus A380. The New York Times. Retrieved from https://www.nytimes.com/2014/08/10/business/oversize-expectations-for-the-airbus-a380.html?_r=0.

Over the past five years, as flight activity has increased, MRO activity has also grown, now accounting for 3.5% of industry revenue.[21] There is a low level of market concentration among MROs – in 2016, the four largest companies within the sector made up just 10% of industry revenue. Most MRO operators serve regional markets, and grow by broadening the scope of services they offer to airlines.[22]

In a time of cost-reductions in Aerospace manufacturing, the MRO business is seen as a potential profit center, and in addition to the independent firms that have traditionally offered MRO, OEMs and Tier 1 suppliers are beginning to offer nose-to-tail MRO programs of their own (especially for the maintenance and repair of highly complex parts like engines). At the same time, some low-cost airlines are relying on MROs to do all of their maintenance, including engine and component maintenance, and own any spare parts inventory.

It is expected that airlines will continue to outsource their maintenance in ever-growing volume over the coming years to service a growing fleet of civil air transport worldwide. Currently, there are around 26,000 planes in the air, and in 15 years, the in-service fleet is expected to have doubled.[23]

MROs will similarly expand in the defense Aviation space — recent budget cuts mean that existing military aircraft need to be maintained longer, and there, too, MROs are playing an increasing role as consumers of aftermarket and spare parts.

New Investment in Kentucky Aviation

It is important to note a key investment that was made while this study has been underway that may change the Aviation landscape in northern Kentucky. It was announced in January 2017 that Amazon is making a $1.49 billion investment in a new hub at Cincinnati/Northern Kentucky International Airport (CVG), the largest-ever investment at CVG. Amazon has signed a 50-year lease at CVG and has promised to bring 2,700 new jobs to the region, 600 of which will be full-time. In return, Amazon will receive $45 million in combined state and local tax incentives.[24] This news increases the standing of CVG as a major player in cargo Aviation — before the Amazon news, CVG was ranked eighth in the nation for cargo traffic.

Demand determinants for cargo Aviation include the time-sensitivity and value of the products being shipped; traditionally, a high value-to-weight ratio has made products worth shipping via air, though Amazon's commitment to high-speed order fulfillment has upended those rules. Increasing freight rates and consumer sentiment both affect the attractiveness of air freight – but, once more, as consumers continue to favor and expect next-day fulfillment, air cargo traffic will likely be a key piece of the supporting logistics puzzle.[25] Additionally, analysts say that more cargo traffic can make CVG more attractive to commercial Aviation. According to one analyst, "CVG's landing fees are based on landed

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21 Haider, Z. (2016). Airport Operations in the U.S. IBISWorld Industry Report 48811.
22 Soshkin, M. (2016). Aircraft Maintenance, Repair, & Overhaul in the U.S. IBISWorld Industry Report 48819.
23 Alix Partners (2013). The 2013 Aerospace & Defense Industry Outlook. Retrieved from http://legacy.alixpartners.com/en/Publications/AllArticles/tabid/635/articleType/ArticleView/articleId/661/Pockets-of-Turbulence.aspx#sthash.2DdGc9i8.dpuf.
24 Williams, J. and Wartman, S. (2017, Jan. 31). Amazon plans worldwide cargo hub, 2,700 jobs at CVG. Cincinanati.com. http://www.cincinnati.com/story/money/2017/01/31/amazon-plans-2700-jobs-15b-investment-cvg/97283034/.
25 D'Costa, V. (2016). Domestic Airlines in the U.S. IBISWorld Industry Report 48111b.

weight. So the more costs a cargo carrier can cover, the more appealing the airport can be to passenger carriers."[26]

Despite the large investment in CVG, UPS, which has a large hub in Louisville and a $1 billion account with Amazon, said that they were not concerned that the Amazon investment would affect their operations in Louisville. A UPS spokesperson was cited as saying, "Louisville and Northern Kentucky are two different labor pools. UPS has invested $2.4 billion…in Louisville, which has been home to our international air hub since 1982."[27]

Development Recommendations

When it comes to the Aerospace & Aviation industries in Kentucky, the one certainty is that opportunity always exists. Aerospace has grown in Kentucky in recent years, while Aviation has declined. However, recent announcements in Kentucky, especially related to cargo Aviation, significantly change the outlook for Aviation. Kentucky is at a pivot point in regard to these industries, and it must leverage its assets to address the threats and opportunities posed by the larger market trends summarized in the previous section. More detail on these trends can be found in Chapter(s) 1 and 4.

The following section details Development Recommendations to address the growth opportunities related to Aerospace, Aviation, and Defense. In some cases, these recommendations may apply to one sector, or to all three (Aviation, Aerospace and Defense Manufacturing), as well as related areas such as Higher Education and Workforce. This section begins with overviews of each area and then describes short-term, mid-term, and long-term Development Recommendations. The guiding principle woven through all of the recommendations is the goal expressed by Governor Matt Bevin of "…making Kentucky the hub of excellence in engineering and manufacturing in America."[28]

Aviation Sector Overview

Although they are related, Aerospace & Aviation have different needs. In Kentucky, the Aviation industry, supported by the DoD and bolstered by a strong logistics industry, is somewhat stable. This industry also encompasses small manufacturers, who are at risk due to constrictions caused by larger trends, including the flattening of the supply chain, which puts small suppliers at risk. To mitigate the effects of these larger trends, small suppliers will need to get leaner and more efficient. However, there is some opportunity due to maintenance, repair, and overhaul labor for planes in both the commercial and defense realms. A steady stream of workers is essential for maintaining this aspect of the Aviation industry in Kentucky—and, unlike the human capital needed for higher end Aerospace growth, these workers can be trained in less time using programs like certifications and apprenticeships. The approach to this industry then is to focus on stabilization, workforce, and mitigation of larger trends.

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26 Williams and Wartman (2017, Jan. 31).
27 Lerner, D. (2017, Jan. 31). Hoover, UPS weigh in on Amazon Northern KY hub. *Courier-Journal*. Retrieved from http://www.courier-journal.com/story/news/local/2017/01/31/hoover-ups-weigh-amazon-northern-ky-hub/97315418/.
28 Middlesboro Daily News. (2017, Jan. 2016). Ky. Awarded $2M to improve career education. Middlesboro Daily News. http://middlesborodailynews.com/news/15414/ky-awarded-2m-to-improve-career-education.

Aerospace Sector Overview

While some firms supported by DoD contracts are involved in Aerospace, these are mostly small manufacturers creating components for higher tier suppliers. From interviews and forums with leaders in Kentucky, especially those in the academic fields, it appears that more innovative Aerospace development is being considered as a growth area, especially in drone and constellation satellite technologies. However, this kind of activity in Aerospace relies on innovation and R&D. The development of human capital in the fields of Aerospace, Materials, and other types of engineering is essential to growth in this field. There are educational programs in Kentucky that support this cluster, but they are fledgling, without significant research dollars to back them. Furthermore, the research that is occurring is not strongly connected to opportunities for commercialization.

Defense Manufacturing Sector Overview

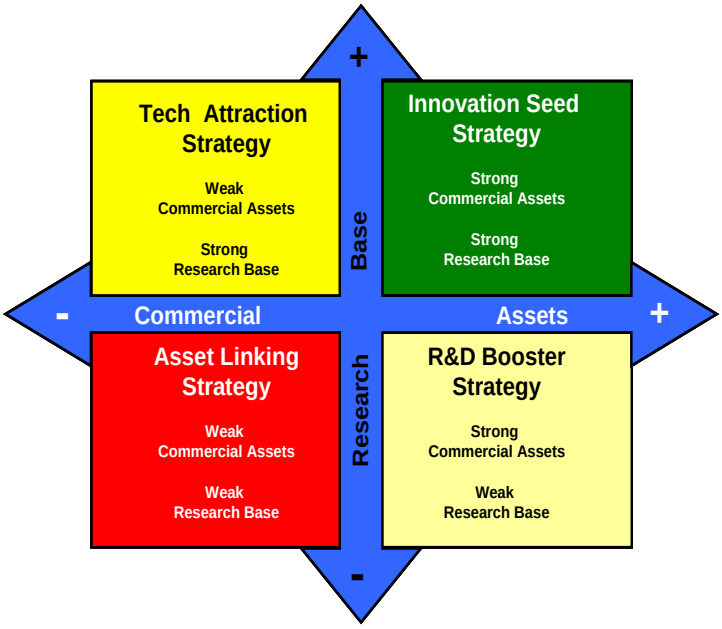
The issues for Defense Manufacturing reflect the larger issues for the Aerospace sector. Making the state's defense manufacturers more competitive and resilient to changes in defense budgets will require more cooperation and innovation among a diverse base of small firms. Kentucky's small defense suppliers need to stay competitive in collaboration with the OEMs and Tier 1 partners, to maintain a supply chain that will support a new generation of Kentucky-based defense manufacturing and innovation. Kentucky's diverse supply chain provides a level of resilience to preserve defense manufacturing capabilities in the event of changes in defense budgets or priorities. However, these suppliers will face the same pressure of cost cutting and consolidation that is impacting the Aerospace supply chain.

The defense manufacturing supply chain of the future will be more cooperative, but it will also demand more of suppliers. Kentucky's defense supply chain, with its many small firms and relatively small contracts, may be especially susceptible to these changes. Efforts to support collaborations and consortia to address the drive for efficiency, reduced costs, and innovation within small firms will be critical to maintaining these capabilities in Kentucky.

Research and Innovation Overview

Future growth in the Aerospace sector in Kentucky is tied to innovation and the commercialization of innovative work on new products and processes. The current suppliers who are heavily reliant on DoD funding will have limited growth prospects if they do not adapt to the changes in the market that are working through the supply chain. An "Innovation Strategy" for the Aerospace industry and defense manufacturing would return more and higher paying jobs. Because an Innovation Strategy has higher returns, it also has higher risks, and it is generally a much more ambitious strategy than the stabilization and efficiency upgrades needed in the Aviation sector.

Figure 4: Innovation Strategies



As shown in Figure 4, there are four types of Innovation Strategies.

- Tech Attraction Strategy
- Innovation Seed Strategy
- Asset Linking Strategy
- R&D Booster Strategy

Kentucky's Aerospace cluster would benefit most from an Asset Linking Strategy, due to the relatively weak commercial assets and research base. This strategy provides options for leveraging a region's assets to develop its commercial or research base. It builds on the core of talent and successful enterprises that exist in the region and offers ways to grow.

One way to grow is through entrepreneurship, which creates pathways and supports for innovators to start their own companies. In Kentucky, this will mean bolstering commercialization activities to turn university R&D into sellable products. Kentucky would benefit from an incubator approach that is all-inclusive from a wrap-around services perspective. Wraparound services from providing assistance with business plans, to prototyping, to funding and legal assistance would all be integral components and would greatly enhance the economic vitality of entrepreneurial prospects. Another way is through linking firms in the region to share practices and resources and to allow first tier firms to pull others along and help build the supply chain.

Creating the Asset Linking strategy in Kentucky will focus mostly on higher education, rather than linking firms. The overall goal in focusing on higher education is to increase Kentucky's capacity for R&D and build the infrastructure for professors to begin to commercialize their innovations in Kentucky.

Short-Term Development Recommendations

In the short term of 1 – 2 years, efforts should be made to convene research leaders in the state and to improve funding for higher education in fields that support the Aerospace industry.

Recommendation 1: Create an Aerospace and Aviation Consortium

The research on Aerospace that is taking place in the higher education institutions of Kentucky is diverse. At Morehead State, the Space Science program is focused on constellation satellites, while at University of Kentucky there is work being done on drones and thermal re-entry protection systems. Researchers at the University of Louisville are focusing on microgravity materials and human exposure to radiation in space. Meanwhile, there are other entities emerging such as Space Tango, an accelerator for companies interested in medical endeavors in space. However, according to interviews, leaders in the Aerospace sector do not have a good way of communicating all that is happening on a regular basis.

One way to ensure more collaboration and communication is to start a consortium to bring the key players in Aerospace in Kentucky together on a quarterly or bi-monthly basis to share the progress they have made and future plans. The Research Triangle Cleantech Cluster Initiative[29] in North Carolina is a good example to follow. This group was convened by the region's largest economic development organization, the Research Triangle Regional Partnership. It operates as a formalized network of companies, universities, government organizations, and nonprofits. Within this group is an academic consortium, which includes the region's top research universities, whose purpose is to link promising research innovations with clean tech industries. A good example of a specialized group already operating in Kentucky is the Unmanned Systems Research Consortium launched in 2013 and spearheaded by the University of Kentucky.

Some other efforts are already underway to bring key players in Kentucky-based Aerospace research together. A cursory search shows at least two groups, Space Kentucky and the Kentucky Aerospace Industry Consortium, are partnering to hold events. This is a good start, but, in order for a consortium to be successful, it needs both vision and capacity, which is why an economic development organization in Kentucky that is similar to the Research Triangle Regional Partnership would be an important partner.

Recommendation 2: Establish a "Blue Ribbon Panel" for UAS

Explored further in Chapter 4 of this study, another chief recommendation for Kentucky's Aerospace & Aviation industry is to establish a Blue Ribbon Panel to create a centralized forum for relevant stakeholders of the UAS industry in Kentucky. As presented and discussed in Alaris' 2016 Unmanned Aircraft Systems (UAS) Industry Study, this Panel's charter should enable it to lead comprehensive planning around the industry in Kentucky. In addition, it should be tasked with positioning the state the leading expertise in UAS/Drones research.

By capitalizing on the UAS expertise already located in the state, with renowned researchers such as Suzanne Smith of the University of Kentucky, the state could further explore attracting additional talent with the ambition of becoming the world's leading region focused on UAS and drone technology.

This would include focusing on:

- Legislation;
- Tax incentives;
- Educational initiatives; and
- Other infrastructure investments.

Recommendation 3: Invest in University R&D

High functioning universities generating a large amount of research and development are essential for the development of a successful cluster. In *Creating the Technopolis: High Technology Development in Austin, Texas*, the authors explain why funding universities is so essential to cluster development:

> "The research university plays a key role in the fostering of research and development activities; the attraction of key scholars and talented graduate students; the spin-offs of new companies; the attraction of major technology-based firms; as a magnet for federal and private sector

29 Research Triangle Cleantech Cluster. Retrieved from http://www.researchtrianglecleantech.org/about.

funding; and as a general source of ideas, employees, and consultants for high-technology as well as infrastructure companies."[30]

While Kentucky's universities are making progress in this area, they have much room for improvement. As a first step, funding should concentrate on research units that focus on groundbreaking technology, as well as attracting high quality professors and graduate level students. While Kentucky can boast being home to several national leading researchers at the University of Kentucky, University of Louisville, Morehead State and others, attracting more leading scientists and engineers will create a critical mass of R&D activity.

Establishing major research centers will draw high quality students and professors in a way that existing programs have not. These centers would need to be catalyzed by funding from state or national government. NASA is the logical source of this type of major funding; Kentucky leaders should be aware of these types of opportunities, such as the NASA University Research Centers, or URCs, which awarded nearly $35 million to seven minority institutions. The state should make a priority of receiving the designation of a university affiliated research center or federally funded research center to ensure federal funds are ongoing. This more guaranteed funding stream would strengthen investment in all R&D aspects. From the data in Chapters 2 and 3, it is apparent that Kentucky's Aerospace talent development pipeline, especially for advanced degrees in areas such as Aerospace, Electromechanical, and Computer Software Engineering, and also in STEM-related fields (science, technology, engineering, and math), is lagging competitor states. According to the Integrated Postsecondary Education Data System (IPEDS), Kentucky institutions awarded no master's degrees in Aerospace engineering in 2015. Further, Kentucky institutions of higher education do not offer programs in Electromechanical or Computer Software Engineering. In STEM fields, Kentucky institutions awarded the second lowest number of doctoral degrees and the lowest number of master's degrees among competitor states. While Kentucky awarded a larger number of undergraduate certificates in fields related to key occupations in A&A than competitor states, Kentucky awarded fewer associate, bachelor's, and post-bachelor's degrees than nearly all other states.

Although higher education options exist in Aerospace Engineering through Morehead State University, Embry-Riddle University, and the University of Kentucky, degree conferrals in this area do not appear in the IPEDS database, and therefore, companies looking at this data to make location decisions may not be aware of them. Furthermore, with Embry-Riddle headquartered in Florida, it reduces the level of support or engagement with the Aerospace sector in Kentucky.

Therefore, money should be invested into a fully-fledged entity within an institution of higher education to create the types of engineering and other STEM graduates that would support an Aerospace industry. This may be catalyzed by state, private, or institutional funding, or all three. Ideally, this program would recruit a distinguished research professor whose interests align with activities already taking place in the state. With improved visibility and at least one more notable professor, this investment would draw high-performing students from across the U.S. ultimately leading to the creation of Centers of Excellence with

30 Smilor, R.; Gibson, D.; and Kozmetsky, G. (1988). Creating the Technopolis: High-technology Development in Austin, Texas. *Journal of Business Venturing, (4), 49-67.* Retrieved from https://www.kcchamber.com/KCChamber/media/Media/PDFs/2012LeadershipExchange/Creating-the-Technopolis-High-Technology-Development-in-Austin.pdf

included incubators for entrepreneurial thought. These Centers of Excellence would include marketing efforts to raise awareness nationally and internationally.

This kind of activity could be supported through Kentucky's current, and highly successful, "Bucks for Brains"[31] programming model. The program is designed to advance Kentucky's economy and is administered by the Council on Postsecondary Education. The associated Research Challenge Trust Fund provides support to the state's universities to attract and retain high caliber staff. Such a model could be re-energized or re-focused with enhanced programs directed at expanding Kentucky's R&D related to Aerospace & Aviation.

As a parallel step, Kentucky should streamline data collection and reporting mechanisms around A&A research that is already occurring. This is a necessary step for the state to tell its stories of research success. First, university staff can improve the quality of their Higher Education Research and Development survey responses. Second, Kentucky could benefit from a concerted effort to standardize university research expenditure recording and reporting. By doing so, Kentucky would be better positioned to voice its progress in A&A research and better equipped to respond accurately to national surveys. The end result would be more favorable comparisons of Kentucky's expertise on the national stage—helping the state to attract additional research investment and talent.

Recommendation 4: Stimulate Connections with the Private Sector

In order to retain the high-performing graduates in Aerospace programs such as those proposed in the previous recommendation, it is imperative to grow and encourage occupations and careers that are exciting and well paying. As indicated in Chapter 2, about 56% of current jobs in the Aerospace field in Kentucky are occupied by those without a college degree (either a high school graduate or a person with some college, but not a bachelor's degree). This indicates some of these jobs may be low-skill and low paying. However, as identified in Chapter 3, over half of the top 30 "key" occupations in Aerospace in Kentucky (those that are projected to be in-demand and relatively high paying) will require a Bachelor's degree or more. Further growing these types of jobs may attract more highly educated, high performers to the industry. Further, creating additional jobs that offer higher pay, attract high performers, and offer the ability to work on difficult problems may continue to increase the quality of the Aerospace workforce. These types of jobs typically are found either in headquarters or satellite offices doing R&D work. Alternatively, they can be found in startup companies.

In order to show existing companies that the potential workforce graduating from Kentucky's institutions of higher education is able and ready to fulfill higher-level jobs, it would be helpful to start to introduce potential workers to potential employers. A first step in creating connections between the private sector and higher education could be something as simple as a panel event, hosting members of both higher education institutions and industry, or it could include sponsoring student teams focused on Aerospace in an Innovation Boot Camp (see Creating a Culture of Innovation). The research consortium, its overarching administrative body, or the next generation sector partnerships described in the workforce recommendations which follow could be tasked with holding these events. The purpose of holding events to interact with the private sector is to build engagement, so in the future these relationships could be leveraged for support. This event could coincide with an announced Aviation and Aerospace Day for the

31 University of Kentucky. (2017). Research Challenge Trust Fund. Received from http://www.research.uky.edu/faculty/rctf/whatis.html.

state, enabling the further communication and showcasing of careers in the sector. These initiatives should be followed up with more proactive hiring events with hiring employers from the industry interviewing and meeting with eligible candidates across the state. A similar technique is currently underway in Arizona focused on the IT industry with their IT Awareness Day. Several prominent employers across the state proactively interview and hire eligible candidates all stemming from this event annually.

Recommendation 5: Conduct Efficiency Audits and Training

The Advantage Kentucky Alliance Manufacturing Extension Partnership (AKA MEP) and the Kentucky Association of Manufacturers are key stakeholders in moving Kentucky towards advanced manufacturing. AKA MEP's focus areas include business growth services, supplier development services, and continuous improvement services. A body like AKA MEP could play an important role in understanding the needs of Kentucky's Aerospace suppliers, and the gaps and challenges that those suppliers are facing, whether they are new certifications or efficiency programs suppliers' customers are demanding, or other types of business challenges. An audit of Aerospace manufacturers in Kentucky to understand their overall stresses and, as individual companies, where their specific challenges lie, could help AKA MEP recommend new sector-wide programs and trainings as well as offer manufacturers training in one of their focus areas.

Recommendation 6: Explore Preferred Vendor Certifications

Kentucky should work with the defense and Aerospace suppliers to address sector-wide, sector-specific challenges that Aerospace manufacturers are facing with regard to procurement. Specific initiatives could then be crafted to get Kentucky suppliers certified or up to speed.

An increasing number of OEMs have preferred supplier/long-term supply programs, from the United Technologies UTC Supplier Gold program, to Boeing's Partnership for Success, to Lockheed Martin's Supplier Excellence Program. In addition, there are industry-wide supplier certifications, like Nadcap accreditation. Once the highest-value programs and certifications have been established, strategic assistance could be given to manufacturers in the relevant supply chains to make it easier for Kentucky Aerospace manufacturers to apply to a program or to successfully pass an audit. If, as in the case of Partnership for Success, suppliers up and down Boeing's supply chain need to become 15% more efficient, this could help as many Kentucky manufacturers as possible maintain their profitability and stay a part of the supply chain.

Mid-Term Development Recommendations

In the 3 – 5 years after putting the first set of strategies into place, Kentucky should focus on increasing capacity around support of the Aerospace industry and branch into private sector sources for funding initiatives.

Recommendation 7: Create an Innovation Center

The next logical step for a consortium would be to establish a support system to move R&D into commercialization. This facilitates startups spinning out of university R&D and creating the jobs that will keep talented graduates in Kentucky. According to Maggie Theroux Fieldsteel in *Building a Successful*

Technology Cluster,[32] in order for universities to contribute to industry clusters effectively, in addition to highly productive professors and researchers, they must have sophisticated patent support and analysis capability, and university entrepreneurship classes or a business incubator.[33] This could take the shape of a bricks and mortar structure, or virtual portal, or both.

Interviews with academics and other leaders in this space indicate that the framework for moving from research to product could be improved. The Kentucky Innovation Network and the Innovation and Commercialization Center under the Kentucky Science & Technology Corporation are engaged in this effort. However, Kentucky has experienced challenges in creating the pipeline for technology transfer from universities to the market. To address this, one potential successful model is to create an affiliated non-profit corporation that handles this bureaucratic burden. An example of this is CalCharge[34] in California, a partnership between Berkeley Lab and the California Clean Energy fund, which connects California's battery technology cluster with the university and government researchers who are developing new innovations.

An innovation center solely focused on Aerospace innovations would necessarily be connected to the research consortium recommended above. Ideally, the affiliated non-profit that would run the innovation center would assume the administrative task of convening the research consortium and implementing their ideas. The board of the affiliated non-profit should also include members of major private companies in the Aerospace industry, including Boeing and Amazon (included due to interest in drone technology), as well as smaller entities, such as SpaceTango. Additionally, non-profit and governmental entities such as the Kentucky Innovation Network[35] should be involved. This engagement between all three sectors would create communication, as well as a network of support for this fledgling industry.

With Fort Campbell representing the highest concentration of helicopters in the world, Kentucky should examine capitalizing on this expertise in the form of a Center of Excellence that recruits maintenance personnel and piolets to develop a training center specializing in maintenance technologies. With the immense opportunities lost represented in civilian contracts going to out of state contractors for these assets, Kentucky could retain this economic impact by developing companies in state to perform the work. Ultimately, capitalizing on the high population of helicopters represented in Fort Campbell and Fort Knox, should be a priority.

Recommendation 8: Build a Culture of Commercialization

Another aspect of transitioning research to the market is to shift researchers' paradigms to include commercialization. Georgia Tech, a long-time leader in commercialization of university research (primarily through their applied research non-profit organization, Georgia Tech Research Institution) encourages their researchers to take part in I-Corps Lean Launchpad. This 5-week program is for teams of two to five students who are interested in commercializing research. It is based on the Lean Launchpad methodology developed by Steve Blank. Teams are taught strategy for creating a business thesis and hypotheses about

32 Fieldsteel, M.T. (2013). Building a Successful Technology Cluster. United States Environmental Protection Agency. Retrieved from https://www.epa.gov/sites/production/files/documents/building_a_successful_technology_cluster.pdf.
33 Ibid.
34 CalCharge. (2015). Retrieved from http://calcharge.org.
35 Kentucky Innovation Network. Retrieved from http://kyinnovation.com.

a business model, which are then tested in a specific market segment. This program is regional to the south, with University of Alabama and University of Tennessee also participating.

Similarly, the University of Kentucky and the Kentucky Innovation Network hold a Boot Camp where business students build teams to work on sponsored projects. During the 13-week experience, they learn the process of commercialization with the sponsored project. These students are volunteers; there is no pay and no academic credit. Their work can feed into the local and state business plan competitions. Programming such as this could be greatly expanded.

Recruiting aerospace firms to advise, mentor or sponsor projects with students would enhance the collaboration with higher education and deepen the linkages between students and industry. These engagements could include the I-Corps model of programs or the Boot Camps. The Industry Consortium should be engaged in these efforts to ensure that the commercialization efforts are integrated with companies engaged in the market.

Recommendation 9: Extend the Manufacturing Region Designation

As Kentucky creates a sector consortium and begins to build the innovation ecosystem for Aerospace & Aviation and Defense, and these sectors become more established, the state might apply for a Manufacturing Region Designation from the Investing in Manufacturing Communities Partnership from the Department of Commerce. The Southwestern Ohio Aerospace Region, which encompasses part of Northern Kentucky, was awarded IMCP designation in 2014. That designation will expire in late 2018. Either expanding the geographic footprint of designation in the future or pursuing an independent designation to include other manufacturing hubs could continue to help grow capital investment in Aerospace manufacturing in Kentucky. It also could bring additional attention and resources to Kentucky's Aerospace manufacturers.

Long-Term Development Recommendations

In the next ten years, ideally, Kentucky will have built the Aerospace industry to create a full cluster, with small, first, and second-tier suppliers and one to two industry leaders. In the long-term time frame, Kentucky can offer significant support for this cluster by creating an embedded lab within its improved higher education system. This will pay dividends to the state by supporting ongoing workforce development and research, as well as attracting companies and creating jobs. The activities will reinforce Kentucky's ability to achieve and sustain itself as the hub for engineering and manufacturing in America.

Recommendation 10: Create an Embedded Lab

A long-term goal that would solidify the Aerospace industry in Kentucky would be to have an embedded lab funded primarily by private interests and staffed by graduate students in Aerospace programs. An embedded lab is a satellite research location of a company or companies located on or near a university campus with the primary objective of facilitating a collaborative industry-university relationship.36 The premier example of this concept is Clemson University International Center for Automotive Research (CU-ICAR), a 250-acre advanced technology research campus located 45 minutes from the main Clemson

36 Hopkins, L. (2013). Clemson University International Center for Automotive Research (CU-ICAR). Best Practices in Foreign Direct Investment and Exporting Based on Regional Industry Clusters. Retrieved from http://fdibestpractice.org/pdf/CU-ICAR.pdf

University campus in Greenville, South Carolina, funded primarily by BMW and other automotive suppliers, and staffed by Clemson University researchers and graduate students. For the strong automotive manufacturing cluster in this region, CU-ICAR supplies automotive testing facilities, engineering talent, and on-site collaboration between researchers from Clemson and the private sector.

The facility stemmed from Clemson's College of Engineering approaching BMW in 2000 to be an investment partner in constructing a commercial wind tunnel to commercialize university research in mechanical engineering related to the auto industry. BMW had located in the area in 1994 and already had this equipment in their primary research facilities in Germany. However, they were interested in building the local automotive engineering workforce for themselves and for suppliers who might locate nearby.

CU-ICAR broke ground in 2003, with a mixture of public and private funding. Initial startup funding was primarily state funded through grants from the South Carolina Department of Commerce for $40 million and a university infrastructure bond for $70 million. BMW and Michelin supplied funding for endowed chairs. As of 2013, funding included $50 million in public funds and $200 from private partnerships, including two more endowed professors.

Developing an embedded lab such as CU-ICAR is an ambitious project. Success would depend on the maturity of the Aerospace cluster and whether previous efforts created start-up businesses that had grown into significant first and second-tier suppliers, which would signal to major Aerospace industry companies the feasibility of investing in a highly trained workforce. Like BMW, it is likely that any major Aerospace company would need to be convinced that, despite their research efforts elsewhere, their capacity could be significantly improved upon by building these efforts in Kentucky.

As the example of CU-ICAR shows, this approach is not without significant investment (and risk) from public institutions. Initial investment would likely come from the state, with private funding flowing in after the project has demonstrated success. However, the rewards could be great. CU-ICAR has drawn significant amounts of foreign direct investment from BMW and its suppliers and created more than 775 new jobs.

Workforce Recommendations

On average, Kentucky's Aerospace & Aviation workers are older than the rest of the state's workforce. 51% of Kentucky's A&A workforce is between 45 and 64 years old, compared to 38% of the state's overall workforce. Further, the state's Aerospace & Aviation workforce is not diverse. Between 85% and 90% of the employees are white, and 75% are male (slightly higher than the national average of 70%). One consequence of this is that OEMs like Boeing, with corporate efforts targeted at promoting diversity in the Aerospace industry workforce and supply chain, may recognize the lack of diversity in Kentucky's A&A workforce, which could place it at a competitive disadvantage compared to other states. Initiatives supporting Woman and Minority-Owned Businesses or veterans in the Aerospace supply chain in Kentucky might help bring diversity, as well as new workers, to the sector.

The goal of the following workforce initiatives is to ensure that a next generation of Kentuckians will learn the right skills to support the future of the state's Aerospace manufacturing sector and its burgeoning cargo Aviation business.

Short-Term Recommendations

Recommendation 11: Establish Sector Partnerships

The public workforce system has long focused on jobseekers as the primary customer of the system, with poor to mixed results, due primarily to a lack of understanding of the needs of businesses and industry. The new federal Workforce Innovation and Opportunity Act calls attention to business and industry as primary customers of the system, as well as promoting the formation of sector partnerships. In many local workforce areas, such partnerships are convened by the local workforce development board and its staff, with a singular focus on workforce and talent issues faced by the business cluster engaged in the partnership. Partners at the table usually include the business leaders in a defined geographical area of companies making up the cluster; educators from secondary and postsecondary schools; and other training providers and the workforce board staff. On occasion, other public agency staff also are included.

While this model certainly gets the workforce system in a better position to respond to the demands of business and industry, there are areas that have adopted a model referred to as "Next Generation Sector Partnerships," an approach that engages broader community members and encourages the business leaders to set whatever agenda (workforce as well as any other topics) they choose. The state of Oregon has adopted this model and provided training and support for its local workforce boards to assist in the creation of such partnerships for target industries in each of the state's nine workforce areas.

The Lane County (OR) Technology Collaborative[37] is a prime example of the type of results such a partnership can yield. In just a few years, this sector partnership has improved the curriculum for technology careers in K-12 and higher education institutions, brought high-speed broadband to downtown Eugene, secured a daily flight from Eugene to Silicon Valley, and influenced other decisions that have resulted in thousands of tech jobs and hundreds of companies calling Eugene home.

Mid-Term Recommendations

Recommendation 12: Expand Apprenticeships

Chapters 2 and 3 of this report study made the case for investing in apprenticeships related to Aerospace & Aviation. Among the reasons cited for this recommendation are that 91% of apprentices are employed after completing their programs; the relatively high starting wage of $60,000 for post-apprenticeship new hires; and the reduced burden apprentices bring to the companies that hire them, based on the specialized on-the-job knowledge that they possess.

Many apprenticeships (including existing apprenticeship programs in Kentucky in carpentry and electrical construction) provide on-the-job experience along with associate degrees in applied sciences or related fields from community colleges. A traditional disadvantage of apprenticeships has been expense. Many employers are not willing to pay an apprentice to work as well as pay for community college education.[38]

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37 Lane Workforce Partnership. (2017). Retrieved from http://www.laneworkforce.org/sector-strategies/lane-county-tech-collaborative/.

38 Otts, C. (2016, Dec. 30). Bevin administration looks to revive apprenticeships in Kentucky. WDRB.com. Retrieved from http://www.wdrb.com/story/34155628/sunday-edition-bevin-administration-looks-to-revive-apprenticeships-in-kentucky.

However, a set of new programs in Kentucky is trying to lower the barrier to entry for apprenticeships, for employers and students alike.

According to the Kentucky Labor Cabinet's Department of Workplace Standards, the state currently offers 215 apprenticeship programs, but only one, for Machinists, which had a total of five participants, that relates to a key Aerospace & Aviation industry. There were no apprenticeships related to the key occupations identified in Chapter 3 for Aerospace & Aviation, which include production jobs like Aircraft Structure, Surfaces, Rigging & Systems Assemblers and Computer-Controlled Machine Tool Operators, or MRO-related occupations like Aircraft Mechanic & Service Technician and Industrial Machinery Mechanic. A set of apprenticeships focused on key occupations for the Aerospace & Aviation industries should be developed. Depending on the needs of the workforce and the specificity of the subject area, these apprenticeships could take the form of up-skilling or "returnships" for more experienced workers.

Potential partners to carry this forward could include the Kentucky Workforce Innovation Board as well as Kentucky's newly-formed Division of Apprenticeship, created with funds from an $896,600 grant from the Department of Labor in late 2016 to create a workforce pipeline in Kentucky for apprenticeships for 1,300 individuals "including women, minorities, 16-24 year olds, individuals age 45 or older, veterans, and people with disabilities."[39] The Kentucky Cabinet for Economic Development and other stakeholders describe this new program as filling employment gaps with industry-specific skills. However, Aerospace & Aviation are not among the industries currently participating in the state's registered apprenticeship program.[40] Given the importance of Aerospace & Aviation to the state, creating apprenticeships that fill some of the key occupations to those industries will help students and the sector itself.

As part of the new apprenticeship programs created, Kentucky's TRACK and YES program could be instrumental in introducing the workforce of the future into Aerospace & Aviation industries. The Tech Ready Apprentices for Careers in Kentucky (TRACK) youth pre-apprenticeship program is a partnership between the Kentucky Department of Education's Office of Career and Technical Education and the Kentucky Labor Cabinet to provide secondary students with career pathways opportunities into Registered Apprenticeship programs. Kentucky's newly developed Youth Employment Solutions (YES) program furthers TRACK's initiative by combining the Department of Education with DOL and the private employment company, Adecco, to cover the liability of young students in manufacturing businesses. Previously a closed door to anyone under the age of 18 and sometimes 21, advanced manufacturing in Kentucky has been utilizing the YES Program to expose the state's youth to manufacturing careers. In combination, Kentucky's TRACK and YES programs, both national best practices for apprenticeships, could ensure the state's Aerospace & Aviation industries the workforce they will need to continue their success. Another potential collaborator for these A&A apprenticeships could be KY FAME, the Kentucky Federation for Advanced Manufacturing Education. KY FAME's regional chapters throughout Kentucky connect participating manufacturers with high-achieving high school students and veterans for internships. The companies in turn provide part-time work experience, which is augmented with classroom experience at local community colleges to reinforce relevant skills. At the end of the two-year program, students receive

39 Hensley, J. (2016, Oct. 24). Labor Cabinet Receives $896,600 Apprenticeship Grant. Kentucky.gov. Retrieved from http://kentucky.gov/Pages/Activity-stream.aspx?n=KentuckyDepartmentofLabor&prId=36.
40 Kentucky Labor Cabinet. (2017). Retrieved from http://labor.ky.gov/dows/doesam/AppAndTraining/Pages/About-Apprenticeship-and-Training.aspx.

an associate degree, are certified as an Advanced Manufacturing Technician, and have two years of relevant work experience. It appears that Aerospace & Aviation is not currently a focus area for KYFAME.

Long-Term Recommendations

Recommendation 13: Partner with Community Colleges

Over the longer term, if apprenticeships are created to support key A&A occupations, the curricula offered by community colleges should also be examined to see if there are opportunities to create programs in Aerospace & Aviation. These curricula and programs could both accompany apprenticeships and be an attractor to students interested in Aerospace & Aviation.

Meetings should be convened with stakeholders from community colleges in Kentucky to better understand workforce training gaps in A&A on a community college level. For example, Embry-Riddle Aeronautical University has a campus in Louisville providing associate and bachelor's degrees in subject areas including Aviation Business Administration, Aviation Maintenance, and Logistics and Supply Chain Management. Such meetings would likely be part of the work of sector partnerships when formed. These groups could focus on answering such questions as: What are Aviation-related degree programs offered at other community colleges (for example, at Embry-Riddle Aeronautical University's main campus in Florida) that might benefit Kentucky's Aviation industry and workforce? What other subject areas are relevant to employers, especially in Aerospace manufacturing?

Policy Recommendations

Kentucky has a few major impediments in the way of a thriving Aerospace & Aviation cluster, and a few opportunities that have not been taken advantage of yet. This section focuses on policies that can be highlighted, changed, or put into place to increase the chances of these industries.

Short-Term Policies

Recommendation 14: Re-align Tax Policies and Incentives

Unlike many states, Kentucky taxes both equipment and inventory. In fact, Kentucky is one of only nine states in the union to tax inventory. This inventory tax has a negative impact on Kentucky's Aerospace & Aviation industries. Kentucky's burgeoning cargo Aviation sector, and its Aviation sector in general, may be negatively impacted by the fact that the inventory tax makes it relatively more expensive for Maintenance, Repair, and Overhaul (MRO) to service aircraft. This is because the parts they keep in stock for repairs are subject to the inventory tax, which in turn makes it more expensive for customers (e.g. airlines or freight shipping companies like UPS or Amazon) to purchase MRO services in Kentucky. This should be seen as a potential threat to cargo Aviation in Kentucky.

Another example of tax policy discouraging economic activity, which could have unintended consequences, is the effects the state's property tax has on general Aviation aircraft and their home airport designation. Kentucky taxes aircraft as property, leading owners and operators to register their planes in other states. This could be problematic, as based aircraft counts are one of the FAA's criteria for

determining eligibility to receive Federal funds through the National Plan of Integrated Airport Systems.[41] While aircraft may operate at airports within Kentucky, many are registered in adjoining states due to the property tax.

While some existing taxes can have a negative impact on the cluster, there are opportunities to use tax policy to encourage economic growth of the sector. One example is the tax break Oklahoma companies receive when they hire engineering graduates from state colleges and universities.

> "Aerospace companies hiring engineers in a variety of fields will receive a tax credit equal to five (5) percent of the compensation paid to an engineer until January 1, 2018, or ten (10) percent if the engineer graduated from an Oklahoma college or university (up to $12,500 per employee per year), plus another credit of up to fifty (50) percent of the tuition reimbursed to an employee until January 1, 2018. Additionally, the engineer hired receives a tax credit of $5,000 per year until January 1, 2018."[42]

Tax credits for research and development could also yield positive results, especially in the long-term. According to 2014 *Location Matters: The State Cost of Doing Business* report from the Tax Foundation, the total effective tax rates for different types of businesses reflect some potential misalignments between investments the state may be looking to make in Aerospace & Aviation and the total taxes affecting those types of businesses. As the Location Matters report states, Kentucky's lack of a tax credit for R&D operations means that R&D firms pay among the highest-taxes categories firms within the state. Additionally, distribution centers are taxed at a 22.7% total effective tax rate, which doesn't bode well for the continued expansion for Kentucky's cargo Aviation operations.

Kentucky's tax system must be examined for these types of unintentional biases against the Aerospace & Aviation cluster. With the inventory tax in place, blue collar jobs in MRO are constricted. With the lack of tax credits for R&D, firms looking to capitalize on Kentucky's engineering talent are unlikely to set up their operations within the state. In addition, and as unmanned aircraft systems R&D grows in the state, Kentucky should explore tax incentives targeted at both manufacturers of these platforms, as well as the main user in the state, agriculture.

Furthermore, in *The 50-State Small Business Regulation Index* published by the Pacific Research Institute, Kentucky ranks 22nd in terms of how burdensome its start-up and annual filing regulations are. While this is not a major impediment for new in-state firms, it could be one more reason for out-of-state new firms not to locate there. These costs and procedures should be simplified to allow for ease of business set-up.

Recommendation 15: Expand and Target Advertising Capacity

As was discussed in Chapter 5 of this report, Kentucky has 16 airports with adequate infrastructure that are currently not being utilized by the Aerospace & Aviation industries but would like to engage with that sector. Furthermore, the state has considerable intermodal capacity, especially in the Louisville area.

41 Federal Aviation Administration: National Based Aircraft Inventory Program. Retrieved from https://www.basedaircraft.com/public/FrequentlyAskedQuestions.aspx.
42 Oklahoma Department of Commerce. Aerospace Industry Engineer Workforce Tax Credits. Retrieved from http://okcommerce.gov/business/incentives/Aerospace-industry-engineer-workforce-tax-credits/.

These infrastructure advantages should be advertised to firms that may potentially be interested in locating in the state.

Several entities in the state could be charged with advertising these advantages. ThinkKentucky, the state's Cabinet for Economic Development, is the main economic development arm, representing the state at various trade shows including Hanover Messe, the world's largest industrial technology fair in Germany. Another group, the Kentucky Aviation Association, could be focused on getting the message out on a more national level, attending trade shows and conferences in the U.S. and explaining the capacity of Kentucky's infrastructure. This initiative would be relatively inexpensive, with funding going toward the development of materials and portions of the budgets for trade shows.

Mid-Term Policies

Recommendation 16: Leverage Appropriate Legislation

Setting up the Aerospace & Aviation industry for success also includes loosening the reins on innovation. From interviews with stakeholders, the Mechanical Engineering program at the University of Kentucky and its research on unmanned aerial systems (commonly called drones) has emerged as a potential leader in the Aerospace & Aviation cluster. While the Federal Aviation Administration has authorized the program to conduct research on this topic, in the 2016 session the state legislature also considered "Anti-Drone" legislation, following an incident where a man shot a drone out of the sky when he assumed it was spying on his family.[43] In the current session, HB 540,[44] an ACT, passed out of committee and would require drone operators to clear their plans with GA airport secretaries when operating within a certain radius of a GA airport. Using this technology for voyeurism or harassment is obviously not to be encouraged, but any legislation considered in current or upcoming sessions should take into account safety and security, as well as the important economic impact that continued research could have on the state.

Recommendation 17: Explore Human Capital Centered Incentives

The main concern of businesses today is workforce; in a knowledge economy, having a highly skilled pool of talent ensures a competitive advantage. In order to ensure a deep well of human capital, Kentucky must focus on excellent education and retaining those who graduate with advanced degrees. Furthermore, they must build on the talents of those with advanced degrees.

One option is to offer incentives for workers to stay in Kentucky. This approach is different than typical workforce incentives, which offer training dollars to companies to train workers via the workforce system. To retain highly talented individuals, and to encourage more students to pursue advanced degrees, the state could offer tuition reimbursement. For example, if students graduate with a master's or PhD, the state could offer to pay half of their student loans if they work in the Aerospace & Aviation sector for five years. This reimbursement could be somehow modified also to impact those graduates who chose to start their own company. Additionally, a next-level model of current programming such as Kentucky's Bucks for Brains could serve this purpose, affecting retention and attraction for the state.

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43 Johnson, S. (2016, Feb. 18). Drone Legislation Passes Kentucky Senate Committee. 88.9 WEKU. Retrieved from weku.fm/post/drone-legislation-passes-kentucky-senate-committee.
44 Kentucky Legislature, HB580. (2017). Retrieved from http://www.lrc.ky.gov/record/17RS/HB540.htm.

Long Term Policies

Recommendation 18: Develop an Advanced Manufacturing Tax Credit

Both Aerospace & Aviation would benefit from the state instituting an Advanced Manufacturing Tax Credit, which many other states are doing. In order for Kentucky to stay competitive, it should consider implementing this type of initiative with an eye on the future—that is, any tax incentive should fund the type of development that the state wishes to see, with a focus on the return on the investment.

Sample types of tax incentives for advance manufacturing include the following:

- Through the Manufacturing Innovation Fund, Connecticut offers an innovation voucher program providing $800,000 to help connect small and medium-sized businesses to partners and universities, as a way to encourage them to take up regular R&D and innovation activities
- Massachusetts has appropriated $1 million to support the Massachusetts Advanced Manufacturing Futures Fund for initiatives across five high-priority areas.

Kentucky Commission on Military Affairs &
the Commonwealth of Kentucky

Appendices

Appendix A: Detailed Company Identification Methodology Description

TPMA's definition of the Aerospace & Aviation cluster in Kentucky is meant to encompass all establishments where Aviation or Aerospace-related production, administration, government contracting, or research and development is performed. The search for companies began by first casting a very wide net, analyzing six sources of data for any possible connection to Aerospace & Aviation activity. In order to identify an establishment for inclusion in the final list, TPMA applied stringent tests for industry classifications using the most detailed information currently available. The result, therefore, was the creation of two lists: 1) a final cluster list of companies that are known to perform some sort of Aerospace & Aviation activity, and 2) a "maybe" cluster list that includes all active companies that were connected to the initial search, but cannot be proven to be involved in Aerospace & Aviation activities. In short, the companies in the "final" list have been linked to Aerospace & Aviation activities by either one very strong indicator or more than one moderate indicator. The companies in the "maybe" list have been linked to Aerospace and Aviation activities by just one moderate or weak indicator. The methodology description below applies to this first "final" cluster, which was used for all analysis in this chapter.

To begin the search for establishments, TPMA consulted definitions for the Aerospace & Aviation cluster created by universities and economic development organizations across the country, including but not limited to Georgia Tech, the Indiana Business Research Center, the U.S. Economic Development Administration, and Harvard Business School. Although each of these sources constructed industry definitions based on six-digit NAICS codes, they did not provide a sufficient level of detail for our purposes. TPMA therefore refined the industry-accepted list using eight-digit SIC codes, a more detailed industry classification system that corresponds to but goes one level beyond NAICS codes. By working off of this list, TPMA was able to include industries that would be missed in NAICS code-based definitions and exclude those industries that–though part of a family of industries where Aerospace work is performed—do not belong to the cluster themselves.

Two steps were performed to complete this task. First, each eight-digit SIC industry code was classified as A.) containing entirely Aerospace & Aviation activities, B.) containing partially Aerospace & Aviation activities, or C.) containing no Aerospace or Aviation activities. Second, TPMA analyzed establishments in the proprietary National Employment Time Series (NETS) database, the most complete and accurate source of establishment data available. Each establishment in this database is classified primarily by one eight-digit SIC code based on the work that is performed at that site. However, many establishments perform work in several different industries, so the NETS database also lists secondary through senary (2nd-6th) industry codes when applicable. Based on this hierarchy of industry classifications, establishments were included in the cluster if they met any of the following conditions corresponding to the classifications mentioned above:

1. They were primarily classified as being in an "A" (exclusively Aerospace & Aviation) industry;
2. They were primarily classified as being in a "B" industry but had a secondary-senary code in an "A" industry; or
3. They were primarily classified as being in a "C" industry, but two or more of their secondary-senary classifications were for an "A" industry.

Next, this list was supplemented by identifying the government contracting activities of Kentucky firms. TPMA identified prime award contractors based on the 4-digit Federal Product Service Codes or Federal Supply Codes identified in the DIBBS Navigator from Business Development Zone (BDZ). These number and letter codes classify the services or products provided by each establishment to the government; they are so detailed that they divide government contracting into more than 3,750 categories. TPMA identified the 167 codes from this list that apply to Aerospace & Aviation activities, then added to the cluster any Kentucky-based establishments from the DIBBS Navigator that had performed contracting activities within those codes between 2012 and 2015.

A similar method was used to identify establishments that had served as subcontractors on federal government contracts in the Aerospace & Aviation industries. Though Federal Product Service Codes and Federal Supply Codes are not available from USASpending.Gov for this category of contractors, primary six-digit NAICS codes were provided for each establishment that has provided subcontracting services between 2012 and 2015. Establishments were therefore included in the cluster if,

1. Their NAICS code consists exclusively of Aerospace & Aviation activities,
   OR
2. Their NAICS code includes but is not exclusively Aerospace & Aviation, but they had a SIC code in the NETS database from the "A" industry list.

To complete the list, TPMA was aided by lists generated from previous Kentucky-based Aviation & Aerospace industry studies and events. These included the Kentucky Space Economy Census Report, the Kentucky Cabinet for Economic Development list of Aerospace Facilities, and the list of attendees to the Kentucky Aviation Association Conference. All existing firms from the Space Economy Census and the Aerospace Facilities lists were included in the cluster, while attendees to the Aviation Association Conference were included in the cluster if they had a location within the state and it could be demonstrated that they do perform Aviation-related work.

Once the complete list was created, a few steps were taken to clean the data for the final list. First, TPMA removed any establishments that were indicated to have moved out of Kentucky. Next, TPMA sought to identify any signs of duplicated establishments within the final list. After looking for all firms that shared longitude and latitude coordinates, establishments were compared based on names, NAICS codes, employment, and sales figures. Because establishments sharing office buildings or airport facilities often have the same geographic coordinates, most occurrences of overlap did not indicate duplication. However, establishments were removed if they shared names, NAICS codes, and employment or sales numbers. Additionally, a 0-1 multiplier—based on the probability of duplication—was used to weight employment and sales numbers for potential duplicates that were not removed from the list. This was done to avoid overestimating the economic impact of the Aerospace & Aviation cluster in Kentucky.

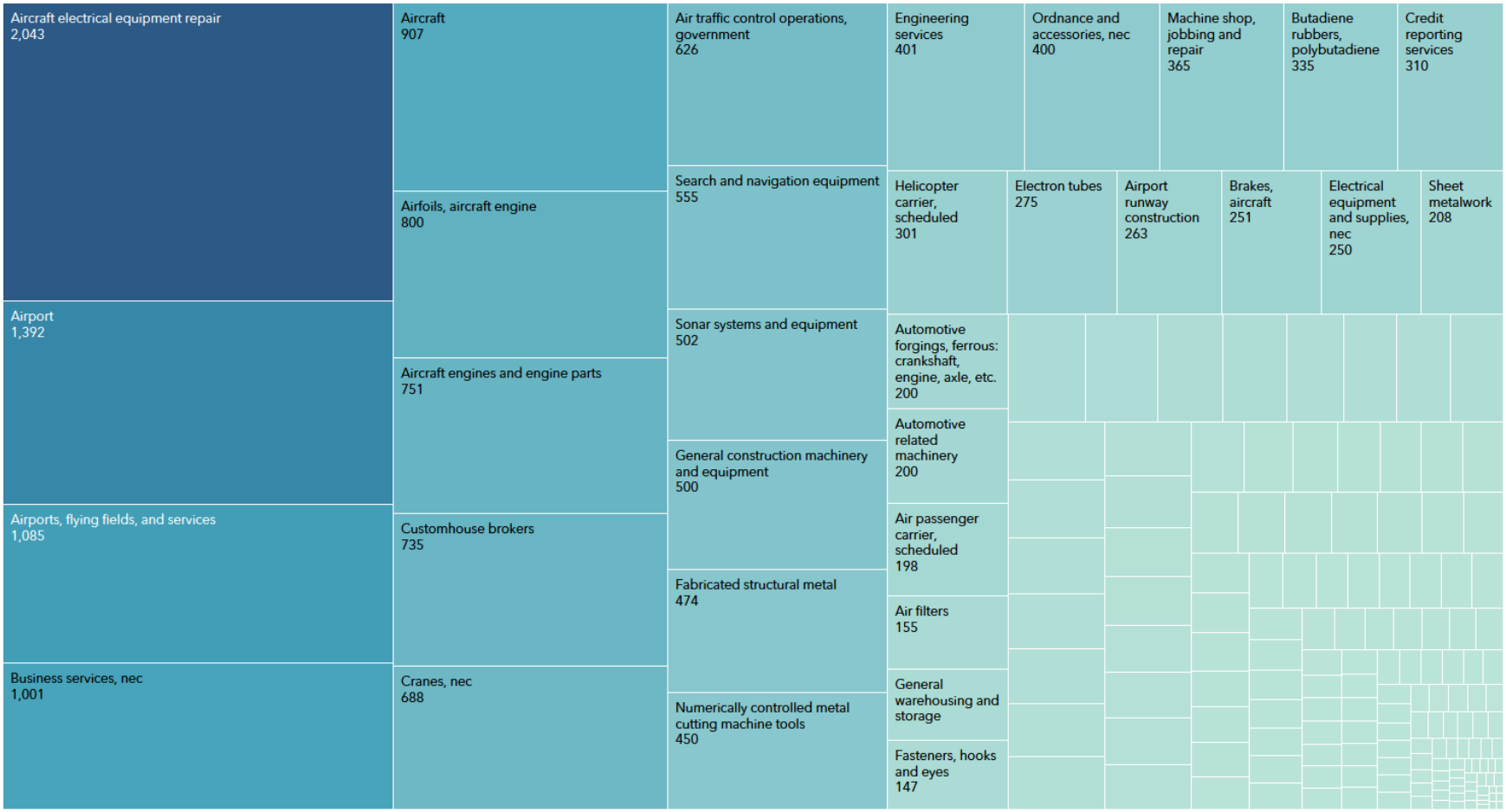
The finished result of this methodology is a comprehensive list of companies within the state of Kentucky that can be demonstrated by a strong set of criteria to be participating in Aerospace or Aviation industry activities.

Appendix B: Full-Page Charts and Maps

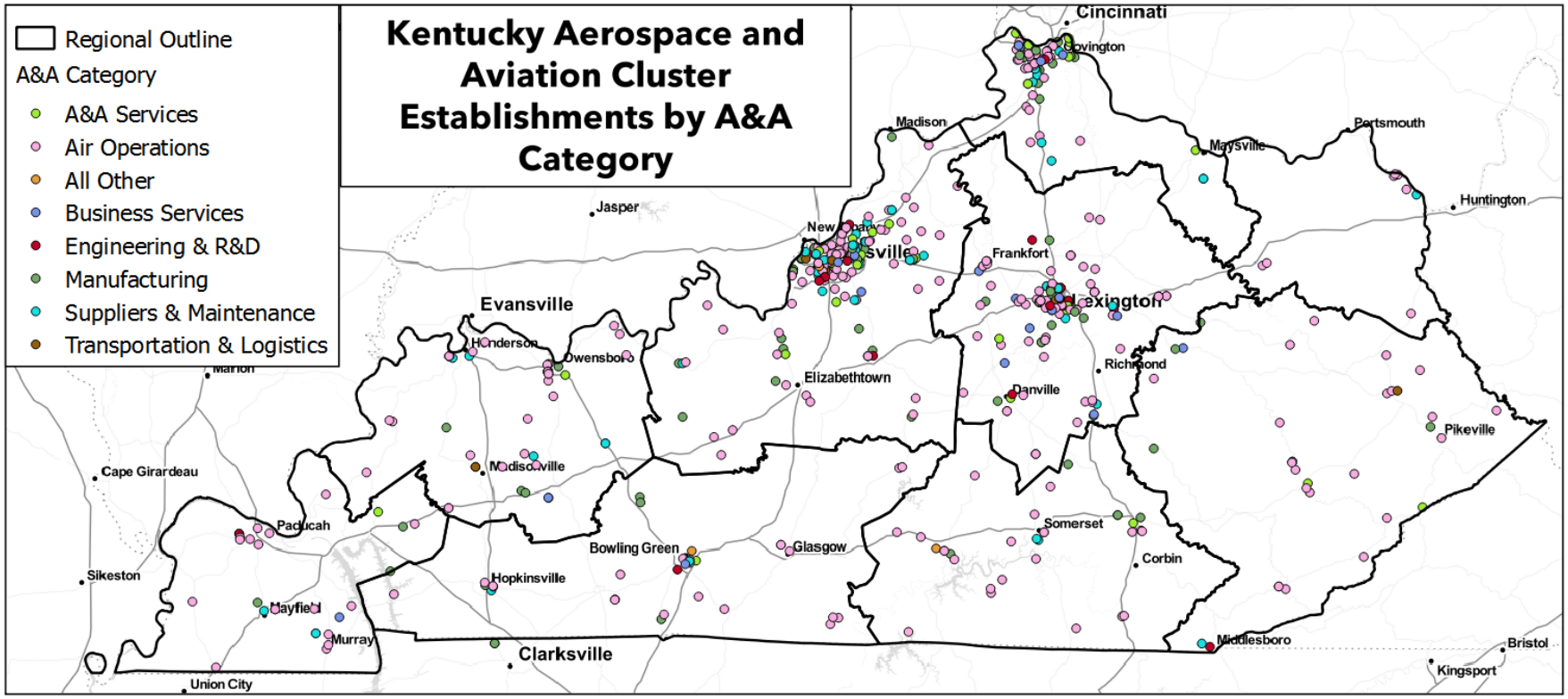
Several of the larger graphics created for this analysis have been reserved until this appendix so that they can be portrayed with adequate size without distracting from the main body of the report.

Aerospace & Aviation Cluster Employment by Standard Industry Classification (SIC Code)

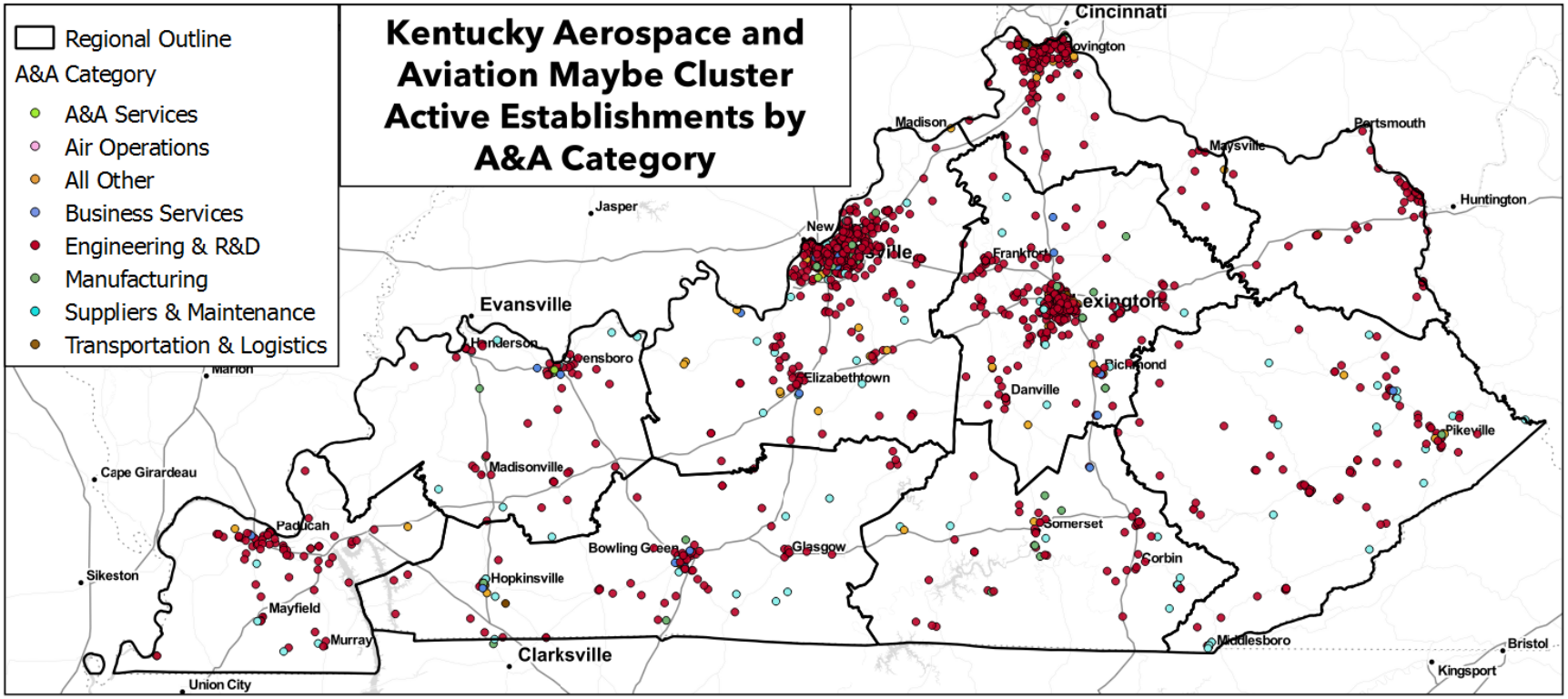
A&A Cluster Employment by Establishment SIC Code



Statewide Map of Active Aerospace & Aviation Cluster Business Locations by Industry Category



Statewide Map of Business Locations that Maybe in the Aerospace & Aviation Cluster by Industry Category



Appendix C: Completions in Majors Related to Key Occupations in Aerospace & Aviation by Institution Type

Appendix C provides detailed breakdowns of completions in each program area and degree level by type of institution, as well as specific breakdowns for Kentucky's four-year public institutions.[1]

Programs Related to Key Occupations (Aerospace Products)

Tables 12-15 provide information on the number and types of degrees conferred in programs related to key occupations in Aerospace Products by type of institution (four-year public, four-year private, four-year proprietary (for-profit), two-year public, and other two-year institutions). Programs are provided in order of CIP code.

Chapter 3 - Table 12: Four-Year Public Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Computer and Information Sciences, General	3	--	--	178	36	217
Information Technology	--	--	--	146	16	162
Informatics	--	--	--	--	0	0
Computer Programming/Programmer, General	0	--	--	--	--	0
Computer Programming, Specific Applications	--	--	--	--	0	0
Information Science/Studies	--	--	--	45	10	55
Computer Science	--	--	--	18	16	34
Aerospace, Aeronautical and Astronautical/Space Engineering	--	--	--	--	0	0
Computer Engineering, General	--	--	--	69	36	105
Mechanical Engineering	--	--	--	197	70	267
Industrial Engineering	7	--	--	35	28	70
Manufacturing Engineering Technology/Technician	2	--	3	90	--	95
Medical Informatics	0	--	--	--	42	42
Logistics, Materials, and Supply Chain Management	--	--	--	1	0	1
Business, Management, Marketing, and Related Support Services, Other	1	--	--	--	0	1
TOTAL	13	--	3	779	254	1,049

1 Institutions are classified as public, private, or proprietary based on their IPEDS classification. For each table, only programs are listed for which at least one institution of that classification offers at least one degree. Where a column has a 0, this indicates that at least one institution of that classification offers a degree at this level, but no degrees were reported to IPEDS as conferred in 2015. If "--" is reported in a given category for a given classification of institution, no institutions in that classification offer that degree, according to IPEDS. The post-bachelor's category for each table includes Post baccalaureate certificates, Masters degrees, and Doctors degrees.

Chapter 3 - Table 13: Four-Year Private (Non-Profit) Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Computer and Information Sciences, General	--	--	6	27	1	34
Information Technology	--	--	0	2	0	2
Computer Systems Analysis/Analyst	--	--	--	1	--	1
Computer Science	--	--	--	9	--	9
Computer Engineering, General	--	--	--	0	--	0
Manufacturing Engineering Technology/Technician	--	--	--	22	--	22
TOTAL	--	--	6	61	1	68

Chapter 3 - Table 14: Four-Year Proprietary Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Information Technology	--	--	10	0	157	167
Computer Programming/Programmer, General	--	--	1	0	--	1
Computer Systems Networking and Telecommunications	--	--	0	--	--	0
Manufacturing Engineering Technology/Technician	--	--	12	6	--	18
Logistics, Materials, and Supply Chain Management	--	--	15	--	--	15
Meeting and Event Planning	--	--	14	--	--	14
Sales, Distribution, and Marketing Operations, General	1	--	11	--	--	12
Business, Management, Marketing, and Related Support Services, Other	0	--	--	--	--	0
TOTAL	1	--	63	6	157	227

Chapter 3 - Table 15: Two-Year Public Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Computer and Information Sciences, General	1,578	--	247	--	--	1,825
Manufacturing Engineering Technology/Technician	17	--	7	--	--	24
Industrial Mechanics and Maintenance Technology	711	126	137	--	--	974
Aircraft Powerplant Technology/Technician	68	1	14	--	--	83
Machine Shop Technology/Assistant	390	99	43	--	--	532
Logistics, Materials, and Supply Chain Management	5	--	1	--	--	6
TOTAL	2,769	226	449	--	--	3,444

Programs Related to Key Occupations (Aviation Services)

Tables 16-20 provide information on the number and types of degrees conferred in programs related to key occupations in Aviation Services by type of institution (four-year public, four-year private, four-year proprietary (for-profit), and two-year public institutions).

Chapter 3 - Table 16: Four-Year Public Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Quality Control Technology/Technician	--	--	--	--	3	3
Public Administration	--	--	--	12	147	159
Airline/Commercial/ Professional Pilot and Flight Crew	--	--	--	27	--	27
Business/Commerce, General	--	--	20	470	535	1,025
Business Administration and Management, General	--	--	13	214	55	282
Entrepreneurship/ Entrepreneurial Studies	--	--	--	20	5	25
International Business/Trade/Commerce	0	--	--	40	--	40
Business, Management, Marketing, and Related Support Services, Other	1	--	--	--	0	1
TOTAL	1	--	33	783	745	1,562

Chapter 3 - Table 17: Four-Year Private Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Business/Commerce, General	--	--	54	382	148	584
Business Administration and Management, General	--	--	17	248	141	406
Entrepreneurship/ Entrepreneurial Studies	--	--	--	0	--	0
International Business/Trade/Commerce	--	--	--	0	--	0
TOTAL	--	--	71	630	289	990

Chapter 3 - Table 18: Four-Year Proprietary Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Public Administration	--	--	--	--	3	3
Business/Commerce, General	0	--	39	--	--	39
Business Administration and Management, General	1	12	141	226	264	644
Accounting Technology/Technician and Bookkeeping	3	5	65	--	--	73
Sales, Distribution, and Marketing Operations, General	1	--	11	--	--	12
TOTAL	5	17	256	226	267	771

Chapter 3 - Table 19: Two-Year Public Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Quality Control Technology/Technician	12	1	2	--	--	15
Industrial Mechanics and Maintenance Technology	711	126	137	--	--	974
Aircraft Powerplant Technology/Technician	68	1	14	--	--	83
Business/Commerce, General	3	--	--	--	--	3
Business Administration and Management, General	1,780	85	416	--	--	2,281
Accounting Technology/Technician and Bookkeeping	0	8	--	--	--	8
TOTAL	2,574	221	569	--	--	3,364

Chapter 3 - Table 20: Two-Year Proprietary Institutions

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Business/Commerce, General	--	--	11	--	--	11
Business Administration and Management, General	0	--	1	--	--	1
Accounting Technology/Technician and Bookkeeping	0	--	2	--	--	2
TOTAL	0	--	14	--	--	14

Completions in Majors Related to Aerospace & Aviation Key Occupations: Breakdown by Four-Year Public Institutions[2]

Chapter 3 - Table 21: Eastern Kentucky University

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer and Information Sciences, General	--	--	--	21	--	21
Computer Science	--	--	--	--	9	9
TOTAL	--	--	--	21	9	30
Aviation Services						
Public Administration	--	--	--	--	13	13
Airline/Commercial/ Professional Pilot and Flight Crew	--	--	--	27	--	27
Business/Commerce, General	--	--	--	34	18	52
Business Administration and Management, General	--	--	--	36	--	36
TOTAL	--	--	--	97	31	128

Chapter 3 - Table 22: Kentucky State University

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer and Information Sciences, General	--	--	--	11	12	23
Information Technology	--	--	--	8	--	8
TOTAL	--	--	--	19	12	31
Aviation Services						
Public Administration	--	--	--	12	20	32
Business/Commerce, General	--	--	--	24	--	24
Business Administration and Management, General	--	--	--	0	5	5
TOTAL	--	--	--	36	25	61

2 Post-Bachelors categories include Post baccalaureate certificates, Masters degrees, and Doctors degrees

Chapter 3 - Table 23: Morehead State University

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer and Information Sciences, General	--	--	--	18	--	18
Aerospace, Aeronautical, and Astronautical/Space Engineering	--	--	--	--	0	0
Manufacturing Engineering Technology/Technician	--	--	3	5	--	8
TOTAL	--	--	3	23	0	26
Aviation Services						
Public Administration	--	--	--	--	9	9
Business/Commerce, General	--	--	--	56	44	100
Business Administration and Management, General	--	--	--	24	--	24
TOTAL	--	--	--	80	53	133

Chapter 3 - Table 24: Murray State University

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Information Technology	--	--	--	10	16	26
Information Science/Studies	--	--	--	23	10	33
Computer Science	--	--	--	18	--	18
Manufacturing Engineering Technology/Technician	--	--	--	2	--	2
Logistics, Materials, and Supply Chain Management	--	--	--	1	--	1
TOTAL	--	--	--	54	26	80
Aviation Services						
Public Administration	--	--	--	0	14	14
Business/Commerce, General	--	--	0	80	115	195
Business Administration and Management, General	--	--	--	17	--	17
International Business/Trade/Commerce	--	--	--	8	--	8
TOTAL	--	--	0	105	129	234

Chapter 3 - Table 25: Northern Kentucky University

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer and Information Sciences, General	--	--	--	41	--	41
Information Technology	--	--	--	84	--	84
Computer Programming/Programmer, General	0	--	--	--	--	0
Computer Programming, Specific Applications	--	--	--	--	0	0
Information Science/Studies	--	--	--	22	0	22
Computer Science	--	--	--	--	7	7
Manufacturing Engineering Technology/Technician	0	--	--	72	--	72
Medical Informatics	0	--	--	--	42	42
TOTAL	0	--	--	219	49	268
Aviation Services						
Public Administration	0	--	--	--	26	26
Business/Commerce, General	--	--	17	81	28	126
Business Administration and Management, General	--	--	--	30	--	30
Entrepreneurship/ Entrepreneurial Studies	--	--	--	14	0	14
TOTAL	0	--	17	125	54	196

Chapter 3 - Table 26: University of Kentucky

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer and Information Sciences, General	--	--	--	69	17	86
Informatics	--	--	--	--	0	0
Information Science/Studies	--	--	--	0	--	--
Computer Engineering, General	--	--	--	30	--	30
Mechanical Engineering	--	--	--	122	18	140
Industrial Engineering	7	--	--	--	2	9
TOTAL	7	--	--	221	37	265
Aviation Services						
Public Administration	--	--	--	--	29	29
Business/Commerce, General	--	--	--	195	200	395
International Business/Trade/Commerce	0	--	--	--	--	0
TOTAL	0	--	--	195	229	424

Chapter 3 - Table 27: University of Louisville

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer Engineering, General	--	--	--	39	36	75
Mechanical Engineering	--	--	--	57	52	109
Industrial Engineering	--	--	--	35	26	61
Logistics, Materials, and Supply Chain Management	--	--	--	--	0	0
TOTAL	--	--	--	131	114	245
Aviation Services						
Public Administration	--	--	--	--	12	12
Business/Commerce, General	--	--	--	--	130	130
Business Administration and Management, General	--	--	--	2	--	2
Entrepreneurship/ Entrepreneurial Studies	--	--	--	--	5	5
TOTAL	--	--	--	2	147	149

Chapter 3 - Table 28: Western Kentucky University

Program Title	<1 year award	1-2 year award	Associate degree	Bachelor's degree	Post-Bachelors	Total
Aerospace Products						
Computer and Information Sciences, General	3	--	--	18	7	28
Information Technology	--	--	--	44	--	44
Mechanical Engineering	--	--	--	18	--	18
Manufacturing Engineering Technology/Technician	2	--	0	11	--	13
Business, Management, Marketing, and Related Supported Services, Other	1	--	--	--	0	1
TOTAL	6	--	0	91	7	104
Aviation Services						
Quality Control Technology/Technician	--	--	--	--	3	3
Public Administration	--	--	--	--	24	24
Business Administration and Management, General	--	--	13	105	50	168
Entrepreneurship/ Entrepreneurial Studies	--	--	--	6	--	6
International Business/Trade/Commerce	--	--	--	32	--	32
Business, Management, Marketing, and Related Support Services, Other	1	--	--	--	0	1
TOTAL	1	--	13	143	77	234

Appendix D: Airport Survey Results

In the following survey results tables, an instance of "N/A" simply means a sufficient response to that specific question was not obtained. In certain cases, the given response was simply not applicable to the question, or the information given in a previous question precluded a response in another. In part, it reflects the conversational aspect of the phone interviews.

Airport Name	Question 1: Use by Aero Mfg.	Question 2: Inquiries	Question 3: Forklift, Other Equipment & Services	Question 4: New Service?	Question 5: Needed Improvements	Question 6: Exec Trans.
Ashland Regional Airport	No	No	No	Possibly	Better access to and from the airport	No
Big Sandy Regional Airport	No	No	Developable land	Yes	Building, forklift, taxiway area	No
Bowman Field	No	No	Yes, FBOs handle air freight	Possibly	N/A	No
Breckinridge County Airport	Yes (limited)	Yes	Newly renovated airport infrastructure.	Yes	Building dedicated for storing part shipments, full-time forklift	Yes
Capital City Airport	Yes	N/A	N/A	N/A	N/A	N/A
Columbia-Adair County	No	No	No	Yes	Longer runway and better, more modern facilities.	No
Cynthiana-Harrison County Airport	No	N/A	N/A	N/A	N/A	N/A
Elizabethtown Regional Airport (Addington Field)	Yes	Yes	Fueling, limited freight handling, forklift.	N/A	More weight handling capability.	Yes.
Fleming-Mason Airport	No	No	No	Yes	Refurbishing of existing buildings, hangars, and facilities	No
Fulton Airport	No	No	N/A	N/A	N/A	No
Gene Snyder Airport	No	No	No	Yes	Additional ramp and hangars	No
Georgetown-Scott County Airport (Marshall Field)	No	No	Two forklifts	Yes	N/A	No
Glasgow Municipal Airport	No	No	No	Yes	Hangar, forklift	No
Grayson County Airport	No	No	No	No	N/A	No

Airport Name	Question 1: Use by Aero Mfg.	Question 2: Inquiries	Question 3: Forklift, Other Equipment & Services	Question 4: New Service?	Question 5: Needed Improvements	Question 6: Exec Trans.
Hancock County Airport (Ron Lewis Field)	Yes (limited)	No	No	Yes	Runway extension jet fuel	Yes
Henderson City-County Airport	Yes, multiple manufacturers	Yes	Forklifts, fuel, do a little of everything	Yes	Longer runway to facilitate larger aircraft	Yes
Hopkinsville-Christian County Airport	No, but they do handle some cargo	No	External company that handles all air freight	Yes	More equipment (forklift)	No
Julian Carroll Airport	No	No	None	Yes	Airport location itself-economically depressed area	No
Kentucky Dam State Park Airport	No	No	No	Yes	N/A	No
Lake Barkley State Park Airport	No	No	Not manned	N/A	They don't have fuel	No
Lake Cumberland Regional Airport (was Somerset-Pulaski County Airport)	Yes	Yes	Ramp access. Shipping companies handle air freight	Yes	Equipment (forklift)	Yes
Lebanon-Springfield Airport	Yes	Yes	New forklift	Yes	More equipment	Yes
Liberty-Casey County	No	No	No facilities or equipment	Yes	Airport location itself-economically depressed area	No
London-Corbin Airport (Magee Field)	Yes	Yes	All-terrain forklift and a regular forklift	Yes	New hangar to handle any aircraft. New runway and taxiway lighting.	Yes
Madison County Airport - Now Central Kentucky Regional (RGA)	No	Yes	They use a forklift service	Yes	Facilities and infrastructure. Equipment (forklift)	Other
Madisonville Municipal Airport	No, but they do handle some cargo	Yes	Open ramp, fuel services	Yes	More ramp space, forklifts.	Other
Marion-Crittenden County Airport	No	No	N/A	No	N/A	No

Airport Name	Question 1: Use by Aero Mfg.	Question 2: Inquiries	Question 3: Forklift, Other Equipment & Services	Question 4: New Service?	Question 5: Needed Improvements	Question 6: Exec Trans.
Mayfield Graves County Airport	No	No	Forklift	No	Runway length, but they don't have any space to expand	No
McCreary County Airport	No	No	No	No	No aerospace manufacturing nearby	No
Middlesboro-Bell County Airport	No	No	N/A	No	N/A	No
Morehead-Rowan County Clyde A. Thomas Regional Airport	No	No	Not set up for any freight	Yes	Not Sure	Other
Mount Sterling-Montgomery County Airport	No	Yes	Forklift, ground transport	No, too busy doing other things	N/A	Other
Muhlenberg County Airport	No	No	10,000 sq ft hangar available. Just completed $3 million runway project	Yes	Equipment (forklift)	No
Murray-Calloway County Airport (Kyle-Oakley Field)	No	Yes	Extremely long runway, ample facilities	Yes	Location, no aerospace manufacturing nearby	No
Ohio County Airport	No	No	5,000 foot runway	Yes	Forklift	No
Pike County Airport (Hatcher Field)	No	No	Fork Lift	Yes	Local Business environment would need to be better	No
Princeton-Caldwell County Airport	No	No	Good amount of land. Very close to highway system (good logistics)	Yes	Buildings, equipment, staffing	No
Providence-Webster County	No	No	No	Yes	Runway overlay	No
Rough River State Park Airport	No	N/A	Not manned, they don't have fuel	N/A	Runway Length, fuel, tower	No
Russell County Airport	No	No	Not set up for any freight	Yes	Airport location itself-economically depressed area	No
Russellville-Logan County Airport	No	No	No	Yes	Runway Extension, warehouse hangar w/	No

Airport Name	Question 1: Use by Aero Mfg.	Question 2: Inquiries	Question 3: Forklift, Other Equipment & Services	Question 4: New Service?	Question 5: Needed Improvements	Question 6: Exec Trans.
					truck loading dock, forklift, pallet jack	
Samuels Field	No	No	Handle all Load/Unloading tasks. Facilitate the ground transportation off airport	Yes	Better Facilities, FBO, loading dock for tractor trailers	Other
Stanton Airport	No	No	No	Yes	Equipment (forklift), runway extension	No
Stuart Powell Field	No (not sure)	N/A	Forklifts, and access to the runway for trucks	N/A	N/A	Other
Sturgis Municipal Airport	No	No	Not set up for any freight	Yes	Not Sure	No
Taylor County Airport	No	No	Can get a forklift with enough advanced notice	Yes	Facilities don't need improvement.	Other
Tompkinsville-Monroe County Airport	No	No	No	Yes	Buildings and roadways	No
Tradewater	No Information Available					
Tucker-Guthrie Memorial Airport	No	No	Yes	Yes	Runway extension	No
Wayne County Airport	No	No	None	No	N/A	Other
Wendell H. Ford Airport	No	No	Forklifts, controlled entry gate, plenty of shovel-ready lots that could be used if needed.	Yes	Extra staff at airport	Other
West Liberty Airport	No	No	No	No	Runway extension	No
Williamsburg-Whitley County Airport	No	Yes	Hangar Space, developable land	Yes	Sewer is the biggest need. Also would need equipment (forklifts)	No

Appendix E: Airport Geographic Proximity to Aerospace Industry Businesses

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
	Lebanon-Springfield Airport	**40069**		
	Samuels Field	**40004**		
1	BLUEGRASS AVI PARTNERS LLC	40004	Air Operations	Airports, flying fields, and services
2	KENTUCKIANA AVIATION GROUP LLC	40004	Air Operations	Airports, flying fields, and services
3	FET ENGINEERING INC	40004	Manufacturing	Molding primary plastics
4	EFFICIENCY MACHINING SERVICE	40013	Manufacturing	Machine shop, jobbing and repair
5	OLDHAM AVIATION LLC	40014	Air Operations	Airports, flying fields, and services
6	HONAKER AVIATION INC	40014	A&A Services	Aviation school
7	SKYS OPEN SPORT AVIATION LLC	40014	Air Operations	Airports, flying fields, and services
8	FLIGHT TRAINING SOLUTIONS LLC	40014	A&A Services	Flying instruction
9	STAR AVIATION INC	40014	Suppliers & Maintenance	Aircraft and heavy equipment repair services
10	B B AVIATION	40014	Air Operations	Airports, flying fields, and services
11	AIR-VEGAS AIRLINES	40031	Air Operations	Air passenger carrier, scheduled
12	EXPRESS JET CORPORATE AVIATION	40031	Air Operations	Aircraft maintenance and repair services
13	AAR MANUFACTURING INC	40033	Manufacturing	Rockets, space and military, complete
14	GOSMAN AIRCRAFT	40045	Manufacturing	Aircraft
15	PATTERSON UTI DRLG	40047	Air Operations	Airports, flying fields, and services
16	GOLDEN AGE AEROPLANE WORK	40047	Air Operations	Aircraft maintenance and repair services
17	GIVENS AVIATION INC	40047	Business Services	Aircraft rental
18	FAST TRACK FLIGHT LLC	40055	Air Operations	Sightseeing airplane service
19	C & G AIR CARGO INC	40057	Air Operations	Air cargo carrier, scheduled
20	JAGGERS EQUIPMENT COMPANY INC	40059	Manufacturing	Railroad equipment
21	STONEWAY AVIATION LLC	40059	Air Operations	Airports, flying fields, and services
22	STRATEGIC AERONAUTICS INC	40059	Engineering & R&D	Aviation and/or aeronautical engineering

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
23	OSPREY AVIATION	40065	Air Operations	Airports, flying fields, and services
24	M R AVIATION	40065	Air Operations	Airports, flying fields, and services
25	AAPER ALCOHOL AND CHEMICAL CO	40065	Manufacturing	Ethylene oxide
26	SHELBY INDUSTRIES LLC	40065	Manufacturing	Winches
27	INTERNATIONAL FIXED-WING INC	40065	Suppliers & Maintenance	Aircraft and heavy equipment repair services
28	KENTUCKY AIR CENTER INC	40065	Suppliers & Maintenance	Aircraft electrical equipment repair
29	CAR DEALZ INC	40065	A&A Services	Aircraft dealers
30	SPACE WING AVIATION LLC	40067	Air Operations	Airports, flying fields, and services
	Breckinridge County Airport	**40143**		
1	MODIFIED AIRCRAFT ACCESSORY	40109	Suppliers & Maintenance	Aircraft and heavy equipment repair services
2	J & W MACHINE INC	40119	Manufacturing	Aircraft assemblies, subassemblies, and parts, nec
3	11TH AVIATION COMMAND	40121	Air Operations	Airports, flying fields, and services
4	ARMY UNITED STATES DEPT OF	40121	Manufacturing	Automatic pilots, aircraft
5	BLUEGRASS AVIATION GROUP LLC	40142	Air Operations	Airports, flying fields, and services
6	WHITWORTH TOOL INC	40143	Manufacturing	Machine shop, jobbing and repair
7	MATTHEWS AVIATION LLC	40143	Suppliers & Maintenance	Aircraft and parts, nec
8	LOCKHEED MARTIN CORPORATION	40160	Manufacturing	Aircraft
9	VETERANS AIRCRAFT SALES	40160	A&A Services	Aircraft dealers
10	CHILDRESS AVIATION LLC	40165	Air Operations	Airports, flying fields, and services
11	MORRIS RANDALL CO INC	40175	Air Operations	Aircraft servicing and repairing
	Morehead-Rowan County Clyde A. Thomas Regional Airport	**40313**		
	Georgetown-Scott County Airport (Marshall Field)	**40379**		
	Mount Sterling-Montgomery County Airport	**40353**		
1	BONEAL AEROSPACE INC	40312	Manufacturing	Aircraft parts and equipment, nec
2	POGO AVIATION LLC	40324	Air Operations	Airports, flying fields, and services
3	FAYETTE AVIATION INC	40324	Air Operations	Airports, flying fields, and services
4	R A WIEDEMANN & ASSOCIATES	40324	Engineering & R&D	Aviation and/or aeronautical engineering

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
5	GEORGTWN-SCOTT CNTY ARPRT CORP	40324	Air Operations	Flying charter service
6	AICHI FORGE USA INC	40324	Manufacturing	Automotive forgings, ferrous: crankshaft, engine, axle, etc.
7	DANVILLE AVIATION LLC	40330	Air Operations	Aircraft servicing and repairing
8	MIDWEST AMERICA CORPORATION	40330	Business Services	Aircraft rental
9	SOUTHEAST APPARATUS LLC	40336	Air Operations	Airports, flying fields, and services
10	YKK SNAP FASTNERS AMERICA INC	40342	Manufacturing	Fasteners, hooks and eyes
11	BONEAL INCORPORATED	40346	Manufacturing	Conveyors and conveying equipment
12	CROSSROADS EXPRESS	40353	Air Operations	Air cargo carrier, scheduled
13	KENTUCKY AIRMOTIVE INC	40353	Air Operations	Airport leasing, if operating airport
14	MIDWEST AIRMOTIVE INC	40353	A&A Services	Aircraft dealers
15	GLC INDUSTRIES LLC	40353	Manufacturing	Permanent wave equipment and machines
16	EAGLE AIRCRAFT RENTAL LLC	40356	Business Services	Aircraft rental
17	LEXINGTON AVIATION CENTER INC	40356	Air Operations	Airports, flying fields, and services
18	Thoroughbred Aviation Maintenance, Inc.	40356	Manufacturing	Aerospace Products & Parts Manufacturing
19	R J CORMAN DIST CTRS LLC	40356	Transportation & Logistics	Railroad freight agency
20	MACHINING PLUS MFG CO LLC	40356	Manufacturing	Screw machine products
21	BRENNAN FARM	40361	Air Operations	Airports, flying fields, and services
22	PATRIOT AVIATION LLC	40372	A&A Services	Aviation school
23	STANTEK LLC	40380	Business Services	Personal service agents, brokers, and bureaus
24	FLAGSHIP AVIATION LLC	40383	Air Operations	Airports, flying fields, and services
25	LIMESTONE AVIATION LLC	40383	Air Operations	Airports, flying fields, and services
26	B AND D CLEANING	40383	Air Operations	Airports, flying fields, and services
27	UNMANNED SERVICES INC	40383	Engineering & R&D	Business consulting, nec
28	GRAX AVIATION LLC	40390	Air Operations	Airports, flying fields, and services
29	FREEDOM AVIATION LLC	40391	Air Operations	Airports, flying fields, and services
30	PALMER ENGINEERING CO	40391	Engineering & R&D	Civil engineering

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
31	AERO-MARK LLC	40391	Business Services	Aircraft rental
32	ORION-METCO LLC	40391	Suppliers & Maintenance	Metals service centers and offices
	Central Kentucky Regional	**40475**		
	Stuart Powell Field	**40484**		
1	BLUEGRASS ULTRALIGHT GROUP	40403	Business Services	Aircraft and industrial truck rental services
2	MIDDLETOWN INDUSTRIAL INC	40403	Suppliers & Maintenance	Hardware stores
3	MIDDLETOWN COMPOSITES INC	40403	Manufacturing	Aircraft parts and equipment, nec
4	EST TOOL & MACHINE INC	40409	Manufacturing	Special dies, tools, jigs, and fixtures
5	Meggitt Aircraft Braking Systems Corporation	40422	Manufacturing	Aerospace Products & Parts Manufacturing
6	Mead and Hunt, Inc.	40422	Engineering & R&D	Architectural & Engineering Services
7	CENTRAL SEAL COMPANY	40422	A&A Services	Surfacing and paving
8	PHOENIX PRODUCTS INC	40447	Manufacturing	Aircraft body assemblies and parts
9	SPECTRUM AVIATION	40475	Air Operations	Airports, flying fields, and services
	Capital City Airport	**40601**		
1	PAUL AND LINDY HUBER	40601	Air Operations	Airport terminal services
2	L-3 VERTEX	40601	Engineering & R&D	Aviation and/or aeronautical engineering
3	HANSON PROFESSIONAL SERVICES	40601	Business Services	Business associations
4	LEGISLATIVE OFFICE OF KENTUCKY	40601	Air Operations	Legislative bodies, state and local
5	CAPITAL CITY AIRPORT	40601	Air Operations	Airports, flying fields, and services
6	LB & B ASSOCIATES	40601	Air Operations	Aircraft cleaning and janitorial service
7	MILITARY AFFAIRS KY COMM ON	40601	Air Operations	Governors' office
8	FLIGHT FIXINS INC	40601	Air Operations	Aircraft servicing and repairing
9	TRANSPORTATION CABINET KY	40622	A&A Services	Airport runway construction
	London-Corbin Airport (Magee Field)	**40744**		
	Williamsburg-Whitley County Airport	**40769**		
1	NEW KOLB AIRCRAFT CO LLC	40741	Manufacturing	Aircraft
2	KOLB AIRCRAFT INC	40741	Manufacturing	Airplanes, fixed or rotary wing
3	IRVINE PAINTING & MAINTENANCE	40741	A&A Services	Aircraft painting
4	HIGHLANDS DIVERSIFIED SVCS INC	40741	Manufacturing	Electrical equipment and supplies, nec

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
5	AK & K INC	40744	Air Operations	Air cargo carriers, nonscheduled
6	WILLIAMSBURG-WHITLEY COUNTY AI	40769	Air Operations	Airports and flying fields
	Ashland Regional Airport	**41183**		
1	ABKEN AVIATION COMPANY INC	41101	Air Operations	Airports, flying fields, and services
2	BRICKER AVIATION PLLC	41183	Air Operations	Airports, flying fields, and services
	Big Sandy Regional Airport	**41214**		
1	DON BAILEY AVIATION INC	41232	Air Operations	Airports, flying fields, and services
2	SOUTHERN AVIATION LLC	41240	Air Operations	Airports, flying fields, and services
	Wendell H. Ford Airport	**41367**		
0	**(none)**			
	Pike County Airport (Hatcher Field)	**41501**		
1	APPALCHIAN AVIATION LLC	41501	Air Operations	Airports, flying fields, and services
2	QUALITY AVIATION	41501	Manufacturing	Automatic pilots, aircraft
3	HIGH ROAD AVIATION	41531	Air Operations	Airports, flying fields, and services
4	WINGSFREE	41537	A&A Services	Aviation school
	Mayfield Graves County Airport	**42066**		
	Murray-Calloway County Airport (Kyle-Oakley Field)	**42071**		
1	UPWARD BOUND AVIATION LLC	42001	Air Operations	Airports, flying fields, and services
2	PROAIR AVIATION LLC	42001	Air Operations	Airports, flying fields, and services
3	TF AVIATION LLC	42001	Air Operations	Airports, flying fields, and services
4	T & T AVIATION LLC	42003	Air Operations	Airports, flying fields, and services
5	PRECISION AG AVIATION LLC	42021	Air Operations	Airports, flying fields, and services
6	J & C AIRCRAFT ENGINES	42025	Air Operations	Aircraft cleaning and janitorial service
7	ATLANTA HELICOPTERS INC	42036	Business Services	Aircraft rental
8	MAIN CHANNEL ENTERPRISES LLC	42038	Manufacturing	Aircraft
9	JOHN CRANE INC	42048	Air Operations	Aircraft servicing and repairing
10	MAYFIELD AIRPORT AWOS	42066	Business Services	Aircraft rental
11	CRAWFORD EQUIPMENT INC	42066	Manufacturing	Aircraft parts and equipment, nec

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
12	ACE	42066	Suppliers & Maintenance	Compressor repair
13	LITTRELL AVIATION LLC	42066	Air Operations	Airports, flying fields, and services
14	MS1 AVIATION LLC	42071	Air Operations	Airports, flying fields, and services
15	MAINSTREAM AVIATION LLC	42071	Air Operations	Airports, flying fields, and services
16	CARDINAL AVIATION INC	42071	Suppliers & Maintenance	Aviation propeller and blade repair
17	MIDWEST AVIATION SERVICES INC	42086	Engineering & R&D	Aviation and/or aeronautical engineering
18	MIDWEST AVIATION INC	42086	A&A Services	Aircraft dealers
	Glasgow Municipal Airport	**42141**		
1	TPM INC	42101	All Other	Environmental cleanup services
2	RER AVIATION LLC	42103	Air Operations	Airports, flying fields, and services
3	RAFFERTYS INC	42103	Air Operations	Air passenger carriers, nonscheduled
4	GIVENS AVIATION INC	42103	A&A Services	Aviation school
5	AERO AVIATION ASSOCIATES LLC	42103	Air Operations	Airports, flying fields, and services
6	AIRLINE TRANSPORT PROFESSIONAL	42103	A&A Services	Airline training
7	COMAR INC	42103	Suppliers & Maintenance	Aviation propeller and blade repair
8	KS WARE	42104	Engineering & R&D	Consulting engineer
9	FLY-BY-MIKE INC	42104	Business Services	Aircraft rental
10	VERMONT THREAD GAGE LLC	42134	Manufacturing	Precision tools, machinists'
11	BOMAR AVIATION INC	42164	Air Operations	Airports, flying fields, and services
12	TOMPKINSVILLE AVIATION LC	42167	Air Operations	Airports, flying fields, and services
	Hopkinsville-Christian County Airport	**42240**		
1	PATRIOT A CONSULTING SVCS LLC	42211	Air Operations	Airports, flying fields, and services
2	NORTHROP GRUMMAN SYSTEMS CORP	42223	Manufacturing	Infrared sensors, solid state
3	BOEING SKRSKY ARCFT SPPORT LLC	42223	Engineering & R&D	Engineering services
4	GIVENS AVIATION	42240	A&A Services	Airline training
5	WESTERFIELD AVIATION LLC	42240	Air Operations	Airports, flying fields, and services
6	DUNLAP SUNBRAND INTL INC	42240	Suppliers & Maintenance	Sewing machines, industrial
7	CLEAN AIR TECH SOLUTIONS LLC	42240	Manufacturing	Filtration devices, electronic

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
8	BLACKHAWK COMPOSITES INC	42261	Manufacturing	Aerospace castings, aluminum
9	BILL AIRCRAFT MODELS LLC	42261	Manufacturing	Aircraft
10	SUNSHINE AVIATION	42276	Air Operations	Airports, flying fields, and services
	Hancock County Airport (Ron Lewis Field)	**42351**		
	Ohio County Airport	**42320**		
	Muhlenberg County Airport	**42345**		
1	EDGCUMBE/G & N INC	42301	Suppliers & Maintenance	Aircraft engines and engine parts
2	KEN-TRON MFG INC	42301	Manufacturing	Electronic enclosures, stamped or pressed metal
3	WATTS BROTHERS CABLE CNSTR INC	42301	Air Operations	Hangars and other aircraft storage facilities
4	MODERN TRANSPORTATION INC	42301	Air Operations	Flying field, except those maintained by clubs
5	PRECISION ENGINE	42301	Suppliers & Maintenance	Aircraft and heavy equipment repair services
6	FLYING DUTCHMAN INC	42303	A&A Services	Flying instruction
7	MPD INC	42303	Manufacturing	Electron tubes
8	BIG SOUTH FORK AVIATION INC	42304	Air Operations	Airports, flying fields, and services
9	ENSIGN BICKFORD AD CO	42344	Manufacturing	Search and navigation equipment
10	ENSIGN-BICKFORD AEROSPC & DEF	42344	Manufacturing	Acceleration indicators and systems components, Aerospace
11	MUHLENBURG COUNTY OF	42345	Business Services	Airport leasing, if not operating airport
12	FORTENER AVIATION INC	42347	Air Operations	Aircraft maintenance and repair services
13	LOWE AVIATION INC	42372	Air Operations	Aircraft maintenance and repair services
	Henderson City-County Airport	**42420**		
	Madisonville Municipal Airport	**42431**		
	Sturgis Municipal Airport	**42459**		
1	SAMS AIRCRAFT LLC	42411	A&A Services	Aircraft dealers
2	CLEAR SKIES AVIATION LLC	42420	Air Operations	Airports, flying fields, and services
3	PRESTON AVIATION LLC	42420	Air Operations	Airports, flying fields, and services
4	MOOSE AVIATION LLC	42420	Air Operations	Airports, flying fields, and services
5	RON COLLINS AVIATION ELEC LLC	42420	Suppliers & Maintenance	Electronic parts and equipment, nec
6	DAVIS DON AVIATION INC	42420	Air Operations	Flying charter service

	Airport/Business	Zip	Aerospace & Aviation Industry Category	Industry Group
7	BRENNTAG MID-SOUTH INC	42420	Suppliers & Maintenance	Industrial chemicals
8	HENDERSON CITY COUNTY AIRPORT	42420	Air Operations	Air freight handling at airports
9	CLARKE POWER SERVICES INC	42420	Suppliers & Maintenance	Industrial machinery and equipment
10	GENERAL ELECTRIC COMPANY	42431	Manufacturing	Airfoils, aircraft engine
11	GENERAL ELECTRIC COMPANY	42431	Transportation & Logistics	Transportation Services Sector
12	BODYCOTE IMT INC	42445	Manufacturing	Metal heat treating
13	DEM AVIATION LLC	42459	Air Operations	Airports, flying fields, and services
	Lake Cumberland Regional Airport	**42501**		
1	SUMMIT AVIATION	42501	Air Operations	Aircraft maintenance and repair services
2	SOMERSET REGIONAL AVIATION	42501	Air Operations	Aircraft maintenance and repair services
3	CUMBERLAND AERO SERVICE INC	42518	Air Operations	Aircraft servicing and repairing
4	CASEY COUNTY OF	42539	Air Operations	Airports, flying fields, and services
5	SOMERSET REGIONAL AVIATION LLC	42544	Air Operations	Airports, flying fields, and services
6	AVSOURCE AVI PROFESSIONALS INC	42553	Air Operations	Airports, flying fields, and services
	Russell County Airport	**42629**		
1	KARNES AVIATION LLC	42629	Air Operations	Airports, flying fields, and services
2	GGF HERITAGE MANUFACTURING LLC	42629	Manufacturing	Aircraft parts and equipment, nec
3	MARLOU AVIATION LLC	42633	Air Operations	Aircraft servicing and repairing
4	SELBY ASPHALT MAINTENANCE	42642	All Other	Resurfacing contractor
	Elizabethtown Regional Airport (Addington Field)	**42701**		
	Taylor County Airport	**42718**		
1	JP TOOLING	42701	Manufacturing	Aircraft forgings, ferrous
2	CLINTON CUMBERLAND COUNTIES AI	42717	Air Operations	Airport terminal services
3	KEY AVIATION INC	42718	Air Operations	Air passenger carrier, scheduled
4	LAKESIDE AIRCRAFT LLC	42726	Air Operations	Airports, flying fields, and services
5	PLANE AVIATION	42754	Air Operations	Airports, flying fields, and services

Appendix F: Air Freight Forwarders Near Kentucky Airports

Company	Zip	Other Locations	Phone	Website
A2 Global Shipping	40511		(859) 449-4737	a2globalshipping.com
Adkins Export Packing & Machinery Movers	40203		(502) 583-5551	adkinsinc.com
Agility Logistics Gil	41018		(859) 689-5600	agility.com
AIT Worldwide Logistics-Louisville	40218	41042	(502) 364-7777	aitworldwide.com
Ameriflight	40213		(502) 368-7539	w3.ameriflight.com
Associated Global Systems	41048	40209	(859) 534-5262	agsystems.com
BDP International	41018		(859) 488-0676	bdpinternational.com
C J International Inc	41042	40209, 46241	(859) 282-7200	cjinternational.com
CEVA Logistics	40213		(800) 888-4949	cevalogistics.com
CNE Worldwide Logistics	40165		(502) 531-9379	cnelogistics.com
Commonwealth Express	40324		(502) 370-4186	
Continental Freight Forwarding	40207		(502) 742-5053	
Dachser Transport of America	41005		(859) 282-6666	dachser.us
DB Schenker USA	41018	40218	(859) 212-2700	dbschenkerusa.com
DSV Air & Sea Inc	41018		(859) 647-6050	us.dsv.com
Dynamic Supply Chain Solutions, LLC	41017		(859) 331-7447	shippei.com
Emo Trans USA Inc	41018		(859) 689-9600	emotrans-global.com
Expeditors	41048		(859) 282-9494	expeditorscincinnati.com
Expeditors International	40213		(502) 367-6700	expeditors.com
Forward Air Inc	40219		(502) 966-6069	forwardair.com
Hanjin Shipping Co	41017		(859) 331-2591	hanjin.com
John S Connor Inc	40213		(502) 962-9900	jsconnor.com
Kentucklana Freight	41008		(502) 662-0662	
Kintetsu World Express USA Inc	41048	40209	(859) 689-0233	kweusa.com
Kuehne & Nagel	40258	41018	(502) 933-6080	
Kyfi	40219		(502) 810-9800	kyfi.com
Landstar Inway Inc	40351		(606) 780-4141	landstar.com
Legion Logistics	41042		(859) 384-1726	jointhelegion.com
Liberty Transportation, Inc.	41018		(859) 282-0505	teamww.com
Mainfreight	41017		(859) 282-0101	mainfreight.com
Miami Valley Worldwide, Inc.	41048		(859) 283-2644	miamivalleyworldwide.com

Company	Zip	Other Locations	Phone	Website
Nippon Express USA	41048		(859) 525-0002	nipponexpressusa.com
NNR Air Cargo Services Inc	41018		(859) 371-3339	nnrglobal.com
Pace Air Freight Inc	41042	40209	(859) 647-0170	paceairfreight.com
Pak Mail	41091		(859) 578-0580	pakmail.com
Phoenix International Freight	41018		(859) 282-1188	phoenixintl.com
Qw Express	40213	40511	(502) 479-3302	qwexpress.com
Saia LTL Freight	40511		(859) 253-0108	saia.com
SBA Global	40209		(859) 331-2591	sbaglobal.com
Seko Worldwide	41018		(859) 647-7507	sekologistics.com
Southeastern Freight Lines	40208		(502) 912-5809	sefl.com
The Expediting Company, Inc	41018		(800) 890-1573	expco.com
Transgroup Worldwide Logistics	41018		(859) 594-4900	transgroup.com
UPS Freight	40509	42104, 41048	(859) 263-2728	upsfreight.com
US Worldwide Logistics Inc	41048		(859) 525-7477	oiaglobal.com
Xpress Global Systems Inc	40218		(502) 966-3329	xgsi.com
YRC Freight	42101	40216	(270) 782-7190	yrc.com
Yusen Air & Sea Services USA	40209		(859) 282-1700	

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