Draft Environmental Assessment for the Denver Metroplex Project

April 22, 2019

Prepared by:

United States Department of Transportation

Federal Aviation Administration

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1 Introduction

The National Environmental Policy Act of 1969 (NEPA) [42 United States Code (U.S.C.) § 4321 et seq.], requires federal agencies to disclose to decision makers a clear, accurate description of the potential environmental impacts that could arise from proposed federal actions. Through NEPA, Congress has directed federal agencies to consider environmental factors in their planning and decision-making processes and to encourage public involvement in decisions that affect the quality of the human environment. As part of the NEPA process, federal agencies are required to consider the environmental effects of a proposed action and reasonable alternatives to the Proposed Action, including a No Action (i.e., analyzing the potential environmental effects of not undertaking the proposed action). The Federal Aviation Administration (FAA) has established a process to ensure compliance with the provisions of NEPA through FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (FAA Order 1050.1F).

The Proposed Action, the subject of this Environmental Assessment (EA), is called the Denver Metroplex or "DEN Metroplex" Project.[1] The Air Traffic Control (ATC) procedures ("ATC procedures") designed for the DEN Metroplex Project would be used by arriving and departing aircraft operating under Instrument Flight Rules (IFR) at the study area airports ("the Study Airports").

This EA, prepared in accordance with FAA Order 1050.1F, documents the potential effects to the environment that may result from the optimization of ATC procedures[2] at the Study Airports. These airports, discussed in further detail in Section 1.4, were selected based on whether they would be directly served by a proposed ATC procedure and if so, whether they served the required number of annual Instrument Flight Rules (IFR) filed operations under FAA Order 1050.1F[3]. The Study Airports are:

- Centennial Airport (APA)
- Denver International Airport (DEN)
- Greeley-Weld County Airport (GXY)
- Northern Colorado Regional Airport (FNL)
- Rocky Mountain Metropolitan Airport (BJC)

This EA includes the following chapters and appendices:

- **Chapter 1: Introduction.** Chapter 1 provides basic background information on the air traffic system, the Next Generation Air Transportation System (NextGen) program, Performance-Based Navigation (PBN), the FAA's Metroplex initiative, and information on the Denver Metroplex and the Study Airports.

[1] The Metroplex initiative was formerly referred to as the Optimization of Airspace and Procedures in the Metroplex (OAPM) initiative. A Metroplex is a geographic area covering several airports, serving major metropolitan areas and a diversity of aviation stakeholders.

[2] See Section 1.2 of this EA for a further discussion of air traffic optimization.

[3] Department of Transportation, Federal Aviation Administration, Order 1050.1F, *Environmental Impacts: Policies and Procedures*, Appendix B. Federal Aviation Administration Requirements for Assessing Impacts Related to Noise and Noise-Compatible Land Use and Section 4(f) of the Department of Transportation Act (49 U.S.C. § 303), Para. B-1. Noise and Noise-Compatible Land Use. July 16, 2015.

- **Chapter 2: Purpose and Need.** Chapter 2 discusses the need (i.e., problem) and purpose (i.e., solution) for airspace and procedure optimization in the Denver Metroplex area, and identifies the Proposed Action.
- **Chapter 3: Alternatives.** Chapter 3 discusses the Proposed Action and the No Action analyzed as part of the environmental review process.
- **Chapter 4: Affected Environment.** Chapter 4 discusses existing environmental conditions within the Denver Metroplex area.
- **Chapter 5: Environmental Consequences.** Chapter 5 discusses the potential environmental impacts associated with the Proposed Action and the No Action.
- **Appendix A: Agency Coordination, Community Involvement, and List of Receiving Parties.** Appendix A documents agency and public coordination associated with the EA process and lists the local agencies and parties identified to receive copies of the Draft and Final EA documents.
- **Appendix B: List of Preparers.** Appendix B lists the names and qualifications of the principal persons contributing information to this EA.
- **Appendix C: References.** Appendix C provides references to documents used to prepare this EA document.
- **Appendix D: List of Acronyms and Glossary.** Appendix D lists acronyms and provides a glossary of terms used in this EA.
- **Appendix E: Basics of Noise.** Appendix E presents information on aircraft noise as well as the general methodology used to analyze noise associated with aviation projects.
- **Appendix F: Denver Metroplex Study Team Final Report.** Appendix F contains the conceptual FAA Study Team methodology, findings, and designs used by the FAA Design and Implementation Team to craft Preliminary and Proposed Final Designs.
- **Appendix G: Denver Metroplex Design and Implementation Team Final Report.** Appendix G contains a summary and detailed summaries of the Preliminary Final Designs for proposed air traffic control procedures analyzed in this EA.
- **Appendix H: Denver Metroplex Flight Schedules Technical Report.** Appendix H describes the methodology and inputs used to forecast air traffic for the Study Airports described in this EA.
- **Appendix I: Denver Metroplex Noise Technical Report.** Appendix I presents detailed and technical information on the noise analysis conducted in support of this EA.
- **Appendix J: Reserved.** Appendix J is reserved for Comments on the Draft EA and is not included in this Draft EA.

1.1 Project Background

On January 16, 2009, the FAA asked RTCA[4] to create a joint government-industry task force to make recommendations for implementation of Next Generation Air Transportation System (NextGen) operational improvements for the nation's air transportation system. In response, RTCA assembled the NextGen Mid-Term Implementation Task Force (Task Force 5), which included more than 300 representatives from commercial airlines, general aviation, the military, aerospace manufacturers, and airport stakeholders.[5] Section 1.2.5 discusses the NextGen Program in more detail.[6]

On September 9, 2009, RTCA issued the NextGen Mid-Term Implementation Task Force Report, which provided the Task Force 5 recommendations. One of these recommendations directed the FAA to undertake planning for implementing Performance-Based Navigation (PBN)[7] ATC procedures on a Metroplex basis, including Area Navigation (RNAV) and Required Navigation Performance (RNP), which are discussed further in Sections 1.2.5.1 and 1.2.5.2. Based on this recommendation, the FAA began the Metroplex initiative.

The purpose of the Metroplex initiative is to optimize ATC procedures and airspace on a regional scale. This is accomplished by developing ATC procedures that take advantage of technological advances in navigation, such as RNAV, while ensuring that aircraft not equipped to use RNAV continue to have access to the National Airspace System (NAS). This approach addresses airspace congestion and other factors that reduce airspace efficiency in busy metroplex areas and accounts for key operating airports and airspace in a metroplex. The DEN Metroplex Study Airports are further discussed in Section 1.4. The metroplex initiative also addresses connectivity with other metroplex areas. The overall intent is to use limited airspace as efficiently as possible for congested metroplex areas.[8]

1.2 Air Traffic Control and the National Airspace System

The following sections provide basic background information on air traffic control and the NAS. This information includes a description of the NAS, the role of ATC, the methods air traffic controllers use to provide services within the Air Traffic Control system, and the different phases of aircraft flight within the NAS. Following this discussion, information is provided on the FAA's NextGen program and the Metroplex initiative.

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[4] RTCA, Inc. Executive Summary, *NextGen Mid-Term Implementation Task Force Report*, September 9, 2009.

[5] RTCA, Inc. is a private, not-for-profit corporation (formerly known as the Radio Technical Commission for Aeronautics and now simply "RTCA") that develops consensus-based recommendations regarding communications, navigation, surveillance (CNS), and air traffic management (ATM) system issues. RTCA functions as a federal advisory committee and includes roughly 400 government, industry, and academic organizations from the United States and around the world. Members represent all facets of the aviation community, including government organizations, airlines, airspace users, airport associations, labor unions, and aviation service and equipment suppliers. More information is available at http://www.rtca.org.

[6] RTCA Inc., Executive Summary, *NextGen Mid-Term Implementation Task Force Report*, September 9, 2009.

[7] Additional information on Performance-Based Navigation (PBN) is provided on the FAA website at https://www.faa.gov/nextgen/how_nextgen_works/new_technology/pbn/ (accessed February 10, 2019).

[8] U.S. Department of Transportation, Federal Aviation Administration, *FAA Response to Recommendations of the RTCA NextGen Mid-Term Implementation Task Force*, January 2010, p. 14.

1.2.1 National Airspace System

Under the Federal Aviation Act of 1958 (49 USC § 40101 *et seq*.), the FAA is delegated control over use of the nation's navigable airspace and regulation of domestic civil and military aircraft operations in the interest of maintaining safety and efficiency. To help fulfill this mandate, the FAA established the NAS. Within the NAS, the FAA provides air traffic services for aircraft takeoffs, landings, and the flow of aircraft between airports through a system of infrastructure (e.g., air traffic control facilities), people (e.g., air traffic controllers, maintenance, and support personnel), and technology (e.g., radar, communications equipment, ground-based navigational aids [NAVAIDs],[9] etc.) The NAS is governed by various FAA rules and regulations.

The NAS comprises one of the most complex aviation networks in the world. The FAA continuously reviews the design of all NAS resources to ensure they are effectively and efficiently managed. The FAA Air Traffic Organization (ATO) is the primary organization responsible for managing airspace and flight ATC procedures in the NAS. When changes are proposed to the NAS, the FAA works to ensure that the changes maintain or enhance system safety and improve efficiency. One way to accomplish this mission is to employ air navigation technologies to increase system flexibility and predictability.

1.2.2 Air Traffic Control within the National Airspace System

The combination of infrastructure, people, and technology used to monitor and guide (or direct) aircraft within the NAS is referred to collectively as ATC. One of ATC's responsibilities is to maintain safety and expedite the flow of traffic in the NAS by applying defined minimum distances or altitude between aircraft (referred to as "separation"). This is accomplished through required communications between air traffic controllers and pilots and the use of navigational technologies.

Air traffic controllers and pilots use specific phraseology to refer to various altitudes. Below 18,000 feet above mean sea level (MSL), altitudes are referred numerically in MSL (e.g. 13,000 MSL is spoken "thirteen thousand feet") and referenced by localized altimeter settings. From 18,000 feet MSL and above, altitudes are referred to as flight level (FL)[10] to denote a common altimeter setting. Pilots operate aircraft under two distinct categories of flight rules: Visual Flight Rules (VFR) and Instrument Flight Rules (IFR).[11] Under VFR[12], pilots are responsible to "see and avoid" other aircraft and obstacles such as terrain to maintain safe separation. Under IFR[13], aircraft operators are required to file flight plans and use navigational

[9] NAVAIDs are facilities that transmit signals that define key points or routes.

[10] Federal Aviation Administration. *Aeronautical Information Manual; Chapter 7, Section 2. Altimeter Setting Procedures*. October 12, 2017.

[11] 14 Code of Federal Regulations (C.F.R.), Part 91.

[12] VFR only available below 18,000 feet MSL unless otherwise approved by air traffic control. See Federal Aviation Administration. *Aeronautical Information Manual; Chapter 3, Airspace*. October 12, 2017.

[13] IFR available at all altitudes below 18,000 feet MSL and required for operation at or above 18,000 feet MSL unless otherwise approved by air traffic control. See Federal Aviation Administration. *Aeronautical Information Manual; Chapter 3, Airspace*. October 12, 2017.

instruments to operate within the NAS. The majority of commercial air traffic operates under IFR.

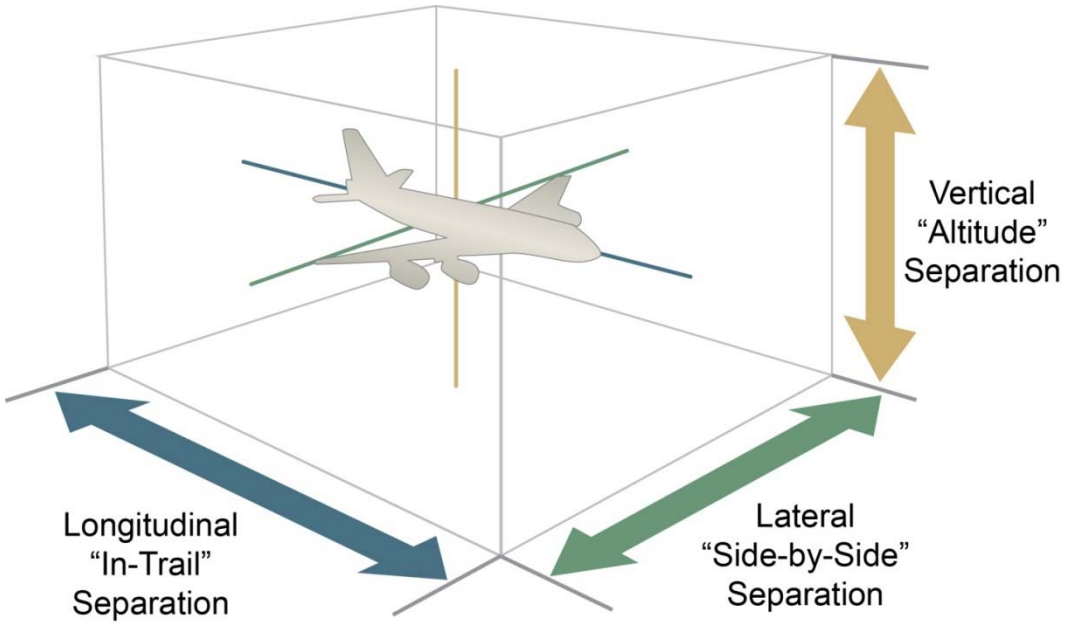
Depending on whether aircraft are operating under IFR or VFR, air traffic controllers apply various techniques to maintain separation between aircraft,[14] including the following:

- **Vertical or "Altitude" Separation:** separation between aircraft operating at different altitudes;
- **Longitudinal or "In-Trail" Separation:** separation between two aircraft operating along the same flight route, referring to the distance between a lead and a following aircraft; and,
- **Lateral or "Side-by-Side" Separation:** separation between aircraft (left or right side) operating along two separate but nearby flight routes.

Exhibit 1-1 depicts the three dimensions around an aircraft used to determine separation.

Air traffic controllers use radar to monitor aircraft and provide services that ensure separation. Published instrument ATC procedures provide predictable, efficient routes that move aircraft through the NAS in a safe and orderly manner. These ATC procedures reduce verbal communication between air traffic controllers and pilots. Published instrument ATC procedures are described as "conventional" ATC procedures when they use ground-based NAVAIDs.

Exhibit 1-1 Three Dimensions Around an Aircraft



Source: ATAC Corporation, December 2012.
Prepared by: ATAC Corporation, January 2019.

In its effort to modernize the NAS, the FAA is developing instrument ATC procedures that use advanced technologies. A primary technology in this effort is RNAV. RNAV uses technology,

[14] Defined in FAA Order JO 7110.65X, *Air Traffic Control*.

including Global Positioning System (GPS), to allow an RNAV-equipped aircraft to fly a more efficient route. This route is based on instrument guidance that references an aircraft's position relative to ground-based NAVAIDs or satellites.

ATC uses a variety of methods and coordination techniques to maintain safety within the NAS, including:

- **Vectors:** Directional headings issued to aircraft to provide navigational guidance and to maintain separation between aircraft and/or obstacles.
- **Speed Control:** Instructions issued to aircraft to reduce or increase aircraft speed to maintain separation between aircraft.
- **Reroute:** Controllers may change an aircraft's route for a variety of reasons, such as avoidance of inclement weather, to maintain separation between aircraft, and/or to protect airspace.
- **Point-out:** Notification issued by one controller when an aircraft might pass through or affects another controller's airspace and radio communications will not be transferred.
- **Holding Pattern/Ground Hold:** Controllers assign aircraft to a holding pattern in the air or hold aircraft on the ground before departure to maintain separation between aircraft and to manage arrival/departure volume.
- **Altitude Assignment/Level-off:** Controllers assign altitudes to maintain separation between aircraft and/or to protect airspace. This may result in aircraft "leveling off" during ascent or descent.

As an aircraft moves from origin to destination, ATC personnel function as a team and transfer control of the aircraft from one controller to the next and from one ATC facility to the next.

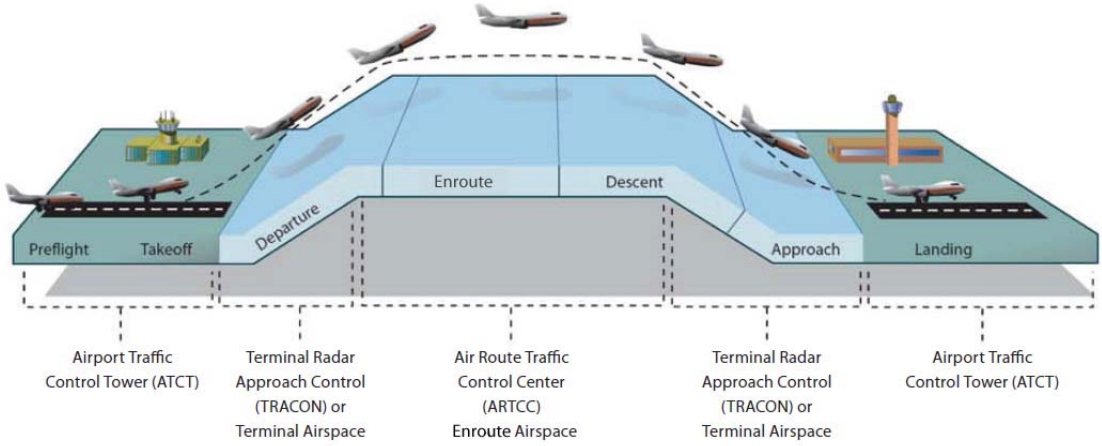
1.2.3 Aircraft Flow within the National Airspace System

An aircraft traveling from airport to airport typically operates through six phases of flight (plus a "preflight" phase.) **Exhibit 1-2** depicts the typical phases of flight for a commercial aircraft. These phases include:

- **Preflight (Flight Planning):** The preflight route planning and flight checks performed in preparation for takeoff.
- **Push Back/Taxi/Takeoff:** The aircraft's transition across the airfield from push-back at the gate, taxiing to an assigned runway, and takeoff from the runway.
- **Departure:** The aircraft's in-flight transition from takeoff to the en route phase of flight, during which it climbs to the assigned cruising altitude.
- **Enroute:** Generally, the level segment of flight (i.e., cruising altitude) between the departure and destination airports.
- **Descent:** The aircraft's in-flight transition from an assigned cruising altitude to the point at which the pilot initiates the approach to a runway at the destination airport.
- **Approach:** The segment of flight during which an aircraft follows a standard ATC procedure that guides the aircraft to the landing runway.

- **Landing:** Touch-down of the aircraft at the destination airport and taxiing from the runway to the gate or parking position.

Exhibit 1-2 Typical Phases of a Commercial Aircraft Flight



Source: U.S. Department of Transportation, Federal Aviation Administration, Houston Area Air Traffic System (HAATS), Airspace Redesign, Final Environmental Assessment, Figure 1.1.1-1, March 2008.
Prepared by: ATAC Corporation, January 2019.

1.2.4 Air Traffic Control Facilities

The NAS is organized into three-dimensional areas of navigable airspace that are defined by a floor, a ceiling, and a lateral boundary. Each is controlled by different types of ATC facilities including:

- **Airport Traffic Control Tower:** Controllers at an Airport Traffic Control Tower (ATCT) located at an airport provide air traffic services for phases of flight associated with aircraft takeoff and landing. The ATCT typically controls airspace extending from the airport to a distance of many miles in all directions. Three of the five airports shown (APA, BJC, DEN) on **Exhibit 1-3** are airport facilities with an ATCT. One airport (FNL) is in the testing phase of a FAA approved Virtual Air Traffic Control Tower installation.[15] The remaining airport (GXY), has neither an ATCT nor any local controller presence.
- **Terminal Radar Approach Control (TRACON):** Controllers at a TRACON provide air traffic service to aircraft as they transition between an airport and the en route phase of flight, and from the en route phase of flight to an airport. This includes the departure, climb, descent, and approach phases of flights. The TRACON airspace is broken down into sectors. As an aircraft moves between sectors, responsibility for it transfers from controller to controller. Controllers maintain separation between aircraft that operate within their sectors. The Primary TRACON facility in the Denver Metroplex is the Denver TRACON (which holds the FAA name code of "D01") located approximately 1.8 statute miles south of the Denver International Airport (DEN) terminal. The terminal airspace in the Denver Metroplex is shown on **Exhibit 1-3**.
- **Air Route Traffic Control Centers (ARTCCs or "Centers"):** Controllers at ARTCCs provide air traffic services during the en route phase of flight. Similar to TRACON airspace, the Center airspace is broken down into sectors. As shown on **Exhibit 1-3**, the Denver Metroplex is comprised of airspace delegated to the Denver ARTCC (ZDV) located in Longmont, Colorado. A small portion of southeastern Colorado airspace is controlled by the Kansas City ARTCC (ZKC), but is beyond the Study Area for this EA.

The following sections discuss how air traffic controllers at these ATC facilities control the phases of flight for aircraft operating under IFR.

1.2.4.1 Departure Flow

As an aircraft operating under IFR, also known as an "IFR aircraft", departs a runway and follows its assigned heading, it moves from the ATCT airspace, through the terminal airspace, and into en route airspace where it proceeds on a specific route to its destination airport.

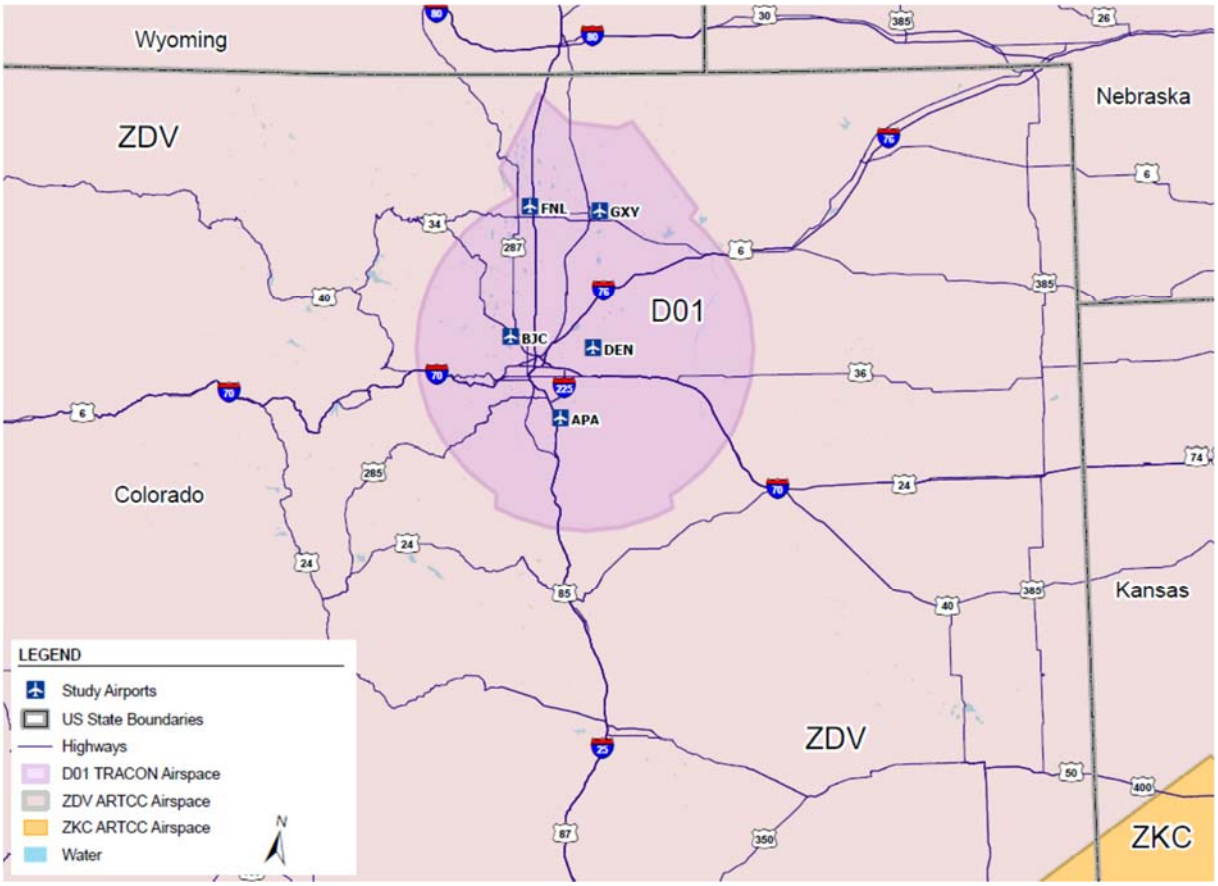
Within the terminal airspace, TRACON controllers provide services to aircraft departing from the ATCT airspace to departure transfer control points referred to as "exit points." An exit point represents an area along the boundary between terminal airspace and en route airspace. Exit points are generally established near commonly used routes to efficiently transfer aircraft between terminal and en route airspace. When aircraft pass through the exit point, control transfers from TRACON to ARTCC controllers as the aircraft joins a specific route.

[15] For more information on the FNL remote tower, see https://www.flynoco.com/faqs/remote-tower-faq/, Accessed February 24, 2019.

Standard Instrument Departures

Departing IFR aircraft use an ATC procedure called a Standard Instrument Departure (SID). A SID provides pilots with defined lateral and vertical guidance to facilitate safe and predictable navigation from an airport through the terminal airspace to a specific route in the en route airspace.

Exhibit 1-3 Airspace in the Denver Metroplex Area



Notes:
FNL – Northern Colorado Regional Airport
GXY – Greeley-Weld County Airport
APA – Centennial Airport
D01 – Denver TRACON
BJC – Rocky Mountain Metropolitan Airport
ZDV – Denver Center (ARTCC)
DEN – Denver International Airport
ZKC – Kansas City Center (ARTCC)

Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways).
Prepared by: ATAC Corporation, February 2019.

A "conventional" SID follows a route defined by ground-based NAVAIDs, may be based on vectoring, or both. Because of the increased precision inherent in RNAV technology, an RNAV SID defines a more predictable route through the airspace than a conventional SID. Some RNAV SIDs may be designed to include paths called "runway transitions" that serve particular runways at airports. Transitions are a series of fixes leading to/from a common

route. They serve as the entry and exit points into terminal and en route airspace. A SID may have several runway transitions serving one or more runways at one or more airports. From the runway transition, aircraft may follow a common path before being directed along one or several diverging routes referred to as "en route transitions." Enroute transitions may terminate at exit fixes or continue into en route airspace where aircraft join a specific route.

1.2.4.2 Arrival Flow

An aircraft begins the descent phase of flight within the en route airspace in order to transition to lower altitudes for less restrictive maneuvering and speed reduction. During descent, the aircraft transitions into the terminal airspace through an "entry point," bound for the destination airport. The entry point represents a physical location in the airspace along the boundary between terminal airspace and en route airspace where control of the aircraft transfers from ARTCC to TRACON controllers.

Standard Terminal Arrival Routes

Aircraft that arrive in the terminal airspace normally follow an instrument ATC procedure called a Standard Terminal Arrival Route (STAR). Aircraft leaving en route airspace and entering terminal airspace may follow an en route transition from an entry fix to the STAR's common route in the terminal airspace. From the common route segment, aircraft may follow a runway transition before making an approach to the airport.

1.2.4.3 Required Aircraft Separation

As controllers manage the flow of aircraft into, out of, and within the NAS, they maintain some of the following separation distances between aircraft[16]:

- **Altitude Separation (vertical):** When operating below 41,000 feet above mean sea level (MSL), two aircraft must be at least 1,000 feet above/below each other until or unless lateral separation is ensured.
- **In-Trail Separation (longitudinal):** Within a radar controlled area, the minimum distance between two aircraft on the same route (i.e., in-trail) can be between 2.5 to 10 nautical miles[17], depending on factors such as aircraft class, weight, and type of airspace.
- **Side-by-Side Separation (lateral):** Similar to in-trail separation, the minimum side-by-side separation must be at least three nautical miles between aircraft in terminal airspace and at least five nautical miles in en route airspace.
- **Visual Separation:** Aircraft may be separated by visual means when other approved separation is assured before and after the application of visual separation.

1.2.5 Next Generation Air Transportation System

The NextGen program is the FAA's long-term plan to modernize the NAS from a ground-based system of air traffic control to a GPS-based system of air traffic management that

[16] For a detailed explanation of separation standards, see FAA Order 7110.65X.

[17] A nautical mile is equivalent to 1.15 statute miles, 1,852 meters, or 6,076.118 feet

allows for the development of PBN ATC procedures.[18] The Metroplex initiative is a key step in the overall process of transitioning to the NextGen system. Achieving the NextGen system requires implementing RNAV and RNP PBN ATC procedures, and aircraft "auto-pilot" and Flight Management System (FMS) capabilities.[19] RNAV and RNP capabilities are now readily available and PBN can serve as the primary means aircraft use to navigate along a route. More than 90 percent of U.S. scheduled air carriers are equipped for some level of RNAV. The following sections describe PBN ATC procedures in greater detail.

1.2.5.1 RNAV

Exhibit 1-4 compares conventional, RNAV and RNP routes. RNAV uses technology, including GPS, to allow an RNAV-equipped aircraft to fly a more efficient route. This route is based on instrument guidance that references an aircraft's position relative to ground-based NAVAIDs or satellites. RNAV enables aircraft traveling through terminal and en route airspace to follow more accurate and better-defined routes. This results in more predictable routes and altitudes that can be pre-planned by the pilot and air traffic control. Predictable routes improve the ability to ensure vertical, longitudinal, and lateral separation between aircraft.

Routes based on ground-based NAVAIDs rely on the aircraft equipment directly communicating with the NAVAID radio signal and are often limited by issues such as line-of-sight and signal reception accuracy. NAVAIDs such as Very High Frequency (VHF) Omnidirectional Ranges (collectively VORs) are affected by variable terrain and other obstructions that can limit their signal accuracy. Consequently, a route that is dependent upon ground-based NAVAIDS requires at least six nautical mile of clearance on either side of its main path to ensure accurate signal reception. As demonstrated by the dashed lines on **Exhibit 1-4**, this clearance requirement increases the farther an aircraft is from the VOR. In comparison, RNAV signal accuracy requires only two nautical miles of clearance on either side of a route's main path.

RNAV routes can mirror conventional routes or, by using satellite technology, provide paths within the airspace that were not previously possible with ground-based NAVAIDs.

1.2.5.2 RNP

RNP is an RNAV ATC procedure with signal accuracy that is increased through the use of onboard performance monitoring and alerting systems. An RNP is an RNAV ATC procedure that requires greater accuracy of on-board performance monitoring and alerting equipment, as well as special pilot training. A defining characteristic of an RNP operation is the ability for an RNP-capable aircraft navigation system to monitor the accuracy of its navigation (based on the number of GPS satellite signals available to pinpoint the aircraft location) and inform the crew if the required data becomes unavailable.

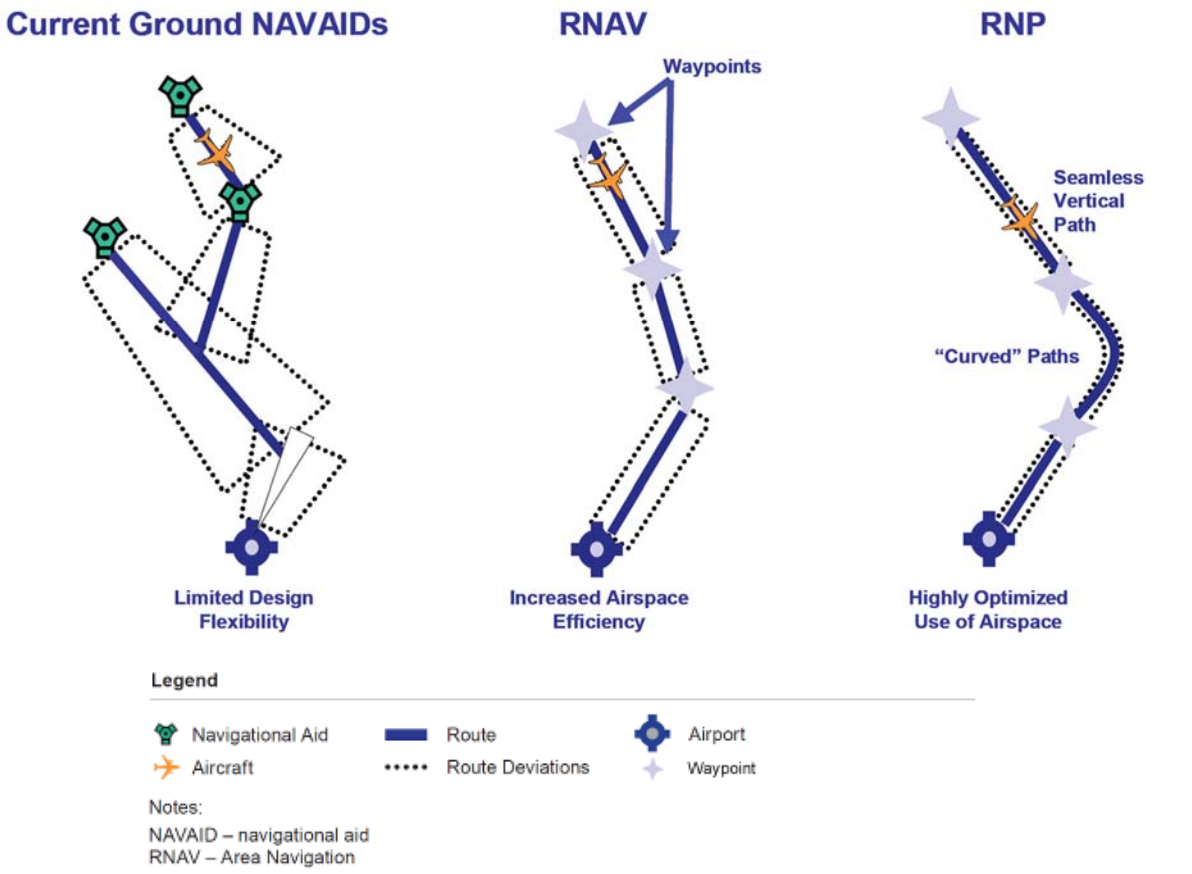
Exhibit 1-4 compares conventional, RNAV, and RNP ATC procedures. It shows how an RNP-capable aircraft navigation system provides a more accurate and seamless horizontal and vertical location (down to less than one nautical mile from the intended path) and will follow a highly predictable path. The enhanced accuracy and predictability makes it possible to

[18] U.S. Department of Transportation, Federal Aviation Administration, https://www.faa.gov/nextgen/how_nextgen_works/nextgen_in_action/ (accessed January 4, 2019).

[19] A Flight Management System (FMS) is an onboard computer that uses inputs from various sensors (e.g., GPS and inertial navigation systems) to determine the geographic position of an aircraft and help guide it along its flight path.

implement ATC procedures within controlled airspace that are not always possible under the current air traffic system.

Exhibit 1-4 Navigational Comparison – Conventional/RNAV/RNP



Source: U.S. Department of Transportation, Federal Aviation Administration, "Performance-Based (PBN) Brochure," October 2009.
Prepared by: ATAC Corporation, January 2019.

1.2.5.3 Optimized Profile Descent

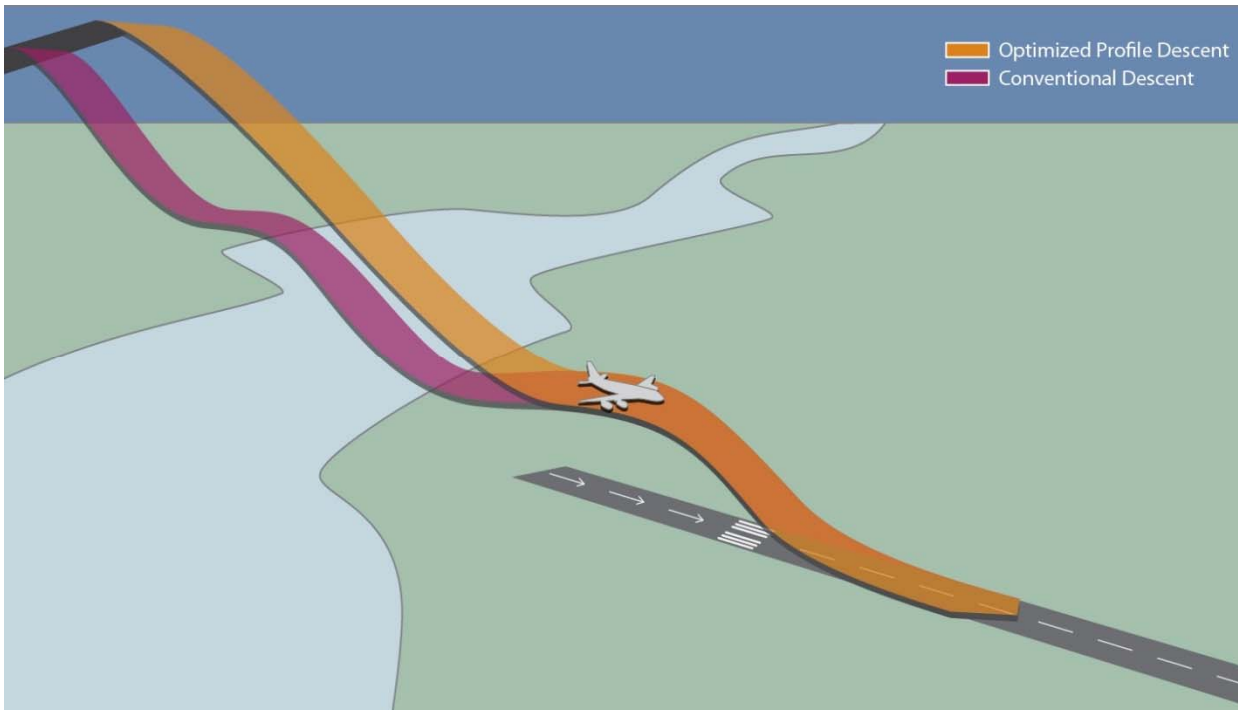
An Optimized Profile Descent (OPD) is an ATC procedure that allows an aircraft using FMS to fly continuously from the top of descent to landing with minimal level-off segments. **Exhibit 1-5** illustrates an OPD ATC procedure compared to a conventional descent. Aircraft that fly OPDs can maintain higher altitudes and lower thrust for longer periods. As level-off segments are minimized, OPDs reduce the need for communications between controllers and pilots.

1.2.6 The Metroplex Initiative

As part of the Metroplex initiative, the FAA is designing and implementing RNAV ATC procedures that take advantage of the technology available in a majority of commercial service aircraft. The Metroplex initiative specifically addresses congestion, airports in close geographical proximity, and other limiting factors that reduce efficiency in busy metroplex airspace. Efficiency is improved by implementing more RNAV-based standard instrument ATC procedures and connecting the routes defined by the standard instrument ATC

procedures to high- and low-altitude RNAV routes. Efficiency is further improved by using RNAV to optimize the use of the limited airspace in congested metroplex environments.

Exhibit 1-5 Optimized Profile Descent Compared to a Conventional Descent



Source: ATAC Corporation, December 2012.
Prepared by: ATAC Corporation, January 2019.

1.3 The Denver Metroplex

The following sections describe the airspace structure and existing standard instrument ATC procedures of the Denver Metroplex that would be affected by the DEN Metroplex Project.

1.3.1 2012 FAA RNAV and RNP Procedures Project

The Denver region was previously an FAA project site for RNAV procedure implementation.[20] The proposed routes and procedures were designed by the FAA to improve the safety and efficiency of the Denver airspace and respond to the growing need for efficiency as the airport operations in the Denver airspace increased. The 2012 FAA RNAV and RNP ATC procedures project was not part of the Metroplex initiative within FAA, but was focused on similar Purpose and Need criteria while adopting a smaller geographic scope.

Following an ATC procedure design process and an Environmental Assessment, the FAA implemented 16 RNAV Directional STARs in late 2012, 16 SIDs in early 2013, and RNP/RNP-AR approaches into DEN in late 2013.

Following implementation and operation of ATC procedures designed under this effort, the FAA found that a number of features were hindering the best use and application of RNAV

[20] Department of Transportation, Federal Aviation Administration. *FAA RNAV and RNP Procedures at Denver International Airport, Centennial Airport and Rocky Mountain Metropolitan Airport Environmental Assessment.* August 2012.

procedures in the Denver airspace. These items were generally found to be: procedure complexity; more procedures than needed; more waypoints than needed; more STAR changes enroute than needed; an increased workload for ZDV controllers and pilots of IFR aircraft; excessive track miles to join new STARs; lateral path deviations on SIDs as the result of errant Lateral Navigation instrument[21] engagements; and that the DEN and surrounding satellite airport ATC procedures were not segregated, resulting in a diverse mixture of air carrier and general aviation air traffic. These issues formed the underlying basis for the application of evolving and newer air traffic management strategies, methods, and

1.3.2 Denver Metroplex Airspace

Exhibit 1-3 (prior) depicts the airspace structure in the Denver Metroplex. The Denver Metroplex consists of airspace delegated to Denver ARTCC (ZDV) and Denver TRACON. ZDV provides Air Traffic Services for 285,000 square miles of en route airspace covering portions of nine states including Colorado, Arizona, New Mexico, Utah, Kansas, Nebraska, South Dakota, Wyoming, and Montana. It abuts Minneapolis (ZMP), Salt Lake City (ZLC), Los Angeles (ZLA), Albuquerque (ZAB), and Kansas City (ZKC) ARTCCs in the US. ZDV is responsible for all private and commercial aircraft landing, departing and traversing inside its lateral boundaries when they are operating under Instrument Flight Rules (IFR) and offers select services to aircraft operating under Visual Flight Rules (VFR). ZDV provides air traffic control service to United States, foreign, and military aircraft operating both IFR and VFR in ZDV airspace. ZDV controllers provide air traffic services in the airspace above and adjacent to the Denver TRACON airspace for facilities noted previously in **Exhibit 1-3**.

Denver TRACON controllers provide air traffic services for terminal airspace from the surface to as high as 23,000 feet MSL, covering 45 square miles of airspace around DEN.[22] The lateral boundaries of the Denver TRACON airspace are surrounded and capped by ZDV ARTCC airspace and extend from the Wyoming border to the Larkspur, Colorado area on a north-south basis and from the Leader, Colorado area to the Empire, Colorado area on an east-west basis.

The Denver TRACON is the final radar facility responsible for separating and sequencing aircraft that are landing at and departing from airports in its airspace. This includes the initial sequencing of DEN departures as well as providing safe and expeditious flows of traffic into and out of six other FAA and contract tower controlled airports (including Pueblo and Grand Junction) and seven public/municipal airports. The Denver TRACON facility provides air traffic control services to IFR-filed aircraft and, when requested or required, VFR aircraft. As with ZDV, the noted TRACON facility also offer these services to military aircraft that are operating in its airspace.

[21] Lateral Navigation (LNAV) approaches are non-precision approaches that provide lateral guidance to aircraft through instrumentation.

[22] The Denver area contains one local approach control facility along with airport traffic control towers located at numerous airports. The responsibilities for airspace in these facilities are generally more localized to individual airports. Additionally one military facility provides air traffic control into and out of a United States Air Force airfield.

1.3.3 Denver Metroplex Airspace Constraints

The following provide a general overview of the constraints related to controlling aircraft within the Denver Metroplex area airspace.

1.3.3.1 Class B Airspace

Class B airspace is regulatory airspace, generally located around and over major airports with operating control towers and TRACON facilities, such as DEN. The rules for flying inside of Class B airspace are more restrictive to pilots and aircraft types than for other classes of airspace. The Class B aircraft equipment and pilot operation rules include but are not limited to the following:[23]

- All aircraft are subject to air traffic clearances to arrive or depart from airports within the Class B limits and/or to enter Class B airspace;
- Aircraft must be equipped with an active transponder beacon that has Mode C (altitude reporting) capability within an identified airspace block generally referred to as a Mode C veil;
- Aircraft operating under VFR, IFR and Special VFR are radar separated;
- Student certificated pilots must have ground and flight instruction with an instructor signoff to operate in specific Class B airspace. A minimum of a private pilot certificate is necessary to land or depart certain airports; and
- Pilots are not to exceed 250 knots unless directed by ATC and to declare “unable” when the aircraft is unable to meet ATC speed requirements.

These rules make for a safer and more orderly flow of traffic within Class B airspace. Class B airspace design has a direct impact on the flow of traffic within the Denver Metroplex area.

Due to Class B airspace design, ZDV delivers arrival flow traffic to TRACON airspace via multiple arrival flows with sequenced aircraft. The multiple arrival flows generally operate in a four corner-post system. The four corner-posts reflect cardinal compass headings for departure flows, and the inter-cardinal compass headings (e.g. northeast, southeast, etc.) for arrival flows. The transfer of control points, where control transfers from the ZDV to the Denver TRACON, are generally located at or near the common lateral boundary of each facility’s airspace.

1.3.3.2 Denver Metroplex Special Use Airspace

Exhibit 1-6 depicts the boundaries of Special Use Airspace (SUA)[24] in the Denver Metroplex illustrating the limited available options for entering and exiting the Denver Metroplex airspace. SUA is airspace with defined vertical and lateral boundaries in which certain activities such as military flight training and air-to-ground military exercises must be confined. These areas either restrict other aircraft from entering or limit aircraft activity allowed within the airspace. Four types of SUA are found within the Denver Metroplex:

[23] FAR 61.95 *Operations in Class B airspace and at airports located within Class B airspace*; FAR 91.131 *Operations in Class B airspace*; FAR 91.117 *Aircraft speed.*

[24] Department of Transportation, Federal Aviation Administration. Joint Order 7400.2M *Procedures for Handling Airspace Matters*, Part 5: Special Use Airspace. February 28, 2019.

- **Alert Areas:** A An alert area is airspace wherein a high volume of pilot training or an unusual type of aeronautical activity is conducted. Alert areas are designated to inform nonparticipating pilots of areas that contain a high volume of pilot training operations, or an unusual type of aeronautical activity, that they might not otherwise expect to encounter. Pilots are advised to be particularly alert when flying in these areas.
- **Restricted Area:** A restricted area is airspace within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Restricted areas are established when determined necessary to confine or segregate activities considered hazardous to nonparticipating aircraft.
- **National Security Area:** A National Security Area (NSA) consists of airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security of ground facilities. Pilots are requested to voluntarily avoid flying through an NSA. When it is necessary to provide a greater level of security, flight in an NSA may be temporarily prohibited.
- **Military Operations Area:** A military operations area (MOA) is airspace designated outside of Class A airspace, to separate or segregate certain nonhazardous military activities from IFR traffic and to identify for VFR traffic where these activities are conducted. MOAs are designated to contain nonhazardous, military flight activities including, but not limited to, air combat maneuvers, air intercepts, low altitude tactics, etc.

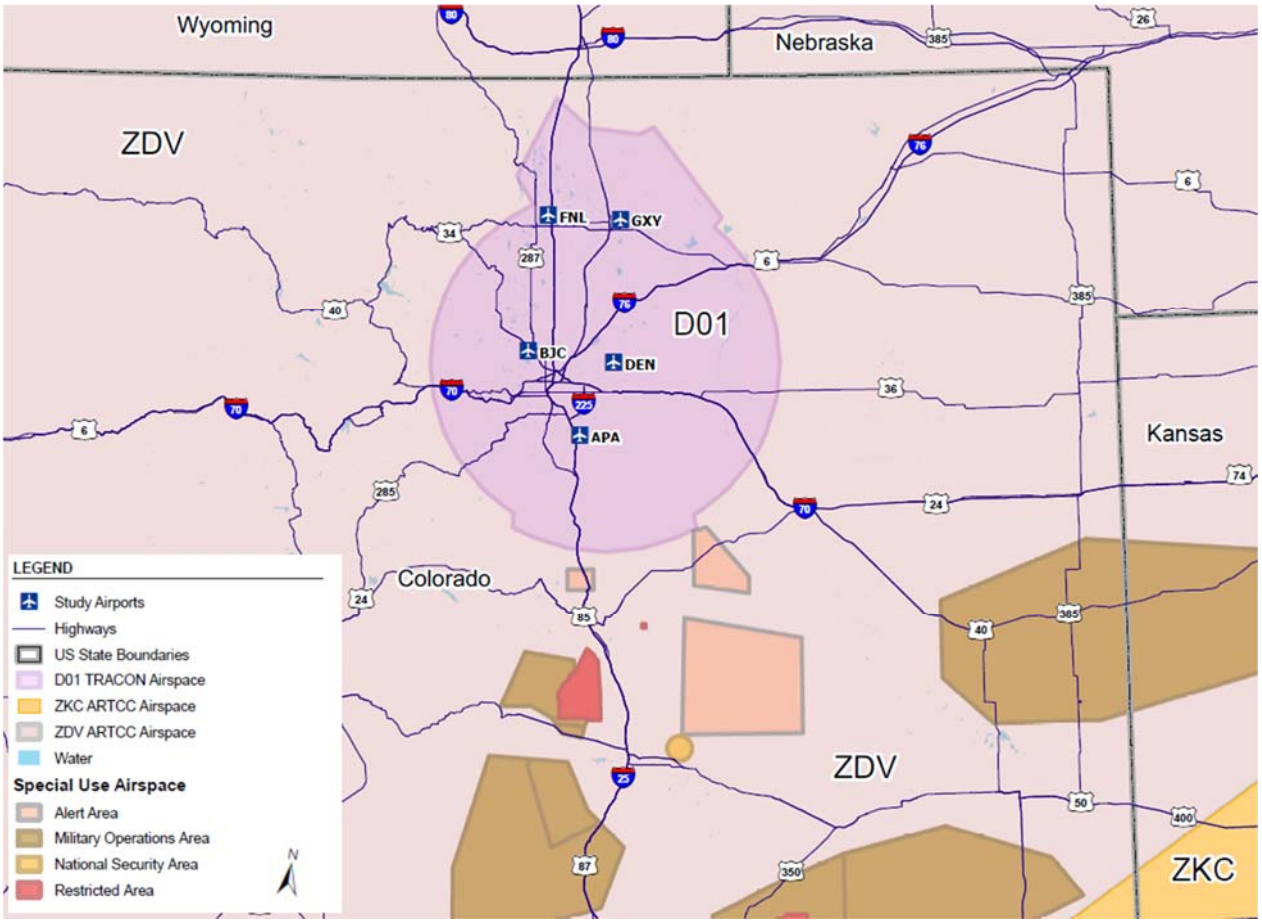
ZDV has 18,505 square miles of special use airspace (SUA), representing 6.9 percent of its total coverage area. ZDV is required to ensure that civilian and military aircraft (not under the authority of the United States Armed Forces)[25] are routed within the remaining 248,068 square miles of airspace.

Due to the location and altitudes SUAs occupy in the ZDV and Denver TRACON control area, there are choke points for departures from the Denver area. This is caused by the funneling of traffic into corridors that are unaffected by airspace restrictions or SUAs.

One such constraint is the need to depart Denver area traffic to the south and southeast while avoiding the Cougar (east) and Two Buttes (south) Military Operations Area (MOA) airspaces. These south and southeast departure routes require additional separation attention for commercial aircraft to be redirected away from, around, or above the proposed and existing MOAs.

[25] Aircraft under the direct control of the military air traffic control facilities are confined to Special Use Areas (SUAs) or departure and arrival patterns near military airfields. These SUAs are specific areas of airspace that are used by military aircraft and are provided air traffic control services by the military. The United States Military branches are specifically charged with management of that airspace when active.

Exhibit 1-6 Special Use Airspace



Notes:
FNL – Northern Colorado Regional Airport
GXY – Greeley-Weld County Airport
APA – Centennial Airport
D01 – Denver TRACON
BJC – Rocky Mountain Metropolitan Airport
ZDV – Denver Center (ARTCC)
DEN – Denver International Airport
ZKC – Kansas City Center (ARTCC)

Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways).
Prepared by: ATAC Corporation, February 2019.

1.3.4 STARs and SIDs Serving Study Airports

As of June 2018, 47 total arrival and departure ATC procedures included 20 published SIDs and 27 STARs serving the Study Airports identified in Section 1.4 within the Denver Metroplex. Of these, 13 are conventional ATC procedures.

1.4 Denver Metroplex Project Study Airports

Exhibit 1-7 shows the locations of the five DEN Metroplex Project Study Airports. The Study Airports were selected based on specific FAA criteria: each airport must have a minimum of 700 annual IFR-filed jet operations or 90,000 or more annual propeller aircraft operations. Airports that did not meet these thresholds were not included as Study Airports because the Proposed Action would result in little or no change to their operations. In addition, airports where the majority of traffic operates under VFR were also excluded from selection as Study Airports because they are not expected to be affected by the Proposed Action. VFR aircraft operating outside controlled airspace are not required to be in contact with ATC. Because these aircraft operate at the discretion of the pilot on a "see and be seen" basis and are not required to file flight plans, FAA generally has very limited information for these operations.

Of the five airports included in the DEN Metroplex Project, the Study Team identified DEN as the Major Study Airport and is the primary focus of the project. DEN is located approximately 25 miles northeast of downtown Denver and is classified as a large hub[26] commercial service airport in the 2019-2023 National Plan of Integrated Airport Systems (NPIAS). DEN has six runways, described in **Table 1-1**. As of June 6, 2018, DEN IFR arrivals may be assigned one of 8 conventional STARs or 16 RNAV STARs. Departing IFR aircraft may be assigned one of 5 conventional SIDs or 15 RNAV SIDs.

Table 1-1 Denver Metroplex Project Major Study Airport

Airport Name	Airport Code	Location	Runways[1/]
Denver International Airport	DEN	Denver, CO	7, 8, 16L, 16R, 17L, 17R, 25, 26, 34L, 34R 35L, 35R

Notes:
1/ A runway can be used in both directions, but are named in each direction separately. Runway number is based on the magnetic direction of the runway, divided by 10 and rounded to the nearest 10 (e.g., Runway 09 points to the compass heading 90 degrees, which is east). The two numbers on either side always differ by 180 degrees. If there is more than one runway pointing in the same direction, each runway number includes an 'L', 'C' or 'R' at the end. This is based on which side a runway is next to another one in the same direction.

Source: Department of Transportation, Federal Aviation Administration. digital-Airport/Facility Directory. January 3, 2019 – February 28, 2019 (http://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/dafd/ January 4, 2019).
Prepared by: ATAC Corporation, January 2019.

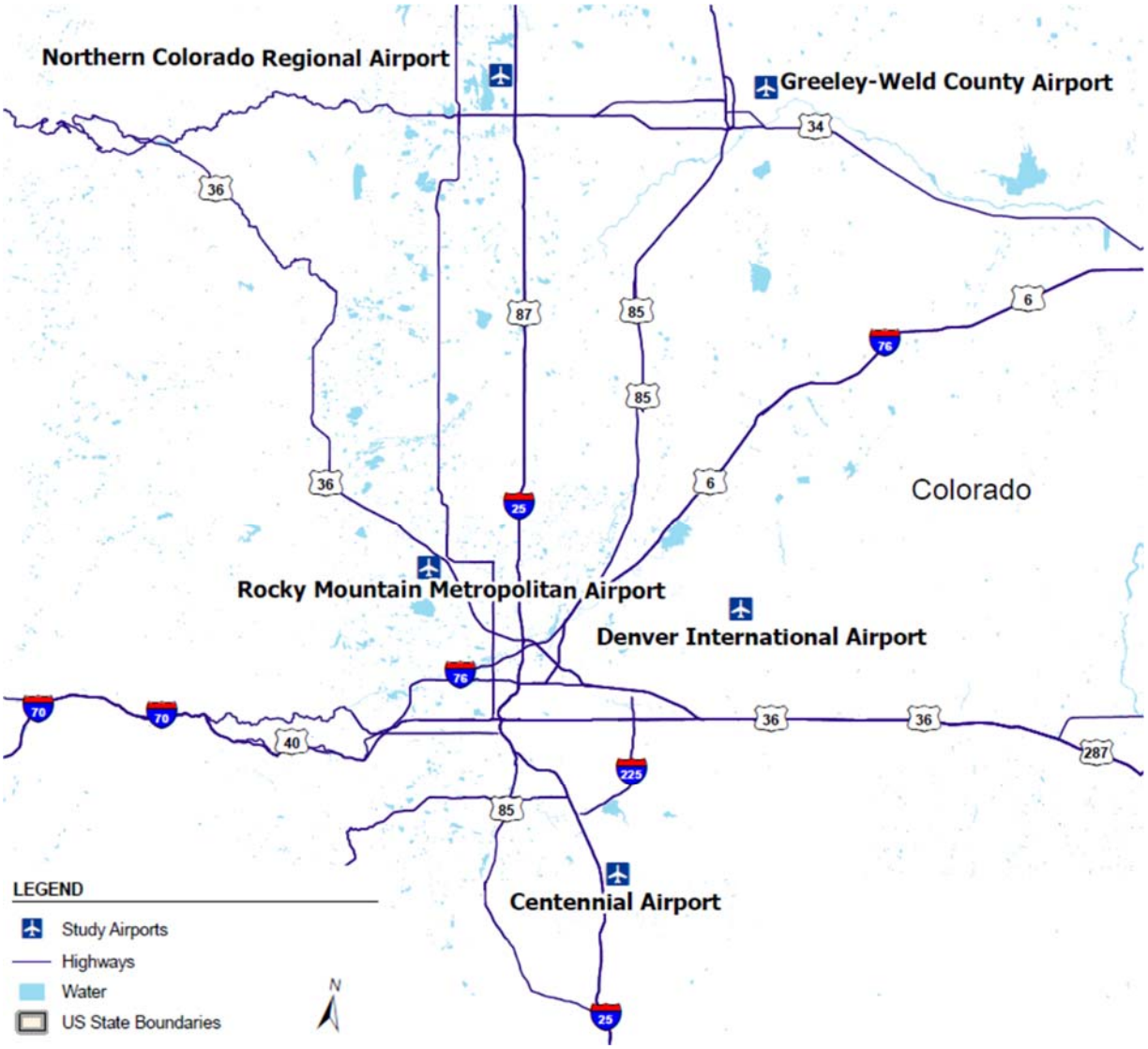
As shown in **Table 1-2**, in 2017, approximately 63 percent of all IFR traffic (itinerant[27] and overflight) within the Denver Metroplex operated at the Study Airports for which FAA data was

[26] FAA classifies airports in primary and non-primary categories. Within the primary category are small, medium, and large hub airports. Large hubs are those airports that each account for one percent or more of total U.S. passenger enplanements. See the FAA's most current *National Plan of Integrated Airport Systems (NPIAS)* for a complete discussion of airport categories at https://www.faa.gov/airports/planning_capacity/npias/reports/.

[27] Airport Operations are the number of arrivals and departures from the airport at which the airport traffic control tower is located. There are two types of airport operations: local and itinerant. 1.) Local operations are those operations performed by aircraft that remain in the local traffic pattern, execute simulated instrument approaches or low passes at the airport, and the operations to or from the airport and a designated practice area within a 20−mile radius of the tower. 2.) Itinerant operations are operations performed by an aircraft, either IFR, SVFR, or VFR, that lands at an airport, arriving from outside the airport area, or departs an airport and leaves the airport area. Found at https://aspmhelp.faa.gov/index.php/Glossary. Accessed March 2019.

available. This data tracks total operations at FNL (94,896) and GXY (122,500),[28] but not IFR operations due to the lack of an ATCT and associated personnel to track the data.

Exhibit 1-7 Study Airport Locations



Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); EA Study Airports.
Prepared by: ATAC Corporation, February 2019.

[28] Department of Transportation, Federal Aviation Administration. GXY and FNL *Airport Master Record (FAA Form 5010)* for the period Jan 1, 2017 to December 31, 2017.

Table 1-2 Distribution of 2017 IFR Traffic under FAA Control Among EA Study Airports

Airport	IFR Operations	Percent of Total Airport Operations
Denver International Airport (DEN)	581,443	99%
Centennial Airport (APA)	70,677	21%
Northern Colorado Regional Airport (FNL)*	N/A	N/A
Greeley-Weld County Airport (GXY)	N/A	N/A
Rocky Mountain Metropolitan Airport (BJC)	21,211	13%
Total IFR Operations	673,331	63%

**Note: FNL is a remote tower testbed that is not reporting formal FAA IFR operations. More information about the remote tower program can be found at https://www.codot.gov/programs/remote-tower*

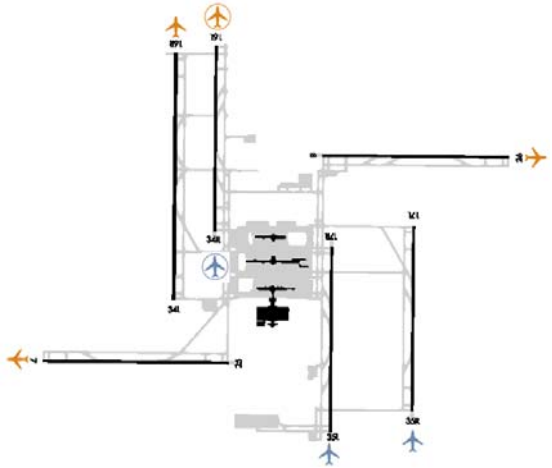
Source: Department of Transportation, Federal Aviation Administration. Operations Network: Tower Counts for DEN, (https://aspm.faa.gov/opsnet/sys/Tower.asp; accessed February 15, 2019).
Prepared by: ATAC Corporation, February 2019.

1.4.1 DEN Runway Operating Configurations

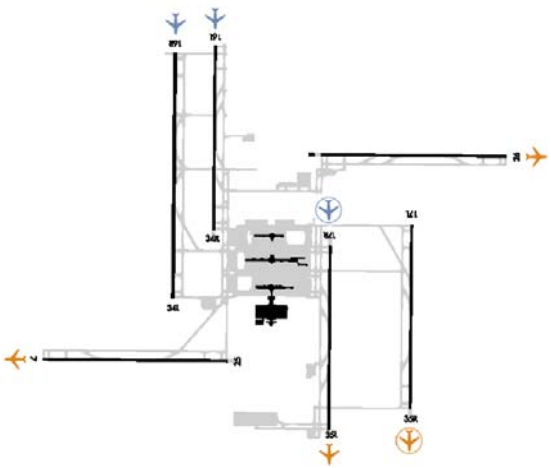
As a Major Study Airport, DEN often operates under several different runway configurations[29] depending on factors such as weather, prevailing wind, and air traffic conditions. As a result, it is possible for the runway ends used for arrivals and departures to change several times throughout a day. Controllers at these airports use different runway operating configurations. **Exhibit 1-8** illustrates the primary runway operating configurations at DEN.

[29] *Runway configuration* is the arrival and departure of aircraft associated with a specified compass direction. Example: A runway oriented north/south has two operational configurations: north and south. In a north runway configuration, aircraft approach the runway from the south landing to the north and aircraft depart from the south end of the runway heading north.

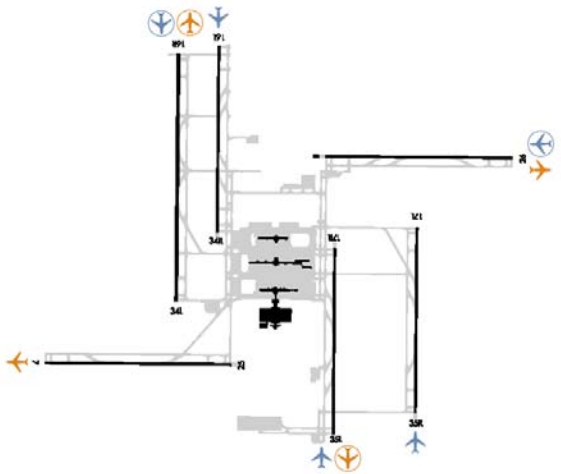
Exhibit 1-8 DEN Runway Operating Configurations



Runways 34R, 35L, 35R | 8, 25, 34L, 34R
Operating Configuration – North
Arrivals 40.7.X% Departures 42.2%



Runways 16L, 16R, 17R | 8, 17L, 17R, 25
Operating Configuration – South
Arrivals 42.9% Departures 43.9%



Runways 16L, 16R, 26, 35L, 35R | 8, 17R, 25, 34L
Operating Configuration – Combined
Arrivals 16.4% Departures 13.8%

Source: U.S. Department of Transportation, Federal Aviation Administration, Airport Diagrams [http://www.faa.gov/airports/runway_safety/diagrams/ (accessed January 2019)]; FAA ASPM (retrieved June 2017).
Prepared By: ATAC Corporation, January 2019.

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2 Purpose and Need

Under NEPA, an EA must describe the purpose and need for the Proposed Action. The following sections discuss the need for the Proposed Action and provide specific examples of the problems in the DEN Metroplex. This discussion is followed by a description of the purpose for the Proposed Action, the criteria that the FAA will use to evaluate the project alternatives, and the requested federal actions needed to complete the DEN Metroplex Project.

2.1 The Need for the Proposed Action

In the context of an EA, "need" refers to the problem that the Proposed Action is intended to resolve. The problem in this case is the inefficiency of the existing aircraft flight air traffic control (ATC) procedures in the DEN Metroplex. This problem is due to the use of older area navigation (RNAV) ATC procedure techniques and strategies applied in a 2012 ATC procedure design for the Denver region. As described in Chapter 1, more than 90 percent of U.S. scheduled air carriers are equipped for some level of RNAV. Under Existing Conditions,[30] 16 of the existing 21 SID ATC procedures currently used in the DEN Metroplex are RNAV ATC procedures.

While conventional ATC procedures lack efficiencies inherent in RNAV-based ATC procedures, the techniques and strategies of air traffic management applied to RNAV ATC procedures are evolving rapidly to take advantage of RNAV capabilities among aircraft, air crews and air traffic controllers. These techniques and strategies provide specific navigational benefits for aircraft, including predetermined speeds or altitudes that aircraft can been directed to achieve at a specific point in the airspace. Refined procedures, strategies, and techniques associated with air traffic management have adjusted and improved to better take advantage of RNAV capabilities and to reduce complexity.

As discussed in Section 1.2.5.1, conventional ATC procedures are subject to lateral and vertical flight path limitations that are eliminated using RNAV technology. RNAV ATC procedures can reduce the need for controllers to employ vectoring and speed adjustments, thus reducing controller and pilot workload. In turn, this adds efficiency to an air traffic system by enhancing predictability, flexibility, and route segregation. By taking advantage of the increased benefits associated with RNAV technology, the FAA is better able to meet one of its primary missions as mandated by Congress – to provide for the efficient use of airspace, to develop plans and policy for the use of the navigable airspace, and to assign by regulation or order the use of the airspace necessary to ensure the safety of aircraft and the efficient use of airspace.[31]

The following sections describe in greater detail the problem and the factors that have caused the problem. Explanations of the technical terms and concepts used in this chapter are found in Chapter 1, *Background*.

[30] For purposes of this Environmental Assessment, "existing conditions" pertains to conditions for the period of July 1, 2016 – June 30, 2017 (the most recent year of radar data available). Existing conditions are further discussed in Chapter 4, Affected Environment.

[31] 49 U.S.C. § 40103(b).

2.1.1 Description of the Problem

As previously stated, the DEN Metroplex airspace can be improved to increase efficiency. Under Existing Conditions, five of the existing 21 SID ATC procedures are conventional ATC procedures which are less efficient than RNAV ATC procedures. The efficiency decreases and the procedural complexity increases in the DEN Metroplex when ATC is required to use aircraft management tools and coordination techniques to provide separation services. These can include speed control, level flight segments, and vectoring.

In many situations, applying these tools and techniques increases the complexity of providing air traffic services and leads to less efficient aircraft operations and use of airspace. As noted in Section 1.3.1, the 2012 FAA RNAV and RNP ATC procedures deployment, while intended to take full advantage of RNAV technology, had a number of consequences that merit attention under the FAA's Metroplex initiative. Aircraft management tools and coordination techniques are further discussed in Section 1.2.2.

As described in Section 1.2.5.1, conventional ATC procedures, compared to RNAV ATC procedures, require larger areas of clearance to ensure accurate signal reception. As a result, conventional ATC procedures typically require more airspace, are less efficient, and may result in increased controller and pilot workload due to the accuracy of the ATC procedures. For example, it may be necessary for aircraft to fly an extended common route prior to diverging on their separate courses to their assigned exit fixes. To ensure appropriate separation between aircraft along the common route, controllers may employ airspace management tools, such as issuing speed control and/or vectors. This may result in more frequent controller/pilot, and controller/controller communication. This increased communication may result in less predictable flight paths due to the time needed for a controller to issue an instruction to a pilot and for a pilot to confirm the instruction prior to executing it. As a result, even more airspace must be protected to allow aircraft the room to operate. This reduces flexibility by limiting the airspace in which air traffic services can be provided to aircraft and results in less efficient operations.

Currently, controllers rely on an assortment of conventional and RNAV departure ATC procedures using both vectors and route structures to maintain adequate separation. This results in excessive vectoring, speed control and limitation issues, in-trail spacing issues, and excessive level-offs as aircraft are climbing or departing DEN Metroplex airspace. Aircraft arriving to or departing from DEN or the Study Airports experience these issues frequently.

In general, the issues associated with the current arrival ATC procedures to DEN are related to inefficient lateral and vertical paths, conflicts with departure traffic, and underutilized en route transitions. As a result, controllers must issue vectors or require aircraft to level-off more frequently to maintain required separation between aircraft. This results in prolonged flight times, as well as increased workload for controllers and pilots as communication must be maintained between controllers and pilots as long as the aircraft is operating on the ATC procedure. Combined, these factors form the basis for the problem within the Denver Metroplex.

It is important to note that a key design constraint is safety. Any proposed change to an ATC procedure to resolve a problem must not compromise safety, and if possible must enhance safety. Although the current ATC procedures are less efficient, they meet current FAA safety criteria.

2.1.2 Causal Factors

The inefficiencies and resulting complexities associated with existing SID and STAR ATC procedures are the primary foundation for the problem in the Denver Metroplex. A problem (or need) is best addressed by examining the circumstances or factors that cause it. Addressing the causal factors behind the problem will help develop a reasonable alternative designed to resolve the problem (i.e., meet the "purpose").

As summarized above, several issues have been identified as causes for the inefficiencies in the Denver Metroplex. For purposes of this EA, these issues were grouped into three key causal factors:

- Lack of flexibility in the efficient transfer of traffic between the en route and terminal area airspace;
- Complex converging and dependent route ATC procedure interactions; and,
- Lack of predictability in the efficient transfer of traffic between en route and terminal area airspace.

These three causal factors are discussed in the following sections.

2.1.2.1 Lack of Flexibility in the Efficient Transfer of Traffic between the Enroute and Terminal Area Airspace

Lack of procedural flexibility limits air traffic controllers' ability to adapt to often changing traffic demands. For example, constraints associated with SUA, delays in other regions, or severe weather along an air traffic route may cause aircraft to enter or exit the en route or terminal area airspace at times and locations other than those previously planned. Controllers require options to manage traffic when faced with these kinds of demands. Additional en route transitions can reduce the need for the vectoring needed to maintain separation between aircraft. Additional transitions can also provide additional options to better balance traffic and controller workload. Transitions were further discussed in Section 1.2.4.1.

Less efficient ATC procedures, with fixes based on ground-based navigational aids (NAVAIDs), may only allow for a limited number of transitions. This can result in some transitions experiencing heavy traffic and congestion while others may go unused. Some existing conventional transitions go unused because they are excessively long and result in inefficient lateral paths for aircraft travelling on them. Other transitions go unused because they conflict with other ATC procedures.

Some current transitions can provide additional challenges. For example, transitions that are used by both propeller and jet aircraft are often constrained because lower-performing aircraft are unable to maintain sufficient speed and altitude to ensure adequate separation from higher-performing aircraft on the route without additional intervention by air traffic controllers. As a result, controllers must employ airspace management tools, such as issuing vectors, to maintain separation between aircraft.

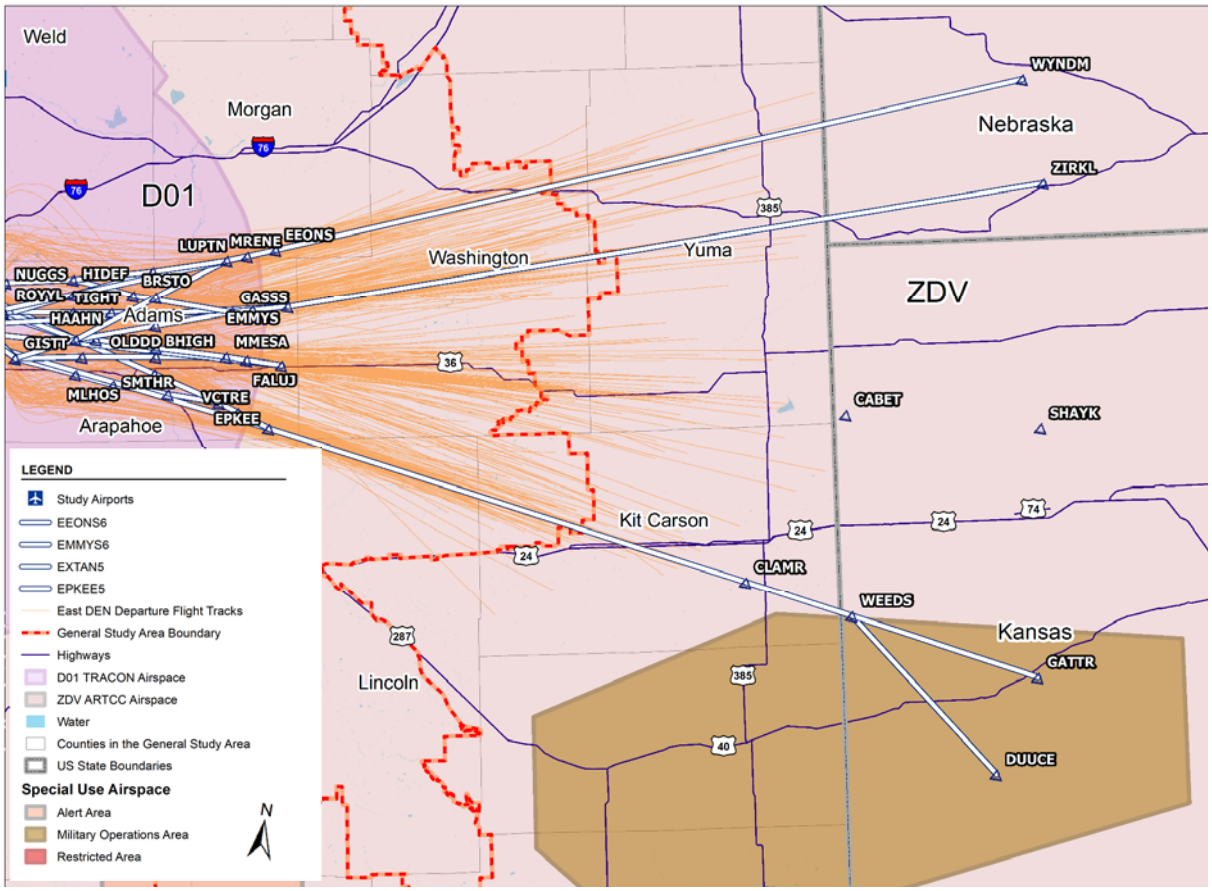
The following sections provide specific examples of how these interactions function within the Denver Metroplex.

DEN EEONS, EMMYS, EXTAN, and EPKEE Eastbound Departures

Exhibit 2-1 (macro view) and **Exhibit 2-2** (micro-view) depict the DEN eastbound departure ATC procedures. These departure ATC procedures account for approximately 36 percent of

all DEN jet departures. The eastbound DEN departures conflict with the Front Range Airport Class D airspace immediately east of DEN on the EEONS and EMMYS SIDs. The eastbound departures on the EPKEE conflict with the Cougar MOA as shown in **Exhibit 2-1**.

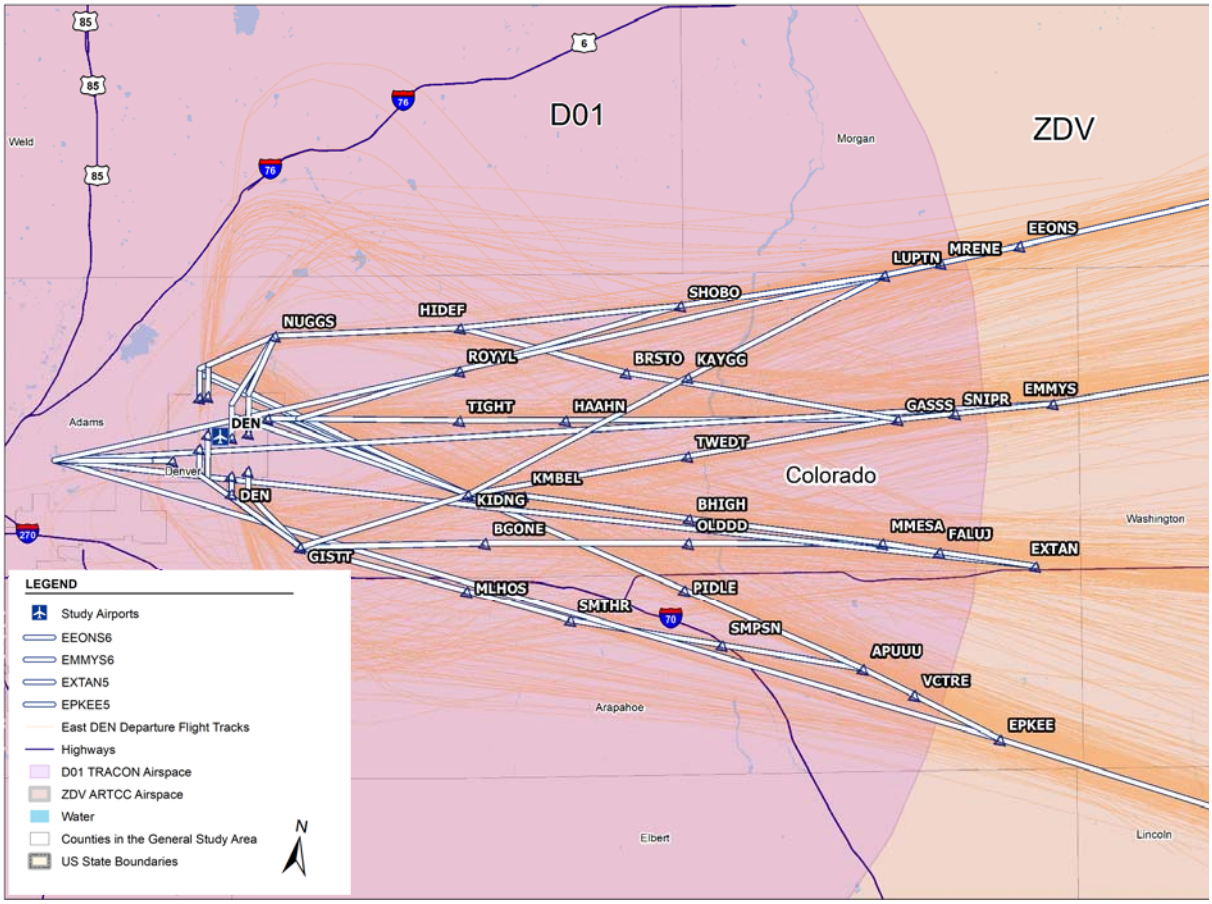
Exhibit 2-1 DEN EEONS, EMMYS, EXTAN, and EPKEE Eastbound Departures (Macro)



Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.

Prepared by: ATAC Corporation, February 2019.

Exhibit 2-2 DEN EEONS, EMMYS, EXTAN, and EPKEE Eastbound Departures (Micro)



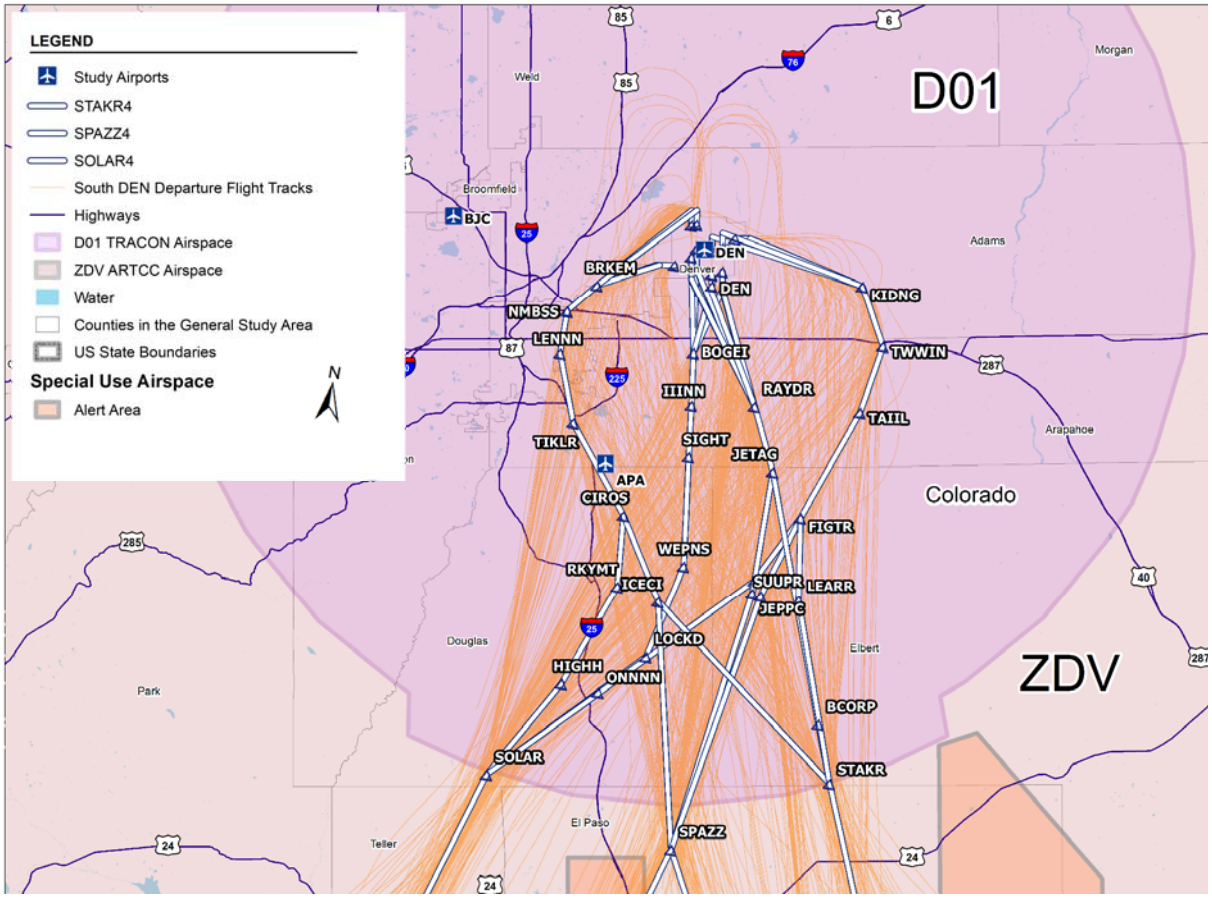
Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.

Prepared by: ATAC Corporation, February 2019.

DEN STAKR, SPAZZ, and SOLAR Southbound SIDs

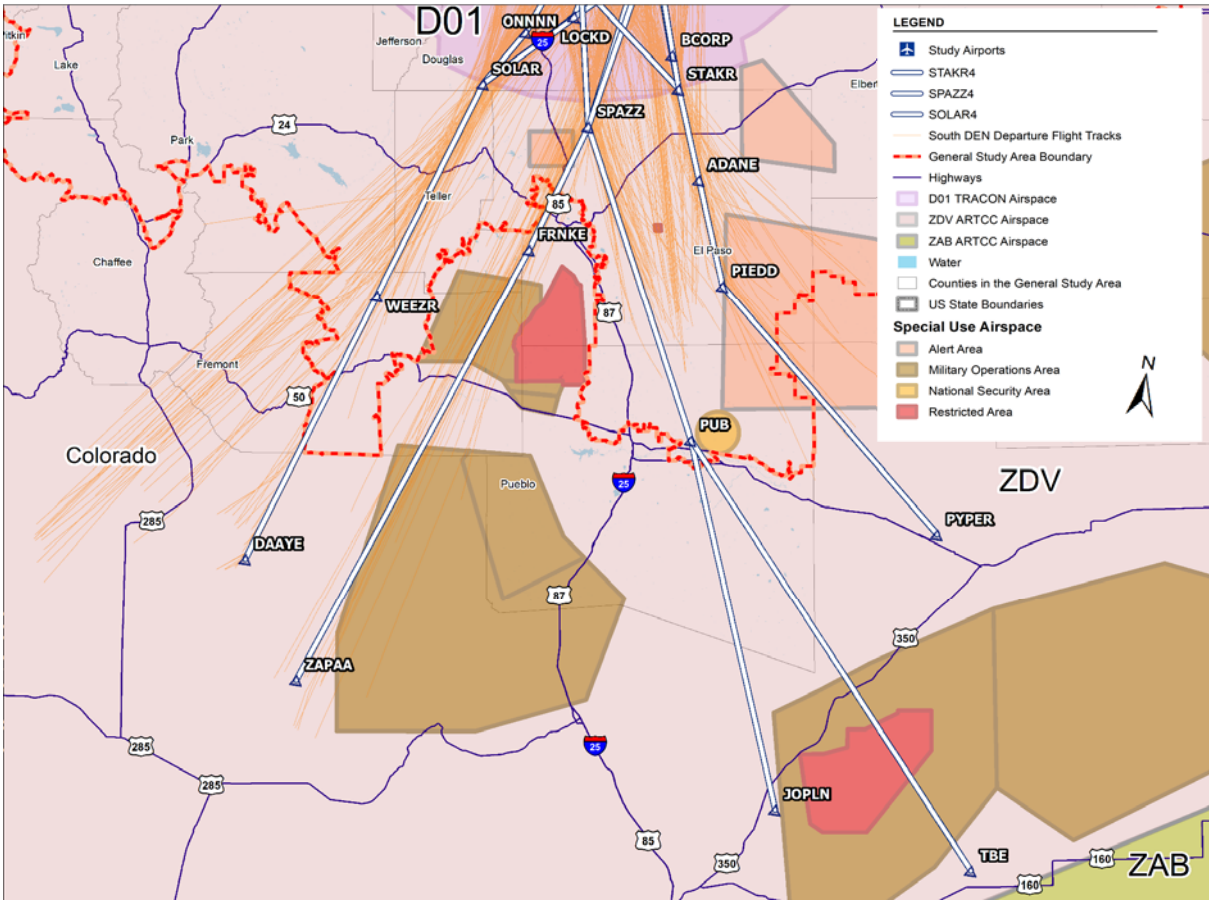
Exhibit 2-3 (macro view) and **Exhibit 2-4** (micro view) depict the DEN southbound departure ATC procedures. These departure ATC procedures account for approximately 17 percent of all DEN jet departures. Currently, the southbound departures routed through SPAZZ result in an inefficient congestion within that en route transition. The Two Buttes MOA to the south also creates a lack of flexibility for routing aircraft to the en route environment.

Exhibit 2-3 DEN STAKR, SPAZZ, and SOLAR Southbound SIDs (Macro)



Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.
Prepared by: ATAC Corporation, February 2019.

Exhibit 2-4 DEN STAKR, SPAZZ, and SOLAR Southbound SIDs (Micro)



Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.
Prepared by: ATAC Corporation, February 2019.

2.1.2.2 Complex Converging and Dependent Route Procedure Interactions

In some areas, the separation between arrival and departure flight routes (e.g., lateral separation between two routes or vertical separation between crossing routes) does not allow for efficient airspace use. This requires that controllers carefully observe aircraft activity along proximate or crossing flight routes and be prepared to provide air traffic services to ensure standard separation is maintained.[32] For example, where arrival and departure flight routes intersect, flight level-offs may be required for either arrivals or departures to ensure adequate vertical separation between aircraft. In some cases, arriving and departing aircraft on nearby flight routes may need to be vectored to ensure safe lateral separation. In other cases, controllers may need to issue point-outs.

[32] Areas where the lateral or vertical separation distances are inadequate to allow efficient use of the airspace are referred to as "confliction points" by air traffic controllers.

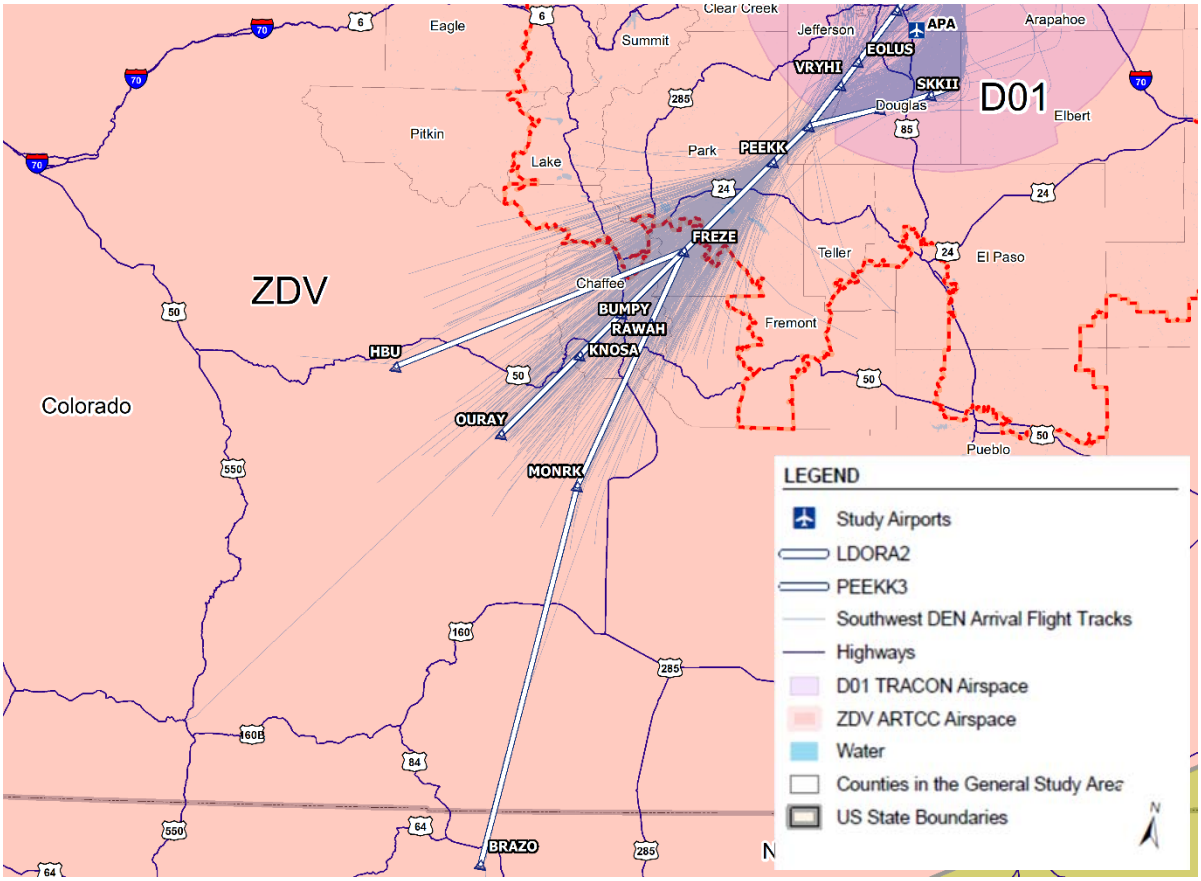
The limited number of ground-based NAVAIDs often results in multiple ATC procedures sharing the same NAVAIDs. This can cause areas of congestion and routes that are dependent on each other. For example, propeller-driven and jet aircraft are frequently placed on different routes that share the same ground based NAVAIDs. This may result in conflicts such as aircraft flying at different speeds along adjacent routes, requiring greater separation to prevent operations at similar altitudes or occupation of the same airspace. To avoid potential conflicts, controllers may need to reroute aircraft by issuing vectors or directing aircraft to level off. This increases pilot and controller workload and system complexity.

The following sections provide examples of how these interactions function within the Denver Metroplex.

Southwest STARs Limit Flexibility and Increase Complexity

Exhibit 2-5 and **Exhibit 2-6** depict traffic operating on the PEEKK and LDORA arrival routes from the southwest. These STARs account for 10 percent of jet arrivals to DEN. The current ATC procedures do not provide RNAV runway transitions to Runways 7 or 26 which results in additional pilot and controller complexity. With only two STARs for north/south flows, the configuration changes due to variance in wind conditions common at DEN negatively impact pilot/controller flexibility. Additionally, aircraft assigned the procedure and beginning and remaining within 1 nautical mile on the full length of the ATC procedure is fairly low and the flight track analysis of these existing ATC procedures demonstrates aircraft are not completely flying the lateral ATC procedure paths.

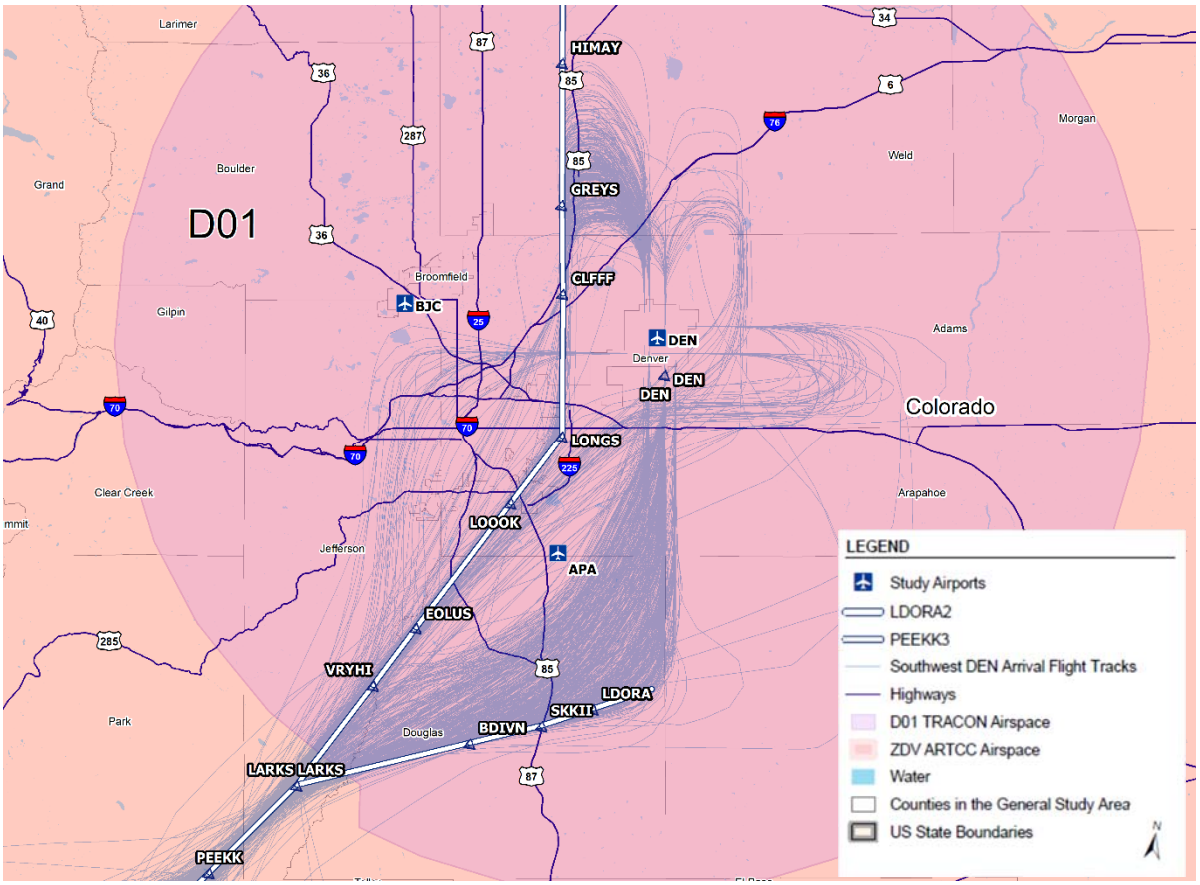
Exhibit 2-6 Southwest STARs Limit Flexibility and Increase Complexity (Macro)



Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.

Prepared by: ATAC Corporation, February 2019.

Exhibit 2-5 Southwest STARs Limit Flexibility and Increase Complexity (Micro)



Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.

Prepared by: ATAC Corporation, February 2019.

2.1.2.3 Lack of Predictability in the Efficient Transfer of Traffic between Enroute and Terminal Area Airspace

Airports with a significant volume of IFR aircraft need SID and STAR ATC procedures to help achieve optimal airspace efficiency. SID and STAR ATC procedures establish consistent flight routes, which help maintain a predictable flow of aircraft to and from an airport. Runway transitions are encoded to the procedure so that predictable, defined routes enable pilots and controllers to know ahead of time how, where, and when an aircraft should be operated. This allows for better planning of airspace use and aircraft control within a given volume of airspace. A predictable route may include expected locations (i.e., where), altitudes (i.e., where and how high), and speeds (i.e., how fast and when) at key points. Aircraft performance and/or piloting technique can vary and may be a factor in reducing predictability. Because conventional ATC procedures are less predictable than RNAV ATC procedures, controllers use vectoring and verbal instructions governing speed, runway transitions, and altitude level-offs to ensure standard separation between aircraft. As discussed in Section 1.2.5.1, RNAV ATC procedures enable aircraft to follow more accurate and better-defined flight routes. This allows for more predictable routes, with fixed locations and altitudes that can be planned ahead of time by the pilot and air traffic control. Fixed routes help segregate traffic by providing separation between aircraft on the routes and an incorporated runway transition enable predictable paths to an alternate landing runway. This allows for improved use of the airspace. Therefore, increased availability of RNAV ATC procedures in a metroplex provides a greater degree of predictability. **Table 2-1** summarizes the conventional and RNAV-based ATC procedures for the Study Airports under Existing Conditions.

Table 2-1 Existing Conditions (2017) STAR and SID Procedures at the Study Airports

	ATC Procedures			
	Conventional Procedures		RNAV Procedures	
Airport	STAR	SID	STAR	SID
APA	DANDD EIGHT LANDR SEVEN LARKS EIGHT POWDR EIGHT QUAIL EIGHT RAMMS SIX SAYGE EIGHT TOMSN SIX	DENVER NINE PIKES EIGHT PLAINS SEVEN ROCKIES TWO YELLOWSTONE NINE	DUNNN TWO PUFFR FOUR ZOMBZ ONE	BAYLR THREE BRYCC THREE CONNR THREE COORZ THREE EEONS FIVE EMMYS FIVE EPKEE THREE EXTAN FOUR FOOOT THREE RIKKK THREE SOLAR THREE SPAZZ THREE STAKR THREE YAMMI THREE YOKES FIVE
BJC	DANDD EIGHT LANDR SEVEN LARKS EIGHT POWDR EIGHT QUAIL EIGHT RAMMS SIX SAYGE EIGHT TOMSN SIX	DENVER NINE PIKES EIGHT PLAINS SEVEN ROCKIES TWO YELLOWSTONE NINE	DUNNN TWO KIPPR FOUR	BAYLR THREE BRYCC THREE CONNR THREE COORZ THREE EEONS FIVE EMMYS FIVE EPKEE THREE EXTAN FOUR FOOOT THREE RIKKK THREE SOLAR THREE SPAZZ THREE STAKR THREE YAMMI THREE YOKES FIVE
GXY	DANDD EIGHT LANDR SEVEN LARKS EIGHT POWDR EIGHT QUAIL EIGHT RAMMS SIX SAYGE EIGHT TOMSN SIX	DENVER NINE PIKES EIGHT PLAINS SEVEN ROCKIES TWO YELLOWSTONE NINE	KIPPR FOUR TSHNR TWO	

Notes:
APA – Centennial Airport
BJC– Rocky Mountain Metropolitan Airport
DEN – Denver International Airport
GXY – Greeley-Weld County Airport
FNL – Northern Colorado Regional Airport

Table 2-1 Existing Conditions (2017) STAR and SID Procedures at the Study Airports

	ATC Procedures			
	Conventional Procedures		RNAV Procedures	
Airport	STAR	SID	STAR	SID
DEN	DANDD EIGHT LANDR SEVEN LARKS EIGHT POWDR EIGHT QUAIL EIGHT RAMMS SIX SAYGE EIGHT TOMSN SIX	DENVER NINE PIKES EIGHT PLAINS SEVEN ROCKIES TWO YELLOWSTONE NINE	ANCHR FOUR BOSSS TWO CREDE THREE FRNCH THREE JAGGR THREE KAILE TWO KIPPR FOUR KOHOE THREE LDORA TWO MOLTN THREE PEEKK THREE PURRL TWO TELLR TWO TSHNR TWO ZPLYN THREE	BAYLR THREE BYRCC THREE CONNR THREE COORZ THREE EEONS FIVE EMMYS FIVE EPKEE THREE EXTAN FOUR FOOOT THREE JMPRS TWO RIKKK THREE SOLAR THREE SPAZZ THREE STAKR THREE YAMMI THREE YOKES FIVE
FNL	DANDD EIGHT LANDR SEVEN LARKS EIGHT POWDR EIGHT QUAIL EIGHT RAMMS SIX SAYGE EIGHT TOMSN SIX	DENVER NINE PIKES EIGHT PLAINS SEVEN ROCKIES TWO YELLOWSTONE NINE	KIPPR FOUR TSHNR TWO	BAYLR THREE BRYCC THREE CONNR THREE COORZ THREE EEONS FIVE EMMYS FIVE EPKEE THREE EXTAN FOUR FOOOT THREE RIKKK THREE SOLAR THREE SPAZZ THREE STAKR THREE YAMMI THREE YOKES FIVE

Notes:

APA – Centennial Airport
BJC– Rocky Mountain Metropolitan Airport
DEN – Denver International Airport
GXY – Greeley-Weld County Airport
FNL – Northern Colorado Regional Airport

Sources: DEN Metroplex *Study Team Final Report*, November 2014; NFDC, accessed June 30, 2017.
Prepared by: ATAC Corporation, February 2019.

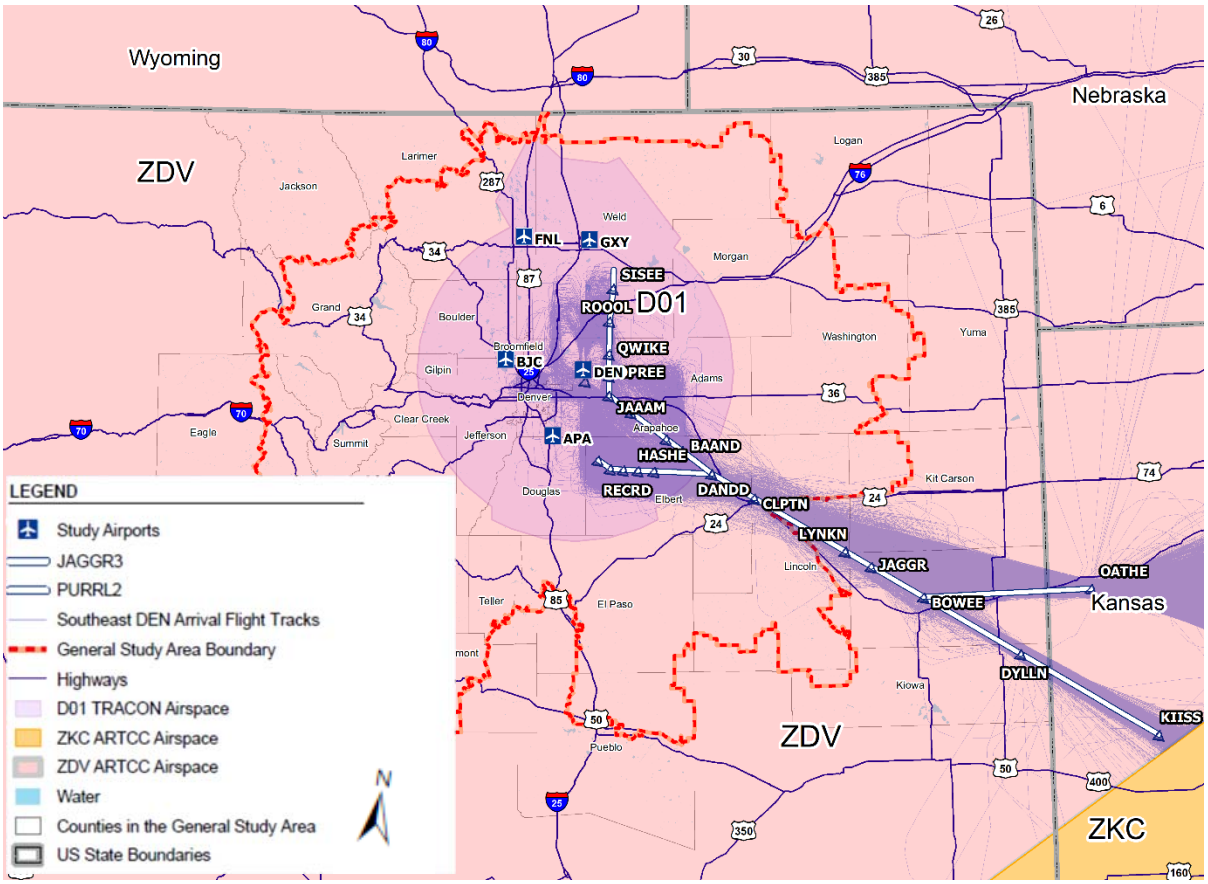
The following sections describe the two areas - ground path and vertical path - in which conventional ATC procedures in the DEN Metroplex are less predictable than RNAV ATC procedures.

Ground Path (Lateral Path)

The ground path is the track along the surface of the earth directly below an aircraft that represents where it is flying. When some of the STAR and SID ATC procedures in the Denver Metroplex airspace use ground-based NAVAIDs, navigation can be affected by line-of-sight and signal degradation issues associated with this type of technology. This limits where conventional ATC procedure routes can be located. Because the NAVAIDs are less precise, conventional ATC procedures require wider areas of airspace to protect aircraft flying on neighboring routes. This can result in aircraft flying routes that vary from those that are published.

Exhibit 2-7 shows how aircraft using multiple conventional SIDs currently follow an extended common path prior to course divergence. Because of the shared common path, in-trail spacing, or the distance between aircraft over the route, must be increased to allow for greater separations between subsequent departures. The increased use of airspace management tools results in more frequent controller-to-pilot and controller-to-controller communication, increasing controller and pilot workload and reducing predictability.

Exhibit 2-7 DEN JAGGR Three and PURRL Two Southeast Arrivals



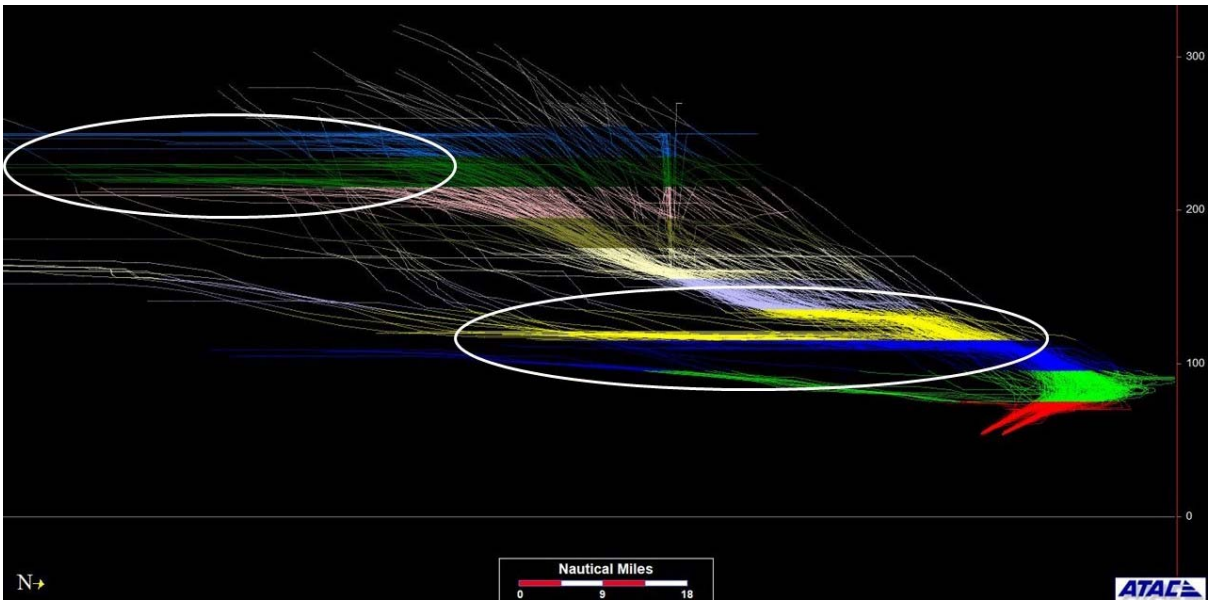
Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.
Prepared by: ATAC Corporation, February 2019.

Vertical Path

In guiding aircraft along their routes, controllers direct aircraft to climb, descend, or level off. During climb, the point when an aircraft reaches an assigned altitude may vary depending upon factors such as aircraft performance, weather conditions and piloting technique. Aircraft arriving at or departing from the Study Airports are often required to level off during climb and descent to maintain vertical separation from other aircraft. Interrupted climbs and descents can increase flight time and distance as the aircraft exit/enter the terminal airspace or transition to/from the runway approach environment.

Exhibit 2-8 depicts vertical profiles for aircraft arriving on the LARKS Eight STAR into DEN indicating the excessive level-offs throughout all phases of the ATC procedure. Level-offs during descent requires application of thrust for aircraft set up to land (e.g., flaps extended) to maintain approach speeds and altitude. This results in increased flight time and distance. Unpredictable vertical guidance resulting from conflicting traffic leads to increased controller workload and inefficient aircraft operation.

Exhibit 2-8 Vertical Arrival Flow Profile Example (LARKS Eight STAR)



Note: Circled areas of radar flight track data indicate areas of aircraft level-off arriving to DEN via the LARKS eight arrival. Color banding is indicative of increasing altitude from red (lowest) to grey (highest). The view is a side view of arrivals looking northward.

Sources: ATAC Corporation (radar track data), June 2016-June 2017.
Prepared by: ATAC Corporation, February 2019.

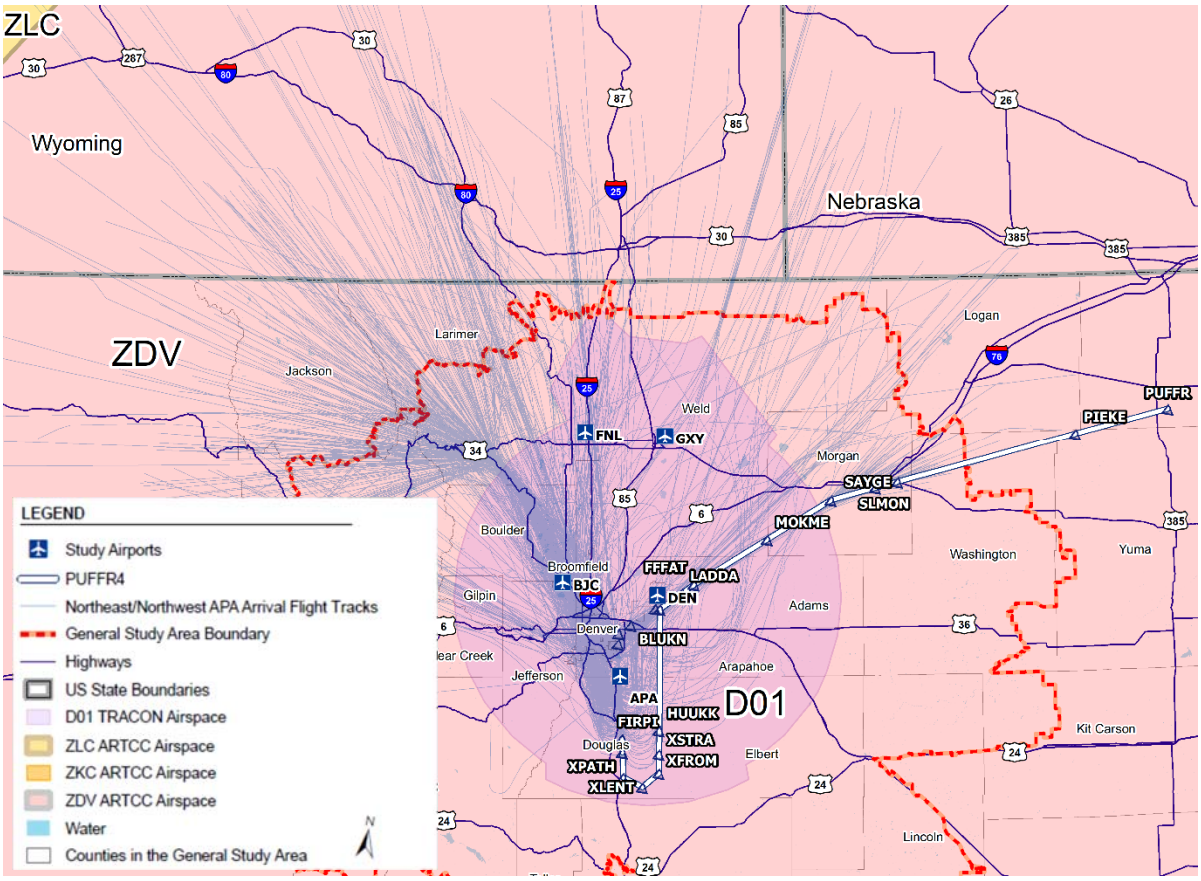
Extended level-offs often result in increased controller/pilot communication. They also may require increased traffic advisories to pilots about the proximity of other aircraft or point-outs to other controllers responsible for neighboring airspace sectors. This adds to complexity and inefficient aircraft performance during a descent or climb.) This results in less predictable routes and reduced airspace efficiency.

Lack of DEN Satellite Arrival Procedures

Aircraft arriving to Denver area satellite airports account for approximately 14 percent of all Denver TRACON arrival traffic.[33] Currently, dedicated satellite airport STARs do not efficiently segregate arriving satellite aircraft from arriving DEN traffic. Aircraft are frequently vectored on de-conflicted headings and altitudes to the destination facility. For example, aircraft arriving to APA currently share arrival flows with DEN arrivals and impede the DEN Optimized Profile Descents (OPDs) which are designed to reduce level segments. As a result, airspace efficiency is affected by the lack of more predictable and dedicated STAR ATC procedures at the DEN area satellite Study Airports. There are also no dedicated arrival ATC procedures for GXY, FNL, and BJC Study Airports. **Exhibit 2-9** depicts the existing PUFFR arrival to APA and demonstrates the lack of dedicated satellite arrivals.

[33] ATAC Corporation, Existing Conditions Radar Track Data. July 1, 2016 – June 30, 2017

Exhibit 2-9 Lack of DEN Satellite Arrival Procedures



Sources: U.S. Department of Transportation, Federal Aviation Administration, National Flight Data Center, National Airspace System Resources, Airport, and Runway databases, accessed January 2019 (airspace boundaries); National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.

Prepared by: ATAC Corporation, February 2019.

2.2 Purpose of the Proposed Action

The purpose of the Proposed Action is to improve the airspace efficiency of the ATC procedures and airspace utilization in the Denver Metroplex. To meet this goal, the Proposed Action would optimize ATC procedures serving the Study Airports, while maintaining or enhancing safety, in accordance with FAA's mandate under federal law. This goal would be achieved by reducing dependence on ground-based NAVAID technology in favor of more efficient satellite-based navigation, such as RNAV. Specifically, the objectives of the Proposed Action are as follows:

- Improve the flexibility in transitioning traffic between en route and terminal area airspace and between terminal area airspace area and the runways;
- Improve the segregation of arrivals and departures in terminal area and en route airspace; and,
- Improve the predictability in transitioning traffic between en route and terminal area airspace and between terminal area airspace area and the runways.

The FAA expects that the frequency of controller/pilot communication would decrease, reducing both controller and pilot workload. Improvements from RNAV ATC procedures would reduce the need for vectoring and level flight segments, resulting in more predictable traffic flows.

Each objective of the Proposed Action is discussed in greater detail below.

2.2.1 Improve Flexibility in Transitioning Aircraft

As discussed in Section 2.1.2.1, the limited number of practically available transitions and associated ATC procedures constrain efficiency in the terminal and en route transitional airspace. This requires merging multiple traffic flows before aircraft arrive at and depart from terminal airspace. One objective of the Proposed Action is to minimize the need for merging traffic flows by increasing the number of transitions and ATC procedures that are dedicated to specific Study Airports. This objective can be measured with the following criteria:

- Where possible, increase the number of available transitions compared with the No Action (measured by number of exit/entry points).
- Where possible, increase the number of RNAV STARs and SIDs compared with the No Action (measured by total count of RNAV STARs and RNAV SIDs for each of the Study Airports.)

2.2.2 Segregate Arrivals and Departures

As discussed in Section 2.1.2.2, arrival and departure routes cross, converge, or are within close proximity of each other in some portions of the airspace. RNAV ATC procedures can be designed with capabilities such as speed control and altitude restrictions that segregate aircraft on the route while reducing controller and pilot workload. One objective of the Proposed Action is to implement ATC procedures that would better segregate arrivals and departures within the airspace. This objective can be measured with the following criterion:

- Segregate arrival and departure traffic (measured by number of RNAV STARs and/or SIDs that can be used independently to/from Study Airports).

2.2.3 Improve the Predictability of Air Traffic Flow

As discussed in Section 2.1.2.3, the lack of up-to-date airspace ATC procedures requires controllers to use vectoring, speed control and level-offs to ensure safe vertical and lateral separation between aircraft during the arrival and departure phases of flight. As a result, controllers and pilots experience more complex workload. Some STARS are underused because of flow restrictions.[34] There are also a limited number of ATC procedures with runway transitions to and from the runways at each of the Study Airports. In addition, there is a lack of RNAV ATC procedures to and from the Satellite Airports, preventing air crews from selecting their preferential arrival or departure with predictable flight expectations. These factors affect predictability within the Denver Metroplex.

This objective can be measured with the following criteria:

- RNAV ATC procedures with altitude controls intended to optimize descent or climb patterns;
- Ensure that the majority of STARs and SIDs to and from the Study Airports are based on RNAV technology (measured by count of RNAV STARs and SIDs for an individual Study Airport).

2.3 Criteria Application

The FAA will evaluate the Proposed Action to determine how well it meets the purpose and need based on the measurable criteria and objectives described above. The evaluation of alternatives will include the No Action, under which the existing (2017) procedures serving the Study Airports would remain unchanged except for planned ATC procedure modifications from other FAA actions that were or are expected to be approved for implementation.

2.4 Description of the Proposed Action

The Proposed Action would implement optimized RNAV SID and STAR ATC procedures and RNP approaches, where feasible, in the Denver Metroplex. This would improve the predictability and segregation of routes, as well as increase flexibility in providing air traffic services. The Proposed Action is described in detail in Chapter 3, *Alternatives*.

Implementation of the Proposed Action would not increase the number of aircraft operations at the Study Airports. Furthermore, the Proposed Action does not involve physical construction of any facilities such as additional runways or taxiways, and does not require permitting or other approvals or actions on a state or local level. Therefore, the implementation of the proposed changes to ATC procedures in the Denver Metroplex would not require any physical alterations to environmental resources identified in FAA Order 1050.1F.

2.5 Required Federal Actions to Implement Proposed Action

Implementing the Proposed Action requires the FAA to

- undertake controller training;

[34] Those air traffic control processes and decisions made to avoid overloads and to ensure that airspace and airport capacity is fully exploited.

- publish new or revised STARs
- publish new or revised SIDs; and
- publish new or revised transitions.

2.6 Agency Coordination

On May 6, 2016, the FAA distributed a letter containing the notice of intent to prepare an EA for the DEN Metroplex Project to 395 federal, state, regional, and local officials. The FAA sent the early notification letter to:

1. Advise agencies of the initiation of the EA study;
2. Request background information about the study area established for the EA; and
3. Provide an opportunity to advise the FAA of any issues, concerns, policies or regulations that may affect the environmental analysis that the FAA will undertake in the EA.

On May 8, 2016, a notice of intent to prepare an EA was published in the Denver Post. 11 comments were received in response to the notice of intent and were considered in preparation of the Draft EA. These comments are contained in **Appendix A***: Agency Coordination, Community Involvement, and List of Receiving Parties.*

On April 8, 2019 the FAA initiated Section 106 consultation with the Colorado SHPO office. There are no federally recognized tribes in the General Study Area, however, the Colorado State Historic Preservation Officer (SHPO) maintains a listing of tribes with a potential historic or cultural interest in the State of Colorado, of which the General Study Area environs are a subset. Because of this potential historic interest, the FAA initiated government to government consultation on April 9, 2019 with 99 parties listed by the Colorado SHPO. **Appendix A**, *Agency Coordination, Community Involvement, and List of Receiving Parties*, includes a copy of the notice of intent letter (and attachments), affidavits of newspaper publication, as well as a list of the receiving agencies.

2.7 Listing of Federal Laws and Regulations Considered

Table 2-2 lists the relevant federal laws and statutes, Executive Orders, and regulations applicable to the Proposed Action and the No Action and considered in preparation of this EA.

Table 2-2 List of Federal Laws and Regulations Considered

Federal Laws and Statutes	Citation
National Environmental Policy Act of 1969	42 U.S.C. § 4321 *et seq.*
Clean Air Act of 1970, as amended	42 U.S.C. § 7401 *et seq.*
American Indian Religious Freedom Act of 1978	42 U.S.C. § 1996
Department of Transportation Act of 1966, Section 4(f)	49 U.S.C. § 303(c)
Aviation Safety and Noise Abatement Act of 1979	49 U.S.C. § 47501 et seq.
Federal Aviation Act of 1958, as amended	49 U.S.C. § 40101 et seq.
Endangered Species Act of 1973	16 U.S.C. § 1531 *et seq*.
Fish and Wildlife Coordination Act of 1958	16 U.S.C. § 661 *et seq*.
The Bald and Golden Eagle Protection Act of 1940	16 U.S.C. § 668 *et seq*.
Lacey Act of 1900	16 U.S.C. § 3371 *et seq*.
Migratory Bird Treaty Act of 1918	16 U.S.C. § 703 *et seq.*
National Historic Preservation Act of 1966, as amended	16 U.S.C. § 470
The Wilderness Act of 1964	16 U.S.C. § 1131-1136
Archaeological and Historic Preservation Act of 1974, as amended	16 U.S.C. § 469 *et seq*.

Executive Orders	Citation
11593, Protection and Enhancement of the Cultural Environment	36 Federal Register (FR) 8921
12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	59 FR 7629
13045, Protection of Children from Environmental Health Risks and Safety Risks	62 FR 19885
13423, Strengthening Federal Environmental, Energy, and Transportation Management	72 FR 3919

Federal Regulations	Citation
Council for Environmental Quality Regulations	40 C.F.R. Part 1500 to Part 1508
General Conformity Regulations	40 C.F.R. Part 93 Subpart B
Protection of Historic Properties Regulations	36 C.F.R. 800
Airport Noise Compatibility Planning Regulations	14 C.F.R. Part 150
Federal Aviation Regulations (FAR) Part 71: Designation of Class A, Class B, Class C, Class D, and Class E Airspace Areas; Airways; Routes; and Reporting Points, December 17 1991.	14 C.F.R. Part 71

FAA/U.S. Department of Transportation Orders

U.S. DOT Order 5610.2a: Final Order to Address Environmental Justice in Low-Income and Minority Populations, 2012.
FAA Order 8260.58A, The United States Standard Performance Based Navigation (PBN) Instrument Procedure Design, March 14, 2016.
FAA Order 8260.43B, *Flight Procedures Management Program*, April 22, 2013.
FAA Joint Order 7110.65X, *Air Traffic Control*, September 12, 2017.
FAA Order 1050.1F: Environmental Impacts: Policies and Procedures, June 16, 2015.
FAA, Order JO 7400.2M, *Procedures for Handling Airspace Matters*, February 28, 2019.
FAA Order 7100.41A, Performance Based Navigation Implementation Process, April 29, 2016.
FAA Order 8260.3D, United States Standard for Terminal Instrument Procedures (TERPS), February 16, 2018.
FAA Order 8040.4B, *Safety Risk Management Policy*, May 02, 2017
FAA Joint Order 1000.37A, Air Traffic Organization Safety Management System, May 30, 2014.
FAA Order 8260.19H, *Flight Procedures and Airspace*, July 20, 2017.
FAA Order 8260.46F, *Departure Procedure (DP) Program*, December 15, 2015.

Table 2-2 List of Federal Laws and Regulations Considered

FAA Advisory Circulars
FAA Advisory Circular 150/5020-1: Noise Control and Compatibility Planning for Airports, August 5, 1983.
FAA Advisory Circular 150/5200-33B: *Hazardous Wildlife Attractants on or near Airports*, August 28, 2007.
FAA Advisory Circular 36-3H: Estimated Airplane Noise Levels in A-Weighted Decibels, April 25, 2002.

Source: ATAC Corporation, April 2019.
Prepared by: ATAC Corporation, April 2019.

3 Alternatives

The Alternatives analysis was conducted pursuant to Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations, parts 1500-1508); and Federal Aviation Administration (FAA) guidance provided in FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (FAA Order 1050.1F). This chapter discusses the following topics:

- Alternative Development Process
- Alternatives Overview
- Comparison of Alternatives

The technical terms and concepts discussed in this chapter are explained in Chapter 1, *Introduction*. Footnotes are added to clarify additional technical terms.

3.1 Alternative Development Process

At the earliest phase of design, the Air Traffic Control (ATC) procedures were conceptual in nature and served as broad outlines of function and form for further development. A subsequent phase of robust design and refinement is referred to in this document as a preliminary ATC procedure. Once a preliminary ATC procedure design was completed, those procedures are referred to as Proposed Final Designs (PFDs) and are carried forward for this environmental analysis.

Developing alternatives for the Denver (DEN) Metroplex Project began with the formation of the DEN Metroplex Study Team (Study Team). In a Final Report (**Appendix F**) issued in November of 2014, the Study Team defined operational issues in the DEN Metroplex and recommended conceptual ATC procedure designs that would address these issues.[35] The recommended conceptual ATC procedures were then given to the DEN Metroplex Design and Implementation (D&I) Team. The D&I Team designed preliminary ATC procedures based on the Study Team's conceptual recommendations. Each preliminary ATC procedure that the D&I Team designed had to meet several design criteria as well as the project Purpose and Need. As discussed in Chapter 2, the purpose of and need for the Proposed Action is to address existing inefficiencies with DEN Metroplex Standard Instrument Departure (SID) and Standard Terminal Arrival Route (STAR) ATC procedures. The FAA rejected individual preliminary ATC procedures if they did not meet the Purpose and Need.

The Proposed Action that this Environmental Assessment (EA) evaluates is a combined package of interrelated PFD ATC procedures. This group of PFD ATC procedures were considered and evaluated in combination with one another to determine whether the Proposed Action ATC procedures would meet the project's Purpose and Need. The FAA considered multiple versions of each preliminary ATC procedure prior to adopting a PFD. Several versions of preliminary ATC procedures were eliminated from further consideration because they failed to meet the project's Purpose and Need.

The following sections describe the Alternative development process the FAA used to create and evaluate a series of preliminary ATC procedures that, when employed together as PFDs, would add efficiency to the DEN Metroplex airspace.

[35] Denver Metroplex Study Team, *Denver Metroplex Study Team Final Report*, November 2014.

3.1.1 DEN Metroplex Study Team

In November 2014, the DEN Metroplex Study Team began work to define operational problems in the DEN Metroplex and identify potential solutions. The Study Team included experts on the ATC system for the DEN Metroplex. The Study Team's work was completed following a process that included identifying and characterizing existing issues, proposing conceptual ATC procedure designs and airspace changes to address these issues, and identifying the expected benefits and risks of the conceptual designs.

The Study Team held a series of outreach meetings with local ATC, pilots, airport representatives, and aviation industry representatives to learn more about the challenges of operating in the DEN Metroplex. These meetings helped identify operational challenges associated with existing ATC procedures and potential solutions that would increase efficiency in the DEN Metroplex airspace. The Study Team identified several performance-based navigation (PBN) solutions that were expected to improve efficiency in the DEN Metroplex airspace. The PBN ATC procedure modifications proposed were conceptual in nature, and did not include a detailed technical assessment to evaluate the feasibility of the ATC procedures, which was reserved for the D&I Team to conduct.[36]

3.1.2 DEN Metroplex Design and Implementation Team

After the Study Team completed its Final Report in November 2014, the D&I Team began work on the preliminary ATC procedure designs. The D&I Team consisted of participants from FAA ATC facilities, the National Air Traffic Controllers Association (NATCA), ATC subject matter experts (SMEs), aviation industry representatives, representatives from the FAA's Western Service Center and other FAA lines of business, and various support contractors. The first step in the D&I Team process was to prioritize the conceptual Study Team proposals based on complexity, interdependencies with other ATC procedures, and the degree of potential quantitative and qualitative benefits. The D&I Team then divided into workgroups to further develop and refine the conceptual Study Team ATC procedure proposals into preliminary ATC procedure designs. Finally, the preliminary ATC procedure designs were brought to the complete D&I Team for review and, if necessary, modification. Following completion of the preliminary ATC procedure designs, the D&I Team engaged the public (i.e., local residents, the general public, and stakeholders) by holding a series of informational meetings on the DEN Metroplex Project. Feedback received during the community involvement process was considered and incorporated in the ATC procedure PFDs, as appropriate. In developing the ATC procedure PFDs, the D&I Team was responsible for following regulatory and technical guidance as well as meeting criteria and standards in three general categories:

1. **Area Navigation (RNAV) Design Criteria and Air Traffic Control Regulatory Requirements** – The below FAA Orders collectively define the majority of processes, procedures, and methods for PBN flight procedure design, amendment, and implementation. Requirements governing air traffic control procedures, air traffic management, and appropriate technical terminology are additionally considered as integral process components.

[36] *Id.* (In this document "*Id.*" is an abbreviation of the Latin term *ibidem*, meaning "in the same place" and always refers to the immediately preceding cited authority, either in the same footnote or the previous footnote.)

- FAA Order 8260.58A, *United States Standard for Performance Based Navigation (PBN) Instrument Procedure Design*;
- FAA Order 8260.43B, *Flight Procedures Management Program*;
- FAA Joint Order 7110.65*X*, *Air Traffic Control*;
- FAA Order 8260.3D, *United States Standards for Terminal Instrument Procedures (TERPS)*;
- FAA Order 7100.41A, *Performance Based Navigation Implementation Process* and *The Guidelines and Updates for Implementing Terminal RNAV Procedures*;
- FAA Order 8260.19H, *Flight Procedures and Airspace*; and
- FAA Order 8260.46F, *Departure Procedure (DP) Program*.

2. **Operational Criteria** – Operational criteria needed to be consistent with the Purpose and Need for the DEN Metroplex Project. This includes increasing airspace efficiency and flexibility, and decreasing complexity in air traffic management. These criteria were measured for all preliminary ATC procedures using a full-motion simulator, a stationary simulator, and/or flight training devices. These criteria were also measured for many preliminary ATC procedures using real time Human-In-The-Loop simulations (HITLs).[37] These simulations further validated that operations in the DEN Metroplex would not be limited by the preliminary ATC procedures. The D&I Team also evaluated each of the preliminary ATC procedure designs with full-motion aircraft simulators. The simulations helped ensure that aircraft could fly the preliminary ATC procedure without any negative effects on airspace efficiency (e.g., pilot workload).

3. **Safety Factors** – Proposed changes were evaluated using the FAA's Air Traffic Organization (ATO) Safety Management System (SMS).[38] The SMS is the system for assessing and managing the safety of ATC and navigation services in the National Airspace System (NAS). If a proposed change introduced a new hazard or increased the severity and/or likelihood of an existing hazard, the preliminary ATC procedure design was adjusted or mitigated to reduce the hazard to acceptable levels. In compliance with SMS requirements, the proposed changes were evaluated by a Safety Risk Management Panel (SRMP) following a five-step process: (1) system analysis, (2) identify hazards, (3) analyze safety risk, (4) assess safety risk, and (5) control safety risk.[39]

[37] A HITL simulation is conducted to evaluate the feasibility of PFDs. Prior to HITL simulation activities, industry partners used flight simulators to evaluate the PFDs. The HITL simulation creates an interactive environment similar to the operational areas of terminal and en route facilities for controllers to evaluate interactions among procedures and assess their workability.

[38] U.S. Department of Transportation, Federal Aviation Administration, Order JO 1000.37A, *Air Traffic Organization Safety Management System*, May 30, 2014.

[39] U.S. Department of Transportation, Federal Aviation Administration, Order 8040.4B, *Safety Risk Management Policy*, May 02, 2017.

3.1.2.1 D&I Team Community Involvement

Throughout the post-Study Team recommendations, and in the period spanning from Preliminary Design to Proposed Final Designs, the D&I Team undertook a Community Involvement process that encompassed 23 select official briefings, aviation stakeholder briefings, and public workshops. These Community Involvement activities occurred between November 2015 and December of 2018. A total of 42 meetings and/or briefings were conducted throughout the Study Area during this timeframe. As a result of the public workshops held along the Front Range, 866 email comments and 61 written comments were received and considered in the procedure design process. Design changes were made to preliminary designs and in all cases where appropriate, were carried forward to the Proposed Action for this project as a result of the extensive Community Involvement process.

3.1.2.2 D&I Team Preliminary ATC Procedure Design Efforts

The D&I Team undertook validation exercises that further refined the preliminary ATC procedures to ensure they were viable, taking into account the limitations imposed by mountainous terrain, Class B airspace[40], and Special Use Airspace[41]. (See Section 1.3.2 for further discussion of airspace constraints in the DEN Metroplex). These three factors resulted in restrictions to the preliminary ATC procedure design options for the DEN Metroplex Project. The D&I Team also examined interactions between Denver International Airport (DEN) and satellite airports[42] including:

- Centennial Airport (APA)
- Rocky Mountain Metropolitan Airport (BJC)
- Northern Colorado Regional Airport (FNL)
- Greeley – Weld County Airport (GXY)

While the design of an ATC procedure into one airport can be a fairly simple process, the D&I Team was charged with providing a more complete and integrated solution to air traffic complexities and inefficiencies in a large and diverse area. The D&I Team tried to create preliminary ATC procedures that would remain laterally separated from each other to the extent feasible. However, the close proximity of arrival and departure ATC procedures in the DEN Metroplex due to terrain, airspace limitations, and acceptable design criteria results in the complex interaction of aircraft using these ATC procedures.

Preliminary ATC procedure designs for arrivals are most efficient when they allow aircraft to descend at or near idle speed, unaffected by other ATC procedures or terrain elevation. As aircraft arriving or departing the DEN Metroplex enter congested airspace, interaction between these aircraft climbing, descending, leveling, accelerating, and slowing increases substantially. Weather can significantly complicate this interaction and is also considered based on historic norms. These increases in interactions between simulated aircraft operating

[40] See Federal Aviation Administration. *Aeronautical Information Manual; Chapter 3; Section 2. Controlled Airspace*. October 12, 2017.

[41] *Special Use Airspace* is used to designate airspace in which certain activities must be confined, or where limitations may be imposed on aircraft operations that are not part of those activities. See Federal Aviation Administration. *Aeronautical Information Manual; Chapter 3; Section 4. Special Use Airspace*. October 12, 2017.

[42] *Satellite airports* are those airports in relatively close proximity the primary air carrier airport and are those that see significant interaction of Instrument Flight Rules (IFR) air traffic needing to be considered in designing ATC procedures.

on different simulated ATC procedures reduces available preliminary ATC procedure design options.

Preliminary ATC procedure designs for departures are most efficient when they allow aircraft to climb unrestricted to cruising altitude, unaffected by other ATC procedures or terrain elevation. Due to the air traffic volume in the DEN Metroplex, departure ATC procedure designs must allow for interactions with departures from surrounding airports while enabling aircraft to join busy en route ATC procedure corridors.

Preliminary arrival and departure PBN ATC procedure designs were developed with lateral routings, crossing points,[43] and altitude restrictions that were the most optimal possible considering the constraints inherent in the DEN Metroplex airspace. The D&I Team worked to meet milestones at the 25, 50, 75, 90, and 100 percent preliminary ATC procedure design levels. Each preliminary ATC procedure design was continuously refined based on industry input, design and testing software; aircraft simulator results, HITL controller/pilot simulations, and technical criteria described previously. The combined package of preliminary ATC procedure designs at the 100% design level in this EA are referred to as the FAA's PFD versions and are collectively the Proposed Action. To better illustrate the iterative process that was undertaken, the following sections describe the process that was used for two PFD ATC procedures (SSKII One STAR and SPAZZ SID) that are included in the Proposed Action.[44]

3.1.2.3 SSKII One STAR

The Study Team identified generalized issues influencing PFD ATC procedure development of the SSKII One STAR. These high-level issues are:

- Change the DEN STARs from a 16 ATC procedure system (four ATC procedures crossing each compass corner post of northeast [NE], northwest [NW], southeast [SE], and southwest [SW]) to an eight ATC procedure system (two ATC procedures crossing each compass corner post of NE, NW, SE, and SW) to reduce pilot and controller task complexity and increase efficiency for north/south runway configurations due to multiple and frequent configuration changes at DEN;
- No dedicated RNAV runway transitions to Runways 7 or 26, which creates additional pilot and controller task complexity; and,
- Actual flight tracks do not follow current arrival ATC procedures.

At a more finite level, the Study Team made five recommendations to address these more generalized issues identified with the SW corner post arrivals:

- RNAV Optimized Profile Descent (OPD) STAR created with runway transitions for north, south, and combined flows resulting in optimized lateral paths to reduce flight track miles.

[43] *Crossing points* are three dimensional locations laterally defined by latitude/longitude coordinates and vertically defined by an altitude or range of altitudes.

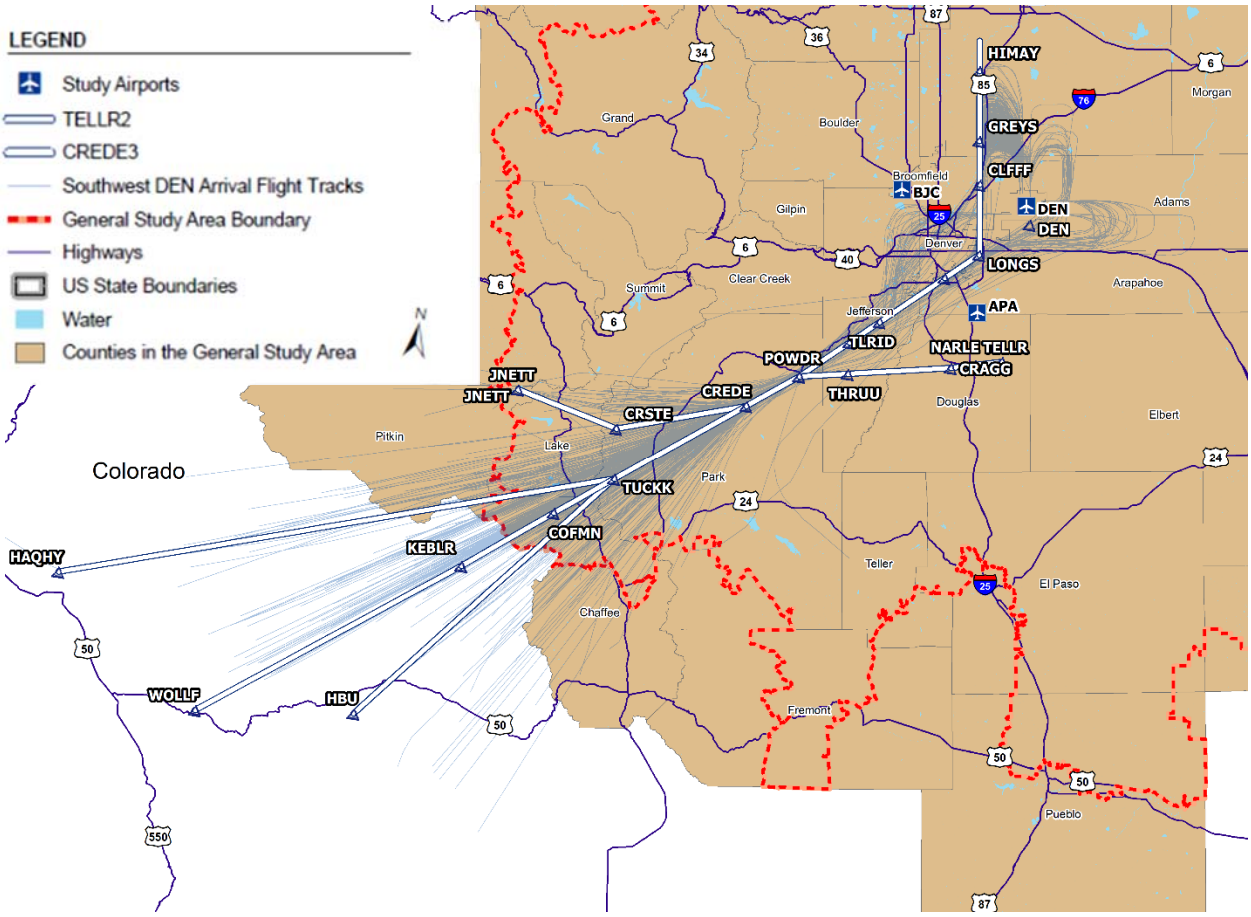
[44] For a complete explanation of the process, methods, and consideration given to all PFDs in the Proposed Action, please refer to Appendix F: *Denver Metroplex Study Team Final Report* and Appendix G: *Denver Metroplex Design and Implementation Team Final Report* that are supplemental to this EA.

- STAR was shortened for operational flexibility, unused en route ATC procedure transitions were removed, and an en route ATC procedure crossover transition was created, which will be ATC assigned only.
- Modified en route and terminal ATC procedure merge points for increased sequencing time where feasible and created runway transitions which merge with RNPs and ILS/RNP ATC procedures.
- Created an altitude window of 17,000 feet above mean sea level MSL to flight level (FL) 230 at the beginning of the common route.
- The proposed JNETT (A052), HAQHY (A050) and HBU (A104) transitions are for mountainous ski-tourist airports and are restricted to at or below FL260.

The existing CREDE and TELLR STARs are two of the four primary arrival routes to the SW corner post in the DEN Metroplex. These two arrivals serve to bring en route traffic into the DEN Metroplex terminal airspace while descending from a cruise altitude and a cruise airspeed to a lower altitude and slower airspeed in the DEN Metroplex terminal airspace. As depicted on **Exhibit 3-1**, the interaction between the existing CREDE and TELLR STARs at the SW corner post creates air crew and controller task complexity. This results in excessive vectoring[45], air traffic management restrictions (e.g. altitude and/or speed restrictions), reduced airspace efficiency, and increased controller/pilot workload and complexity.

[45] *Vectoring* is an ATC term used to describe the process of an air traffic controller manually directing an aircraft crew to fly a specific heading, speed, and/or altitude separate from a defined ATC procedure such as the CREDE or TELLR STARs.

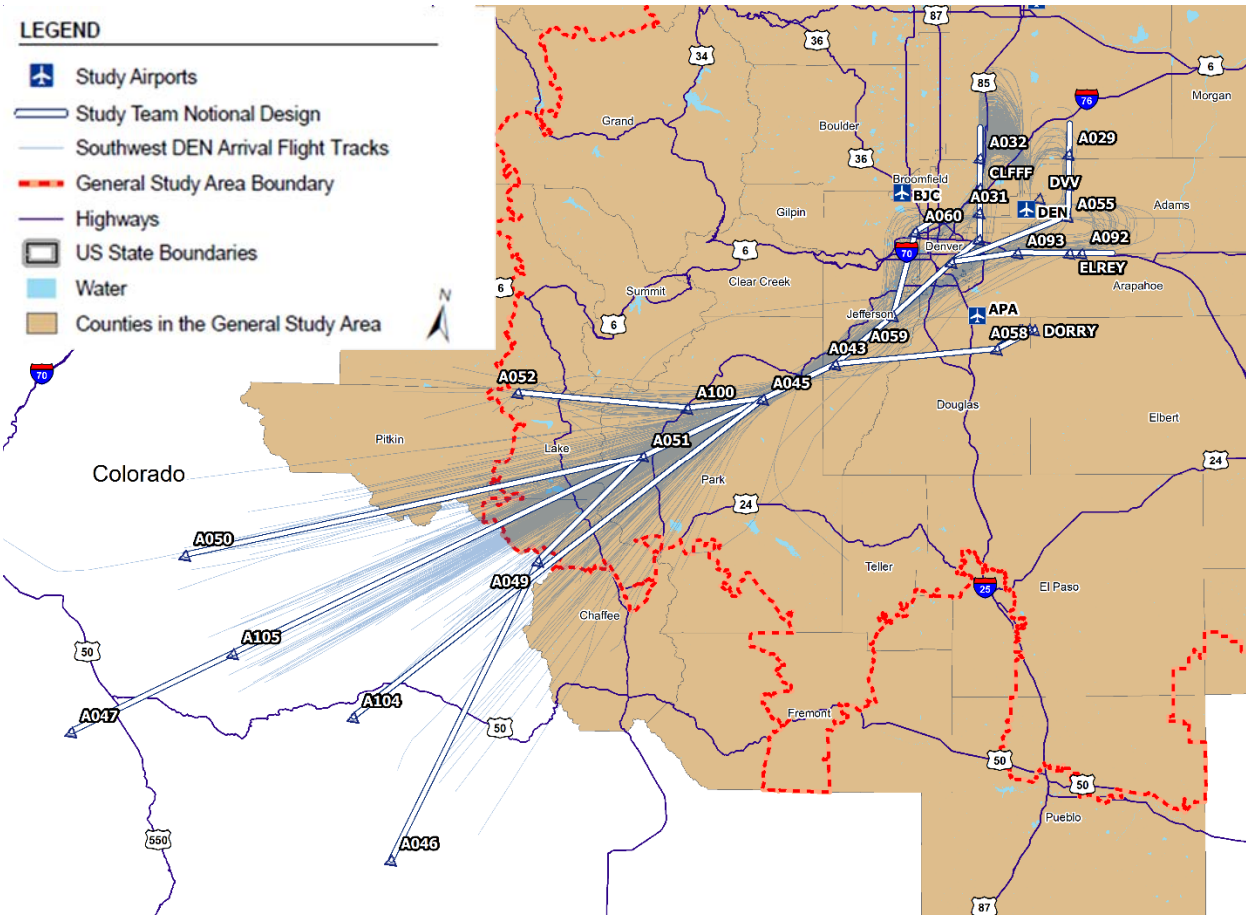
Exhibit 3-1 Existing CREDE Three and TELLR Two STARs



Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.
Prepared by: ATAC Corporation, February 2019.

In order to address the Study Team recommendations, the D&I team iteratively combined the existing CREDE and TELLR STARs at the SW corner post into a single PFD ATC procedure to create the SSKII One STAR. In the same manner, the existing PEEKK and LDORA STARs that serve as the other half of the four total arrivals to the SW corner post were iteratively combined by the D&I Team to create the TBARR STAR at the SW corner post. The combination of the SSKII One and TBARR PFD STARs achieved the need to reduce the SW corner post from four ATC procedures to two ATC procedures and supported the larger goal of reducing 16 STARs to an 8 STAR corner post system in the DEN Metroplex airspace. This reduction in PFD ATC procedures also met the purpose of the DEN Metroplex project. **Exhibit 3-2** illustrates the Study Team's conceptual ATC Procedure recommendations compared to the existing ATC procedures.

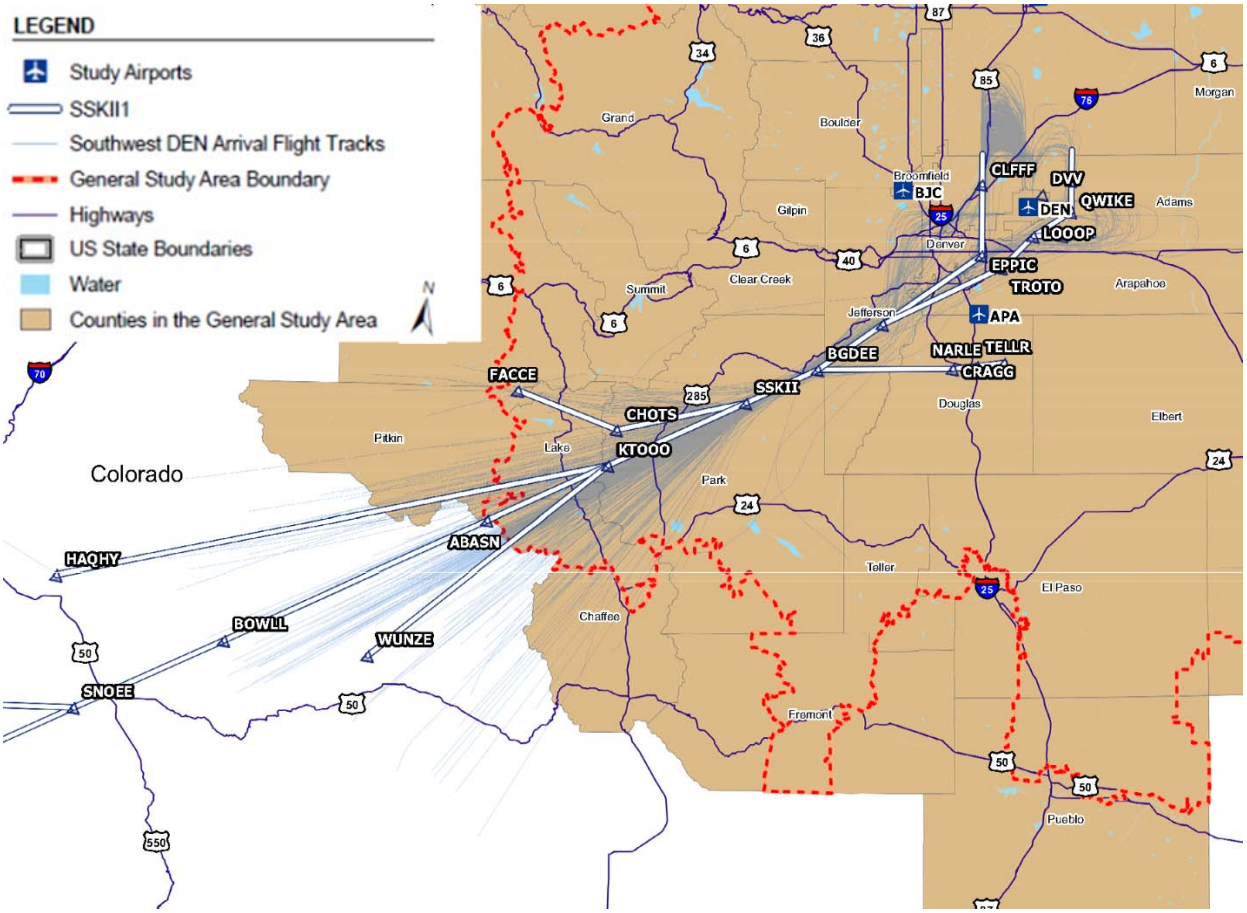
Exhibit 3-2 Study Team Recommendation – SSKII One STAR



Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.
Prepared by: ATAC Corporation, February 2019.

In developing the SSKII One RNAV STAR PFD ATC Procedure, the D&I Team considered interactions between the Study Team designated SW STAR 1 and SW STAR 2 traffic for DEN and traffic into and out of the satellite airports, as well as certain terrain and airspace restrictions. The D&I Team modified the Study Team recommendations to improve the vertical profile and address the issues identified by the Study Team. **Exhibit 3-3** depicts the PFD for the SSKII One STAR.

Exhibit 3-3 D&I Team PFD – SSKII One STAR



Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex D&I Team *DEN SSKII One STAR Proposed Final Design Sheet*, April 2019.
Prepared by: ATAC Corporation, April 2019.

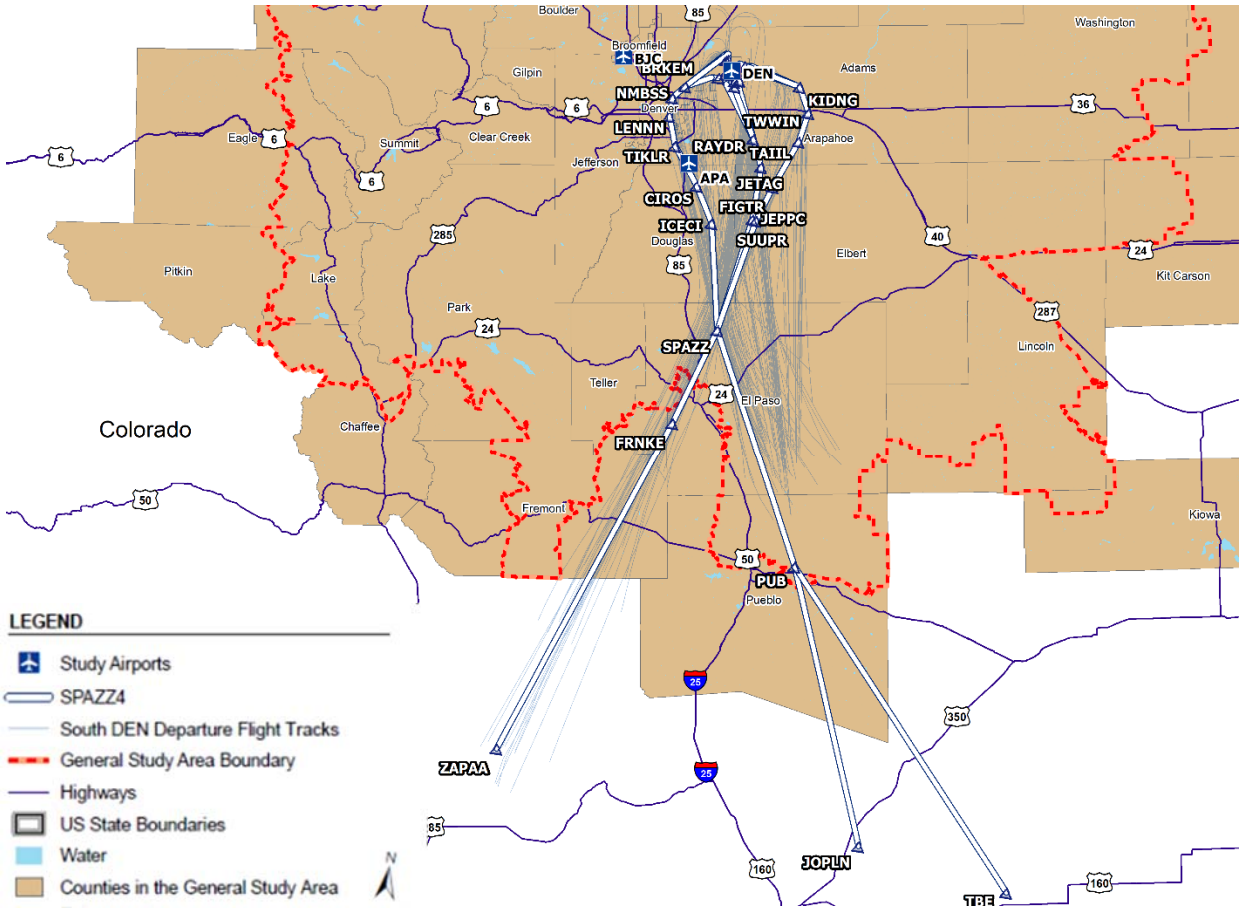
3.1.2.4 SPAZZ SID

Exhibit 3-4 provides the current ATC procedure depiction of the SPAZZ SID to illustrate the starting point for the design revisions. All of the revised SIDs for DEN shared a number of prescribed Study Team design criteria:

- Optimization of lateral paths to reduce flight track miles
- Segregation of RNAV SIDs from arrivals where practical
- Elimination of unused en route transition(s)
- Minimum of eight nautical miles between all departure and arrival transfer control points
- RNAV off-the-ground departure ATC procedures
- Combination of initial RNAV ATC procedure segments as appropriate

- Initial altitude assignment of 10,000 feet MSL (all other altitudes are tactically assigned by ATC)
- Shortening of en route transitions for added flexibility

Exhibit 3-4 Existing SPAZZ Four SID



Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex D&I Team *DEN SUDDZ SID Proposed Final Design Sheet*, June 2016.
Prepared by: ATAC Corporation, February 2019.

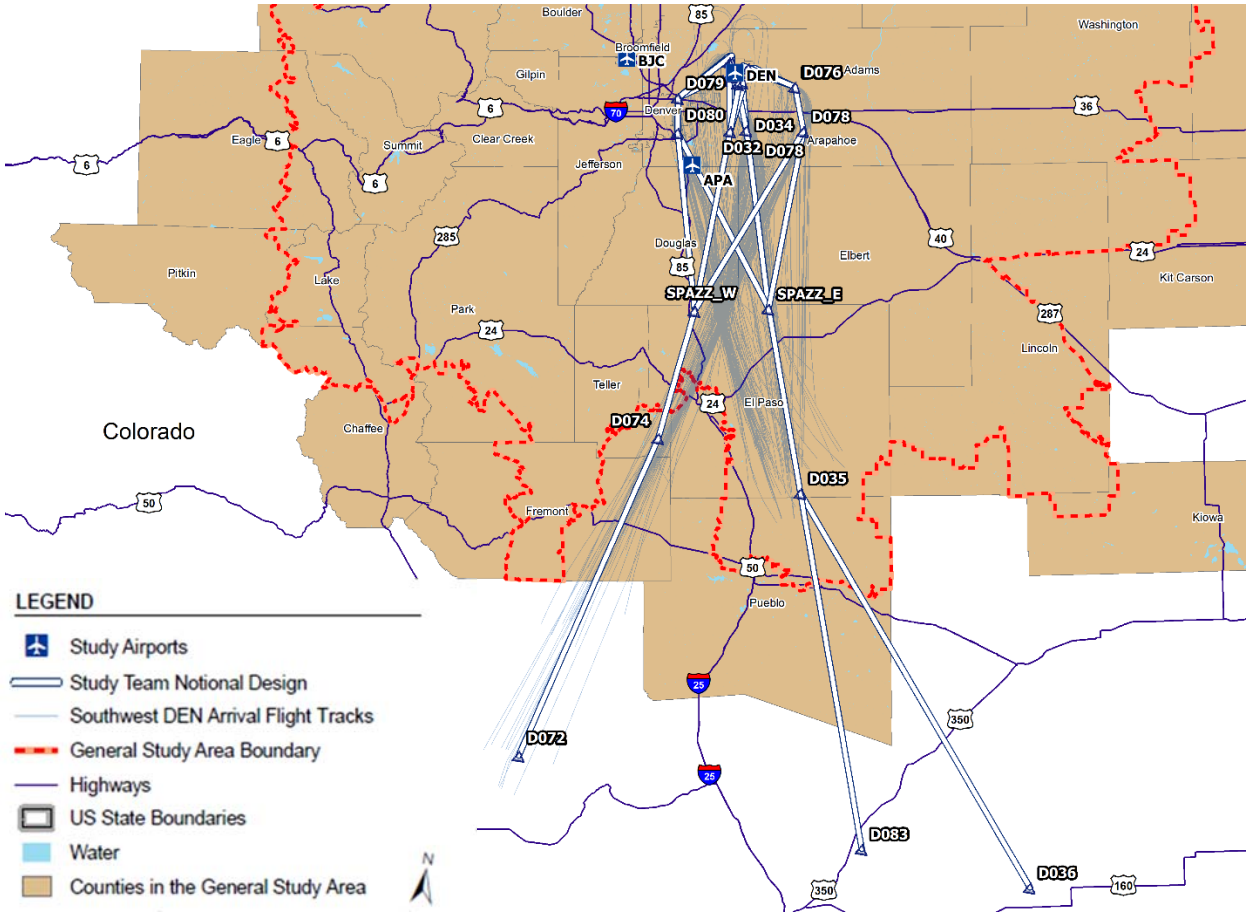
The Study Team made more specific recommendations to address the issues identified with SPAZZ departures:

- Routes were shortened for flight track mile savings.
- Current SPAZZ SID should be split into two ATC procedures (a proposed SPAZZ E and a proposed SPAZZ W) which creates an additional departure gate for increased flexibility.
- A proposed SPAZZ E and a proposed SPAZZ W SIDs would avoid restricted area R-2601 SUA (US Army Fort Carson Live Fire Range).

- A proposed SPAZZ E SID avoids Two Buttes Military Operations Area (MOA) (primarily operated by the Colorado Air National Guard for military air exercises and training)

Exhibit 3-5 illustrates the Study Team's recommended conceptual ATC procedure design.

Exhibit 3-5 Study Team Recommendation – Conceptual SPAZZ East and SPAZZ West SIDs to replace SPAZZ Four SID

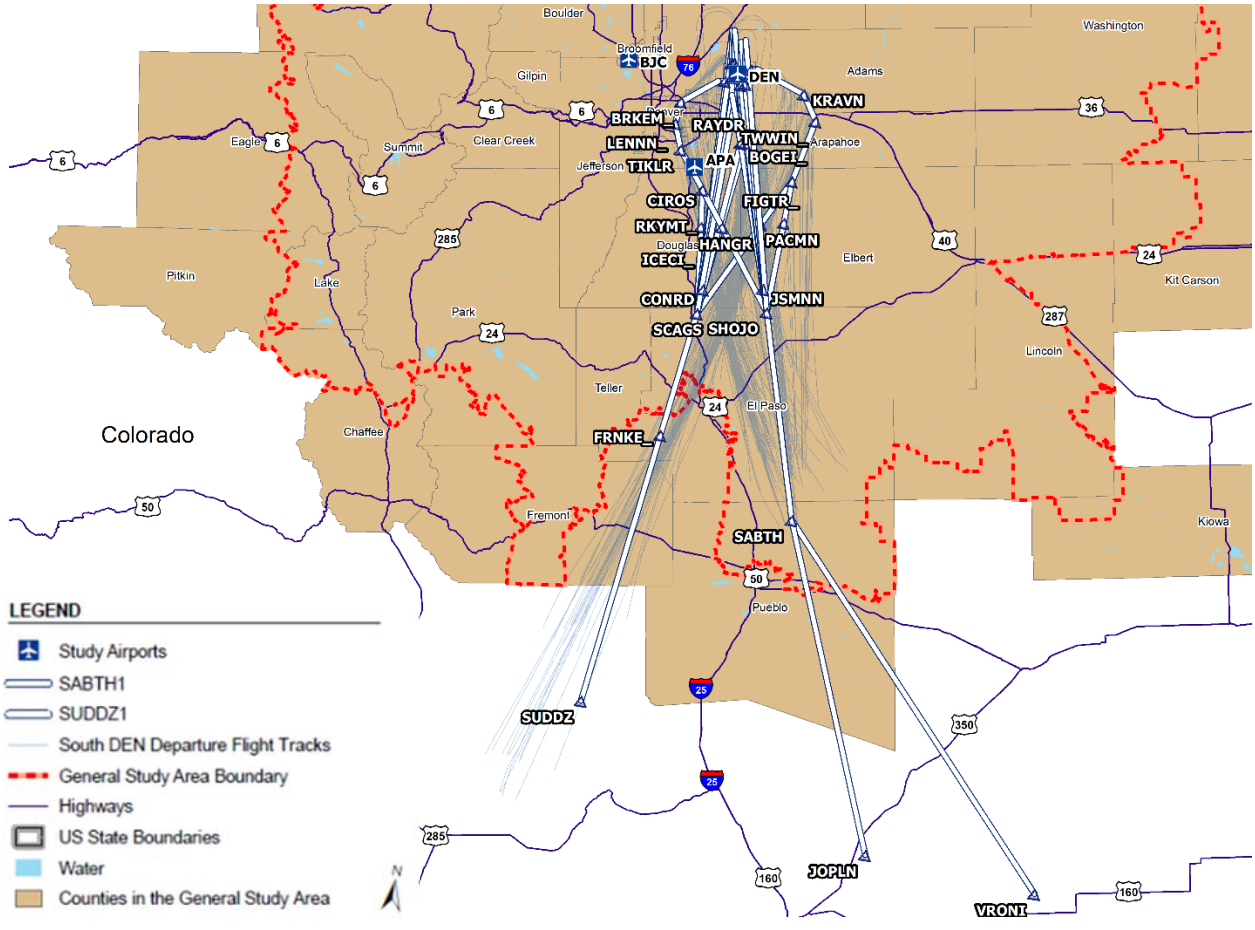


Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex Study Team, *Study Team Final Report*, November 2014.
Prepared by: ATAC Corporation, February 2019.

Based on the Study Team recommendations, the D&I Team developed new preliminary ATC procedure SIDs named SUDDZ and SABTH. The D&I Team considered the Study Team concept that split the SPAZZ SID into two separate SIDs (E and W), which aids operational flexibility and sequencing aircraft departures in advance of departing an airport. The D&I Team added additional runway transitions to increase DEN ATCT flexibility. The waypoints BRKEM and KDING were moved to align with the E and W SIDs. The BOGEI waypoint was added and the RAYDR waypoint was moved on the SUDDZ SID to regain operational flexibility and de-conflict simultaneous runway departures. Finally, restrictions were placed on the ATC procedure segment from the CIROS to RKYMT waypoints to de-conflict departures from the SSKII One and TBARR STARs when the DEN airport runway configuration is landing

north. **Exhibit 3-6** depicts the D&I Team's PFD ATC procedure for the SUDDZ and SABTH SIDs.

Exhibit 3-6 D&I Team PFD – SUDDZ One and SABTH One SIDs



Sources: National Atlas of the United States of America (U.S. County and State Boundaries, Water Bodies); Bureau of Transportation Statistics, National Transportation Atlas Database (U.S. and Interstate Highways); ATAC Corporation (Flight Track Data); DEN Metroplex D&I Team *SUDDZ SID Proposed Final Design Sheet*, June 2016.
Prepared by: ATAC Corporation, February 2019.

3.2 Alternatives Overview

The following sections discuss the No Action and the Proposed Action, which are the Alternatives carried forward for analysis in the EA (refer to Section 3.2). A robust alternatives process was undertaken from the Study Team preliminary designs through the Proposed Final Design process.

3.2.1 No Action

Under the No Action, the FAA would maintain existing arrival/departure ATC procedures. The related routes and air traffic flow in use in the DEN Metroplex as of 2017 (representing Existing Conditions) would remain largely the same. Some ATC procedure modifications independent of those recommended as part of the DEN Metroplex are intended to be implemented prior to the Proposed Action to deal with specific independent utility issues

separate from the DEN Metroplex. These independent ATC procedures are included in the No Action and are taken into account in the analysis of impacts associated with the No Action (see Chapter 5, *Environmental Consequences*).

3.2.1.1 No Action Procedures

The No Action includes 47 ATC procedures: 13 conventional ATC procedures and 34 RNAV ATC procedures.[46] The JMPRS TWO ATC procedure serving DEN in the Existing Conditions has been retired.

Table 3-1 lists the names of the No Action ATC procedures; the ATC procedure type (i.e., SID or STAR); the basis of design on which the ATC procedures are based (shown as RNAV or conventional [CONV]); and the number of runway and en route transitions for each ATC procedure.

[46] National Flight Data Center National Airspace System Resources Database, accessed June 2018; Department of Transportation, FAA Operational Procedure Files June 2018.

Table 3-1 No Action SIDs and STARs

No Action Procedure	Procedure Type	Basis of Design	Transitions (en route/ runway)	Airports Served
ANCHR FOUR	STAR	RNAV	5/0	DEN
BAYLR FOUR	SID	RNAV	2/7	DEN, APA, BJC, FNL
BOSSS TWO	STAR	RNAV	2/0	DEN
BRYCC FOUR	SID	RNAV	1/8	DEN, APA, BJC, FNL
CONNR FIVE	SID	RNAV	1/7	DEN, APA, BJC, FNL
COORZ FOUR	SID	RNAV	1/6	DEN, APA, BJC, FNL
CREDE THREE	STAR	RNAV	4/0	DEN
DANDD NINE	STAR	CONV	3/0	DEN, APA, BJC, FNL, GXY
DENVER ONE	SID	CONV	0/0	DEN, APA, BJC, FNL, GXY
DUNNN TWO	STAR	RNAV	1/2	APA, BJC
EEONS SIX	SID	RNAV	1/7	DEN, APA, BJC, FNL
EMMYS SIX	SID	RNAV	1/7	DEN, APA, BJC, FNL
EPKEE FIVE	SID	RNAV	2/5	DEN, APA, BJC, FNL
EXTAN FIVE	SID	RNAV	1/5	DEN, APA, BJC, FNL
FOOOT FOUR	SID	RNAV	1/6	DEN, APA, BJC, FNL
FRNCH THREE	STAR	RNAV	3/0	DEN
JAGGR THREE	STAR	RNAV	2/0	DEN
KAILE TWO	STAR	RNAV	3/0	DEN
KIPPR FIVE	STAR	RNAV	5/0	DEN, APA, BJC, FNL, GXY
KOHOE THREE	STAR	RNAV	3/0	DEN
LANDR NINE	STAR	CONV	5/0	DEN, APA, BJC, FNL, GXY
LARKS NINE	STAR	CONV	5/0	DEN, APA, BJC, FNL, GXY
LDORA TWO	STAR	RNAV	3/0	DEN
MOLTN THREE	STAR	RNAV	2/0	DEN
PEEKK THREE	STAR	RNAV	3/0	DEN
PIKES ONE	SID	CONV	3/0	DEN, APA, BJC, FNL, GXY
PLAINS NINE	SID	CONV	10/0	DEN, APA, BJC, FNL, GXY
POWDR NINE	STAR	CONV	3/0	DEN, APA, BJC, FNL, GXY
PUFFR FOUR	STAR	RNAV	1/2	DEN
PURRL TWO	STAR	RNAV	2/0	DEN
QUAIL NINE	STAR	CONV	3/0	DEN, APA, BJC, FNL, GXY
RAMMS SEVEN	STAR	CONV	4/0	DEN, APA, BJC, FNL, GXY
RIKKK FOUR	SID	RNAV	1/8	DEN, APA, BJC, FNL
ROCKIES FOUR	SID	CONV	6/0	DEN, APA, BJC, FNL, GXY
SAYGE ONE	STAR	CONV	4/0	DEN, APA, BJC, FNL, GXY
SOLAR FOUR	SID	RNAV	1/8	DEN, APA, BJC, FNL
SPAZZ FOUR	SID	RNAV	3/8	DEN, APA, BJC, FNL
STAKR FOUR	SID	RNAV	1/8	DEN, APA, BJC, FNL
TELLR TWO	STAR	RNAV	4/0	DEN
TOMSN SEVEN	STAR	CONV	3/0	DEN, APA, BJC, FNL, GXY
TSHNR THREE	STAR	RNAV	2/0	DEN, FNL, GXY

Table 3-1 No Action SIDs and STARs

No Action Procedure	Procedure Type	Basis of Design	Transitions (en route/ runway)	Airports Served
WAHUU TWO	STAR	RNAV	3/0	DEN
YAMMI FOUR	SID	RNAV	1/9	DEN, APA, BJC, FNL
YELLOWSTONE TWO	SID	CONV	7/0	DEN, APA, BJC, FNL, GXY
YOKES SIX	SID	RNAV	2/9	DEN, APA, BJC, FNL
ZOMBZ ONE	STAR	RNAV	1/1	APA
ZPLYN THREE	STAR	RNAV	2/0	DEN

STAR=Standard Terminal Arrival Route *SID=Standard Instrument Departure* *RNAV=Area Navigation* *CONV=Conventional ground based navaid ATC procedure*
DEN – Denver International Airport *APA – Centennial Airport* *BJC – Rocky Mountain Metropolitan Airport* *FNL – Northern Colorado Regional Airport*
GXY – Greeley-Weld County Airport

Sources: National Flight Data Center National Airspace System Resources Database, accessed November 7, 2018; Department of Transportation, FAA Operational Procedure Files, November 7, 2018.
Prepared by: ATAC Corporation, February 2019.

The final approaches to the runways and initial departure flows from the runways remain similar in altitude and lateral width for the No Action compared to Existing Conditions for all of the Study Airports. Small modification in aircraft vertical and lateral tracks were necessary to connect the No Action ATC procedures to the final approaches and initial departure flows. An aircraft on final approach is generally indicated by the last flight segment where an aircraft has lined up with the landing runway and established a stable flight configuration with the intent of landing. An aircraft on an initial departure flow is generally defined as an aircraft that has left the departing runway, is climbing normally and at a normal speed, and is under positive ATC identification and contact.

3.2.1.2 Airspace Control Structure under the No Action

When aircraft depart or arrive to the DEN Metroplex on an assigned route or SID/STAR, transfer of control of an aircraft occurs between multiple air traffic facilities. As noted previously, these transfer control points are identified points in the airspace for common reference between ATC and the air crew. Under the No Action, the transfer control points would remain unchanged from Existing Conditions. For purposes of this EA, the areas where transfers occur are defined based on arrival gates and departure exit gates. The gates are purposely located to laterally and vertically segregate arrivals and departures where possible.

The DEN Metroplex Study Airports all have independent runway configurations that are based on weather and wind. Airport arrival and departure flows can interact with other airport traffic flows in different runway configurations. DEN generally has a north and south flow, but the airport is unique in that there are transition periods and other conditions that result in a combined configuration of multi-directional flows. Therefore, the D&I Team considered all possible combinations of the various runway operating configurations that are sorted into the categories of North flow, South flow, and Combined flow.

Exhibit 3-7 through **Exhibit 3-9** show these arrival and departure flows to the Study Airports associated with the No Action. Corridors are grouped by ATC procedure type (conventional or RNAV), operation (arrival or departure), and Study Airport.

No Action - Major Study & Satellite Airports, North Flow

This exhibit allows the viewer to see No Action Alternative arrival and departure conventional and RNAV flight corridors under north flow conditions within the GSA (General Study Area).

Layering – To the left of the image you will see a list of conventional and RNAV arrival and departure flight corridors categorized by Study Airport. If the list is not visible, click on the < > icon, and the list of corridor names will appear. The various corridors can be turned off and on by clicking on the box to the left of the corridor title. To turn the corridor layer on, click on the box and an < > icon will appear. Click on multiple boxes and the additional corridors will display. To turn the layer off, click on the box and the < > icon will disappear.

Zoom – To zoom in on an exhibit, click on the < > icon at the top or bottom of the screen until the desired resolution has been reached. To zoom out, select the < > icon. If these icons are not visible, hover your mouse near the top or bottom of the window and they will appear. Use the < > icon to click and drag the map around within the window.

Turn off this box by clicking the < > icon to the left of the introduction layer in the list to the left.

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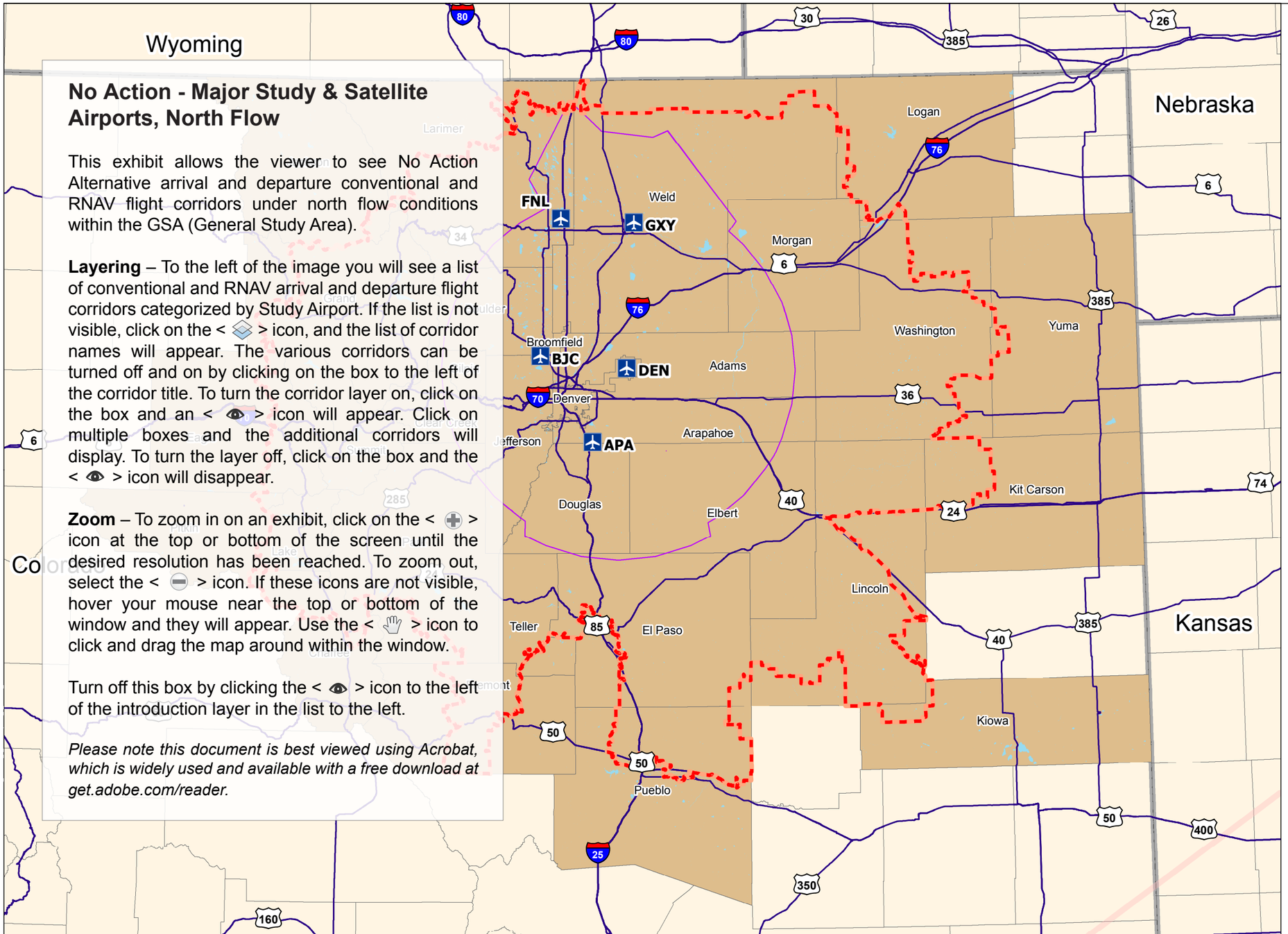

LEGEND

- General Study Area Boundary
- Study Airports
- Counties in the General Study Area
- US Counties
- US State Boundaries
- Highways
- Water
- D01 TRACON Boundary
- ZDV ARTCC Boundary

- Conventional Arrival
- Conventional Departure
- RNAV Arrival
- RNAV Departure
- RNAV Arrival with Vectoring
- RNAV Departure with Vectoring

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, January 2019.

Exhibit 3-7

No Action North Flow

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No Action - Major Study & Satellite Airports, South Flow

This exhibit allows the viewer to see No Action Alternative arrival and departure conventional and RNAV flight corridors under south flow conditions within the GSA (General Study Area).

Layering – To the left of the image you will see a list of conventional and RNAV arrival and departure flight corridors categorized by Study Airport. If the list is not visible, click on the < > icon, and the list of corridor names will appear. The various corridors can be turned off and on by clicking on the box to the left of the corridor title. To turn the corridor layer on, click on the box and an < > icon will appear. Click on multiple boxes and the additional corridors will display. To turn the layer off, click on the box and the < > icon will disappear.

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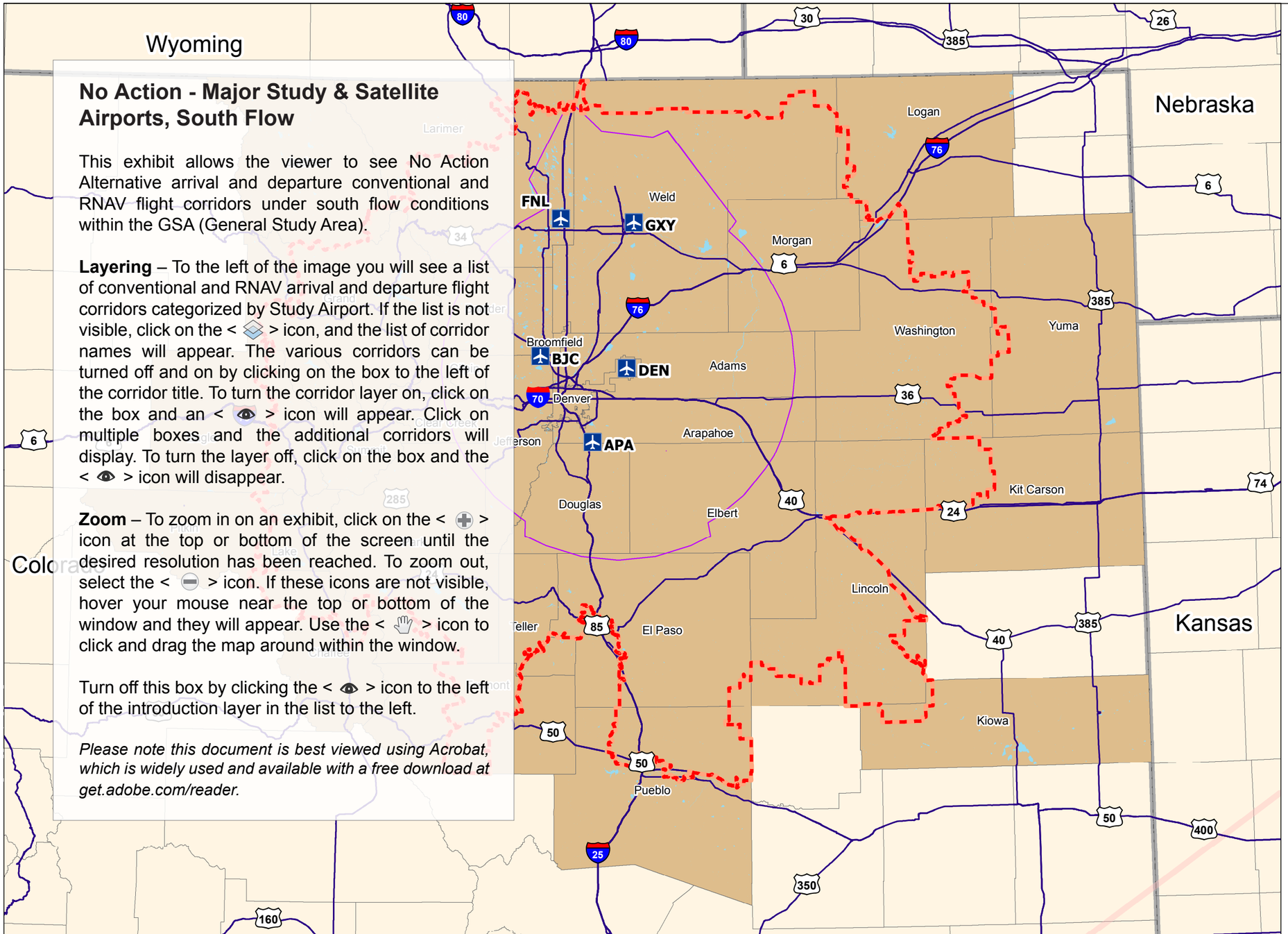

LEGEND

- General Study Area Boundary
- Study Airports
- Counties in the General Study Area
- US Counties
- US State Boundaries
- Highways
- Water
- D01 TRACON Boundary
- ZDV ARTCC Boundary

- Conventional Arrival
- Conventional Departure
- RNAV Arrival
- RNAV Departure
- RNAV Arrival with Vectoring
- RNAV Departure with Vectoring

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, January 2019.

Exhibit 3-8

No Action South Flow

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No Action - Major Study & Satellite Airports, Combined Flow

This exhibit allows the viewer to see No Action Alternative arrival and departure conventional and RNAV flight corridors under combined flow conditions within the GSA (General Study Area).

Layering – To the left of the image you will see a list of conventional and RNAV arrival and departure flight corridors categorized by Study Airport. If the list is not visible, click on the < > icon, and the list of corridor names will appear. The various corridors can be turned off and on by clicking on the box to the left of the corridor title. To turn the corridor layer on, click on the box and an < > icon will appear. Click on multiple boxes and the additional corridors will display. To turn the layer off, click on the box and the < > icon will disappear.

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Turn off this box by clicking the < > icon to the left of the introduction layer in the list to the left.

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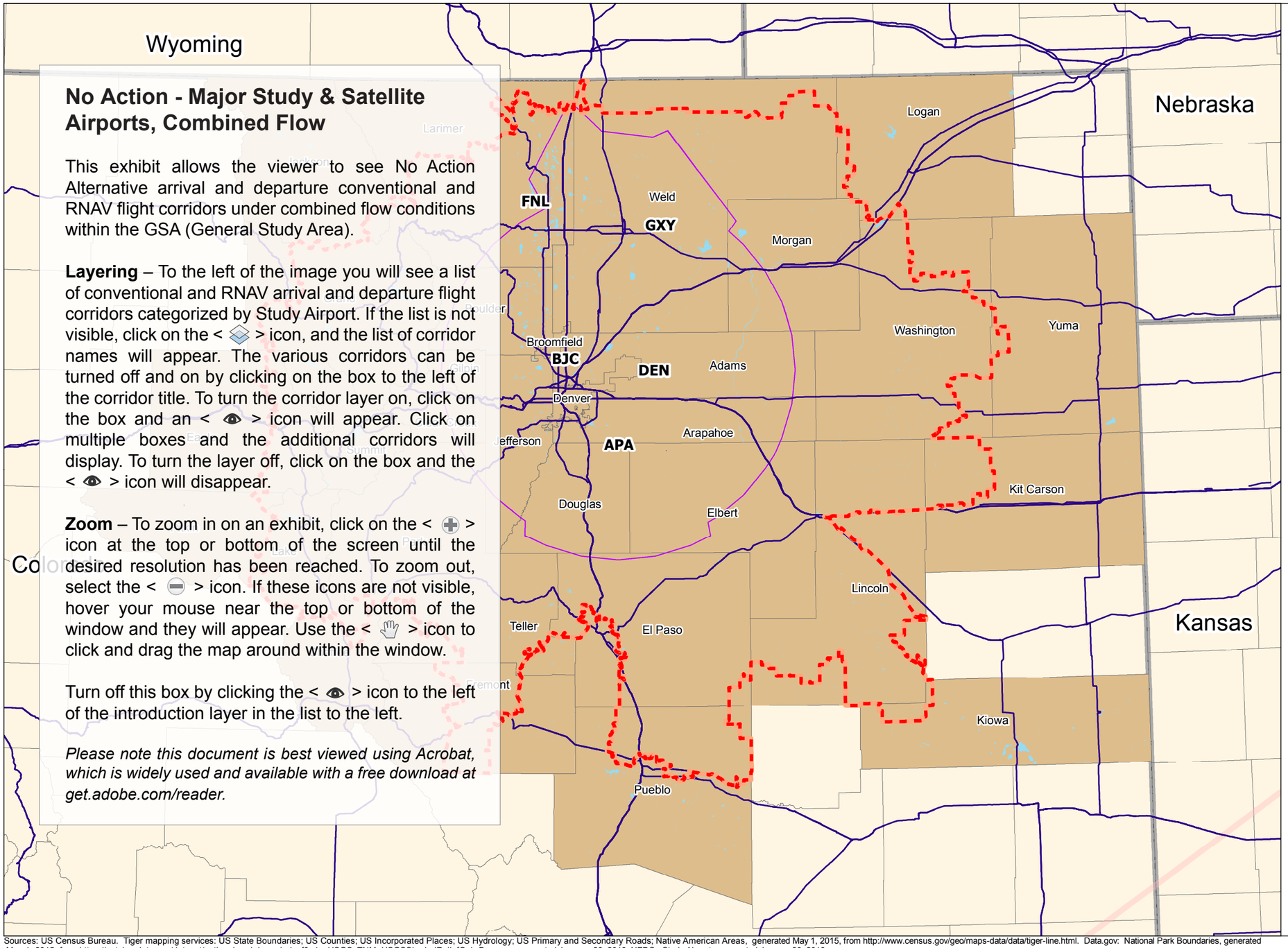

LEGEND

- General Study Area Boundary
- Study Airports
- Counties in the General Study Area
- US Counties
- US State Boundaries
- Highways
- Water
- D01 TRACON Boundary
- ZDV ARTCC Boundary

- Conventional Arrival
- Conventional Departure
- RNAV Arrival
- RNAV Departure
- RNAV Arrival with Vectoring
- RNAV Departure with Vectoring

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, January 2019.

Exhibit 3-9

No Action Combined Flow

DEN METROPLEX EA

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3.2.2 Proposed Action

As discussed in Section 3.1, the Proposed Action consists of the PFDs for all ATC procedures the D&I Team developed, plus existing ATC procedures that would continue to be used in a configuration that is the same or similar to current configurations and has been cleared by the NEPA process when necessary. This Alternative is expected to increase efficiency in the DEN Metroplex airspace by improving flexibility in transitioning aircraft, segregating arrivals and departures, and improving the predictability of air traffic flows.

The Proposed Action contains 45 ATC procedures, including:

- 12 new RNAV STARs,
- 20 new RNAV SIDs,
- 8 existing/no action conventional STARs,
- 5 existing/no action conventional SIDs.

Table 3-2 lists the Proposed Action ATC procedures, the No Action ATC procedure that the Proposed Action would replace (if applicable), the ATC procedure type, the basis of design (indicated by the type of NAVAID on which the ATC procedures are based and shown as RNAV or CONV); and the number of runway and en route transitions for each ATC procedure. The table also shows the airport(s) that the Proposed Action ATC procedures serve, and the number of runway and en route transitions for each ATC procedure. Finally, the table lists the objectives each ATC procedure design achieves.

Table 3-2 Proposed Action SIDs and STARs

Proposed Action Procedure	No Action Procedure	Procedure Type	Basis of Design	Transitions (en route/ runway)	Airports Served
AALLEE ONE	ANCHR FOUR	STAR	RNAV	2/5	DEN
	KIPPR FIVE	STAR	RNAV	2/5	DEN
NIIXX ONE	BOSSS TWO	STAR	RNAV	3/6	DEN
	ZPLYN THREE	STAR	RNAV	3/6	DEN
SSKII ONE	CREDE THREE	STAR	RNAV	6/5	DEN
	TELLR TWO	STAR	RNAV	6/5	DEN
DANDD NINE	DANDD NINE	STAR	CONV	3/0	DEN, APA BJC, GXY, FNL
LONGZ ONE	FRNCH THREE	STAR	RNAV	3/6	DEN
	KAILE TWO	STAR	RNAV	3/6	DEN
CLASH ONE	JAGGR THREE	STAR	RNAV	2/5	DEN
	PURLL TWO	STAR	RNAV	2/5	DEN
LAWGR ONE	KOHOE THREE	STAR	RNAV	1/4	DEN
	WAHUU TWO	STAR	RNAV	1/4	DEN
LANDR NINE	LANDR NINE	STAR	CONV	5/0	DEN, APA BJC, GXY, FNL
LARKS NINE	LARKS NINE	STAR	CONV	5/0	DEN, APA BJC, GXY, FNL
TBARR ONE	LDORA TWO	STAR	RNAV	4/6	DEN
	PEEKK THREE	STAR	RNAV	4/6	DEN
FLATI ONE	MOLTN THREE	STAR	RNAV	3/6	DEN
	TSHNR THREE	STAR	RNAV	3/6	DEN
POWDR NINE	POWDR NINE	STAR	CONV	3/0	DEN, APA BJC, GXY, FNL
QUAIL NINE	QUAIL NINE	STAR	CONV	3/0	DEN, APA BJC, GXY, FNL
RAMMS SEVEN	RAMMS SEVEN	STAR	CONV	4/0	DEN, APA BJC, GXY, FNL
SAYGE ONE	SAYGE ONE	STAR	CONV	4/0	DEN, APA BJC, GXY, FNL
TOMSN SEVEN	THOMSN SEVEN	STAR	CONV	3/0	DEN, APA BJC, GXY, FNL
BAYLR FIVE	BAYLR FOUR	SID	RNAV	1/12	DEN
HHOTH ONE	BRYCC FOUR	SID	RNAV	2/10	DEN
CONNR SIX	CONNR FIVE	SID	RNAV	1/12	DEN
COORZ FIVE	COORZ FOUR	SID	RNAV	1/12	DEN
DENVER ONE	DENVER ONE	SID	CONV	0/0	DEN, APA BJC, GXY, FNL
ECHOO ONE	PLAINS NINE	SID	RNAV	4/0	APA BJC, GXY, FNL
	EEONS SIX	SID	RNAV	4/0	APA BJC, GXY, FNL
	EMMYS SIX	SID	RNAV	4/0	APA BJC, GXY, FNL
	EPKEE FIVE	SID	RNAV	4/0	APA BJC, GXY, FNL
	EXTAN FIVE	SID	RNAV	4/0	APA BJC, GXY, FNL
EEONS SEVEN	EEONS SIX	SID	RNAV	1/12	DEN

Table 3-2 Proposed Action SIDs and STARs

Proposed Action Procedure	No Action Procedure	Procedure Type	Basis of Design	Transitions (en route/ runway)	Airports Served
EMMYS SEVEN	EMMYS SIX	SID	RNAV	1/12	DEN
EPKEE SIX	EPKEE FIVE	SID	RNAV	2/12	DEN
EXTAN SIX	EXTAN FIVE	SID	RNAV	1/12	DEN
ZIMMR ONE	FOOOT FOUR	SID	RNAV	1/12	DEN
MRSHH ONE	YELLOWSTONE TWO	SID	RNAV	5/0	APA BJC, GXY, FNL
	BRYCC FOUR	SID	RNAV	5/0	APA BJC, GXY, FNL
	RIKKK FOUR	SID	RNAV	5/0	APA BJC, GXY, FNL
	YOKES SIX	SID	RNAV	5/0	APA BJC, GXY, FNL
	YAMMI FOUR	SID	RNAV	5/0	APA BJC, GXY, FNL
PIKES ONE	PIKES ONE	SID	CONV	3/0	DEN, APA BJC, GXY, FNL
PLAINS NINE	PLAINS NINE	SID	CONV	10/0	DEN, APA BJC, GXY, FNL
EXWNG ONE	RIKKK FOUR	SID	RNAV	1/10	DEN
ROCKIES FOUR	ROCKIES FOUR	SID	CONV	6/0	DEN, APA BJC, GXY, FNL
	SOLAR FOUR	SID	RNAV	5/0	DEN, APA BJC, GXY, FNL
	SPAZZ FOUR	SID	RNAV	5/0	DEN, APA BJC, GXY, FNL
SKYEE ONE	STAKR FOUR	SID	RNAV	5/0	APA BJC, GXY, FNL
	DENVER ONE	SID	RNAV	5/0	APA BJC, GXY, FNL
	PIKES ONE	SID	RNAV	5/0	APA BJC, GXY, FNL
SMMUR ONE	SOLAR FOUR	SID	RNAV	2/10	DEN
SUDDZ ONE	SPAZZ FOUR	SID	RNAV	1/10	DEN
SABTH ONE	SPAZZ FOUR	SID	RNAV	2/10	DEN
SLEEK ONE	STAKR FOUR	SID	RNAV	1/10	DEN
DDRTH ONE	YAMMI FOUR	SID	RNAV	1/10	DEN
YELLOWSTONE TWO	YELLOWSTONE TWO	SID	CONV	7/10	DEN, APA BJC, GXY, FNL
CHUWY ONE	YOKES SIX	SID	RNAV	1/10	DEN
DUNNN THREE	DUNNN TWO	STAR	RNAV	2/0	APA, BJC
	PUFFR FOUR	STAR	RNAV	2/0	APA, BJC
BRNKO ONE	PUFFR FOUR	STAR	RNAV	2/0	APA BJC, GXY, FNL
	KIPPR FIVE	STAR	RNAV	2/0	APA BJC, GXY, FNL
ZOMBZ TWO	ZOMBZ ONE	STAR	RNAV	1/0	APA
	N/A	N/A	RNAV		BJC
PINNR ONE	RAMMS SEVEN	STAR	RNAV	1/0	APA BJC, GXY, FNL

Table 3-2 Proposed Action SIDs and STARs

Proposed Action Procedure	No Action Procedure	Procedure Type	Basis of Design	Transitions (en route/ runway)	Airports Served
	TSHNR THREE	STAR	RNAV	1/0	APA BJC, GXY, FNL
WNGSS ONE	BAYLR FOUR	SID	RNAV	4/0	APA BJC, GXY, FNL
	CONNR FIVE	SID	RNAV	4/0	APA BJC, GXY, FNL
	COORZ FOUR	SID	RNAV	4/0	APA BJC, GXY, FNL
	FOOOT FOUR	SID	RNAV	4/0	APA BJC, GXY, FNL
	ROCKIES FOUR	SID	RNAV	4/0	APA BJC, GXY, FNL

Notes:
STAR=Standard Terminal Arrival Route
SID=Standard Instrument Departure
RNAV=Area Navigation
CONV=Conventional ground based navaid ATC procedure
DEN – Denver International Airport
APA – Centennial Airport
BJC – Rocky Mountain Metropolitan Airport
FNL – Northern Colorado Regional Airport
GXY – Greeley-Weld County Airport

Sources: National Flight Data Center National Airspace System Resources Database, accessed November 2018; Department of Transportation, FAA Operational Procedure Files, accessed November 2018.
Prepared by: ATAC Corporation, February 2019.

Exhibit 3-10 through **Exhibit 3-12** show all arrival and departure flows to the Study Airports associated with the Proposed Action. Corridors are grouped by ATC procedure type (conventional or RNAV), operation (arrival or departure), and airport.

Proposed Action - Major Study & Satellite Airports, North Flow

This exhibit allows the viewer to see Proposed Action Alternative arrival and departure conventional and RNAV flight corridors under north flow conditions within the GSA (General Study Area).

Layering – To the left of the image you will see a list of conventional and RNAV arrival and departure flight corridors categorized by Study Airport. If the list is not visible, click on the < > icon, and the list of corridor names will appear. The various corridors can be turned off and on by clicking on the box to the left of the corridor title. To turn the corridor layer on, click on the box and an < > icon will appear. Click on multiple boxes and the additional corridors will display. To turn the layer off, click on the box and the < > icon will disappear.

Zoom – To zoom in on an exhibit, click on the < > icon at the top or bottom of the screen until the desired resolution has been reached. To zoom out, select the < > icon. If these icons are not visible, hover your mouse near the top or bottom of the window and they will appear. Use the < > icon to click and drag the map around within the window.

Turn off this box by clicking the < > icon to the left of the introduction layer in the list to the left.

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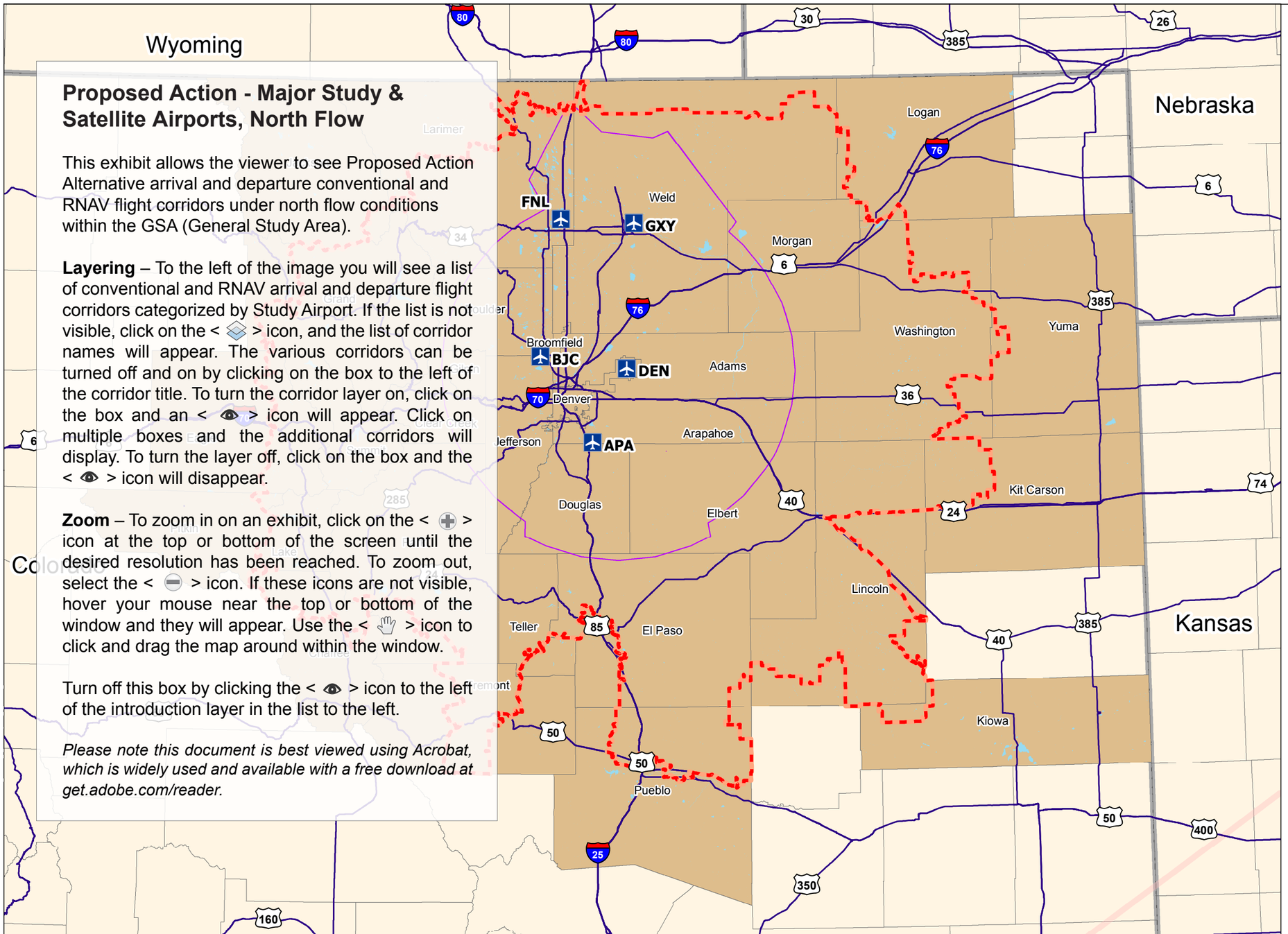

LEGEND

- General Study Area Boundary
- Study Airports
- Counties in the General Study Area
- US Counties
- US State Boundaries
- Highways
- Water
- D01 TRACON Boundary
- ZDV ARTCC Boundary

- Conventional Arrival
- Conventional Departure
- RNAV Arrival
- RNAV Departure
- RNAV Arrival with Vectoring
- RNAV Departure with Vectoring

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, January 2019.

Exhibit 3-10

Proposed Action North Flow

DEN METROPLEX EA

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Proposed Action - Major Study & Satellite Airports, South Flow

This exhibit allows the viewer to see Proposed Action Alternative arrival and departure conventional and RNAV flight corridors under south flow conditions within the GSA (General Study Area).

Layering – To the left of the image you will see a list of conventional and RNAV arrival and departure flight corridors categorized by Study Airport. If the list is not visible, click on the < > icon, and the list of corridor names will appear. The various corridors can be turned off and on by clicking on the box to the left of the corridor title. To turn the corridor layer on, click on the box and an < > icon will appear. Click on multiple boxes and the additional corridors will display. To turn the layer off, click on the box and the < > icon will disappear.

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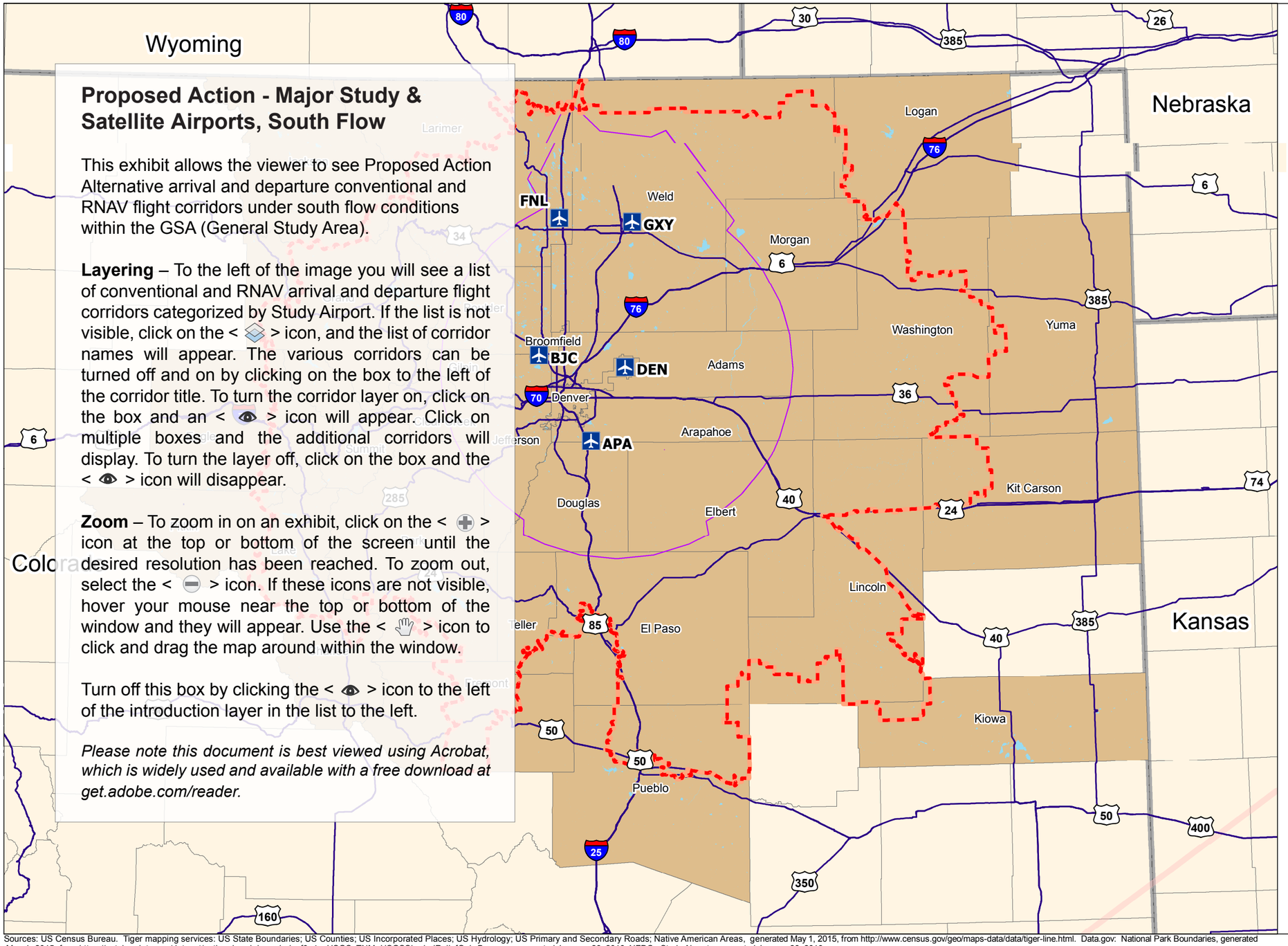

LEGEND

- General Study Area Boundary
- Study Airports
- Counties in the General Study Area
- US Counties
- US State Boundaries
- Highways
- Water
- D01 TRACON Boundary
- ZDV ARTCC Boundary

- Conventional Arrival
- Conventional Departure
- RNAV Arrival
- RNAV Departure
- RNAV Arrival with Vectoring
- RNAV Departure with Vectoring

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, January 2019.

Exhibit 3-11

Proposed Action South Flow

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Proposed Action - Major Study & Satellite Airports, Combined Flow

This exhibit allows the viewer to see Proposed Action Alternative arrival and departure conventional and RNAV flight corridors under combined flow conditions within the GSA (General Study Area).

Layering – To the left of the image you will see a list of conventional and RNAV arrival and departure flight corridors categorized by Study Airport. If the list is not visible, click on the < > icon, and the list of corridor names will appear. The various corridors can be turned off and on by clicking on the box to the left of the corridor title. To turn the corridor layer on, click on the box and an < > icon will appear. Click on multiple boxes and the additional corridors will display. To turn the layer off, click on the box and the < > icon will disappear.

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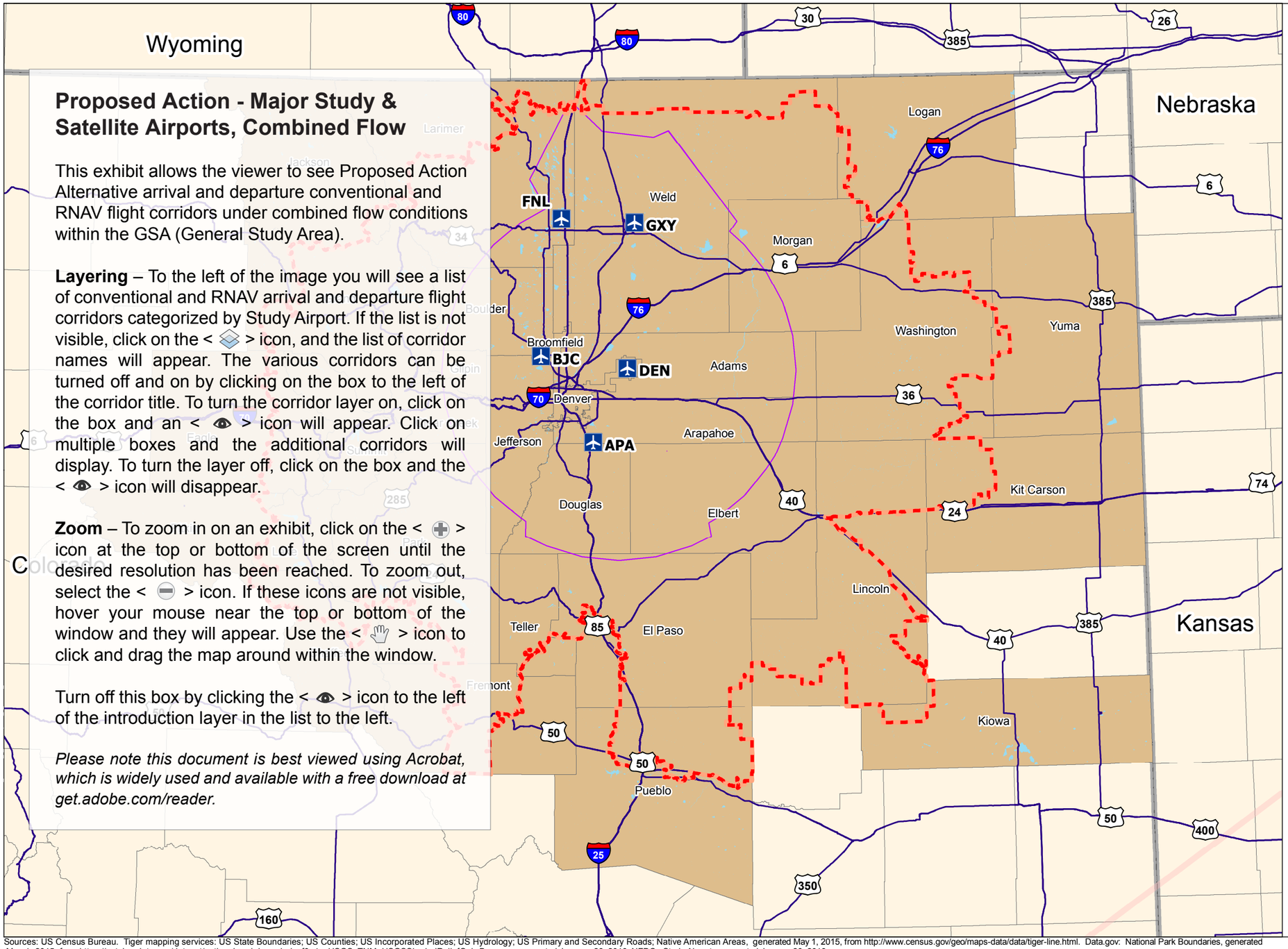

LEGEND

- General Study Area Boundary
- Study Airports
- Counties in the General Study Area
- US Counties
- US State Boundaries
- Highways
- Water
- D01 TRACON Boundary
- ZDV ARTCC Boundary

- Conventional Arrival
- Conventional Departure
- RNAV Arrival
- RNAV Departure
- RNAV Arrival with Vectoring
- RNAV Departure with Vectoring

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, anuary 2019.

Exhibit 3-12

Proposed Action Combined Flow

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3.3 Summary Comparison of the Proposed Action and No Action

This section provides a comparative summary between the No Action and Proposed Action based on the objectives defined in Section 2.2:

- Improve the flexibility in transitioning traffic between en route and terminal area airspace and between terminal area airspace and the runways;
- Improve the segregation of arrivals and departures in terminal area airspace and en route airspace; and,
- Improve the predictability of air traffic flow for traffic transitioning between en route and terminal area airspace and between terminal area airspace and the runways.

3.3.1 Improve the Flexibility in Transitioning Aircraft

Section 2.2.1 includes two criteria established to measure the objective to increase the flexibility in transitioning aircraft between the terminal airspace area and the en route airspace:

- Where possible, increase the number of available transitions compared with the No Action (measured by number of exit/entry points).
- Where possible, increase the number of RNAV STARs and SIDs compared with the No Action (measured by total count of RNAV STARs and RNAV SIDs for each of the Study Airports.)

Table 3-3 provides a summary comparison of the Proposed Action and No Action based on the criteria defined above. Under the No Action, there are 81 IFR entry points into the DEN Metroplex airspace and 46 exit points. Under the Proposed Action, the number of IFR entry points decreases to 63, while the IFR exit points increase to 64. This balance allows for more efficient use of the airspace. The decrease in IFR entry points is due to the elimination of unused transitions and combining routes that were previously specific to defined Study Airport runway configuration.

Under the No Action, there are 127 en route transitions and 113 runway transitions. Under the Proposed Action the number of en route transitions remains unchanged at 127 and the number of runway transitions increases to 219. It should be noted that there are additional en route transitions for departures increasing the flexibility for routing associated with departing aircraft. The decrease in en route transitions for arriving aircraft is not expected to reduce flexibility, as the transitions that were eliminated were not used or infrequently used and their elimination allowed for the development of other routings thereby increasing flexibility. The additional runway transitions allow controllers to assign aircraft to routes that were not available previously.

Table 3-3 Alternatives Evaluation: Improve Flexibility in Transitioning Aircraft

Criteria	Alternative	
	No Action	Proposed Action
Total Entry Points	81	63
Total Exit Points	46	64
Total Enroute Transitions	127	127
Total Runway Transitions	113	219

Notes:
**A runway transition is counted if it is a unique path (identical paths serving more than one runway are counted only once) and there is at least one waypoint or fix beyond the common route.*

Sources: Denver Metroplex Study Team, November 2014.
Prepared by: ATAC Corporation, April 2019.

3.3.2 Segregate Arrival and Departure Flows

Section 2.2.2 includes one criterion to measure the objective to increase flexibility in transitioning aircraft between the terminal area airspace and en route airspace:

- Segregate arrival and departure traffic (measured by number of RNAV STARs and/or SIDs that can be used independently to/from Study Airports).

Table 3-4 provides a summary comparison of the Proposed Action and No Action based on the criteria defined above. Under the No Action, there are 15 independent RNAV ATC procedures. The Proposed Action has 24 independent RNAV ATC procedures. The greater number of independent RNAV routes allows for greater segregation of arrival and departure flows. Most notable is the segregation of DEN traffic from nearby airport traffic which was achieved by increasing the number of independent ATC procedures at DEN from 14 to 24.

Table 3-4 Alternatives Evaluation: Segregate Arrival and Departure Flows

Criteria	Alternative	
	No Action	Proposed Action
Number of Independent RNAV Procedures		
DEN	14	24
APA	1	0
BJC	0	0
FNL	0	0
GXY	0	0

Sources: Denver Metroplex Study Team, November 2014.
Prepared by: ATAC Corporation, February 2019.

3.3.3 Improve Predictability of Air Traffic Flow

Section 2.2.3 includes two criteria to measure the objective to increase flexibility in transitioning aircraft between the terminal area airspace and en route airspace:

- RNAV ATC procedures with altitude controls intended to optimize descent or climb patterns (measured by count of ATC procedures with altitude controls);
- Ensure that the majority of STARs and SIDs to and from the Study Airports are based on RNAV technology (measured by count of RNAV STARs and SIDs for an individual Study Airport).

Under the No Action, 35 of the ATC procedures include altitude controls that define or limit vertical ranges of altitudes within which aircraft may operate. In comparison, the Proposed

Action includes 33 ATC procedures with altitude controls. Although this indicates a reduction of two ATC procedures, additional analysis demonstrates that when accounting for the ATC procedures that were combined (reducing the STARS from 24 to 16), there is an actual increase in the routing that include altitude controls (i.e. if the ATC procedures had not been combined there would be 41 ATC procedures with altitude controls).

Table 3-5 provides a summary comparison of the Proposed Action and No Action based on the criteria defined above. The total number of RNAV ATC procedures serving study airports increases from 85 under the No Action to 100 under the Proposed Action. Both the No Action and the Proposed Action have a total of 70 conventional ATC procedures. Under the Proposed Action, four of these conventional ATC procedures were retained for non RNAV equipped aircraft and adjusted to more closely align with the proposed new RNAV ATC procedures.

Table 3-5 Alternatives Evaluation: Improve Predictability of Air Traffic Flow

Criteria	Alternative	
	No Action	Proposed Action
DEN	31	32
APA	18	22
BJC	17	20
FNL	17	19
GXY	2	7

Sources: *Denver Metroplex Study Team Final Report*, November 2014. *Denver Metroplex Design and Implementation Team Final Report. March 2019*
Prepared by: ATAC Corporation, April 2019.

3.4 Preferred Alternative Determination

Of the two Alternatives carried forward for analysis, the Proposed Action would better meet the Purpose and Need for the DEN Metroplex Project based on the criteria presented and referenced in this and prior Chapters of this EA document. Therefore, the Proposed Action is the Preferred Alternative. Although it would not meet the Purpose and Need, the No Action was carried forward, as required by Council on Environmental Quality (CEQ) regulations, to establish a benchmark against which decision makers can measure the environmental effects of undertaking the Preferred Alternative.

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4 Affected Environment

This chapter describes the human, physical, and natural environmental conditions that could be affected by the Preferred Alternative. Specifically, this Environmental Assessment (EA) considers effects on the environmental resource categories identified in Federal Aviation Administration (FAA) Order 1050.1F, *Environmental Impacts: Policies and Procedures* (FAA Order 1050.1F) and 1050.1F Desk Reference. The potential environmental impacts of the Preferred Alternative and No Action are discussed in Chapter 5, *Environmental Consequences.*

The technical terms and concepts discussed in this chapter are explained in Chapter 1, *Background*.

4.1 General Study Area

To describe existing conditions in the Denver Metroplex, the FAA developed a General Study Area. The General Study Area is used to evaluate the potential for environmental impacts under the Preferred Alternative. **Exhibit 4-1** depicts the General Study Area. **Table 4-1** lists the 31 Colorado counties included in the General Study Area.

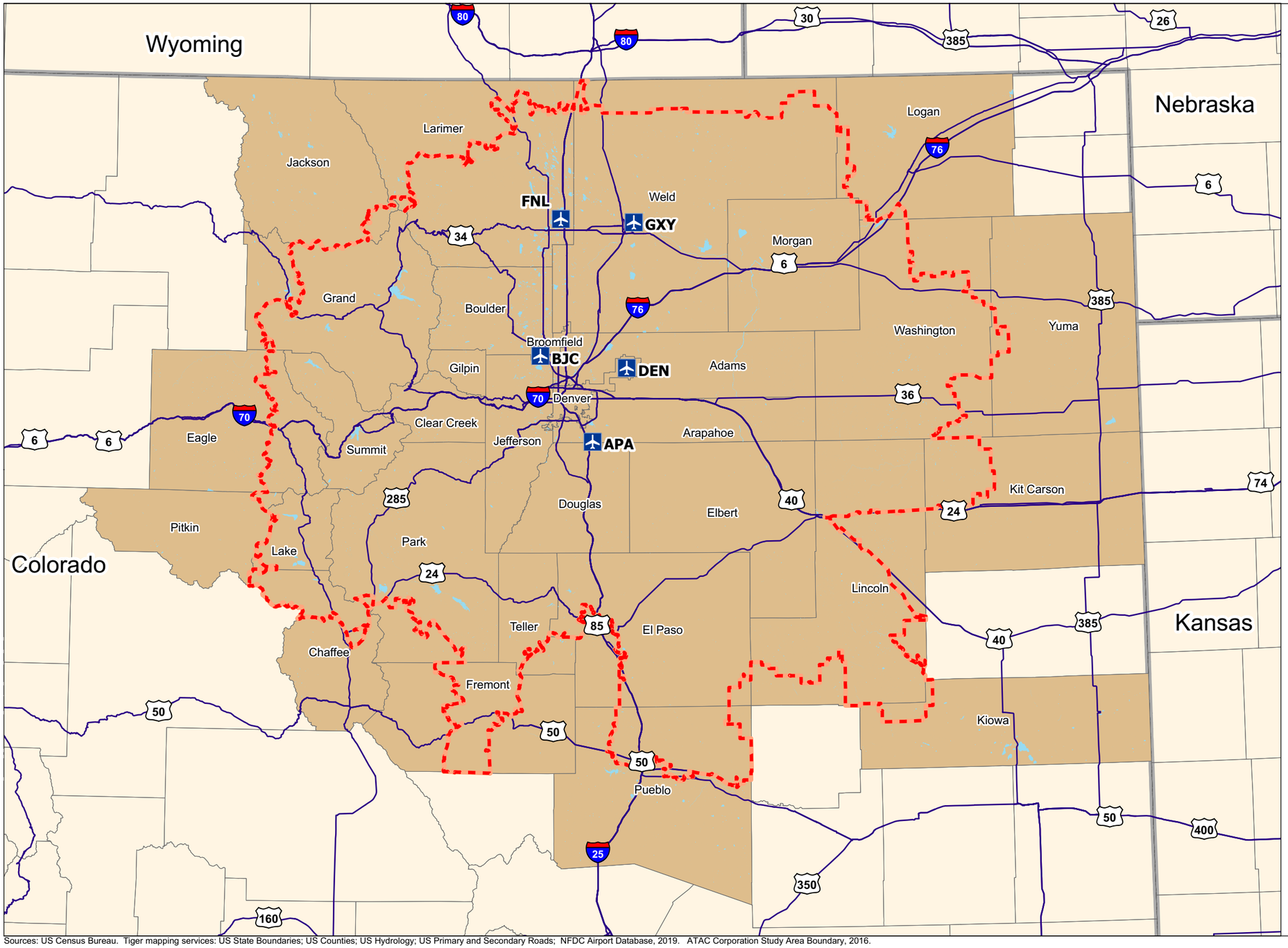
Two overall objectives guided the development of the General Study Area:

1. The General Study Area captures all flight tracks identified for the No Action using radar data from the period of July 1, 2016 to June 30, 2017 which is the most recent year of data available. The General Study Area also captures flight tracks designed for the Preferred Alternative where 95 percent of departing aircraft are below 10,000 feet altitude Above Ground Level (AGL) and 95 percent of arriving aircraft are below 7,000 feet AGL. The threshold for Satellite Airports is set at 85 percent to account for the lower altitudes many aircraft operating from these airports tend to fly. The thresholds are set below 100 percent to account for outlier operations which may not reach the prescribed altitudes within a reasonable distance of the Study Airports or may not reach them at all. By excluding the flight tracks for these kinds of operations, potential distortion of the lateral boundary can be avoided and the General Study Area is kept to a reasonable size. The FAA requires consideration of impacts of airspace actions from the surface to 10,000 feet AGL if the study area is larger than the immediate area around an airport or involves more than one airport.[47,48] Furthermore, policy guidance issued by the FAA Program Director for Air Traffic Airspace Management states that for air traffic project environmental analyses noise impacts should be evaluated for proposed changes in arrival ATC procedures between 3,000 and 7,000 feet AGL and departure ATC procedures between 3,000 and 10,000 feet AGL for large civil jet aircraft weighing over 75,000 pounds.[49]

[47] Department of Transportation, Federal Aviation Administration, Order 1050.1F, *Environmental Impacts: Policies and Procedures*, Appendix B. *Federal Aviation Administration Requirements for Assessing Impacts Related to Noise and Noise-Compatible Land Use and Section 4(f) of the Department of Transportation Act (49 U.S.C. § 303)*, Para. B-1.3, *Affected Environment*. July 16, 2015.

[48] Department of Transportation, Federal Aviation Administration, *1050.1F Desk Reference*, Ch. 11, *Noise and Noise-Compatible Land Use*, Para 11.2, *Affected Environment*., July 2015.

[49] Department of Transportation, Federal Aviation Administration, *Memorandum Regarding Altitude Cut-Off for National Airspace Redesign (NAR) Environmental Analyses*, September 15, 2003.



LEGEND

- General Study Area Boundary
- Study Airports
- Water
- US State Boundaries
- Highways
- Counties in the General Study Area
- US Counties

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads; NFDC Airport Database, 2019. ATAC Corporation Study Area Boundary, 2016.

Prepared by: ATAC Corporation, March 2019.

DEN METROPLEX EA

Exhibit 4-1

General Study Area

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2. The lateral boundary of the General Study Area is defined by U.S. Census tract boundaries where aircraft cross at or below the 10,000/7,000 feet AGL thresholds. This extent is concisely defined to focus on areas of air traffic flow.

Table 4-1 Colorado Counties within General Study Area

Adams	Eagle	Kiowa	Pitkin
Arapahoe	El Paso	Kit Carson	Pueblo
Boulder	Elbert	Lake	Summit
Broomfield	Fremont	Larimer	Teller
Chafee	Gilpin	Lincoln	Washington
Clear Creek	Grand	Logan	Weld
Denver	Jackson	Morgan	Yuma
Douglas	Jefferson	Park	

Sources: ESRI, TomTom, U.S. Department of Commerce, U.S. Census Bureau, 2018
Prepared by: ATAC Corporation, February 2019.

4.2 Resource Categories or Sub-Categories Not Affected

This section discusses the environmental resource categories or sub-categories that would remain unaffected by the Preferred Alternative. These resource categories would remain unaffected because the resource either does not exist within the General Study Area or the types of activities associated with the Preferred Alternative would not affect them. The resource categories or sub-categories are:

- **Biological Resources (including fish and plants only)**: Air traffic airspace and ATC procedure changes do not involve ground disturbance activities. Such changes would not destroy or modify critical habitat for any species. The Preferred Alternative would not affect habitat for non-avian fish or plants, and thus no further analysis is required.
- **Coastal Resources**: The Preferred Alternative would not involve any actions (physical changes or development of facilities) that would be inconsistent with management plans for designated Coastal Barrier Resource System (CBRS) areas, which are not found in the General Study Area. The Preferred Alternative would not directly affect any shorelines or change the use of shoreline zones and be inconsistent with any NOAA-approved state Coastal Zone Management Plan (CZMP) since there are no shorelines in the General Study Area. Thus, no further analysis is required.
- **Farmlands**: The Preferred Alternative would not involve the development of any land regardless of use, nor would it have the potential to convert any farmland to non-agricultural uses. Thus, no further analysis is required.
- **Hazardous Materials, Solid Waste, and Pollution Prevention:** The Preferred Alternative would not result in any construction or development or any physical disturbances of the ground. Therefore, the potential for impact in relation to hazardous materials, pollution prevention, and solid waste is not anticipated, and thus no further analysis is required.
- **Historical, Architectural, Archeological, and Cultural Resources – Archeological and Architectural sub-category only**: The Preferred Alternative

would not involve excavation of archaeological resources on Federal and Indian lands, disposition of cultural items, or affect the physical integrity and access to American Indian sacred sites. The Preferred Alternative would not result in any construction, development, or any physical disturbances of the ground. Therefore, the potential for impact in relation to architectural compatibility with the character of a surrounding historic district or property is not anticipated, and thus no further analysis is required.

- **Land Use**: The Preferred Alternative would not involve any changes to existing, planned, or future land uses within the General Study Area, and thus no further analysis is required.
- **Natural Resources and Energy Supply – Natural Resources sub-category only**: The Preferred Alternative would not require the need for unusual natural resources and materials, or those in short supply. Thus, no further analysis is required.
- **Socioeconomic Impacts, Environmental Justice, and Children's Environmental Health and Safety Risks** –
    - **Socioeconomic Impacts sub-category**: The Preferred Alternative would not involve acquisition of real estate, relocation of residents or community businesses, disruption of local traffic patterns, loss in community tax base, or changes to the fabric of the community, and thus no further analysis is required.
    - **Children's Environmental Health and Safety Risks sub-categories**: The Preferred Alternative would not affect products or substances that a child would be likely to come into contact with, ingest, use, or be exposed to, and would not result in environmental health and safety risks that could disproportionately affect children. Thus, no further analysis is required.
- **Visual Effects (Light Emissions Only)**: The Preferred Alternative would not change aviation lighting; thus, no further analysis is required.
- **Water Resources (including Wetlands, Floodplains, Surface Waters, Groundwater, and Wild and Scenic Rivers)**
    - **Wetlands**: The Preferred Alternative would not result in the construction of facilities and would therefore not encroach upon areas designated navigable waters. Thus, no further analysis is required.
    - **Floodplains**: The Preferred Alternative would not result in the construction of facilities. Therefore, it would not encroach upon areas designated as a 100-year flood event area as described by the Federal Emergency Management Agency (FEMA), and thus no further analysis is required.
    - **Surface Waters**: The Preferred Alternative would not result in any changes to existing discharges to water bodies, create a new discharge that would result in impacts to surface waters, or modify a water body. The Preferred Alternative would, therefore, not result in any direct or indirect impacts on surface waters, and thus no further analysis is required.

- **Groundwater**: The Preferred Alternative does not involve land acquisition or ground disturbing activities that would withdraw groundwater from underground aquifers or reduce infiltration or recharge to ground water resources through the introduction of new impervious surfaces, and thus no further analysis is required.
- **Wild and Scenic Rivers**: The Cache La Poudre River, which covers 76 river miles (0.07%) out of 107,403 total river miles in Colorado,[50] is the only designated wild and scenic river located within the General Study Area. However, the Preferred Alternative would not foreclose or downgrade Wild, Scenic, or Recreational river status of a river or river segment included in the Wild and Scenic River System and thus, no further analysis is required.

4.3 Potentially Affected Resource Categories or Sub-Categories

This section provides information on the current conditions within the General Study Area for environmental resource categories or components that the Preferred Alternative could potentially affect. These environmental resource categories or sub-categories include:

- **Air Quality** (Section 4.3.1)
- **Biological Resources – Wildlife sub-category only** (Section 4.3.2)
- **Climate** (Section 4.3.3)
- **Department of Transportation Act: Section 4(f) Resources** (Section 4.3.4)
- **Historic, Architectural, Archeological, and Cultural Resources – Historic and Cultural Resources sub-categories only** (Section 4.3.5)
- **Natural Resources and Energy Supply- Energy Supply sub-category only (aircraft fuel only**) (Section 4.3.6)
- **Noise and Noise Compatible Land Use** (Section 4.3.7)
- **Socioeconomic Impacts, Environmental Justice, and Children's Environmental Health and Safety Risks – Environmental Justice sub-category only** (Section 4.3.8)
- **Visual Effects (Visual Resources / Visual Character Only)** (Section 4.3.9)

The following sections discuss each of the above listed environmental resource categories in detail.

4.3.1 Air Quality

This section describes air quality conditions within the General Study Area. In the United States, air quality is generally monitored and managed at the county or regional level. The U.S. EPA, pursuant to mandates of the federal Clean Air Act, (42 U.S.C. § 7401 et seq. (1970)), has established the National Ambient Air Quality Standards (NAAQS) to protect public health, the environment, and quality of life from the detrimental effects of air pollution. Standards have been established for the following criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O3), particulate matter (PM), and sulfur dioxide

[50] National Wild and Scenic River System. Accessed via https://www.rivers.gov/colorado.php January 2019.

(SO_2). PM standards have been established for inhalable coarse particles ranging in diameter from 2.5 to 10 micrometers (µm) (PM_{10}) and fine particles less than 2.5 µm ($PM_{2.5}$) in diameter.

In accordance with the Clean Air Act Amendments (CAAA) of 1997, (91 Stat. 685, P.L. 95-95), the U.S. EPA uses air monitoring data it compiles as well as data collected by local air quality agencies to classify counties and some sub-county geographical areas by their compliance with the NAAQS. An area with air quality at or below the NAAQS is designated as an attainment area. An area with air quality that exceeds the NAAQS is designated as a nonattainment area. Nonattainment areas are further classified as extreme, severe, serious, moderate, and marginal by the extent the NAAQS are exceeded. Areas that have been reclassified from nonattainment to attainment are identified as maintenance areas. An area may be designated as unclassifiable when there is a temporary lack of data on which to base its attainment status. **Table 4-2** identifies those areas that fall within the General Study Area that are in nonattainment or maintenance for the reported pollutants.

Table 4-2 NAAQS Nonattainment and Maintenance Areas in the General Study Area

Pollutant	Status	Area
Ozone (O3) – (8-Hour Standard [2015])	Nonattainment	Adams County Arapahoe County Boulder County Broomfield County Denver County Douglas County Jefferson County Larimer County (Partial) Weld County (Partial)
Carbon Monoxide	Serious - Maintenance	Adams County (Partial) Arapahoe County (Partial) Boulder County (Partial) Broomfield County Denver County Douglas County (Partial) Jefferson County (Partial)
	Moderate <=12.7ppm-Maintenance	El Paso County (Partial) Larimer County (Partial) Teller County (Partial)
	Not Classified - Maintenance	Weld County (Partial)

Source: US Environmental Protection Agency (EPA) Green Book; (https://www.epa.gov/green-book); Accessed January 2019
Prepared by: ATAC Corporation, February 2019.

4.3.2 Biological Resources – Wildlife Sub-Category

This section discusses the existing wildlife resources within the General Study Area. The Preferred Alternative involves redesigning standard instrument arrival and departure ATC procedures and the supporting airspace management structure serving the Study Airports. Accordingly, the discussion is limited to avian species that may be present within the General Study Area. No bat species of concern are found in the General Study Area, thus there is no discussion regarding bats.

4.3.2.1 Threatened and Endangered Species and Migratory Birds

The Endangered Species Act (ESA) of 1973, (16 U.S.C. § 1531 et seq. (1973)), requires the evaluation of all federal actions to determine whether a Preferred Alternative is likely to jeopardize any proposed, threatened, or endangered species or proposed or designated critical habitat. A federal action is one conducted, funded, or permitted by a federal agency. Section 7 of the ESA requires the lead federal agency (in this case the FAA) to consult with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries to determine whether the proposed federal action would jeopardize the continued existence of any species listed or proposed for listing as threatened or endangered; or result in the destruction or adverse modification of designated or proposed critical habitat. Critical habitat includes areas that will contribute to the recovery or survival of a listed species. Federal agencies are responsible for determining if an action "may affect" listed species. If so, the federal agency is required to prepare a Biological Assessment (BA) to determine if the action is "likely to adversely affect the species." The potential for federal and state listed avian and bat species was assessed based on the USFWS reports. Data from the USFWS were used to identify potential federally-listed species. No bat species are listed in the General Study Area.

4.3.2.2 Migratory Birds

The Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. §§ 703-712) prohibits the taking of any migratory bird and any part, nest, or egg of any such bird, without a permit issued by the USFWS. "Take" under the MBTA is defined as the action or attempt to "pursue, hunt, shoot, capture, collect, or kill." Migratory birds listed under the ESA are managed by the agency staff members who handle compliance with Section 7 of the ESA; management of all other migratory birds is overseen by the Migratory Bird Division of the ESA. Several migratory bird species occur in, or migrate through, the General Study Area.

Birds migrate along four main routes or flyways in North America: the Atlantic, the Central, the Mississippi, and the Pacific flyways, which are loosely delineated in these geographic regions. The Continental Divide, roughly bisecting Colorado on a north to south basis, is the geographic dividing line between the Central Flyway east of the Divide and the Pacific Flyway west of the Divide. The Study Area spans both east and west of the Continental Divide, thus having migratory bird species from both the Pacific and Central Flyways. These flyways are not specific lines the birds follow but broad areas through which the birds migrate. Migration routes may be defined as the various lanes birds travel from their breeding ground to their winter quarters. The actual routes followed by a given bird species differ by distance traveled, starting time, flight speed, geographic position and latitude of the breeding, and wintering grounds.

Table 4-3 identifies the USFWS listed bird species of concern that are believed to or known to occur in the General Study Area by county.

Table 4-3 Federally Listed Bird Species Believed to or Known to Occur in the GSA

Status	Species	Type	County within the GSA
Threatened	Yellow-billed Cuckoo (*Coccyzus americanus*)	Animal (Bird)	Eagle, Grand, Jackson, Pitkin, Summit
Threatened	Mexican spotted owl (Strix occidentalis lucida)	Animal (Bird)	Adams, Arapahoe, Boulder, Chaffee, Clear Creek, Douglas Eagle, El Paso, Fremont, Gilpin, Jefferson, Larimer, Park, Pitkin, Pueblo, Summit, Teller, Weld
Threatened	Piping Plover (Charadrius melodus)	Animal (Bird)	Kiowa
Threatened	Gunnison sage-grouse (*Centrocercus minimus*)	Animal (Bird)	Chaffee
Endangered	Least tern (Sterna antillarum)	Animal (Bird)	Jackson, Kiowa, Park

Source: US Fish and Wildlife Service, https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=CO, Accessed February 22, 2019.
Prepared By: ATAC Corporation, February 2019.

4.3.3 Climate

Greenhouse gases (GHGs) are naturally occurring and man-made gases that trap heat in the earth's atmosphere. These gases include CO_2, methane (CH4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). According to the EPA, domestic aviation contributed approximately three percent of total national CO_2 emissions[51].

In December 2014, the CEQ issued revised draft NEPA guidance for considering effects of climate change and GHG emissions. The guidance recommended consideration of potential effects of a proposed action or its alternatives on climate change as indicated by GHG emissions, and the implications of climate change for the environmental effects of a proposed action on its alternatives.

This Draft EA calculated total MT of CO_2, reported as MT CO_2e, using AEDT 2d estimates of the amount of fuel burned by IFR aircraft arriving and departing from the Study Airports in the General Study Area for the No Action and applying accepted Environmental Protection Agency factors to calculate CO_2e. Fuel burn calculations are discussed in Section 4.3.6, *Energy Supply*.

Both the EPA and the FAA have determined that aircraft operations at or above a mixing height of 3,000 feet AGL have a very small effect on pollutant concentrations at ground level.[52,53,54] The mixing height represents the height of the completely mixed portion of the

[51] U.S. Environmental Protection Agency. https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-aircraft. Accessed April 2019.

[52] Wayson, Roger, and Fleming, Gregg, *Consideration of Air Quality Impacts by Airplane Operations at or Above 3000 feet AGL*, Volpe National Transportations Systems Center and FAA Office of Environment & Energy, FAA-AEE-00-01-DTS-34, September 2000. (https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/media/catex.pdf)

[53] 40 C.F.R. § 93.150(c)(2) (xxii).

[54] 72 Fed. Reg. 6641 (February 12, 2007).

atmosphere that begins at the earth's surface and extends to a few thousand feet overhead where the atmosphere becomes fairly stable.[55] Mixing heights will vary based on a variety of factors including topography, time of day, temperature, wind, and season. A mixing height of 3,000 feet AGL represents the annual national average mixing height. While 3,000 feet AGL is the threshold established by the EPA and the FAA, FAA research on mixing heights indicate that changes in air traffic ATC procedures above 1,500 ft. AGL and below the mixing height would have little if any effect on emissions and ground concentrations.[56]

[55] U.S. Department of Transportation, Federal Aviation Administration, *Air Quality Procedures For Civilian Airports & Air Force Bases*, (https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Air_Quality_Handbook_Appendices.pdf) January 2015.

[56] Report on ''Consideration of Air Quality Impacts by Airplane Operations At or Above 3,000 feet AGL,''FAA–AEE–00–01, September 2000, p. 5.

4.3.4 Department of Transportation Act, Section 4(f) Resources

Section 4(f) of the DOT Act (codified at 49 U.S.C. § 303(c)), states that, subject to exceptions for de minimis impacts:

> … [the] Secretary of Transportation will not approve any program or project that requires the use of any publicly owned land from a public park; recreation area; or wildlife and waterfowl refuge of national, state, or local significance as determined by the officials having jurisdiction thereof, unless there is no feasible and prudent alternative to the use of such land…and [unless] the project includes all possible planning to minimize harm resulting from the use.

The term "use" includes both physical and indirect or "constructive" impacts to Section 4(f) resources. Direct use is the physical occupation or alteration of a Section 4(f) property or any portion of a Section 4(f) property. A "constructive" use does not require direct physical impacts or occupation of a Section 4(f) resource. A constructive use would occur when a proposed action would result in substantial impairment of a resource to the degree that the activities, features, or attributes of the resource that contribute to its significance or enjoyment are substantially diminished. The determination of use must consider the entire property and not simply the portion of the property used for a proposed project.

Parks and natural areas where a quiet setting is a generally recognized purpose and attribute receive special consideration. In these areas, the FAA "…must consult all appropriate Federal, State, and local officials having jurisdiction over the affected Section 4(f) resources when determining whether project-related noise impacts would substantially impair the resource." Privately-owned parks, recreation areas, and wildlife refuges are not subject to the Section 4(f) provisions.

Many Section 4(f) properties are also subject to the Section 6(f) of the Land and Water Conservation Fund Act of 1965 (LWCF) (16 U.S.C. § 460l–4 et seq.) Section 6(f) states that no public outdoor recreation areas acquired or developed with LWCF assistance can be converted to non-recreation uses without the approval of the Secretary of the Interior. The Secretary of the Interior may only approve conversions if they are in accordance with the comprehensive statewide outdoor recreation plan and if other recreation lands of reasonably equivalent usefulness and location will replace the converted areas.

4.3.4.1 Section 4(f) Resources in the General Study Area

The FAA used data from federal and state sources to identify 63,862 Section 4(f) resource analysis points within the General Study Area. Excluding properties listed on the National Register of Historic Places (NRHP), **Exhibit 4-2** depicts the locations of these resources. A list of the Section 4(f) resources identified in the General Study Area, the type of resource (i.e., federal, state, or local), the county in which they are located, site acreage, and DNL calculated for each resource under Existing Conditions is included in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*.

4.3.5 Historic, Architectural, Archeological, and Cultural Resources – Historic Properties and Cultural Resources Sub-Categories

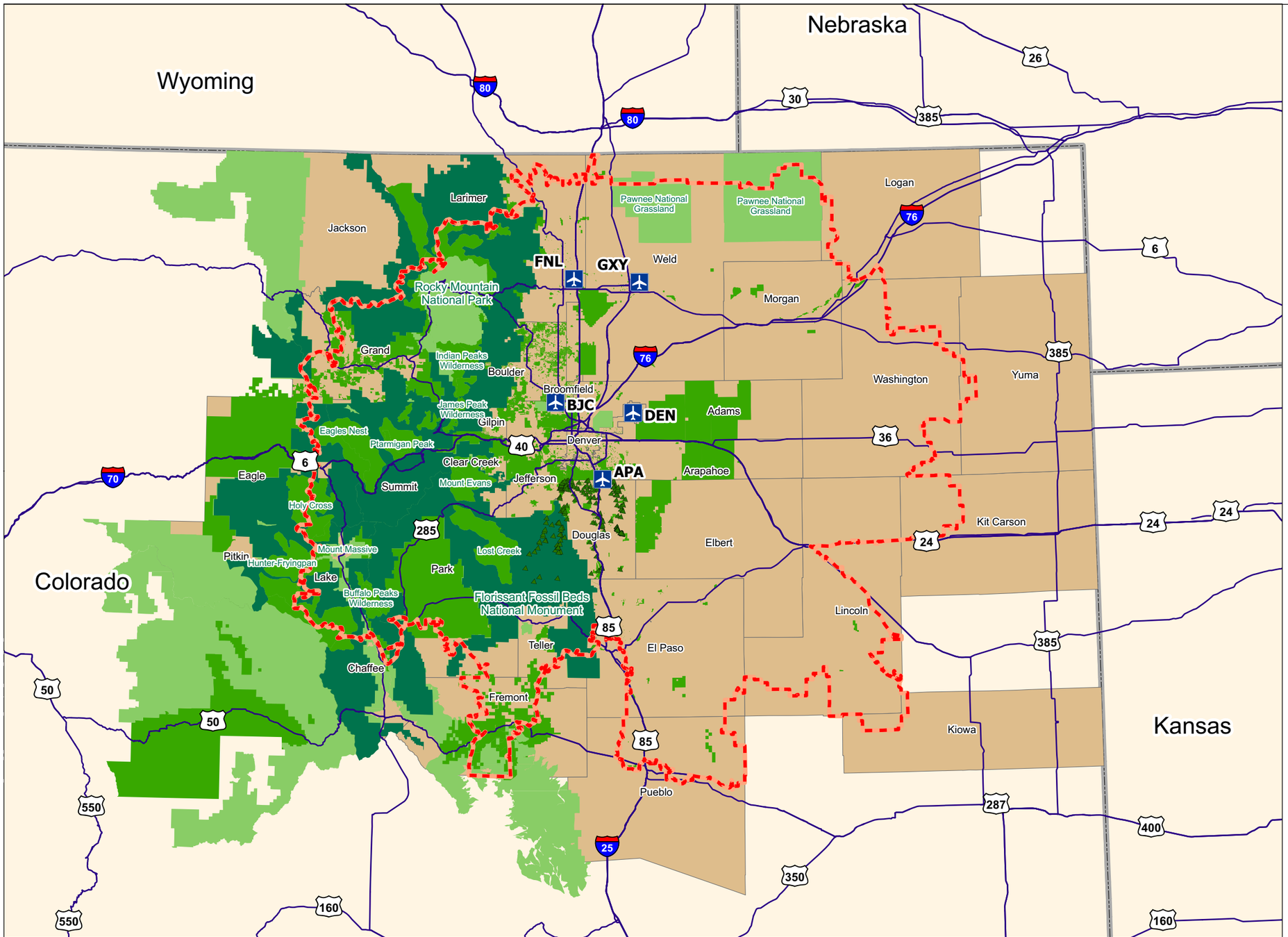
The National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. §470, as amended) requires federal agencies to consider the effects of their undertakings on properties listed or eligible for listing in the NRHP. Compliance requires agencies to consider the effects of such undertakings on properties listed, or eligible for listing, in the National Register of Historic Places (NRHP). Regulations related to this process are described in 36 CFR Part 800, Protection of Historic Properties. In accordance with Executive Order 13175 *Consultation and Coordination with Indian and Tribal Governments* and FAA Order 1210.20 *American Indian and Alaska Native Tribal Consultation Policy and Procedures* the FAA invited identified tribal government-to-government consultations regarding any concerns that uniquely or significantly affect a Tribe related to the proposed project.

This EA defines historic properties as "…any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the NRHP criteria."[57] It is possible that changes in aircraft flight routes associated with the Preferred Alternative could introduce or increase aircraft routing over historic properties and result in potential adverse noise impacts. As noted in Section 4.2, the Preferred Alternative does not involve ground disturbance that could potentially impact archaeological or architectural resources. The Preferred Alternative is located above the ground and does not involve the construction, disturbance, or alteration of any physical structure on, in, or emanating from the ground. Thus, the EA does not further discuss these resources.

4.3.5.1 Historic Properties in the General Study Area

Exhibit 4-3 shows the location of 4(f), historic, and cultural resources identified in the General Study Area. A total of 1,686 NRHP listed and eligible to be listed properties were identified. A list of the historic and cultural resources identified in the General Study Area, the county in which they are located, and DNL calculated for each resource under Existing Conditions is included in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*.

[57] 36 CFR Part 800.16(l)(1)



LEGEND

- General Study Area Boundary
- Highways

Section 4(f) Resources

- National Forest
- National Park Service Properties
- State/Local park or forest
- Parks/Trails
- Counties in the General Study Area
- US State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Water features have been removed for clarity

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads; NFDC Airport Database, 2019. National Parks Service, Register of Historic Places, 2019. U.S. Geological Survey, Geographic Names Information System, 2019. Colorado Parks and Wildlife (CPW properties), 2019. ATAC Corporation Study Area Boundary, 2016.
Prepared by: ATAC Corporation, March 2019.

Exhibit 4-2

Section 4(f) Resources in the General Study Area

DEN METROPLEX EA

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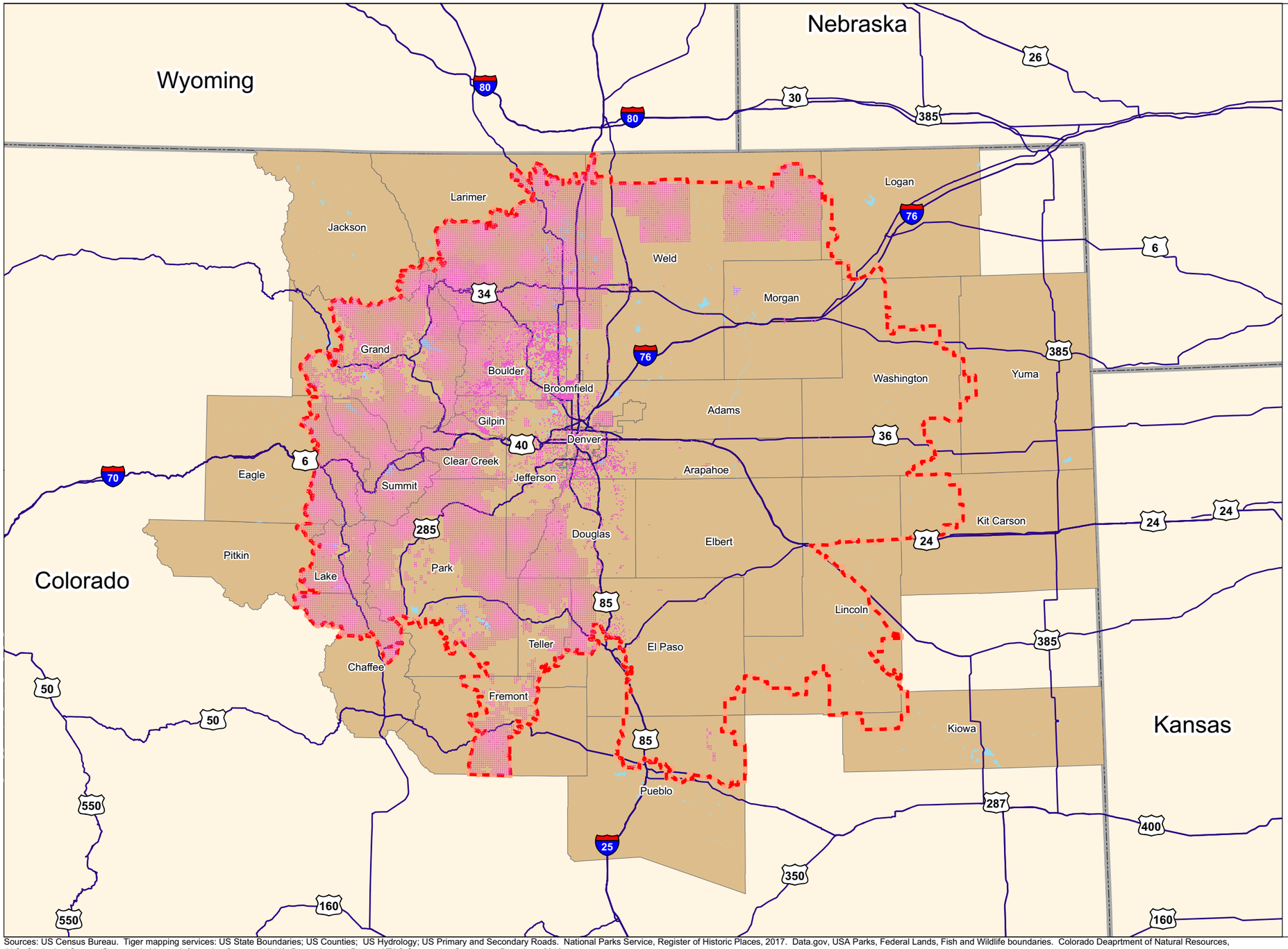

LEGEND

- 4(f), Historic, and Cultural Resources
- General Study Area Boundary
- Highways
- Water
- Counties in the General Study Area US
- State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads. National Parks Service, Register of Historic Places, 2017. Data.gov, USA Parks, Federal Lands, Fish and Wildlife boundaries. Colorado Deaprtment of Natural Resources, U.S. Geological Survey, Geographic Names Information System, Wildlife Properties and Parks. ATAC Corporation Study Area Boundary, 2019.
Prepared by: ATAC Corporation, April 2019.

Exhibit 4-3

DEN METROPLEX EA

4(f), Historic, and Cultural Resource Analysis Points in the General Study Area

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4.3.6 Energy Supply (Aircraft Fuel)

This section describes fuel consumption by IFR aircraft arriving at and departing from the Study Airports. Using the AEDT version 2d noise model, the FAA calculated aircraft fuel burn to estimate fuel consumption associated with air traffic flows under Existing Conditions. AEDT calculates fuel burn using the same input used for calculating noise (See Section 4.3.7.1 for a discussion of AEDT model inputs). Based on the AEDT calculation, IFR aircraft arriving at and departing from the Study Airports burn approximately 381,994 gallons of fuel[58] on an annual average day.

4.3.7 Noise and Noise Compatible Land Use

Aircraft noise is often the most noticeable environmental effect associated with any aviation project. This section discusses FAA guidance on conducting noise analyses, noise model input development, and existing aircraft noise conditions. **Appendix E** provides background information on the physics of sound, the effects of noise on people, and noise metrics. Detailed results of the noise analysis are included in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*.

4.3.7.1 Noise Modeling Methodology

To comply with NEPA requirements, the FAA has issued guidance on assessing aircraft noise in FAA Order 1050.1F. This guidance requires that aircraft noise analysis use the yearly Day-Night Average Sound Level (DNL) metric. The DNL metric is a single value representing the aircraft sound level over a 24-hour period and includes all of the sound energy generated within that period. The DNL metric includes a 10-decibel (dB) weighting for noise events occurring between 10:00 P.M. and 6:59 A.M. (nighttime). This weighting helps account for the greater level of annoyance caused by nighttime noise events. Accordingly, the metric essentially equates one nighttime flight to 10 daytime flights. The DNL metric is further discussed in **Appendix E**.

The 1050.1F Desk Reference requires FAA to evaluate aircraft noise using one of four noise models: (1) Aviation Environmental Design Tool (AEDT) 2b, (2) U.S. Department of Defense NOISEMAP, (3) U.S. Department of Defense's Military Operating Area and Range Noise Model, or (4) PCBOOM. The FAA uses AEDT to model noise for flight track changes over large areas and at altitudes over 3,000 feet AGL. For this EA the FAA uses AEDT version 2d, released on September 27, 2017, to analyze noise associated with the Preferred Alternative and No Action.

Although the noise environment around major airports comes almost entirely from jet aircraft operations, the DNL calculations reflect noise from many types of jet and propeller aircraft on Instrument Flight Rules (IFR) flight plans that could be affected by the Preferred Alternative.

When operating outside certain categories of controlled airspace, aircraft operating under Visual Flight Rules (VFR) are not required to be in contact with ATC. Because these aircraft operate at the pilot's discretion and are often not required to file flight plans, the FAA has very limited information about these operations. Consequently, there is no known source for comprehensive route, altitude, aircraft type, and frequency information for VFR operations in the General Study Area. However, even if complete information were available for VFR

[58] For fuel burn purposes, jet fuel ("Jet-A," available only in the US) is calculated at 6.66 pounds per gallon. Approximately 2,544,080.04 pounds of fuel are burned by IFR aircraft arriving and departing the Study Airports on an annual average day.

operations, the Preferred Alternative would not require any changes to routing or altitudes to accommodate these operations. If they could be modeled, they would use the same flight routes and altitudes under the Preferred Alternative and No Action scenarios. Their operations would not be affected by the forecast conditions in 2019 (the proposed first year of implementation) and 2024 (five years after implementation) for either the Preferred Alternative or the No Action. Therefore, VFR aircraft were not included in the analysis.

AEDT requires a variety of inputs, including local environmental data temperature and humidity, runway layout, number and type of aircraft operations, runway use, and flight tracks. Accordingly, the FAA assembled detailed information on aircraft operations for the Study Airports for input into AEDT. This includes specific aircraft fleet mix information such as aircraft type, arrival and departure times, and origin/destination airport.

Radar data obtained from the FAA's Performance Data Analysis and Reporting System (PDARS) identified 662,603 IFR-filed flights to and from the Study Airports between July 1, 2016 and June 30, 2017. The 365 days of usable data span all seasons and runway usage configurations for the Study Airports. The FAA used this data to develop the average annual day (AAD) fleet mix, time of day and night and runway use input for AEDT. More detailed information about the AEDT input for Existing Conditions can be found in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*.

The PDARS data provided radar tracks for each flight that occurred between July 1, 2016 and June 30, 2017. The FAA used the data to define the AAD track locations and nature of the aircraft fleet mix and operations. This represents a typical flow of air traffic, as well as the typical climb and descent patterns that occur along each flow trajectory. The FAA analyzed the tracks using proprietary software. All the trajectories were bundled into a set of tracks representing an air traffic flow. The air traffic flows comprise all the typical flight routings within the General Study Area for an AAD. AEDT tracks are then developed based on the group of bundled radar tracks representing each flow.

The AEDT model was used to calculate noise levels for the following specific locations on the ground:

Census Block Centroids: The AEDT model was used to calculate DNL at the geographic centers (centroids) of census blocks to estimate the population exposed to varying levels of aircraft noise exposure. This EA analyzed population within the General Study Area using 2010 U.S. Census block geometry. A census block is the smallest geographical unit that the United States Census uses to collect data. The census block centroid DNL represents the DNL for the total maximum potential population within that census block.

Of the 105,308 census block centroids identified in the General Study Area, 42,373 were devoid of population and are thus excluded from the Census Block Centroid analysis but were covered by Grid Points and/or Unique Points (see following). The smallest centroid in this EA has a population of one, and the largest centroid has a population of 3,193. Because noise levels are analyzed only at the centroid point and applied to the entire census block area population and because the area represented by each centroid varies depending on the density of population; the actual noise exposure level for individuals will vary from the reported level based on their proximity to the modeled geographic centroid.

Grid Points: The AEDT model calculated noise exposure at evenly spaced grid points. This EA covered the General Study Area with a grid of noise receptor points spaced evenly at one-half (0.5) nautical mile intervals. Noise was calculated for these grid points throughout the

General Study Area. In addition, these grid points were evaluated for noise at any Section 4(f) resource or historic property not captured using unique points as described below.

Unique Points – Section 4(f) and Historical and Cultural Resources: The AEDT model analyzed noise levels at sites of interest that are too small to be captured in the 0.5 nautical mile grid. These sites include individual Section 4(f) resources that are less than one square nautical mile in area (such as significant public parks or trails), and specific historic sites (such as individual buildings). Refer to Section 4.3.4 for a discussion of what constitutes a Section 4(f) resource and Section 4.3.5 for a discussion of historic properties in the General Study Area.

This EA also calculated the noise levels at grid points provided by the DEN Study Airport noise office. The DEN Airport Noise and Operations Monitoring System (ANOMS) enables the City and County of Denver to monitor aircraft noise in the vicinity of the DEN Study Airport. The DEN ANOMS monitors noise levels at 27 permanent and one portable noise monitoring terminals. These terminals are located throughout the Denver metro area. In addition to monitoring noise levels, the system calculates Noise Exposure Performance Standards (NEPS) at 101 grid points in Adams County. Results calculated for the unique DEN ANOMS Noise Monitoring Terminal (NMT) and NEPS grid points are included in **Appendix I**: *Denver Metroplex Noise Technical Report*.

Unique Points – Noise Sensitive Areas and Uses: In addition to the unique points identified for individual Section 4(f) resources and specific historic sites, the AEDT model was used to analyze noise at noise sensitive areas and uses generally exposed to existing noise of DNL 65 dB and above. These locations are further discussed in Section 4.3.7.3 and disclosed in **Table 4-6**.

In total, noise exposure levels were calculated at 62,935 census block centroids representing a total population of 3,917,842 persons; 196,197 half nautical mile grid points; 64,559 Section 4(f) points; 128 DEN Airport unique NEPS/NMT points; and 7,506 unique points throughout the General Study Area.

4.3.7.2 Existing Aircraft Noise Exposure

Table 4-5 identifies the total population exposed to aircraft noise between DNL 45 dB and 60 dB, DNL 60 dB and 65 dB, and DNL 65 dB and higher. This data establishes a baseline for existing aircraft noise exposure. **Exhibit 4-4** provides a graphical representation, by DNL 5dB bands, of existing noise exposure based on radar data collected from July 1, 2016 through June 30, 2017 within the General Study Area. As shown on **Exhibit 4-4**, areas exposed to higher DNL are generally aligned with Study Airport runways and areas with existing aircraft traffic.

Table 4-5 Maximum Population Exposed to Aircraft Noise (DNL) within the General Study Area

DNL Range (dB)	Population
DNL 45 dB to DNL 60 dB	1,094,788
DNL 60 dB to less DNL 65 dB	6,180
DNL 65 dB and higher	731
Total above DNL 45 dB	1,101,699

Sources: AEDT 2d; US Census Bureau, 2014 Tracts and American Community Survey Selected Economic Characteristics, 2010-2014.
Prepared by: ATAC Corporation, February 2019.

4.3.7.3 Noise Sensitive Areas and Uses

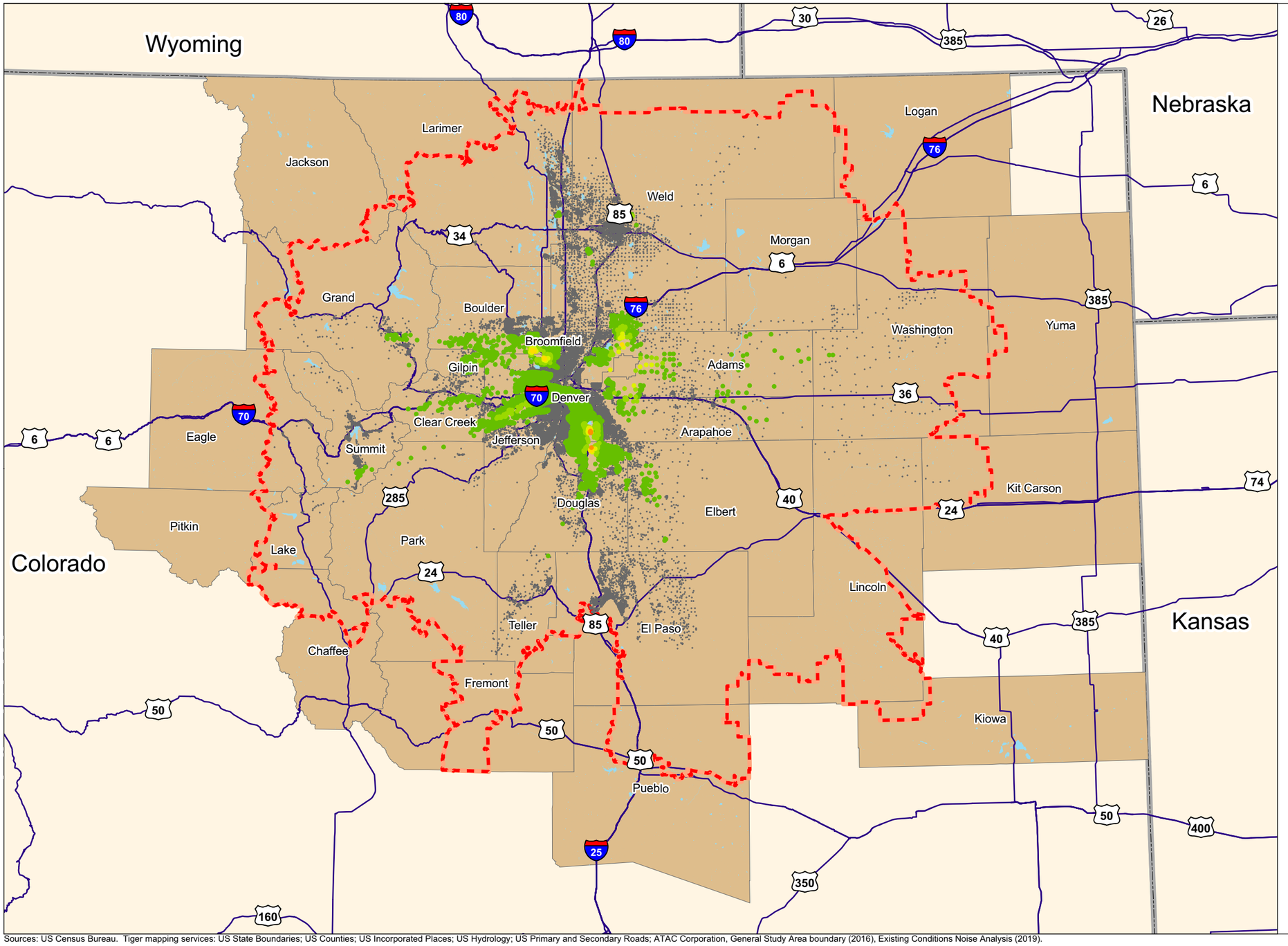
Appendix B to Order 1050.1F requires the FAA to identify the location and number of noise sensitive uses in addition to residences (e.g., schools, hospitals, parks, recreation areas) that could be significantly impacted by noise. As defined in Paragraph 11-5b(8) of Order 1050.1F, a noise sensitive area is "[a]n area where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas, areas with wilderness characteristics, wildlife refuges, and cultural and historical sites." Potential impacts to residential population is considered using US Census blocks population centroids as described in Section 4.3.7.1. The compatibility of noise sensitive uses is evaluated through comparison with the compatibility guidelines provided in 14 CFR Part 150, Appendix A, table 1. The guidelines focus on areas exposed to noise levels of DNL 65 dB and greater. This section identifies other noise sensitive facilities identified in areas around the Study Airports generally exposed to existing noise of DNL 65 dB and above. **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*, Table A7.1 lists those locations identified as noise sensitive in the General Study Area and reports the noise values associated with each location.

4.3.7.4 Noise Compatible Land Use

Noise compatibility or non-compatibility of land use is determined by comparing the DNL values of the centroids to the values of FAA's land use compatibility guidelines.[59] Due to the extensive coverage area of the Preferred Alternative, only areas with population exposed to DNL 65 dB or higher were further screened for noise compatibility of land use.

Existing land use in the General Study Area is depicted in **Exhibit 4-5**. It is characterized using generalized land coverage data from the USGS National Land Cover Database 2011 (NLCD 2011). The eastern portion of the General Study Area is dominated by cultivated crops and pasture, while the western portion is dominated by deciduous forest. The majority of urban development in the General Study Area is predominantly characterized by areas of rural, urban, and suburban development around the Denver, Broomfield, Fort Collins, and Greeley areas. As noted in Section 4.3.4, the General Study Area also includes other types of recreational and preservation resources managed by local, state, and federal agencies.

[59] See https://www.faa.gov/about/office_org/headquarters_offices/apl/noise_emissions/planning_toolkit/media/III.B.pdf at page V-10. Accessed February 7, 2019.



LEGEND

Noise Levels (DNL)

- <45 dB
- 45-50 dB
- 50-55 dB
- 55-60 dB
- 60-65 dB
- 65-70 dB
- General Study Area Boundary
- Water
- US State Boundaries
- Highways
- Counties in the General Study Area

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airportt
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; ATAC Corporation, General Study Area boundary (2016), Existing Conditions Noise Analysis (2019).

Prepared by: ATAC Corporation, March 2019.

Exhibit 4-4

DEN METROPLEX EA

2017 Baseline DNL Noise Exposure by Census Block

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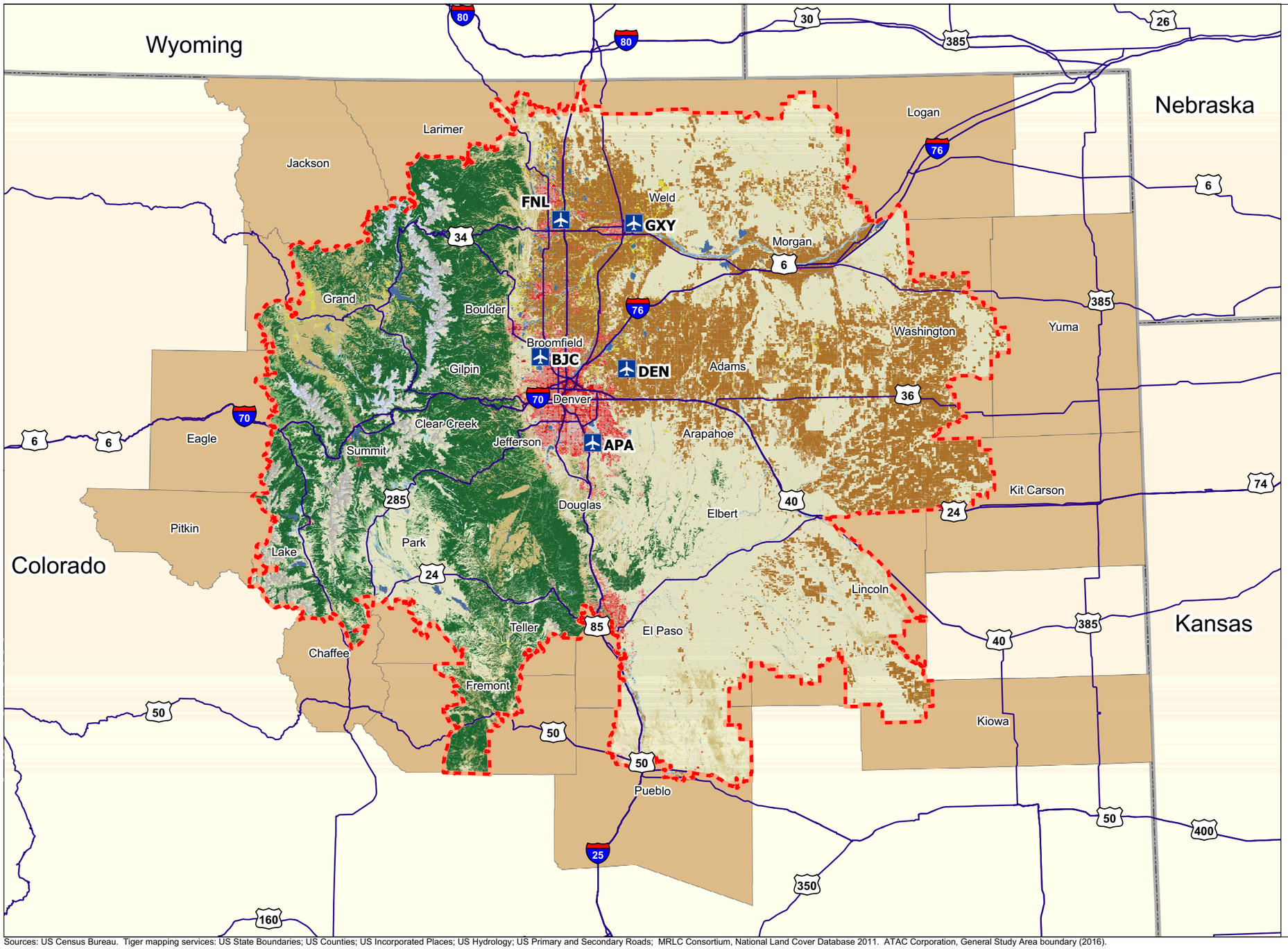

LEGEND

- Study Airports
- General Study Area Boundary
- US State Boundaries
- Highways
- Counties in the General Study Area

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Water features outside the GSA have been removed for clarity

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; MRLC Consortium, National Land Cover Database 2011. ATAC Corporation, General Study Area boundary (2016).

Prepared by: ATAC Corporation, March, 2019.

Exhibit 4-5

Land Coverage in the General Study Area

DEN METROPLEX EA

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4.3.8 Socioeconomic Impacts, Environmental Justice, and Children's Environmental Health and Safety Risks – Environmental Justice Sub-Category

This section is limited to a discussion of Environmental Justice as it pertains to potential aircraft noise impacts in the General Study Area. An environmental justice analysis considers the potential of the proposed project alternatives to cause disproportionate and adverse effects on low-income or minority populations. In the event that adverse effects are determined, applicable mitigation ensures that no low income or minority population bears a disproportionate burden of effects.

FAA Order 1050.1F Desk Reference notes that Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* and the accompanying Presidential Memorandum, as well as DOT Order 5610.2a, *Final Order to Address Environmental Justice in Low-Income and Minority Populations,* require the FAA to provide for meaningful public involvement by minority and low-income populations. These documents encourage considering environmental justice impacts in EAs to determine whether a disproportionately high and adverse impact may occur.

The socioeconomic and racial characteristics of the population within the General Study Area are based on data from the U.S. Census, 2010-2014 American Community Survey (ACS) 5-Year Data Release. Minority and low-income populations for each census block group that has a portion within the General Study Area are identified using the AEDT 2d noise model and depicted in **Exhibit 4-6.** This analysis defines and identifies minority population and low-income population as follows:

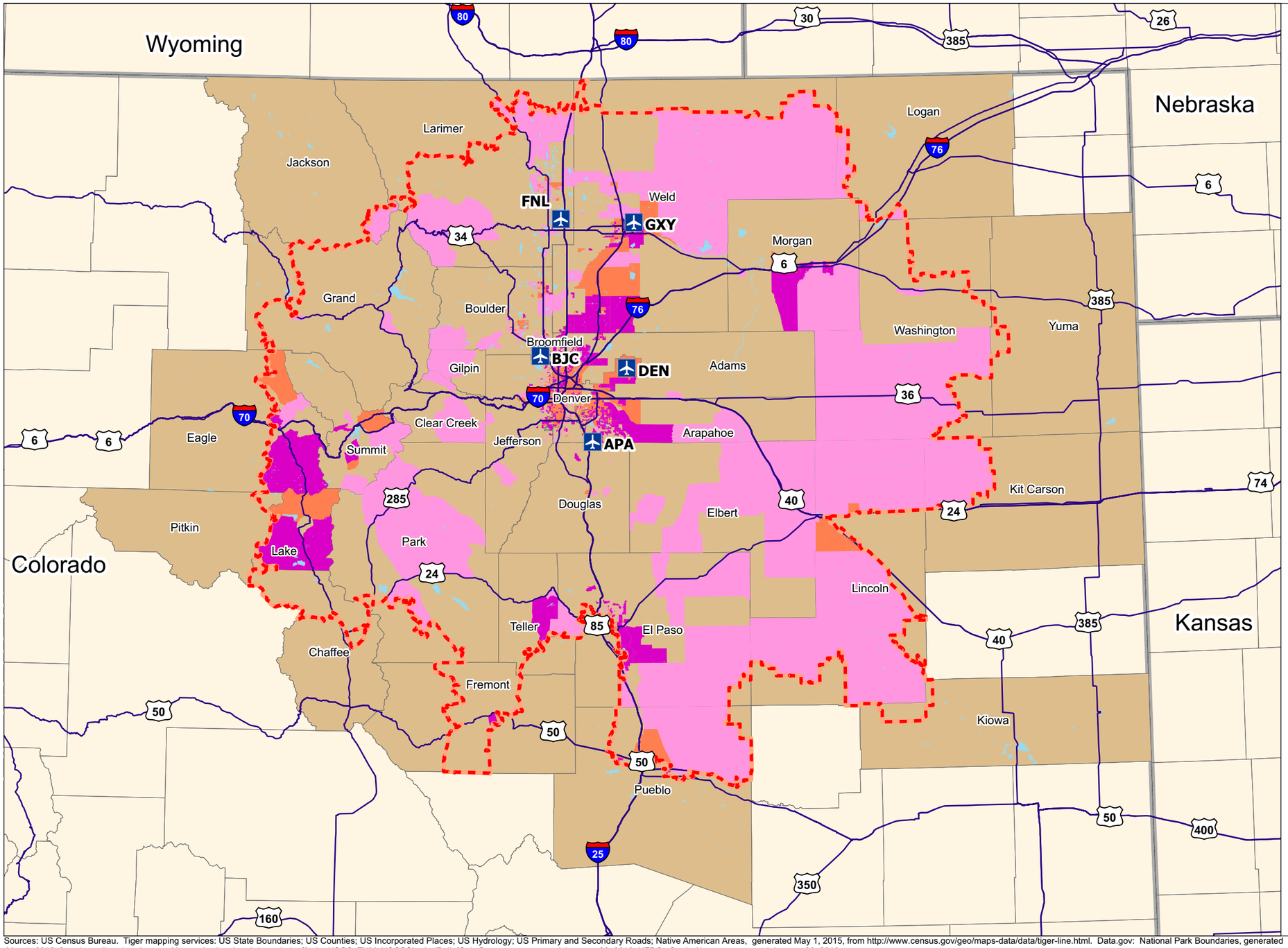
- A **minority census block group** is a census block group with a minority population percentage greater than the average minority population percentage of each census block group that has a portion within the General Study Area. AEDT 2d calculated the average percentage of minority population residing in the General Study Area to be 29.96 percent. Therefore, if a census block group had a percentage of minority population greater than 29.96 percent, it is designated as a census block group of environmental justice concern.
- A **low-income population census block group** is a census block group with a greater percentage of low-income population than the average percentage of low-income population for each census block group that has a portion within the General Study Area. The average percentage of low-income population residing in the overall General Study Area was 12.64 percent. Therefore, if a census block group had a percentage of low-income population greater than 12.64 percent, it is designated as a census block group of environmental justice concern.

Exhibit 4-6 depicts areas of environmental justice concern that exceeded either one or both of the average percentages in the General Study Area. **Table 4-6** presents a summary of minority and low-income populations reported by county for census block groups that are wholly or partially within the General Study Area.

Table 4-6 Areas of Environmental Justice Concern by County in General Study Area

County	Reported Minority %	Reported Low Income %
Adams	48.51	15.05
Arapahoe	36.43	11.48
Boulder	19.82	14.91
Crowley	17.30	32.70
Custer	7.25	19.45
Denver	43.82	17.67
Gunnison	34.90	34.90
Jackson	22.30	13.70
Kit Carson	7.05	15.45
Larimer	15.33	15.64
Lincoln	19.04	16.80
Morgan	36.32	12.60
Pueblo	36.90	13.98
Weld	32.52	13.94

Source: US Census Bureau, 2010-2014 American Community Survey (ACS) 5-Year Estimate.
Prepared by: ATAC Corporation, February 2019.



LEGEND

- Study Airports
- General Study Area Boundary
- Highways
- Water

Areas of Environmental Justice Concern

- Low Income Population
- Minority Population
- Low Income/Minority Population

- Counties in the General Study Area
- US Counties
- US State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 5 10 20 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Incorporated Places; US Hydrology; US Primary and Secondary Roads; Native American Areas, generated May 1, 2015, from http://www.census.gov/geo/maps-data/data/tiger-line.html. Data.gov: National Park Boundaries, generated May 1, 2015, from https://catalog.data.gov/dataset/national-park-boundariesf0a4c. USGS. TNM: USGSShadedReliefOnly Basemap, generated January, 26, 2016. NFDC. Study Airports, generated January 26, 2016.
Prepared by: ATAC Corporation, March 2019.

Exhibit 4-6

Environmental Justice Communities in the General Study Area

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4.3.9 Visual Effects (Visual Resources / Visual Character Only)

Visual Effects deal with the extent to which a Preferred Alternative would result in visual impacts within the General Study Area. The Preferred Alternative includes changes that would generally occur at altitudes at or above 3,000 feet AGL (with any changes at and below that altitude occurring within the footprint of existing ATC procedures).

Currently, historic radar track data indicates that all areas of the General Study Area are exposed to the sight of: (1) IFR aircraft arriving at and departing from the Study Airports that are the exclusive focus of this analysis, (2) both IFR and VFR aircraft overflights through the General Study Area by aircraft not within the focus of this analysis, and (3) those aircraft operating under VFR arriving at and departing from the Study Airports that are also not part of this study. Any potential visual impacts would only arise from changes in the visibility (as perceived from the ground) of IFR aircraft within the General Study Area arriving to and departing from the Study Airports.

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5 Environmental Consequences

This chapter discusses the potential environmental impacts that could result from implementing the Preferred Alternative and the No Action. Specifically, this EA considers effects on the environmental resource categories identified in FAA Order 1050.1F. Both the Preferred Alternative and the No Action were evaluated under forecasted 2019 conditions, which is the first year the Preferred Alternative could potentially be implemented, and under forecasted 2024 conditions. This evaluation considers the direct, indirect, and cumulative effects associated with the Preferred Alternative and No Action, as required under FAA Order 1050.1F.

Potential environmental impacts are identified for the environmental resource categories described in Section 4.3. Neither the Preferred Alternative nor the No Action would involve land acquisition; physical changes to the environment resulting from ground disturbance or construction activities; changes in patterns of population movement or growth, increases in public service demands, or business and economic activity; or generation, disturbance, transportation, or treatment of hazardous materials. Therefore, neither Alternative is expected to result in impacts to certain environmental resource categories (please see Section 4.2 for a list of excluded categories). The excluded environmental resource categories are not further discussed in this chapter.

Table 5-1 identifies the environmental impact categories that the Preferred Alternative could potentially affect, the thresholds of significance used to determine the potential for impacts, and a side-by-side comparative summary of the potential for environmental impacts resulting from implementing the Preferred Alternative under 2019 and 2024 forecast conditions.

Table 5-1 Summary of Potential Environmental Impacts

Environmental Impact Category	Threshold of Significance/Factors to Consider	Impact? 2019	Impact? 2024
Noise and Noise Compatible Land Use	A significant noise impact would occur if the proposed action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65dB level due to a DNL 1.5dB or greater increase, when compared to the No Action for the same timeframe.	No	No
Air Quality	A significant impact would occur if the proposed action would cause pollutant concentrations to exceed one or more of the National Ambient Air Quality Standards (NAAQS), as established by the Environmental Protection Agency under the Clean Air Act, for any of the time periods analyzed, or to increase the frequency or severity of any such existing violations.	No	No

Table 5-1 Summary of Potential Environmental Impacts

Environmental Impact Category	Threshold of Significance/Factors to Consider	Impact? 2019	Impact? 2024
Wildlife (Avian Species)	A significant impact to federally-listed threatened and endangered species would occur when the United States Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS) determines that the proposed action would be likely to jeopardize the continued existence of the species in question, or would result in the destruction or adverse modification of Federally-designated critical habitat. Lesser impacts including impacts on non-listed species could also constitute a significant impact based on consideration factors such as long-term or permanent loss of unlisted wildlife species and adverse impacts to special status species or their habitats. The FAA has not established a significance threshold for non-listed species.	No	No
Climate	The FAA has not established a significance threshold for Climate and has not identified specific factors to consider in making a significance determination.	No	No
Department of Transportation Act, Section 4(f) Resources	A significant impact would occur if the proposed action involves more than a minimal physical use of a Section 4(f) resource or constitutes a "constructive use" based on an FAA determination that the aviation project would substantially impair the Section 4(f) resource. Resources that are protected by Section 4(f) are publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance; and publicly or privately owned land from an historic site of national, state, or local significance. Substantial impairment occurs when the activities, features, or attributes of the resource that contribute to its significance or enjoyment are substantially diminished. Substantial impairment occurs when the activities, features, or attributes of the Section 4(f) resource that contribute to its significance or enjoyment are substantially diminished.	No	No
Historic Properties and Cultural Resources	The FAA has not established a significance threshold for Historical and Cultural Resources.	No	No
Energy Supply (Aircraft Fuel)	The FAA has not established a significance threshold for Energy Supply. However, a significant factor to consider is if the action would have the potential to cause demand to exceed available or future (project year) supplies of these resources.	No	No

Table 5-1 Summary of Potential Environmental Impacts

Environmental Impact Category	Threshold of Significance/Factors to Consider	Impact? 2019	Impact? 2024
Environmental Justice	The FAA has not established a significance threshold for Environmental Justice. However, significant factor to consider to determine potential significant impact is if the action would have the potential to lead to a disproportionately high and adverse impact to an environmental justice population, i.e., a low-income or minority population due to significant impacts in other environmental impact categories, and/or causes impacts on the physical or natural environment that affect an environmental justice population in a way that the FAA determines are unique to the environmental justice population and significant to that population	No	No
Visual Effects	The FAA has not established a significance threshold for Visual Resources / Visual Character. Significant factors to consider include potential affect an action has on the nature of the visual character of the area, potential to contrast with the visual resources and/or visual character in the study area, and/or potential to block or obstruct the views of visual resources	No	No

Source: FAA Order 1050.1F, Exhibit 4-1, July 2015.
Prepared By: ATAC Corporation, April 2019.

The following sections describe the impact findings for each environmental resource category, followed by a discussion of potential cumulative impacts. In summary, no significant impacts to any environmental resource category have been identified.

5.1 Noise and Compatible Land Use

This section discusses the analysis of aircraft noise exposure under the Preferred Alternative and the No Action, under both 2019 and 2024 forecast conditions. This discussion includes identifying the differences in noise exposure between the Preferred Alternative and the No Action. This comparison is used to determine if implementing the Preferred Alternative would result in significant noise impacts. Additional information on noise metrics and the basics of noise can be found in **Appendix E**. Detailed information on the noise analysis prepared for the DEN Metroplex Project is included in Appendix I: *Denver Metroplex Aircraft Noise Technical Report*.

5.1.1 Summary of Impacts

Aircraft noise exposure was modeled for both the Preferred Alternative and the No Action under 2019 and 2024 forecast conditions. The noise analysis demonstrates that implementing the Preferred Alternative would not result in a day-night average sound level (DNL) increase of 1.5 dBA or higher in noise- sensitive areas exposed to DNL 65 dB or higher. Therefore, neither the Preferred Alternative nor No Action would result in a significant noise impact.

5.1.2 Methodology

The noise analysis evaluated noise exposure to communities within the General Study Area from aircraft forecasted to be operating under Instrument Flight Rules (IFR) -filed flight plans, at altitudes between ground level up to 10,000 feet above ground level (AGL). IFR-filed aircraft activity was forecasted for the years 2019 and 2024 and used to model conditions under both the Preferred Alternative and the No Action. Noise modeling was conducted using Aviation Environmental Design Tool (AEDT) 2d, the FAA-required noise model for aviation projects, including air traffic changes over large areas and altitudes over 3,000 feet AGL.[60]

If the FAA approves the Preferred Alternative, the agency expects to begin implementation in 2019. Therefore, aircraft noise modeling was conducted for 2019 and five years later (2024), as required by FAA Order 1050.1F. Future year noise exposure levels modeled for the Preferred Alternative and the No Action were compared to determine whether there is a potential for noise impacts. While the overall number and type of aircraft operations will increase between 2019 and 2024, the number and type of aircraft operations are the same under both the Preferred Alternative and No Action in 2019 and 2024. The Preferred Alternative does not include developing or constructing facilities, such as runways or terminal expansions, that would be necessary to accommodate an increase in aviation activity; therefore, no additional growth in operations associated with the Preferred Alternative is anticipated. The noise analysis reflects the change in noise exposure resulting from the proposed changes in aircraft routes (i.e., flight tracks) under the Preferred Alternative compared to the No Action.

Detailed information on IFR-filed aircraft operations within the General Study Area was assembled for input into AEDT, including the following data:

Average Annual Day IFR-Filed Aircraft Flight Schedules: The IFR-filed aircraft flight schedules identify arrival and departure times, aircraft types, and origin/destination information for an average annual day (AAD) in 2019 and in 2024. The AAD represents all the aircraft operations for every day in a study year divided by 365, the number of days in a year. The AAD does not reflect a particular day, but is meant to represent a typical day over a period of a year. The forecast was based on the FAA's 2016 Terminal Area Forecast (TAF),[61] modified for 2019 and 2024 with additional details using previously identified arrival/departure times, aircraft types, and origin/destination information. More detail related to the development of the forecasts is provided in Appendix H: *Denver Metroplex Flight Schedules Technical Report*.

Weather: The AEDT model includes data for multiple meteorological parameters, including temperature, pressure, and humidity. Weather conditions for all Study Airports were defined and used in the noise study. Further discussion on the weather data employed in the AEDT model can be found in Appendix I: *Denver Metroplex Aircraft Noise Technical Report*.

Flight Tracks: The flight tracks used in noise modeling were based on radar data collected for the Existing Conditions (2017) noise analysis and information provided by FAA Air Traffic Control (ATC) personnel. Aircraft routings under both the No Action and Preferred Alternative are depicted on **Exhibit 3-7** through **Exhibit 3-12** in Chapter 3, *Alternatives*. For the Preferred

[60] FAA Order 1050.1F Desk Reference, *Noise and Noise-Compatible Land Use*, Sec. 11.1.3, July 2015.

[61] U.S. Department of Transportation, Federal Aviation Administration, Terminal Area Forecast, 2012 (https://aspm.faa.gov/main/taf.asp; accessed September 2015).

Alternative, flight tracks were developed from the aircraft ATC procedures created by the DEN Metroplex Design & Implementation (D&I) Team using the Terminal Area Route Generation, Evaluation, Traffic and Simulation (TARGETS) program. The majority of the No Action modeled flight tracks are based on the Existing Conditions noise analysis. The remaining No Action flight tracks for amended or new ATC procedures were modeled based on input from the air traffic control experts who developed the ATC procedures. Illustrations depicting Existing Conditions radar tracks and Preferred Alternative ATC procedure designs were developed and shared with the D&I team as part of the consultation process. The consultations were conducted to seek out key model input assumptions such as frequency of Preferred Alternative ATC procedure usage and air traffic control techniques, such as vectoring. The assumptions were then used for refining model track locations, altitude profiles, and utilization.

TARGETS flyability lines, or the lines indicating the actual 3D path of different categories of aircraft ideally flying the ATC procedure for the Preferred Alternative ATC procedures served as the center of the 1 nautical mile and 0.3 nautical mile containment area for RNAVs and RNPs, respectively. The containment area is generally where dispersed tracks are contained, but during the D&I consultation process, air traffic control experts could indicate the need for vectors off of the RNAV with a rejoin of the RNAV at a later point. For those identified cases NIRS model tracks were developed to account for that type of dispersion.

Runway Use: Runway use percentages were identified for all runways at the Study Airports. Forecasted aircraft operations were assigned to particular runways representing operating conditions at the Study Airports under Preferred Alternative and No Action conditions. Runway use patterns did not change under the Preferred Alternative at the Study Airports compared to the No Action.

More detail related to the development of the NIRS model input files is provided in Appendix I: *Denver Metroplex Aircraft Noise Technical Report*.

As discussed in Section 4.3.7.1, the AEDT model was used to compute DNL values for 2019 and 2024 Preferred Alternative and No Action conditions at multiple sets of data points throughout the General Study Area:

- 62,935 2010 Census block centroids;
- 196,197 uniform grid points at 0.5-nautical mile (nm) intervals on a uniform grid covering the General Study Area,
- 64,559 points used to calculate DNL values at potential Department of Transportation Act (DOT), Section 4(f) resources, including 1,686 National Register listed historic Sites; and 7,506 unique points representing other Section 4(f) resources.
- Other unique points evaluated consist of 128 DEN Airport related points representing historic noise monitoring and noise reporting points.

As discussed in Section 4.3.7.1, DNL is the FAA's primary noise metric. **Table 5-2** provides the criteria used to assess the changes in aircraft noise exposure attributable to the Preferred Alternative compared with the No Action. FAA Order 1050.1F defines a significant impact as an increase of DNL 1.5 dB at noise-sensitive land use locations (e.g., residences, schools, etc.) exposed to aircraft noise of DNL 65 dB or higher under the Preferred Alternative. For example, an increase from 63.5 dB to 65 dB is considered a significant impact.

FAA Order 1050.1F also recommends that when there are DNL increases of 1.5 dB or more at noise-sensitive locations in areas exposed to aircraft noise of DNL 65 dB and higher, DNL increases of 3 dB or more in areas exposed to aircraft noise between DNL 60 dB and 65 dB should also be evaluated and disclosed. It is important to note that DNL increases of 3 dB in areas exposed to aircraft noise below DNL 65 dB are not considered "significant impacts" but are to be considered in the environmental evaluation of a proposed project.

FAA Order 1050.1F also stipulates that changes in exposure of DNL 5 dB or greater in areas exposed to aircraft noise between DNL 45 dB and 60 dB should be considered for airspace actions, such as changes to air traffic routes. This threshold was established in 1990, following issuance of an FAA noise screening ATC procedure to evaluate whether certain airspace actions above 3,000 feet AGL might increase DNL levels by 5 dB or more. The FAA prepared this noise-screening ATC procedure because experience indicated that DNL increases 5 dB or more at cumulative levels well below DNL 65 dB could be disturbing to people and become a source of public concern. As shown in **Table 5-2**, a 3 dB increase in areas exposed to DNL 60 to 65 dB and a 5 dB increase in areas exposed to DNL 45 to 60 dB are considered reportable noise increases.

Table 5-2 Criteria for Determining Impact of Changes in Aircraft Noise

DNL Noise Exposure Level	Increase in DNL with Preferred Alternative	Aircraft Noise Exposure Change Consideration
DNL 65 and higher	DNL 1.5 dB or more[1/]	Exceeds Threshold of Significance
DNL 60 to 65	DNL 3.0 dB or more[2/]	Reportable Noise Increase (Considered When Evaluating Air Traffic Actions)
DNL 45 to 60	DNL 5.0 dB or more[3/]	Reportable Noise Increase (Information Disclosed When Evaluating Air Traffic Actions)

Notes:
1/ Source FAA Order 1050.1F Desk Reference, Pg. 11-9; Title 14 C.F.R. Part 150.21 (2) (d); and Federal Interagency Committee on Noise, Federal Agency Review of Selected Airport Noise Issues, August 1992.
2/ Source FAA Order 1050.1F Desk Reference, Pg. 11-9; and Federal Interagency Committee on Noise, Federal Agency Review of Selected Airport Noise Issues, August 1992.
3/ Source FAA, Order 1050.1F Desk Reference, Pg. 11-9.

Source: FAA Order 1050.1F Desk Reference, Ch. 11, *Noise and Noise-Compatible Land Use*, July 2015.
Prepared by: ATAC Corporation, February 2019

5.1.3 Potential Impacts – 2019

Table 5-3 summarizes the results of the noise analysis for 2019 conditions. The results indicate that the Preferred Alternative when compared to the No Action would not result in a DNL 1.5 dB or higher increase in noise in sensitive areas exposed to DNL 65 dB or higher. Furthermore, no population would experience a reportable noise increase in areas exposed to DNL between 60 dB and 65 dB. However, a total of 104 people, associated with four population centroids located west, east, and south of DEN that would experience a DNL 5 dB increase in areas exposed to DNL between 45 dB and 60 dB. These population centroids are located in three general regions: two of the centroids are located approximately 27 nm west of DEN, in unincorporated Jefferson County; one centroid is located approximately 38 NM south of DEN, in unincorporated Elbert County, CO; and the last centroid is located approximately 27 NM east of DEN, in unincorporated Adams County, CO.

The reportable noise increase for the two population centroids west of DEN can be attributed to aircraft operating on the COORZ3 departure procedure in the 2019 No Action Alternative Scenario shifting to COORZ4 in the 2019 Preferred Alternative Scenario. The noise increase to the south of DEN can be attributed to the shifting of traffic from the STAKR3 departure procedure in the 2019 No Action Alternative Scenario to the SLEEK1 procedure in 2019 Preferred Alternative Scenario. Lastly, the noise increase to the east of DEN can be attributed to aircraft operating on the EMMYS5 departure procedure in the 2019 No Action Alternative Scenario shifting to EMMYS6 in the 2019 Preferred Alternative Scenario.

Table 5-3 Change in Potential Population Exposed to Aircraft Noise – 2019

DNL Noise Exposure Level Under the Preferred Alternative	Increase in DNL with the Preferred Alternative	Population Exposed to Noise that Exceeds the Threshold
		Preferred Alternative
DNL 65 and higher	DNL 1.5 dB or greater	0
DNL 60 to 65	DNL 3.0 dB or greater	0
DNL 45 to 60	DNL 5.0 dB or greater	104

Sources: U.S. Census Bureau, 2010 Census (population centroid data), accessed March 2015; ATAC Corporation, April 2019 (AEDT modeling results).
Prepared by: ATAC Corporation, April 2019.

Exhibit 5-1 shows the location of the population centroids that would experience the reportable noise increase under 2019 conditions. Although there is a reportable noise increase in 2019, these results indicate that the Preferred Alternative would not result in a significant noise exposure impact on population exposed to DNL 65 dB or higher levels under the Preferred Alternative. Detailed information on the population centroids can be found in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*.

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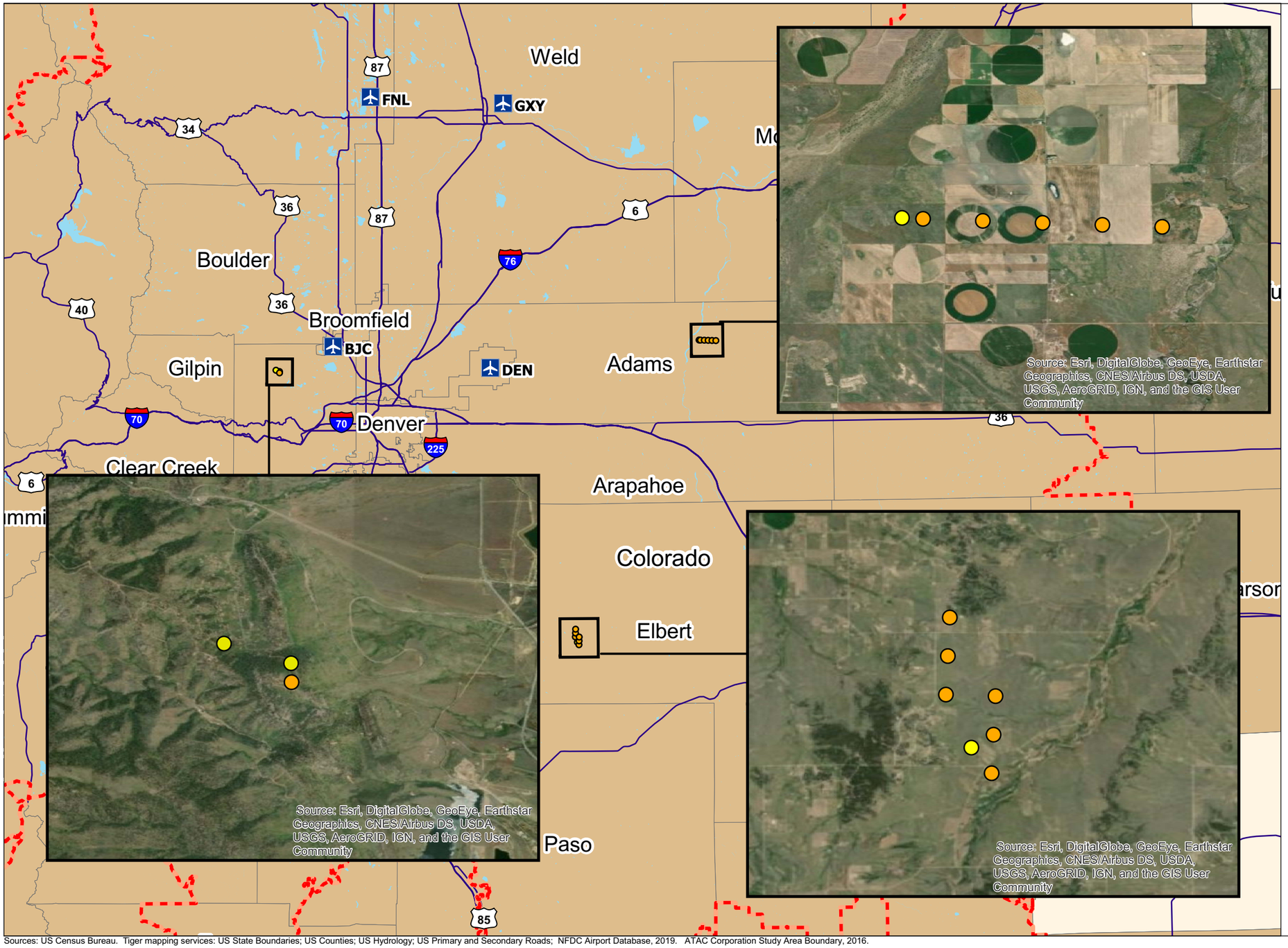

LEGEND

- Census Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- Evenly-Spaced Grid Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- General Study Area Boundary
- Study Airports
- Water
- Highways
- Counties in the General Study Area
- US Counties
- US State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 3.75 7.5 15 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads; NFDC Airport Database, 2019. ATAC Corporation Study Area Boundary, 2016.

Prepared by: ATAC Corporation, April 2019.

Exhibit 5-1

Change in Potential Population Exposed to Aircraft Noise - 2019

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Under the No Action, no changes to air traffic routes in the Denver Metroplex would occur in 2019 and no effects related to changes in aircraft noise exposure would be anticipated.

5.1.4 Potential Impacts – 2024

Potential impacts were also evaluated under 2024 conditions for both the Preferred Alternative and No Action using the same methodology and criteria employed to analyze impacts under 2019 conditions. **Table 5-4** summarizes the results of the noise change analysis prepared for 2024.

The noise analysis results indicate that the Preferred Alternative when compared to the No Action would not result in a DNL 1.5 dBA or higher increase in sensitive areas exposed to DNL 65 dB or higher. In addition, no population would be exposed to reportable noise increases between DNL 60 dB and 65 dB. However, a total of 138 people associated with five population centroids would experience a DNL 5 dB increase in areas exposed to DNL between 45 dB and 60 dB. These population population

are located in three general regions: two of the centroids are located approximately 27 nm west of DEN, in unincorporated Jefferson County; two other centroids are located approximately 38 nm south of DEN, in unincorporated Elbert County, CO; and the last centroid is located approximately 27 nm east of DEN, in unincorporated Adams County, CO.

Table 5-4 Change in Potential Population Exposed to Aircraft Noise – 2024

DNL Noise Exposure Level Under the Preferred Alternative	Increase in DNL with the Preferred Alternative	Population Exposed to Noise that Exceeds the Threshold
		Preferred Alternative
DNL 65 and higher	DNL 1.5 dB or greater	0
DNL 60 to 65	DNL 3.0 dB or greater	0
DNL 45 to 60	DNL 5.0 dB or greater	138

Sources: U.S. Census Bureau, 2010 Census (population centroid data), accessed March 2015; ATAC Corporation, April 2019 (AEDT modeling results).
Prepared by: ATAC Corporation, April 2019.

Exhibit 5-2 shows the location of the population centroids that would experience the reportable noise increase. Although there is a reportable noise increase in 2024, these results indicate that the Preferred Alternative would not result in a significant noise exposure impact on population exposed to DNL 65 dB or higher levels under the Preferred Alternative. Detailed information on the population centroids can be found in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*.

Under the No Action no changes to air traffic routes in the Denver Metroplex would occur in 2024 and no effects related to changes in aircraft noise exposure would be anticipated.

5.1.5 Noise Sensitive Uses and Areas

In addition to disclosing potential noise impacts to residential population, FAA Order 1050.1F requires the FAA to identify and describe noise sensitive uses and areas in the General Study Area. As defined in Paragraph 11-5b(8) of Order 1050.1F, a noise sensitive area is "[a]n area where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas, areas with wilderness characteristics, wildlife refuges, and cultural and historical sites." Potential impacts to residential population are discussed in Sections 5.1.3

and 5.1.4. Potential impacts to recreational areas, areas with wilderness characteristics, wildlife refuges, and cultural and historical sites are discussed in Sections 5.5 and 5.6. Excluding these resources, **Table 4-6** in Chapter 4 lists the locations identified as noise sensitive uses in the General Study Area. The noise analysis results indicate that the Preferred Alternative when compared to the No Action would not result in a DNL 1.5 dBA or higher increase to noise sensitive uses or noise sensitive areas in locations exposed to DNL 65 dB or higher. In addition, these resources would not experience reportable noise increases between DNL 60 dB and 65 dB and DNL 45 and 60 dB.

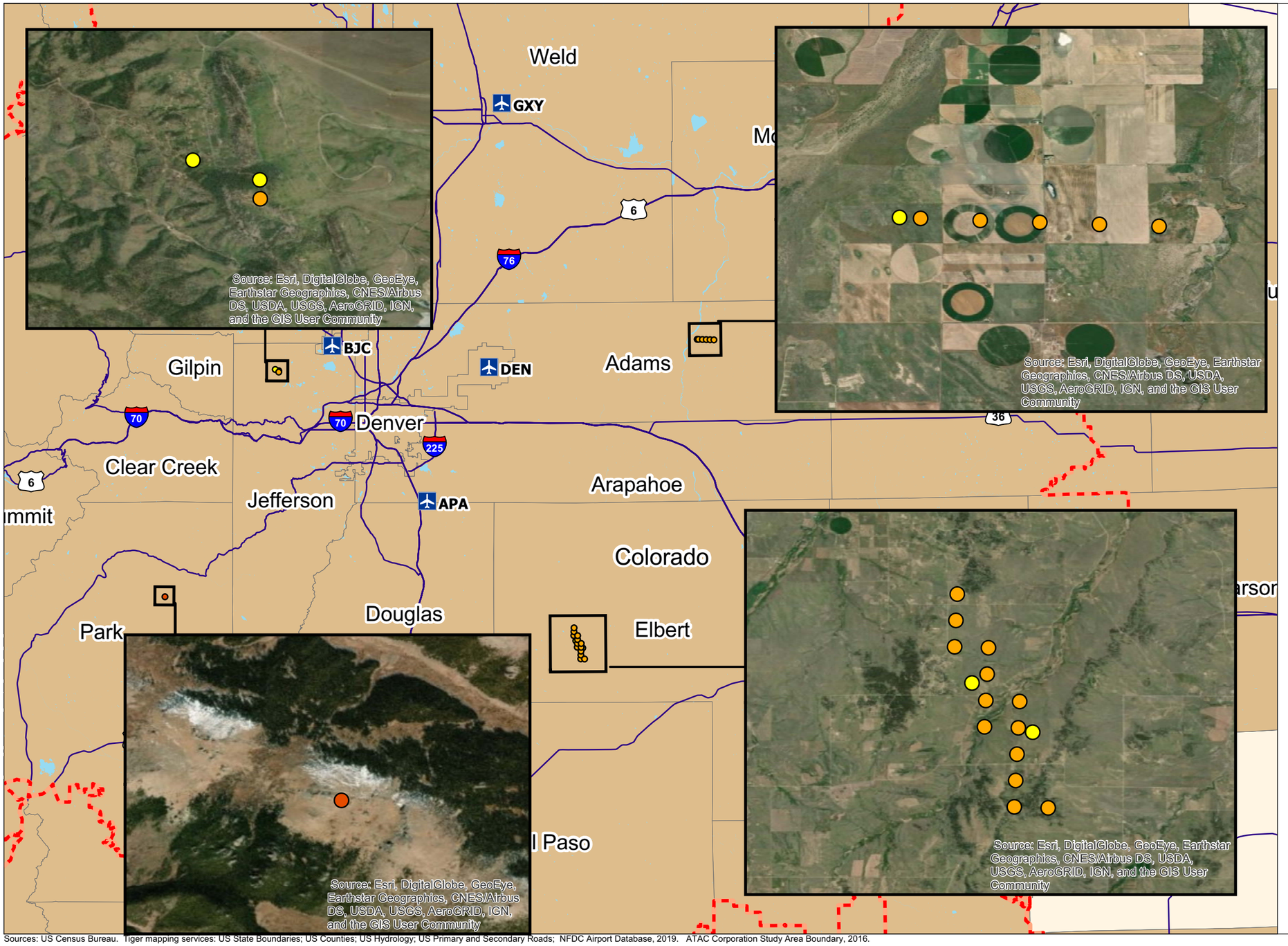
5.1.6 Noise Compatible Land Use

FAA Order 1050.1F requires that EA documents discuss possible conflicts between the proposed action and the objectives of federal, regional, state, local and tribal land use plans, policies and controls for the area concerned. Potential impacts to noise compatible land use were focused on changes in aircraft noise exposure resulting from implementing the Preferred Alternative. FAA Order 1050.1F states, "The compatibility of existing and planned land uses in the vicinity of an airport is usually associated with the extent of the airport's noise impact. If the noise analysis concludes that there is no significant impact, a similar conclusion usually may be drawn with respect to compatible land use." Air traffic actions like the DEN Metroplex Project do not result in direct impacts to land such as ground disturbance. Accordingly, the compatible land use analysis relies on changes in aircraft noise exposure between the Preferred Alternative and the No Action (discussed in Section 5.1) as the basis for determining compatible land use impacts within the General Study Area.

5.1.6.1 Potential Impacts – 2019 and 2024

As stated in Section 5.1, the Preferred Alternative, when compared with the No Action, would not result in changes in aircraft noise exposure in 2019 or 2024 that would exceed the FAA's significance threshold. Likewise, there are no conflicts with federal, regional, state, local land use plans, policies and controls. Therefore, the Preferred Alternative would not result in significant compatible land use impacts.

Under the No Action, there would be no changes to air traffic routing in the General Study Area and no changes in aircraft noise exposure expected to occur in either 2019 or 2024. Therefore, the No Action would not result in significant compatible land use impacts



LEGEND

- Census Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- Section 4(f) Grid Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- Evenly-Spaced Grid Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- General Study Area Boundary
- Study
- Water
- Highways
- Counties in the General Study
- US Counties
- US State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
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N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads; NFDC Airport Database, 2019. ATAC Corporation Study Area Boundary, 2016.

Prepared by: ATAC Corporation, April 2019.

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Exhibit 5-2

Change in Potential Population Exposed to Aircraft Noise - 2024

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5.2 Air Quality

This section discusses the analysis of air quality impacts under the Preferred Alternative and the No Action.

5.2.1 Summary of Impacts

The Preferred Alternative would result in a slight increase in emissions when compared to the No Action. However, changes to flight paths under the Preferred Alternative would occur at or above 3,000 feet AGL and are presumed to conform with the applicable state implementation plans (SIPs). Furthermore, changes to flight paths below the mixing height are also presumed to conform when modifications to ATC procedures are designed to enhance operational airspace efficiency. The slight increase in emissions is expected to have little if any effect on emissions or ground concentrations. Therefore, no significant impacts to air quality would be anticipated.

The No Action would not result in a change in the number of aircraft operations or air traffic routes; therefore, no impacts to air quality would be anticipated.

5.2.2 Methodology

Typically, significant air quality impacts would be identified if an action would result in the exceedance of one or more of the NAAQS for any time period analyzed.[62] Section 176(c) of the *Clean Air Act* requires that federal actions conform to the appropriate SIP in order to attain the air quality goals identified in the CAA. However, a conformity determination is not required if the emissions caused by a federal action would be less than the *de minimis* levels established in regulations issued by EPA.[63] FAA Order 1050.1F provides that further analysis for NEPA purposes is normally not required where emissions do not exceed the EPA's *de minimis* thresholds.[64] The EPA regulations identify certain actions that would not exceed these thresholds, including ATC activities and adoption of approach, departure, and en route ATC procedures for aircraft operations above the mixing height specified in the applicable SIP (or 3,000 feet AGL in places without an established mixing height). In addition, the EPA regulations allow federal agencies to identify specific actions as "presumed to conform" (PTC) to the applicable SIP.[65] In a notice published in the Federal Register, the FAA has identified several actions that "will not exceed the applicable *de minimis* emissions levels" and, therefore, are presumed to conform, including ATC activities and adoption of approach, departure, and en route ATC procedures for air operations.[66] The FAA's PTC notice explains that aircraft emissions above the mixing height do not have an effect on pollution concentrations at ground level. The notice also specifically notes that changes in air traffic ATC procedures above 1,500 feet AGL and below the mixing height "would have little if any effect on emissions and ground concentrations."[67] Furthermore, "air traffic actions below the

[62] FAA Order 1050.1F Desk Reference, Section 1, July 2015.

[63] 40 C.F.R. § 93.153(b).

[64] FAA Order 1050.1F Desk Reference, Section 1, July 2015.

[65] *Id*. at 93.153(f).

[66] Federal Presumed to Conform Actions under General Conformity, 72 Fed. Reg. 41565 (July 30, 2007).

[67] *Id.*

mixing height are also presumed to conform when modifications to routes and ATC procedures are designed to enhance operational efficiency (i.e., to reduce delay)."[68]

5.2.3 Potential Impacts – 2019 and 2024

Under the Preferred Alternative there would be a slight increase in fuel burn (1.83 percent in 2019 and 1.85 percent in 2024) when compared to the No Action. While increased fuel burn corresponds with an increase in emissions, operational changes that could result in an increase in fuel burn would occur at 3,000 feet AGL or above and would not result in an increase in emissions and ground concentrations. Any operational changes that could result in an increase in fuel burn would occur at or above 3,000 feet AGL. Procedures above 3,000 feet AGL are considered a *de minimis* action, would have little if any effect on emissions and ground concentrations, and are presumed to conform to all SIPs for criteria pollutants. Therefore, no further air quality analysis is necessary, a conformity determination is not required, and the Preferred Alternative would not result in a significant impact to air quality. The No Action would not result in a change in the number of aircraft operations or air traffic routes; therefore, no impacts to air quality would be anticipated.

5.3 Wildlife (Avian and Bat Species) and Migratory Birds

This section discusses the analysis of potential impacts to avian and bat species under the Preferred Alternative and the No Action.

5.3.1 Summary of Impacts

The greatest potential for impacts to wildlife species would result from wildlife strikes on avian and bat species at altitudes below 3,000 feet AGL. Changes to flight paths under the Preferred Alternative would primarily occur at or above 3,000 feet AGL. Therefore, the Preferred Alternative would not result in significant impacts to avian and bat species when compared with the No Action.

The No Action would not involve changes to air traffic flows, land acquisition, construction, or other ground disturbance activities. Therefore, the No Action would not result in significant impacts to fish, wildlife, or plants.

5.3.2 Methodology

The FAA's *Wildlife Strike Database*[69] and an accompanying annual wildlife strike compendium[70] is the best information available for assessing potential impacts of aircraft on wildlife. Strike reports over the past 27 years aggregated nationally as well as for individual airports are available from the database and compendium to understand existing conditions. Strike reports are comparable to known information on the presence of specific species of concern to corroborate the reports.

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[68] *Id.*

[69] U.S. Department of Transportation, Federal Aviation Administration, *FAA Wildlife Strike Database* (http://wildlife-mitigation.tc.faa.gov/wildlife/default.aspx) accessed April 2019.

[70] U.S. Department of Transportation, Federal Aviation Administration, and U.S. Department of Agriculture Wildlife Services. *Wildlife Strikes to Civil Aircraft in the United States 1990-2017*. January 2019.

This analysis involved a review of wildlife strike reports[71] for the Study Airports under both the Preferred Alternative and the No Action, and an evaluation of the potential for the presence of federal- and state-listed threatened and endangered species (i.e., special-status species) within the General Study Area. The FAA compared modifications in flight ATC procedures to the occurrence of special-status species to qualitatively assess the likelihood of whether wildlife strikes might change under the Preferred Alternative.

5.3.3 Potential Impacts – 2019 and 2024

A significant impact would be likely to occur if the Preferred Alternative were to jeopardize the existence of special-status species or result in destroying or adversely modifying critical habitat in the General Study Area. Changes to flight paths under the Preferred Alternative would primarily occur at or above 3,000 feet AGL, so there is no potential for these effects in the General Study Area. Accordingly, the analysis is focused on the potential for significant impacts to species resulting from increased wildlife strikes with aircraft.

Since 1990, the FAA has compiled pilot and airport reports of wildlife strikes with aircraft. Between the most recent comprehensive reporting period of 1990 and 2017, 197,833 wildlife strikes were reported nationally.[72] Of the records that identify the type of animal involved in the strike incident, birds represent 95.0 percent of all strikes.[73] Of those records, for commercial and GA aircraft, 71 and 73 percent of the bird strikes, respectively, occurred at or below 500 feet AGL and declined by 34 percent for every 1,000-foot gain in height for commercial aircraft and 44 percent for GA aircraft. The Wildlife Strike Database reports that of identified species, waterfowl, gulls, and raptors are the species groups of birds with the most damaging strikes.[74]

Table 5-5 provides a summary of wildlife strikes reported for the Study Airports between January 1, 1990 and April 14, 2019. In total, 7,011 reported strikes (97.78 percent of all strike records) occurred at altitudes below 3,000 feet AGL. A total of 4,676 strikes reported below 3,000 feet AGL at the Study Airports included species identification.

The *Migratory Bird Treaty Act (MBTA) of 1918* (16 U.S.C. §§ 703–712) protects all the bird species identified in these reports. Furthermore, federal and state laws protect listed endangered and threatened species. In Chapter 4, **Table 4-3** identifies the federally-listed bird species believed to occur or known to occur in counties in the General Study Area. None of the bird strike reports at the Study Airports included the species listed in **Table 4-3**.

The number of aircraft operations under the Preferred Alternative and No Action would be the same. Therefore, the assessment of the potential impacts focuses on changes to flight paths and the potential for impact due to wildlife strikes. As shown in **Table 5-5**, only 2.22 percent of bird/bat strikes (159 of 7,170 total records) occurred at altitudes above 3,000 feet AGL. The substantial decline in the number of strikes reported above 3,000 feet AGL indicates that there is less likelihood of bird/bat strikes at these altitudes. Under the Preferred Alternative, changes to proposed flight paths would primarily occur at or above 3,000 feet AGL and no

71 U.S. Department of Transportation, Federal Aviation Administration, *FAA Wildlife Strike Database* (http://wildlife-mitigation.tc.faa.gov/wildlife/default.aspx) accessed April 2019.

72 U.S. Department of Transportation, Federal Aviation Administration, and U.S. Department of Agriculture Wildlife Services. *Wildlife Strikes to Civil Aircraft in the United States 1990-2017*. January 2019.

73 *Id.*

74 *Id.*

significant changes to arrival and departure corridors below 3,000 feet AGL would be expected. Therefore, no significant impacts to bird or bat species would be anticipated.

The No Action would not involve changes to air traffic flows, land acquisition, construction, or other ground disturbance activities. Therefore, no impacts to avian and bat species would occur.

Table 5-5 FAA Wildlife Strike Database Records for Study Airports by Altitude (1990 – 2019)

Type of Strike	Airport	3,000 ft. AGL or less	>3,000 ft. AGL to ≤ 10,000 ft. AGL	Greater than 10,000 ft. AGL	Total
Identified Bird and Bat Species	APA	230	2	0	232
	BJC	181	0	0	181
	DEN	4,225	16	3	4,244
	FNL	27	0	0	27
	GXY	13	1	0	14
Total		4,676	19	3	4,698
Unknown Bird and Bat Species	APA	75	6	0	81
	BJC	29	3	0	32
	DEN	2,219	100	27	2,346
	FNL	8	0	0	8
	GXY	4	1	0	5
Total		2,335	110	27	2,472
Grand Total		7,011	129	30	7,170
Percentage		97.78%	1.80%	0.42%	100%

APA – Centennial Airport *BJC – Rocky Mountain Metropolitan Airport* *DEN – Denver International Airport*
FNL – Northern Colorado Regional Airport *GXY – Greeley-Weld County Airport*

NOTE: DEN totals only include the current airport location beginning February 28, 1995 and exclude the former Stapleton International Airport (also having used the "DEN" Identifier) location results that ended February 27, 1995.
NOTE: Unknown altitudes (left blank in database) were assumed at or below 3,000 feet AGL except where relevant data indicated otherwise.
NOTE: Terrestrial mammals and reptiles were excluded from the above counts where reported.

Source: U.S. Department of Transportation, Federal Aviation Administration, *FAA Wildlife Strike Database* (http://wildlife-mitigation.tc.faa.gov/wildlife/default.aspx) accessed April 2019.
Prepared by: ATAC Corporation, April 2019.

5.4 Climate

This section discusses greenhouse gas (GHG) emissions and effects to the climate as they relate to the Preferred Alternative and the No Action.

5.4.1 Summary of Impacts

Although fuel burn would increase slightly under the Preferred Alternative as compared to the No Action, no significant impacts to the climate would be anticipated.

The No Action would not result in a change in the number of aircraft operations or air traffic routes; therefore, no impacts to climate would be anticipated.

5.4.2 Methodology

In accordance with FAA guidance, estimated CO_2 emissions were calculated from the amount of fuel burned under the No Action and the Preferred Alternative in 2019 and 2024 (see Section 5.7). The resulting CO_2 emissions were then reported as CO_2e.

5.4.3 Potential Impacts – 2019 and 2024

Table 5-6 shows project-related CO_2e emissions. In 2019, the Preferred Alternative would produce approximately 3,862.52 MT of CO2e and the No Action would produce approximately 3,793.19 MT of CO2e. This represents a slight increase of approximately 69.32 MT of CO2e or 1.83% percent under the Preferred Alternative when compared to the No Action. The 2024 Preferred Alternative amount of 4,373.23 MT would compromise less than .000000829 percent of U.S.-based greenhouse gas emissions as reported for 2017.[75] Similarly, in 2024, the No Action would produce approximately 4,293.73 MT of CO2e and the Preferred Alternative would produce approximately 4,373.23 MT of CO2e. This represents a slight increase of approximately 79.5 MT of CO2e or 1.85% percent under the Preferred Alternative when compared to the No Action. This would compromise less than .000000829 percent of U.S.-based greenhouse gas emissions as reported for 2017.

Table 5-6 CO_2e Emissions – 2019 and 2024

	2019		2024	
	No Action	**Preferred Alternative**	**No Action**	**Preferred Alternative**
CO_2e Emissions (MT)	3,793.19	3,862.52	4,293.73	4,373.23
Volume Change (MT)		69.32		79.5
(Preferred Alternative – No Action)		1.83%		1.85%

Note: CO_2e = Carbon Dioxide Equivalent

Source: ATAC Corporation, April 2019 (AEDT modeling results).
Prepared by: ATAC Corporation, April 2019.

5.5 Department of Transportation Act, Section 4(f) Resources

This section discusses potential impacts to Department of Transportation (DOT) Act, Section 4(f) Resources. **Exhibit 4-2** depicts Section 4(f) resources within the General Study Area as described in Section 4.3.4.

5.5.1 Summary of Impacts

Evaluating potential impacts to Section 4(f) resources focuses on changes in aircraft noise exposure resulting from implementing the Preferred Alternative. The FAA's aircraft noise exposure analysis indicates that the Preferred Alternative would not substantially change the noise environment at any Section 4(f) resource identified within the General Study Area when compared with the No Action. Furthermore, any changes in aircraft traffic patterns would occur at altitudes and distances from viewers that would not substantially impair the view or setting of Section 4(f) resources. Therefore, no constructive use of a Section 4(f) resource associated with the Preferred Alternative would occur and no impacts would be anticipated.

[75] U.S. Environmental Protection Agency (EPA), *Fast Facts 1990-2017 National Level U.S. Greenhouse Gas Inventory*. April 2019.

Under the No Action, no changes in air traffic routes in the General Study Area would occur. Therefore, no changes to aircraft noise exposure or aircraft overflight patterns would occur over Section 4(f) resources and no impacts would be anticipated.

5.5.2 Methodology

The FAA evaluates potential effects on Section 4(f) resources in terms of both direct impacts (i.e., physical use) and indirect impacts (i.e., constructive use). A direct impact would occur as a result of land acquisition, construction, or other ground disturbance activities that would result in physical use of all or a portion of a Section 4(f) property. As land acquisition, construction, or other ground disturbance activities would not occur under either the Preferred Alternative or the No Action, neither Alternative would have the potential to cause a direct impact to a Section 4(f) resource. Therefore, analysis of potential impacts to Section 4(f) resources is limited to identifying indirect impacts resulting from constructive use. A constructive use of a Section 4(f) resource would occur if there were a substantial impairment of the resource to the degree that the activities, features, or attributes of the site that contribute to its significance or enjoyment are substantially diminished. This could occur as a result of both visual and noise impacts. Concerning aircraft noise, a constructive use would occur if noise levels substantially impair the resource. Refer to Section 5.9, Visual Impacts, regarding potential visual impacts within the General Study Area.

Noise exposure levels were calculated for grid points placed at Section 4(f) properties. A list of the resources evaluated is provided in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*. The analysis of potential impacts to Section 4(f) resources considered whether these properties would experience a significant noise increase, when comparing the Preferred Alternative with the No Action, using the applicable thresholds shown in **Table 5-2**.

FAA Order 1050.1F identifies additional factors in deciding whether to apply the thresholds listed above to determine the significance of noise impacts on Section 4(f) resources. If a reportable noise increase were to occur, the Section 4(f) properties would be evaluated further to determine if the project-related effects would constitute a constructive use. Further evaluation can include identifying the specific attributes for which the property is managed (e.g., for traditional recreational uses or where other noise is very low and a quiet setting is a generally recognized purpose and attribute).

In cases where Land and Water Conservation Fund Act (LWCF)[76] resources are "used" by a transportation project, FAA Order 1050.1F stipulates that replacement satisfactory to the Secretary of the Interior is required for recreation lands aided by the Department of Interior's LWCF. Therefore, these resources are considered as part of the Section 4(f) impact analysis process.

5.5.3 Potential Impacts – 2019 and 2024

As stated in Section 5.1, the Preferred Alternative, when compared with the No Action, would not result in changes in aircraft noise exposure in 2019 or 2024 that would exceed the FAA's significance threshold. Noise analysis results for Section 4(f) properties located within the General Study Area can be found in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*. As stated in Section 5.9, the Preferred Alternative, when compared with the No Action, would not cause a significant visual impact in 2019 or 2024. Any changes in aircraft

[76] 16 U.S.C. §§ 460l-4, et seq.

traffic patterns would occur at altitudes and distances from viewers that would not substantially impair the view or setting of the Section 4(f) resources. Therefore, the Preferred Alternative would not result in potential impacts to Section 4(f) resources from a visual impact perspective.

For the 4(f), Historic, and Cultural Resource areas in 2019, the Preferred Alternative would not result in a DNL 1.5 dB increase or decrease in areas exposed to DNL of 65 dB and higher, nor would it result in a reportable noise increase or decrease of DNL 3.0 dB in areas exposed to DNL 60 dB to 65 dB compared with the 2019 No Action. Additionally, the Preferred Alternative would not result in a DNL 5 dB increase or decrease in areas exposed to DNL between 45 dB and 60 dB compared with the 2019 No Action.

For the 4(f), Historic, and Cultural Resources areas in 2024, the Preferred Alternative would not result in a DNL 1.5 dB increase or decrease in areas exposed to DNL of 65 dB and higher, nor would it result in a reportable noise increase or decrease of DNL 3.0 dB in areas exposed to DNL 60 dB to 65 dB compared with the 2019 No Action. However, one 4(f) point would experience a DNL 5 dB increase in areas exposed to DNL between 45 dB and 60 dB (a reportable increase in noise).

The single reportable 4(f) point is located in the Kenosha Mountains on a ridgeline south of Shawnee Peak at approximately 12,000 feet MSL. This location has been and remains the primary southwest arrival gate, or corner post, for the DEN arrivals and arrivals to all airports using the en route transition to Denver TRACON arrival procedures through this southwest arrival gate. Radar track data analysis from the existing condition data (2017) and additional radar track analysis indicated aircraft have been present over this point historically since the opening of the DEN airport. From an air traffic perspective, the point is just outside the Denver TRACON boundary, between the SSKII and BGDEE fixes on the Preferred Alternative SSKII1 procedure. From a geographic perspective, the point is approximately 6.5 statute miles west-southwest of Bailey, Colorado and 4.1 statute miles south-southwest of Shawnee, Colorado and is contained in the Pike National Forest, also within the Lost Creek Wilderness Area. The reportable 4(f) point is 1.5 statute miles north of vehicle accessible and travelled County Road 56, also known as Lost Park Road that leads to the Lost Creek Campground. The reportable 4(f) point is bound on the north by the Craig Park/Craig Creek (hiking/biking) Trail, on the south by the Colorado (hiking/biking) Trail, the Ben Tyler (hiking/biking) Trail on the west, and the Brookside McCurdy (hiking/biking) Trail on the east.

The Lost Creek Wilderness Area[77] was designated a wilderness area on December 22, 1980. The Congressional “Wilderness Area” designation carries the expectation that human activities are restricted to scientific study and non-mechanized recreation; horses are permitted but motorized vehicles and equipment are not. Despite this Congressional Wilderness area designation, recent and historic aircraft overflight activity have occurred in a similar fashion to the Preferred Alternative over this Wilderness area since at least 1995 and potentially as far back as the mid 1950’s.

[77] In 1963, the 15,120 acre Lost Creek Scenic Area was created under the precursor of the Wilderness Act, the "U-Regulations" of 1939. In 1966, the Scenic Area was also designated a National Natural Landmark. During the first U.S. Forest Service RARE process, Lost Creek received more comments recommending its wilderness designation than any other Colorado area. In 1980 the 105,000 acre Lost Creek Wilderness was created under the Colorado Wilderness Act of 1980. Approximately 14,700 additional acres were later added to the west end of the Wilderness under the Colorado Wilderness Act of 1993. https://www.wilderness.net/printFactSheet.cfm?WID=331 accessed April 2019.

The reportable noise increase in the 2024 Preferred Alternative can be attributed to aircraft operating on the TELLR2 and CREDE3 arrival procedures in the 2024 No Action shifting to SSKII1 in the 2024 Preferred Alternative. In the 2024 No Action, there were 37,168 (approximately 102 flights per day) DEN arrival operations using this southwest arrival gate of which 36,315 (97.7%, approximately 99 flights per day) are within ±1.5 nautical miles of the Preferred Alternative procedure (SSKII1) center-line. Flights range from 15,500 feet MSL (3,500' feet AGL) to 22,000 feet (10,000 feet AGL) in this region. In the 2024 Preferred Alternative, there were 37,255 (approximately 102 flights per day) DEN arrival operations using this southwest arrival gate of which 36,535 (98.0% or approximately 100 flights per day) are within ±1.5Nm of the Preferred Alternative (SSKII1) procedure center-line. Flights also range from 15,500 feet MSL (3,500 feet AGL) to 22,000 feet MSL (10,000 feet AGL) in this region. The FAA Aeronautics Information Manual (AIM) specifies a minimum altitude of "…2,000 feet above the surface…" for "…Wilderness…" properties[78] and is reiterated in FAA Advisory Circular 91-36D for Visual Flight Rules (VFR) flights.[79] The aircraft altitudes are historically and proposed at approximately 3,500 feet AGL or greater for the general area of the reported 4(f) point. The basis for this occurrence is the PFD in the Preferred Alternative moved the CREDE waypoint on CREDE3 STAR 0.743 nautical miles to the northwest (on a heading 339) to become the SSKII waypoint on the Preferred Alternative SSKII1 STAR.

Although this would result in a reportable aircraft noise exposure DNL 5 dB increase in areas exposed to DNL between 45 dB and 60 dB, the project does not physically incorporate the resource nor is it close enough, frequent enough, or of a severity to impact important features, activities, or attributes associated with it, or to substantially impair it. Due to the historic presence of aircraft in this vicinity, no impairment to the view or setting of Section 4(f) resources would be anticipated. Therefore, the Preferred Alternative would not result in potential impacts to Section 4(f) resources.

5.6 Historic and Cultural Resources

This section discusses the analysis of impacts to historic properties under the Preferred Alternative and the No Action. Section 4.3.5 provides information on historic properties within the General Study Area. The FAA initiated consultation with the State Historic Preservation Officer (SHPOs) for the State of Colorado on April 9, 2019, in accordance with Section 106 of the *National Historic Preservation Act of 1966* (16 U.S.C. § 470 *et seq*.) and the implementing regulations at 36 C.F.R. Part 800. Although there are no on-tribal or off-tribal[80] lands located within the General Study Area based on readily available data and there are no historically recognized lands within the General Study Area, Tribal Historic Preservation Officers (THPOs) were contacted as part of the Section 106 process as a means of initiating government to government consultation regarding any concerns that uniquely or significantly affect Tribal interests related to the DEN Metroplex Project.

[78] U.S. Department of Transportation. Federal Aviation Administration. Airman Information Manual, Section 4.7-4-6b Flights Over Charted U.S. Wildlife Refuges, Parks, and Forest Service Areas.

[79] US Department of Transportation. Federal Aviation Administration. Advisory Circular 91-36D. *Visual Flight Rules (VFR) Near Noise Sensitive Areas*. September 17, 2004.

[80] "Off-Tribal" lands may include Protected Tribal Resources or Native American sacred sites.

5.6.1 Summary of Impacts

The aircraft noise exposure analysis indicates that there would be no significant impact to the noise environment at any historic properties under the Preferred Alternative compared with the No Action. The aircraft noise exposure analysis indicates there would be reportable noise increases (see **Table 5-3 and Table 5-4**) in the unincorporated Elbert County, unincorporated Adams County, and unincorporated Jefferson County areas (south, east, and west of DEN, respectively) of the General Study Area. Changes in historic and current aircraft traffic patterns would occur at altitudes and distances from viewers that would not substantially impair the view or setting of historic properties or those properties potentially eligible for NRHP listing. The Preferred Alternative would not directly or indirectly change the characteristics qualifying or potentially qualifying a historic resource for inclusion in or its eligibility for the NRHP. Therefore, no adverse effects to historic properties under the Preferred Alternative would be anticipated for 2019 or 2024.

Under the No Action, no changes to air traffic routes in the DEN Metroplex would occur in either 2019 or 2024 and no changes to aircraft noise exposure or changes in aircraft overflight patterns over historic properties would be anticipated. Therefore, no historic properties would be affected by aircraft noise, nor would there be any visual impacts at historic properties under the No Action.

5.6.2 Methodology

The *National Historic Preservation Act of 1966* requires the FAA to consider the effects of its undertakings on properties listed or eligible for listing in the National Register of Historic Places (i.e., National Register). In assessing whether an undertaking, such as the Preferred Alternative, affects a property listed or eligible for listing on the National Register, FAA must consider both direct and indirect effects. An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

Federal regulations define an area of potential effect (APE) as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.[81] Direct effects generally occur at the time and place of the proposed action. An APE has been defined for the DEN Metroplex Project to assess the potential direct and indirect effects of the Preferred Alternative on historic properties.

For purposes of this analysis, the APE is the same geographic area and boundary as the General Study Area. **Exhibit 4-3** in Section 4.3.4 shows analysis points for cultural and historic properties listed and eligible for listing on the National Register that are found within the General Study Area. These analysis points are combined with the 4(f) resource points on **Exhibit 4-3**.

All historic properties identified within the APE require further evaluation by the FAA to determine if the property may experience a potential adverse effect. Therefore, noise exposure levels at points representing historic properties listed on the National Register were

[81] 36 CFR 800.16(d)

calculated for purposes of determining potential adverse effects. A list of the resources evaluated is provided in **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report*. In addition, noise exposure results for the uniform grid points (located at 0.5 nm intervals throughout the General Study Area) were evaluated to identify potential adverse effects to historic properties that are eligible but may not be listed on the National Register. If a significant or reportable noise increase were identified at one of these grid points, the surrounding area would be examined for the presence of eligible-to-be-listed historic properties. **Table 5-7** shows those properties identified as greater than 50 years of age via the respective County building records in the immediate vicinity of reportable noise points derived from the EA noise analysis.

Table 5-7 Reportable Noise for Potentially Eligible Structures by Location

Address	City	State	Zipcode	Year Built	Reportable Noise Increase in Immediate Vicinity?
12796 County Rd. 118	Kiowa	CO	80117	1923	40.17dBA to 45.32dBA = +5.16dBA
12400 Price Rd.	Byers	CO	80103	1932	45.08dBA to 50.14dBA = +5.05dBA
12400 Price Rd.	Byers	CO	80103	1933	45.08dBA to 50.14dBA = +5.05dBA

Source: Adams County Assessor, http://gisapp.adcogov.org/quicksearch/ Accessed April, 2019. Elbert County Assessor, http://services.elbertcounty-co.gov/assessor/taxweb/search.jsp Accessed April, 2019
Prepared by: ATAC Corporation, April 2019.

The analysis of potential impacts to historic properties considers whether these properties would experience a significant noise increase, when comparing the Preferred Alternative with the No Action, using the applicable thresholds shown in **Table 5-2**. Properties exposed to DNL 65 dB or higher under the Preferred Alternative and an increase of DNL 1.5 dB or higher may be considered to be potentially adversely effected by the project. Reportable increases in noise were detected for properties potentially eligible for NRHP listing (based on an age of 50 years or greater) and exposed to DNL between DNL 45 dB and lower than 65 dB, thus the FAA considered further whether the increase would result in an adverse effect on properties over 50 years in age. The noise analysis indicated a reportable change for two properties consisting of three structure greater than 50 years of age and thus potentially eligible for NRHP listing. Aircraft overflight and visual presence have been documented in the General Study Area since approximately 1956. Historic jet traffic from military and civilian sources in the Denver area have served the region and exposed properties to jet aircraft overflight including the Elbert, Jefferson, and Adams County areas since the mid-1950s. Further research on the subject properties determined the reportable increase would not diminish the integrity of the applicable property's setting for which the setting potentially contributes to historical or cultural significance.

5.6.3 Potential Impacts – 2019 and 2024

As stated in Section 5.1, when compared with the No Action, the Preferred Alternative would not result in changes in aircraft noise exposure in 2019 or 2024 that would exceed FAA's significance threshold for noise. While reportable noise increases to residential population were identified, none of these increases occur at NRHP listed historic properties. The three structures in the immediate vicinity of the reportable noise increases would experience no

effect in their continuing potential eligibility for NRHP listing from implementation of the Preferred Alternative due to the historic and continuing overflight presence since the mid-1950s. Therefore, the Preferred Alternative would not result in an adverse effect to historic properties. Noise analysis results for historic properties located within the General Study Area can be found in the **Appendix I**: *Denver Metroplex Aircraft Noise Technical Report.*

Under the No Action no changes to air traffic routes in the Denver Metroplex would occur in either 2019 or 2024 and no adverse effects related to changes in aircraft noise exposure would be anticipated. Therefore, the No Action would not result in impacts to historic or cultural resources.

5.7 Energy Supply (Aircraft Fuel)

This section discusses whether changes in the movement of aircraft would result in measurable effects on local energy supplies under the Preferred Alternative and the No Action.

5.7.1 Summary of Impacts

In comparison to the No Action, the Preferred Alternative would result in a relatively small increase in aircraft fuel burned: 1.83 percent increase in 2019 and 1.85 percent increase in 2024. These increases would not be expected to affect local aircraft fuel supplies. Therefore, no significant impacts to energy supply would be anticipated.

The No Action would not involve changes to air traffic flows, construction, or other ground disturbance activities. Therefore, the No Action would not result in the depletion of local energy supply.

5.7.2 Methodology

The Preferred Alternative would not change the number of aircraft operations relative to the No Action, but it would involve changes to air traffic flows during the departure, descent, and approach phases of flight. These changes affect both the route an aircraft may follow as well as its climb-out and descent profiles. This in turn may directly affect aircraft fuel burn (or fuel expended). Aircraft fuel burn is considered a proxy for determining whether the Preferred Alternative would have a measurable effect on local energy supplies when compared with the No Action.

In addition to calculating aircraft noise exposure, the FAA's AEDT model calculates aircraft-related fuel burn (e.g., AAD flight schedules, flight tracks, and runway use). See Section 5.1.2 for further discussion on AEDT input data. Determining the difference in fuel burn between Alternatives can be used as an indicator of changes in fuel consumption resulting from implementation of the Preferred Alternative when compared with the No Action.

5.7.3 Potential Impacts – 2019 and 2024

Table 5-8 presents the results of the fuel burn analysis for the Preferred Alternative and No Action. In comparison to the No Action, the Preferred Alternative would result in approximately 22 metric tons (MT) more fuel burned in 2019 (1.83% percent increase) and approximately 25 MT more fuel burned in 2024 (1.85% percent increase). Given these relatively small increases, the FAA expects that when compared with the No Action, the Preferred Alternative

would not adversely affect local fuel supplies. Therefore, no significant impacts to energy supply would be anticipated.

Table 5-8 Energy Consumption Comparison

	2019		2024	
	No Action	**Preferred Alternative**	**No Action**	**Preferred Alternative**
Fuel Burn (MT)	1,207.04	1,229.10	1,366.32	1,391.62
Volume Change (MT) (Preferred Alternative – No Action)		22.06		25.3
Percent Change from No Action		1.83%		1.85%

Note: MT = Metric Ton

Source: ATAC Corporation, April 2019 (AEDT modeling results).
Prepared by: ATAC Corporation, April 2019.

5.8 Environmental Justice

This section presents a summary of the analysis of environmental justice impacts under the Preferred Alternative and the No Action.

5.8.1 Summary of Impacts

Neither the Preferred Alternative nor the No Action would displace people or businesses; therefore, implementing the Preferred Alternative or No Action would not result in direct impacts in this category. No areas within the General Study Area would experience significant impacts to air quality or noise. While some areas would be exposed to reportable noise increases of DNL 5 dB within areas exposed to DNL 45 to 60 dB, these would not constitute a significant impact related to a change in DNL exposure to people, including members of minority and/or low-income populations (see Section 5.1 and Section 5.8). Therefore, no disproportionately high and adverse effects to minority populations or low-income populations would occur under either the Preferred Alternative or the No Action.

5.8.2 Methodology

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that federal agencies include environmental justice as part of their mission by identifying and addressing as appropriate, the potential for disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. Environmental justice applies to all environmental resources. Therefore, a disproportionately high and adverse human health or environmental effect on minority and low-income populations may represent a significant impact.

5.8.3 Potential Impacts – 2019 and 2024

Under the Preferred Alternative, neither people nor businesses would be displaced. As discussed in Section 5.1, under the Preferred Alternative, no census block centroids in the General Study Area would experience a significant noise impact in either 2019 or 2024. The Preferred Alternative would not have the potential to lead to a disproportionately high and adverse impact to an environmental justice population, i.e., a low-income or minority

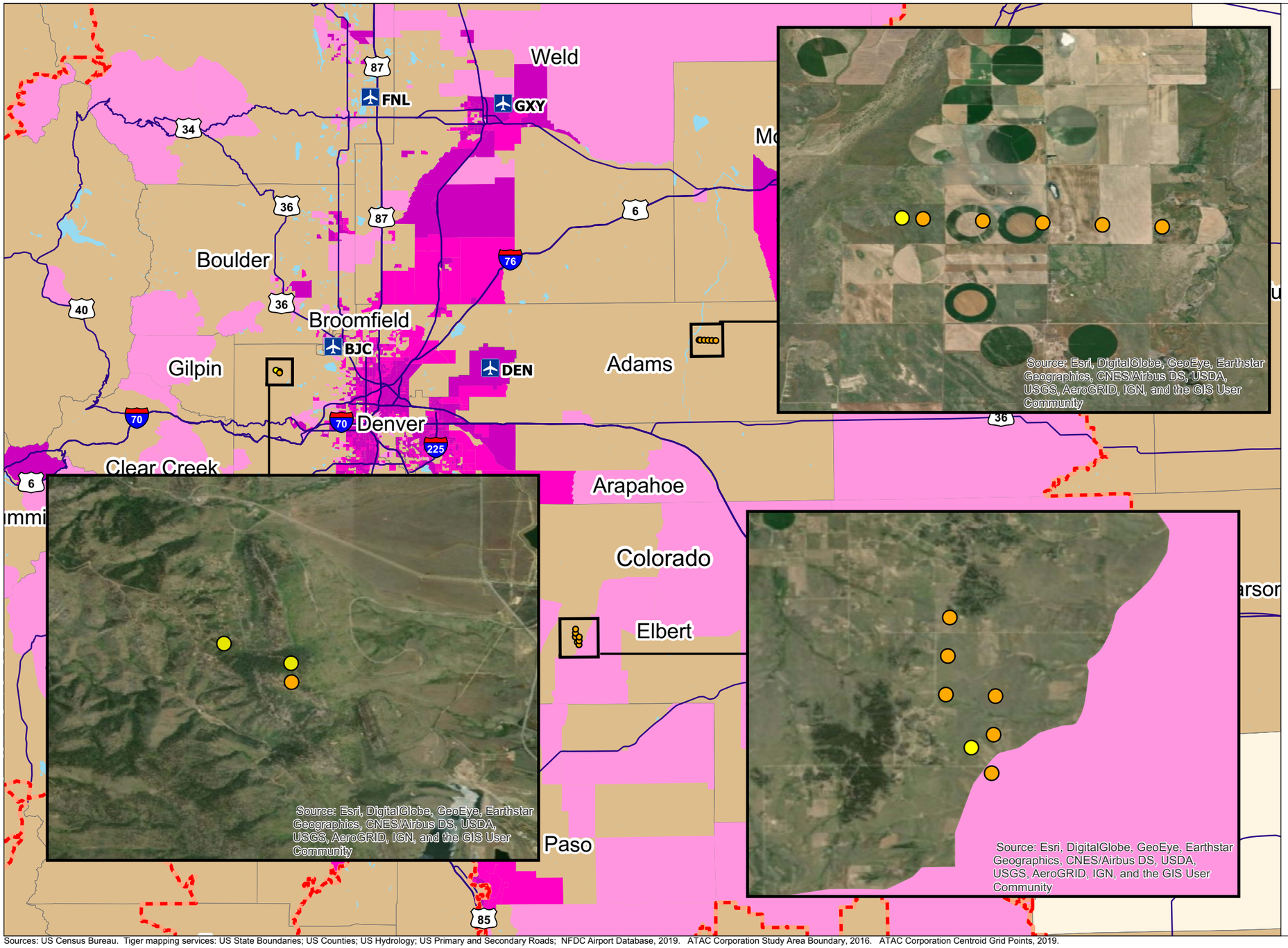
population, due to an absence of significant impacts in other environmental impact categories; and a lack of significant impacts on the physical or natural environment that affect an environmental justice population in a way that the FAA has determined are unique to the environmental justice population and significant to that population. Under 2019 conditions, there are no population centroids (thus representing zero persons) located in areas identified as environmental justice communities that experience reportable noise increases of DNL 5 dB in areas exposed to DNL 45 to 60 dB. One 0.5nm grid point is on the edge of an area identified as an environmental justice community that experience reportable noise increases of DNL 5 dB in areas exposed to DNL 45 to 60 dB. The 0.5nm grid point affected by reportable noise is depicted in **Exhibit 5-3**.

At the location of the 2019 0.5nm grid point experiencing a reportable noise increase located in the area of Environmental Justice, two ranch/farm residences with multiple outbuildings are located in the immediate vicinity. One ranch/farm residence is immediately north of the 0.5nm grid point, and the second ranch/farm residence is immediately south of the 0.5nm grid point for a total of two ranch/farm residences in the immediate vicinity. A total of 9,623 housing units are reported in Elbert County as of 2017.[82] The two ranch/farm residences in the immediate vicinity of the 0.5nm grid point for reportable noise represent .021% of the total residences in Elbert County and thus do not represent a disproportionately high number of total residences affected by reportable noise exposure.

Under 2024 conditions, there is one population centroid representing 34 persons and eight 0.5nm grid points located in areas identified as environmental justice communities that experience reportable noise increases of DNL 5 dB in areas exposed to DNL 45 to 60 dB. This census centroid and the 0.5nm grid points are depicted in **Exhibit 5-4**. Approximately 3,917,842 persons reside in the General Study Area and of this total, one census centroid located in Elbert County represents .000087% of the total noise exposed population are exposed to a reportable noise increase. The reportable noise does not represent significant noise impacts, nor do they reflect disproportionately high or adverse impacts to minority or low-income communities relative to the General Study Area or Elbert County as whole. Therefore, no adverse direct or indirect effects would occur to any environmental justice populations within the General Study Area under the Preferred Alternative for 2019 and 2024.

Under the No Action, neither people nor businesses would be displaced. Furthermore, air traffic routes would not change and there would be no change in aircraft noise exposure in 2019 or 2024 that could result in an indirect impact. Therefore, the No Action would not result in disproportionately high and adverse human health or environmental effects on minority and low-income populations.

82 U.S. Census Bureau. *Quick Facts Elbert County, Colorado v2017*. https://www.census.gov/quickfacts/fact/table/elbertcountycolorado/AFN120212. Accessed April 2019.



LEGEND

- Census Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- Evenly-Spaced Grid Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- General Study Area
- Study
- Water

Areas of Environmental Justice Concern

- Low Income Population
- Minority Population
- Low Income/Minority Population
- Highways
- Counties in the General Study
- US Counties
- US State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 0.35 0.7 1.4 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads; NFDC Airport Database, 2019. ATAC Corporation Study Area Boundary, 2016. ATAC Corporation Centroid Grid Points, 2019.

Prepared by: ATAC Corporation, April 2019.

Exhibit 5-3

DEN METROPLEX EA

Change in Potential Population Exposed to Aircraft Noise in Environmental Justice Areas - 2019

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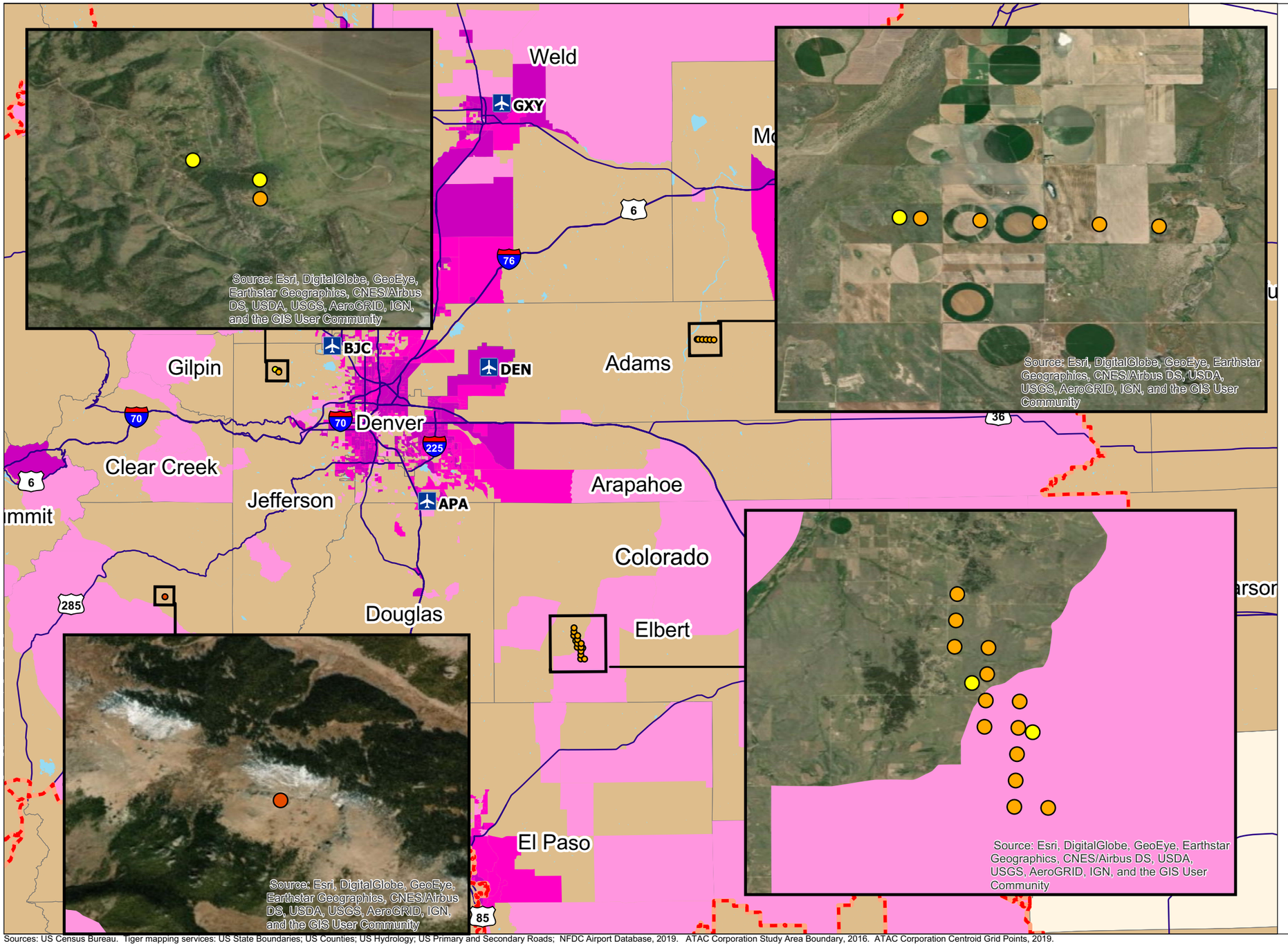

LEGEND

- Census Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- Section 4(f) Grid Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- Evenly-Spaced Grid Centroid Exposed to a DNL 45 to 60 dB with a DNL 5 dB Increase
- General Study Area
- Study
- Water

Areas of Environmental Concerns

- Low Income Population
- Minority Population
- Low Income/Minority Population
- Highways
- Counties in the General Study
- US Counties
- US State Boundaries

Notes:
APA - Centennial Airport
BJC - Rocky Mountain Metropolitan Airport
DEN - Denver International Airport
FNL - Northern Colorado Regional Airport
GXY - Greeley-Weld County Airport

Zoom in for additional detail

Projection :GCS North American 1983
Scale: 1:2,631,162

0 0.5 1 2 Miles

N

Sources: US Census Bureau. Tiger mapping services: US State Boundaries; US Counties; US Hydrology; US Primary and Secondary Roads; NFDC Airport Database, 2019. ATAC Corporation Study Area Boundary, 2016. ATAC Corporation Centroid Grid Points, 2019.

Prepared by: ATAC Corporation, April 2019.

Exhibit 5-4

DEN METROPLEX EA

Change in Potential Population Exposed to Aircraft Noise in Environmental Justice Areas - 2024

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5.9 Visual Impacts

This section discusses the analysis of visual impacts under the Preferred Alternative and the No Action.

5.9.1 Summary of Impacts

As stated in Section 5.1, implementation of the Preferred Alternative would not increase the number of aircraft operations at the Study Airports compared with the No Action. Changes in aircraft traffic patterns under the Preferred Alternative are expected to be at altitudes and distances sufficiently removed from viewers that visual impacts would not be anticipated.

Under the No Action, no changes in air traffic routes would occur and no changes in aircraft overflight patterns would be expected. Therefore, the No Action would not result in visual impacts.

5.9.2 Methodology

As discussed in FAA Order 1050.1F, visual, or aesthetic, impacts are difficult to define and evaluate because of the subjectivity involved. Aesthetic impacts deal more broadly with the extent that the project contrasts with the existing environment and whether the difference is considered objectionable by the agency responsible for the location in which the project is set. Visual impacts are normally related to the disturbance of the aesthetic integrity of an area caused by development, construction, or demolition, and thus, do not typically apply to airspace changes.

To evaluate the potential for indirect impacts resulting from changes in aircraft routings and visual intrusion, the general altitudes at which aircraft route changes occur beyond the immediate airport environs, which experience overflights on a routine basis, are considered to evaluate the potential for visual impacts.

5.9.3 Potential Impacts – 2019 and 2024

According to FAA Order 1050.1F, the visual sight of aircraft, aircraft contrails, or aircraft lights at night, particularly at a distance that is not normally intrusive, should not be assumed to constitute an adverse impact. Changes in aircraft routes associated with the Preferred Alternative would generally occur at altitudes above 3,000 feet AGL; therefore, the visual sight of aircraft and aircraft lights would not be considered intrusive. Consequently, the Preferred Alternative would not result in significant visual impacts. Accordingly, significant visual impacts resulting from the Preferred Alternative or the No Action would not be anticipated.

5.10 Cumulative Impacts

Consideration of cumulative impacts applies to the impacts resulting from the implementation of the Preferred Alternative with other actions. CEQ regulations define a cumulative impact as “an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.”[83] The regulations also state that cumulative impacts can result from individually minor, but collectively significant actions that take place over a period of time.

[83] 40 C.F.R § 1508.7

5.10.1 Summary of Impacts

The implementation of the Preferred Alternative when considered with other past, present, and reasonably foreseeable future actions would not be expected to result in significant cumulative impacts.

The No Action does not involve a proposed project or action that could contribute to the effects of past, present, and reasonably foreseeable projects that would cumulatively result in significant impacts and would not result in a change in the number of aircraft operations or air traffic routes; therefore, no cumulative impacts would be anticipated.

5.10.2 Methodology

Research was conducted to identify planned airport improvement projects at all Study Airports that in combination with the Preferred Alternative might result in cumulative environmental impacts. A robust examination was made of the potential resources affected by the Preferred Alternative, and only past, present, and reasonably foreseeable future actions that would have direct or indirect effects on aircraft flight patterns within the General Study Area were to be considered. Therefore, the type of projects that would be considered under the cumulative impact analysis were primarily limited to airfield projects, specifically projects that directly affect or involve runways and modifications to parallel taxiways. “Reasonably foreseeable future actions” refers to projects that would likely be completed before 2024. A comprehensive search of the FAA Airport Capital Improvement Programs for the identified Study Airports yielded no substantive runway endpoint or elevation changes within the timeline horizons of this EA.

The same significance thresholds used to determine impacts associated with the Preferred Alternative are applied to determine significant cumulative impacts. Because there is no potential for impact, those environmental resource categories that are not affected by the Preferred Alternative (listed in Section 4.2) are not further evaluated for cumulative impacts. Similarly, if no impacts to an environmental resource category were identified under the Preferred Alternative when compared to the No Action, then no further analysis for cumulative impacts was required. Resource categories in which no impacts were identified that would warrant further analysis for cumulative impacts from this Project or the past, present, and reasonably foreseeable future actions include Noise, Compatible Land Use, Department of Transportation Act, Section 4(f) Resources, Historic and Cultural Resources, Wildlife (Avian and Bat Species) and Migratory Birds, and Environmental Justice.

5.10.3 Potential Impacts – 2019 and 2024

As stated in Section 5.10.2, extensive research was conducted to identify relevant airport improvement projects related to runway changes in a vertical or horizontal manner. Sources reviewed included FAA, state, and local Capital Improvement Project lists and websites for all airports and associated state, county, and local planning, public works, and transportation agencies. No identified documents included information on past, present, and reasonably foreseeable future actions with the potential for direct or indirect effects on aircraft flight patterns within the General Study Area. Accordingly, no cumulative impacts would be anticipated for the Preferred Alternative when compared to the No Action for either 2019 or 2024.

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