Federal Aviation Administration

Draft Environmental Assessment for Drone Package Delivery in Tolleson, Arizona

July 2024

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Washington, D.C.

Notice of Availability, Notice of Public Comment Period, and Request for Comment on the Draft Environmental Assessment for Amazon Prime Air Package Delivery Operations in Tolleson, Arizona

The Federal Aviation Administration (FAA) provides notice that a Draft Environmental Assessment (EA), prepared pursuant to the National Environmental Policy Act (NEPA) (42 United States Code §§ 4321 – 4355), to assess Amazon Prime Air's proposed commercial drone delivery service in the Tolleson, AZ area is available for review and comment.

Amazon Prime Air is seeking to amend its air carrier Operation Specifications (OpSpec) and other FAA approvals necessary to introduce commercial drone delivery operations in Arizona. The FAA's approval of the amended OpSpec is considered a major federal action under NEPA and Council on Environmental Quality (CEQ) NEPA–implementing regulations (40 Code of Federal Regulations Parts 1500–1508) and requires a NEPA review. The Draft EA is submitted for review pursuant to NEPA, CEQ NEPA Implementing Regulations, FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, Section 4(f) of the Department of Transportation Act (49 U.S.C. § 303), and Section 106 of the National Historic Preservation Act (16 U.S.C. § 470). The Draft EA will be available for a 30-day public review beginning on Friday, July 12, 2024 and ending on Sunday, August 11, 2024.

The Draft EA is available for online review at:
https://www.faa.gov/uas/advanced_operations/nepa_and_drones

Comments on the Draft EA may be submitted electronically to 9-faa-drone-environmental@faa.gov. Written comments may be submitted via U.S. Mail to the address below. Please ensure adequate time for receipt. All comments must be received by 5:00 p.m. Central Time on *Sunday, August 11, 2024*.

Federal Aviation Administration, Suite 802W
C/O AVS Environmental
800 Independence Ave SW
Washington, DC 20591

All substantive comments received will be responded to in the Final EA.

PRIVACY NOTICE: Before including your address, phone number, email address, or other personal identifying information in your comment, be advised that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold from public review your personal identifying information, we cannot guarantee that we will be able to do so.

This Draft EA becomes a federal document when evaluated, signed, and dated by the Responsible FAA Official.

Responsible FAA Official:

DEREK W HUFTY Digitally signed by DEREK W HUFTY Date: 2024.07.03 10:39:00 -04'00'

_________________________________ Date: ____________________________

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CHAPTER 1
Purpose and Need

1.1 Introduction

Amazon.com Services LLC, doing business as Amazon Prime Air (Amazon or Prime Air), intends to expand its delivery capabilities in 2024 by adding the next generation MK30 drone variant to its fleet under its existing Part 135 air carrier certificate and related operating authorizations. Prime Air is seeking to amend its current Operations Specifications (OpSpec) and other Federal Aviation Administration (FAA) authorizations needed to integrate the MK30 and commence commercial drone package delivery operations from the new Prime Air Drone Delivery Center (PADDC)[1] located in Tolleson, AZ.

This Draft Environmental Assessment (EA) is being prepared by the FAA to evaluate the potential environmental impacts that may result from FAA's approval of the Proposed Action, and the amendment of Prime Air OpSpecs to grant airspace access to the MK30 in the proposed operating area. For purposes of this Draft EA, the MK30 drone operating area is the Study Area and is further defined in **Chapter 2**.

The issuance of an OpSpec is considered a major federal action subject to environmental review requirements. The FAA has prepared this Draft EA pursuant to the National Environmental Policy Act of 1969 (NEPA)[2] and its implementing regulations[3]. Under NEPA, federal agencies are required to consider the environmental effects of proposed federal actions and to disclose to decision-makers and the public a clear and accurate description of the potential environmental impacts of proposed major federal actions. Additionally, under NEPA, federal agencies are required to consider the environmental effects of a proposed action, the reasonable alternatives to the proposed action, and a no action alternative (assessing the potential environmental effects of not implementing the proposed action). The FAA has established a process to ensure compliance with the provisions of NEPA through FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, and the FAA Order 1050.1F Desk Reference.

1.2 Proposed Operations

The 78-pound (lb) MK30 drone carries packages weighing up to 5 lbs. (3 kilograms [kg]) and has a maximum takeoff weight of approximately 83.2 lbs. (37.8 kg). Prime Air proposes to operate up to 469 MK30 delivery flights per operating day over the course of 365 operating days per year, for a total of roughly 171,329 annual delivery operations. All drone operations would originate from and terminate at the PADDC located at 10601 W. Van Buren Street, Tolleson, AZ, which is approximately 13 miles (mi) (21 kilometers [km]) west of downtown Phoenix, AZ. Commercial delivery operations from the Tolleson

[1] An Amazon PADDC is a ground-based service area where drones are assigned and where flights originate and return.

[2] 42 United States Code (U.S.C.) § 4321 et seq.

[3] 40 Code of Federal Regulations (CFR) §§1500-1508.

PADDC would occur between 7 A.M. and 10 P.M., up to seven days per week.[4] The MK30's proposed operating range is 7.5 mi (12 km) from the PADDC, with a potential operating area of 174 square (sq) mi (450.6 sq km).

The proposed PADDC facility would be located on the same property as and adjacent to an existing Amazon warehouse building with office space, ground control station, aircraft maintenance area, battery storage area, paved departure and arrival pads, and perimeter fencing. The proposed PADDC site is zoned for Light Industrial and General Commercial[5] and is located immediately south of Van Buren Street, east of 107th Avenue, and west of 104th Avenue.[6] The properties adjacent to the proposed PADDC are a mix of privately-owned commercial, industrial, and residential. The closest residential neighborhood is approximately 1,300 feet (ft) (0.4 km) west of the site. Prime Air would conduct deliveries from the PADDC to eligible delivery sites, such as private residences and commercial facilities.[7] The proposed PADDC location is shown in **Figures 1-1** and **1-2** below.

1.3 FAA Role and Federal Action

The FAA has a statutory obligation to review Prime Air's request to amend the OpSpec and determine whether the amendment would affect safety in air transportation or air commerce, and to determine whether the public interest requires the amendment. In general, Congress has charged the FAA with the safety of air commerce in the United States and to encourage the development of civil aeronautics.[8]

In addition, the FAA has specific statutory and regulatory obligations related to its issuance of a Part 135 certificate and the related OpSpec. The FAA is required to issue an operating certificate to an air carrier when it "finds, after investigation, that the person properly and adequately is equipped and able to operate safely under this part and regulations and standards prescribed under this part."[9] An operating certificate also specifies "terms necessary to ensure safety in air transportation; and (2)…the places to and from which, and the airways of the United States over which, a person may operate as an air carrier."[10] Also included in air carrier certificates is a stipulation that the air carrier's operations must be conducted in accordance with the provisions and limitations specified in the OpSpec.[11]

4 The proposed hours of operation would be between 7 A.M. and 10 P.M. It should be noted that the FAA and Amazon Prime Air are currently consulting with the United States Fish and Wildlife Service to determine the optimal operating window to minimize potential impacts to biological resources, as discussed in Section 3.3.

5 Tolleson Zoning Map, November 2014. https://www.tolleson.az.gov/DocumentCenter/View/2468/Tolleson-Zoning-Map?bidId= (Accessed April 22, 2024)

6 The coordinates of PADDC (in decimal degrees) are 33.44788 and 112.28644.

7 Each delivery site is vetted by Amazon to ensure that the area can receive deliveries.

8 49 U.S.C. § 40104.

9 49 U.S.C. § 44705.

10 Id.

11 14 CFR § 119.5 (g), (l).

SOURCE: ESA, 2023; Maxar, 2022; US Census Bureau, 2021; US Geological Survey, 2022.

Draft Environmental Assessment for Amazon Prime Air — Tolleson, AZ

Figure 1-1
Prime Air's PADDC Location in Tolleson, AZ

SOURCE: ESA, 2023; Maxar, 2022; US Census Bureau, 2021; US Geological Survey, 2022.

Draft Environmental Assessment for Amazon Prime Air — Tolleson, AZ

Figure 1-2
Close-up View of the Tolleson PADDC

The regulations also specify that a Part 135 certificate holder may not operate in a geographical area unless its OpSpec specifically authorizes the certificate holder to operate in that area.[12] The regulations implementing Section 44705 specify that an air carrier's approved OpSpec must include, among other things, "authorization and limitations for routes and areas of operations."[13] An air carrier's OpSpec may be amended at the request of an operator if the FAA "determines that safety in air commerce and the public interest allows the amendment."[14] After making this determination, the FAA must take an action on the OpSpec amendment.

1.4 Purpose and Need

The **purpose** of Prime Air's request is to begin commercial drone delivery service in Tolleson, AZ, which, in its business judgment, Prime Air has determined is an appropriate market for expanded commercial delivery operations. The requested OpSpec amendments are **needed** so that Prime Air can begin MK30 drone delivery operations from its Tolleson PADDC location. The approval will offer Prime Air an opportunity to further assess the viability of commercial drone delivery options under real world conditions and demonstrate that it can conduct operations safely and meet its compliance obligations. Furthermore, it could also help Prime Air gauge public demand for commercial drone delivery services and provide an opportunity to assess community response to commercial delivery operations in this area.

1.5 Public Involvement

The FAA provided a Notice of Availability (NOA) of the Draft EA on July 12, 2024 to local interest groups, local government officials, public park authorities, and the State Historic Preservation Office (SHPO), tribes and Tribal Historic Preservation Offices (THPOs). On the same date, the FAA made the Draft EA available to the general public on the FAA website. The NOA, which was published in The Arizona Republic newspaper, can be found in **Appendix A** and provides information about the Proposed Action and requests review and comments on this Draft EA, which is available on the FAA website for a 30-day comment period. Interested parties are invited to submit comments on any environmental concerns related to the Proposed Action to a specifically assigned email address.

[12] 14 CFR § 119.5(j).

[13] 14 CFR § 119.49(a)(6).

[14] 14 CFR § 119.51(a); see also 49 U.S.C. § 44709.

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CHAPTER 2
Proposed Action and Alternatives

FAA Order 1050.1F, Paragraph 6-2.1(d) states that, "[a]n EA may limit the range of alternatives to the proposed action and no action alternative when there are no unresolved conflicts concerning alternative uses of available resources." The FAA has not identified any unresolved conflicts concerning alternative uses of available resources associated with Prime Air's proposal. Therefore, this Draft EA only considers the No Action and the Proposed Action alternatives.

2.1 No Action Alternative

Council on Environmental Quality (CEQ) regulations at 40 CFR § 1502.14(c) require agencies to consider a no action alternative in their NEPA analyses. Thus, the no action alternative serves as a baseline to compare the impacts of the proposed action. Under the No Action alternative, the FAA would not issue the approvals necessary (e.g., the OpSpec amendment) and Prime Air would not be authorized to conduct commercial drone package delivery flights from the Tolleson PADDC. This alternative does not support the stated purpose and need.

2.2 Proposed Action

The FAA would amend Prime Air's OpSpec to enable commercial drone package deliveries in new locations. Accordingly, Prime Air has requested the FAA to approve its OpSpec amendment so that it can begin drone commercial delivery operations in this new operating area (Tolleson, AZ). The B050 OpSpec, *Authorized Areas of En Route Operations, Limitations, and Provisions*, includes a reference section titled Limitations, Provisions, and Special Requirements. The FAA's approval of this OpSpec amendment – including the paragraph in the B050 OpSpec's reference section with descriptive language about the operating area boundaries, including the specific location and operational profile proposed in Prime Air's request – is the proposed federal action for this EA. The B050 OpSpec will restrict Prime Air to this location; any future expansion beyond the authorization and limitations for the area of operations described in the B050 OpSpec may require additional OpSpec amendments from the FAA, and may be subject to appropriate NEPA review, as necessary.

2.2.1 Description of Proposed Operations

As described in **Section 1.2**, Prime Air anticipates operating up to 469 delivery flights per operating day, up to 10 hours per day, and 7 days per week, from the Tolleson PADDC. These operational levels would result in a projected total of approximately 365 operating days and 171,329 delivery operations per year based on the scope of the Proposed Action. The operations would occur between 7 A.M. and 10 P. M. and are anticipated to be distributed evenly across the operating area. The MK30's proposed operating range is 7.5 mi (12 km) from the PADDC, with a potential operating area of 174 sq mi (450.6 sq km). The drone departure and arrival paths from and to the PADDC would generally correspond to the geographical location of the package delivery address.

The proposed operating area, which also serves as the Study Area for the Draft EA, is depicted in **Figure 2-1**.

2.2.2 Drone Specifications

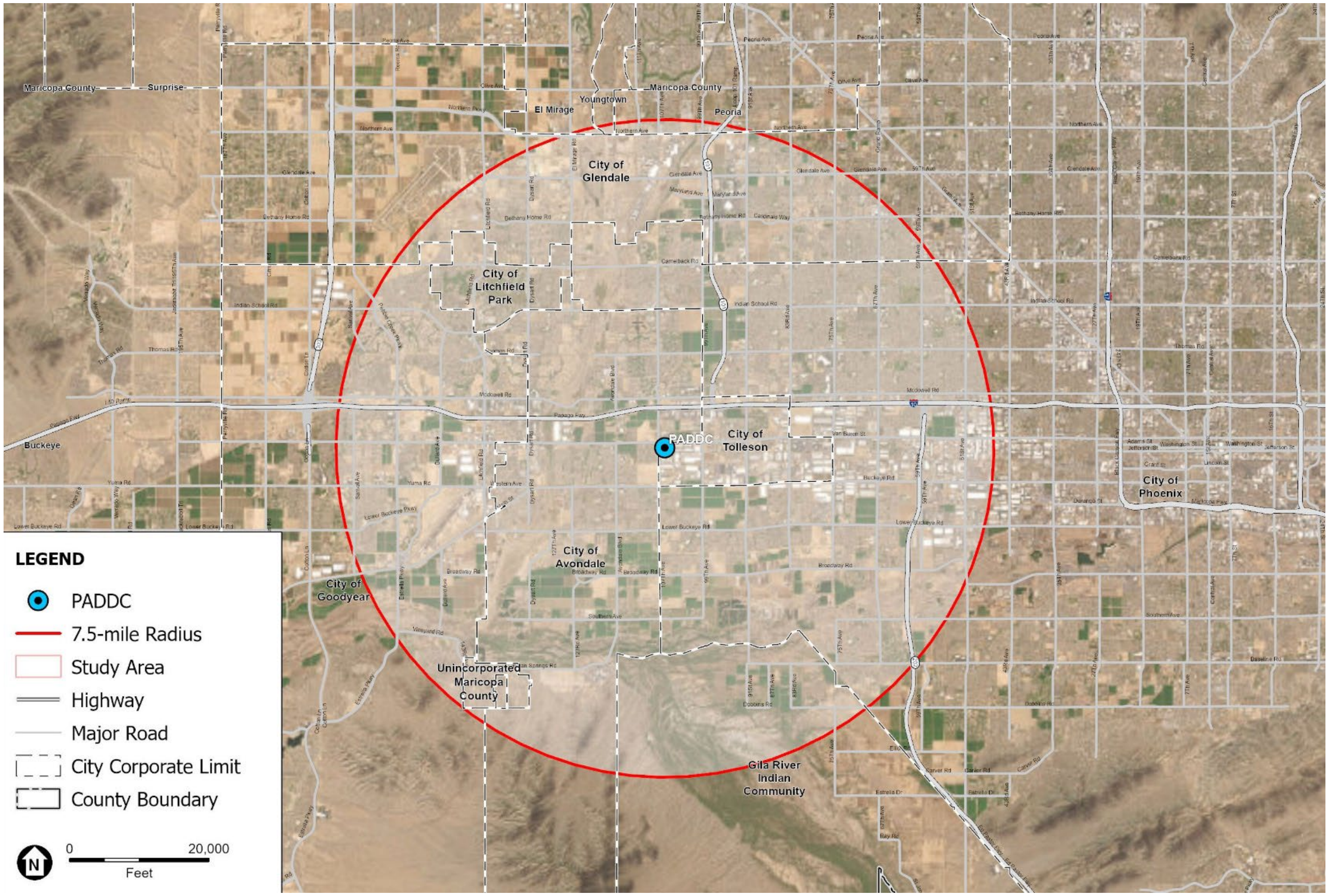
As shown in **Figure 2-2**, the MK30 is an electric powered drone that has a vertical take-off and landing, and transitions to wing borne flight using wing lift during en route flight. The drone systems include hardware and software designed for safety and efficiency. The airframe is composed of staggered wings. The propulsion system includes a rechargeable lithium-ion battery and six (6) motors that include propellers designed for noise reduction. The package delivery system contains the package in a two-door interior receptacle, and a camera and avionics system that has redundancy for critical systems. The drone weighs 77.9 lbs (35.5 kg) and has a maximum takeoff weight of 83.2 lbs. (37.8 kg), which includes a maximum payload of 5 lbs (3 kg). It has a maximum operating range of 7.5 mi (12 km) and can fly up to 400 ft (122 m) above ground level (AGL) at a maximum cruise speed of 73 mph (64 knots) during horizontal flight.

2.2.3 Flight Operations

As shown in **Figure 2-3**, a typical flight profile can be broken into the following general flight phases: launch, *en route* outbound, delivery, *en route* inbound, and landing. After launch, Prime Air's MK30 drone would rise to an altitude of less than 400 ft (122 m) AGL and follow a predefined route to its delivery site.[15] Drones would typically fly *en route* at between approximately 180 to 377 ft (55 to 115 m) AGL, except when descending to drop a package. Packages would be carried internally in the drone's fuselage. When making a delivery, the drone descends, opens a set of payload doors, and drops the package to the ground from approximately 13 ft (4 m) AGL. Prime Air's drone would not touch the ground in any place other than the PADDC (except during safe contingent landings) and will remain airborne while throughout the operation, including the delivery stage.[16] After the package is dropped, the MK30 drone climbs vertically and follows its predefined route back to the PADDC at its assigned altitude.

[15] Prime Air may modify operations, if warranted, to avoid or minimize any negative impacts.

[16] The MK30 is built with multiple redundant safety features and "detect and avoid" technology. The drone is designed to handle unexpected situations; it is independently safe.



SOURCE: ESA, 2023; Maxar, 2022; US Census Bureau, 2021; US Geological Survey, 2022.

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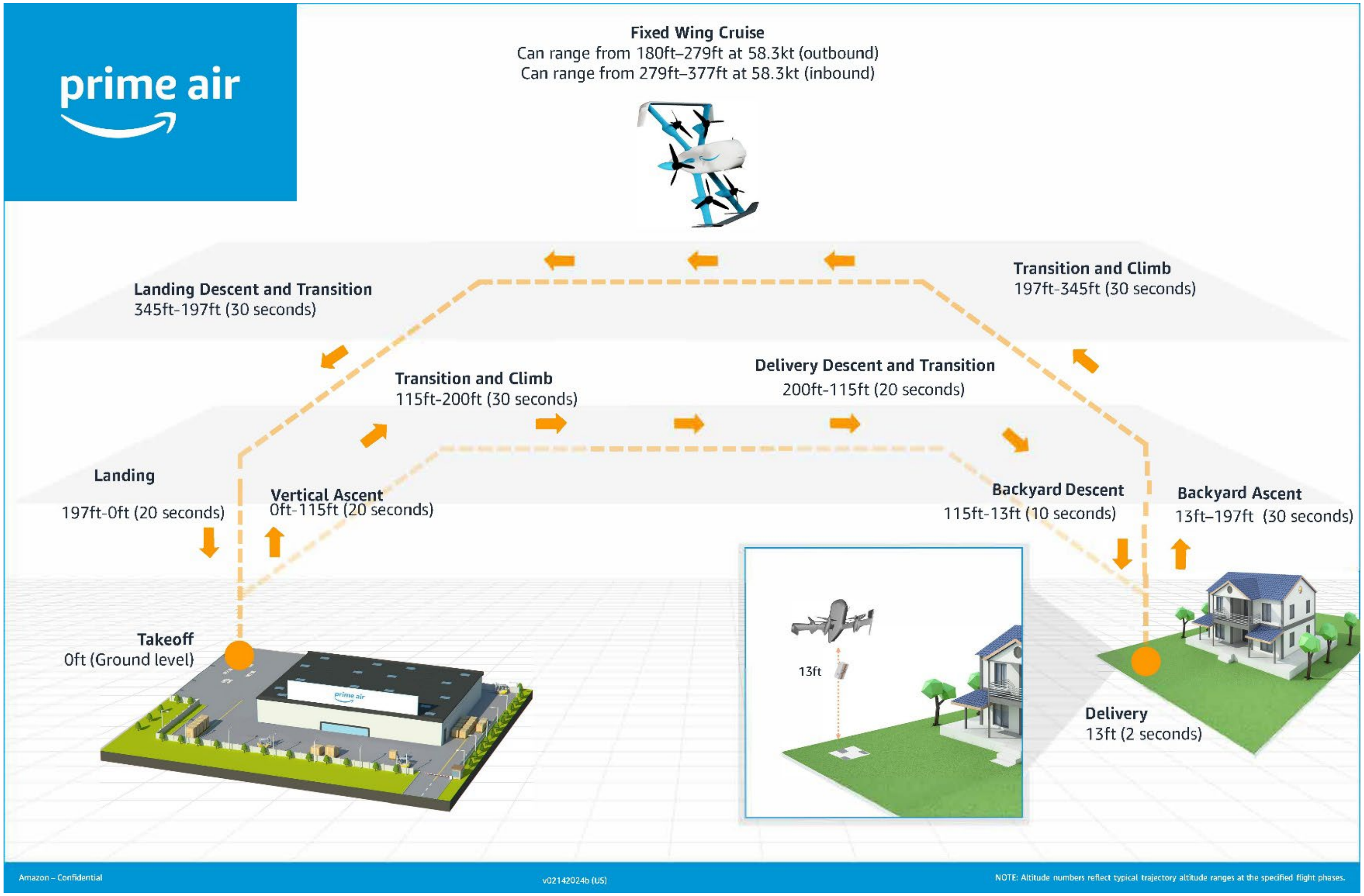
Figure 2-1
MK30 Drone Operations/Study Area

SOURCE: Amazon Prime Air, 2023.

Draft Environmental Assessment for Amazon Prime Air — Tolleson, AZ

Figure 2-2
MK30 Drone



SOURCE: Amazon Prime Air, 2024.

Draft Environmental Assessment for Amazon Prime Air — Tolleson, AZ

Figure 2-3
MK30 Drone Flight Profile

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CHAPTER 3
Affected Environment and Environmental Consequences

3.1 Introduction

This chapter provides a description of the affected environment and potential environmental consequences for the environmental impact categories that have the potential to be affected by the No Action Alternative and Proposed Action, as required by CEQ's NEPA–implementing regulations and FAA Order 1050.1F. As required by FAA Order 1050.1F, this EA presents an evaluation of impacts for the environmental impact categories listed below.

- Air quality
- Biological resources (including fish, wildlife, and plants)
- Climate
- Coastal resources
- Department of Transportation Act, Section 4(f)
- Farmlands
- Hazardous materials, solid waste, and pollution prevention
- Historical, architectural, archaeological, and cultural resources
- Land use
- Natural resources and energy supply
- Noise and noise-compatible land use
- Socioeconomics, environmental justice, and children's environmental health and safety risks
- Visual effects (including light emissions)
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers)

The study area evaluated for potential impacts is defined as Prime Air's proposed operating area shown in **Figure 2-1**. The level of detail provided in this chapter is commensurate with the importance of the potential impacts (40 CFR § 1502.15). EAs are intended to be concise documents that focus on aspects of the human environment that may be affected by the Proposed Action.

3.2 Environmental Impact Categories Not Analyzed in Detail

This EA did not analyze potential impacts on the following environmental impact categories in detail because the Proposed Action would not affect the resources included in the category (see FAA Order 1050.1F, Paragraph 4-2.c).

Air Quality and **Climate**: The MK30 is battery-powered and does not generate emissions that could result in air quality impacts or climate impacts. Electricity consumed for battery charging at the PADDC would be minimal. The electricity consumed for the Proposed Action would come from the power grid. Although Tolleson, AZ is located in an area designated by the U.S. Environmental Protection Agency as maintenance for carbon monoxide and nonattainment for ozone and 10-micron particulate matter, these emissions would be minimal and would not contribute to any exceedance of National Ambient Air Quality Standards. As described in Section III Part 13 of 72 FR 6641, the use of electric drone technology would Presume to Conform with the General Conformity requirements for a State Implementation Plan under the Clean Air Act of 1990.[17]

The MK30 would be used to replace personal vehicle trips to stores for urgently needed items. The Proposed Action is expected to decrease emissions from automobile delivery services that contribute to GHG emissions; as such, the decreased emissions would have positive effects on climate change as the Proposed Action would replace vehicle miles traveled by GHG-emitting consumer vehicles. MK30 operations are not expected to be impacted by climate change impacts (e.g., rising sea levels, increasing temperatures). Research suggests that drone-based package delivery could reduce greenhouse gas (GHG) emissions and energy use in the freight sector (Lyon-Hill et al. 2020, Rodrigues et al. 2022, Stolaroff et al. 2018), which would have beneficial effects on climate change. Therefore, the Proposed Action would not affect nor be affected by the impacts of climate change, and it is consistent with the January 9, 2023, CEQ *NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*.

- **Coastal Resources**: The Proposed Action would not directly affect any shorelines or change the use of shoreline zones and be inconsistent with any National Oceanic and Atmospheric Administration–approved state Coastal Zone Management Plan as there are no shorelines in the proposed area of operations. The study area is approximately 300 miles from the nearest shoreline in California.
- **Farmlands**: The Proposed Action would not involve the development or disturbance of any land, regardless of use, nor would it have the potential to convert any farmland to non-agricultural uses. The Proposed Action would not affect designated prime or unique farmlands.
- **Hazardous Materials, Solid Waste, and Pollution Prevention**: The Proposed Action would not result in any construction, development, or any physical disturbances of the ground. Therefore, the potential for impacts related to hazardous materials, pollution prevention, and solid waste is not anticipated. The drones are made of common aircraft-related materials, such as steel, aluminum, and light composite materials, such as plastic. Drone/battery disposal would be properly managed at the end of its operating life in accordance with applicable 14 CFR Part 43, *Disposition of life-limited aircraft parts,* and any hazardous materials would be disposed of in accordance with all applicable federal, tribal, state, and local laws, including 40 CFR Part 273, *Standards for Universal Waste Management*.

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[17] https://www.federalregister.gov/documents/2007/02/12/E7-2241/federal-presumed-to-conform-actions-under-general-conformity.

- **Land Use**: The Proposed Action would not involve any changes to existing, planned, or future land uses within the area of operations. Prime Air would use the Tolleson, AZ PADDC to conduct its MK30 operations. The PADDC must conform with all applicable local or state land use ordinances and zoning requirements.
- **Natural Resources and Energy Supply**: The Proposed Action would not require the need for unusual amounts of natural resources and materials, or those in scarce supply. The MK30 is powered by a rechargeable battery which does not consume fossil fuel (e.g., gasoline or aviation fuel) resources. The battery is charged by an electric charger which can leverage the local grid to charge the batteries. The MK30 would be used to replace personal vehicle trips to stores for urgently needed items; thus, the MK30 is expected to reduce consumption of fossil fuel resources. The Proposed Action is expected to decrease emissions from automobile delivery services that contribute to greenhouse gases (GHG) emissions. As such, the decreased emissions would have positive effects on climate change as the Proposed Action would replace vehicle miles traveled by GHG-emitting consumer vehicles.
- **Socioeconomics and Children's Environmental Health and Safety Risks**: The Proposed Action 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. Executive Order (EO) 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires federal agencies to ensure that children do not suffer disproportionately from environmental or safety risks. The Proposed Action would not introduce products or substances 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. It is not anticipated that the Proposed Action would pose a greater health and safety risk to children than package delivery by other means (truck, mail, personal automobile, etc.).
- **Visual Effects (Light Emissions Only)**: The Proposed Action would not result in significant light emission impacts because flights would be conducted between 7 A.M. and 10 P.M.
- **Water Resources (Wetlands, Floodplains, Surface Water, Groundwater, Wild and Scenic Rivers)**: The Proposed Action would not result in any further construction of facilities and would not encroach upon areas designated as navigable waters or directly impact wetlands. The proposed operation does not include any new facilities in areas identified as flood hazard areas according to the approaches established in the Federal Flood Risk Management Standard (FFRMS).[18] Although the PADDC is located in a 500-year floodplain[19] which would meet FFRMS criteria for flood hazard area identification, there is no proposed construction which would alter the floodplain in any way or create new flood risks. The Proposed Action 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 Proposed Action 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. The Proposed Action would not affect any river segments in the Wild and Scenic River System (WSRS) as there are no WSRS river segments nearby. The Proposed Action would not affect any river segments in the Nationwide Rivers Inventory (NRI) as the nearest NRI river segment (the confluence of Red Creek and the Verde River) is approximately 60 miles from the operating area boundary.

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[18] Executive Order 14030, *Climate-Related Financial Risk*, May 2021.

[19] Federal Emergency Management Agency, National Flood Hazard Layer (NFHL) Viewer, < https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd > (accessed April 30, 2024).

- **Biological Resources (Fish and Plants)**: The Proposed Action would not result in impacts to fish and plant species as the action is launched from developed/industrial areas, transported by drone, and delivered to residential houses and communities.

3.3 Biological Resources (Wildlife)

3.3.1 Definition of Resource and Regulatory Setting

Biological resources include plant and animal species and their habitats, including special status species (federally-listed or state-listed threatened or endangered species, species proposed for listing, species that are candidates for federal listing, marine mammals, and migratory birds) and environmentally sensitive or critical habitat. In addition to their intrinsic values, biological resources provide aesthetic, recreational, and economic benefits to society.

3.3.1.1 Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973 [16 U.S.C. § 1531 et seq.] requires the evaluation of all federal actions to determine whether a proposed action is likely to jeopardize any proposed, threatened, or endangered species or proposed or designated 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, which determines whether formal or informal consultation with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS) is needed. If the FAA determines that the action may affect listed species, consultation with the USFWS must be initiated. Conversely, if the FAA determines the action would have *no effect* on listed species or critical habitat, consultation is not required.

Impacts considered significant to federally listed threatened and endangered species would occur when the USFWS or NMFS determines that the proposed action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species or would be likely to result in the destruction or adverse modification of federally designated critical habitat. An action need not involve a threat of extinction to federally listed species to meet the NEPA standard of significance. Lesser impacts, including impacts on non-listed or special status species, could also constitute a significant impact.

3.3.1.2 Migratory Birds

The Migratory Bird Treaty Act (16 U.S.C. §§ 703-712) protects migratory birds, including their nests, eggs, and parts, from possession, sale, purchase, barter, transport, import, export, and take. The USFWS is the federal agency responsible for the management of migratory birds as they spend time in habitats of the U.S. For purposes of the Migratory Bird Treaty Act, "take" is defined as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR § 10.12). The Migratory Bird Treaty Act applies to migratory birds identified in 50 CFR § 10.13 (defined hereafter as "migratory birds").

3.3.1.3 Bald and Golden Eagles

The Bald and Golden Eagle Protection Act prohibits anyone from "taking" a Bald or Golden Eagle, including their parts, nests, or eggs, without a permit issued by the USFWS. Implementing regulations (50 CFR § 22), and USFWS guidelines as published in the National Bald Eagle Management Guidelines, provide for additional protections against "disturbances." Like take, "disturb" means to agitate or bother a Bald or Golden Eagle to a degree that causes, or is likely to cause, injury to an eagle or causes either a decrease in its productivity or nest abandonment due to a substantial interference with breeding, feeding, or sheltering. A permitting process provides limited exceptions to the Bald and Golden Eagle Protection Act's prohibitions. The USFWS has issued regulations for the permitting process in 50 CFR Part 22, which include permits for the incidental take of Bald Eagles. Such permits are only needed when avoidance of incidental take is not possible. According to the USFWS National Bald Eagle Management Guideline, to avoid Bald Eagle disturbance resulting from new or intermittent activities, the implementation of conservation measures to avoid operating aircraft within 1,000 feet of a nest during the breeding season should be implemented.[20] According to Arizona Game and Fish guidance, pilots are reminded to maintain the FAA-recommended 2,000-foot above ground level advisory when flying over known bald eagle nesting areas. Bald Eagles are sensitive to even short durations of low-flying activity around their nests and just a few minutes of disturbance can lead to a nesting failure."[21]

3.3.2 Affected Environment

This section describes the existing biological environment of the action area. The action area is located in the American Semi-Desert and Desert Province (ASD) ecoregion. The ASD ecoregion topography is characterized by extensive plains, most gently undulating and includes isolated low mountains and buttes that rise abruptly.[22] Additionally the Proposed Action would take place over land cover identified in the urban areas as low, medium and high-density development, with scattered areas of scrub/shrub and grasslands/herbaceous habitat within the rural portions of the action area.[23]

The creosote bush (*Larrea tridnetata*) is the most widely distributed plant within the natural portions of this ecoregion, sparsely accompanied by cacti, shrubs, and herbs. These areas provide habitat for many of the more common and ubiquitous bird and mammal species in the region, including deer, squirrels, raccoons, armadillos, wild boar, jackrabbits, mice, badgers, songbirds, raptors, waterfowl, and insects.[24]

3.3.3 Special Status Species

3.3.3.1 Federally Listed Species

The potential for impacts to federally listed species was assessed using the USFWS Information for Planning and Consultation (IPaC) online system (January 23, 2024). The action area covered the entire operating area, outlined in red in **Figure 2-1** of this EA. The USFWS official species list, obtained through IPaC, is included with this EA (see **Appendix B**). Below, **Table 3-1** lists the federally threatened

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20 National Bald Eagle Management Guidelines, US Fish and Wildlife Service, May 2007.

21 Closures Benefit Eagles During Breeding Season. Available: https://www.azgfd.com/2023/12/19/bald-eagle-breeding-season-prompts-seasonal-restrictions/#:~:text=Pilots%20are%20reminded%20to%20maintain,to%20avoid%20the%20areas%20completely. Accessed January 2024.

22 322 American Semidesert and Desert Province. Available: https://www.fs.usda.gov/land/ecosysmgmt/colorimagemap/images/322.html. Accessed January 2024.

23 EPA NEPAssist, NLCD 2019 CONUS Land Cover. Available: https://nepassisttool.epa.gov/nepassist/nepamap.aspx?wherestr=tolleson. Accessed January 2024.

24 Bird Conservation and Eco Regions in Arizona and New Mexico. Available: https://www.fs.usda.gov/detail/r3/plants-animals/wildlife/. Accessed January 2024.

and endangered species that could be present in the action area. The action area does not contain any designated critical habitat for any species.

Based on the official species list, there are five federally listed endangered and threatened species, one experimental population, and one candidate species with potential to occur within the action area. This includes one mammal species: the Sonoran Pronghorn - experimental population (Non-Essential) and five bird species: Cactus Ferruginous Pygmy Owl (*Glaucidium brasilianum cactorum*) – threatened; California Least Tern (*Sternula antillarum browni*) - endangered; Southwestern Willow Flycatcher (*Empidonax traillii extimus*) - endangered; Yellow-Billed Cuckoo (*Coccyzus americanus*) -threatened; and Yuma Ridgway's Rail (*Rallus obsoletus* yumanensis) - endangered. The monarch butterfly *(Danaus plexippus*) is also included as a candidate for listing that has the potential to occur in the action area.

TABLE 3-1
IPAC RESULTS

Species	Common Name	Species Name	ESA Status	Critical Habitat
Mammals	Sonoran Pronghorn	*Antilocapra americana sonoriensis*	Experimental Population; Non-Essential	No
Birds	Cactus Ferruginous Pygmy Owl	*Glaucidium brasilianum cactorum*	Threatened	No
	California Least Tern	*Sternula antillarum browni*	Endangered	No
	Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	No
	Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	No
	Yuma Ridgway's Rail	*Rallus obsoletus* yumanensis	Endangered	No
Insects	Monarch Butterfly	*Danaus plexippus*	Candidate	No

SOURCE: USFWS IPaC; accessed January 2024.

As identified within Table 3-1, the Sonoran Pronghorn has an experimental population in Arizona that is listed as Non-Essential. Their locations include: an area north of Interstate 8 and south of Interstate 10, bounded by the Colorado River on the west and Interstate 10 on the east; and an area south of Interstate 8, bounded by Highway 85 on the west, Interstates 10 and 19 on the east, and the U.S.-Mexico border on the south.[25] The action area is located outside of the experimental population locations. Therefore, this species has been removed from further consideration.

The Cactus Ferruginous Pygmy Owl is federally listed as a threatened raptor that is currently found in southern Arizona, southern Texas, and Mexico. Pygmy-Owl habitat has been protected through conservation planning and habitat acquisition and protection in Pima County, where these small raptors are known to exist (approximately 150 miles south of the action area).[26] The Cactus Ferruginous Pygmy

[25] Sonoran Pronghorn (Antilocapra americana sonoriensis). Available: https://ecos.fws.gov/ecp/species/4750. Accessed January 2024.

[26] USFWS. Cactus Ferruginous Pygmy-Owl Listed. Available: https://www.fws.gov/press-release/2023-07/cactus-ferruginous-pygmy-owl-listed. Accessed: February 2024.

Owl is typically found along desert rivers, washes, and in pristine Sonoran Desert habitats at elevations below 4,000 feet.[27] Minimal habitat for this species exists within the action area.

The California Least Tern typically nests from May to June on open flat beaches, sometimes on mud or sand flats or on dredge spoils.[28] According to IPaC, no critical habitat is designated for the California Least Tern. Minimal habitat exists for this species within the action area.

The Southwestern Willow Flycatcher requires wet vegetative conditions and breeds in dense riparian vegetation near surface water or saturated soils. Nests are typically built in nonnative tamarisk and native willow trees. Patches of riparian habitat are used by the Willow Flycatchers for migration as well as open brushy areas near open water. Threats to the Southwestern Willow Flycatcher are mainly destruction of riparian habitat.[29] Based on the Southwestern Willow Flycatcher's preferred habitat, minimal habitat is available within the action area.

Yellow-Billed Cuckoo habitat exists along riparian systems that are heavily wooded with dense cover that includes low, scrubby vegetation. It should be noted that this long-distance, nocturnal migrant are vulnerable to collisions with tall buildings, cell towers and other structures that exists between southern United States and its wintering spots in South America.[30] Known survey locations of the yellow-billed cuckoo include the Agua Fria National Monument, the Hassayampa River, and Tonto Creek[31]. Habitat for this species may exist within the southern region of the action area.

Yuma Ridgway Rail's habitat requirements include emergent riparian vegetation. Typically, individuals utilize wet substrates with dense herbaceous or woody vegetation for nesting and foraging. These habitats include freshwater marshes dominated by cattail or bulrush, marshes with little residual vegetation, as well as habitats with (less than 12-inches) open water areas. The rail's most important threat includes loss of marsh habitat through channelization, dredging/filling activities, decline in quality of marsh habitat, and selenium contamination of the prey base.[32] Habitat for this species can be found in marshes associated with the Gila River, west of Phoenix, Arizona. Therefore, appropriate habitat is available within the action area.

Data received using the USFWS IPaC system also identified the monarch butterfly as potentially occurring in the action area. Monarchs occur throughout the United States during summer months and is a candidate species for federal listing. The preferred habitat for monarchs is open meadows, fields, and

[27] Center for Biological Diversity. Cactus Ferruginous Pygmy Owl. Natural History. Available: https://www.biologicaldiversity.org/species/birds/cactus_ferruginous_pygmy_owl/natural_history.html. Accessed: February 2024.

[28] California Least Tern. Available: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.104205/Sternula_antillarum_browni. Accessed January 2024.

[29] Southwestern Willow Flycatcher. Available: https://www.nps.gov/articles/southwestern-willow-flycatcher.htm. Accessed January 2024.

[30] USFWS. Yellow-Billed Cuckoo. Available: https://www.fws.gov/species/yellow-billed-cuckoo-coccyzus-americanus. Accessed: February 2024.

[31] Audubon Southwest. The Western Yellow-Billed Cuckoo. Available: https://southwest.audubon.org/birds/western-yellow-billed-cuckoo. Accessed: February 2024.

[32] Yuma Ridgway's rail (Rallus obsoletus yumanensis). Available: https://ecos.fws.gov/ecp/species/3505. Accessed January 2024.

wetland edges with the presence of milkweed and flowering plants. Monarchs are present in Arizona between October and April. The state is a migration path for both the western and eastern populations of monarch butterflies.[33]

3.3.3.2 State Species of Concern

The Arizona Fish and Wildlife Department's Heritage Data Management System database of Special Status Species lists 87 species of amphibians, birds, fish, invertebrates, mammals, plants, and reptiles in Maricopa County.[34] This list (included as **Appendix B**) includes all species that have been identified as special status species, including threatened or endangered species with statewide extinction (Arizona Administrative Code, Chapter 4 – Game and Fish Commission). Species on this list are protected under state law: "It is unlawful for a person to knowingly and without lawful authority under state or federal law import and transport into this state and release within this state a species of wildlife that is listed as a threatened, endangered or candidate species under the endangered species act of 1973 (P.L. 93-205; 87 Stat. 884; 16 United States Code sections 1531 through 1544)".[35]

Because any federally listed species with potential to occur in the action area would be identified in the USFWS official species list, the FAA did not analyze state endangered species that are not included in the official species list for this action area. The likelihood of state-listed species' occurrence in the action area depends on the presence of species' preferred habitats. Much of the action area is densely developed and potential wildlife habitat is limited to riparian and prairie areas south and east of the PADDC.

The state-listed endangered, threatened, and rare species in Maricopa County, Arizona, are presented in **Appendix B**. While these species are listed for Maricopa County, it does not automatically convey that they have the potential to occur in the action area. Additionally, state-listed amphibians, fish, plants and reptiles are included in the list; however, the FAA does not anticipate that these species could be affected as there is no ground disturbance or construction under the Proposed Action.

3.3.3.3 Migratory Birds

Migratory bird species found within the operating area will vary throughout the year. During certain weeks in the spring and fall, hundreds of species of songbirds, raptors, and waterfowl may potentially pass through the operating area. Additionally, several dozen species of birds may potentially nest in the operating area at certain times of the year.

The official species list identifies 13 Birds of Conservation Concern (BCC) that could occur in the operating area, along with information on the likelihood that they may be nesting in the area (see USFWS IPaC in **Appendix B**,). Habitat used by BCC species listed in the action area would occur mostly in grasslands and riparian environments.

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33 Monarch Butterflies and Milkweeds. Available: https://dbg.org/monarch-butterflies-and-milkweeds/. Accessed January 2024.

34 In the Sonoran Sun. Available: https://sonoransun.blogspot.com/2017/05/mobbing-behavior-in-birds.html. Accessed January 2024.

35 Association of Fish & Wildlife Agencies, Endangered species – Enforcement and Penalties. Available: Endangered Species - Enforcement and Penalties - Arizona :: Association of Fish & Wildlife Agencies (fishwildlife.org). Accessed: February 2024.

The Bald Eagle (*Haliaeetus leucocephalus)* is not listed by USFWS as a BCC in the action area, but it is protected under the Bald and Golden Eagle Protection Act and is considered a Key Conservation Species within the state. The Southwestern Bald Eagle Management Committee (SWBEMC) has established "Bald Eagle breeding areas" along certain riparian corridors and lakes in the state including the Salt and Gila River's Bald Eagle Breeding Areas located within the operating area (see **Figure B-1** in **Appendix B**). The National Bald Eagle Management Guidelines state that aircraft should stay at least 1,000 feet from Bald Eagle nests during the breeding season unless the aircraft is operated by a trained wildlife biologist.[36] However, under the Arizona Game and Fish guidance, pilots are reminded to maintain the FAA-recommended 2,000-foot above ground level advisory when flying over known Bald Eagle breeding areas during the nesting season (December 1st through June 30th).

3.3.4 Environmental Consequences

Drones used for commercial package delivery fly at lower speeds and elevations and are smaller than conventional aircraft. Furthermore, the drones would be hovering in fixed positions at both the nest and delivery locations leaving them temporarily exposed to a potential mobbing and/or attacking bird defending its breeding territory.

Bird behavior, in particular mobbing and territorial defense behaviors, on flying and hovering drones is the most important risk consideration analysis, as these behaviors are the most pertinent to the Proposed Action. Mobbing behavior includes birds emitting alarm calls, flying at the predator, diverting its attention, and harassing it. Mobbing and aerial attack behaviors typically occur when a raptor, crow, or other aerial predator enters the airspace of a breeding habitat bird or territorial male.[37] Certain species of birds are known to harass, mob, and attack aerial predators that fly into or near their territory, especially during the breeding season when birds are actively nesting. The defending birds will chase, dive bomb, attack the backside, and vocalize to harass the aerial predator until the offender is far enough from the territory that the defending birds cease attacking and return to their nests and foraging activities.[38] Not all bird species exhibit mobbing and territorial defensive behaviors. Some bird species are more aggressive, defensive, and cued on aerial predators, while other species may show aggression or interest towards an overflying hawk in its territory. Species of birds that exhibit mobbing and territorial defense behaviors include chickadees, titmice, kingbirds, blackbirds, grackles, jays, crows, ravens, and some raptors.[39] The PADDC is designed to be part of an existing storage and distribution facility; as such, no additional construction or ground disturbance would be necessary.

Prime Air's aircraft would not touch the ground in any other place than the PADDC (except during emergency landings) since it remains airborne while conducting deliveries. The operations would be

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36 U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. Available: https://www.fws.gov/sites/default/files/documents/national-bald-eagle-management-guidelines.pdf. Accessed: October 19, 2021 and February 2024.

37 Royal Society for the Protection of Birds (RPSB). 2023. What is Mobbing? Available: https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/birdwatching/bird-behaviour/what-is-mobbing/. Accessed: July 2023 and February 2024.

38 Kalb, N., and C. Randler. 2019. Behavioral Responses to Conspecific Mobbing Calls Are Predator-Specific in Great Tits (Parus major). Ecology and Evolution 9(16):9207–9213. Available: https://doi.org/10.1002/ece3.5467. Accessed February 2024.

39 In the Sonoran Sun. Available: https://sonoransun.blogspot.com/2017/05/mobbing-behavior-in-birds.html. Accessed: January 2024.

taking place within airspace, and typically well above the tree line and away from sensitive habitats. After launch, Prime Air's drone would rise to a cruising altitude between 180 feet and 377 feet AGL and follow a preplanned route to its delivery site. The pre-planned route is optimized to avoid terrain and object obstructions, areas of high aircraft traffic, and areas where people may gather in large numbers such as highways, parks, and schools.

Aircraft would typically stay at 180 to 377 feet AGL or higher except when descending to drop a package. When making a delivery, the aircraft descends, and packages are dropped to the ground from approximately 13 feet AGL. Packages are carried internally in the aircraft's fuselage and are dropped by opening a set of payload doors on the aircraft. After the package is dropped the drone then climbs vertically to approximately 180 to 377 feet and reverses the path taken, returning to the takeoff/landing pad at the PADDC. The drone would take approximately 53 seconds to complete a delivery, which includes the descent from en route altitude, dropping the package, and returning back to en route altitude. As a result, the duration of exposure by most wildlife on the ground to the visual or noise impacts from the drone would be of very short duration (less than a minute).

It is not likely that listed species would be in the vicinity of the delivery location because such locations would be developed areas. However, even if species were expected to be exposed to this noise level, the noise would be unlikely to cause significant disturbance (for context, a drone overflight at 50 feet is approximately 74.2 decibels, whereas a leaf blower at 50 feet is approximately 73 to 77 decibels).[40] At a potential maximum of 469 flights per day across the entire action area, the distribution and altitude of the flights are not expected to significantly affect wildlife in the action area.

A significant impact on federally listed threatened and endangered species would occur when the USFWS or NMFS determines the proposed action would be likely to ***jeopardize*** the continued existence of a federally listed threatened or endangered species or would be likely to result in the destruction or adverse modification of federally designated critical habitat. An action need not involve a threat of extinction to federally listed species to meet the NEPA standard of significance. Lesser impacts, including impacts on non-listed or special-status species, could also constitute a significant impact.

Additionally, the FAA has looked at the potential effects of wildfires that may be caused by the Proposed Action. While the Prime Air drone has been evaluated for airworthiness and is considered to be safe for the proposed operations over the operating area, the FAA acknowledges that a crash may occur and could result in a wildfire. Amazon Prime Air will use system reported data to locate and report an off-nominal drone and will follow their Safety Management System's prescribed Incident Response Process to coordinate with local first responders as required.

The FAA understands that Prime Air would immediately notify local emergency fire response services if one of its drones were to crash, and that fire responders would be able to manage any wildfire that could occur before the wildfire could cause significant impacts to biological resources in the operating area.

[40] Appendix E: Noise Assessment Amazon Prime Air MK27-2 Unmanned Aircraft Operations at Tolleson, AZ, Table 10 and Characteristics of Lawn and Garden Equipment Sound: A Community Pilot Study (National Institutes of Health) (National), December 2017, Available https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6707732/, Table 2.

3.3.4.1 No Action Alternative

Under the No Action Alternative, as described in **Section 1.2**, the FAA would not issue the approvals necessary to enable Prime Air to conduct up to 171,329 commercial drone package delivery operations per year in the Tolleson, AZ area. Accordingly, the No Action Alternative would not result in impacts on biological resources.

3.3.4.2 Proposed Action

The Proposed Action includes up to 469 MK30 drone flights per day, up to 365 days per year, operating between 7 A.M. and 10 P.M. There would be no ground construction or habitat modification associated with the Proposed Action. The drone would not touch the ground in any other place than the PADDC (except during emergency landings) because it remains aerial while conducting deliveries. Scheduled deliveries would initiate from the nest, approach an en route altitude less than 400 feet AGL, and would generally occur between 180 and 377 feet AGL. The drone would lower to around 13 feet AGL and hover for two seconds to make a delivery. Then, the drone would ascend and transition back to an en route flight mode to return to the PADDC.

Operations would occur mostly in an urban environment, typically well above the tree line and away from sensitive habitats and given the short duration of increased ambient sound levels, flights are not expected to significantly influence wildlife in the area. A direct line of communication would be established with Arizona's Game and Fish Department to discuss any potential concerns regarding impacts on wildlife or habitat in the action area. In addition, Prime Air would also specifically coordinate with the managing entities of state parks and natural areas within the action area on the thoughtful placement and use of delivery sites within these areas as necessary.

3.3.4.3 Special Status Species

The Monarch Butterfly, a candidate for federal listing, has the potential to occur in the operating area. Information regarding drone impacts on insects is limited and there have been no widespread negative impacts identified in the scientific literature. Some research shows that Monarch Butterflies are not commonly observed at higher AGL altitudes and would not be expected to frequently occur at the altitudes where Prime Air is proposing to operate.[41]

The federally-threatened species Cactus Ferruginous Pygmy Owl is a non-migrating species that lives along desert rivers and washes, mostly in the Sonoran Desert Habitat of southern Arizona and in northwestern Mexico, at elevations below 4,000 feet.[42] They primarily live in cavities of trees or cacti like the saguaro and organ pipe, in holes often made by woodpeckers. Once common in Arizona from the New River north of Phoenix to the Mexican border, now this owl is only found between Tucson and points south.[43] Given the restricted range of this species (over 150 miles southeast of Tolleson) due to

41 Altitudes attained by migrating monarch butterflies, Danaus p. plexippus (Lepidoptera: Danaidae), as reported by glider pilots. Available: https://cdnsciencepub.com/doi/abs/10.1139/z81-084. Accessed April 2022 and February 2024.

42 Arizona Center for Nature Conservation, Phoenixzoo. Cactus Ferruginous Pygmy-Owl. Available: Cactus Pygmy Owl Conservation | Phoenix Zoo. Accessed: February 2024.

43 Center for Biological Diversity, Cactus Ferruginous Pygmy Owl Natural History. Available: https://www.biologicaldiversity.org/species/birds/cactus_ferruginous_pygmy_owl/natural_history.html. Accessed: February 2024.

habitat fragmentation, habitat destruction/conversion, and climate change, it is not anticipated that the Proposed Action would affect the life cycle of the Cactus Ferruginous Pygmy Owl, therefore, *no effect* will occur to this species as a result of the Proposed Action.

The California Least Tern is a federally listed species that can be found in various habitats throughout Arizona. Although they are mostly associated with coastal areas, these gulls can be seen near beaches, marshes, lakes, rivers, and agricultural fields and have even adapted to diverse environments within urban areas.[44] Although California Least Terns may be found throughout sections of Arizona, the action area supports minimal habitat. Therefore, it is anticipated that a *may effect, not likely to adversely affect* determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

Southwestern Willow Flycatchers are federally listed as endangered. This species requires dense riparian habitats and is typically found below 8,500 feet in elevation. Although the USFWS IPaC did not identify critical habitat for this species within the action area, critical habitat was identified for the County of Maricopa.[45] Although habitat may be present within the action area (specifically along the Agua Fria River to the east and the Gila and Salt Rivers to the south) this species forages and nests in thick, undisturbed habitat within wetlands and streams. Considering the typical delivery locations and flight protocols for delivery within the action area (housing and developed communities within upland areas), incursions with this species is not expected. Although incursions are not anticipated, the Southwestern Willow Flycatcher breeds in riparian habitat across the southwest, therefore, although the action area may support minimal habitat for this neotropical migrant, it is anticipated that a *may effect, not likely to adversely affect* determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

The Yellow-Billed Cuckoo is listed as a federally threatened species that also utilizes thick riparian habitat that can include abandoned farmland and tickets, nesting near streams and rivers and foraging on insects and small wild fruits.[46] As with the Southwestern Willow Flycatcher, the Yellow-Billed Cuckoo prefers habitat that is similar to the southern portion of the action area, where progressive development has not occurred. Considering the typical delivery locations and flight protocols for delivery within the action area (housing and developed communities within upland areas), incursions with this species is not expected. However, the Yellow-Billed Cuckoo is a long-distance, nocturnal migrant that is vulnerable to collisions, therefore, it is anticipated that a *may effect, not likely to adversely affect* determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

Yuma Ridgway’s Rail is a federally-endangered species that is found in marshes of the lower Colorado River, the Salton Sea in California, the Ciénega de Santa Clara in Mexico, and the Gila River west of

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44 Gulls and Terns: A Guide to Arizona’s Diverse Bird Family. Available: https://www.bing.com/search?q=do+mud+flats+for+california+terns+exist+in+arizona&form=ANNH01&refig=9327cc8f059247d8b05e3adc6ed51de1&pc=LCTS&ntref=1. Accessed: February 2024.

45 USFWS. Southwestern Willow Flycatcher. Available: https://www.fws.gov/species/southwestern-willow-flycatcher-empidonax-traillii-extimus. Accessed: February 2024.

46 USFWS. Yellow-Billed Cuckoo. Available: https://www.fws.gov/species/yellow-billed-cuckoo-coccyzus-americanus. Accessed: February 2024.

Phoenix, Arizona.[47] This species of rail is secretive and rarely seen, completing their lifecycles within marshes, preferring stands of cattail and bulrush and eating crayfish and other invertebrates.[48] Although this species may be found in the southern portion of the action area (specifically within the Gila River corridor) incursion with this species is not expected given the species habitat and considering the typical delivery locations and flight protocols for delivery. However, since habitat does exist within the action area, *a may effect, not likely to adversely affect* determination for this migrant species is appropriate as the impacts are considered insignificant for the proposed action.

The FAA electronically submitted a Section 7 consultation letter to the USFWS on April 29, 2024, which is included in **Appendix B**. The FAA and Prime Air are currently coordinating with USFWS staff to determine the following: time of day drone operating window, en route drone speed, and the need for and extent of possible wildlife habitat assessments/surveys. As these program elements are more fully defined during the consultation process, Section 3.3, and potentially other sections of this EA, will be updated accordingly. The Final EA will document the results of the consultation process.

3.3.4.4 Migratory Birds

Prime Air would monitor the operating area for any active Bald Eagle nests that may occur. Bald Eagle nests are typically very conspicuous, usually five to nine feet in diameter, with a vertical depth up to eight feet, and Prime Air should be able to visually identify any nests that may be present in the area.[49] Online resources such as iNaturalist may also be used to identify Bald Eagle nests that may be active in the operating area. At this time, two Bald Eagle Breeding Areas, located along the Salt and Gila Rivers are within the operating area (please refer to **Figure B-1** in **Appendix B**). As stated under Arizona Game and Fish guidance, pilots are reminded to maintain the FAA-recommended 2,000-foot above ground level advisory when flying over known Bald Eagle breeding areas during the nesting season (December 1st through June 30th). If Prime Air identifies additional Bald Eagle nests or is notified of the presence of a nest by a state regulator or naturalist group, Prime Air will establish an avoidance area such that there is at least 2,000 feet from an active Bald Eagle nest during the breeding season, or a qualified biologist indicates the nest has been vacated.

The other BCC species identified in the IPaC official species list breed in a variety of habitats and a majority of these species are not likely to be nesting out in the open and within close proximity to human presence. These other BCC species typically nest in or on the edge of forests / woodlands, desert grasslands and woodlands, and riparian corridor environments that are not within close proximity to locations where the Prime Air drone will be completing its ascent and descent. Additionally, the drone's en route overflights are not expected to result in effects to any lifecycles of these species.

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[47] Audubon Southwest. Finding the Yuma Ridgway's Rail. Available: https://southwest.audubon.org/finding-yuma-ridgways-rail. Accessed: February 2024.

[48] Audubon Southwest. Yuma Ridgeways' Rail Conservation. Available: https://southwest.audubon.org/our-work/water/yuma-ridgways-rail. Accessed: February 2024.

[49] USFWS Midwest Region: Identification of Large Nests. Available: https://www.fws.gov/midwest/eagle/Nhistory/nest_id.html. Accessed: December 13, 2021.

Due to the limited operating area and proposed number of daily operations, occasional drone overflights at approximately 180 to 377 feet AGL are not expected to impact critical lifecycles of wildlife species or their ability to survive.

An Affects Determination Table (**Table 3-2**) for the Federally-listed species discussed can be found below.

TABLE 3-2
AFFECTS DETERMINATION TABLE

Common Name	Species Name	Federal Status	Affects Determination
Cactus Ferruginous Pygmy Owl	*Glaucidium brasilianum cactorum*	Threatened	*No Effect*
California Least Tern	*Sternula antiliarum browni*	Endangered	*Not Likely to Adversely Affect (NLAA)*
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	*Not Likely to Adversely Affect (NLAA)*
Yellow-Billed Cuckoo	*Coccyzus americanus*	Candidate	*Not Likely to Adversely Affect (NLAA)*
Yuma Ridgway's Rail	*Rallus obsoletus yumanensis*	Endangered	*Not Likely to Adversely Affect (NLAA)*
Monarch butterfly	*Danaus plexippus*	Candidate Species	*No Effect*

SOURCE: FAA, 2024.

Accordingly, the Proposed Action is not expected to cause any of the following impacts:

- A long-term or permanent loss of unlisted plant or wildlife species, i.e., extirpation of the species from a large project area;
- Adverse impacts to special status species (e.g., state species of concern, species proposed for listing, migratory birds, bald and golden eagles) or their habitats;
- Substantial loss, reduction, degradation, disturbance, or fragmentation of native species' habitats or their populations; or
- Adverse impacts on a species' reproductive success rates, natural mortality rates, non-natural mortality (e.g., road kills and hunting), or ability to sustain the minimum population levels required.

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

3.4.1 Definition of Resource and Regulatory Setting

Section 4(f) of the U.S. Department of Transportation (DOT) Act (codified at 49 U.S.C. § 30I)) protects significant publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historic sites. Section 4(f) states that "…[the] Secretary of Transportation may approve a transportation program or project requiring the use of any publicly owned land from a public park, recreation area, or wildlife or waterfowl refuge of national, state, or local significance or land from a historic site of national, state, or local significance, only if there is no feasible and prudent alternative to the use of such land and the program or project includes all possible planning to minimize harm resulting from the use."

The word "use" can mean either a physical or constructive use. A physical use is the actual physical taking of a Section 4(f) property through purchase of land or a permanent easement, physical occupation of a portion or all of the property, or alteration of structures or facilities on the property. A "constructive" use does not require a physical taking of a Section 4(f) property. A constructive use would occur when a project would produce an effect, such as excessive noise, that would result in substantial impairment to a property to the degree that the activities, features, or attributes of the property 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 being used for a Proposed Action.

The procedural obligations for Section 4(f) compliance are outlined in DOT Order 5610.1C, *Procedures for Considering Environmental Impacts*. Additionally, the FAA adheres to the regulations and guidance provided by the Federal Highway Administration (FHWA) when evaluating potential impacts on Section 4(f) properties.[50, 51] While these requirements are not obligatory for the FAA, they may be utilized as guidance to the extent that they are applicable.[52]

3.4.2 Affected Environment

The FAA used data from federal, state, and other publicly accessible sources to identify potential Section 4(f) resources within the study area, as shown in **Table C-1** of **Appendix C**. The FAA identified a total of 98 properties that could meet the definition of a Section 4(f) resource, including public parks administered by federal, state, city, and county authorities. Historic and cultural resources are addressed by both Section 4(f) and the National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. § 470, as amended), and are discussed further in **Section 3.5**. Additionally, the FAA requested assistance from national, state, city, and county governments in identifying the appropriate stakeholders that likely have an interest in the project and its effects on Section 4(f) resources. The entities with Section 4(f) regulatory interest, such as Bureau of Land Management, U.S. Fish and Wildlife Service, Arizona Fish and Game Department, Maricopa County, City of Phoenix, City of Goodyear, City of Tolleson, City of Avondale, City of Litchfield Park, and City of Glendale, were informed of the Proposed Action and the opportunity to provide comments via the Notice of Availability, which was electronically distributed to them on July 12, 2024.

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50 FHWA, July 20, 2012. Section 4(f) Policy Paper. Office of Planning, Environment and Realty Project Development and Environmental Review, Washington, DC. Available at: https://www.environment.fhwa.dot.gov/legislation/section4f/4fpolicy.aspx.

51 23 CFR Part 774, Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and historic Sites (Section 4(f)).

52 Further details about the DOT Act and Section 4(f) can be accessed in 23 CFR Part 774 et seq.

3.4.3 Environmental Consequences

3.4.3.1 No Action Alternative

Under the No Action Alternative, as described in **Section 1.2**, the FAA would not issue the approvals necessary to enable Prime Air to conduct commercial drone package delivery operations in the Tolleson, AZ area. Accordingly, the No Action Alternative would not result in impacts on Section 4(f) resources.

3.4.3.2 Proposed Action

Under the Proposed Action, the FAA would amend Prime Air's OpSpec to enable commercial drone package deliveries. There would be no physical use of Section 4(f) resources because the Proposed Action has no direct interaction with any resources on the ground. Constructive use could occur when a project would produce an effect, such as excessive noise, that would result in substantial impairment to a property where the features of that property are substantially diminished. However, as discussed in **Section 3.6**, the Proposed Action would not result in a significant increase in noise levels at any location within the study area. As further described in **Section 3.8**, the short duration of en route flights would minimize any potential for significant visual impacts. Therefore, the FAA has determined that the Proposed Action would not cause substantial impairment, *physical* or *constructive* use, as defined in **Section 3.4.1**, to any Section 4(f) resources in the study area.

3.5 Historical, Architectural, Archaeological, and Cultural Resources

3.5.1 Regulatory Setting

This section discusses historic, architectural, archaeological, and cultural resources within the study area. These resources reflect human culture and history in the physical environment, and may include structures, objects, and other features important in past human events. Cultural resources can also include characteristics of the physical environment such as natural features and biota that are important to traditional cultural practices and institutions.

The primary laws pertaining to the treatment of historic, architectural, archaeological, and cultural resources during environmental analyses are the *National Historic Preservation Act of 1966* (NHPA) (54 U.S.C. §§ 300101 *et seq*.), the *Archaeological Resources Protection Act* (16 U.S.C. §§ 470aa-470mm), and the *Native Graves Protection and Repatriation Act* (25 U.S.C. §§ 3001-3013).

Section 106 of the NHPA requires federal agencies with jurisdiction over a proposed federal action (referred to as an "undertaking" under the NHPA) to take into account the effects of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on any undertaking that would adversely affect properties eligible for listing in the National Register of Historic Places (National Register). The term "historic properties" describes "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register" (36 CFR § 800.16(l)(1)).

As documented in the 1050.1F Desk Reference, the regulations implementing Section 106 require the FAA to consult with certain parties, such as the State Historic Preservation Office (SHPO) and the Tribal

Historic Preservation Officer (THPO) of a Federally Recognized Indian Tribe pursuant to Section 1010(d)(2) of the NHPA. Consultation with THPO(s) occurs if an undertaking is occurring on tribal lands or if an undertaking's Area of Potential Effects (APE) is located outside tribal lands but include historic resources of religious and cultural significance to a tribe. The purpose of consultation is to identify potentially affected historic properties, assess effects to such properties, and seek ways to avoid, minimize, or mitigate any adverse effects on such properties. The agency also must provide an opportunity for public involvement (36 CFR § 800.1(a)). Consultation with Federally Recognized Indian Tribes regarding issues related to Section 106 must recognize the government-to-government relationship between the Federal Government and Native American tribes as set forth in Executive Order (EO) 13175, "*Consultation and Coordination with Indian Tribal Governments*" and the Presidential Memorandum on Tribal Consultation, dated November 5, 2009.

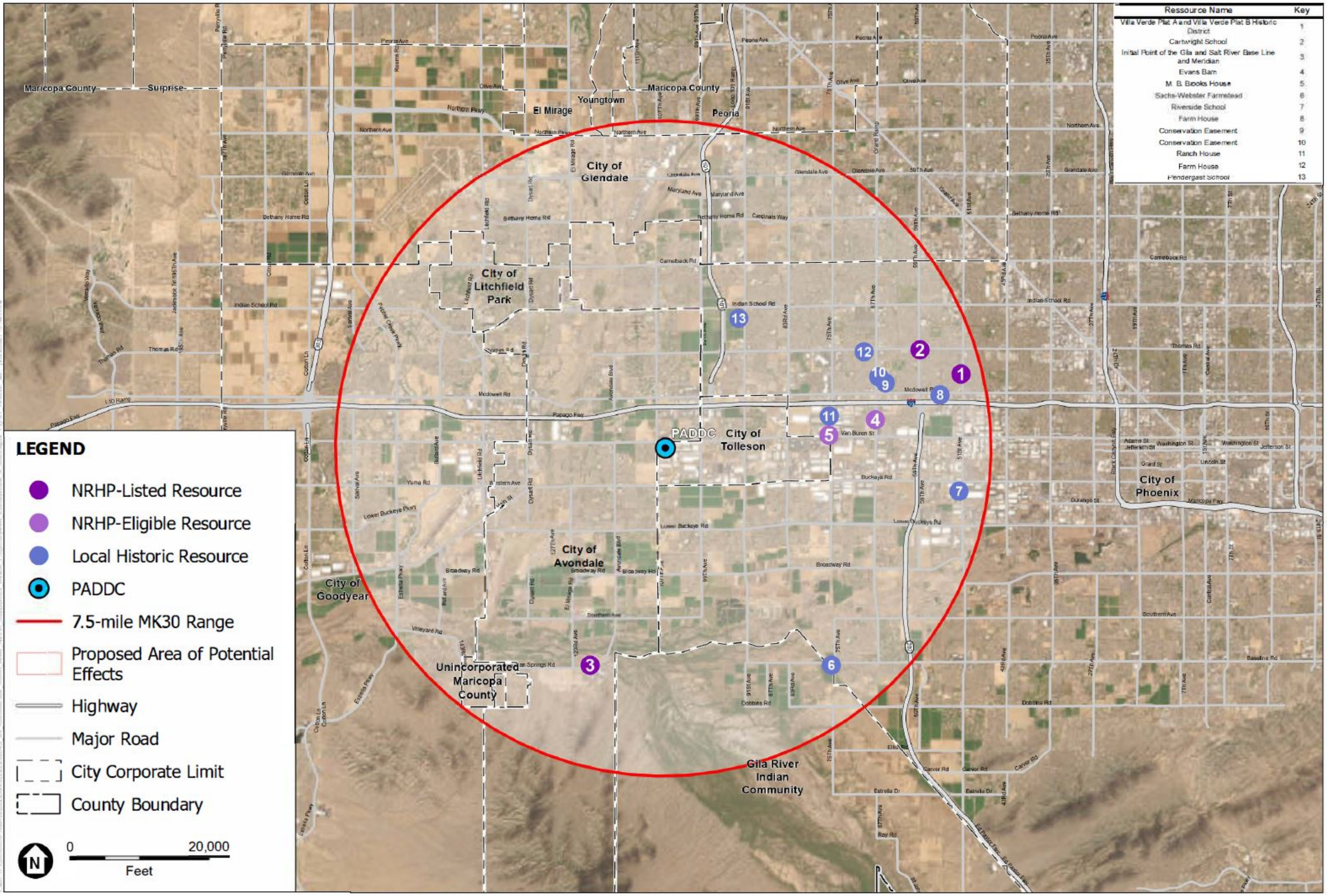
Consultation under Section 106 is not required if the undertaking has no potential to affect historic properties. The regulations implementing Section 106 state: "If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under section 106 of this part." (36 CFR § 800.3(a)(1)).

As discussed in FAA Order 1050.1F, the FAA has not established a significance threshold for Historical, Architectural, Archaeological, and Cultural Resources. Whether an action would result in a finding of adverse effect through the Section 106 process is a consideration when assessing the significance of an impact. However, a finding that an adverse effect has occurred does not necessarily mean an impact is significant; nor would it necessarily require the preparation of an Environmental Impact Statement. Should an adverse effect be determined to have occurred, the Section 106 process would be resolved through a Memorandum of Agreement (MOU) or Programmatic Agreement (PA) to record resolution measures to mitigate or minimize adverse effects.

3.5.2 Affected Environment

An APE was established pursuant to 36 CFR § 800.4(a) which encompasses approximately 175 square miles occurring within a 7.5-mile radius surrounding the PADDC. The APE is depicted in **Figure 3-1**. According to geospatial data published by the National Park Service, there are three historic resources listed in the National Register located in the APE. Additionally, there are two National Register-eligible resources, and eight resources of local significance located in the APE. The historic and cultural attributes of these sites are unlikely to be affected by drone overflights. Historic resources occurring within the APE are listed in **Table D-1** of **Appendix D**.

In accordance with 36 CFR § 800.4(a)(1) and (d)(1), the FAA and Amazon Prime Air are currently consulting with the Arizona SHPO and the results of that consultation will be documented in the Final EA. The FAA also consulted with Tribal Governments, on May 6, 2024, that may potentially attach religious or cultural significance to resources in the APE. A copy of representative correspondence with the tribes is included in **Appendix D**, as well as a complete listing of all Tribal Governments consulted.



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023; National Park Service, 2023; City of Phoenix, 2024.

Draft Environmental Assessment for Amazon Prime Air – Tolleson, AZ

Figure 3-1
Historical, Architectural, Archaeological, and Cultural Resources
Tolleson, AZ

ESA

3.5.3 Environmental Consequences

3.5.3.1 No Action Alternative

Under the No Action Alternative, as described in **Section 1.2**, the FAA would not issue the approvals necessary to enable Prime Air to conduct commercial drone package delivery operations in the Tolleson, AZ area. Accordingly, the No Action Alternative would not result in impacts on historical, architectural, archaeological, and cultural resources.

3.5.3.2 Proposed Action

The effect of drone operations on historic properties would be limited to non-physical, reversible impacts such as the introduction of audible and/or visual elements. The number of daily drone operations would be limited such that any historic or cultural resource would only be subject to a small number of overflights per day. Furthermore, as described in **Section 3.6**, a noise analysis concluded that noise levels would be below the FAA's threshold for significance, even in areas with the highest noise exposure. As documented in **Appendix D**, on July 2, 2024, the FAA requested concurrence from the Arizona SHPO that the Proposed Action would result in "*no historic properties affected*."

3.6 Noise and Noise-Compatible Land Use

3.6.1 Regulatory Setting

Aircraft noise is often the most noticeable environmental effect associated with any aviation project. Several federal laws, including the Aviation Safety and Noise Abatement Act of 1979, as amended (49 U.S.C. §§ 47501-47507) regulate aircraft noise. Through 14 CFR Part 36, the FAA regulates noise from aircraft. To ensure that noise would not cause a significant impact to any residential land use or noise sensitive resource within the study area, the FAA initiated an analysis of the potential noise exposure in the area that could result from implementation of the Proposed Action.

FAA Order 1050.1F, Appendix B, Paragraph B-1.3 requires the FAA to identify the location and number of noise sensitive areas that could be significantly impacted by noise. As defined in FAA Order 1050.1F, Paragraph 11-5b, *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."

Sound is measured in terms of the decibel (dB), which is the ratio between the sound pressure of the sound source and 20 micropascals, which is nominally the threshold of human hearing. Various weighting schemes have been developed to collapse a frequency spectrum into a single dB value. The A-weighted decibel, or dBA, corresponds to human hearing accounting for the higher sensitivity in the mid-range frequencies. Unless otherwise noted, all sound levels discussed in this document should be understood to be A-weighted.

To comply with NEPA requirements, the FAA has issued requirements for assessing aircraft noise in FAA Order 1050.1F, Appendix B. The FAA's primary noise metric for aviation noise analysis is the yearly DNL metric. The DNL metric is a single value representing the logarithmically average aircraft sound level at a location over a 24-hour period, with a 10 dB adjustment added to those noise events occurring from 10:00 P.M. and up to 7:00 A.M. the following morning. A significant noise impact is defined in Order 1050.1F as an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure or a noise exposure at or above the 65 dB level due to a DNL 1.5 dB or greater increase at a noise sensitive receiver (e.g. residential).

3.6.2 Affected Environment

As shown in **Figure 2-1**, the study area is approximately 175 square miles, and the estimated population within the area is roughly 509,000. The population density is approximately 2,900 persons per square mile.[53] There are four airports and six heliports located in the proposed MK30 operating area, including[54]:

- Phoenix Goodyear Airport, 1658 S. Litchfield Rd., Goodyear, AZ
- Glendale Municipal Airport, 6801 N. Glen Harbor Blvd., Glendale, AZ
- Luke Air Force Base, 14185 Falcon St, Luke AFB, AZ
- Airscrew Performance Flightpark, 7308 W. Griffin Ln., Glendale, AZ
- West Valley Medical Center Heliport, 13677 W. McDowell Rd., Goodyear, AZ
- Boulais Heliport, 5346 N. 91st Ave., Glendale, AZ
- State Farm Stadium Heliport, 1 Cardinals Dr., Glendale, AZ
- Banner Estrella Medical Center Heliport, 9201 W. Thomas Rd., Phoenix, AZ
- Westridge Mall Heliport, 7611 W. Thomas Rd., Phoenix, AZ
- S R P Tolleson Center Heliport, 221 N. 79th Ave., Tolleson, AZ

3.6.3 Environmental Consequences

3.6.3.1 No Action Alternative

Under the No Action Alternative, as described in **Section 1.2**, the FAA would not issue the approvals necessary to enable Prime Air to conduct commercial drone package delivery operations in the Tolleson, AZ area. Accordingly, the No Action Alternative would not result in impacts on compatible land use.

3.6.3.2 Proposed Action

Human perception of noise depends on a number of factors, including overall noise level, number of noise events, the extent of audibility above the background ambient noise level, and acoustic frequency content (pitch).[55] Drone noise generally has high frequency acoustic content, which can often be more discernable from other typical noise sources.

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53 Environmental Protection Agency's (EPA) Environmental Justice Screening Tool (EJSCREEN). Available: https://www.epa.gov/ejscreen. Accessed: February 7, 2024.

54 It is necessary to evaluate the cumulative noise exposure in areas subject to other aviation noise sources.

55 Federal Aviation Administration, Fundamentals of Noise and Sound. Available: https://www.faa.gov/noise/aviation_noise/fundamentals_of_noise. Accessed: April 30, 2024.

To ensure that noise would not cause a significant impact to any noise sensitive area within the action area, the FAA initiated an analysis of the potential noise exposure in the area that could result from implementation of the Proposed Action. Away from the actual PADDC property, the rural, commercial, and residential properties surrounding the PADDC location are likely to experience the highest noise levels as a result of the Proposed Action. This is due to noise from drone departures and arrivals, as well as more concentrated en route noise from the aircraft.

3.6.3.3 Noise Exposure

Since-the MK30 drone is still under development and final noise data is not yet available, a more conservative approach was taken that uses the MK27-2 noise data to assess potential environmental impacts associated with the Proposed Action. This ensures that the noise impact of the MK30 (which was demonstrated during acoustical testing to be quieter than the MK27-2) falls within the analyzed parameters and supports the Proposed Action. The measured difference in Maximum A-Weighted Level (Lmax)[56] for the MK30 drone during the takeoff and landing phase of flight was between 5 and 7 dB lower than the MK27-2 drone, and the measured Sound Exposure Level (SEL)[57] was lower in all cases for the MK30 when compared to the MK27-2. The measured Lmax for the MK30 drone during the forward flight flyover phase were equivalent or lower when compared to the MK27-2.

The flight profiles between the MK27-2 and MK30 are also similar in nature, in that they both perform a VTOL climb, a transition to fixed-wing flight en route to backyard, transition back to VTOL for descent into the backyard for delivery at 13 feet AGL, followed by the same maneuvers to return to the PADDC. Differences between the drones are shown in the manner at which they operate in each phase of flight. For example, the MK30 en route altitude is between 200 feet and 345 feet AGL as compared to the 160-foot AGL en route altitude of the MK27-2. In addition to the increased altitudes of the MK30, the ground speed also increased from 52.4 to 58.3 knots. Additional information on the drone comparison, noise measurement methodology, and results can be found in **Appendix E.**

To this end, it is determined that the MK27-2 noise exposure data would be used for this EA noise analysis. It is expected that the noise generated by the MK27-2 is equivalent to or louder than the MK30, therefore, this substitution represents a more conservative approach to estimating community noise exposure. Importantly, this substitution ensures that the noise exposure values presented in this EA are higher than what is expected to occur when the MK30 drone is deployed into delivery service. Utilizing the operational projections defined in **Chapters 1** and **2**, the noise analysis methodology detailed in **Appendix E** was then used to estimate DNL levels for the proposed Tolleson operations. Noise levels were calculated for each flight phase and are presented in the following three sub-sections:

- Noise Exposure for PADDC Operations
- Noise Exposure for En route Operations
- Noise Exposure for Delivery Operations

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[56] Lmax is defined as the maximum, or peak, sound level during a noise event, expressed in decibels. The metric only accounts for the highest A-weighted sound level measured during a noise event, not for the duration of the event.

[57] SEL is defined as the sound energy of a single noise event at a reference duration of one second, expressed in decibels. The sound level is integrated over the period that the level exceeds a threshold. Therefore, SEL accounts for both the maximum sound level and the duration of the sound.

Noise Exposure for PADDC Operations

Based on the anticipated average daily maximum of 469 deliveries provided by Prime Air, the extent of noise exposure associated with PADDC operations is shown in **Figure 3-2**. This region was determined based on a review of the layout of the Tolleson PADDC location and using the noise level information presented in Table 8 of the Noise Technical Report in **Appendix E**. **Table 3-3** provides the extent of noise exposure for nest operations for the DNL 65 dB and lower noise levels.

TABLE 3-3
ESTIMATED EXTENT OF NOISE EXPOSURE FROM PADDC

Annual Average Daily DNL Equivalent Deliveries	Annual DNL Equivalent Deliveries	DNL 50 dB	DNL 55 dB	DNL 60 dB	DNL 65 dB
≤480	≤175,200	1,100 feet	450 feet	250 feet	150 feet

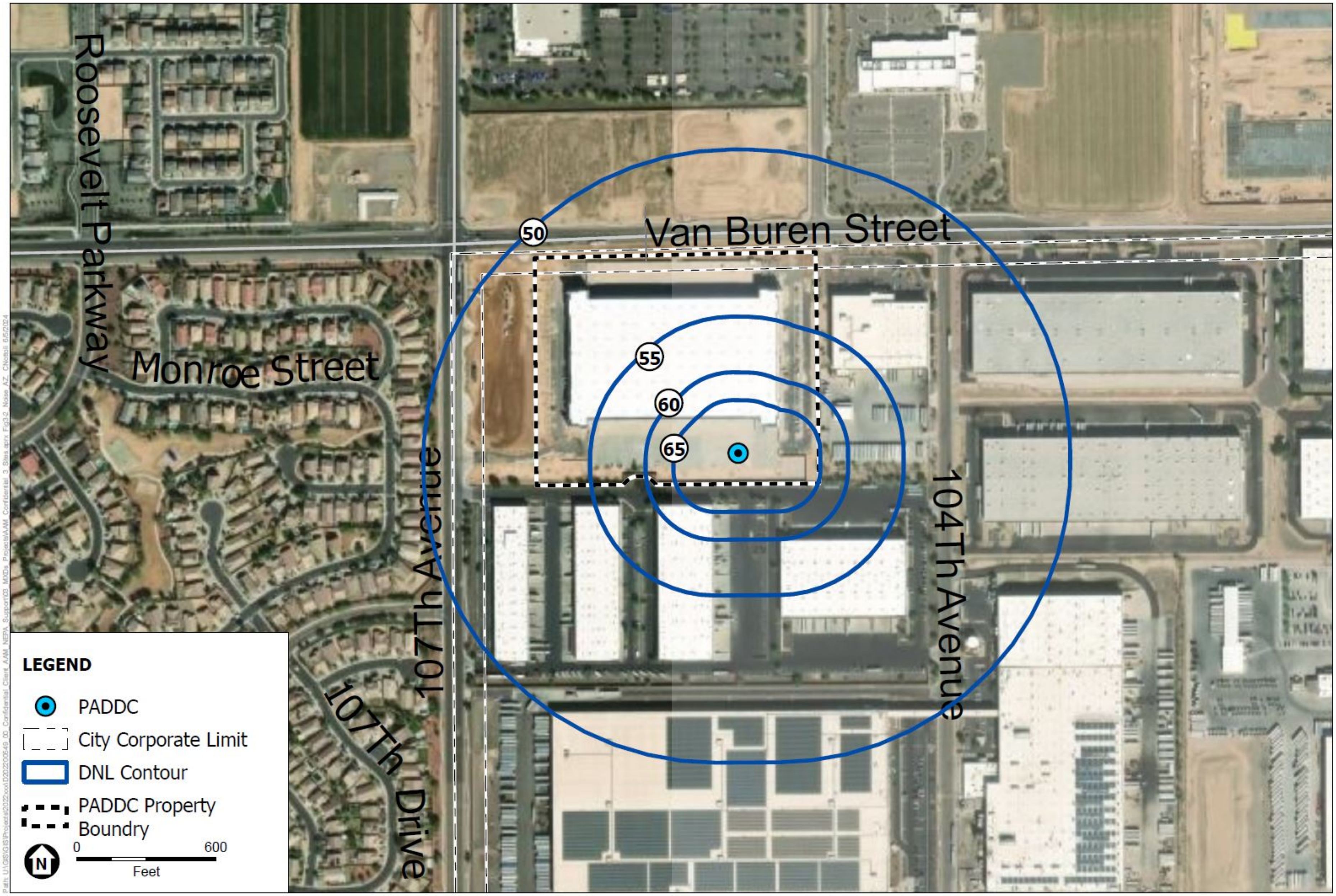
Source: ESA, 2024.

Noise Exposure for En Route Operations

As described in the Noise Technical Report in **Appendix E**, the drone is expected to typically fly the same outbound flight path between the PADDC and the delivery point and inbound flight path back to the PADDC. While the average daily deliveries from the PADCC is 469, the number of overflights in a day will be dispersed because the PADCC is centrally located in the proposed operating area and delivery locations would be distributed throughout the proposed operating area. A conservative estimate for the maximum number of overflights over any one location would be half, or 235 daily overflights. The en route noise exposure can be determined by referencing **Tables 9** and **10** of the Noise Technical Report in **Appendix E**. This analysis shows that en route noise levels could reach DNL 45 dB in any location within the action area.

Noise Exposure for Delivery Operations

Due to the inherent uncertainty of the exact delivery site locations, the noise analysis developed a minimum and maximum representative distribution of deliveries in the study area. The noise analysis conservatively assumes the minimum and maximum distribution of average daily deliveries that could occur at a single delivery location. The distribution of average annual daily deliveries ranges from 0.1 to 4.0 deliveries per operating day. The noise exposure for delivery operations also includes en route overflights at the lower end of the typical operating altitude of 165 feet AGL, as modeled, for operations associated with deliveries to other locations. En route flight altitudes for the MK30 are expected to be flown at higher altitudes than what was modeled.



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

Figure 3-2
PADDC Noise Exposure Contours
Tolleson, AZ

ESA

A conservative estimate of delivery noise exposure can then be determined by referencing **Table 11** of the Noise Technical Report in **Appendix E**. The estimated delivery DNL includes values at the minimum and maximum distribution of DNL equivalent deliveries at various distances from the delivery point. They include the minimum listener distance from the delivery point at 16.4 feet, which is representative of the closest distance a person may approach before the aircraft takes automated actions to safely cancel the delivery. This is in addition to the minimum measured distance from the drone for which noise measurement data was available for a delivery, which is 32.8 feet. Values were also calculated at distances of 50 feet, 75 feet, 100 feet, and 125 feet from the delivery point, and are representative of distances from which nearby properties may experience noise from a delivery based on the average lot size for sold homes as reported in the 2022 US Census.[58] The noise exposure for any one delivery point (with en route noise, as mentioned above) is provided in **Table 3-4**. Noise exposure from deliveries is shown graphically in **Figure 3-3**. The noise exposure is depicted over the PADDC but is only representative of a maximum of five deliveries at any one delivery point.

TABLE 3-4
DNL FOR DELIVERY LOCATIONS BASED ON MAXIMUM DELIVERIES PER LOCATION

Average Daily DNL Equivalent Deliveries	Annual DNL Equivalent Deliveries	Estimated Delivery DNL at 16 Feet[1]	Estimated Delivery DNL at 32.8 Feet[2]	Estimated Delivery DNL at 50 Feet	Estimated Delivery DNL at 75 Feet	Estimated Delivery DNL at 100 Feet	Estimated Delivery DNL at 125 Feet
≤5	≤1,825	58.1	54.7	53.7	52.2	50.2	48.6

NOTES:
1. Minimum possible listener distance from drone.
2. Minimum measured listener distance.
3. Assumes conservative estimate of 235 overflights over any one delivery location as mentioned above.

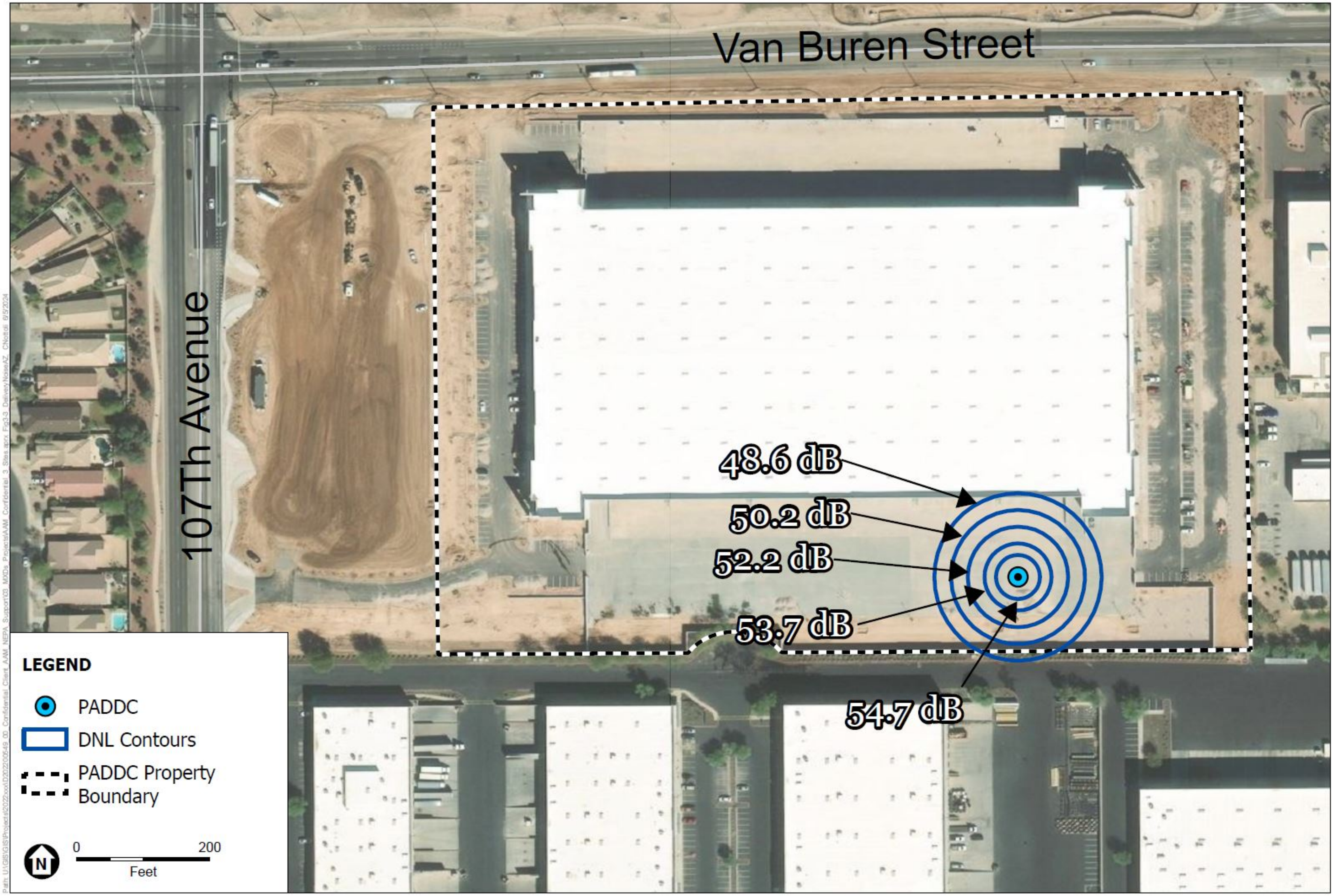
SOURCE: ESA, 2024.

Table 3-4 shows that, with the maximum number of average annual daily deliveries at a single location, including overflights, noise levels approaching DNL 49 dB could extend beyond 125 feet from the delivery location and may reach adjacent properties. However, these noise levels would not exceed the FAA's significance threshold for noise of DNL 65 dB in any of the areas where Prime Air anticipates providing deliveries.

3.6.3.4 Total Noise Exposure Results

The maximum noise exposure levels within the study area would occur at the PADDC site where noise levels at or above DNL 50 dB would extend approximately 1,100 feet from the Tolleson PADDC. Noise levels at or above DNL 65 dB would extend approximately 150 feet from the PADDC, although this is within the PADDC property. Additionally, the estimated noise exposure for en route operations could reach DNL 45 dB at any location within the action area, and the estimated noise exposure for delivery operations, including en route overflights, would not have the potential to exceed DNL 55 dB at any location in the action area and is below the FAA's threshold of significance for noise.

58 The 2022 US Census national average lot size for single-family sold homes was 15,265 square feet. This is representative of a property with dimensions of a 123.55 x 123.55-foot square. 125 feet represents a 125-foot lateral width of the parcel rounded up to the nearest 25 feet. Available: https://www.census.gov/construction/chars/xls/soldlotsize_cust.xls. Accessed: January 18, 2024.



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

Figure 3-3
Noise Exposure Contours Based on Maximum Deliveries Per Location
Tolleson, AZ

ESA

Tolleson has a noise ordinance under Article 7-1-11 of the Tolleson Code of Ordinances which declares a nuisance should noise otherwise interfere with the comfortable enjoyment of life or property.[59] The Ordinance, however, does not prescribe any thresholds for which aviation noise should not exceed.

As explained in **Section 3.6.1** above, the FAA has an established noise significance threshold, defined in FAA Order 1050.1F, which is used when assessing noise impacts in a particular project area. A significant noise impact is defined as an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure or a noise exposure at or above the 65 dB level due to a DNL 1.5 dB or greater increase. Based on the results of the noise analysis performed for this EA, the DNL 65 dB contour is expected to extend approximately 150 feet from the launch pads and be contained within PADDC property. Thus, noise impacts from the Tolleson operations are not expected to result in a significant impact. Nor is the noise generated by the Tolleson operations expected to be incompatible with noise sensitive resources within the action area. The resulting noise exposure for delivery site locations at a distance of 32 feet between drone and receiver is DNL 54.7 dB. Noise exposure from deliveries includes the en route overflight at the typical operating altitude of 165 feet AGL, as modeled in **Appendix E**. The maximum noise exposure at any property line in residential zoned property would not exceed DNL 55 dB, which is well below the FAA's DNL 65 dB significance threshold.

3.7 Environmental Justice

3.7.1 Regulatory Setting

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies. Meaningful involvement means people have an opportunity to participate in decisions about activities that may affect their environment and/or health; the public's contribution can influence the regulatory agency's decision; community concerns will be considered in the decision-making process; and decision makers will seek out and facilitate the involvement of those potentially affected.[60]

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was enacted in 1994. The purpose of the EO is to focus federal attention on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities. The EO directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law. The order is also intended to promote nondiscrimination in federal programs that affect human health

[59] City of Tolleson, Arizona. Code of Ordinances Article. 7-1-11- – Noise. Available: https://library.municode.com/az/tolleson/codes/code_of_ordinances?nodeId=CD_ORD_CH7OF_ART7-1GEOF_S7-1-11NO. Accessed: February 2024.

[60] US Environmental Protection Agency, https://www.epa.gov/environmentaljustice/learn-about-environmental-justice (accessed February 5, 2024).

and the environment, as well as provide minority and low-income communities' access to public information and public participation.

EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All* (April 21, 2023), made changes to federal policy regarding environmental justice including an update of the definition of environmental justice, an expansion of what constitutes an environmental justice impact, and a broadening of what constitutes a community with environmental justice concerns.

DOT Order 5610.2C, *Procedures for Considering Environmental Impact*, incorporates consideration of environmental justice principles into the Department of Transportation's planning and decision-making processes. The order provides helpful guidance for defining minority and low-income populations. The term minority population is established to refer to "any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy, or activity." A minority person is defined as a person who is:

- Black: a person having origins in any of the black racial groups of Africa;
- Hispanic or Latino: a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race;
- Asian American: a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent;
- American Indian and Alaska Native: a person having origins in any of the original people of North America, South America (including Central America), and who maintains cultural identification through tribal affiliation or community recognition; or
- Native Hawaiian and Other Pacific Islander: people having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

DOT Order 5610.2C establishes a low-income population as "any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy, or activity." A low-income person is "a person whose median household income is at or below the Department of Health and Human Services poverty guidelines."

The FAA has not established a significance threshold for Environmental Justice.

FAA Order 1050.1F indicates the factors to be considered in determining whether an action would have the potential to lead to a disproportionate and adverse impact to communities with environmental justice concerns include:

- Significant impacts in other environmental impact categories; or
- Impacts on the physical or natural environment that affect a community in a way that the FAA determines are unique to communities with environmental justice concerns and significant to that population.

Whether an adverse effect is "disproportionately high" on minority and low-income populations depends on whether that effect is:

- Predominantly borne by an environmental justice community of concern population; or
- Will be suffered by the environmental justice community of concern population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the population outside of the environmental justice community of concern.[61]

3.7.2 Affected Environment

The environmental justice communities of concern were identified using demographic and socioeconomic data derived from 2022 American Community Survey data published by the US Census Bureau. The census block group level of census geography was used to map populations, and to compare minority populations and occurrences of household income below the Department of Health and Human Services Poverty Guidelines.

The study area encompasses 296 census block groups occurring within Maricopa County. An aggregation of the 296 census block groups was determined to serve as the baseline to which individual census block groups were compared. Data for the State of Arizona and the United States was also provided for additional context.

Census block groups were identified as communities of environmental justice concern when the proportion of minority or low-income populations exceeded that of the reference area. Additionally, communities in which populations with environmental justice concerns predominated were also identified as communities with environmental justice concerns. Census block groups with populations greater than or equal to 50 percent were also retained for analysis.

The demographic data for the census block groups within the reference area are presented in **Tables F-1** and **F-2** of **Appendix F**. The data were gathered from 2018-2022 American Community Survey 5-Year Estimates from the U.S. Census Bureau. The HHS Poverty Guidelines were gathered from the US Department of Health and Human Services Federal Poverty Income Guidelines, effective January 17, 2024.[62]

Table F-1 indicates the racial demographic information for the reference area and all 296 census block groups. The percentage of the population identified as minority includes the total population, less the white, non-Hispanic population. The minority population of the reference area is 76 percent of the total population. The aggregate threshold for the reference area and a predominately minority population (50 percent or greater) were used to determine communities of environmental justice concern.

Table F-2 indicates the income and poverty data for each area. The Health and Human Services Poverty Guidelines in **Table F-2** were determined by comparing the Federal Poverty Income Guidelines annual income per persons to the average household size provided by the American Community Survey 5-year estimates. The poverty threshold is proportional to the household size, and both measures are presented in

61 Federal Aviation Administration, Office of Environment and Energy, 1050.1F Desk Reference, p. 12-12, October 2023.

62 US Department of Health and Human Services, Poverty Guidelines, January 17, 2024. https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines.

the table. The percentage of households below poverty were determined by gathering the annual household income below the Health and Human Services Poverty Guideline. As with the data on ethnicity, the low-income population aggregate threshold for the reference area was used to determine communities of environmental justice concern. Approximately 12 percent of the households residing in the reference area are living below poverty. Any census block group whose percentage of households below poverty equals or exceeds the reference area constitutes a community of environmental justice concern. Reference Area communities of environmental justice concern are listed in **Table F-3** of **Appendix F**.

Of the 296 census block groups evaluated in the reference area, 261 have been identified as communities of environmental justice concern. This total includes 257 census block groups with predominantly minority populations and 123 census block groups with occurrences of low-income households exceeding that of the reference area aggregate percentage. There are 120 census block groups with both a predominately minority population and a percentage of low-income households exceeding the reference area aggregate percentage. Communities of environmental justice concern in the reference area are depicted on **Figure 3-4**.

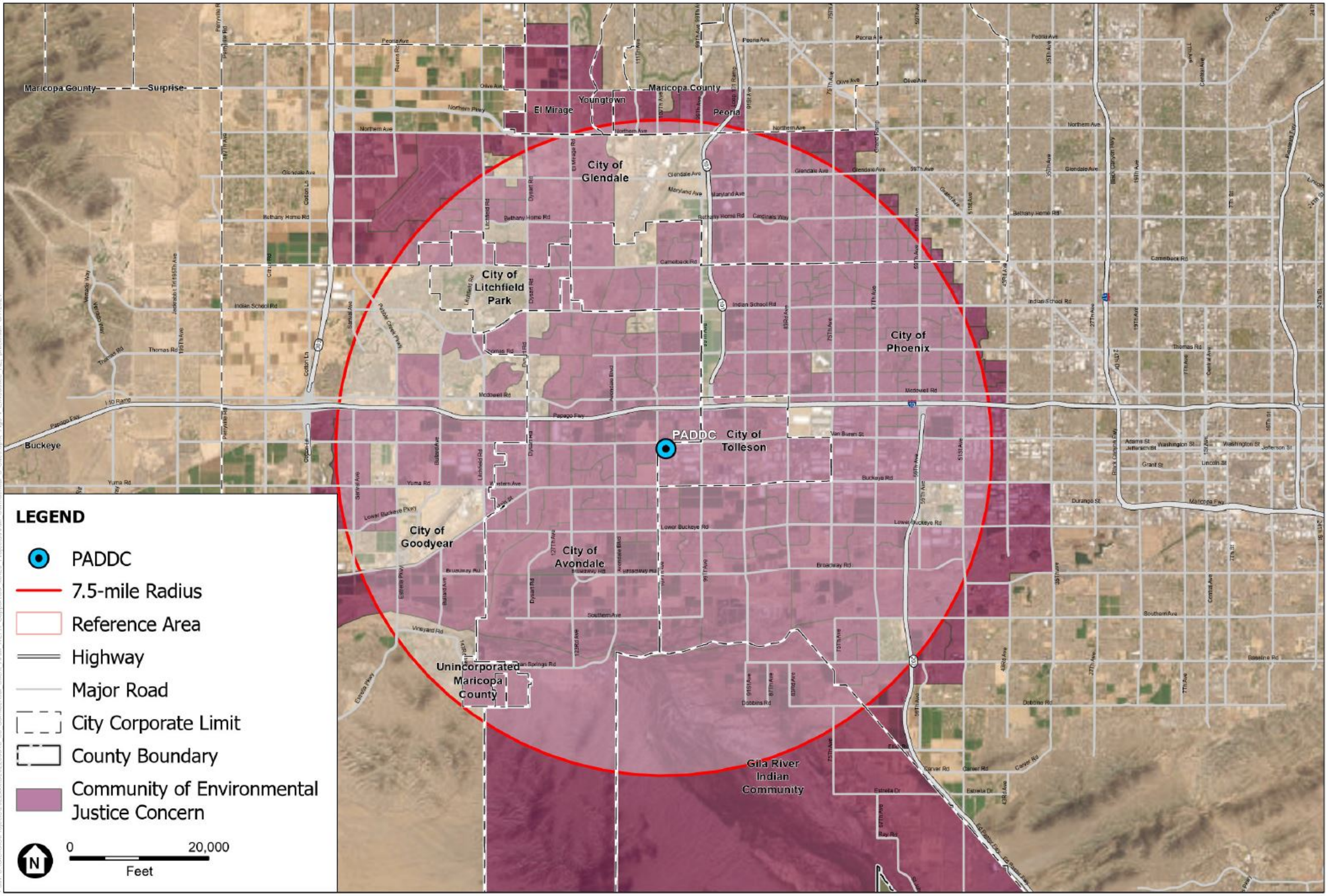
3.7.3 Environmental Consequences

3.7.3.1 No Action Alternative

Under the No Action Alternative, as described in **Section 1.2**, the FAA would not issue the approvals necessary to enable Prime Air to conduct commercial drone package delivery operations in the Tolleson, AZ area. Accordingly, the No Action Alternative would not result in impacts on environmental justice communities.

3.7.3.2 Proposed Action

As indicated previously in this EA, the Proposed Action *would not result in significant impacts in any environmental impact categories evaluated,* and there is no indication any disproportionately high and adverse effects would be borne by any communities with environmental justice concerns. As noted in **Section 3.6**, the drone's noise emissions could be perceptible in areas within the study area, but noise exposure equal to or greater than DNL 65 dB - the level determined to constitute a significant impact - would not occur in any residential areas or other sensitive locations. Furthermore, the drone delivery operations could provide increased access to in-demand goods without increasing congestion on local roads. As traffic congestion may have a disproportionate effect on low-income populations in denser urban settings, the implementation of commercial drone delivery services could positively affect low-income populations. Thus, the Proposed Action would not create impacts exceeding thresholds of significance in any environmental impact categories; neither would the Proposed Action generate impacts that affect an environmental justice population in a way that the FAA determines are unique and significant to that population. Therefore, *the Proposed Action would not result in significant environmental justice impacts or disproportionately high and adverse effects on minority and low-income populations.*



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023; US Census Bureau, 2022.

Figure 3-4
Reference Area Communities of Environmental Justice Concern
Tolleson, AZ

ESA

3.8 Visual Effects (Visual Resources and Visual Character)

3.8.1 Regulatory Setting

Visual resources and visual character impacts deal with the extent to which the Proposed Action would result in visual impacts to resources in the operating area. Visual impacts can be difficult to define and evaluate because the analysis is generally subjective, but are normally related to the extent that the Proposed Action would contrast with, or detract from, the visual resources and/or the visual character of the existing environment. In this case, visual effects would be limited to the introduction of a visual intrusion – a drone in flight – which could be out of character with the suburban or natural landscapes.

The FAA has not developed a visual effects threshold of significance similar to noise impacts. Factors the FAA considers in assessing significant impacts include the degree to which the action would have the potential to: (1) affect the nature of the visual character of the area, including the importance, uniqueness, and aesthetic value of the affected visual resources; (2) contrast with the visual resources and/or visual character in the study area; or (3) block or obstruct the views of visual resources, including whether these resources would still be viewable from other locations.

3.8.2 Affected Environment

The Proposed Action would take place over a combination of suburban and commercial properties. As noted in **Section 3.4**, there are public parks that could be valued for aesthetic attributes within the study area. Prime Air's proposal is to avoid overflights of large open-air gatherings of people during the scope of the Proposed Action, which includes public parks and other public properties that may be covered under Section 4(f) (which are identified in **Appendix C**).

3.8.3 Environmental Consequences

3.8.3.1 No Action Alternative

Under the No Action Alternative, as described in **Section 1.2**, the FAA would not issue the approvals necessary to enable Prime Air to conduct commercial drone package delivery operations in the Tolleson, AZ area. Accordingly, the No Action Alternative would not result in visual impacts on local communities.

3.8.3.2 Proposed Action

The Proposed Action makes no changes to any landforms or land uses, and visual effects would be short-term in nature; thus, there would be no effect to the visual character of the area. Excluding ground-based activities supporting the drones, the operations would be occurring in airspace only. The FAA estimates that at typical operating altitude and speeds the drone en route would be observable for approximately 3.6 seconds by an observer on the ground. The Proposed Action involves airspace operations that are unlikely to result in visual impacts anywhere in the study area, including Section 4(f) properties. The short duration that each drone flight could be seen from any resource in the operating area – approximately 3.6 seconds while the drone is traveling en route at 52.4 knots (approximately 60 mph) – and the distribution of flights throughout the 175-square mile operating area, would minimize any potential for significant visual impacts at any location in the study area. Any visual effects are expected to be similar to existing air traffic in the vicinity of the operating area. *Therefore, the Proposed Action would not result in significant visual impacts*.

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CHAPTER 4
Cumulative Effects

Consideration of cumulative impacts applies to the impacts resulting from implementing the Proposed Action along with other actions. The CEQ regulations define cumulative impacts as "effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR § 1508.1(g)(3).)

As most of the potential impacts discussed in Chapter 3, *Affected Environment and Environmental Consequences*, were found to be minimal and given that drone operations are not likely to interact with other outside actions due to the short duration of flights, the Proposed Action's contribution to cumulative impacts in the Study Area would largely be from noise. Thus, this section will focus on the Proposed Action's potential cumulative impact on the noise environment.

Because drone operations would occur in areas subject to other aviation noise sources, it is necessary to evaluate the cumulative noise exposure that would result from the other aviation noise sources present. Examples of such scenarios are drone operations occurring in the vicinity of Prime Air's operating areas with increased aviation activity (e.g., where other commercial drone operators operate or operations close to airports). Aviation noise sources are most likely to be the dominant contribution to noise exposure near airports. By comparison, other sources of noise would not appreciably contribute to overall noise levels at these locations.

There are three surface areas of Class D airspace located in the proposed area of operations, which include Phoenix Goodyear Airport, Glendale Municipal Airport, and Luke Air Force Base. In addition, there is a private air strip within the proposed area of operations, Airscrew Performance Flightpark. The potential for noise and compatible land use cumulative effects would result from drone and manned aircraft operating within an airport's DNL 55 dB contour. However, the potential for cumulative effects would be minimized because Prime Air's PADDC is located outside of the surface areas of Class D airspace of the three identified airports. Prime Air delivery route planning takes into account air traffic to avoid dense airspace restrictions such as airport runways. This will avoid potential noise cumulative effects of the air traffic near all three airports. It is important to note that while the MK30 drone operating area conceptually overlaps various sectors of the Class B airspace associated with Phoenix Sky Harbor International Airport, the drones would be operating no higher than 400 ft AGL, which is 2,600 ft below the 3,000-ft AGL minimum altitude restriction assigned to those sectors. It is also important to note that a portion of the proposed MK30's operating area overlaps with the restricted airspace associated with Luke Air Force Base (see **Appendix E**); as such, Prime Air would not conduct any drone operations in that restricted portion of the overlapping MK30 operating area.

The addition of Prime Air's commercial delivery service is not expected to result in cumulative effects with other potential Part 135 commercial drone operations, but Prime Air would also monitor any potential, future drone operations that may occur in the vicinity of the PADDC. Any future Part 135 operators would be required to work with the FAA to complete an environmental review before beginning operations, ensuring that any potential cumulative effects are properly analyzed and disclosed, and the appropriate siting of potential drone operating facilities would be considered to avoid a significant impact on the environment.

The PADDC is located in an area zoned for commercial activities and away from noise-sensitive areas. Future drone operators may propose locating operations within this Proposed Action's Study Area. Should that occur, Prime Air understands the potential for impacts may increase due to a future operator's project and would work with that operator and the FAA to mitigate potential impacts. Prime Air also understands that the FAA, during its NEPA analysis, would identify the potential for noise impacts associated with any future Part 135 operators.

As discussed in Chapter 3, the Proposed Action is not expected to significantly impact any of the environmental impact categories. Areas of existing aviation noise sources within the Study Area would be avoided; thus, the Proposed Action would not contribute to significant cumulative noise impacts. No other actions are anticipated to interact with the Proposed Action to result in cumulative effects; therefore, the *Proposed Action is not expected to result in significant cumulative effects*.

Appendix A
Notice of Availability

(English and Spanish Versions)

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Washington, D.C.

Notice of Availability, Notice of Public Comment Period, and Request for Comment on the Draft Environmental Assessment for Amazon Prime Air Package Delivery Operations in Tolleson, Arizona

The Federal Aviation Administration (FAA) provides notice that a Draft Environmental Assessment (EA), prepared pursuant to the National Environmental Policy Act (NEPA) (42 United States Code §§ 4321 – 4355), to assess Amazon Prime Air's proposed commercial drone delivery service in the Tolleson, AZ area is available for review and comment.

Amazon Prime Air is seeking to amend its air carrier Operation Specifications (OpSpec) and other FAA approvals necessary to introduce commercial drone delivery operations in Arizona. The FAA's approval of the amended OpSpec is considered a major federal action under NEPA and Council on Environmental Quality (CEQ) NEPA–implementing regulations (40 Code of Federal Regulations Parts 1500–1508) and requires a NEPA review. The Draft EA is submitted for review pursuant to NEPA, CEQ NEPA Implementing Regulations, FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, Section 4(f) of the Department of Transportation Act (49 U.S.C. § 303), and Section 106 of the National Historic Preservation Act (16 U.S.C. § 470). The Draft EA will be available for a 30-day public review beginning on Friday, July 12, 2024 and ending on Sunday, August 11, 2024.

The Draft EA is available for online review at:
https://www.faa.gov/uas/advanced_operations/nepa_and_drones

Comments on the Draft EA may be submitted electronically to 9-faa-drone-environmental@faa.gov. Written comments may be submitted via U.S. Mail to the address below. Please ensure adequate time for receipt. All comments must be received by 5:00 p.m. Central Time on *Sunday, August 11*, *2024*.

Federal Aviation Administration, Suite 802W
C/O AVS Environmental
800 Independence Ave SW
Washington, DC 20591

All substantive comments received will be responded to in the Final EA.

PRIVACY NOTICE: Before including your address, phone number, email address, or other personal identifying information in your comment, be advised that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold from public review your personal identifying information, we cannot guarantee that we will be able to do so.

This Draft EA becomes a federal document when evaluated, signed, and dated by the Responsible FAA Official.

Responsible FAA Official:

DEREK W HUFTY Digitally signed by DEREK W HUFTY Date: 2024.07.03 10:39:00 -04'00'
__________________________________ Date: ____________________________

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

DEPARTMENTO DE TRANSPORTACIÓN

Administración Federal de Aviación

Washington, D.C.

AVISO DE DISPONIBILIDAD, NOTIFICACIÓN DE PERÍODO DE COMENTARIOS PÚBLICOS Y SOLICITUD DE COMENTARIOS SOBRE EL BORRADOR DE EVALUACIÓN AMBIENTAL PARA OPERACIONES COMERCIALES DE ENTREGA DE PAQUETES MEDIANTE DRONES DE AMAZON PRIME AIR EN TOLLESON, ARIZONA

La Administración Federal de Aviación (FAA, sigla en inglés) notifica que un Borrador de Evaluación Ambiental (EA), preparado conforme a la Ley de Política Ambiental Nacional (NEPA) (42 Código de los Estados Unidos §§ 4321 - 4355), para evaluar el servicio propuesto por Amazon Prime Air para llevar acabo operaciones comerciales de entrega de paquetes mediante drones en el área de Tolleson, AZ, está disponible para revisión y comentarios.

Amazon Prime Air busca enmendar sus especificaciones operacionales (OpSpec) y otras autorizaciones emitidas por la FAA que son necesarias para introducir las operaciones comerciales de entrega de paquete mediante drones en Arizona. La aprobación de la FAA de los OpSpecs enmendados se considera una acción federal mayor en virtud de NEPA y de los reglamentos de implementación del Consejo de Calidad Ambiental (CEQ) de NEPA (40 Código Federal de Reglamentos Partes 1500-1508) y requiere una evaluación bajo NEPA. El Borrador de EA ha sido sometido para revisión conforme a NEPA, los reglamentos de implementación de CEQ NEPA, la Orden 1050.1F de la FAA, *Impactos Ambientales: Políticas y Procedimientos*, Sección 4(f) de la Ley del Departamento de Trasportación (49 U.S.C. § 303), y la Sección 106 de la Ley de Preservación Nacional Histórica (16 U.S.C. § 470). El Borrador de EA estará disponible para revisión pública durante 30 días, comenzando el viernes, 12 de julio de 2024 y terminando el domingo 11 de agosto de 2024.

El Borrador de EA está disponible para revisión en línea en:
https://www.faa.gov/uas/advanced_operations/nepa_and_drones

Puede someter comentarios electrónicos a cerca del Borrador de EA enviándolos 9-faa-drone-environmental@faa.gov. También se pueden someter enviando un escrito por correo postal a la dirección a continuación. Asegúrese de dejar tiempo suficiente para la recepción de sus comentarios. Todos los comentarios deben recibirse antes de las 5:00 p.m., hora Central, domingo 11 de agosto de 2024.

Federal Aviation Administration, Suite 802W
C/O AVS Environmental
800 Independence Ave SW
Washington, DC 20591

Se responderá a todos los comentarios recibidos en el EA final.

AVISO DE PRIVACIDAD: Antes de incluir su dirección, número de teléfono, dirección de correo electrónico u otra información de identificación personal en su comentario, tenga en cuenta que la totalidad de su comentario, incluida su información de identificación personal, podría hacerse pública en cualquier momento. Si bien puede pedirnos en su comentario que no divulguemos al público su información de identificación personal, no podemos garantizar que podamos hacerlo.

Este Borrador de EA se convierte en un documento federal luego de ser evaluado, firmado y fechado por un oficial autorizado de la FAA.

Appendix A-1
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Prime Air NEPA Notice of Availability Distribution - Tolleson

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Planning and Zoning Committee	Chris Jacques	planning@peoriaaz.gov	
Economic Development	Jennifer Stein	jennifer.stein@peoriaaz.gov	Director
Development Services	Chris Jacques	planning@peoriaaz.gov	Director
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Councilmember/Vice Mayor -Willow District	John Edwards	Jon.Edwards@peoriaaz.gov	
Councilmember/Mayor Pro Tem - Acacia District	Jennifer Crawford	Jennifer.Crawford@peoriaaz.gov	
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City Clerk's Office	Agnes Goodwine	CityClerk@peoriaaz.gov	
Fire Department	Gary Bernard	InetFireDept@peoriaaz.gov	Chief
Chief of Police	Thomas Intrieri	policedept@peoriaaz.gov	Chief
Public Comminication Manager	Diane Arthur	diane.arthur@peoriaaz.gov	Director of Communications

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Vice Mayor	Paul Faith	pfaith@litchfieldpark.gov	
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Councilmember	Lisa Brainard Watson	lbrainardwatson@litchfieldpark.gov	
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Councilmember	Justin James	jjames@litchfieldpark.gov	
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City Clerk's Office	Terri Roth	troth@litchfieldpark.gov	City Clerk
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Planning and Development	Jon Froke	jfroke@litchfieldpark.gov	City Planner
Chief of Police	Avondale Police Department	EmailPoliceDepartment@avondaleaz.gov	Service agreement with Avondale

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Mericopa Audobon Society		larsonwarren@gmail.com	Local Chapter
Sonoran Audubon Society		klaf@cox.net	Local Chapter
Audubon Southwest		southwest@audubon.org	AZ/NM

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Appendix B
Biological Resources and Agency Consultation

U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., SW.
Washington, DC 20591

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office - Phoenix
9828 North 31st Avenue
Suite C3
Phoenix, AZ 85051-2517
Email: incomingAZcorr@fws.gov

SUBJECT: **Endangered Species Act Section 7 Consultation for Drone Commercial Package Delivery Operations in Tolleson, Arizona**

In accordance with Section 7 of the Endangered Species Act (ESA), the Federal Aviation Administration (FAA) is requesting U.S. Fish and Wildlife Service (USFWS) concurrence that the FAA's action of authorizing Amazon Prime Air (Amazon) to introduce commercial drone package delivery operations from its Prime Air Drone Delivery Center (PADDC) located in Tolleson, AZ ***may affect, but is not likely to adversely affect***, the California Least Tern (*Sternula antiliarum browni*), Southwestern Willow Fly Catcher (*Empidonax traillii extimus*), the Yellow-Billed Cuckoo (*Coccyzus americanus*) and the Yuma Ridgway's Rail (*Rallus obsoletus yumanensis*). Our biological evaluation is provided below, including a brief background, project description, identification of the action area, and a discussion of potential effects to ESA-listed species.

Project Description

Amazon is seeking a Part 135 Air Carrier Certificate from the FAA, which will allow it to conduct commercial package deliveries using drones in the Tolleson, AZ area. Amazon intends to introduce its drone delivery capabilities in 2024 and has requested the FAA to authorize the operation of its MK30 drone variant so it can provide public access to its drone package delivery services across its operating area.

Amazon projects flying up to approximately 470 MK30 drone flights per operating day from the PADDC located in Tolleson, with each flight taking a package to a customer delivery address before returning to the PADDC. The number of flights per day would vary based on customer demand and weather conditions. Amazon is taking an incremental approach to operations and expects to gradually ramp up to approximately 470 flights per day as consumer demand increases over time. Drone flights could be conducted up to 365 days a year and, as Amazon ramps up operations, it could operate up to 10 hours per day. Operations will not occur before 7 A.M. or after 10 P.M. The proposed MK30 operating area and PADDC are depicted in **Attachment A**.

Unmanned Aircraft

As pictured in **Attachment B**, the MK30 drone is a hybrid multicopter fixed-wing tail-sitter drone with six propulsors allowing it to take off and land vertically and transition to wing borne flight. Its airframe is composed of staggered tandem wings for stable wing borne flight. The drone weighs approximately 78 pounds and has a maximum takeoff weight of approximately 83 pounds, which includes a maximum payload of 5 pounds. It has a maximum operating range of 7.5 miles and can fly up to 58 knots (67 miles per hour) during wing-borne flight. It uses electric power from rechargeable lithium-ion batteries and is launched vertically using powered lift and converts to using wing lift during en route flight.

Flight Operations

The MK30 drone would generally be operated at an altitude of 300 feet above ground level (AGL) and up to a maximum operating altitude of 400 feet AGL while en route to and from delivery locations. At a delivery location, the drone would descend vertically to a stationary hover and drop a package to the ground. Once a package has been delivered, the drone would ascend vertically to the en route altitude and depart the delivery area to return to the PADDC. The drone would fly a predefined flight path that is set prior to takeoff. Flight missions would be automatically planned by Amazon's flight planning software, which assigns, deconflicts, and routes each flight. The PADDC is a controlled area wherein drone flights are launched and recovered.

Takeoff

Once a package is loaded onto the MK30 drone and the drone is cleared for takeoff at the PADDC, the drone takes off from the ground vertically to an altitude of about 180 feet AGL and then transitions and climbs to its en route altitude of about 300 feet AGL.

En Route Outbound

The en route outbound phase is the part of flight in which the MK30 drone transits from the PADDC to a delivery point on a predefined flight path. During this flight phase, the drone will typically operate at an altitude of 300 feet AGL with a typical airspeed of 58 knots (67 miles per hour).

Delivery

The delivery phase consists of descent from the en route altitude to a delivery point to deliver a package. The MK30 drone transitions and descends to about 180 feet AGL and then vertically descends to about 13 feet AGL while maintaining position over the delivery point. The drone hovers while dropping the package and then proceeds to climb vertically back to en route inbound altitude.

En Route Inbound

The MK30 drone continues to fly at an altitude of about 300 feet AGL with a speed of 58 knots towards the PADDC.

Landing

Upon reaching the PADDC, the MK30 drone slowly descends over its assigned landing pad and lands on the pad.

Predicted Sound Levels

The FAA conducted a noise analysis using sound level measurement data for the MK27-2 drone, which is the predecessor to the MK30 drone. Amazon reports that improvements made to the MK30 model have reduced the overall operating sound level of the drone by 1 to 7 decibels (dB), depending on the phase of flight, and as such, use of the MK27-2 as a surrogate in the noise analysis is conservative for noise estimation. The estimated maximum sound exposure level (SEL) for the takeoff, delivery, and landing phases of flight is approximately 95.7, 96.3, and 94.8 dB, respectively, at 32.8 feet from the drone. Predicted sound levels decrease as distances from the drone increase. The maximum SEL for the en route phase is approximately 67.7 dB when the drone is flying about 52 knots (60 miles per hour). The detailed noise analysis is provided as **Attachment C**.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR § 402.02). The action area is defined as Amazon's proposed MK30 operating area (see **Attachment A**). This area captures all possible flight routes to the delivery areas and where potential effects (e.g., visual, auditory, physical) to listed species could occur.

According to the United States Department of Agriculture's (USDA) Forest Service, the action area is located in the American Semi-Desert and Desert Province (ASD) ecoregion, located in Maricopa County, Arizona. The ASD ecoregion topography is characterized by extensive plains, most gently undulating and includes isolated low mountains and buttes that rise abruptly.[1] Additionally the proposed action would take place over land cover identified as urban areas with low, medium and high-density development, with scattered areas of scrub/shrub and grasslands/herbaceous habitat within the rural portions of the action area.[2] The creosote bush (*Larrea tridnetata*) is the most widely distributed plant within the natural portions of this ecoregion, sparsely accompanied by cacti, shrubs, and herbs. Much of the developed land of the action area provides habitat for many of the more common and ubiquitous bird and mammal species in the region, including deer, squirrels, raccoons, armadillos, wild boar, jackrabbits, mice, badgers, songbirds, raptors, waterfowl, and insects.

ESA-Listed Species and Critical Habitat in the Action Area

The FAA acquired the Official Species List (see **Attachment D**) from the USFWS Information for Planning and Conservation online system to identify ESA-listed species and candidate species for listing within the action area (**Table 1**). The action area does not contain designated critical habitat for any species.

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[1] 322 American Semidesert and Desert Province.
Available: https://www.fs.usda.gov/land/ecosysmgmt/colorimagemap/images/322.html. Accessed January 2024.
[2] EPA NEPAssist, NLCD 2019 CONUS Land Cover. Available:
https://nepassisttool.epa.gov/nepassist/nepamap.aspx?wherestr=tolleson. Accessed January 2024.

Table 1. ESA-Listed Species, Species Proposed for Listing, and Candidate Species Potentially Present in the Action Area

Species	Common Name	Species Name	Federal Status	Critical Habitat
Mammals	Sonoran pronghorn	*Antilocarpra americana sonoriensis*	Experimental Population; Non-Essential	N
Birds	Cactus Ferruginous Pygmy Owl	*Glaucidium brasilianum cactorum*	Threatened	N
	California Least Tern	*Sternula antiliarum browni*	Endangered	N
	Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	N
	Yellow-Billed Cuckoo	*Coccyzus americanus*	Candidate	N
	Yuma Ridgway's Rail	*Rallus obsoletus yumanensis*	Endangered	N
Insects	Monarch butterfly	*Danaus plexippus*	Candidate Species	N
SOURCE: USFWS IPaC, accessed January 2024				

The Official Species List states the Sonoran pronghorn is an experimental population that is non-essential. Their locations include: an area north of Interstate 8 and south of Interstate 10, bounded by the Colorado River on the west and Interstate 10 on the east; and an area south of Interstate 8, bounded by Highway 85 on the west, Interstates 10 and 19 on the east, and the United States Mexico border on the south.[3] The action area is located outside of the experimental population locations; therefore, the proposed action would have ***no effect*** on the Sonoran pronghorn.

Potential Effects of the Action on ESA-Listed and Candidate Species

Drone noise, visual presence, and the potential for airborne strikes with flying species are the action's potential stressors or threats to ESA-listed species. Flight operations would take place mostly in an urban environment, within airspace, and typically remain well above the tree line while en route to and from the PADDC. The duration of exposure by wildlife on the ground to visual or noise impacts from the drone would be of very short duration (approximately 30 seconds during takeoff/landing and delivery and a few seconds during the en route phase).

As noted above, the highest estimated SEL associated with Amazon's proposed operations is 96.3 dB, which would occur when the drone is taking off from or landing at the PADDC in a commercial area and during a delivery. For reference, the sound level of a diesel truck at 50 feet or a noisy urban environment during the day is approximately 80 to 90 dB. The SEL on the ground when the drone is at an altitude of 165 feet AGL is estimated to be around 67.7 dB, which is comparable to the sound of an air conditioning unit at 100 feet (60 dB). The MK30 drone is expected to operate at altitudes higher than 165 feet AGL during en route flight; as such, the en route sound level is expected to be less than 67.7 dB.

A noise descriptor for noise effects on wildlife has not been universally adopted, but some research indicates SEL is the most useful predictor of responses. Characteristic of the bulk of research to date has been lack of systematic documentation of the source noise event. Many studies report "sound levels" without specifying the frequency spectrum or duration. A notable exception is a study sponsored by U.S. Air Force that identifies SEL as the best descriptor for response of domestic turkey poults to low-altitude aircraft overflights (Bradley et al. 1990). This study identified a threshold of response for disturbance of

[3] Sonoran Pronghorn (Antilocapra americana sonoriensis). Available: https://ecos.fws.gov/ecp/species/4750. Accessed January 2024.

domestic turkeys ("100 percent rate of crowding") as SEL 100 dB. None of the predicted sound levels for the different flight phases exceed SEL 96.3 dB.

The following paragraphs describe the anticipated effects of the action on the remaining ESA-listed and candidate species, as listed in **Table 1**.

Cactus Ferruginous Pygmy Owl

The federally threatened Cactus Ferruginous Pygmy Owl is a non-migrating species that lives along desert rivers and washes, mostly in the Sonoran Desert Habitat of southern Arizona and in northwestern Mexico, at elevations below 4,000 feet.[4] They primarily live in cavities of trees or cacti like the saguaro and organ pipe, in holes often made by woodpeckers. Once common in Arizona from the New River north of Phoenix to the Mexican border, now this owl is only found between Tucson and points south.[5] Given the restricted range of this species (over 150 miles southeast of Tolleson) due to habitat fragmentation, habitat destruction/conversion, and climate change, this species is not expected to occur in the action area. Therefore, the proposed action would have ***no effect*** on the Cactus Ferruginous Pygmy Owl.

California Least Tern

The California Least Tern is a federally listed species that is largely found in southern California, northern Mexico and South America's Pacific shorelines. However, they also can be found transitioning through portions of Arizona. Although no known observations have been recorded within the action area,[6] adjacent cities such as Phoenix have reported sightings. Although these birds are mostly associated with coastal areas, these gulls can be seen near marshes, lakes, rivers, and agricultural fields and have even adapted to diverse environments within urban areas.[7] Although the action area may support minimal habitat for this migratory bird, it is anticipated that a ***may effect, not likely to adversely affect*** determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

Southwestern Willow Flycatcher

Southwestern Willow Flycatchers are federally listed as endangered. This species requires dense riparian habitats and is typically found below 8,500 feet in elevation. Although the USFWS IPaC did not identify critical habitat for this species within the action area, critical habitat was identified for the County of Maricopa.[8] Although habitat may be present within the action area (specifically along the Agua Fria River to the east and the Gila and Salt Rivers to the south) this species forages and nests in thick,

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[4] Center for Biological Diversity, Cactus Ferruginous Pygmy Owl Natural History. Available: https://www.biologicaldiversity.org/species/birds/cactus_ferruginous_pygmy_owl/natural_history.html. Accessed: February 2024.

[5] Arizona Center for Nature Conservation, Phoenix Zoo. Cactus Ferruginous Pygmy-Owl. Available: Cactus Pygmy Owl Conservation | Phoenix Zoo. Accessed: February 2024.

[6] All About Birds, California Least Tern Sightings Map, Available: https://www.allaboutbirds.org/guide/Least_Tern/maps-sightings, Accessed: February 2024

[7] Gulls and Terns: A Guide to Arizona's Diverse Bird Family. Available: https://www.bing.com/search?q=do+mud+flats+for+california+terns+exist+in+arizona&form=ANNH01&refig=9327cc8f059247d8b05e3adc6ed51de1&pc=LCTS&ntref=1. Accessed: February 2024.

[8] USFWS. Southwestern Willow Flycatcher. Available: https://www.fws.gov/species/southwestern-willow-flycatcher-empidonax-traillii-extimus. Accessed: February 2024.

undisturbed habitat within wetlands and streams. Considering the typical delivery locations and flight protocols for delivery within the action area (housing and developed communities within upland areas), interaction with this species is not expected. However, the Southwestern Willow Flycatcher breeds in riparian habitat across the southwest, therefore, although the action area may support minimal habitat for this neotropical migrant, it is anticipated that a ***may effect, not likely to adversely affect*** determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

Yellow-Billed Cuckoo

The Yellow-Billed Cuckoo is listed as a federally threatened species that also utilizes thick riparian habitat that can include abandoned farmland and tickets, nesting near streams and rivers and foraging on insects and small wild fruits. It should be noted that these long-distance, nocturnal migrants are vulnerable to collisions with tall buildings, cell towers and other structures that exist between southern United States and its wintering spots in South America.[9] Known survey locations of the Yellow-Billed Cuckoo include the Agua Fria National Monument, the Hassayampa River, and Tonto Creek. Habitat for this species may exist within the southern region of the action area.[10] Considering the typical delivery locations and flight protocols for delivery within the action area (housing and developed communities within upland areas), interactions with this species is not anticipated. However, the yellow-billed cuckoo is a long-distance, nocturnal migrant that is vulnerable to collisions, therefore, it is anticipated that a ***may effect, not likely to adversely affect*** determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

Yuma Ridgway's Rail

Yuma Ridgway's Rail is a federally endangered, non-migratory species that is found in marshes of the lower Colorado River, the Salton Sea in California, the Ciénega de Santa Clara in Mexico, and the Gila River west of Phoenix, Arizona.[11] This species of rail is secretive and rarely seen, completing their life cycles within marshes, preferring stands of cattail and bulrush and eating crayfish and other invertebrates.[12] Although this species may be found within portions of the action area, interactions with this non-migratory species is not expected given its specific habitat preferences. Since typical drone delivery locations and flight protocols for delivery are not anticipated to occur in, or within close proximity to habitat, and that interactions due to migration are not expected, it is anticipated that a ***may effect, not likely to adversely affect*** determination for this species is appropriate as the impacts are considered insignificant for the proposed action.

Monarch Butterfly

The Monarch butterfly is a candidate for federal listing. The primary threat to monarch butterflies is habitat loss, including the loss of breeding, migratory, and overwintering habitat. The action does not include any ground construction or habitat modification and during normal operations, the drone would not touch the ground except at the PADDC, which is a developed area. The action would not result in any physical disturbance to habitat or host plants. Monarch butterflies could be struck by drones

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[9] USFWS. Yellow-billed Cuckoo. Available: https://www.fws.gov/species/yellow-billed-cuckoo-coccyzus-americanus. Accessed: February 2024.

[10] Audubon Southwest. The Western Yellow-Billed cuckoo. Available: https://southwest.audubon.org/birds/western-yellow-billed-cuckoo. Accessed: February 2024.

[11] Audubon Southwest. Finding the Yuma Ridgway's Rail. Available: https://southwest.audubon.org/finding-yuma-ridgways-rail. Accessed: February 2024.

[12] Audubon Southwest. Yuma Ridgeways' Rail Conservation. Available: https://southwest.audubon.org/our-work/water/yuma-ridgways-rail. Accessed: February 2024.

enroute to and from delivery; however, strikes are not likely given the species' mobility. Some research shows that Monarch butterflies are not commonly observed at higher altitudes (i.e., at the MK30 en route operational altitude of 300 feet).[13] However, information regarding drone impacts on insects is limited, and there have been no widespread negative impacts identified in the scientific literature. Based on the information available and the limited scale of operations, the FAA does not anticipate adverse effects to the monarch butterfly.

Conclusion

Based on the analysis above, the FAA has determined the proposed action ***may affect, but is not likely to adversely affect*** the California Least Tern, Southwestern Willow FlyCatcher, the Yellow-Billed Cuckoo and the Yuma Ridgway's Rail. The FAA appreciates your review of the proposed project and requests your concurrence with our effects determinations for these three (3) species within 30 days of receiving this letter. If you have any questions, please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov.

Sincerely,

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Attachments:
Attachment A – Proposed MK30 Operating Area
Attachment B – MK 30 Drone
Attachment C – Technical Noise Report
Attachment D – Official Species List

References

Altitudes attained by migrating monarch butterflies, Danaus p. plexippus (Lepidoptera: Danaidae), as reported by glider pilots. Available: https://cdnsciencepub.com/doi/abs/10.1139/z81-084. Accessed April 2022 and February 2024.

Audubon Southwest. 2017. Priority Birds - The Western Yellow-Billed cuckoo. Available: https://southwest.audubon.org/birds/western-yellow-billed-cuckoo. Accessed: February 2024.

[13] Altitudes attained by migrating monarch butterflies, Danaus p. plexippus (Lepidoptera: Danaidae), as reported by glider pilots. Available: https://cdnsciencepub.com/doi/abs/10.1139/z81-084. Accessed April 2022 and February 2024.

Audubon Southwest. Finding the Yuma Ridgway's Rail. Available: https://southwest.audubon.org/finding-yuma-ridgways-rail. Accessed: February 2024.

Audubon Southwest. Yuma Ridgeways' Rail Conservation. Available: https://southwest.audubon.org/our-work/water/yuma-ridgways-rail. Accessed: February 2024.

Center for Biological Diversity. Birds - Cactus Ferruginous Pygmy Owl Natural History. Available: https://www.biologicaldiversity.org/species/birds/cactus_ferruginous_pygmy_owl/natural_history.html. Accessed: February 2024.

CornellLab.2024. About Birds, California Least Tern Sightings Map, Available: https://www.allaboutbirds.org/guide/Least_Tern/maps-sightings. Accessed: February 2024.

Hummingbirds Plus. 2024. Gulls and Terns: A Guide to Arizona's Diverse Bird Family. Available: https://www.bing.com/search?q=do+mud+flats+for+california+terns+exist+in+arizona&form=ANNH01&refig=9327cc8f059247d8b05e3adc6ed51de1&pc=LCTS&ntref=1. Accessed: February 2024.

PhoenixZoo. Arizona Center for Nature Conservation. Cactus Ferruginous Pygmy-Owl. Available: https://www.phoenixzoo.org/local-conservation/cactus-pygmy-owl/. Accessed: February 2024.

US Environmental Protection Agency.2023. NEPAssist Launch Tool - NLCD 2019 CONUS Land Cover. Available: https://nepassisttool.epa.gov/nepassist/nepamap.aspx?wherestr=tolleson. Accessed January 2024.

US Fish and Wildlife Service. Environmental Conservation Online System - Sonoran Pronghorn (*Antilocapra americana sonoriensis*). Available: https://ecos.fws.gov/ecp/species/4750. Accessed January 2024.

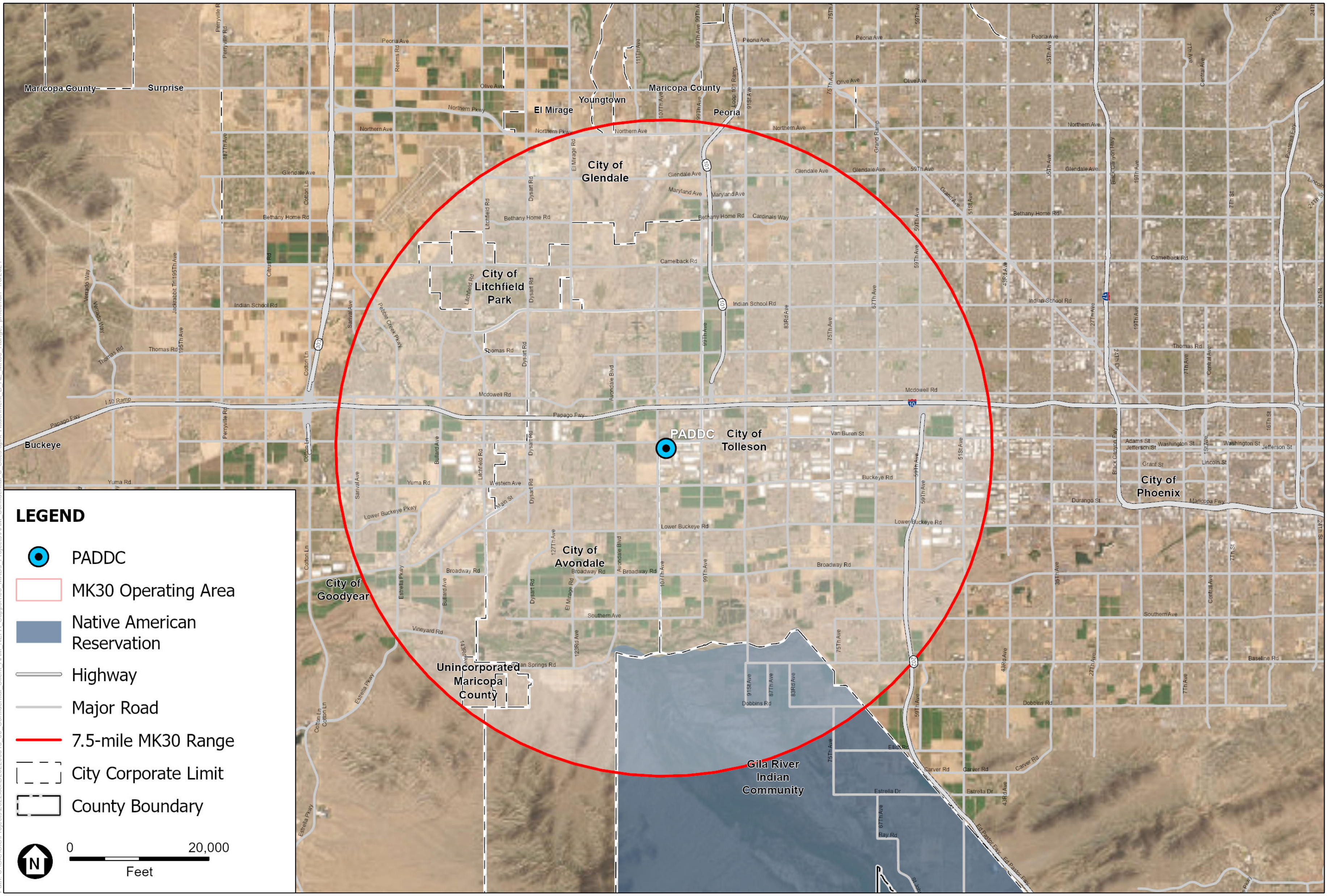
US Fish and Wildlife Service. 2024. Southwestern Willow Flycatcher. Available: https://www.fws.gov/species/southwestern-willow-flycatcher-empidonax-traillii-extimus. Accessed: February 2024.

US Fish and Wildlife Service. 2024. Yellow-billed Cuckoo. Available: https://www.fws.gov/species/yellow-billed-cuckoo-coccyzus-americanus. Accessed: February 2024.

US Forest Service. 1995. Description of the Ecoregions of the United States, 322 American Semidesert and Desert Province. Available: https://www.fs.usda.gov/land/ecosysmgmt/colorimagemap/images/322.html. Accessed January 2024.

Attachment A

Proposed MK30 Operating Area



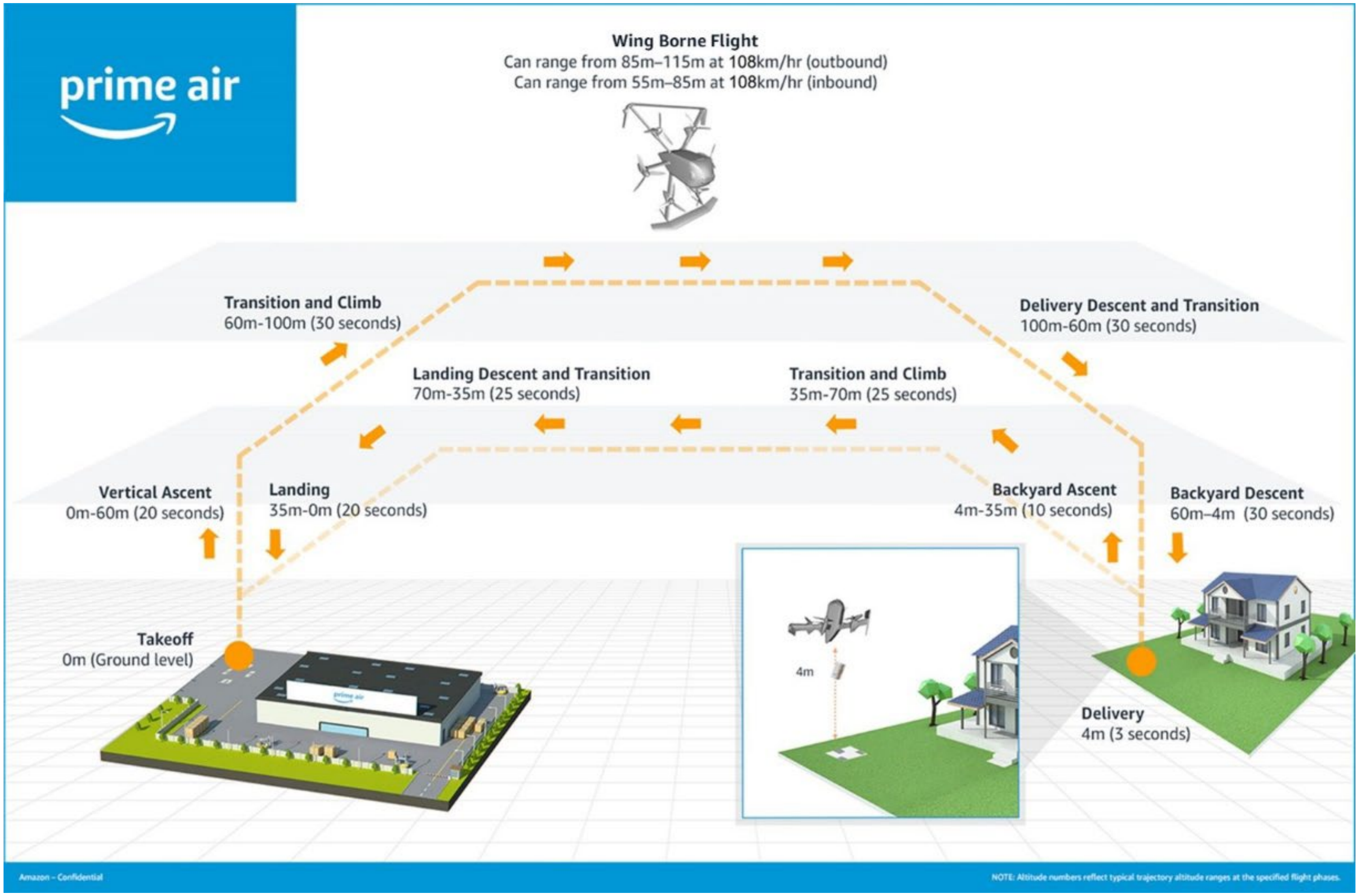
SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023; National Park Service, 2023; US Census Bureau, 2024.

Draft Environmental Assessment for Amazon Prime Air – Tolleson, AZ

MK30 Operating Area
Tolleson, AZ

Attachment B

MK30 Drone



SOURCE: Amazon Prime Air, 2023.

MK30 Drone Flight Profile

Attachment C
Technical Noise Report

NOISE ASSESSMENT AMAZON PRIME AIR MK27-2 UNMANNED AIRCRAFT OPERATIONS AT TOLLESON ARIZONA

Noise Technical Report

February 2024

ESA

NOISE ASSESSMENT
AMAZON PRIME AIR
MK27-2 UNMANNED AIRCRAFT OPERATIONS AT TOLLESON ARIZONA

Noise Technical Report

February 2024

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1 Introduction

Amazon Prime Air (Prime Air) is proposing to conduct drone delivery operations with the MK27-2 drone at their distribution hub (the Prime Air Drone Delivery Center, or PADDC) in Tolleson, Arizona. The PADDC is located approximately 1.5 miles west of downtown Tolleson at the intersection of West Van Buren Street and North 107th Avenue, as shown in **Figure 1**..

This document outlines the methodology and estimation of noise exposure expected with the proposed use of Prime Air's drone package delivery operations. The nonstandard methodology, equivalent to Federal Aviation Administration (FAA) Order 1050.1F, was approved by the FAA to inform the environmental decision-making regarding drone noise exposure from the proposed Prime Air package delivery operations[1]. Noise measurements of the MK27-2 drone were conducted by Amazon and processed by the FAA for the five phases of flight expected from drone operations. The methodology below adheres to the requirements of the National Environmental Policy Act (NEPA) and other relevant environmental local and federal review requirements. The results of the noise analysis are presented in terms of the annual Day-Night Average Sound Level (DNL), considering varying levels of operations for areas at ground level below each flight phase.

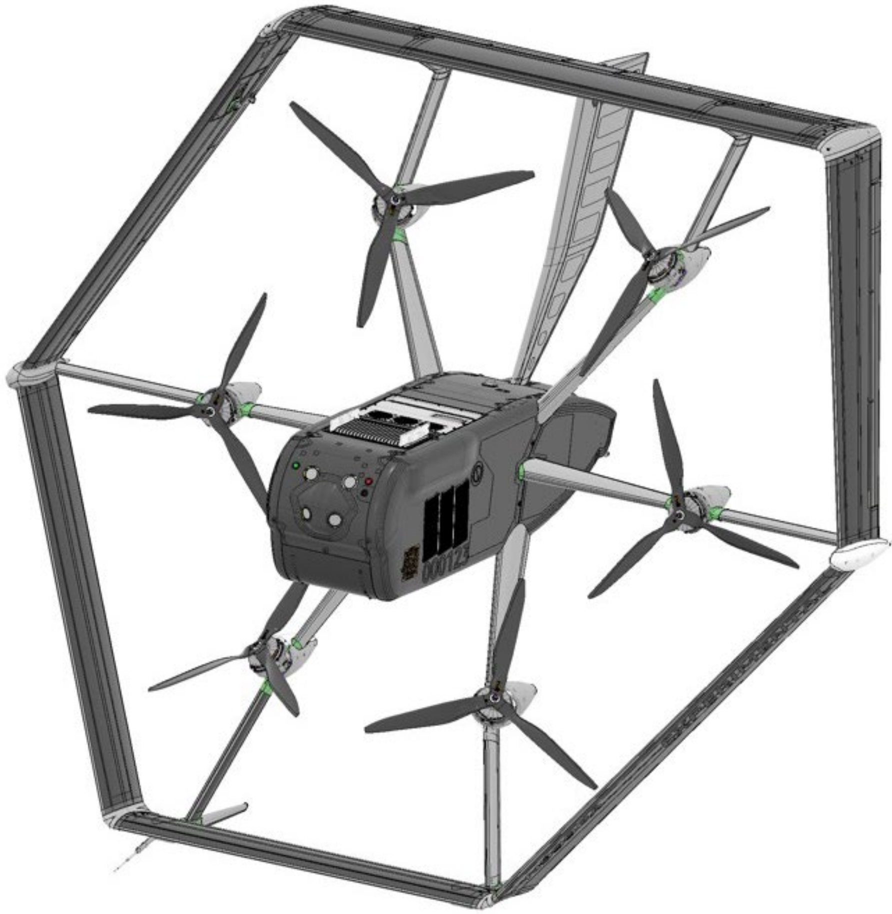
The MK27-2 is equipped with a multi-rotor design consisting of six propellers extending horizontally from the central frame with the ability to switch between vertical and horizontal flight. Per the specification from Prime Air, the drones' empty weight, including the battery, is 86.6 pounds with a maximum allowable takeoff weight is 91.5 pounds. The maximum allowable package weight the UA is certified to carry is 4.9 pounds. Packages delivered by the UA are transported within an internal cargo bay. An image of the MK27-2 drone is shown in **Figure 2**.

[1] *Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air Commercial Package Delivery Operations with the MK27-2 UA from College Station, Texas,* FAA Office of Environment and Energy, September 2022. (See Attachment A).

Figure 1. PADDC Regional Location

Source: ESA, 2024; Maxar; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

Figure 2. Amazon Prime Air MK27-2 Drone



Source: Amazon Prime Air, 2022.

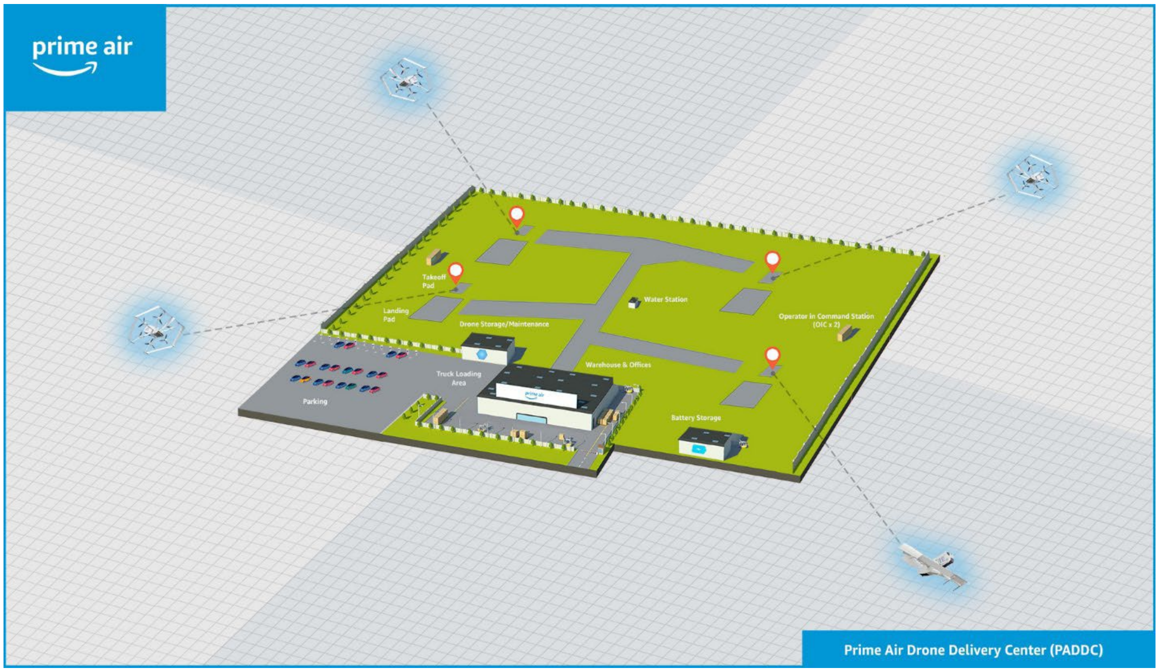
2 Drone Delivery Operations

The PADDC and its associated flight routes are determined by 'Prime Air's business and operational needs.

Takeoff pads at the PADDC's are four meters by four meters. Landing pads are eight meters by eight meters. Both pads are contained within a launch area approximately 35 meters by 45 meters. A diagram of a representative PADDC layout is presented in **Figure 3**.

The MK27-2 drone is capable of vertical ascent and descent, hovering, and flying upright with forward-facing propellers for en route travel. Airspeeds during normal en route flight are expected to be approximately 52.4 knots. A typical flight will commence with a vertical ascent from the launch pad to the en route altitude ranging between 160 and 180 feet Above Ground Level (AGL). The drone then maintains altitude and follows a predetermined route, traveling at 52.4 knots toward the designated delivery point. Upon arrival of the delivery point, the drone decelerates o zero speed and begins a vertical descent to 13 feet AGL at which time the package is released. The drone will ascend back to en route altitude and accelerate to 52.4 knots along the predetermined route back to the PADDC. Once the drone arrives at the PADDC it will decelerate to zero speed and begin a vertical descent to the landing pad.

Figure 3. Representative PADDC Layout



Source: Amazon Prime Air, 2022.

2.1 Flight Paths and Flight Profiles

Flight profiles of drone operations are broken into five general phases: takeoff, transitions to and from vertical and horizontal flight, en route, delivery, and landing. These phases can be combined to represent the typical operational profile of the drone as outlined below. A graphical representation of the operational profile is presented in **Figure 4** and each phase is summarized in **Table 1**.

Takeoff and Vertical Ascent

The drone departs from the launch pad once cleared for takeoff. It will ascend vertically to the en route altitude of between 160 and 180 feet AGL in vertical flight mode.[2]

Transition and Outbound Climb

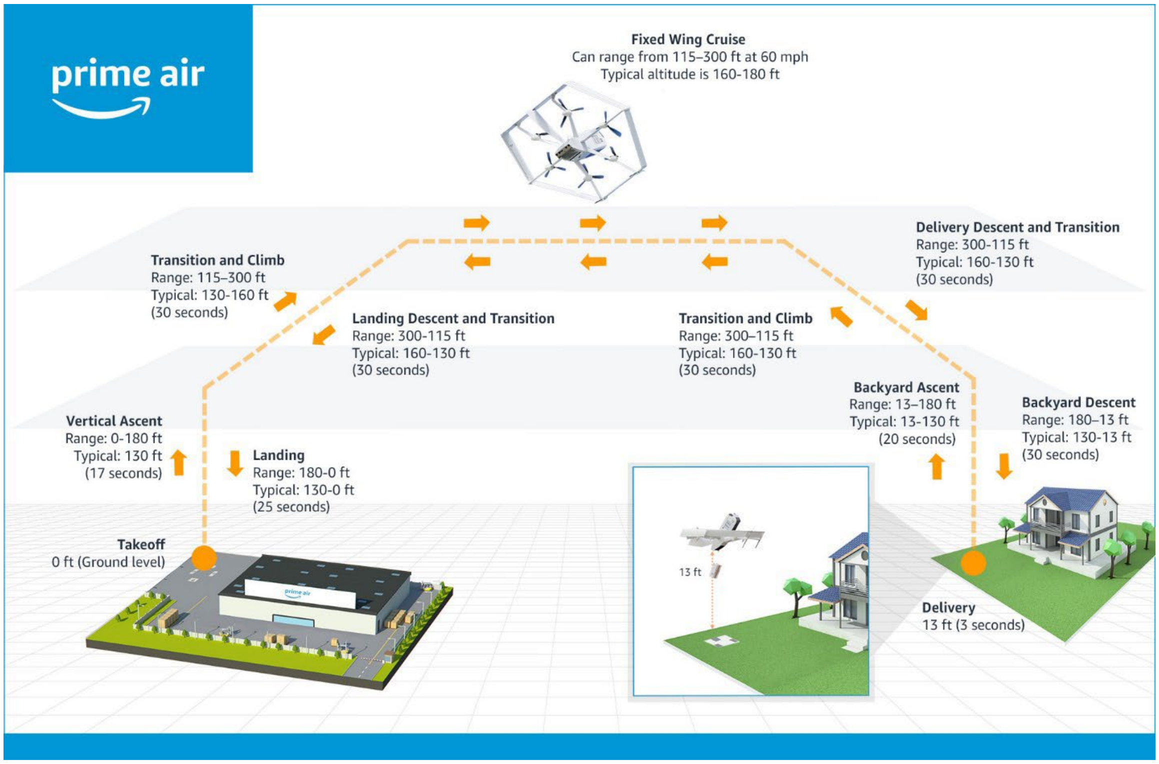
Upon reaching the en route altitude and while still positioned above the launch pad, the drone transitions from zero speed to its cruise speed of 52.4 knots. This transition is accompanied by a shift from vertical flight mode to horizontal flight mode.

Fixed-wing Outbound Cruise

The drone proceeds to fly at between 160 and 180 feet AGL and 52.4 knots to the delivery point.

[2] En route altitude is assumed to be 165 feet AGL, corresponding to the measurement data reviewed in FAA's memorandum, *Estimated Noise Levels for Amazon Prime Air MK27-2 UA*, FAA Office of Environment and Energy, August 2022 (See Attachment B).

Figure 4. Representative Operational Profile



Source: Amazon Prime Air, 2022.

Table 1. Representative Operational Profile by Phase of Flight

Phase of Flight	Altitude (feet AGL)	Ground Speed (knots)	Duration (seconds)
Takeoff and Vertical Ascent	Ascent from 0 to 165	0	21
Transition and Outbound Climb	165	0 to 52.4	20
Fixed-wing Outbound Cruise	165	52.4	Variable
Delivery Decent and Transition	165	52.4 to 0	20
Backyard Descent	Descend from 165 to 13	0	32
Delivery	13	0	2
Backyard Ascent	Ascent from 13 to 165	0	24
Transition and Inbound Climb	165	0 to 52.4	20
Fixed-wing Inbound Cruise	165	52.4	Variable
Landing Descent and Transition	165	52.4 to 0	20
Vertical Descent and Landing	Descend from 165 to 0	0	38

SOURCE: FAA, August 2022.

Delivery Descent and Transition

The drone decelerates from the en route speed of 52.4 knots and transitions to vertical flight mode, where it will be positioned over the delivery point at zero speed.

Backyard Descent, Delivery, and Ascent

The drone beings a vertical descent from en route altitude to 13 feet AGL while maintaining position above the delivery point. Once at 13 feet AGL, the drone drops the package and ascends vertically back to the en route altitude. It's important to note that the nearest allowable proximity of any individual, animal, or other obstacles to the delivery point during this maneuver is 16.4 feet.

Transition and Inbound Climb

Once at the en route altitude and positioned above the delivery point, the drone transitions from zero speed to en route speed while changing from vertical flight to horizontal flight.

Fixed-wing Inbound Cruise

The drone continues to fly at the en route altitude and speed towards the PADDC.

Landing Descent and Transition

The drone decelerates as it approaches the PADDC and transitions from horizontal flight to vertical flight, coming to a zero-speed position over its assigned landing pad.

Vertical Descent and Landing

The drone descends over its assigned landing pad in vertical flight until it touches down and shuts down the motors.

3 Acoustical Data of Flight Profiles

Prime Air conducted noise measurements of the MK27-2 drone in April 2021 at the Pendleton UAS Range located at the Eastern Oregon Regional Airport (KPDT). The FAA processed and analyzed the measurement data and calculated the estimate noise levels for each of the five phases of flight.[3] The following tables show either the A-weighted Sound Exposure Levels (SEL) or formulas to calculate the estimated SELs used for this analysis, which can be matched to each flight phase detailed in **Table 1**. The formula is based on Equation 1 below.

$$eq. 1.\ SEL = m\ x\ Log_{10}(d) + b(dB)$$

Where:

- d is the distance along the ground in feet between the drone and receiver
- m and b are parameters provided in the tables below

Table 2 provides parameters to use within Equation 1 to estimate SELs associated with takeoff as a function of distance from the PADDC launch pad to the receiver. **Table 3** provides parameters to use within Equation 1 to estimate SELs associated with takeoff as a function of distance from the PADDC launch pad to the receiver. **Table 4** provides parameters to use within Equation 1 to estimate the SEL associated with delivery, as a function of distance from the delivery point to the receiver. **Table 5** presents the estimated SELs that correspond to the transition between vertical flight to horizontal flight. The values in this table are for distances relative to the point under the vertical flight path. **Table 5** is applicable to all transition phases discussed in **Section 2.1**. These levels should be integrated with data from appropriate phases of flight (e.g., to estimate maximum possible landing noise, combine the transition noise from **Table 5** with the landing noise from **Table 3**.). Lastly, **Table 6** presents the estimates of en route SEL.

Table 2. Parameters for Estimating Sound Exposure Level for Takeoff versus Distance

Range for d (feet from launch pad)	m	b
32.8 to 49.2	-9.09	109.47
49.2 to 65.6	-16.41	121.86
65.6 to 85.3	-26.39	140.00
85.3 to 142.2	-27.79	142.71
142.2 and greater	-23.39	134.99

SOURCE: FAA, August 2022.

Note: Distance is along ground from launch pad to receiver.

[3] *Estimated Noise Levels for Amazon Prime Air MK27-2 UA,* FAA Office of Environment and Energy, August 2022 (See Attachment B).

Table 3. Parameters for Estimating Sound Exposure Level for Landing versus Distance

Range for d (feet from delivery point)	m	b
32.8 to 49.2	-9.26	108.81
49.2 to 65.6	-8.80	108.05
65.6 to 85.3	-17.1	123.12
85.3 to 142.2	-24.56	137.53
142.2 and greater	-23.39	134.99

SOURCE: FAA, August 2022.
Note: Distance is along ground from launch pad to receiver.

Table 4. Parameters for Estimating Sound Exposure Level for Delivery versus Distance

Range for d (feet from delivery point)	m	b
32.8 to 49.2	-5.85	105.35
49.2 to 65.6	-7.20	107.64
65.6 to 85.3	-16.92	125.3
85.3 to 142.2	-26.31	143.42
142.2 and greater	-21.9	133.91

SOURCE: FAA, August 2022.
Note: Distance is along ground from launch pad to receiver.

Table 5. Estimated Sound Exposure Levels from Transition Phase of Flight Profile at 165 Feet Above Ground Level

Distance from launch pad, landing pad or delivery point (ft)	SEL (dB)
0	69.9
100	70.6
200	70.3
400	69.4
800	68.2
1600	67.7
3200	67.7

SOURCE: FAA, August 2022.

Table 6. Estimates of En Route SEL

Aircraft Configuration	Reference Air Speed (knots)	Reference Altitude (feet AGL)	SEL (dB)
Max Weight	52.4	165	67.7

SOURCE: FAA, August 2022.

4 Methodology

Operations originating from the Tolleson PADDC is expected to occur daily between the hours of 7:00 AM and 10:00 PM. The number of daily and equivalent annual delivery operations is 469 and 171,329, respectively. As previously mentioned, there is not a standardized process for drone noise assessments. Therefore, ESA is applying technical guidance that was previously approved by the FAA Office of Environment and Energy for past analyses. The following subsection outlines this methodology.

4.1 Daytime Equivalent Operations and DNL

As mentioned, results are presented as DNL which applies a 10 dB weighting, or equivalent to 10 time the number of nighttime operations, for operations between 10:00 PM and 7:00 AM. Therefore, the operations near point i can be weighted to develop a daytime equivalent number of operations ($N_{equiv,i}$).

$$eq. 2.\ N_{Equiv,i} = W_{Day}\ x\ N_{Day,i} + W_{Eve}\ x\ N_{Eve,i} + W_{Night}\ x\ N_{Night,i}$$

Where:

- $N_{Day,i}$ is the number of user-specified operations between 7 AM and 7 PM local time
- $N_{Eve,i}$ is the number of user-specified operations between 7 PM and 10 PM local time
- $N_{Night,i}$ is the number of user-specified operations between 10 PM and 7 AM local time
- W_{Day} is the day-time weighting factor, which is 1 operation for DNL
- W_{Eve} is the evening weighting factor, which is 1 operation for DNL
- W_{Night} is the night-time weighting factor, which is 10 operations for DNL

The number of daytime equivalent operations, $N_{DNL,i}$ can be simplified to

$$eq. 3.\ N_{DNL,i} = N_{Day,i} + N_{Eve,i} + 10\ x\ N_{Night,i}$$

4.2 PADDC Infrastructure

The PADDC at Tolleson accommodates four sets of launch and landing pads. In the context of this noise analysis, it is assumed that only one launch/landing pad is under consideration at a given time. To conservatively represent all operations within the PADDC, including all launch and landing pads, the analysis is focused on the southernmost launch and landing pad that is closest to the noise-sensitive location. Since the precise location of the nearest single launch or landing pad is unknown, the respective PADDC boundary is used for the analysis.

4.3 Application of Acoustical Data

The summation of the SELs in the previous section are used to estimate the DNL for Prime Air's drone operations covered in this report. SEL results are detailed in FAA's Memorandum found in **Attachment B**.

For calculating SEL, five specific activities are considered:

- The drone taking off from the PADDC

- The drone transitioning from either vertical to horizontal flight or horizontal to vertical flight
- En route travel of the drone in horizontal flight between the PADDC and the delivery point
- Delivery
- The drone landing at the PADDC

This analysis is based on the SEL data provided in **Section 3**. **Table 5** displays noise exposure values at distinct increments corresponding to the drone vertical profile, ranging from 0 to 3,200 feet. In instances where additional values within this range are required, linear interpolation can be employed to approximate SEL values at intermediary distances. However, extrapolating SEL values for distances less than 32.8 feet during takeoff, landing, or delivery is discouraged due to increased deviations in the estimation method's accuracy as the distance approaches the noise source.

4.3.1 Takeoff

The process for calculating SELs for the takeoff profile is presented in **Section 3**, Equation 1 combined with the parameters presented **Table 2**.

Application of the SEL is based on the position of the southernmost launch pad at a PADDC. However, since the exact location of the launch pad is not known, this analysis uses the outer boundary of the PADDC, at a point closest to the receiver, to be conservative. It should be noted that the SEL values provided do not include the transition to horizontal flight or the acceleration to en route speed that would occur after the climb.

4.3.2 Transitions between Vertical and Horizontal Flight

Table 5 presents noise exposure values SELs for the transition between vertical and horizontal flight. Noise exposure is expressed at discrete increments relative to the drone’s ground location for distances from 0 to 3,200 feet. These values are applicable to the drone when it is in level flight at 165 feet AGL and is either accelerating or decelerating within the speed range of 0 to 52.4 knots over a duration of 20 seconds.

4.3.3 En Route

The anticipated flight speed of the drone en route is 52.4 knots at a cruise altitude of 165 feet AGL. Sound exposure level for a given point *i* (*SELi*) with the drone flying directly overhead at altitude (*Alti*) in feet and a ground speed (*Vi*) in knots, is calculated based on the guidance in *14 CFR Part 36 Appendix J, Section J36.205 Detailed Data Correction Procedures*.[4] The equations presented in this section are only applicable for a drone that is moving relative to a stationary receptor. The sound exposure level adjustment for the altitude of a moving drone is presented in Equation 4.

$$Eq.4.\ \Delta J_1 = 10\ x\ Log_{10}\frac{H_A}{H_T}, dB$$

Where:

- ΔJ_1 is the quantity in decibels that must be algebraically added to the measured SEL in order to estimate the SEL for a level flight path at an altitude differing from the altitude corresponding to the measured SEL.

[4] https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-36.

- H_A is the reference height, in feet, corresponding to the measured SEL.
- H_T is the altitude at which an estimate of the SEL is being made; and the constant (12.5) accounts for the effects on spherical spreading and duration from the off-reference altitude.

Note the value of ΔJ_1 is 0 if H_T is equal to H_A and can be negative if H_T is greater than (higher altitude) than H_A.

The sound exposure level adjustment for speed is presented in Equation 5.

$$Eq. 5.\ \Delta J_3 = 10\ x\ Log_{10} \frac{V_R}{V_{RA}}, dB$$

Where:

- ΔJ_3 is the quantity in decibels that must be algebraically added to the measured SEL noise level to estimate the SEL of the drone at speed V_{RA} when the measured SEL corresponds to the drone traveling at a reference speed V_R.

This adjustment accounts for how the varying speed impacts the duration of the overflight at the stationary receptor.

As shown in **Table 6**, the SEL is 67.7 dB when the drone is at maximum weight, at 165 feet from the stationary receiver and traveling at approximately 52.4 knots. Using the maximum weight (outbound) en route condition when the drone is operating at an altitude of Alt_i feet (AGL) and ground speed of V_i knots can be made using Equation 6 to arrive at an estimate SEL_{max} weight dB for that respective phase of flight.

$$Eq. 6.\ SEL_{Max} = 67.7 + 12.5\ x\ Log_{10} \frac{165}{Alt_i} + Log_{10} \frac{52.4}{V_i}, dB$$

For this analysis, it was assumed that Equation 6 is applicable for all en route activity to ensure a conservative assumption for drone flyovers at 165 feet AGL.[5]

4.3.4 Delivery

The available SELs to be applied for the delivery phase in Equation 1 are presented in **Table 4**. The SELs are based on the distance of the receiver relative to the position of the delivery point. The minimum distance used for calculation between the delivery point and a person is 16.4 feet.[6] The values in **Table 4** are valid for distances from the delivery point of 32.8 feet or greater. SEL values for distances of between 16 and 32.8 feet are adjusted by distance to the delivery point and sound level adjustment of a stationary source as provided by Equation 7.

$$Eq. 7.\ SEL_{Delivery} = 96.5 + 12.5\ x\ Log_{10} \frac{32.8}{Distance\ from\ Delivery\ Point\ (ft)}$$

The SEL values in **Table 4** do not provide the noise contribution from the horizontal flight associated with either the drone transitioning from en route speed to vertical flight before delivery,

[5] *Estimated Noise Levels for Amazon Prime Air MK27-2 UA*, FAA Office of Environment and Energy, August 2022 (See Attachment B)

[6] Prime Air's safety guidance stipulates that there should not be a person, animal or object within 5 meters of the delivery point, and if the drone detects a person, animal or object within 5 meters of the delivery point, it will abort the delivery.

or the transition between vertical flight to en route speed after delivery. The SEL values only include descent from en route altitude to delivery altitude, various maneuvers associated with the delivery, and climb back to en route altitude.

4.3.5 Landing

The available SELs to be applied for the landing profile in Equation 1 are presented in **Table 3**. Application of the SEL is based on the location of the southernmost landing pad at a PADDC. However, since the exact landing pad is not known, using an outer boundary of the PADDC, at a point closest to the receiver, provides a conservative approach. It should be noted that the SEL values provided only include descent from en route altitude and do not include the deceleration from en route speed or transition to vertical flight that would occur after descent.

4.4 DNL Estimation Methodology

The number of operations flying over a specific receiver's ground location will fluctuate depending on the proposed operating area and demand. For a given receiver location, i, and a single instance of sound source, A, the SEL for that sound source SEL_{iA} is (energy) summed for the average annual daily number of DNL daytime equivalent operations ($N_{DNL,iA}$) to compute the equivalent DNL in Equation 8.

$$Eq.8.\ DNL_{iA} = SEL_{iA} + 10\ x\ \ Log_{10}(N_{DNL,iA}) - 49.4, dB$$

The above equation applies to an SEL value representing one noise source such as a drone takeoff or landing. For cases where a receiver would be exposed to multiple noise sources (e.g. takeoff, transiting, en route, and departure), the complete DNL at that point was calculated with Equation 9.

$$Eq.9.\ DNL_i = 10\ x\ \ Log_{10}\left(10^{\left(\frac{DNL_{ia}}{10}\right)} + 10^{\left(\frac{DNL_{ib}}{10}\right)} + \cdots + 10^{\left(\frac{DNL_{iz}}{10}\right)}\right), dB$$

For each of the conditions presented below, results are presented in tabular format based on the equivalent daytime operations, in DNL daytime equivalent, for the estimated DNL. The proper output of DNL is dependent on the calculation of respective daytime equivalent operations.

4.4.1 DNL at PADDC

The takeoffs and landings are anticipated to occur at the same location. Therefore, the results for both will be calculated for a single set of receptors. Operations were assumed to takeoff and the landing flight paths along the path.

Takeoff operations are represented by two sound levels. The drone will take off and climb to en route altitude as discussed in Section 2. The drone will then begin en route flight by transitioning from vertical flight to horizontal flight and accelerating to en route speed of 52.4 knots.

Landing operations are also represented by two sound levels. The drone flies to the PADDC at en route altitude while slowing down and transitions from horizontal to vertical flight as described in Section 2. Then the drone descends from en route altitude to the ground and shuts down.

The four noise sources representing the complete takeoff and landing cycle associated with a single delivery departing and returning at the PADDC were added together in Equation 9.

4.4.2 DNL for En Route

A receiver will be positioned directly under the flight path, and the DNL will be calculated based on the altitude and speed-adjusted delivery SEL calculated in Section 3. The number of operations would be based on relevant materials and assume that a drone directly overflies the receiver while at maximum weight for both outbound and inbound for a single delivery. The en route outbound and inbound noise level are added together with Equation 9.

4.4.3 DNL for Delivery Points

Delivery operations will be represented by three sound levels. First, the drone decelerates from en route speed and transitioning from horizontal flight to vertical flight over the delivery point at the en route altitude of 165 ft. Second, delivery phase where the package is dropped at the delivery point. Lastly, the drone transitions from vertical flight to horizontal flight after reaching the en route altitude of 165 feet AGL and accelerating to en route speed. The three sound levels are added together with Equation 9.

5 Estimated Noise Exposure

This section outlines the estimated noise exposure for Prime Air's proposed operations for any given number of average annual day (AAD) deliveries. Results are based off the estimated number of DNL equivalent deliveries associated with the PADDC and presented in tabular format. Prime Air expects to conduct 469 daily deliveries, which per note B in **Table 7**, the average daily deliveries rounds to 480. Note that one delivery includes the outbound takeoff and inbound landing and is representative of two operations.

The DNL equivalent deliveries, $N_{DNL,i}$ as described in Section 4.1, is presented below as Equation 10.

$$Eq. 10.\ Deliveries_{DNL,i} = Deliveries_{Day} + 10\ x\ Deliveries_{Night}$$

$Deliveries_{Day}$ are between 7 AM and 10 PM and $Deliveries_{Night}$ are between 10 PM and 7 AM. If a portion of a delivery (either takeoff or landing) occurs in the nighttime hours, then it is counted within $Deliveries_{Night}$. If a portion of a delivery (either takeoff or landing) occurs in two time periods, then it should be counted within $Deliveries_{Night}$ for a more conservative approach.

For estimating noise exposure, the noise levels for each flight phase are considered separate based on the level of proposed operations for a given location. When a particular receptor is at the transition of different flight phases, the cumulative noise exposure is then determined by adding the noise from each phase.

5.1 Noise Exposure for Operations at the PADDC

For operations at the PADDC, noise generated by the drone includes takeoff, landing, and transitions from vertical to fixed-wing horizontal flight within the corresponding en route flight phases. It was assumed that all operations follow the same en route flight path, with outbound and inbound flights traversing it in opposing directions for a conservative approach.

Table 7 presents data for the number of average daily DNL equivalent deliveries (including the takeoff and climb, transition to en route outbound, transition from en route inbound, and descent and landing as detailed in Section 2. The table provides the estimated extent of DNL 45 dB, 50 dB, 55 dB, 60 dB, and 65 dB contours under the flight path for the PADDC. The analyses presented were rounded up conservatively to the nearest interval available from the data from Section 3, out to 3,500 feet.

Table 7. Estimated Extent of Noise Exposure from PADDC per Number of Deliveries

Number of DNL Equivalent Deliveries		Estimated Extent of Exposure (feet)				
Average Daily	Annual	DNL 45	DNL 50	DNL 55	DNL 60	DNL 65
<= 1	<= 365	75	32.8	32.8	32.8	32.8
<= 5	<= 1,825	150	100	50	32.8	32.8
<= 10	<= 3,650	250	150	75	32.8	32.8
<= 15	<= 5,475	250	150	100	50	32.8
<= 20	<= 7,300	300	200	100	75	32.8
<= 40	<= 14,600	450	250	150	100	32.8
<= 60	<= 21,900	550	300	200	100	75
<= 80	<= 29,200	650	350	200	150	75
<= 100	<= 36,500	750	400	250	150	75
<= 120	<= 43,800	850	400	250	150	100
<= 140	<= 51,100	1000	450	250	150	100
<= 160	<= 58,400	1150	500	300	150	100
<= 180	<= 65,700	1400	500	300	200	100
<= 200	<= 73,000	1650	550	300	200	100
<= 220	<= 80,300	2650	600	300	200	100
<= 240	<= 87,600	Note 3	600	350	200	150
<= 260	<= 94,900	Note 3	650	350	200	150
<= 280	<= 102,200	Note 3	700	350	200	150
<= 300	<= 109,500	Note 3	700	350	200	150
<= 340	<= 124,100	Note 3	800	400	250	150
<= 360	<= 131,400	Note 3	800	400	250	150
<= 380	<= 138,700	Note 3	850	400	250	150
<= 400	<= 146,000	Note 3	900	450	250	150
<= 420	<= 153,300	Note 3	950	450	250	150
<= 440	<= 160,600	Note 3	1000	450	250	150
<= 460	<= 167,900	Note 3	1050	450	250	150
<= 480	<= 175,200	Note 3	1100	450	250	150

SOURCE: ESA, 2024.

Notes:

1. One delivery accounts for the outbound takeoff and inbound landing and is representative of two operations.
2. If a value for deliveries is not specifically defined in this table, use the next highest value. For example, if there are 50 average daily DNL equivalent deliveries, use the entry for 60 average daily DNL equivalent deliveries.

3 The DNL noise level noted extends more than 3,500 feet from the PADDC based on the level of operations specified as the aircraft continues along its en route flight path. En route results in Section 5.2 may be more applicable in these instances for determining noise levels.

5.2 Noise Exposure under En Route Paths

When the drone is en route it is expected to fly the same outbound flight path between the PADDC and the delivery point and inbound flight path back to the PADDC. Therefore, each receiver under the en route path would experience two overflights for each delivery served by the corresponding en route flight path.

Table 8 provides the estimated DNL for a receiver on the ground directly under an en route path for various counts of daily average DNL equivalent deliveries. The en route noise calculated for each delivery includes both the inbound and outbound traversal of the en route path at 165 feet AGL and a ground speed of 52.4 knots.

The drone may overfly locations at operational levels that differ from both an inbound and outbound traversal of the en route path by the drone as described above and presented in **Table 8**. For these circumstances, **Table 9** presents the equations for calculating the estimated DNL for a receiver directly under a specified given number of DNL equivalent average daily individual overflights, defined as N_o.

Table 8. Estimated Noise Exposure Directly Under En Route Flight Paths

Number of DNL Equivalent Deliveries		
Average Daily	Annual	DNL
<= 1	<= 365	21.3
<= 5	<= 1,825	28.3
<= 10	<= 3,650	31.3
<= 15	<= 5,475	33.1
<= 20	<= 7,300	34.4
<= 40	<= 14,600	37.4
<= 60	<= 21,900	39.1
<= 80	<= 29,200	40.4
<= 100	<= 36,500	41.3
<= 120	<= 43,800	42.1
<= 140	<= 51,100	42.8
<= 160	<= 58,400	43.4
<= 180	<= 65,700	43.9
<= 200	<= 73,000	44.4
<= 220	<= 80,300	44.8
<= 240	<= 87,600	45.1
<= 260	<= 94,900	45.5
<= 280	<= 102,200	45.8
<= 300	<= 109,500	46.1
<= 340	<= 124,100	46.7
<= 360	<= 131,400	46.9
<= 380	<= 138,700	47.1
<= 400	<= 146,000	47.4
<= 420	<= 153,300	47.6
<= 440	<= 160,600	47.8
<= 460	<= 167,900	48.0
<= 480	<= 175,200	48.2
<= 500	<= 182,500	48.3

SOURCE: ESA, 2024.

Table 9. Estimated Noise Exposure Directly Under Overflights

Altitude of Overflight	SEL for One Overflight (dB)	DNL for One Overflight Between 7 AM and 10 PM (dB)	DNL Equation for the Number of DNL Equivalent Overflights
115 feet AGL	69.7	20.3	10 x $\log_{10}(No)$ + 20.3
160 feet AGL	67.9	18.5	10 x $\log_{10}(No)$ + 18.5
165 feet AGL	67.7	18.3	10 x $\log_{10}(No)$ + 18.3
180 feet AGL	67.2	17.9	10 x $\log_{10}(No)$ + 17.9
300 feet AGL	64.5	15.1	10 x $\log_{10}(No)$ + 15.1
N Feet AGL	12.5 x $\log_{10}(165/N_{ft})$ + 67.7	SEL_1 – 49.4	10 x $\log_{10}(No)$ + DNL_1

SOURCE: ESA, 2024.

Notes:

1. The DNL value for a given number of average DNL Equivalent Operations, N_o, can be found by using the equations associated with operation of the drone at a specified altitude and speed interval. In this case, one operation represents a single overflight.
2. All values in this table are for level flight at maximum weight and 52.4 knots.

5.3 Noise Exposure for Operations at Delivery Point

Table 10 presents the estimated DNL values for a range of potential daily average DNL equivalent delivery counts at a delivery point. Also included in **Table 10** is the equation for calculating the estimated DNL for a specific number of daily average DNL equivalent delivery counts at a delivery point, defined as N_d, for instances where the number of deliveries may fall between the range of presented delivery count intervals.

The DNL values include the transition from en route speed to vertical flight at en route altitude, the delivery maneuver, and the transition from vertical flight at en route altitude to en route speed as discussed in Section 4.4.3. The minimum listener distance is 16.4 feet from the delivery point and corresponds to minimum distance between a person and delivery point. Values are also presented at 32.8 feet from the delivery point which corresponds to minimum distance from the available measurement data and analysis presented by FAA. Values were also calculated at distances of 50 feet, 75 feet, 100 feet, and 125 feet from the delivery point and are representative of distances from which nearby properties may experience noise from a delivery.[7]

[7] The 2022 US Census national average lot size for single-family sold homes was 15,265 square feet. This is representative of a property with dimensions of a 123.55 x 123.55-foot square. 125 feet represents a 125-foot lateral width of the parcel rounded up to the nearest 25 feet. https://www.census.gov/construction/chars/ See file “Soldlotsize_cust.xls” sheet MALotSizeSold. Accessed January 18, 2024.

Table 10. Estimated Noise Exposure at Various Distances from a Delivery Point per Number of DNL Equivalent Deliveries

Average Daily Deliveries	Annual Deliveries	DNL at 16.4 feet[1]	DNL at 32.8 feet[2]	DNL at 50 feet	DNL at 75 feet	DNL at 100 feet	DNL at 125 feet
<= 1	<= 365	51.0	47.2	46.1	44.3	41.6	39.1
<= 5	<= 1,825	57.9	54.2	53.1	51.3	48.6	46.1
<= 10	<= 3,650	61.0	57.2	56.1	54.3	51.6	49.1
<= 15	<= 5,475	62.7	58.9	57.9	56.1	53.3	50.8
<= 20	<= 7,300	64.0	60.2	59.1	57.3	54.6	52.1
<= 40	<= 14,600	67.0	63.2	62.1	60.3	57.6	55.1
<= 60	<= 21,900	68.7	65.0	63.9	62.1	59.3	56.9
<= 80	<= 29,200	70.0	66.2	65.1	63.3	60.6	58.1
<= 100	<= 36,500	71.0	67.2	66.1	64.3	61.6	59.1
<= 120	<= 43,800	71.7	68.0	66.9	65.1	62.4	59.9
<= 140	<= 51,100	72.4	68.6	67.6	65.8	63.0	60.5
<= 160	<= 58,400	73.0	69.2	68.2	66.3	63.6	61.1
<= 180	<= 65,700	73.5	69.7	68.7	66.9	64.1	61.6
<= 200	<= 73,000	74.0	70.2	69.1	67.3	64.6	62.1
<= 220	<= 80,300	74.4	70.6	69.5	67.7	65.0	62.5
<= 240	<= 87,600	74.8	71.0	69.9	68.1	65.4	62.9
<= 260	<= 94,900	75.1	71.3	70.3	68.5	65.7	63.2
<= 280	<= 102,200	75.4	71.7	70.6	68.8	66.0	63.6
<= 300	<= 109,500	75.7	72.0	70.9	69.1	66.3	63.9
<= 340	<= 124,100	76.3	72.5	71.4	69.6	66.9	64.4
<= 360	<= 131,400	76.5	72.8	71.7	69.9	67.1	64.6
<= 380	<= 138,700	76.8	73.0	71.9	70.1	67.4	64.9
<= 400	<= 146,000	77.0	73.2	72.1	70.3	67.6	65.1
<= 420	<= 153,300	77.2	73.4	72.4	70.5	67.8	65.3
<= 440	<= 160,600	77.4	73.6	72.6	70.7	68.0	65.5
<= 460	<= 167,900	77.6	73.8	72.7	70.9	68.2	65.7
<= 480	<= 175,200	77.8	74.0	72.9	71.1	68.4	65.9
<= 500	<= 182,500	77.9	74.2	73.1	71.3	68.6	66.1

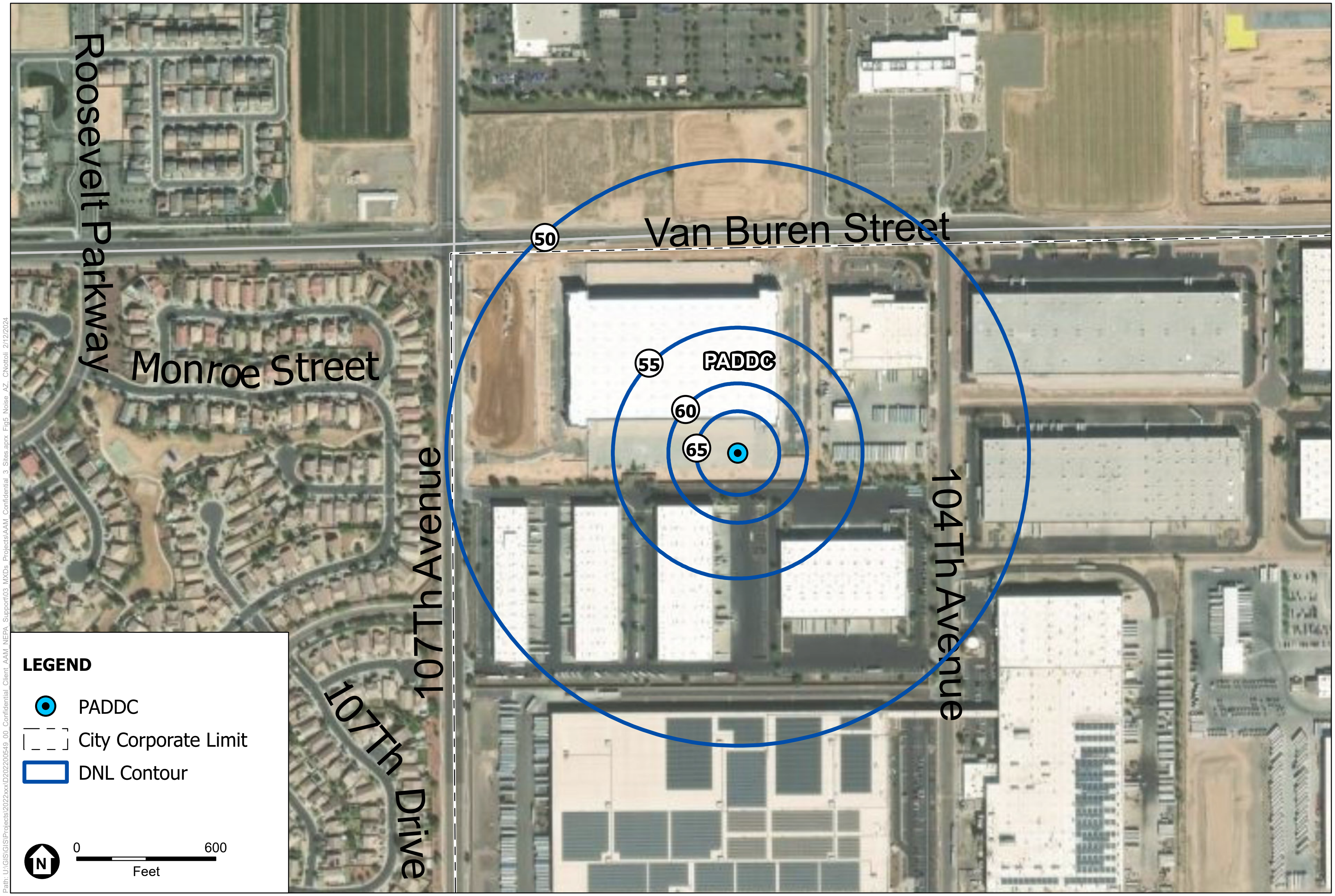
SOURCE: ESA, 2024.

Notes:

1. Minimum possible listener distance from drone.
2. Minimum measured distance to listener from drone.
3. The DNL values presented in this table only reflect the UA conducting descent and climb flight maneuvers associated with a delivery. DNL values associated with en route flight to and from a PADDC to a delivery point associated with a delivery, or nearby en route overflights, should be added to these values utilizing the DNL presented in Table 8.
4. If a value for deliveries is not specifically defined in this table, use the next highest value. For example, if there are 50 average daily DNL equivalent deliveries, use the entry for 60 average daily DNL equivalent deliveries.

6 Results

The DNL 50-, 55-, 60-, and 65-dB contours for Proposed Action are presented in **Figure 5**. These contours represent the 24-hour drone noise exposure to areas surrounding the Tolleson PADDC on an average annual day. Note that the DNL 65 dB contour does not extend beyond the Prime Air property line and is expected that no noise impacts to non-compatible land uses would occur.



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

Draft Environmental Assessment for Amazon Prime Air – Tolleson, AZ

Figure 5
PADDC Noise Exposure Contours
Tolleson, AZ

ESA

Attachment A

Federal Aviation Administration

Memorandum

Date:	September 22, 2022
To:	Don Scata, Noise Division Manager, Office of Environment and Energy (AEE-100)
	MICHAEL JAY MILLARD Digitally signed by MICHAEL JAY MILLARD Date: 2022.09.22 13:41:19 -04'00'
From:	Mike Millard, Flight Standards (AFS), General Aviation Operations Branch, AFS-830
Subject:	Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air MK27-2 UA Part 135 Operations at College Station, TX

FAA Office of Flight Standards (AFS) requests FAA Office of Environmental and Energy, Noise Division (AEE-100) approval of the noise methodology to be used for the Environmental Assessment (EA) for Amazon operations using the Amazon Prime Air MK27-2 unmanned aircraft (UA) in College Station, TX to provide package delivery services as a 14 CFR Part 135 operator as described below.

As required under the National Environmental Policy Act (NEPA), the FAA must consider the potential for environmental impacts in informing the agency's decision to approve Federal actions, including the potential for noise impacts as detailed in FAA Order 1050.1F.

As the FAA does not currently have a standard approved noise model for UA, this memo serves as a request for written approval from AEE-100 to use the methodology proposed in the following sections to support the noise analysis for this EA.

Description of Aircraft and Proposed Operations

AFS is evaluating Amazon's proposed commercial package delivery operations using the Model MK27-2 UA from one Prime Air Drone Delivery Center (PADDC) located in the College Station, TX operating area. Approval of a Federal Action providing Amazon's air carrier Operations Specifications (OpSpecs) is required before these operations can occur.

Amazon is proposing to perform package delivery operations from the site within the proposed operating area to transport packages to delivery sites including residential homes in the area.

The MK27-2 UA is a multi-rotor design with six propellers mounted on equally spaced arms extending horizontally from a center frame. The UA can transition between vertical and horizontal flight. According to data provided by Amazon, the maximum allowable takeoff weight of the UA is 91.5 pounds, its empty weight (including battery) is 86.6 pounds, and its maximum allowable package weight is 4.9 pounds. The package is carried in an internal cargo bay.

The MK27-2 can climb and descend vertically, hover, and fly upright with its propellers facing forward like a fixed-wing aircraft for en route flight. Airspeeds during normal en route flight are expected to be approximately 52 knots. Typical flights begin with the UA ascending vertically from a PADDC launch pad at ground level to an en route altitude between 160 and 180 feet Above Ground Level (AGL). The UA then flies a pre-assigned route between 160 and 180 feet AGL and 52 knots to a selected delivery point. Once near the delivery point, the UA decelerates and descends vertically over the delivery point. The UA descends to 13 feet AGL, drops the package, and ascends back to en route altitude. Once back at en route altitude, the UA accelerates to 52 knots and follows a predefined track to return to its originating PADDC. When the UA arrives at the PADDC, it decelerates and vertically descends to its sector's assigned landing pad. Once it lands, the UA is serviced and prepared for the next delivery.

A single PADDC is expected to have four sectors and each sector will have no more than one UA operating at a time. Amazon projects operating 52,000 annual deliveries, no night time flights, with 142.47 total deliveries on an average annual daily basis. Based on those overall levels Amazon expects deliveries to be distributed among delivery locations with a minimum number of 0.1 deliveries per day or less at any one location and maximum of 4.0 per day at any one location on an average annual daily basis.

Noise Analysis Methodology

AFS requests use of the noise analysis methodology described in HMMH Report No. 309990.003-7 for the "Noise Assessment for Amazon Prime Air Proposed Package Delivery Operations with Amazon Prime Air MK27-2 Unmanned Aircraft" dated August 19, 2022.

Federal Aviation Administration

Memorandum

Date: September 26, 2022

To: Mike Millard, Flight Standards (AFS), General Aviation Operations Branch, AFS-830

From: Don Scata, Manager, Noise Division, Office of Environment and Energy (AEE-100)

Digitally signed by DONALD S SCATA
Date: 2022.09.26 09:42:28 -04'00'

Subject: Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air Commercial Package Delivery Operations with the MK27-2 UA from College Station, Texas

The Office of Environment and Energy (AEE) has reviewed the proposed non-standard noise modeling methodology to be used for Amazon Prime Air (Amazon) operations using the MK27-2 unmanned aircraft (UA) from College Station, Texas. This request is in support of an Environmental Assessment (EA) for Amazon to provide package delivery services as a 14 CFR Part 135 operator in College Station and a surrounding operating area.

The Proposed Action is to use the MK27-2 UA to deliver packages from a central distribution center, referred to as a Prime Air Drone Delivery Center (PADCC), to potential delivery locations such as residential homes within a proposed operating area in College Station. Typical operations of the UA will consist of departure from a launch/takeoff pad at the PADCC followed by a vertical climb to a typical en route altitude of 160 to180 feet above ground level (AGL). The UA then transitions from vertical to horizontal flight and accelerates to a typical en route speed of 52 knots for transit to a delivery location. Approaching the delivery location, the UA will deaccelerate and transition from horizontal to vertical flight, and then descend vertically over the delivery point. At 13 feet AGL, the UA drops the package at the delivery point, and ascends vertically back to en route altitude. Once back at en route altitude, the UA transitions from vertical to horizontal flight and accelerates to 52 knots for transit back to its originating PADDC. When the UA arrives at the PADDC, the UA will deaccelerate and transition from horizontal to vertical flight and vertically descends to its assigned landing pad. Once it lands, the UA is serviced and prepared for the next delivery.

Amazon expects to operate four sectors at the College Station PADCC and each sector will have no more than one UA operating at a time. Amazon projects operating a maximum of 52,000 annual deliveries, no night time flights, with 142.47 total deliveries on an average annual daily (AAD) basis. Amazon anticipates deliveries will be distributed throughout the operating area with a maximum of 4 per day at any one delivery location on an AAD basis as detailed in the proposed non-standard noise modeling methodology request, “Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air MK27-2 UA Part 135 Operations at College Station, TX” dated September 22, 2022.

As the FAA does not currently have a standard approved noise model for assessing UA, and in accordance with FAA Order 1050.1F, all non-standard noise analysis in support of the noise impact analysis for the National Environmental Policy Act (NEPA) must be approved by AEE. This letter serves as AEE's response to the method developed in in HMMH Report No. 309990.003-7 for the "Noise Assessment for Amazon Prime Air Proposed Package Delivery Operations with Amazon Prime Air MK27-2 Unmanned Aircraft" dated August 19, 2022.

The proposed methodology appears to be adequate for this analysis; therefore, AEE concurs with the methodology proposed for this project. Please understand that this approval is limited to this particular Environmental Review, location, vehicle, and circumstances. Any additional projects using this or other methodologies or variations in the vehicle will require separate approval.

Attachment B

Federal Aviation Administration

Date:	August 4, 2022
To:	Donald Scata, Manager, Noise Division, Office of Environment and Energy (AEE-100)
From:	Christopher Hobbs, General Engineer, Noise Division, Office of Environment and Energy (AEE-100)
Subject:	Estimated Noise Levels for Amazon Prime Air MK27-2 UA

This memo presents an analysis of noise measurements of the Amazon Prime Air MK27-2 Unmanned Aircraft (UA) by Amazon Prime Air (Amazon), measured between April 1 and April 16, 2022 at the Pendleton UAS Range located at the Eastern Oregon Regional Airport (KPDT) in Pendleton, Oregon. The purpose of the analysis is to provide estimates of expected sound exposure levels resulting from typical operations of the Amazon MK27-2 UA by Amazon and provides the methods used to create the noise estimates. Any deviation of the expected flight profile from those measured at Pendleton will need to be accounted for in the noise estimates using appropriate methodology.

1. Flight Profile and Segment Noise

The phases of a typical flight profile from takeoff to landing from a Prime Air Drone Delivery Center (PADDC) with an included delivery are listed in Table 1 for the MK27-2 UA. For the purposes of this analysis, the point on the ground that the UA takes off of (launch pad), delivers to (delivery point), and lands on (landing pad) will be referred to as the PADDC. For normal operations Amazon will be basing the UA at a PADDC containing the landing and takeoff pad infrastructure, and delivery will be completed at a remote location using a target on the ground at the delivery location to mark the specific delivery point. All noise measurements at Pendleton were made with the UA carrying a 5 lbs package representative of the UA operating at the max takeoff weight of 91.5 lbs. The package was not released during the delivery phase of the flight profile. It is assumed that the noise generated during the climb out after delivery with the package will be greater than if the package had been released; therefore, the noise measurements presented here are a conservative estimate of those during actual operations.

The method used to estimate the noise on the ground during each phase of flight is listed below. The methodology presented for estimating the noise for each flight phase uses the best available information from available measurement data for the MK27-2 UA and represents a conservative estimate of the noise levels resulting from operations of this UA.

Table 1. Phases of Flight for Typical Flight Profile of MK27-2 UA

Phase of Flight	Description
Takeoff	Vertical launch from PADDC on ground to en route altitude (165 ft Above Ground Level (AGL)) in vertical flight mode (pointed upward)
Transition to Outbound En Route Flight	Transition from zero speed above PADDC at en route altitude to cruise speed (52.4 kts) while changing from vertical flight mode to fixed-wing flight mode (pointed horizontally)
Outbound En Route Flight	Fixed-wing flight mode at operational en route altitude and cruise speed
Transition to Delivery	Transition from cruise speed at en route altitude and fixed-wing flight mode to zero speed above PADDC/delivery point at en route altitude and in vertical flight mode
Delivery	Vertically descend from en route altitude to 13 ft AGL delivery altitude, drop a package at the PADCC/delivery point, and vertical ascent back to en route altitude in vertical flight mode
Transition to Inbound En Route Flight	Transition from zero speed above PADDC/delivery point at en route altitude to cruise speed while changing from vertical flight mode to fixed-wing flight mode
Inbound En Route Flight	Fixed-wing flight mode at operational en route altitude and cruise speed
Transition to Landing	Transition from cruise speed at en route altitude and fixed-wing flight mode to zero speed above PADDC at en route altitude and in vertical flight mode
Landing	Descend from en route altitude to PADDC on ground in vertical flight mode

1.1 Transition Noise

Because the transition phase from vertical to fixed-wing flight mode or vice versa is involved in the takeoff, delivery, and landing phases of flight it will be discussed first. The measurements made by Amazon were done with the microphones oriented normal to the flight track as shown in Figure 1. As the figure shows, the UA did not fly over the microphones after takeoff. The same is true for the transitions before and after delivery and the transition before landing. To estimate the maximum noise at a distance from the takeoff/landing pad or delivery point on the ground one must combine the noise emitted from the UA during the vertical portion of the trajectory (descent or ascent) and the noise the UA make as it transitions from the vertical flight mode (pointed up) to fixed-wing flight mode (pointed horizontally). The microphones were not positioned to capture the majority of the transition noise; thus, an estimate of the noise made by the UA while transitioning had to be made based on the overflight measurements as discussed below.

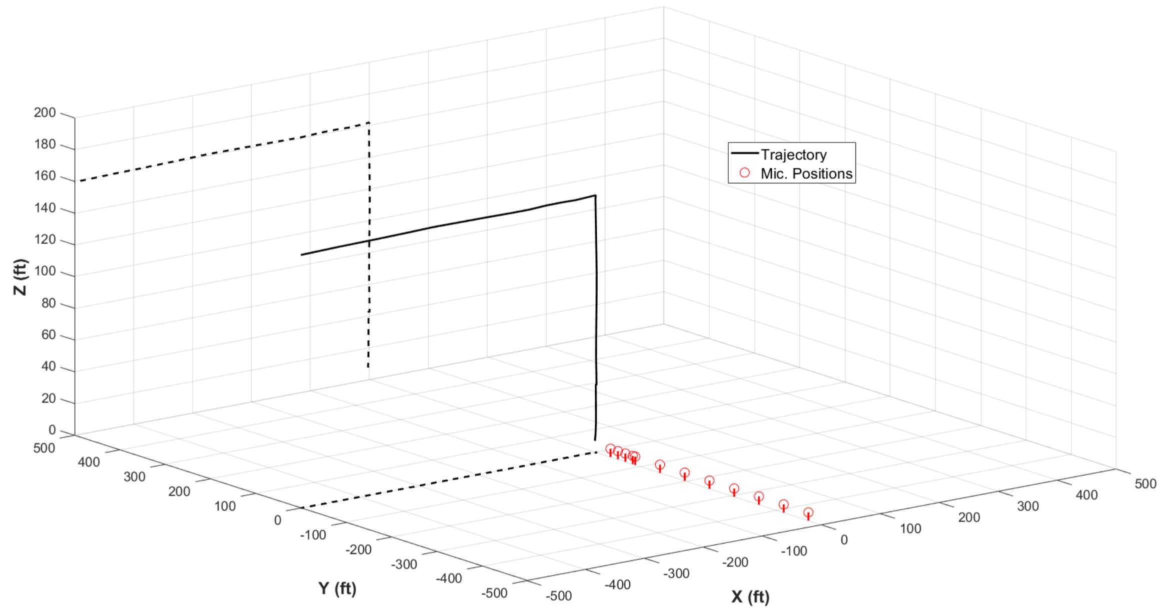


Figure 1. Microphone locations for takeoff, delivery, and landing measurements for MK27-2 UA with example takeoff trajectory.

The duration of the transition of the UA from vertical to fixed-wing flight mode was measured using the time it took the UA to reach cruise speed after it reached the top of the vertical climb during takeoff and post-delivery. The start of the duration for both phases was set as the time the UA began having non-zero ground speed. For the duration of the transition of the UA from fixed-wing flight mode to vertical flight during landing and pre-delivery, the transition duration was measured from the time the UA began to decelerate from cruise speed to zero ground speed. In all cases the acceleration was noted as being nearly constant. The pitch of the UA from vertical to horizontal fixed-wing flight mode was shown to coincide with this time as well. Table 2 shows the average durations for the UA to transition to and from fixed-wing flight mode. As presented in Table 2, the average duration for transition during takeoff and landing was the same 20 seconds. Assuming a constant acceleration to and from a 52.4 knot cruise speed, the distance to transition from vertical to fixed-wing flight mode is approximately 884 ft. It is the same approximate distance to transition from fixed-wing to vertical flight mode.

Table 2. Description of Transition to and from Fixed-Wing Flight Mode

Phase	Description	Altitude (ft AGL)	Ground Speed (kts)	Duration (s)
Transition to Fixed-Wing Mode	Transition from vertical to horizontal fixed-wing flight	165	0 accelerating to 52.4	20
Transition from Fixed-Wing Mode	Transition from horizontal fixed-wing flight to vertical flight	165	52.4 decelerating to 0	20

In order to estimate the noise made by the UA at positions undertrack as it transitions to or from fixed-wing flight mode, the following assumption has been made:

The noise of the UA in fixed-wing flight mode is approximately the same it transitions; furthermore, the noise radiated from the UAS is assumed to be omnidirectional. That is to say that the noise level measured a fixed distance from the UA will be the same in all directions.

To calculate the noise from the transition phase of the flight profile at distances from the PADDC undertrack, the following steps were performed:

1. The maximum noise level from measured overflights was corrected to the en route altitude distance (165 ft) using spherical spreading.
2. At each distance from the PADDC undertrack the estimated sound pressure level was calculated from 25 ft segments along the transition flight trajectory based on the maximum sound level measured during the overflight corrected to the distance between using spherical spreading. The duration applied to each respective segment's sound pressure level was found from the calculated motion of the UA as a function of time to / from a cruise speed of 52.4 kts to / from zero kts using constant acceleration.
3. The sound pressure level duration products were summed to find the estimated sound exposure level at each position.
4. The estimate of the sound exposure levels were corrected to match the overflight sound exposure level once past the effects of the transition at approximately 1600 ft from the PADDC.

The levels in Table 3 are the results of the calculations. It is recommended to use linear interpolation to find values between the distances in the table for the transition flight phases. This estimate of the transition phase of flight can be used for the transition from zero speed to the cruise speed as well as the transition from cruise speed to zero speed. The calculation was done for an estimated altitude of 165 ft AGL.

Table 3. Estimated Sound Exposure Levels from Transition Phase of Flight Profile

Distance from PADDC (ft)	Sound Exposure Level (dBA)[1]
0	69.9
100	70.6
200	70.3
400	69.4
800	68.2
1600	67.7
3200	67.7

Notes: 1) Applicable to either profile described in Table 2.

The sound exposure levels presented in Table 3 show that beyond 1600 ft from the PADDC the transition profile (Table 2) does not differ from the en route levels (Section 1.3); therefore, the transition phase noise levels present in Table 2 should be added to the noise created by the UA during takeoff, delivery, and landing out to a distance of 1,600 feet. The sound exposure levels from the overflight measurements should be combined with the other phases of flight for distances greater than 1,600 feet from the PADDC.

1.2 Takeoff and Landing Noise

There are two flight activities that generate noise in the vicinity of the takeoff and landing pads at the PADCC. The vertical portion of the trajectory (i.e., the climb or descent to/from the en route altitude), and the transition from vertical flight mode to horizontal fixed-wing flight mode as described above. During takeoff, the MK27-2 will climb from the ground vertically to an operational altitude of 165 feet AGL, then transition from vertical to fixed-wing flight for transit to the delivery location. After completing delivery, the UA returns from the delivery location at 165 feet AGL in fixed-wing flight, transitions to vertical flight, and then descends vertically to the ground at the landing pad. Table 4 details the takeoff and landing phases of the flight profile. The durations in the table are the average time it took the UA to ascend or descend from the cruise altitude.

Table 4. MK27-2 UA Takeoff and Landing Profile Details

Phase of Flight	Flight Description	Altitude (ft AGL)	Ground Speed (kts)	Duration (s)
Takeoff	Vertical ascent to cruise altitude	0 ascend to 165	0	21
Landing	Descent from cruise altitude to land	165 descend to 0	0	38

To estimate the sound exposure level from the takeoff and landing phases of the flight profile, measurements of the noise emissions of the MK27-2 UA were made when the UA was at maximum weight and was following a simulated takeoff and landing profile representative of typical operations. The profile included the vehicle climbing vertically from the PADDC to en route altitude where it transitioned to fixed-wing mode for en route flight, flying an oval “racetrack” pattern at en route altitude to simulate outbound en-route flight, and transitioning from en-route altitude in fixed-wing flight mode to the vertical flight mode for a descent to landing. The microphone positions relative to the takeoff and landing pad are shown in Figure 1. The PADDC is located at the origin in the plot. It is important to note that only 4 microphones were used for each flight. They were moved to different positions between flights.

The sound exposure level was calculated from the data collected by each microphone for each flight. The sound exposure level was calculated from the entire A-weighted time history of the event. Because the microphone array is normal to the flight track, the noise during transition between en route fixed-wing flight to vertical flight mode is not completely captured as it would be under the vehicle for the inbound and outbound phases of the flight profile and is assumed to not be accounted for in the following tables. Because of this, the sound exposure values versus distance measured from the PADDC must be supplemented to estimate the most conservative sound exposure as detailed below.

There were a total of nine flights where the UA performed a takeoff, delivery, and landing. The microphones were moved for some of the flights. The number of flights for each positioning of the four microphone was not equal; however, the available data represents a good range of distance from the PADDC and has a behavior that can be used to adequately represent the noise emissions from the vertical portion of the flight profile. There were two other flights performed for overflight measurements. Because the aircraft's flight track on takeoff and landing was not the same orientation to the microphone array as the first nine flights, metrics for those four events were not included in the averages. Table 5 presents the averaged results at each microphone for all takeoff events, and Table 6 presents the averaged results for averaged landing events.

Table 5. Average Sound Exposure Levels of MK27-2 UA during Takeoff versus Distance

Position	Distance (ft)	Sound Exposure Level (dBA)1
1	32.8	95.7
2	49.2	94.1
3	65.6	92.1
4	82.0	90.1
5	87.5	88.3
6	142.2	83.0
7	196.9	78.7
8	251.5	77.7
9	306.2	75.8
10	360.9	73.8
11	415.6	72.4
16	689.0	69.1
17	743.7	65.6
18	798.4	64.7
19	853.0	64.0

Notes: 1) Applicable for the takeoff profile presented in Table 4.

Table 6. Average Sound Exposure Levels of MK27-2 during Landing versus Distance

Position	Distance (ft)	Sound Exposure Level (dBA)[1]
1	32.8	94.8
2	49.2	93.2
3	65.6	92.1
4	82.0	90.2
5	87.5	90.1
6	142.2	85.0
7	196.9	80.7
8	251.5	79.0
9	306.2	77.3
10	360.9	74.9
11	415.6	73.7
16	689.0	69.7
17	743.7	67.6
18	798.4	67.0
19	853.0	66.2

Notes: 1) Applicable for the landing profile presented in Table 4.

The measured data are presented in the following figures. The curve fits in the Tables below represent the best estimates of the sound levels for the distance ranges listed. It is recommended to use the curve fit equations to calculate the sound exposure levels representing only the vertical portion of the flight profile noise emissions for the takeoff and landing phases. Positions four and five were averaged together and the effective distance weight-averaged because of their proximity. The distance of 149 feet from the PADDC is the minimum distance for which the behavior of the noise levels versus distance is consistently decreasing by approximately 6 dB per doubling of distance for the takeoff, delivery, and landing phases of flight. The same distance was chosen to begin the curve fit for consistency. The coefficients in the table for distance less than 149 feet are effectively linear interpolations between the average, measured values.

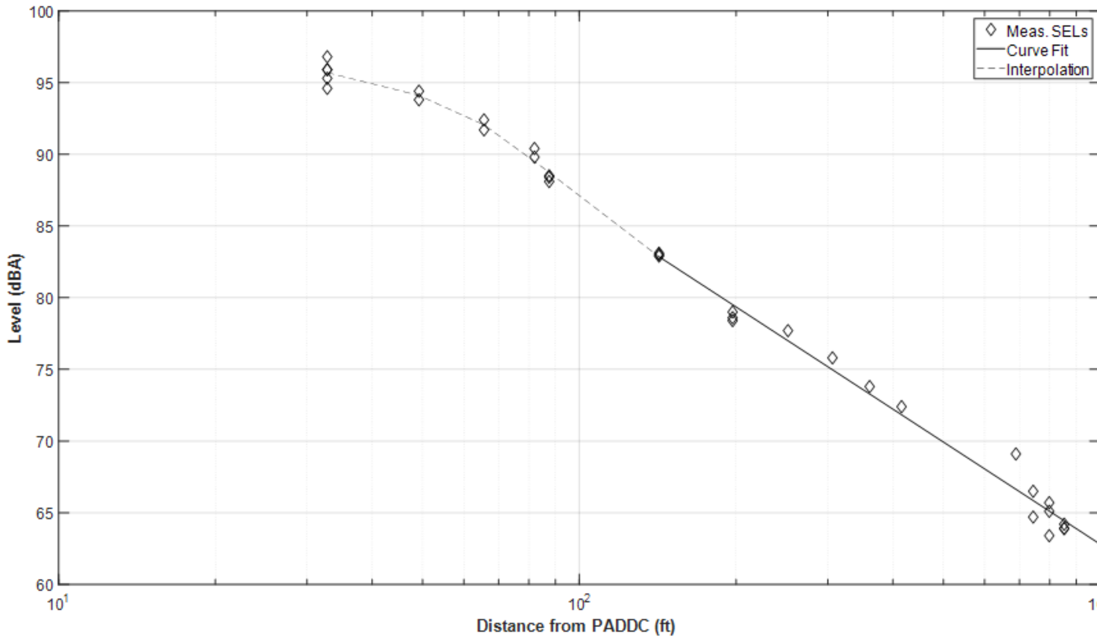


Figure 2. Measured sound exposure levels during takeoffs as described in Table 4.

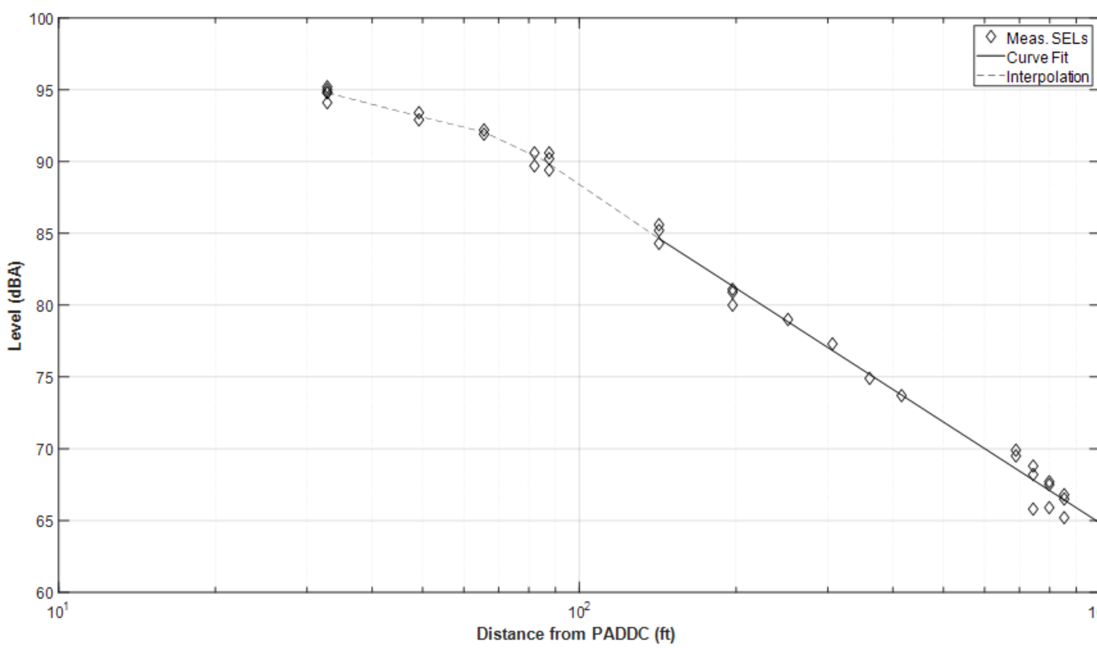


Figure 3. Measured sound exposure levels during landings as described in Table 4.

The following equation governs how to estimate the sound exposure level for a given distance, *d*, in feet from the PADDC resulting from the vertical portion of the takeoff, delivery, or landing portion of the flight profile of the UA. The constants m and b are to be used in Eq. 1 for the appropriate row in the tables based on the Range. These estimates assume the UA reaches an en route altitude of 165 feet AGL.

$$SEL = m * \log_{10}(d + b) \qquad (dB) \tag{1}$$

Table 7. Parameters for Estimating Sound Exposure Level for Takeoff versus Distance[2]

Range for *d* (ft from PADDC)	m	b
32.8 to 49.2	-9.09	109.47
49.2 to 65.6	-16.41	121.86
65.6 to 85.3[1]	-26.39	140.00
85.3[1] to 142.2	-27.79	142.71
Greater than 142.2	-23.39	134.99

Notes: 1) Average, weighted distance for the 82 and 87.5 ft position measurements
2) Applicable for the takeoff profile in Table 4

Table 8. Parameters for Estimating Sound Exposure Level for Landing versus Distance[2]

Range for *d* (ft from PADDC)	m	b
32.8 to 49.2	-9.26	108.81
49.2 to 65.6	-8.80	108.05
65.6 to 85.3[1]	-17.10	123.12
85.3[1] to 142.2	-24.56	137.53
Greater than 142.2	-23.39	134.99

Notes: 1) Average, weighted distance for the 82 and 87.5 ft position measurements
2) Applicable for the landing profile in Table 4

1.3 En Route Noise

Two flights were flown to measure noise from the en route phase of flight. The UA flew in a "dog bone" pattern in order to overfly the lead microphone in the array three times traveling in each direction. The microphone array was not moved between the flights and the four positions were the only distances measured from undertrack. A cross wind may be responsible for the microphone undertrack not measuring the highest noise level. The 12 sound exposure levels measured from the two flights were averaged at each of the positions and results presented in Table 9. The slant range column presented in Table 9 is the distance between the UA and position at the closest point of approach during the overflight.

It is recommended that 67.7 dBA sound exposure level be used to represent the noise generated by the UA at cruise speed of 52.4 kts and en route altitude of 165 ft AGL because it is the highest level measured; therefore, it is the most conservative estimate.

Table 9. Average Sound Exposure Levels Measured During Level Overflights

Position	Sound Exposure Level[1] (dBA)	Maximum Level (dBA)	Distance from Undertrack (ft)	Slant Range (ft)	Sound Exposure Level Normalized to 165 ft[2] (dBA)	Maximum Level Normalized to 165 ft[3] (dBA)
1	66.0	59.2	0	165	66.0	59.2
5	67.0	60.3	88	187	67.7	61.4
6	65.1	57.8	142	218	66.6	60.2
7	63.0	55.2	197	257	65.4	59.1

Notes: 1) Measured levels normalized to 52.4 kts before averaging.
*2) Using 12.5*log10(Slant/Distance)*
*3) Using 20*log10(Slant/Distance)*

To estimate the sound exposure level of the UA traveling at speed v_1 when the measured sound exposure level for a level overflight was done when the UA was traveling at speed v_{ref} add the value *del1* calculated with Eq. 2 to the sound exposure level measured with the speed v_{ref}.

$$del1 = 10 * \log_{10}\left({}^{v_1}/_{v_{ref}} \right) \qquad (dB) \qquad (2)$$

To estimate the sound exposure level of the UA traveling at a height, h_1 ft, above the ground different than 165 ft AGL, add the value *del2* calculated with Eq. 3 to the 67.7 dBA sound exposure level.

$$del2 = 12.5 * \log_{10}\left({}^{h_{ref}}/_{h_1} \right) \qquad (dB) \qquad (3)$$

1.4 Delivery Noise

There are five flight activities that generate noise in the vicinity of a delivery location. The MK27-2 will approach the delivery location from fixed-wing en route flight at 165 feet AGL, transition to vertical flight, and then descend vertically to a delivery altitude of 13 ft AGL. At delivery altitude, the UA will drop the package while in hover which takes approximately 2 seconds. At completion of the delivery, the UA will climb from the delivery altitude vertically back to an en route altitude of 165 feet AGL, and then transition from vertical to fixed-wing flight mode for en route flight back to the PADDC. This section considers only the noise generated from the vertical phases of the flight profile during delivery. Table 10 details the vertical portion of the delivery procedure starting at en route altitude and positioned over the delivery point to return to en route altitude. Within this portion of the procedure, Table 10 details the average durations for the descent, delivery, and ascent portions of the profile.

Table 10. MK27-2 UA Delivery Profile Details

Phase	Flight Description	Altitude (ft AGL)	Ground Speed (kts)	Duration (s)
Descent	After transition to above PADDC, descend to delivery height	165 to 13	0	32
Delivery	Drop package on PADDC	13	0	2
Ascent	Ascend to en route altitude before transitioning to en route flight	13 to 165	0	24

To estimate the sound exposure level at a delivery location, measurements of the noise emissions of the MK27-2 UA were made when the UA was at maximum weight utilizing a simulated delivery profile representative of typical operations. The profile included the vehicle flying an oval "racetrack" pattern in fixed-wing mode flight at en route altitude to simulate outbound en route flight, transition from fixed-wing flight mode to vertical flight for descent and delivery at the PADDC, vertical descent to delivery altitude, delivery, vertical climb back to en-route altitude, and transition back to fixed-wing flight mode to simulate inbound en route flight. The microphone locations utilized for the delivery measurements are the same as shown Figure 1. As with the takeoff and landing measurements, the 4 microphones were moved between flights in order to measure the noise at different distances from the PADDC. As with the takeoff and landing measurements, the transition noise was not fully captured by the microphones because the UA did not perform the transition above them.

The average sound exposure level for the entire vertical portions of the delivery phase (descent, delivery, and ascent) were then calculated at each of the microphones. As with the takeoff and landing measurements each position did not have the same number of measurements. The results were then averaged together for each microphone position. Table 11 presents the averaged results at each microphone for all delivery events. Figure 4 shows a plot of the measurements versus distance along with lines showing the methods of estimating the levels between and beyond positions. Table 12 contains the parameters suggested for use in Eq. 1 for estimating the sound exposure level at distances from the delivery location for the noise emitted from the UA during the vertical portion of the delivery. As was the case for the takeoff and landing flight phases, it is recommended for the delivery phase to use the appropriate parameters in Table 12 for the required distance. In order to estimate the noise levels near the delivery location the transition noise would need to be logarithmically added to this noise in order to properly estimate the maximum levels expected for undertrack locations.

Table 11. Average Sound Exposure Level of MK27-2 UA during Delivery versus Distance

Position	Distance (ft)	Sound Exposure Level (dBA)1
1	32.8	96.5
2	49.2	95.5
3	65.6	94.6
4	82.0	93.1
5	87.5	92.3
6	142.2	87.4
7	196.9	82.8
8	251.5	81.6
9	306.2	79.8
10	360.9	77.9
11	415.6	76.3
16	689.0	72.3
17	743.7	70.9
18	798.4	70.4
19	853.0	69.6

Notes: 1) Applicable for the delivery profile presented in Table 10

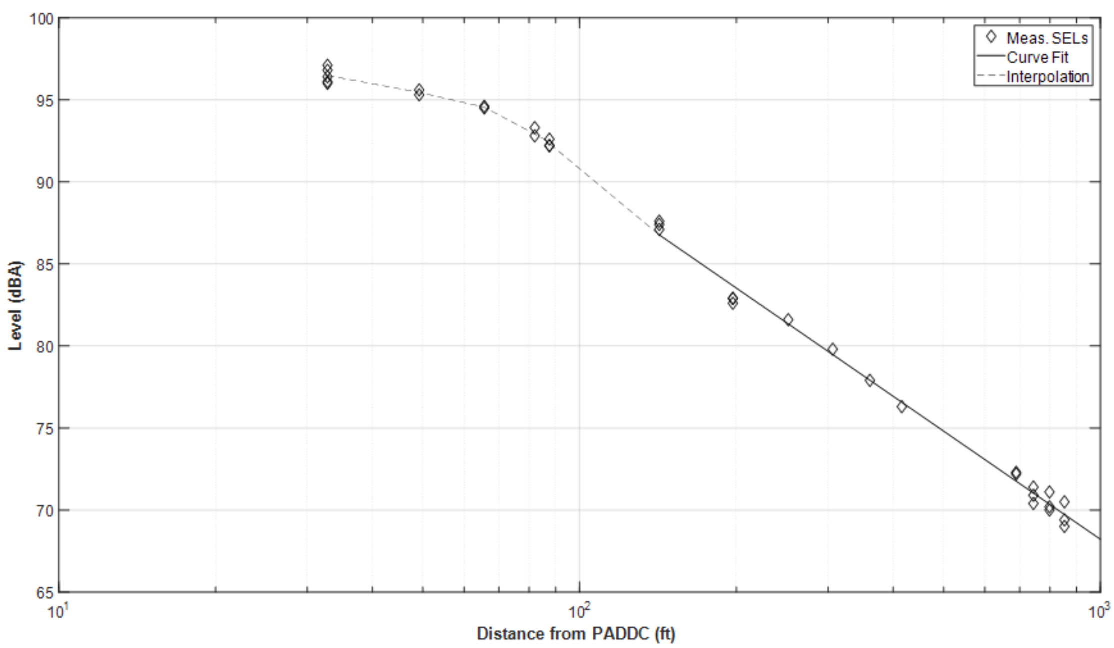


Figure 4. Measured Sound Exposure Levels during deliveries as described in Table 10.

Table 12. Parameters for Estimating Sound Exposure Level for Delivery versus Distance[2]

Range for *d* (ft from PADDC)	m	b
32.8 to 49.2	-5.85	105.35
49.2 to 65.6	-7.20	107.64
65.6 to 85.3[1]	-16.92	125.30
85.3[1] to 142.2	-26.31	143.42
Greater than 142.2	-21.90	133.91

Notes: 1) Average, weighted distance for the 82 and 87.5 ft position measurements
2) Applicable for the delivery profile presented in Table 10

2. Analysis

The analysis of the measurements performed while the MK27-2 flew a typical profile can be used for estimating the noise created for each phase of flight. It is important to combine the transition noise with the takeoff, delivery, and landing phases in order to estimate the maximum noise expected undertrack for those portions of the flight profile. In order to estimate the noise from a flight profile with different speed or altitude, utilization of the correction for different cruise speed using equation 2 and a different en route altitude using equation 3 should be used. It is not expected that the contribution to the noise levels around the takeoff, delivery, or landing sites from the vertical part of the flight profile will change if the cruise speed or altitude are different.

3. Conclusion

This memo provides the means to estimate the sound exposure level from the typical flight profile for the MK27-2 delivering a package. By combining the transition noise with the noise from the vertical phases of the flight profile a conservative estimate of the noise created by the UA is achieved in that the estimate should be greater than the actual noise levels. The means for adjusting the provided noise levels for different flight profile parameters are provided with the assumption that minor changes to the en route altitudes will not change the noise levels for the takeoff, delivery, and landing phases of flight.

Attachment D

Official Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arizona Ecological Services Field Office
9828 North 31st Ave
#c3
Phoenix, AZ 85051-2517
Phone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer To: 03/27/2024 19:36:20 UTC
Project Code: 2024-0069193
Project Name: Amazon Package Delivery UAS-Drone Tolleson AZ

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The Fish and Wildlife Service (Service) is providing this list under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The list you have generated identifies threatened, endangered, proposed, and candidate species, and designated and proposed critical habitat, that *may* occur within the One-Range that has been delineated for the species (candidate, proposed, or listed) and it's critical habitat (designated or proposed) with which your project polygon intersects. These range delineations are based on biological metrics, and do not necessarily represent exactly where the species is located. Please refer to the species information found on ECOS to determine if suitable habitat for the species on your list occurs in your project area.

The purpose of the Act is to provide a means whereby threatened and endangered species and the habitats upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of Federal trust resources and to determine whether projects may affect federally listed species and/or designated critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.
If the Federal action agency determines that listed species or critical habitat *may be affected* by a federally funded, permitted or authorized activity, the agency must consult with us pursuant to 50 CFR 402. Note that a "may affect" determination includes effects that may not be adverse and that may be beneficial, insignificant, or discountable. An effect exists even if only one individual

or habitat segment may be affected. The effects analysis should include the entire action area, which often extends well outside the project boundary or "footprint." For example, projects that involve streams and river systems should consider downstream affects. If the Federal action agency determines that the action may jeopardize a *proposed* species or may adversely modify *proposed* critical habitat, the agency must enter into a section 7 conference. The agency may choose to confer with us on an action that may affect proposed species or critical habitat.

Candidate species are those for which there is sufficient information to support a proposal for listing. Although candidate species have no legal protection under the Act, we recommend that they be considered in the planning process in the event they become proposed or listed prior to project completion. More information on the regulations (50 CFR 402) and procedures for section 7 consultation, including the role of permit or license applicants, can be found in our Endangered Species Consultation Handbook at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf.

We also advise you to consider species protected under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712) and the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668 *et seq.*). The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when authorized by the Service. The Eagle Act prohibits anyone, without a permit, from taking (including disturbing) eagles, and their parts, nests, or eggs. Currently 1,026 species of birds are protected by the MBTA, including the western burrowing owl (*Athene cunicularia hypugaea*). Protected western burrowing owls can be found in urban areas and may use their nest/burrows year-round; destruction of the burrow may result in the unpermitted take of the owl or their eggs.

If a bald eagle or golden eagle nest occurs in or near the proposed project area, our office should be contacted for Technical Assistance. An evaluation must be performed to determine whether the project is likely to disturb or harm eagles. The National Bald Eagle Management Guidelines provide recommendations to minimize potential project impacts to bald eagles (see https://www.fws.gov/law/bald-and-golden-eagle-protection-act and https://www.fws.gov/program/eagle-management).

The Division of Migratory Birds (505/248-7882) administers and issues permits under the MBTA and Eagle Act, while our office can provide guidance and Technical Assistance. For more information regarding the MBTA, BGEPA, and permitting processes, please visit the following web site: https://www.fws.gov/program/migratory-bird-permit. Guidance for minimizing impacts to migratory birds for communication tower projects (e.g. cellular, digital television, radio, and emergency broadcast) can be found at https://www.fws.gov/media/recommended-best-practices-communication-tower-design-siting-construction-operation.

The U.S. Army Corps of Engineers (Corps) may regulate activities that involve streams (including some intermittent streams) and/or wetlands. We recommend that you contact the Corps to determine their interest in proposed projects in these areas. For activities within a National Wildlife Refuge, we recommend that you contact refuge staff for specific information about refuge resources, please visit this link or visit https://www.fws.gov/program/national-wildlife-refuge-system to locate the refuge you would be working in or around.

If your action is on tribal land or has implications for off-reservation tribal interests, we encourage you to contact the tribe(s) and the Bureau of Indian Affairs (BIA) to discuss potential tribal concerns, and to invite any affected tribe and the BIA to participate in the section 7 consultation. In keeping with our tribal trust responsibility, we will notify tribes that may be affected by proposed actions when section 7 consultation is initiated. For more information, please contact our Tribal Coordinator, John Nystedt, at 928/556-2160 or John_Nystedt@fws.gov.

We also recommend you seek additional information and coordinate your project with the Arizona Game and Fish Department. Information on known species detections, special status species, and Arizona species of greatest conservation need, such as the western burrowing owl and the Sonoran desert tortoise (*Gopherus morafkai*) can be found by using their Online Environmental Review Tool, administered through the Heritage Data Management System and Project Evaluation Program (https://www.azgfd.com/wildlife-conservation/planning-for-wildlife/project-evaluation-program/).

We appreciate your concern for threatened and endangered species. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office. If we may be of further assistance, please contact our Flagstaff office at 928/556-2118 for projects in northern Arizona, our general Phoenix number 602/242-0210 for central Arizona, or 520/670-6144 for projects in southern Arizona.

Sincerely,
/s/

Heather Whitlaw
Field Supervisor
Attachment

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Arizona Ecological Services Field Office
9828 North 31st Ave
#c3
Phoenix, AZ 85051-2517
(602) 242-0210

PROJECT SUMMARY

Project Code: 2024-0069193
Project Name: Amazon Package Delivery UAS-Drone Tolleson AZ
Project Type: Drones - Use/Operation of Unmanned Aerial Systems
Project Description: Commercial package delivery using drones. Operating from Amazon Fulfillment Center located at 10601 W. Van Buren Street, Tolleson, AZ.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@33.450133550000004,-112.28710049411674,14z

Counties: Maricopa County, Arizona

ENDANGERED SPECIES ACT SPECIES

There is a total of 8 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Sonoran Pronghorn *Antilocapra americana sonoriensis* Population: U.S.A. (AZ), Mexico No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4750	Experimental Population, Non-Essential

BIRDS

NAME	STATUS
Cactus Ferruginous Pygmy-owl *Glaucidium brasilianum cactorum* There is **final** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/1225	Threatened
California Least Tern *Sternula antillarum browni* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8104	Endangered
Southwestern Willow Flycatcher *Empidonax traillii extimus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6749	Endangered
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened
Yuma Ridgway's Rail *Rallus obsoletus yumanensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3505	Endangered

FISHES

NAME	STATUS
Gila Topminnow (incl. Yaqui) *Poeciliopsis occidentalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1116	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

---

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)

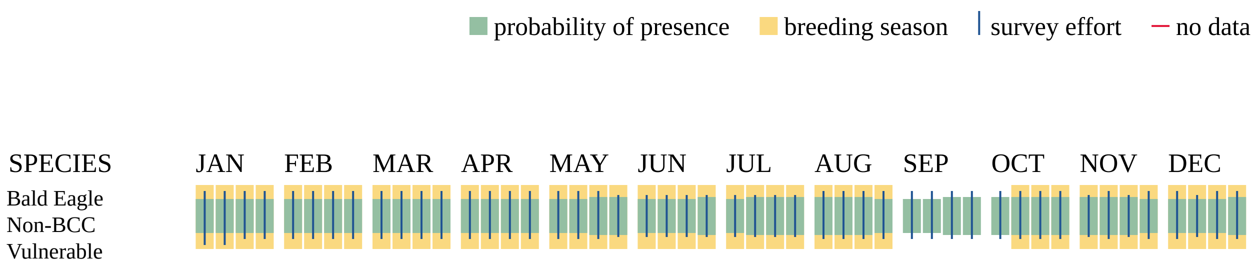
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)

Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)

A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Avocet *Recurvirostra americana* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/11927	Breeds Apr 21 to Aug 10
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Aug 31
Bendire's Thrasher *Toxostoma bendirei* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9435	Breeds Mar 15 to Jul 31
Black-chinned Sparrow *Spizella atrogularis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9447	Breeds Apr 15 to Jul 31
Clark's Grebe *Aechmophorus clarkii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10575	Breeds Jun 1 to Aug 31

NAME	BREEDING SEASON
Costa's Hummingbird *Calypte costae* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9470	Breeds Jan 15 to Jun 10
Gila Woodpecker *Melanerpes uropygialis* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/5960	Breeds Apr 1 to Aug 31
Gilded Flicker *Colaptes chrysoides* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/2960	Breeds May 1 to Aug 10
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Western Grebe *aechmophorus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10669	Breeds elsewhere

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence ( )

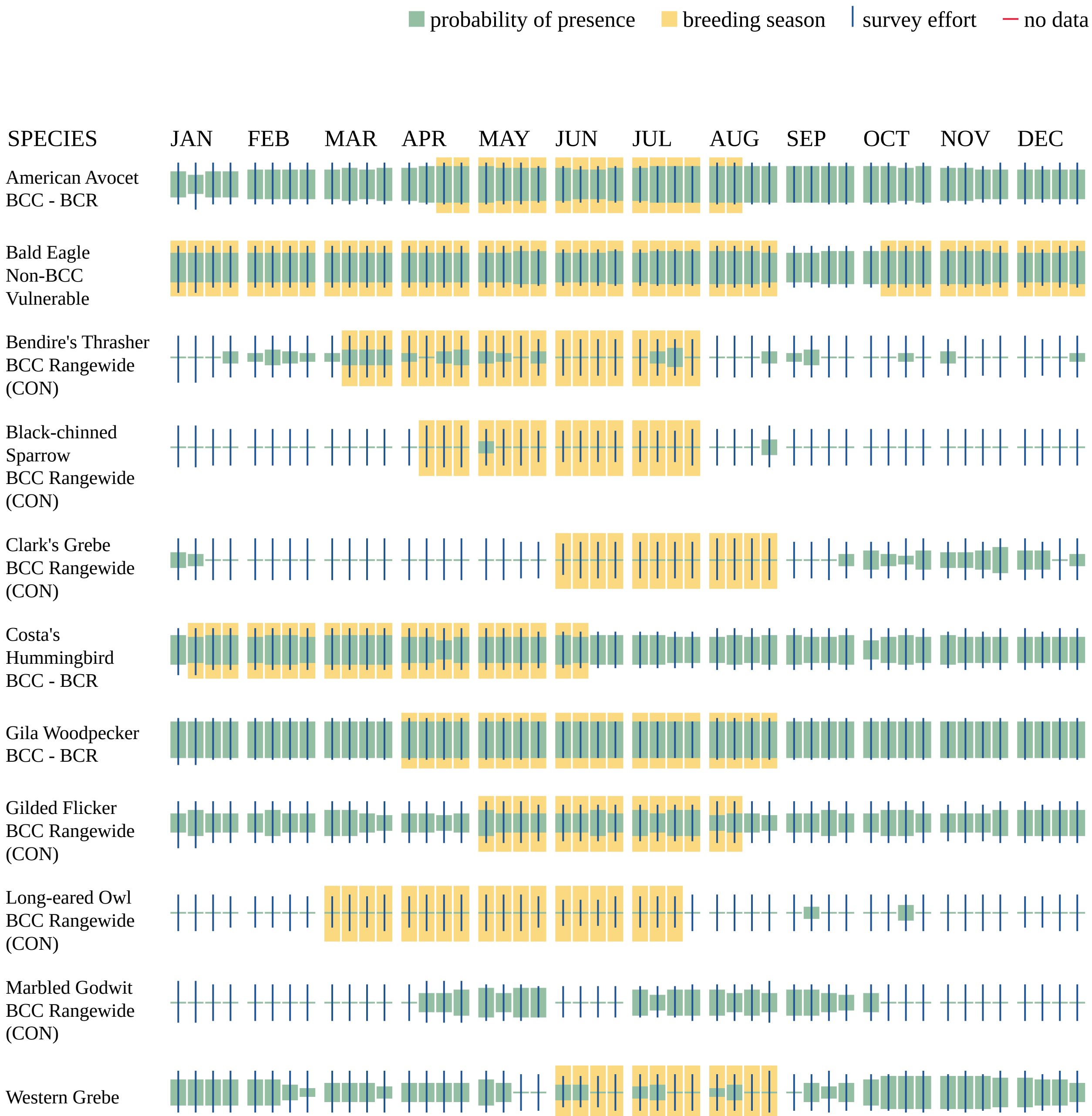
Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season ( )

Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

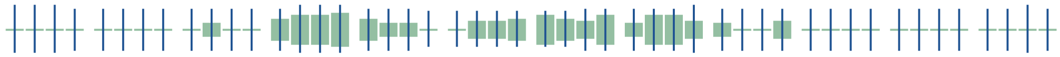
Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



BCC Rangewide
(CON)

Willet
BCC Rangewide
(CON)



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

IPAC USER CONTACT INFORMATION

Agency: Federal Aviation Administration
Name: Chris Hurst
Address:
Address Line 2:
City:
State:
Zip:
Email christopher.a.hurst@faa.gov
Phone: 2022679700

APPENDIX B – Special Status Species in Maricopa County

Arizona Game and Fish Department, Heritage Data Management System

Updated: 4/12/2023

TAXON	SCIENTIFIC NAME	COMMON NAME	ESA	ELCODE SRANK	GRANK
Amphibian	*Anaxyrus microscaphus*	Arizona Toad	SC	S3	G3G4
Amphibian	*Anaxyrus retiformis*	Sonoran Green Toad	S	S3	G4
Amphibian	*Gastrophryne mazatlanensis*	Sinoloan Narrow-mouthed Toad	S	S3	G4
Amphibian	*Rana chiricahuensis*	Chiricahua Leopard Frog	LT	S2S3	G3?
Amphibian	*Rana yavapaiensis*	Lowland Leopard Frog	SC	S2S3	G4
Amphibian	*Smilisca fodiens*	Lowland Burrowing Treefrog	S	S2	G4
Bird	*Aquila chrysaetos*	Golden Eagle	S	S4	G5
Bird	*Athene cunicularia hypugaea*	Western Burrowing Owl	SC	S3	G4T4
Bird	*Catharus ustulatus*	Swainson's Thrush		S1B	G5
Bird	*Charadrius nivosus nivosus*	Western Snowy Plover		S1B	G3T3
Bird	*Coccyzus americanus*	Yellow-billed Cuckoo (Western DPS)	LT	S3	G5
Bird	*Empidonax traillii extimus*	Southwestern Willow Flycatcher	LE	S2S3B	G5T2
Bird	*Falco peregrinus anatum*	American Peregrine Falcon	SC	S4	G4T4
Bird	*Glaucidium brasilianum cactorum*	Cactus Ferruginous Pygmy-owl	PT	S1S2	G5T2

Bird	*Haliaeetus leucocephalus* (wintering pop.)	Bald Eagle	SC	S4N	G5TNRQ
Bird	*Haliaeetus leucocephalus*	Bald Eagle - Sonoran Desert Population	SC	S2S3	G5TNRQ
Bird	*Ictinia mississippiensis*	Mississippi Kite	PR	S2B	G5
Bird	*Rallus obsoletus yumanensis*	Yuma Ridgway's Rail	LE	S3	G3T3
Bird	*Strix occidentalis lucida*	Mexican Spotted Owl	LT	S3	G3G4T3T4
Bird	*Toxostoma lecontei*	LeConte's Thrasher	S	S3	G4
Fish	*Agosia chrysogaster chrysogaster*	Gila Longfin Dace	SC	S3S4	G4T3T4
Fish	*Catostomus clarkii*	Desert Sucker	SC	S3S4	G3G4
Fish	*Catostomus insignis*	Sonora Sucker	SC	S3	G3G4
Fish	*Cyprinodon macularius*	Desert Pupfish	LE	S1	G1
Fish	*Gila elegans*	Bonytail Chub	LE	S1	G1
Fish	*Gila robusta*	Roundtail Chub	SC	S2S3	G3
Fish	*Poeciliopsis occidentalis occidentalis*	Gila Topminnow	LE	S1S2	G3
Fish	*Ptychocheilus lucius*	Colorado Pikeminnow	LE,XN	S1	G1
Fish	*Rhinichthys osculus*	Speckled Dace	SC	S3S4	G5
Fish	*Xyrauchen texanus*	Razorback Sucker	LE	S1	G1
Invertebrate	*Cicindela oregona maricopa*	Maricopa Tiger Beetle	SC	S3	G5T3
Invertebrate	*Danaus plexippus*	Monarch	C	S2S4N	G4

Invertebrate	*Maricopella allynsmithi*	Phoenix Talussnail	SC	S3	G3
Mammal	*Antilocapra americana sonoriensis*	Sonoran Pronghorn	LE,XN	S1	G5T1
Mammal	*Corynorhinus townsendii pallescens*	Pale Townsend's Big-eared Bat	SC	S3S4	G4T3T4
Mammal	*Eumops perotis californicus*	Greater Western Bonneted Bat	SC S	S2S3	G4G5T4
Mammal	*Lasiurus blossevillii*	Western Red Bat	S	S3	G4
Mammal	*Lasiurus xanthinus*	Western Yellow Bat	S	S2S3	G4G5
Mammal	*Leptonycteris yerbabuenae*	Lesser Long-nosed Bat	SC	S2S3	G3
Mammal	*Lepus alleni*	Antelope Jackrabbit		S3	G5
Mammal	*Macrotus californicus*	California Leaf-nosed Bat	SC	S3	G3G4
Mammal	*Myotis velifer*	Cave Myotis	SC	S3S4	G4G5
Mammal	*Myotis yumanensis*	Yuma Myotis	SC	S3S4	G5
Mammal	*Nyctinomops femorosaccus*	Pocketed Free-tailed Bat		S3S4	G5
Mammal	*Tadarida brasiliensis*	Brazilian Free-tailed Bat		S3S4	G5
Plant	*Abutilon parishii*	Pima Indian Mallow	SC	S3S4	G3
Plant	*Agave delamateri*	Tonto Basin Agave	SC	S2	G2
Plant	*Agave murpheyi Hohokam*	Agave	SC	S2?	G2?
Plant	*Agave toumeyana var. bella*	Toumey Agave	SR	S3	G3T3
Plant	*Agave x arizonica*	Arizona agave	HS	SHYB	GNA

Plant	*Allium bigelovii*	Bigelow Onion	SR	S2S3	G3
Plant	*Berberis harrisoniana*	Kofa Mountain Barberry	S	S1	G2
Plant	*Cryptantha ganderi*	Gander's Cryptantha	SC	S1	G3?
Plant	*Cylindropuntia echinocarpa*	Golden Cholla	SR	S5	G5
Plant	*Echinocereus yavapaiensis*	Yavapai Hedgehog Cactus	SR	S2S3	G2G3
Plant	*Echinomastus erectocentrus var. acunensis*	Acuna Cactus	LE	S1	G3QT1T2Q
Plant	*Echinomastus johnsonii*	Johnson's Fishhook Cactus	SR	S2	G3G4Q
Plant	*Erigeron piscaticus*	Fish Creek Fleabane	SC	S1	G1
Plant	*Eriogonum ripleyi*	Ripley Wild-buckwheat	SC	S2	G2
Plant	*Ferocactus cylindraceus*	Desert Barrel Cactus	PR	S4	G5
Plant	*Ferocactus emoryi*	Emory's Barrel-cactus	SR	S1S2	G4
Plant	*Fremontodendron californicum*	Flannel Bush	S	S2S3	G4
Plant	*Heuchera eastwoodiae*	Senator Mine Alumroot	S	S3	G3
Plant	*Lotus alamosanus*	Sonoran Bird's-foot Trefoil	S	S1	G3G4
Plant	*Lotus mearnsii var. equisolensis*	Horseshoe Deer Vetch	S	S1	G3T1
Plant	*Lupinus lemmonii*	Lemmon's Lupine	S	S1	G1Q
Plant	*Mabrya acerifolia*	Mapleleaf False Snapdragon	S	S2	G2
Plant	*Mammillaria viridiflora*	Varied Fishhook Cactus	SR	S4	G4

Plant	*Opuntia engelmannii var. flavispina*	Cactus Apple	SR	S3	G5T3?
Plant	*Perityle saxicola*	Roosevelt Dam Rockdaisy	SC	S1	G1
Plant	*Purshia subintegra*	Arizona Cliff Rose	LE	S2	G2
Plant	*Rhinotropis rusbyi*	Rusby's Milkwort	S	S3	G3
Plant	*Stenocereus thurberi*	Organ Pipe Cactus	SR	S4	G5
Plant	*Tumamoca macdougalii*	Tumamoc Globeberry	SC	S3	G4
Plant	*Vauquelinia californica ssp. sonorensis*	Arizona Sonoran Rosewood	S	S1S2	G4T2
Reptile	*Aspidoscelis pai Pai*	Striped Whiptail		S1	G5T3T4
Reptile	*Aspidoscelis stictogramma*	Giant Spotted Whiptail	SC	S2	G4
Reptile	*Aspidoscelis xanthonota*	Red-backed Whiptail	SC	S2	G3
Reptile	*Chionactis annulata*	Resplendent Shovel-nosed Snake		S3	G5
Reptile	*Crotaphytus nebrius*	Sonoran Collared Lizard		S3S4	G4
Reptile	*Gopherus morafkai*	Sonoran Desert Tortoise	CCA	S4	G4
Reptile	*Heloderma suspectum*	Gila Monster		S4	G4
Reptile	*Kinosternon arizonense*	Arizona Mud Turtle		S2	G4
Reptile	*Lichanura trivirgata*	Three-Lined Boa	SC	S1S2	G4G5
Reptile	*Phyllorhynchus browni*	Saddled Leaf-nosed Snake		S5	G5
Reptile	*Sauromalus ater*	Common Chuckwalla	SC	S4	G5

Reptile	*Thamnophis eques megalops*	Northern Mexican Gartersnake	LT	S2	G4T3
Reptile	*Xantusia bezyi*	Bezy's Night Lizard	S	S2	G2

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arizona Ecological Services Field Office
9828 North 31st Ave
#c3
Phoenix, AZ 85051-2517
Phone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer To: January 30, 2024
Project Code: 2024-0042792
Project Name: Drone Project 2

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The Fish and Wildlife Service (Service) is providing this list under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The list you have generated identifies threatened, endangered, proposed, and candidate species, and designated and proposed critical habitat, that *may* occur within the One-Range that has been delineated for the species (candidate, proposed, or listed) and it's critical habitat (designated or proposed) with which your project polygon intersects. These range delineations are based on biological metrics, and do not necessarily represent exactly where the species is located. Please refer to the species information found on ECOS to determine if suitable habitat for the species on your list occurs in your project area.

The purpose of the Act is to provide a means whereby threatened and endangered species and the habitats upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of Federal trust resources and to determine whether projects may affect federally listed species and/or designated critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.
If the Federal action agency determines that listed species or critical habitat *may be affected* by a federally funded, permitted or authorized activity, the agency must consult with us pursuant to 50 CFR 402. Note that a "may affect" determination includes effects that may not be adverse and that may be beneficial, insignificant, or discountable. An effect exists even if only one individual

or habitat segment may be affected. The effects analysis should include the entire action area, which often extends well outside the project boundary or "footprint." For example, projects that involve streams and river systems should consider downstream affects. If the Federal action agency determines that the action may jeopardize a *proposed* species or may adversely modify *proposed* critical habitat, the agency must enter into a section 7 conference. The agency may choose to confer with us on an action that may affect proposed species or critical habitat.

Candidate species are those for which there is sufficient information to support a proposal for listing. Although candidate species have no legal protection under the Act, we recommend that they be considered in the planning process in the event they become proposed or listed prior to project completion. More information on the regulations (50 CFR 402) and procedures for section 7 consultation, including the role of permit or license applicants, can be found in our Endangered Species Consultation Handbook at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf.

We also advise you to consider species protected under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712) and the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668 *et seq.*). The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when authorized by the Service. The Eagle Act prohibits anyone, without a permit, from taking (including disturbing) eagles, and their parts, nests, or eggs. Currently 1,026 species of birds are protected by the MBTA, including the western burrowing owl (*Athene cunicularia hypugaea*). Protected western burrowing owls can be found in urban areas and may use their nest/burrows year-round; destruction of the burrow may result in the unpermitted take of the owl or their eggs.

If a bald eagle or golden eagle nest occurs in or near the proposed project area, our office should be contacted for Technical Assistance. An evaluation must be performed to determine whether the project is likely to disturb or harm eagles. The National Bald Eagle Management Guidelines provide recommendations to minimize potential project impacts to bald eagles (see https://www.fws.gov/law/bald-and-golden-eagle-protection-act and https://www.fws.gov/program/eagle-management).

The Division of Migratory Birds (505/248-7882) administers and issues permits under the MBTA and Eagle Act, while our office can provide guidance and Technical Assistance. For more information regarding the MBTA, BGEPA, and permitting processes, please visit the following web site: https://www.fws.gov/program/migratory-bird-permit. Guidance for minimizing impacts to migratory birds for communication tower projects (e.g. cellular, digital television, radio, and emergency broadcast) can be found at https://www.fws.gov/media/recommended-best-practices-communication-tower-design-siting-construction-operation.

The U.S. Army Corps of Engineers (Corps) may regulate activities that involve streams (including some intermittent streams) and/or wetlands. We recommend that you contact the Corps to determine their interest in proposed projects in these areas. For activities within a National Wildlife Refuge, we recommend that you contact refuge staff for specific information about refuge resources, please visit this link or visit https://www.fws.gov/program/national-wildlife-refuge-system to locate the refuge you would be working in or around.

If your action is on tribal land or has implications for off-reservation tribal interests, we encourage you to contact the tribe(s) and the Bureau of Indian Affairs (BIA) to discuss potential tribal concerns, and to invite any affected tribe and the BIA to participate in the section 7 consultation. In keeping with our tribal trust responsibility, we will notify tribes that may be affected by proposed actions when section 7 consultation is initiated. For more information, please contact our Tribal Coordinator, John Nystedt, at 928/556-2160 or John_Nystedt@fws.gov.

We also recommend you seek additional information and coordinate your project with the Arizona Game and Fish Department. Information on known species detections, special status species, and Arizona species of greatest conservation need, such as the western burrowing owl and the Sonoran desert tortoise (*Gopherus morafkai*) can be found by using their Online Environmental Review Tool, administered through the Heritage Data Management System and Project Evaluation Program (https://www.azgfd.com/wildlife-conservation/planning-for-wildlife/project-evaluation-program/).

We appreciate your concern for threatened and endangered species. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office. If we may be of further assistance, please contact our Flagstaff office at 928/556-2118 for projects in northern Arizona, our general Phoenix number 602/242-0210 for central Arizona, or 520/670-6144 for projects in southern Arizona.

Sincerely,
/s/

Heather Whitlaw
Field Supervisor
Attachment

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Arizona Ecological Services Field Office
9828 North 31st Ave
#c3
Phoenix, AZ 85051-2517
(602) 242-0210

PROJECT SUMMARY

Project Code: 2024-0042792
Project Name: Drone Project 2
Project Type: Drones - Use/Operation of Unmanned Aerial Systems
Project Description: Drone
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@33.44617185,-112.28551109171084,14z

Counties: Maricopa County, Arizona

ENDANGERED SPECIES ACT SPECIES

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Sonoran Pronghorn *Antilocapra americana sonoriensis* Population: U.S.A. (AZ), Mexico No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4750	Experimental Population, Non-Essential

BIRDS

NAME	STATUS
Cactus Ferruginous Pygmy-owl *Glaucidium brasilianum cactorum* There is **final** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/1225	Threatened
California Least Tern *Sternula antillarum browni* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8104	Endangered
Southwestern Willow Flycatcher *Empidonax traillii extimus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6749	Endangered
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened
Yuma Ridgway's Rail *Rallus obsoletus yumanensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3505	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

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1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are bald and/or golden eagles in your project area.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

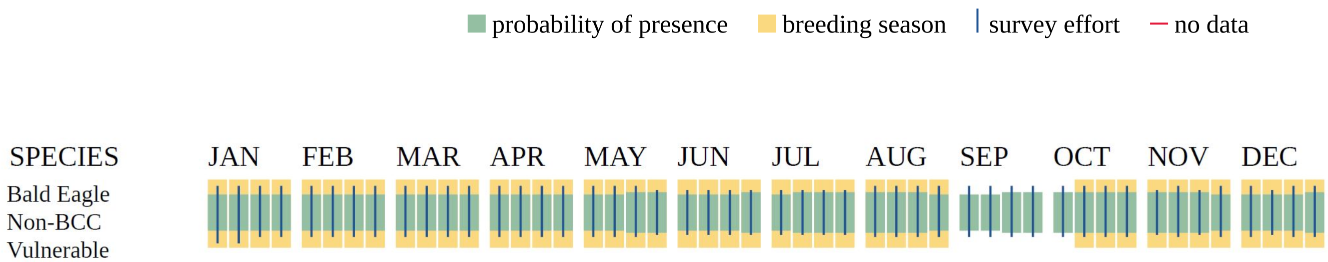
Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)

Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE

SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Aug 31
Bendire's Thrasher *Toxostoma bendirei* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9435	Breeds Mar 15 to Jul 31
Black-chinned Sparrow *Spizella atrogularis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9447	Breeds Apr 15 to Jul 31
Clark's Grebe *Aechmophorus clarkii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10575	Breeds Jun 1 to Aug 31
Costa's Hummingbird *Calypte costae* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9470	Breeds Jan 15 to Jun 10
Gila Woodpecker *Melanerpes uropygialis* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/5960	Breeds Apr 1 to Aug 31
Gilded Flicker *Colaptes chrysoides* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/2960	Breeds May 1 to Aug 10
Grace's Warbler *Dendroica graciae* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9514	Breeds May 20 to Jul 20
Lawrence's Goldfinch *Carduelis lawrencei* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9464	Breeds Mar 20 to Sep 20

NAME	BREEDING SEASON
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Rufous-winged Sparrow *Aimophila carpalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9508	Breeds Jun 15 to Sep 30
Western Grebe *aechmophorus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10669	Breeds elsewhere

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

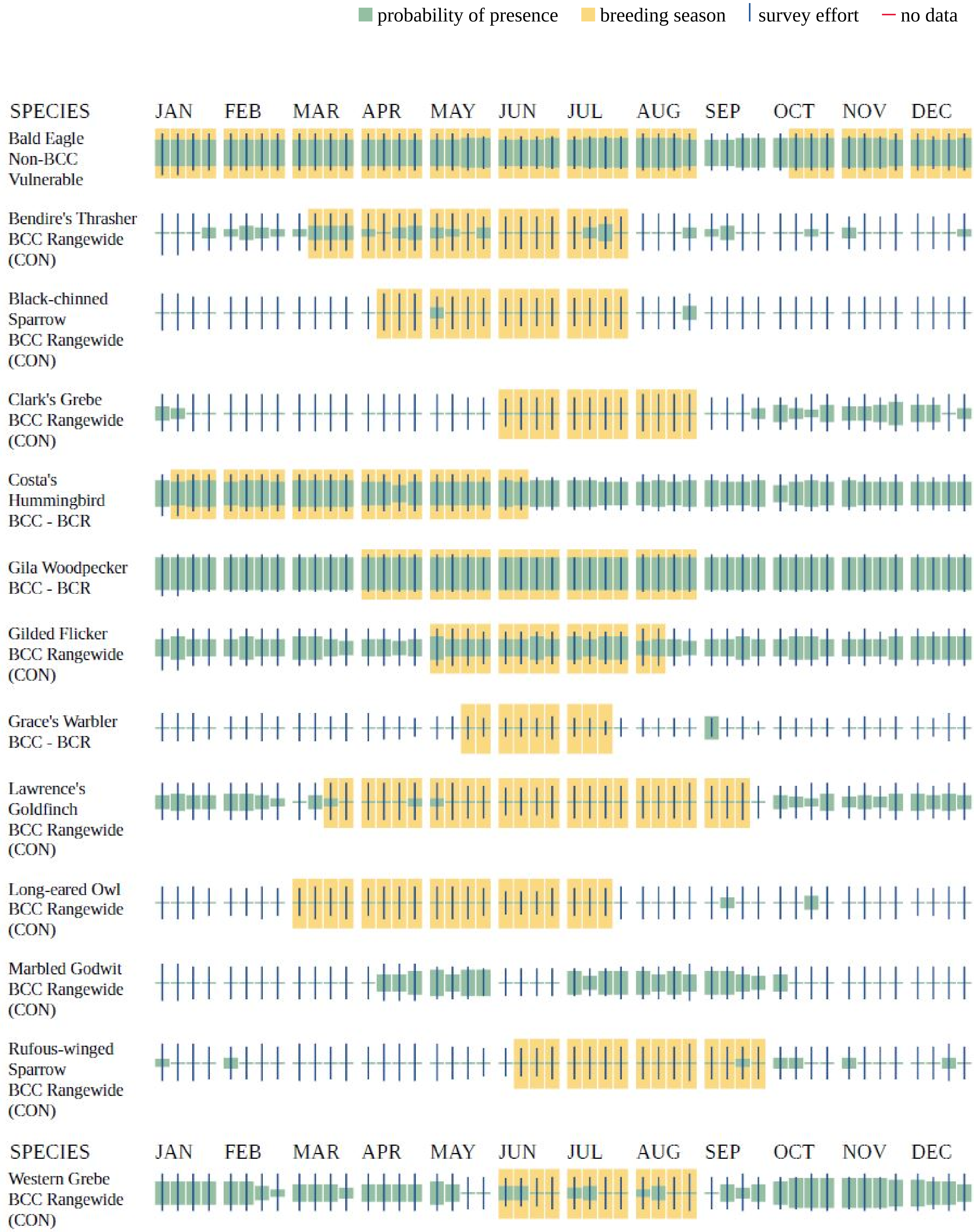
Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.


probability of presence
breeding season
survey effort
no data
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Bald Eagle
Non-BCC
Vulnerable
Bendire's Thrasher
BCC Rangewide
(CON)
Black-chinned
Sparrow
BCC Rangewide
(CON)
Clark's Grebe
BCC Rangewide
(CON)
Costa's
Hummingbird
BCC - BCR
Gila Woodpecker
BCC - BCR
Gilded Flicker
BCC Rangewide
(CON)
Grace's Warbler
BCC - BCR
Lawrence's
Goldfinch
BCC Rangewide
(CON)
Long-eared Owl
BCC Rangewide
(CON)
Marbled Godwit
BCC Rangewide
(CON)
Rufous-winged
Sparrow
BCC Rangewide
(CON)
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Western Grebe
BCC Rangewide
(CON)

Willet
BCC Rangewide
(CON)

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

FRESHWATER EMERGENT WETLAND

- PEM1B
- PEM1C
- PEM1F

FRESHWATER FORESTED/SHRUB WETLAND

- PSS1B
- PSS1J
- PSSC
- PFOC
- PSS1Ah
- PSS1A

RIVERINE

- R4SBJ
- R5UBFx
- R4SBJx

- R2USC
- R2UBH
- R5UBH
- R4SBC

FRESHWATER POND

- PUBF

LAKE

- L2USC
- L2UBH

SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023; Federal Aviation Administration, 2024.

Figure B-1
SWBEMC Bald Eagle Breeding Areas
Tolleson, AZ

ESA

IPAC USER CONTACT INFORMATION

Agency: Private Entity
Name: Sarah McAbee
Address: 1001 Virginia Avenue
City: Hapeville
State: GA
Zip: 30354
Email smcabee@esassoc.com
Phone: 4076006723

Appendix C
Section 4(f) Resources

Appendix C

Table C-1
Section 4(F) Resources in the Study Area

Name	Owner	Address
Alamar Park	Avondale, City of	
Avondale Aquatic Center	Avondale, City of	Existing City Hall and Library on West Civic Center Drive
Base & Meridian Wildlife	Avondale, City of	
DeConcini Park	Avondale, City of	
Dessie Lorenz Park	Avondale, City of	
Doc Rhodes Park	Avondale, City of	
Donny Hale Park	Avondale, City of	
Festival Fields	Avondale, City of	
Fred Campbell Park	Avondale, City of	
Friendship Park	Avondale, City of	
Hay Moon Community Park	Avondale, City of	
Las Ligas Park	Avondale, City of	
Mountain View Park	Avondale, City of	
Park Avenue Plaza	Avondale, City of	755 N. 114th Ave.
Sernas Plaza	Avondale, City of	
Bureau of Land Management	Bureau of Land Management	
Bureau of Land Management	Bureau of Land Management	
Bureau of Land Management	Bureau of Land Management	
Gila River Waterfowl Management Area	Fish and Wildlife Service	
Bicentennial Park	Glendale, City of	5401 N 73rd Ave
Desert Mirage Park	Glendale, City of	8665 W Maryland Ave
Discovery Park	Glendale, City of	7900 W Maryland Ave
Glendale Heroes Regional Park	Glendale, City of	6121 N 83rd Ave
Glendale Youth Sports Complex	Glendale, City of	Sun-Sat
Grand Canal Linear Park	Glendale, City of	5568 N 78th Dr
O'Neil Park	Glendale, City of	6448 W Missouri Ave
Orangewood Vista Park	Glendale, City of	7801 W Orangewood Ave
Pasadena Park	Glendale, City of	8586 W Pasadena Ave
Retention 71/Maryland	Glendale, City of	7030 W Maryland Ave
Retention 74/Luke	Glendale, City of	7475 W Luke Ave
Retention 74/Medlock	Glendale, City of	5175 N 74th Ln
Retention 76/Missouri	Glendale, City of	7729 W Luke Ave
Retention 79/Camelback	Glendale, City of	Sun-Sat
Retention 79/Krall	Glendale, City of	7880 W Krall St
Retention 79/Market	Glendale, City of	6630 N 79th Ave

Name	Owner	Address
Retention 79/Solano	Glendale, City of	7825 W Solano Dr
Retention 81/Georgia	Glendale, City of	8100 W. Georgia
Retention 82/Maryland	Glendale, City of	8230 W Maryland Ave
Retention 85/Maryland	Glendale, City of	6601 N 85th Dr
Retention 90/McLellan	Glendale, City of	6602 N 90th Ave
Retention 91/Rose Ln	Glendale, City of	91st Ave & Rose Ln
Sunset Ridge Park	Glendale, City of	8600 W. Missouri
Sycamore Grove Park	Glendale, City of	8699 W Helen Ln
Windsor Park	Glendale, City of	6305 W Windsor Blvd
BMX Park	Goodyear, City of	15660 W Roeser Rd
Bullard Wash Park Phase 1	Goodyear, City of	14925 W Camelback Rd
Bullard Wash Park Phase 2	Goodyear, City of	15350 W Monte Vista Rd
Estrella Vista Park North	Goodyear, City of	2575 S 157th Ave
Estrella Vista Park South	Goodyear, City of	2700 S 157th Ave
Falcon Park	Goodyear, City of	15050 W Indian School Rd
Falcon Retention	Goodyear, City of	15175 W Westview Dr
Goodyear Community Park	Goodyear, City of	3151 N Litchfield Rd
Goodyear Recreation Campus	Goodyear, City of	
Loma Linda Park	Goodyear, City of	400 E Loma Linda Blvd
Palm Valley Park	Goodyear, City of	13189 W Monte Vista Dr
Palmateer Park	Goodyear, City of	200 E Western Ave
Parque De Paz Park	Goodyear, City of	830 E Calle Adobe Ln
Portales Park	Goodyear, City of	15513 W Monte Vista Rd
Rio Paseo Park	Goodyear, City of	15200 W Virginia Ave
Roscoe Dog Park	Goodyear, City of	15600 W Roeser Rd
Wildflower Park North	Goodyear, City of	16151 W Monroe St
Wildflower Park South	Goodyear, City of	16150 W Desert Bloom St
Aleppo Park	Litchfield Park, City of	940 W. Village Parkway
Camelback Park	Litchfield Park, City of	1185 Villa Nueva Drive
Kiwanis Park	Litchfield Park, City of	
LITCHFIELD PARK RECREATION CENTER	Litchfield Park, City of	100 S Old Litchfield Rd
Little Park	Litchfield Park, City of	Little Street & Adobe Street in the Village of Litchfield Park
Memorial Park	Litchfield Park, City of	101 E. Wigwam Boulevard
Rose Park	Litchfield Park, City of	580 W. Village Parkway
Scout Park	Litchfield Park, City of	203 W. Fairway Drive
Staggs Park	Litchfield Park, City of	300 S. Old Litchfield Road
Tierra Verde Lake Park	Litchfield Park, City of	301 S. Old Litchfield Road

Name	Owner	Address
Turtle Park	Litchfield Park, City of	675 Villa Nueva Drive
Village Park	Litchfield Park, City of	4901 N. Village Parkway East
Estrella Mountain Regional Park	Maricopa County Parks & Recreation	14805 W Vineyard Ave
Ak-Chin Pavilion	Phoenix, City of	2121 N 83rd Avenue
Bethany Home Outflow Channel	Phoenix, City of	Camelback to 75th Ave
Desert Star Park	Phoenix, City of	8550 W. Encanto Blvd
Desert West Park	Phoenix, City of	6501 W Encanto Blvd
Dust Devil Park	Phoenix, City of	10645 W Camelback Rd
El Oso Park	Phoenix, City of	3451 N. 75th Ave
Farmland Park	Phoenix, City of	87th Ave & Lower Buckey Rd
Holiday Park	Phoenix, City of	4530 N 67th Ave
Laveen Area Conveyance Channel	Phoenix, City of	
Laveen Heritage Park	Phoenix, City of	71st Avenue and Meadows Loop Rd
Marivue Park	Phoenix, City of	5625 W Osborn Rd
Grand Canyon University Championship Golf Course	Phoenix, City of	4444 N 51st Ave
Maryvale Tot Lot Park	Phoenix, City of	3206 N 65th Ave
Santa Maria Park	Phoenix, City of	3425 S 71st Ave
Starlight Park	Phoenix, City of	7810 W Osborn Rd
Sunridge Park	Phoenix, City of	6201 West Roosevelt St
Sunset Basin	Phoenix, City of	63rd Ave & Indian School
Trailside Point Park	Phoenix, City of	7215 W. Vineyard Rd
Tres Rios Wetlands	Phoenix, City of	
McNeel Park	Tolleson, City of	712 N. 95th Ave.
The P.L.A.C.E.	Tolleson, City of	9257 W Van Buren St
Tolleson Veteran's Park	Tolleson, City of	8601 W. Van Buren St
The Base and Meridian Wildlife Area	Arizona Game and Fish Department	

SOURCE: City of Goodyear, 2024; City of Glendale, 2024; City of Avondale, 2024; City of Litchfield Park, 2024; City of Phoenix, 2024; City of Tolleson, 2024; Maricopa County, 2024; USFWS, 2024; BLM, 2024.

Appendix D

Section 106 Resources and Agency Consultation

APPENDIX D

TABLE D-1
HISTORIC RESOURCES IN THE APE

Map Key	Resource Name	Significance
1	Villa Verde Plat A and Villa Verde Plat B Historic District	NRHP Listed
2	Cartwright School	NRHP Listed
3	Initial Point of the Gila and Salt River Base Line and Meridian	NRHP Listed
4	Evans Barn	NRHP Eligible
5	Brooks, M. B., House	NRHP Eligible
6	Sachs-Webster Farmstead	Local
7	Riverside School	Local
8	Farm House	Local
9	Conservation Easement	Local
10	Conservation Easement	Local
11	Ranch House	Local
12	Farm House	Local
13	Pendergast School	Local

SOURCE: National Park Service, 2024; City of Phoenix, 2024.

D-1 SHPO Consultation

U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., SW.
Washington, DC 20591

State Historic Preservation Office
Arizona State Parks & Trails
1110 W Washington St, Suite 100
Phoenix, AZ 85007

Via electronic submission to azshpo@azstateparks.gov

Re: Concurrence with No Historic Properties Affected for Commercial Drone Delivery Operations in Tolleson, AZ

State Historic Preservation Officer:

The Federal Aviation Administration (FAA) is currently evaluating a proposal from Amazon.com Services, doing business as Amazon Prime Air, to introduce commercial drone package delivery operations in the Tolleson, AZ area. The FAA has determined the Proposed Action, which requires FAA approvals to enable operations, is an undertaking, as defined under the regulations implementing Section 106 of the National Historic Preservation Act (36 CFR § 800.16(y)). The purpose of this letter is to coordinate with the Arizona State Historic Preservation Officer (SHPO) and request your concurrence on the FAA's finding of *no historic properties affected* associated with the Proposed Undertaking.

The FAA received concurrence from the Arizona SHPO on the definition of the Area of Potential Effects (APE) on March 26, 2024 (see **Attachment A**).

The FAA conducted consultation with all potentially affected Tribal Governments in full accordance with the protocols outlined in the *Government to Government Consultation Toolkit*. The Tribal consultation period closed on July 01, 2024 and one (1) reply was received (see **Attachment A**).

Proposed Undertaking

Amazon Prime Air is currently seeking to operate under Title 14 Code of Federal Regulations Part 135 in Tolleson, AZ, which includes a Part 135 Air Carrier Operating Certificate from the FAA to allow it to carry the property of another for compensation or hire beyond visual line of sight in those areas of Arizona. The certificate contains a stipulation that operations must be conducted in accordance with the provisions and limitations specified in the carrier's Operations Specifications. Amazon Prime Air has requested the FAA to authorize the operation of its next generation MK30 drone variant so it can add it to its Part 135 fleet to provide broader access to its drone package delivery services across its operating areas.

Amazon Prime Air projects flying up to 469 MK30 drone flights per operating day from the Prime Air Drone Delivery Center (PADDC) located in Tolleson, AZ, with each flight taking a package to a customer delivery address before returning to the PADDC. The number of flights per day would vary based on customer demand and weather conditions. Amazon Prime Air is taking an incremental approach to operations and expects to gradually ramp up to 469 flights per day as consumer demand increases over time. Drone flights could be conducted up to 365 days a year and, as it ramps up operations, it could operate up to 10 hours per day, but operations will not occur before 7 A.M. or after 10 P.M.

Unmanned Aircraft

As pictured in **Attachment B**, the Amazon Prime Air MK30 drone is a hybrid multicopter fixed-wing tail-sitter drone with six propulsors allowing it to take-off and land vertically and transition to wing borne flight. Its airframe is composed of staggered tandem wings for stable wing borne flight. The drone weighs 78.15 pounds and has a maximum takeoff weight of 83.292 pounds, which includes a maximum payload of 5 pounds. It has a maximum operating range of 7.5 miles and can fly up to 58 knots during wing borne flight. It uses electric power from rechargeable lithium-ion batteries and is launched vertically using powered lift and converts to using wing lift during en route horizontal flight.

Flight Operations

The MK30 drone would generally be operated at an altitude of 115 to 300 feet above ground level (AGL) and up to a maximum operating altitude of 400 feet AGL while en route to and from delivery locations. At a delivery location, the drone would descend vertically to a stationary hover and drop a package to the ground. Once a package has been delivered, the drone would ascend vertically to the en route altitude, and depart the delivery area back to the PADDC. The drone would fly a predefined flight path that is set prior to takeoff. Flight missions would be automatically planned by Amazon Prime Air's flight planning software, which assigns, deconflicts, and routes each flight. The PADDC would have access to a controlled area wherein drone flights are launched and recovered.

A typical drone flight profile can be broken into the following general flight phases: takeoff, en route outbound, delivery, en route inbound, and landing, as depicted in **Attachment C**.

Takeoff

Once the loaded MK30 drone is cleared for takeoff at the PADDC, it takes off from the ground vertically to an altitude of about 180 feet AGL and then transitions and climbs to its en route altitude of about 300 feet AGL.

En Route Outbound

The en route outbound phase is the part of flight in which the MK30 drone transits from the PADDC to a delivery point on a predefined flight path. During this flight phase, the drone will typically operate at an altitude of 300 feet AGL with a typical airspeed of 58 knots.

Delivery

The delivery phase consists of descent from the en route altitude to a delivery point to deliver a package. The MK30 drone transitions and descends to about 180 feet AGL and then vertically descends to about 13 feet AGL while maintaining position over the delivery point. The drone hovers while dropping the package and then proceeds to climb vertically back to en route inbound altitude.

En Route Inbound

The MK30 drone continues to fly at an altitude of about 300 feet AGL with a speed of 58 knots towards the PADDC.

Landing
Upon reaching the PADDC, the MK30 drone slowly descends over its assigned landing pad and lands on the pad.

Predicted Sound Levels
The FAA conducted a noise analysis using sound level measurement data for the MK27-2 drone, which is the drone model currently in use by Amazon Prime Air for commercial package delivery at other locations across the country. However, Amazon Prime Air intends to operate the newer MK30 drone at the Tolleson PADDC. Amazon Prime Air reports that improvements made to the MK30 model have reduced the overall operating sound level of the drone and, as such, use of the MK27-2 as a surrogate in the noise analysis is conservative for noise estimation.

The estimated maximum sound exposure level (SEL) for the takeoff, delivery, and landing phases of flight is approximately 95.7, 96.3, and 94.8 decibels (dB), respectively, at 32.8 feet from the drone.[1] Predicted sound levels decrease as distances from the drone increase. The maximum SEL for the en route phase is approximately 67.7 dB when the drone is flying 52.4 knots at 165 feet AGL, the lowest altitude the drone is anticipated to operate.

The drone is generally expected to fly the same outbound flight path between the PADDC and the delivery point and inbound flight path back to the PADDC. While the average daily deliveries from the PADCC is not expected to exceed 469, the number of daily overflights will be dispersed because the PADCC is centrally located, and delivery locations would be distributed throughout the proposed operating area. A conservative estimate for the maximum number of overflights over any one location would not be anticipated to exceed half, or 235 daily overflights, which would result in en route noise levels of Day-Night Average Sound Level (DNL) 45.1 dB at any location within the action area.

Additionally, due to the inherent uncertainty of the exact delivery site locations, the noise analysis developed a minimum and maximum representative distribution of deliveries in the action area. The noise analysis conservatively assumes the minimum and maximum distribution of average daily deliveries that could occur at a single delivery location, which ranges from 0.1 to 4.0 deliveries per operating day. The resulting DNL values include the descent, climb flight maneuvers associated with a delivery, and the noise exposure for delivery operations also includes the en route overflight at the typical operating altitude of 165 feet AGL, as discussed above. The resulting noise exposure for delivery site locations is DNL 54.7 dB.

Area of Potential Effects
In accordance with 36 CFR § 800.4(a)(1), the FAA has defined the APE in consideration of the undertaking's potential direct and indirect effects. The APE is the drone operating area outlined in red in **Attachment D** and encompasses a portion of the Tolleson area within a 7.5-mile drone operating radius around the PADDC. The Arizona SHPO issued an APE concurrence on March 26, 2024.

Identification of Historic Properties

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[1] SEL is a single event metric that considers both the noise level and duration of the event, referenced to a standard duration of one second.

The proposed undertaking does not have the potential to affect below ground or archaeological resources because it does not include ground disturbance, but may include visual and auditory effects. Therefore, the FAA focused its identification efforts on above-ground historic properties. According to the National Park Service's online database of the National Register of Historic Places (NRHP), there are three historic resources listed in the National Register located in the APE. Additionally, there are two National Register-eligible resources and eight resources of local significance located in the APE (see **Attachments E** and **F**). Additional properties in the APE may be otherwise recognized for historical significance by the SHPO.

Assessment of Effects

Given the small size of the MK30 drone and predicted sound levels, operations would not produce vibrations that could impact the architectural structure or contents of any structure in the APE. While the MK30 drone is not expected to generate significant noise levels at or within any historic property, the FAA considered drone delivery noise and potential visual effects on historic properties where a quiet setting or visually unimpaired sky might be a key attribute of the property's significance.

The noise modeling methodology and methods presented in the Draft Environmental Assessment are suitable for the evaluation of Federal actions in compliance with the National Environmental Policy Act (NEPA) and other applicable environmental regulations or federal review standards at the discretion and approval of the FAA. In particular, the analysis is intended to function as a nonstandard equivalent methodology under FAA Order 1050.1F, and therefore required prior written consent from the FAA's Office of Environment and Energy for each project seeking a NEPA determination. The results presented above are expressed in terms of the DNL, considering varying levels of operations for areas at ground level below each flight phase.

The FAA has not developed a visual effects significance threshold; however, factors the FAA considers in assessing significant impacts include the degree to which the action would have the potential to: (1) affect the nature of the visual character of the area, including the importance, uniqueness, and aesthetic value of the affected visual resources; (2) contrast with the visual resources and/or visual character in the study area; or (3) block or obstruct the views of visual resources, including whether these resources would still be viewable from other locations. The Proposed Action makes no changes to any landforms or land uses, and visual effects would be short-term in nature; thus, there would be no effect to the visual character of the area. Excluding ground-based activities supporting the drones, operations would be occurring in airspace only. The FAA estimates that, at typical operating altitude and speeds, the drone would be observable for approximately 3.6 seconds during en route flight by an observer on the ground.

The FAA has not identified any properties in the APE that would be affected by the drone's sound levels or visual effects, which are not anticipated to be significant at any locations along the drone's flight path, including delivery locations. Therefore, *the FAA has made a finding of no historic properties affected*.

Conclusion

The FAA requests your concurrence on the FAA's finding of *"no historic properties affected"* from the Proposed Undertaking. Your response within the next 30 days will greatly assist us in our environmental review process. In the event that you would like to consult with the FAA about the determination, please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov.

Sincerely,

DEREK W HUFTY
Digitally signed by DEREK W HUFTY
Date: 2024.06.27 10:41:13 -04'00'

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Enclosures:
Attachment A – Section 106 Correspondence APE Concurrence/Tribal Responses
Attachment B – Amazon Prime Air MK30 Drone
Attachment C – MK30 Drone Flight Profile
Attachment D – Area of Potential Effects
Attachment E – NRHP Resources within the Area of Potential Effects
Attachment F – Listing of NRHP Resources

Attachment A
Section 106 Correspondence

SHPO-2024-0029 (174140) Rec: 03-20-24

U.S. Department of Transportation
Federal Aviation Administration

Aviation Safety

800 Independence Ave., SW.
Washington, DC 20591

State Historic Preservation Office
Arizona State Parks & Trails
1110 W Washington St, Suite 100
Phoenix, AZ 85007

Via electronic submission to azshpo@azstateparks.gov

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State Historic Preservation Officer:

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Proposed Undertaking

Amazon Prime Air is currently seeking to operate under Title 14 Code of Federal Regulations Part 135 in Tolleson, AZ, which includes a Part 135 Air Carrier Operating Certificate from the FAA to allow it to carry the property of another for compensation or hire beyond visual line of sight in those areas of Arizona. The certificate contains a stipulation that operations must be conducted in accordance with the provisions and limitations specified in the carrier's Operations Specifications.[1]

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Unmanned Aircraft

As pictured in **Attachment A**, the Amazon Prime Air MK30 drone is a hybrid multicopter fixed-wing tail-sitter drone with six propulsors allowing it to take-off and land vertically and transition to wing borne flight. Its airframe is composed of staggered tandem wings for stable wing borne flight. The drone

[1] An Operations Specifications is a document that defines the scope of aircraft operations that the FAA has authorized.

weighs 78.15 pounds and has a maximum takeoff weight of 83.292 pounds, which includes a maximum payload of 5 pounds. It has a maximum operating range of 7.5 miles and can fly up to 58 knots during wing borne flight. It uses electric power from rechargeable lithium-ion batteries and is launched vertically using powered lift and converts to using wing lift during en route flight.

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Landing

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Area of Potential Effects

In accordance with 36 CFR § 800.4(a)(1), the FAA has defined the APE in consideration of the undertaking's potential direct and indirect effects. The proposed APE is the drone operating area outlined in red in **Attachment B**. This area encompasses a portion of the Tolleson area within a 7.5-mile drone operating radius around the PADDC.

Conclusion

The FAA requests your concurrence on the definition of the proposed APE. Your response within the next 30 days will greatly assist us in our environmental review process. In the event that you would like to consult with the FAA about the proposed APE, please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov.

Sincerely,

DEREK W HUFTY Digitally signed by DEREK W HUFTY Date: 2024.06.27 10:41:50 -04'00'

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Enclosures:
Attachment A – Amazon Prime Air MK30 Drone
Attachment B – Proposed Area of Potential Effects

SHPO concurs with the proposed APE

David Zimmerman, M.A.
Arizona State Historic Preservation Office
March 26, 2024

White Mountain Apache Tribe

Office of Historic Preservation
PO Box 1032
Fort Apache, AZ 85926
Ph: (928) 338-3033 Fax: (928) 338-6055

To: Chris Hurst – REM/CEA/CESCO Environmental Protection Specialist

Date: June 04, 2024

Re: *Expansion of FAA Amazon Commercial Unmanned Aircraft System Operation*

The White Mountain Apache Tribe Historic Preservation Office appreciates receiving information on the project dated; May 24, 2024. In regards to this, please refer to the following statement(s) below.

Thank you for allowing the White Mountain Apache tribe the opportunity to review and respond to the above proposed expansion of Amazon Prime Air's UAS delivery system operation, in Tolleson, Maricopa County, Arizona.

Please be advised, we have reviewed the information provided, we have determined the proposed project plans will have ***"No Adverse Effect"*** to the tribe's traditional cultural resources and/or historic properties. We concur with the proposed project plans.

Thank you for the continued tribal engagement and consultation, and collaborations in protecting and preserving places of cultural and historical importance.

Sincerely,

Mark Altaha

White Mountain Apache Tribe – THPO
Historic Preservation Office

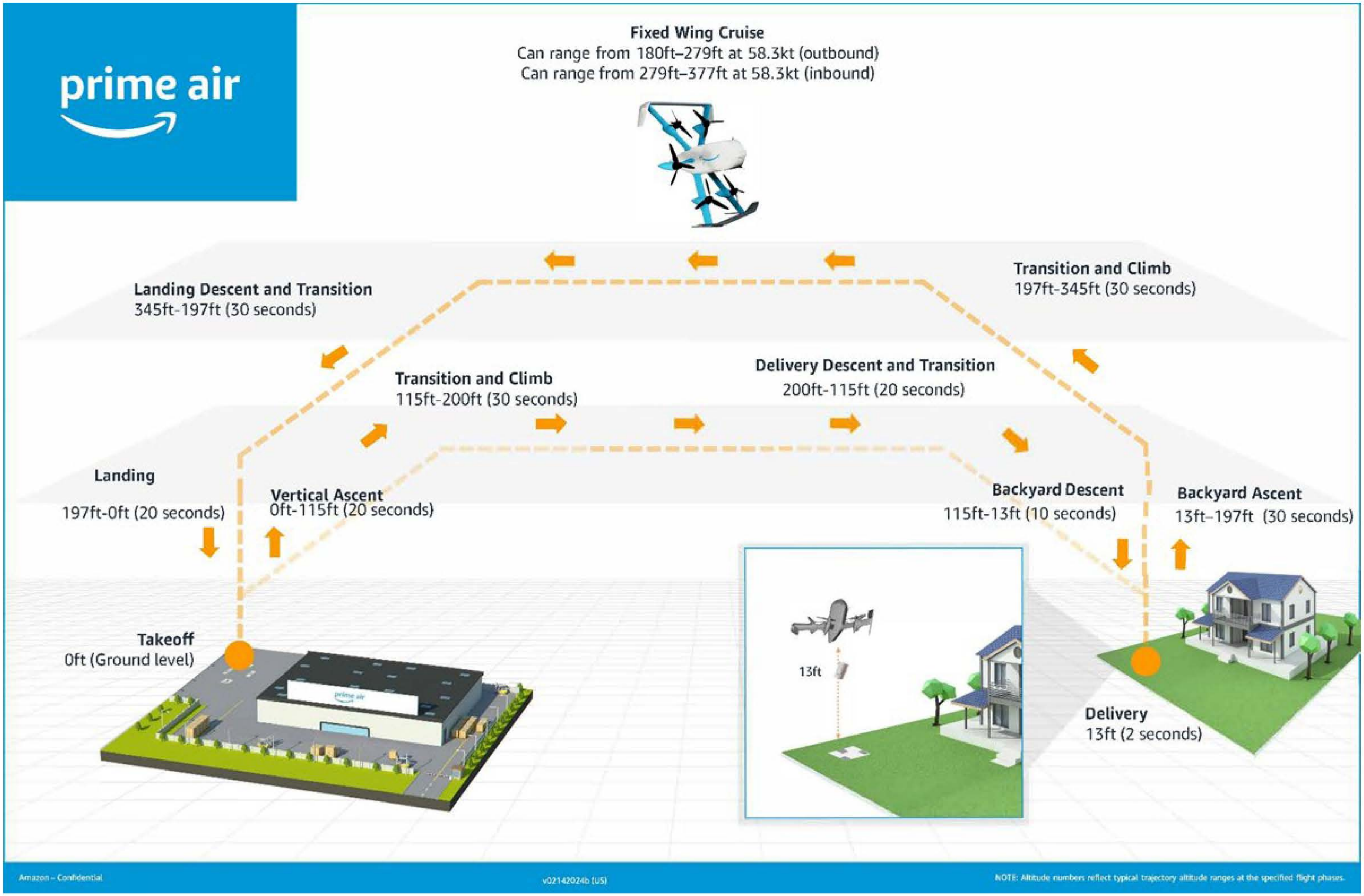
Attachment B
Amazon Prime Air MK30 Drone

Attachment B

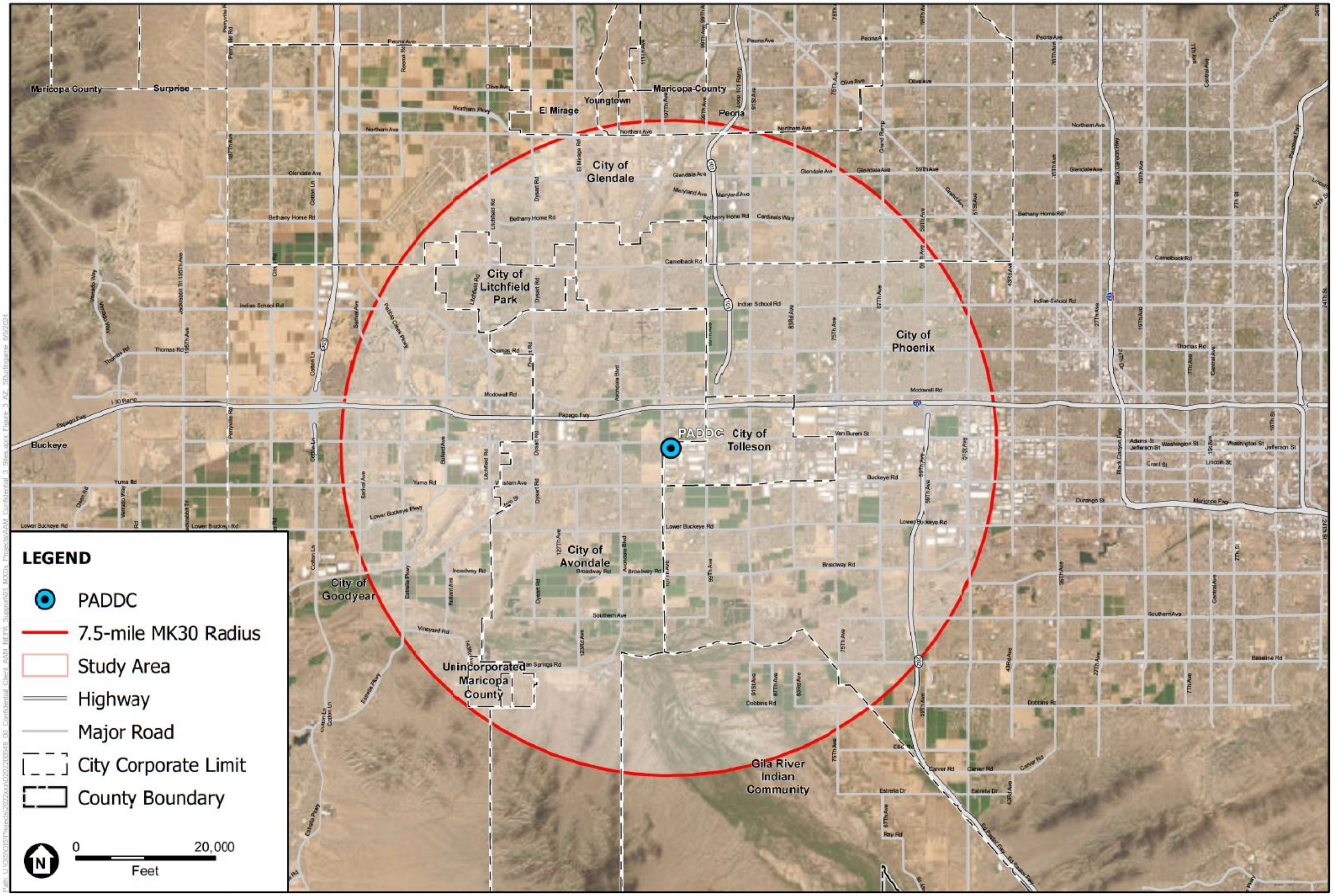
Prime Air MK30 Unmanned Aircraft

Attachment C

MK30 Drone Flight Profile


prime air
Fixed Wing Cruise
Can range from 180ft–279ft at 58.3kt (outbound)
Can range from 279ft–377ft at 58.3kt (inbound)
Landing Descent and Transition
345ft-197ft (30 seconds)
Transition and Climb
197ft-345ft (30 seconds)
Transition and Climb
115ft-200ft (30 seconds)
Delivery Descent and Transition
200ft-115ft (20 seconds)
Landing
197ft-0ft (20 seconds)
Vertical Ascent
0ft-115ft (20 seconds)
Backyard Descent
115ft-13ft (10 seconds)
Backyard Ascent
13ft–197ft (30 seconds)
Takeoff
0ft (Ground level)
13ft
Delivery
13ft (2 seconds)
Amazon – Confidential
v02142024b (US)
NOTE: Altitude numbers reflect typical trajectory altitude ranges at the specified flight phases.

Attachment D
Area of Potential Effects

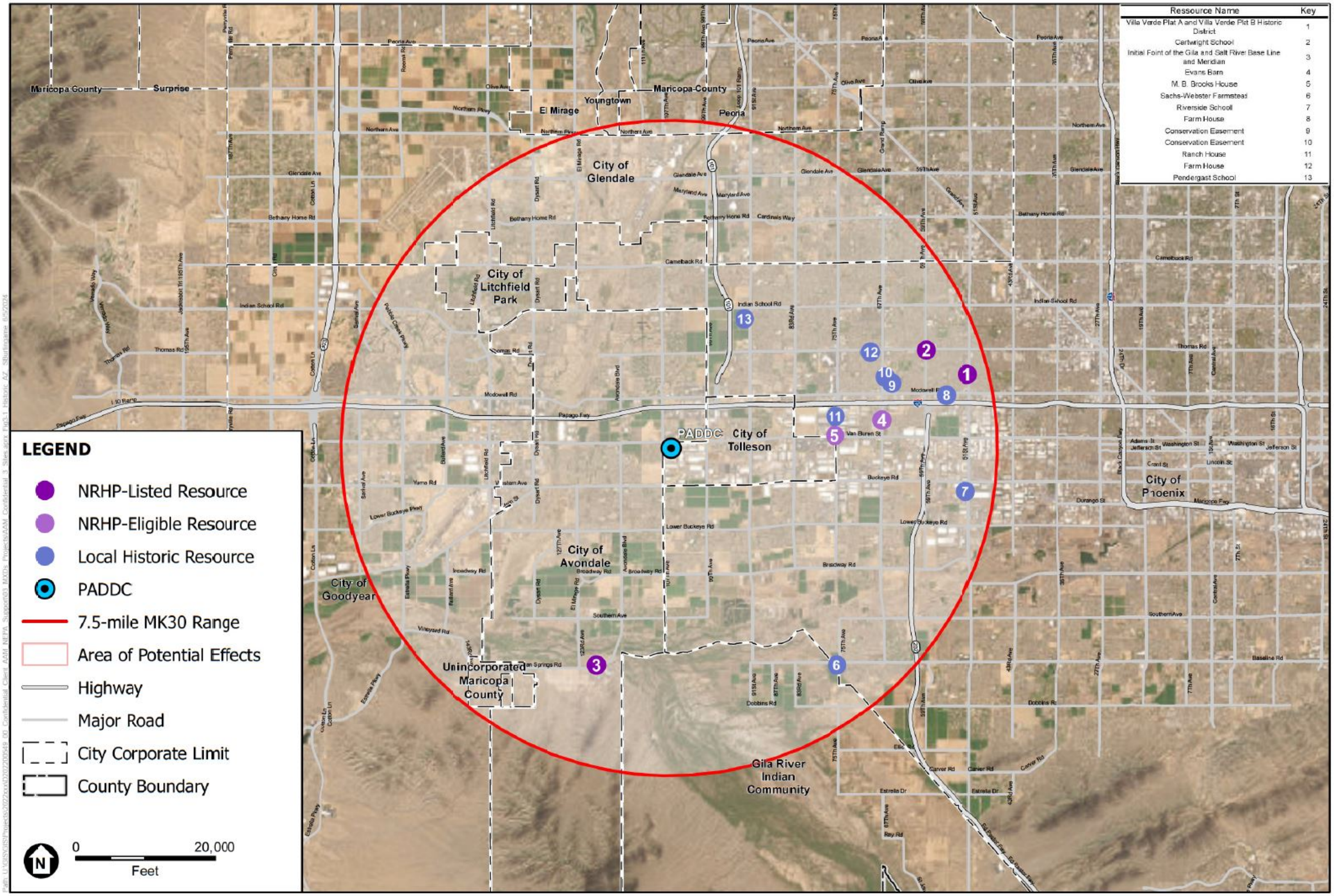


SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

ESA

Area of Potential Effects
Tolleson, AZ

Attachment E
NRHP Resources within the Area of Potential Effects



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023; National Park Service, 2023; City of Phoenix, 2024.

Draft Environmental Assessment for Amazon Prime Air – Tolleson, AZ

Historical, Architectural, Archaeological, and Cultural Resources
Tolleson, AZ

ESA

Attachment F
Listing of NRHP Resources

HISTORIC RESOURCES IN THE APE

Map Key	Resource Name	Significance
1	Villa Verde Plat A and Villa Verde Plat B Historic District	NRHP Listed
2	Cartwright School	NRHP Listed
3	Initial Point of the Gila and Salt River Base Line and Meridian	NRHP Listed
4	Evans Barn	NRHP Eligible
5	Brooks, M. B., House	NRHP Eligible
6	Sachs-Webster Farmstead	Local
7	Riverside School	Local
8	Farm House	Local
9	Conservation Easement	Local
10	Conservation Easement	Local
11	Ranch House	Local
12	Farm House	Local
13	Pendergast School	Local

SOURCE: National Park Service, 2024; City of Phoenix, 2024.

U.S. Department of Transportation
Federal Aviation Administration

Aviation Safety

800 Independence Ave., SW.
Washington, DC 20591

State Historic Preservation Office
Arizona State Parks & Trails
1110 W Washington St, Suite 100
Phoenix, AZ 85007

Via electronic submission to azshpo@azstateparks.gov

Re: Concurrence with Proposed Area of Potential Effects for Drone Delivery Operations in Tolleson, AZ

State Historic Preservation Officer:

The Federal Aviation Administration (FAA) is currently evaluating a proposal from Amazon.com Services, doing business as Amazon Prime Air, to introduce drone package delivery operations in the Tolleson, AZ area. The FAA has determined the proposed action, which requires FAA approvals to enable operations, is an undertaking as defined under the regulations implementing Section 106 of the National Historic Preservation Act (36 CFR § 800.16(y)). The purpose of this letter is to coordinate with the State Historic Preservation Officer (SHPO) and request concurrence on the definition of the Area of Potential Effects (APE).

Proposed Undertaking
Amazon Prime Air is currently seeking to operate under Title 14 Code of Federal Regulations Part 135 in Tolleson, AZ, which includes a Part 135 Air Carrier Operating Certificate from the FAA to allow it to carry the property of another for compensation or hire beyond visual line of sight in those areas of Arizona. The certificate contains a stipulation that operations must be conducted in accordance with the provisions and limitations specified in the carrier's Operations Specifications.[1]

Amazon Prime Air projects flying up to approximately 469 MK30 drone flights per operating day from the Prime Air Drone Delivery Center (PADDC) located in Tolleson, with each flight taking a package to a customer delivery address before returning to the PADDC. The number of flights per day would vary based on customer demand and weather conditions. Amazon Prime Air is taking an incremental approach to operations and expects to gradually ramp up to approximately 469 flights per day as consumer demand increases over time. Drone flights could be conducted up to 365 days a year and, as it ramps up operations, it could operate up to 10 hours per day, primarily during daylight hours (but operations will not occur before 7 A.M. or after 10 P.M).

Unmanned Aircraft
As pictured in **Attachment A**, the Amazon Prime Air MK30 drone is a hybrid multicopter fixed-wing tail-sitter drone with six propulsors allowing it to take-off and land vertically and transition to wing borne flight. Its airframe is composed of staggered tandem wings for stable wing borne flight. The drone

[1] An Operations Specifications is a document that defines the scope of aircraft operations that the FAA has authorized.

weighs 78.15 pounds and has a maximum takeoff weight of 83.292 pounds, which includes a maximum payload of 5 pounds. It has a maximum operating range of 7.5 miles and can fly up to 58 knots during wing borne flight. It uses electric power from rechargeable lithium-ion batteries and is launched vertically using powered lift and converts to using wing lift during en route flight.

Flight Operations

The MK30 drone would generally be operated at an altitude of 300 feet above ground level (AGL) and up to a maximum operating altitude of 400 feet AGL while en route to and from delivery locations. At a delivery location, the drone would descend vertically to a stationary hover and drop a package to the ground. Once a package has been delivered, the drone would ascend vertically to the en route altitude, and depart the delivery area back to the PADDC. The drone would fly a predefined flight path that is set prior to takeoff. Flight missions would be automatically planned by Amazon Prime Air's flight planning software, which assigns, deconflicts, and routes each flight. The PADDC would have access to a controlled area wherein drone flights are launched and recovered.

A typical drone flight profile can be broken into the following general flight phases: takeoff, en route outbound, delivery, en route inbound, and landing.

Takeoff

Once the loaded MK30 drone is cleared for takeoff at the PADDC, it takes off from the ground vertically to an altitude of about 180 feet AGL and then transitions and climbs to its en route altitude of about 300 feet AGL.

En Route Outbound

The en route outbound phase is the part of flight in which the MK30 drone transits from the PADDC to a delivery point on a predefined flight path. During this flight phase, the drone will typically operate at an altitude of 300 feet AGL with a typical airspeed of 58 knots.

Delivery

The delivery phase consists of descent from the en route altitude to a delivery point to deliver a package. The MK30 drone transitions and descends to about 180 feet AGL and then vertically descends to about 13 feet AGL while maintaining position over the delivery point. The drone hovers while dropping the package and then proceeds to climb vertically back to en route inbound altitude.

En Route Inbound

The MK30 drone continues to fly at an altitude of about 300 feet AGL with a speed of 58 knots towards the PADDC.

Landing

Upon reaching the PADDC, the MK30 drone slowly descends over its assigned landing pad and lands on the pad.

Area of Potential Effects

In accordance with 36 CFR § 800.4(a)(1), the FAA has defined the APE in consideration of the undertaking's potential direct and indirect effects. The proposed APE is the drone operating area outlined in red in **Attachment B**. This area encompasses a portion of the Tolleson area within a 7.5-mile drone operating radius around the PADDC.

Conclusion

The FAA requests your concurrence on the definition of the proposed APE. Your response within the next 30 days will greatly assist us in our environmental review process. In the event that you would like to consult with the FAA about the proposed APE, please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov.

Sincerely,

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Enclosures:
Attachment A – Amazon Prime Air MK30 Drone
Attachment B – Proposed Area of Potential Effects

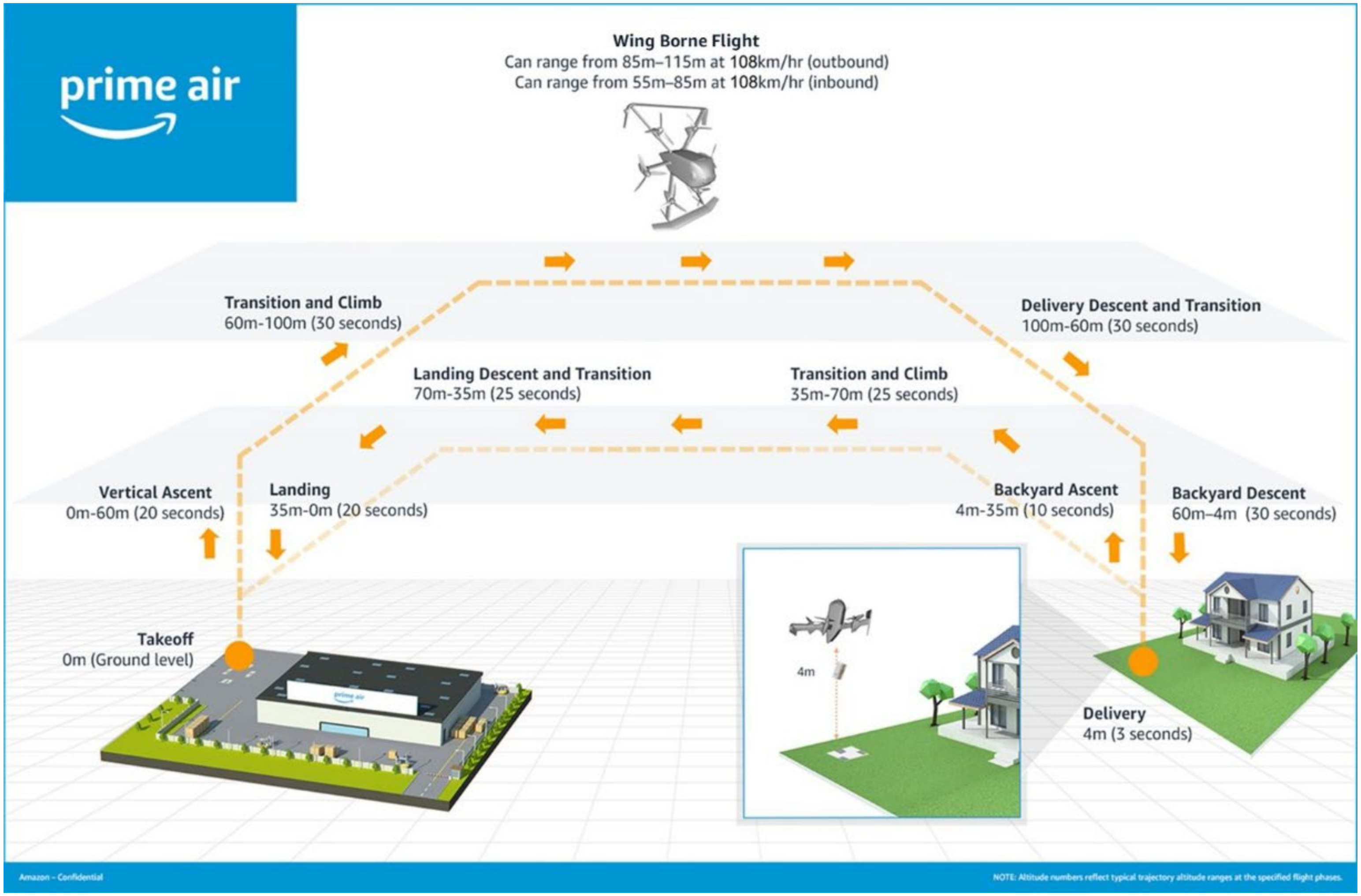
SHPO concurs with the proposed APE

David Zimmerman, M.A.
Arizona State Historic Preservation Office
March 26, 2024

Attachment A
Amazon Prime Air MK30 Drone

SOURCE: Amazon Prime Air, 2023.

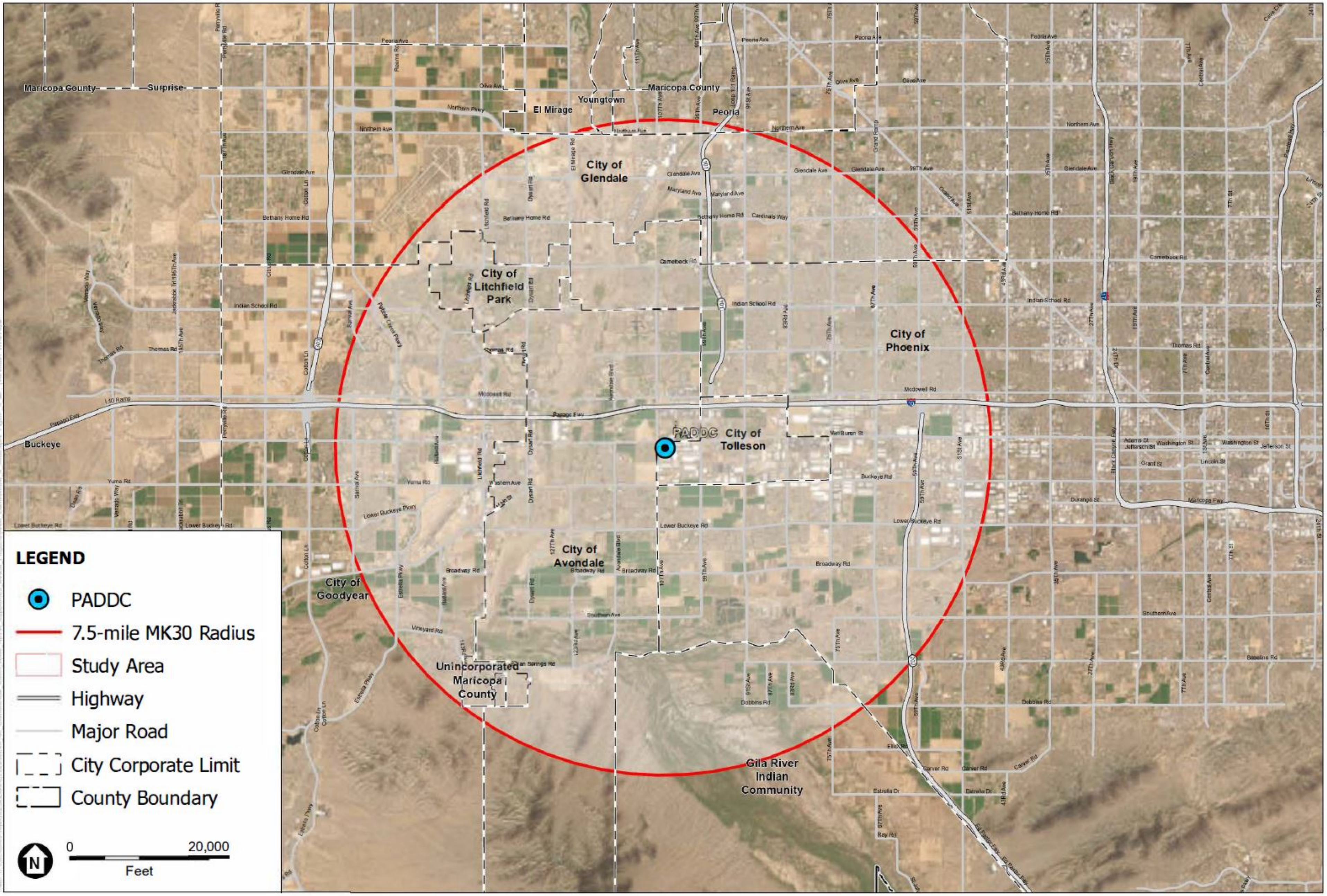
MK30 Drone



SOURCE: Amazon Prime Air, 2023.

MK30 Drone Flight Profile

Attachment B
Proposed Area of Potential Effects



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

ESA

Proposed Area of Potential Effects
Tolleson, AZ

D-2 Tribal Consultation

The following Tribal Governments were consulted as part of this EA:

Ak-Chin Indian Community

Chemehuevi Indian Tribe

Cocopah Indian Tribe

Colorado River Indian Tribes

Fort McDowell Yavapai Nation

Fort Mojave Indian Tribe

Fort Sill Apache Tribe

Fort Yuma-Quechan Tribe

Gila River Indian Community

Havasupai Tribe

Hopi Tribe

Hualapai Tribe

Kaibab Band of Paiute Indians

Mescalero Apache Tribe

Moapa Band of Paiute Indians

Navajo Nation

Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony

Paiute Indian Tribe of Utah

Pascua Yaqui Tribe

Pueblo of Acoma

Pueblo of Zuni

Salt River Pima-Maricopa Indian Community

San Carlos Apache Tribe

San Juan Southern Paiute

Tohono O’odham Nation

Tonto Apache Tribe

Ute Mountain Ute

White Mountain Apache

Yavapai-Apache Nation

Yavapai-Prescott Indian Tribe

U.S. Department of Transportation
Federal Aviation Administration

Aviation Safety

800 Independence Ave., SW.
Washington, DC 20591

Via Email

Chairman Kasey Velasquez
White Mountain Apache Tribe
P.O. Box 700
Whiteriver, AZ 85941
Kasey.velasquez@wmat.us

RE: Invitation for Government-to-Government Tribal Consultation for Drone Package Delivery Operations in Arizona

The purpose of this letter is to initiate formal government-to-government consultation regarding a proposal under consideration by the Federal Aviation Administration (FAA) to authorize commercial Unmanned Aircraft Systems (UAS) operators to deliver goods to customers (referred to as package delivery) using unmanned aircraft (also referred to as drones) in accordance with 14 Code of Federal Regulations Part 135 (Part 135) in Arizona. The FAA is the lead federal agency for government-to-government consultation for the proposed project. Amazon Prime Air is the proponent of the project. We wish to solicit your views regarding potential effects on tribal interests in the area.

The primary purpose of government-to-government consultation is to ensure that Federally Recognized Tribes are given the opportunity to provide meaningful and timely input regarding proposed FAA actions that uniquely or significantly affect the Tribes. This policy is provided in Federal Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*; Presidential Memorandum, *Uniform Standards for Tribal Consultation*; DOT Order 5301.1A, *Department of Transportation Tribal Consultation Policy and Procedures*; and FAA Order 1210.20, *American Indian and Alaska Native Tribal Consultation Policy and Procedures*.

Consultation Initiation

With this letter, the FAA is seeking input concerning any Tribal lands or sites of religious or cultural significance that may be affected by the proposed operation. Early identification of Tribal concerns, or known properties of traditional, religious, and cultural importance, will allow the FAA to consider ways to avoid or minimize potential impacts to Tribal resources. We are available to discuss the details of the proposed project with you.

Proposed Activity Description

The FAA is preparing an Environmental Assessment to assess the potential environmental impacts of commercial package delivery operations using drones in Tolleson, AZ under Part 135. Since 2019, the FAA has been issuing air carrier certificates to UAS operators in accordance with Part 135 so that operators can conduct package delivery flights. Generally, these approvals are associated with issuing a new or amended Part 135 air carrier Operations Specifications as the operative approval. For your reference, the project description used for consultation under Section 106 is enclosed with this letter.

Confidentiality

We understand that you may have concerns about the confidentiality of information on areas or resources of traditional, religious, and cultural importance to your Tribe. We are available to discuss these concerns and develop procedures to ensure the confidentiality of such information is maintained.

FAA Contact Information

Your timely response over the next 30 days will greatly assist us in incorporating your concerns into our environmental review of the operation. In addition, we respectfully request your response in the event that the White Mountain Apache Tribe would like to consult with the FAA in a government-to-government relationship about this proposal. Please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov within 30 days of receipt of this letter to confirm your intent to participate in this government-to-government consultation.

Sincerely,

DEREK W HUFTY

Digitally signed by DEREK W HUFTY
Date: 2024.05.06 10:21:18 -04'00'

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

CC: Mr. Mark Altaha
Tribal Historic Preservation Officer

Mr. Ramon Riley
Cultural Resource Office Repatriation Specialist

Enclosure:
Attachment A – Section 106 Consultation Package

Attachment A
Section 106 Consultation Package

U.S. Department of Transportation
Federal Aviation Administration

Aviation Safety

800 Independence Ave., SW.
Washington, DC 20591

Mr. Mark Altaha

Tribal Historic Preservation Officer
White Mountain Apache Tribe
P.O. Box 700
Whiteriver, AZ 85941
Kasey.velasquez@wmat.us

Dear Chairman Kasey Velasquez,

The Federal Aviation Administration (FAA) is currently evaluating Amazon Prime Air's proposal to conduct commercial drone delivery operations in the Tolleson, AZ area. Amazon Prime Air must obtain approval from the FAA prior to introducing operations and operating the MK30 drone in Tolleson, AZ. The FAA has determined that its proposed action, which would encompass all FAA approvals necessary to enable operations, is an undertaking as defined under the regulations implementing Section 106 of the National Historic Preservation Act (NHPA) (36 CFR § 800.16(y)). The purpose of this letter is to initiate Section 106 consultation with White Mountain Apache Tribe and to solicit your views regarding potential effects on tribal interests in the area. The FAA has begun an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) to analyze the proposed action. FAA intends to complete consultation for Section 106 of the NHPA concurrently with the NEPA process.

Project Description

Amazon Prime Air is proposing to transport consumer goods via drone delivery in the communities round Tolleson, AZ by using the MK30 drone. The MK30 drone would take off from the Tolleson Prime Air Drone Delivery Center (PADDC) and quickly rise to a cruising altitude of between 180 to 377 feet above ground level (AGL). The MK30 drone weighs approximately 87 pounds and can transport a small package up to about 5 pounds. The MK30 drone has an approximate 7.5-mile service radius. Once at the delivery site, the MK30 drone hovers in place at about 13 feet AGL and drops the package to the ground. Once the package has been delivered, the drone flies back to the Tolleson PADDC at roughly the same altitude.

Amazon Prime Air is proposing up to 470 MK30 drone flights per day from the Tolleson PADDC, with each flight taking a package to a customer delivery address before returning. There is variability in the number of flights per day based on customer demand and weather conditions. Initially, Amazon Prime Air expects to fly much less than 470 flights per day from the PADDC and gradually ramp up to the proposed level as consumer demand increases. Flights will occur up to 365 days a year, with operations being conducted for up to 10 hours per day, primarily during daylight hours, but never before 7 A.M. or after 10 P.M. There are no ground disturbing activities associated with this proposed action.

Area of Potential Effects

In accordance with 36 CFR § 800.4(a)(1), the FAA has defined the Area of Potential Effects (APE) in consideration of the undertaking's potential direct and indirect effects. The proposed APE has been coordinated with the Arizona SHPO and would be limited to areas near Tolleson, AZ, which includes densely populated or congested regions. The enclosed map (see **Attachment A**) shows the proposed APE in detail.

Identification of Historic Properties

The proposed undertaking does not have the potential to affect below ground or archeological resources because the undertaking does not include ground disturbance, but could result in auditory or visual effects. Therefore, the FAA focused its identification efforts on above-ground historic properties.

Consultation

The FAA is now soliciting the opinion of the tribes concerning any tribal lands, or sites of religious or cultural significance that may be affected by the proposed operations area. Your response over the next 30 days will greatly assist us in incorporating your concerns into our environmental review of the operation. If you have any questions or need additional information, please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov within 30 days of receipt of this letter.

Sincerely,

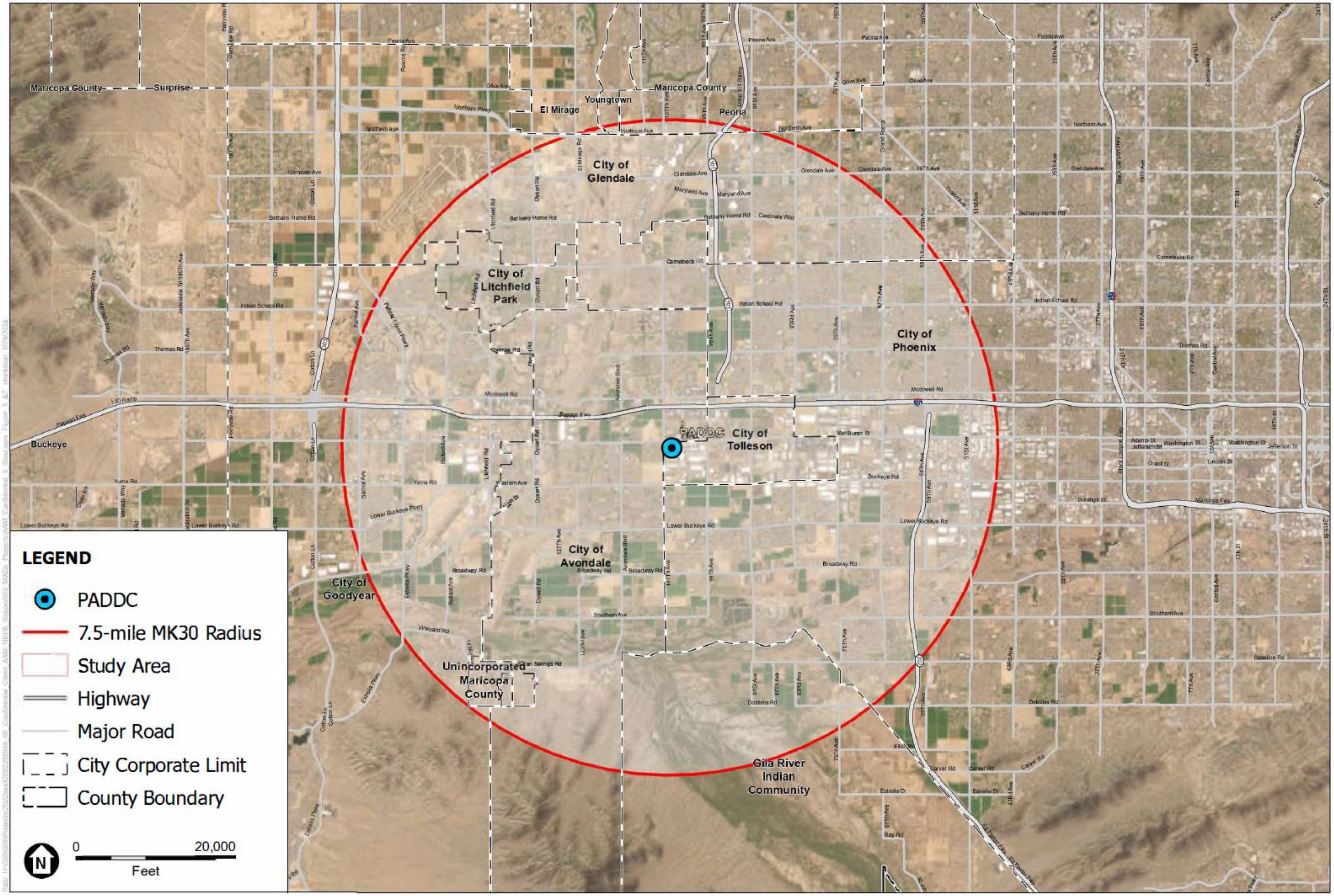
DEREK W HUFTY

Digitally signed by DEREK W HUFTY
Date: 2024.05.06 10:21:56 -04'00'

Derek Hufty
Manager, General Aviation and Commercial Branch (AFS-750)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Enclosure:
Attachment A – Proposed Area of Potential Effects

Attachment A
Proposed Area of Potential Effects



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

ESA

Proposed Area of Potential Effects
Tolleson, AZ

White Mountain Apache Tribe

Office of Historic Preservation
PO Box 1032
Fort Apache, AZ 85926
Ph: (928) 338-3033 Fax: (928) 338-6055

To: Chris Hurst – REM/CEA/CESCO Environmental Protection Specialist

Date: June 04, 2024

Re: *Expansion of FAA Amazon Commercial Unmanned Aircraft System Operation*

…………………………………………………………………………………………

The White Mountain Apache Tribe Historic Preservation Office appreciates receiving information on the project dated; May 24, 2024. In regards to this, please refer to the following statement(s) below.

Thank you for allowing the White Mountain Apache tribe the opportunity to review and respond to the above proposed expansion of Amazon Prime Air's UAS delivery system operation, in Tolleson, Maricopa County, Arizona.

Please be advised, we have reviewed the information provided, we have determined the proposed project plans will have ***"No Adverse Effect"*** to the tribe's traditional cultural resources and/or historic properties. We concur with the proposed project plans.

Thank you for the continued tribal engagement and consultation, and collaborations in protecting and preserving places of cultural and historical importance.

Sincerely,

Mark Altaha

White Mountain Apache Tribe – THPO
Historic Preservation Office

Appendix E
Technical Noise Report

NOISE ASSESSMENT
AMAZON PRIME AIR
MK27-2 UNMANNED AIRCRAFT OPERATIONS AT TOLLESON ARIZONA

Noise Technical Report

May 2024

ESA

NOISE ASSESSMENT
AMAZON PRIME AIR
MK27-2 UNMANNED AIRCRAFT OPERATIONS AT TOLLESON ARIZONA

Noise Technical Report

May 2024

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202200549.03

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1 Introduction

Amazon Prime Air (Prime Air) is proposing to conduct drone delivery operations with the MK30 drone at their distribution hub (the Prime Air Drone Delivery Center, or PADDC) in Tolleson, Arizona. The PADDC is located approximately 1.5 miles west of downtown Tolleson at the intersection of West Van Buren Street and North 107th Avenue, as shown in **Figure 1**. This figure shows the 7.5-mile extent of the drone's operating radius, which corresponds to the project area.

Since the MK30 drone is still under development and final noise data is not yet available, a more conservative approach was taken that uses the MK27-2 noise data to assess potential environmental impacts associated with the Proposed Action. This ensures that the noise impact of the MK30 (which was demonstrated during acoustical testing to be quieter than the MK27-2) falls within the analyzed parameters.

The MK27-2 and MK30 are equipped with a multi-rotor design consisting of six propellers extending horizontally from the central frame with the ability to switch between vertical and horizontal flight. Per the specification from Prime Air, the empty weight of each drone includes the battery, and is 86.6 pounds for the MK27-2 and 77.9 pounds for the MK-30. The maximum allowable takeoff weight is 91.5 pounds for the MK27-2 and 83.2 pounds for the MK-30. The maximum allowable package weight that both drones are certified to carry is 5 pounds. Packages delivered by the UA are transported within an internal cargo bay. An image of the MK27-2 and MK30 drone is shown in **Figure 2** and **Figure 3**, respectively.

As shown in **Table 1**, the flight profiles are similar in nature, in that they both perform a VTOL climb, a transition to fixed-wing flight en route to backyard, transition back to VTOL for descent into the backyard for delivery at 13 feet Above Ground Level (AGL), followed by the same maneuvers to return to the PADDC. Differences between the drones are shown in the manner at which they operate in each phase of flight. A breakdown of each difference is shown in **Table 1** and in **Figure 4** and **Figure 5**.

Prime Air conducted noise measurements from flights in February 2024 to compare noise exposure between each drone. The measured difference in Maximum A-Weighted Level (Lmax)[1] for the MK30 drone during the takeoff and landing phase of flight was between 5 and 7 dB lower than the MK27-2 drone, and the measured Sound Exposure Level (SEL)[2] was lower in all cases for the MK30 when compared to the MK27-2. The measured Lmax for the MK30 drone during the forward flight flyover phase were equivalent or lower when compared to the MK27-2. The difference in Lmax between the MK30 and the MK27-2 is expected to be smaller in the flyover phase versus the takeoff/landing phase. However, given that the MK30 flies faster and higher than the MK27-2 in actual operation, the SEL in operational flyover will still be lower for the MK30 due to the shorter event duration. Overall, the measurement data showed that the MK27-2 has an equivalent or louder noise profile compared to the MK-30 drone. Additional information on the drone comparison, noise measurement methodology, and results can be found in **Attachment A,** ***MK30 to MK27-2 Noise Flight Test Comparison Report***.

[1] Lmax is defined as the maximum, or peak, sound level during a noise event, expressed in decibels. The metric only accounts for the highest A-weighted sound level measured during a noise event, not for the duration of the event.

[2] SEL is defined as the sound energy of a single noise event at a reference duration of one second, expressed in decibels. The sound level is integrated over the period that the level exceeds a threshold. Therefore, SEL accounts for both the maximum sound level and the duration of the sound.

Table 1. Comparison of Typical MK27-2 and MK30 Operational Flight Profiles

Phase of Flight	Altitude (feet AGL)		Ground Speed (knots)		Duration (seconds)	
	MK27-2	MK30	MK27-2	MK30	MK27-2	MK30
Takeoff and Vertical Ascent	Ascent from 0 to 130	Ascent from 0 to 115	0	0	21	15
Transition and Outbound Climb	130 to 160	115 to 200	0 to 52.4	0 to 58.3	20	30
Fixed-wing Outbound Cruise	160	200	52.4	58.3	Variable*	Variable
Delivery Decent and Transition	Descent from 160 to 130	Descent from 200 to 115	52.4 to 0	58.3 to 0	20	30
Backyard Descent	Descent from 130 to 13	Descent from 115 to 13	0	0	32	21
Delivery	13	13	0	0	2	2
Backyard Ascent	Ascent from 13 to 130	Ascent from 13 to 197	0	0	24	26
Transition and Inbound Climb	Ascent from 130 to 160	Ascent from 197 to 345	0 to 52.4	0 to 58.3	20	30
Fixed-wing Inbound Cruise	160	345	52.4	58.3	Variable*	Variable
Landing Descent and Transition	Descent from 160 to 130	Descent from 345 to 197	52.4 to 0	58.3 to 0	20	30
Vertical Descent and Landing	Descent from 130 to 0	Descent from 197 to 0	0	0	38	35

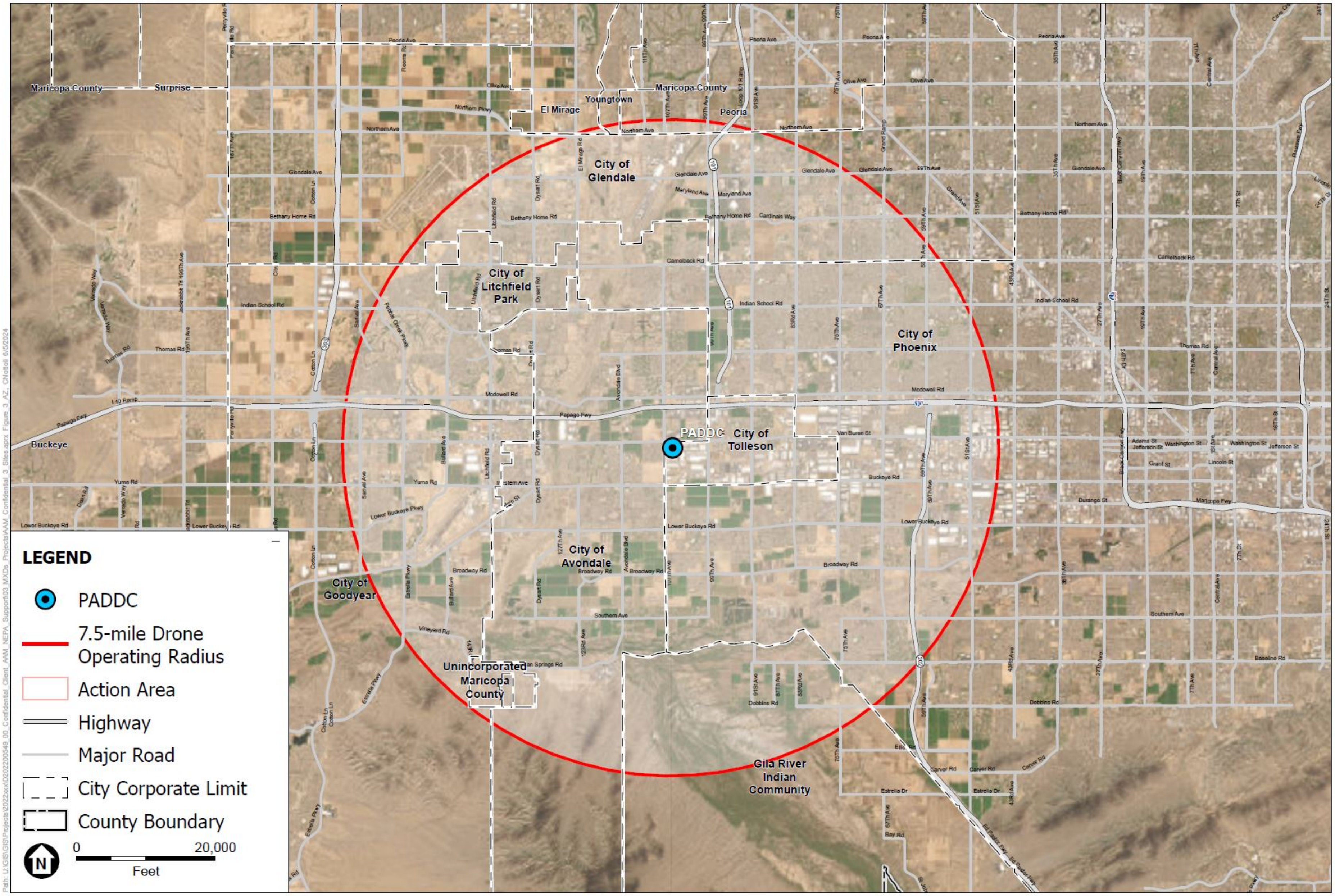
SOURCE: Amazon Prime Air, April 2024

Note: *Duration of fixed-wing flight time varies based on distance to customer.

This document outlines the methodology and estimation of noise exposure expected with the proposed use of Prime Air's drone package delivery operations.[3] The methods presented below are suitable for the evaluation of Federal actions in compliance with the National Environmental Policy Act (NEPA) and other applicable environmental regulations or federal review standards at the discretion and approval of the FAA. In particular, this report is intended to function as a nonstandard equivalent methodology under FAA Order 1050.1F, and therefore requires prior written consent from the FAA's Office of Environment and Energy (AEE) for each project seeking a NEPA determination.[4] The results of the noise analysis are presented in terms of the annual Day-Night Average Sound Level (DNL), considering varying levels of operations for areas at ground level below each flight phase.

[3] *Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air Commercial Package Delivery Operations with the MK30 Unmanned Aircraft (UA) from Tolleson, Arizona,* FAA Office of Environment and Energy, June 2024. (See Attachment B).

[4] See FAA Order 1050.1F, July 16, 2015,
Appendix B, Section B-1.2, for discussion on the use of "equivalent methodology", available online at https://www.faa.gov/documentLibrary/media/Order/FAA_Order_1050_1F.pdf#page=113



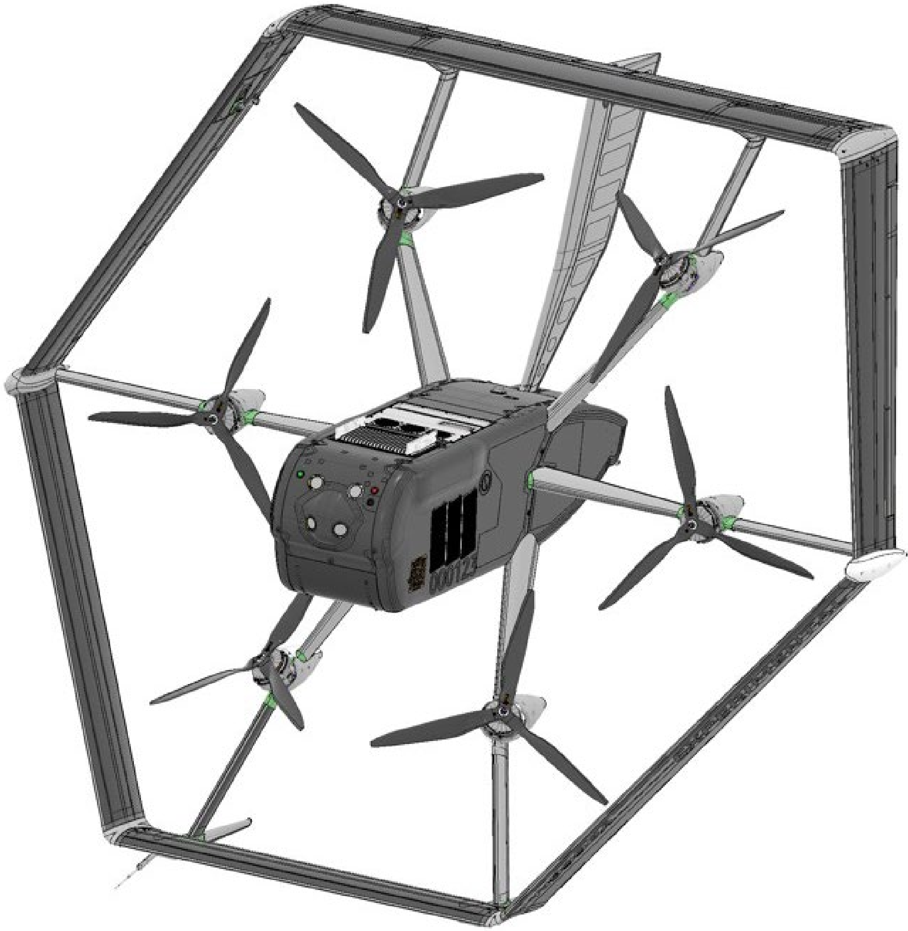
SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

Draft Environmental Assessment for Amazon Prime Air – Tolleson, AZ

Figure 1
Proposed Area of Potential Effects
Tolleson, AZ

ESA

Figure 2. Amazon Prime Air MK27-2 Drone

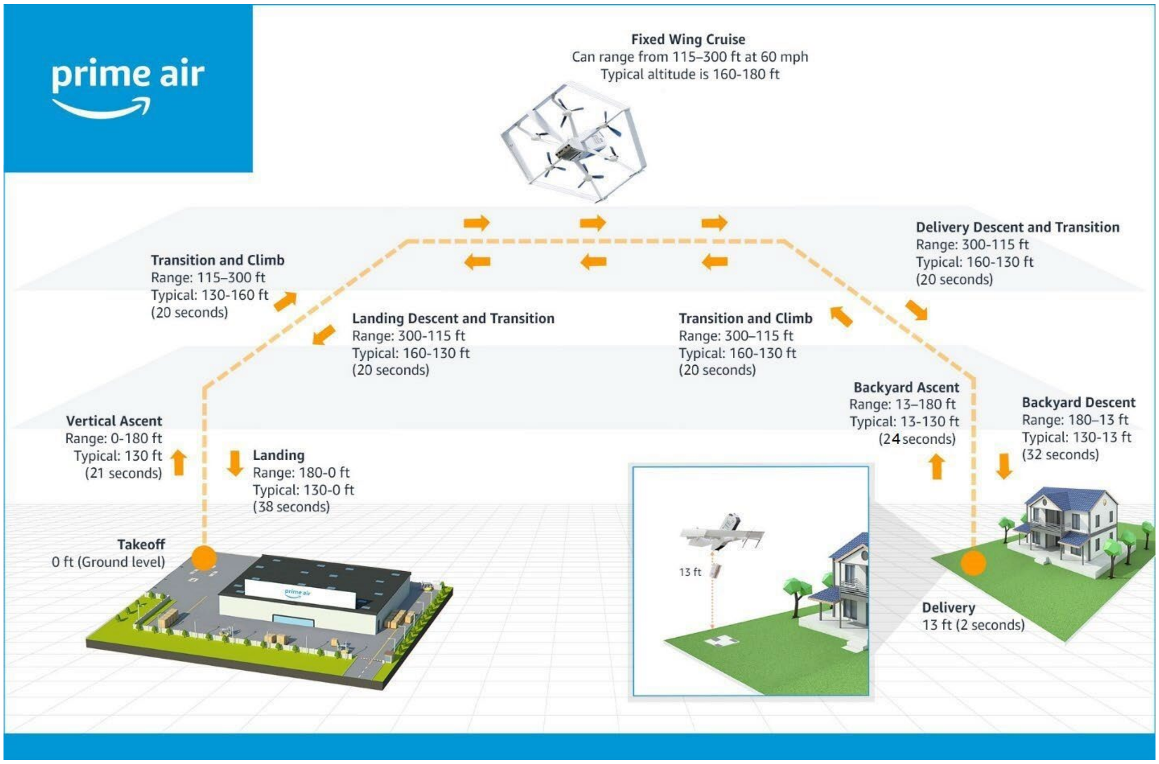


Source: Amazon Prime Air, 2022.

Figure 3. Amazon Prime Air MK30 Drone

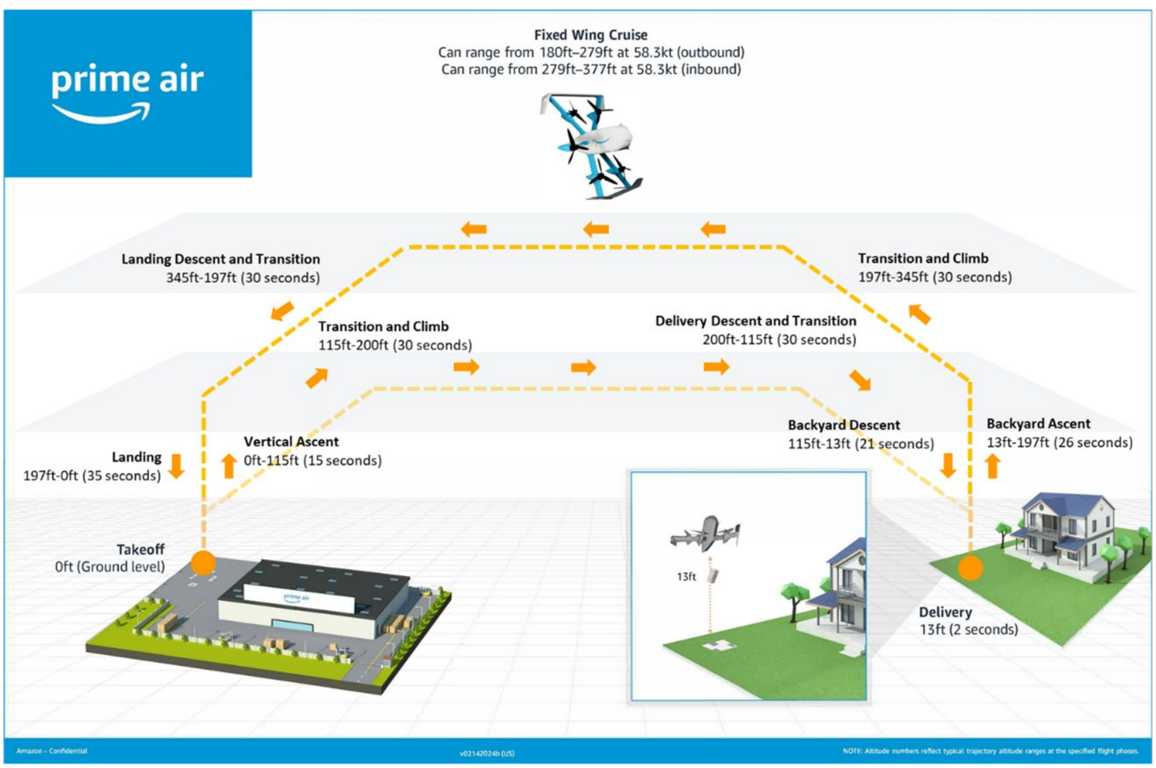
Source: Amazon Prime Air, 2024.

Figure 4. Representative Operational Profile of the MK27-2



Source: Amazon Prime Air, 2022.

Figure 5. Representative Operational Profile of the MK30



2 Drone Delivery Operations

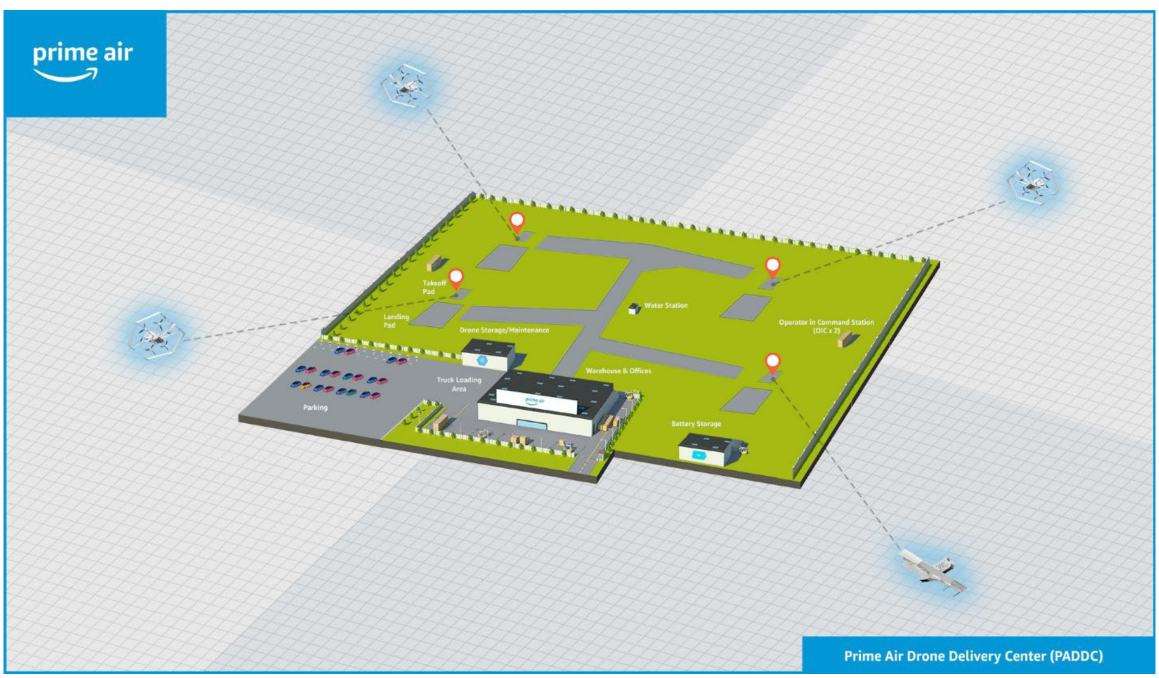
The PADDC and its associated flight routes are determined by 'Prime Air's business and operational needs.

As demonstrated above, MK27-2 is a conservative surrogate to the MK30 through its similar flight profiles and equivalent or louder noise profile. As such, the flight profiles of the MK27-2 are discussed below.

Takeoff pads at the PADDC's are four meters by four meters. Landing pads are eight meters by eight meters. Both pads are contained within a launch area approximately 35 meters by 45 meters. A diagram of a representative PADDC layout is presented in **Figure 6**.

The MK27-2 drone is capable of vertical ascent and descent, hovering, and flying upright with forward-facing propellers for en route travel. Airspeeds during normal en route flight are expected to be approximately 52.4 knots. A typical flight will commence with a vertical ascent from the launch pad to the en route altitude ranging between 160 and 180 feet AGL. The drone then maintains altitude and follows a predetermined route, traveling at 52.4 knots toward the designated delivery point. Upon arrival at the delivery point, the drone decelerates to zero-speed and begins a vertical descent to 13 feet AGL at which time the package is released. The drone will ascend back to en route altitude and accelerate to 52.4 knots along the predetermined route back to the PADDC. Once the drone arrives at the PADDC it will decelerate to zero speed and begin a vertical descent to the landing pad.

Figure 6. Representative PADDC Layout



Source: Amazon Prime Air, 2022.

2.1 Flight Profiles

Flight profiles of drone operations are broken into five general phases: takeoff, transitions to and from vertical and horizontal flight, en route, delivery, and landing. These phases can be combined to represent the typical operational profile of the drone as outlined below. A graphical representation of the operational profile is presented in **Figure 4** and each phase is summarized in **Table 2**.

Takeoff and Vertical Ascent

The drone departs from the launch pad once cleared for takeoff. It will ascend vertically to the en route altitude of between 160 and 180 feet AGL in vertical flight mode.[5]

Transition and Outbound Climb

Upon reaching the en route altitude and while still positioned above the launch pad, the drone transitions from zero speed to its cruise speed of 52.4 knots. This transition is accompanied by a shift from vertical flight mode to horizontal flight mode.

Fixed-wing Outbound Cruise

The drone proceeds to fly at between 160 and 180 feet AGL and 52.4 knots to the delivery point.

Table 2. Representative Operational Profile by Phase of Flight

Phase of Flight	Altitude (feet AGL)	Ground Speed (knots)	Duration (seconds)
Takeoff and Vertical Ascent	Ascent from 0 to 165	0	21
Transition and Outbound Climb	165	0 to 52.4	20
Fixed-wing Outbound Cruise	165	52.4	Variable
Delivery Decent and Transition	165	52.4 to 0	20
Backyard Descent	Descend from 165 to 13	0	32
Delivery	13	0	2
Backyard Ascent	Ascent from 13 to 165	0	24
Transition and Inbound Climb	165	0 to 52.4	20
Fixed-wing Inbound Cruise	165	52.4	Variable
Landing Descent and Transition	165	52.4 to 0	20
Vertical Descent and Landing	Descend from 165 to 0	0	38

SOURCE: FAA, August 2022.

[5] En route altitude is assumed to be 165 feet AGL, corresponding to the measurement data reviewed in FAA's memorandum, *Estimated Noise Levels for Amazon Prime Air MK27-2 UA*, FAA Office of Environment and Energy, August 2022 (See Attachment C).

Delivery Descent and Transition

The drone decelerates from the en route speed of 52.4 knots and transitions to vertical flight mode, where it will be positioned over the delivery point at zero speed.

Backyard Descent, Delivery, and Ascent

The drone begins a vertical descent from en route altitude to 13 feet AGL while maintaining position above the delivery point. Once at 13 feet AGL, the drone drops the package and ascends vertically back to the en route altitude. It's important to note that the nearest allowable proximity of any individual, animal, or other obstacles to the delivery point during this maneuver is 16.4 feet.

Transition and Inbound Climb

Once at the en route altitude and positioned above the delivery point, the drone transitions from zero speed to en route speed while changing from vertical flight to horizontal flight.

Fixed-wing Inbound Cruise

The drone continues to fly at the en route altitude and speed towards the PADDC.

Landing Descent and Transition

The drone decelerates as it approaches the PADDC and transitions from horizontal flight to vertical flight, coming to a zero-speed position over its assigned landing pad.

Vertical Descent and Landing

The drone descends over its assigned landing pad in vertical flight until it touches down and shuts down the motors.

3 Acoustical Data of Flight Profiles

As demonstrated above, MK27-2 is a conservative surrogate to the MK30 through its similar flight profiles and equivalent or louder noise profile. As such, the noise profiles of the MK27-2 are discussed below.

Prime Air conducted noise measurements of the MK27-2 drone in April 2021 at the Pendleton UAS Range located at the Eastern Oregon Regional Airport (KPDT). The FAA processed and analyzed the measurement data and calculated the estimate noise levels for each of the five phases of flight.[6] The following tables show either the A-weighted Sound Exposure Levels (SEL) or formulas to calculate the estimated SELs used for this analysis, which can be matched to each flight phase detailed in **Table 2**. The formula is based on Equation 1 below.

$$eq.1.\ SEL = m\ x\ Log_{10}(d) + b(dB)$$

Where:

- d is the distance along the ground in feet between the drone and receiver
- m and b are parameters provided in the tables below

Table 3 provides parameters to use within Equation 1 to estimate SELs associated with takeoff as a function of distance from the PADDC launch pad to the receiver. **Table 4** provides parameters to use within Equation 1 to estimate SELs associated with landing as a function of distance from the PADDC launch pad to the receiver. **Table 5** provides parameters to use within Equation 1 to estimate the SEL associated with delivery, as a function of distance from the delivery point to the receiver. **Table 6** presents the estimated SELs that correspond to the transition between vertical flight to horizontal flight. The values in this table are for distances relative to the point under the vertical flight path. **Table 6** is applicable to all transition phases discussed in **Section 2.1**. These levels should be integrated with data from appropriate phases of flight (e.g., to estimate maximum possible landing noise, combine the transition noise from **Table 6** with the landing noise from **Table 4**.). Lastly, **Table 7** presents the estimates of en route SEL.

Table 3. Parameters for Estimating Sound Exposure Level for Takeoff versus Distance

Range for d (feet from launch pad)	m	b
32.8 to 49.2	-9.09	109.47
49.2 to 65.6	-16.41	121.86
65.6 to 85.3	-26.39	140.00
85.3 to 142.2	-27.79	142.71
142.2 and greater	-23.39	134.99

SOURCE: FAA, August 2022.

Note: Distance is along ground from launch pad to receiver.

[6] *Estimated Noise Levels for Amazon Prime Air MK27-2 UA,* FAA Office of Environment and Energy, August 2022 (See Attachment C).

Table 4. Parameters for Estimating Sound Exposure Level for Landing versus Distance

Range for d (feet from delivery point)	m	b
32.8 to 49.2	-9.26	108.81
49.2 to 65.6	-8.80	108.05
65.6 to 85.3	-17.1	123.12
85.3 to 142.2	-24.56	137.53
142.2 and greater	-23.39	134.99

SOURCE: FAA, August 2022.
Note: Distance is along ground from launch pad to receiver.

Table 5. Parameters for Estimating Sound Exposure Level for Delivery versus Distance

Range for d (feet from delivery point)	m	b
32.8 to 49.2	-5.85	105.35
49.2 to 65.6	-7.20	107.64
65.6 to 85.3	-16.92	125.3
85.3 to 142.2	-26.31	143.42
142.2 and greater	-21.9	133.91

SOURCE: FAA, August 2022.
Note: Distance is along ground from launch pad to receiver.

Table 6. Estimated Sound Exposure Levels from Transition Phase of Flight Profile at 165 Feet Above Ground Level

Distance from launch pad, landing pad or delivery point (ft)	SEL (dB)
0	69.9
100	70.6
200	70.3
400	69.4
800	68.2
1600	67.7
3200	67.7

SOURCE: FAA, August 2022.

Table 7. Estimates of En Route SEL

Aircraft Configuration	Reference Air Speed (knots)	Reference Altitude (feet AGL)	SEL (dB)
Max Weight	52.4	165	67.7

SOURCE: FAA, August 2022.

4 Methodology

Operations originating from the Tolleson PADDC is expected to occur daily between the hours of 7:00 A.M. and 10:00 P.M. The number of daily and equivalent annual delivery operations is 469 and 171,329, respectively. As previously mentioned, there is not a standardized process for drone noise assessments. Therefore, ESA is applying technical guidance that was previously approved by the FAA Office of Environment and Energy for past analyses. The following subsection outlines this methodology.

4.1 Daytime Equivalent Operations and DNL

As mentioned, results are presented as DNL which applies a 10 dB weighting, or equivalent to 10 time the number of nighttime operations, for operations between 10:00 P.M. and 7:00 A.M. Therefore, the operations near point *i* can be weighted to develop a daytime equivalent number of operations ($N_{equiv,i}$).

$$eq. 2.\ N_{Equiv,i} = W_{Day}\ x\ N_{Day,i} +\ W_{Eve}\ x\ N_{Eve,i} +\ W_{Night}\ x\ N_{Night,i}$$

Where:

- $N_{Day,i}$ is the number of user-specified operations between 7 A.M. and 7 P.M. local time
- $N_{Eve,i}$ is the number of user-specified operations between 7 P.M. and 10 P.M. local time
- $N_{Night,i}$ is the number of user-specified operations between 10 P.M. and 7 A.M. local time
- W_{Day} is the day-time weighting factor, which is 1 operation for DNL
- W_{Eve} is the evening weighting factor, which is 1 operation for DNL
- W_{Night} is the night-time weighting factor, which is 10 operations for DNL

The number of daytime equivalent operations, $N_{DNL,i}$ can be simplified to

$$eq. 3.\ N_{DNL,i} = N_{Day,i} +\ N_{Eve,i} +\ 10\ x\ N_{Night,i}$$

4.2 PADDC Infrastructure

The PADDC at Tolleson accommodates four sets of launch and landing pads. In the context of this noise analysis, it is assumed that only one launch/landing pad is under consideration at a given time. To conservatively represent all operations within the PADDC, including all launch and landing pads, the analysis is focused on the southernmost launch and landing pad that is closest to the noise-sensitive location. Since the precise location of the nearest single launch or landing pad is unknown, the respective PADDC boundary is used for the analysis.

4.3 Application of Acoustical Data

The summation of the SELs in the previous section are used to estimate the DNL for Prime Air's drone operations covered in this report. SEL results are detailed in FAA's Memorandum found in **Attachment C**.

For calculating SEL, five specific activities are considered:

- The drone taking off from the PADDC
- The drone transitioning from either vertical to horizontal flight or horizontal to vertical flight

- En route travel of the drone in horizontal flight between the PADDC and the delivery point
- Delivery
- The drone landing at the PADDC

This analysis is based on the SEL data provided in **Section 3**. **Table 6** displays noise exposure values at distinct increments corresponding to the drone transition profile, ranging from 0 to 3,200 feet. In instances where additional values within this range are required, linear interpolation can be employed to approximate SEL values at intermediary distances. However, extrapolating SEL values for distances less than 32.8 feet during takeoff, landing, or delivery is discouraged due to increased deviations in the estimation method's accuracy as the distance approaches the noise source.

4.3.1 Takeoff

The process for calculating SELs for the takeoff profile is presented in **Section 3**, Equation 1 combined with the parameters presented **Table 3**.

Application of the SEL is based on the position of the southernmost launch pad at a PADDC. However, since the exact location of the launch pad is not known, this analysis uses the outer boundary of the PADDC, at a point closest to the receiver, to be conservative. It should be noted that the SEL values provided do not include the transition to horizontal flight or the acceleration to en route speed that would occur after the climb.

4.3.2 Transitions between Vertical and Horizontal Flight

Table 6 presents noise exposure values SELs for the transition between vertical and horizontal flight. Noise exposure is expressed at discrete increments relative to the drone's ground location for distances from 0 to 3,200 feet. These values are applicable to the drone when it is in level flight at 165 feet AGL and is either accelerating or decelerating within the speed range of 0 to 52.4 knots over a duration of 20 seconds.

4.3.3 En Route

The anticipated flight speed of the drone en route is 52.4 knots at a cruise altitude of 165 feet AGL. Sound exposure level for a given point *i* (*SELi*) with the drone flying directly overhead at altitude (*Alti*) in feet and a ground speed (*Vi*) in knots, is calculated based on the guidance in *14 CFR Part 36 Appendix J, Section J36.205 Detailed Data Correction Procedures*.[7] The equations presented in this section are only applicable for a drone that is moving relative to a stationary receptor. The sound exposure level adjustment for the altitude of a moving drone is presented in Equation 4.

$$Eq. 4.\ \Delta J_1 = 10\ x\ Log_{10} \frac{H_A}{H_T}, dB$$

Where:

- ΔJ_1 is the quantity in decibels that must be algebraically added to the measured SEL in order to estimate the SEL for a level flight path at an altitude differing from the altitude corresponding to the measured SEL.
- H_A is the reference height, in feet, corresponding to the measured SEL.

[7] https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-36.

- H_T is the altitude at which an estimate of the SEL is being made; and the constant (12.5) accounts for the effects on spherical spreading and duration from the off-reference altitude.

Note the value of ΔJ_1 is 0 if H_T is equal to H_A and can be negative if H_T is greater than (higher altitude) than H_A.

The sound exposure level adjustment for speed is presented in Equation 5.

$$Eq.5.\ \Delta J_3 = 10\ x\ Log_{10} \frac{V_R}{V_{RA}}, dB$$

Where:

- ΔJ_3 is the quantity in decibels that must be algebraically added to the measured SEL noise level to estimate the SEL of the drone at speed V_{RA} when the measured SEL corresponds to the drone traveling at a reference speed V_R.

This adjustment accounts for how the varying speed impacts the duration of the overflight at the stationary receptor.

As shown in **Table 7**, the SEL is 67.7 dB when the drone is at maximum weight, at 165 feet from the stationary receiver and traveling at approximately 52.4 knots. Using the maximum weight (outbound) en route condition when the drone is operating at an altitude of Alt_i feet (AGL) and ground speed of V_i knots can be made using Equation 6 to arrive at an estimate SEL_{max} weight dB for that respective phase of flight.

$$Eq.6.\ SEL_{Max} = 67.7 + 12.5\ x\ Log_{10} \frac{165}{Alt_i} + Log_{10} \frac{52.4}{V_i}, dB$$

For this analysis, it was assumed that Equation 6 is applicable for all en route activity to ensure a conservative assumption for drone flyovers at 165 feet AGL.[8]

4.3.4 Delivery

The available SELs to be applied for the delivery phase in Equation 1 are presented in **Table 5**. The SELs are based on the distance of the receiver relative to the position of the delivery point. The minimum distance used for calculation between the delivery point and a person is 16.4 feet.[9] The values in **Table 5** are valid for distances from the delivery point of 32.8 feet or greater. SEL values for distances of between 16 and 32.8 feet are adjusted by distance to the delivery point and sound level adjustment of a stationary source as provided by Equation 7.

$$Eq.7.\ SEL_{Delivery} = 96.5 + 12.5\ x\ Log_{10} \frac{32.8}{Distance\ from\ Delivery\ Point\ (ft)}$$

The SEL values in **Table 5** do not provide the noise contribution from the horizontal flight associated with either the drone transitioning from en route speed to vertical flight before delivery, or the transition between vertical flight to en route speed after delivery. The SEL values only include descent

[8] *Estimated Noise Levels for Amazon Prime Air MK27-2 UA*, FAA Office of Environment and Energy, August 2022 (See Attachment C)

[9] Prime Air's safety guidance stipulates that there should not be a person, animal or object within 5 meters of the delivery point, and if the drone detects a person, animal or object within 5 meters of the delivery point, it will abort the delivery.

from en route altitude to delivery altitude, various maneuvers associated with the delivery, and climb back to en route altitude.

4.3.5 Landing

The available SELs to be applied for the landing profile in Equation 1 are presented in **Table 4**. Application of the SEL is based on the location of the southernmost landing pad at a PADDC. However, since the exact landing pad is not known, using an outer boundary of the PADDC, at a point closest to the receiver, provides a conservative approach. It should be noted that the SEL values provided only include descent from en route altitude and do not include the deceleration from en route speed or transition to vertical flight that would occur after descent.

4.4 DNL Estimation Methodology

The number of operations flying over a specific receiver's ground location will fluctuate depending on the proposed operating area and demand. For a given receiver location, i, and a single instance of sound source, A, the SEL for that sound source SEL_{iA} is (energy) summed for the average annual daily number of DNL daytime equivalent operations ($N_{DNL,iA}$) to compute the equivalent DNL in Equation 8.

$$Eq. 8.\ DNL_{iA} = SEL_{iA} + 10\ x\ \ Log_{10}\left(N_{DNL,iA}\right) - 49.4, dB$$

The above equation applies to an SEL value representing one noise source such as a drone takeoff or landing. For cases where a receiver would be exposed to multiple noise sources (e.g. takeoff, transiting, en route, and departure), the complete DNL at that point was calculated with Equation 9.

$$Eq. 9.\ DNL_i = 10\ x\ \ Log_{10}\left(10^{\left(\frac{DNL_{ia}}{10}\right)} + 10^{\left(\frac{DNL_{ib}}{10}\right)} + \cdots + 10^{\left(\frac{DNL_{iz}}{10}\right)}\right), dB$$

For each of the conditions presented below, results are presented in tabular format based on the equivalent daytime operations, in DNL daytime equivalent, for the estimated DNL. The proper output of DNL is dependent on the calculation of respective daytime equivalent operations.

4.4.1 DNL at PADDC

The takeoff and landing operations are anticipated to occur at the one Pad for this analysis. Therefore, the results at PADDC will be calculated for a single set of receptors. Operations were assumed to takeoff and land along the same flight path.

Takeoff operations are represented by two sound levels. The drone will takeoff and climb to en route altitude as discussed in Section 2. The drone will then begin en route flight by transitioning from vertical flight to horizontal flight and accelerating to en route speed of 52.4 knots.

Landing operations are also represented by two sound levels. The drone flies to the PADDC at en route altitude while slowing down and transitions from horizontal to vertical flight as described in Section 2. Then the drone descends from en route altitude to the ground and shuts down.

The four noise sources representing the complete takeoff and landing cycle associated with a single delivery departing and returning at the PADDC were added together using Equation 9.

4.4.2 DNL for En Route

A receiver will be positioned directly under the flight path, and the DNL will be calculated based on the altitude and speed-adjusted delivery SEL calculated in Section 3. The number of operations would be based on relevant materials and assume that a drone directly overflies the receiver while at maximum weight for both outbound and inbound for a single delivery. The en route outbound and inbound noise level are added together with Equation 9.

4.4.3 DNL for Delivery Points

Delivery operations will be represented by three sound levels. The first sound level is represented by the deceleration of the drone from en route speed and transitioning from horizontal flight to vertical flight over the delivery point at the en route altitude of 165 ft. The second sound level is represented by the delivery phase where the package is dropped at the delivery point. The first sound level is represented by the drone's transition from vertical flight to horizontal flight after reaching the en route altitude of 165 feet AGL and accelerating to en route speed. The three sound levels are added together with Equation 9.

5 Estimated Noise Exposure

This section outlines the estimated noise exposure for Prime Air's proposed operations for any given number of average annual day (AAD) deliveries. Results are based off the estimated number of DNL equivalent deliveries associated with the PADDC and presented in tabular format. Prime Air expects to conduct 469 daily deliveries, which per note B in **Table 8**, the average daily deliveries rounds to 480. Deliveries will not occur during nighttime hours (10 P.M. – 7 A.M.). Note that one delivery includes the outbound takeoff and inbound landing and is representative of two operations.

The DNL equivalent deliveries, $N_{DNL,i}$ as described in Section 4.1, is presented below as Equation 10.

$$Eq. 10.\ Deliveries_{DNL,i} = Deliveries_{Day} + 10\ x\ Deliveries_{Night}$$

$Deliveries_{Day}$ are between 7 A.M. and 10 P.M. and $Deliveries_{Night}$ are between 10 P.M. and 7 A.M. If a portion of a delivery (either takeoff or landing) occurs in the nighttime hours, then it is counted within $Deliveries_{Night}$. If a portion of a delivery (either takeoff or landing) occurs in two time periods, then it should be counted within $Deliveries_{Night}$ for a more conservative approach.

For estimating noise exposure, the noise levels for each flight phase are considered separate based on the level of proposed operations for a given location. When a particular receptor is at the transition of different flight phases, the cumulative noise exposure is then determined by adding the noise from each phase.

5.1 Noise Exposure for Operations at the PADDC

For operations at the PADDC, noise generated by the drone includes takeoff, landing, and transitions from vertical to fixed-wing horizontal flight within the corresponding en route flight phases. It was assumed that all operations follow the same en route flight path, with outbound and inbound flights traversing it in opposing directions for a conservative approach.

Table 8 presents data for the number of average daily DNL equivalent deliveries (including the takeoff and climb, transition to en route outbound, transition from en route inbound, and descent and landing as detailed in Section 2. The table provides the estimated extent of DNL 45 dB, 50 dB, 55 dB, 60 dB, and 65 dB contours under the flight path for the PADDC. The analyses presented were rounded up conservatively to the nearest interval available from the data from Section 3, out to 3,500 feet.

Table 8. Estimated Extent of Noise Exposure from PADDC per Number of Deliveries

Number of DNL Equivalent Deliveries		Estimated Extent of Exposure (feet)				
Average Daily	**Annual**	**DNL 45**	**DNL 50**	**DNL 55**	**DNL 60**	**DNL 65**
<= 1	<= 365	75	32.8	32.8	32.8	32.8
<= 5	<= 1,825	150	100	50	32.8	32.8
<= 10	<= 3,650	250	150	75	32.8	32.8
<= 15	<= 5,475	250	150	100	50	32.8
<= 20	<= 7,300	300	200	100	75	32.8
<= 40	<= 14,600	450	250	150	100	32.8
<= 60	<= 21,900	550	300	200	100	75
<= 80	<= 29,200	650	350	200	150	75
<= 100	<= 36,500	750	400	250	150	75
<= 120	<= 43,800	850	400	250	150	100
<= 140	<= 51,100	1000	450	250	150	100
<= 160	<= 58,400	1150	500	300	150	100
<= 180	<= 65,700	1400	500	300	200	100
<= 200	<= 73,000	1650	550	300	200	100
<= 220	<= 80,300	2650	600	300	200	100
<= 240	<= 87,600	Note 3	600	350	200	150
<= 260	<= 94,900	Note 3	650	350	200	150
<= 280	<= 102,200	Note 3	700	350	200	150
<= 300	<= 109,500	Note 3	700	350	200	150
<= 340	<= 124,100	Note 3	800	400	250	150
<= 360	<= 131,400	Note 3	800	400	250	150
<= 380	<= 138,700	Note 3	850	400	250	150
<= 400	<= 146,000	Note 3	900	450	250	150
<= 420	<= 153,300	Note 3	950	450	250	150
<= 440	<= 160,600	Note 3	1000	450	250	150
<= 460	<= 167,900	Note 3	1050	450	250	150
<= 480	<= 175,200	Note 3	1100	450	250	150
<= 500	<= 182,500	Note 3	1,150	500	300	150

SOURCE: ESA, 2024.

Notes:

1. One delivery accounts for the outbound takeoff and inbound landing and is representative of two operations.
2. If a value for deliveries is not specifically defined in this table, use the next highest value. For example, if there are 50 average daily DNL equivalent deliveries, use the entry for 60 average daily DNL equivalent deliveries.

3 The DNL noise level noted extends more than 3,500 feet from the PADDC based on the level of operations specified as the aircraft continues along its en route flight path. En route results in Section 5.2 may be more applicable in these instances for determining noise levels.

5.2 Noise Exposure under En Route Paths

When the drone is en route it is expected to fly the same outbound flight path between the PADDC and the delivery point and inbound flight path back to the PADDC. Therefore, each receiver under the en route path would experience two overflights for each delivery served by the corresponding en route flight path.

Table 9 provides the estimated DNL for a receiver on the ground directly under an en route path for various counts of daily average DNL equivalent deliveries. The en route noise calculated for each delivery includes both the inbound and outbound traversal of the en route path at 165 feet AGL and a ground speed of 52.4 knots.

The drone may overfly locations at operational levels that differ from both an inbound and outbound traversal of the en route path by the drone as described above and presented in **Table 9**. For these circumstances, **Table 10** presents the equations for calculating the estimated DNL for a receiver directly under a specified given number of DNL equivalent average daily individual overflights, defined as N_o.

Table 9. Estimated Noise Exposure Directly Under En Route Flight Paths

Number of DNL Equivalent Deliveries		
Average Daily	Annual	DNL
<= 1	<= 365	21.3
<= 5	<= 1,825	28.3
<= 10	<= 3,650	31.3
<= 15	<= 5,475	33.1
<= 20	<= 7,300	34.4
<= 40	<= 14,600	37.4
<= 60	<= 21,900	39.1
<= 80	<= 29,200	40.4
<= 100	<= 36,500	41.3
<= 120	<= 43,800	42.1
<= 140	<= 51,100	42.8
<= 160	<= 58,400	43.4
<= 180	<= 65,700	43.9
<= 200	<= 73,000	44.4
<= 220	<= 80,300	44.8
<= 240	<= 87,600	45.1
<= 260	<= 94,900	45.5
<= 280	<= 102,200	45.8
<= 300	<= 109,500	46.1
<= 340	<= 124,100	46.7
<= 360	<= 131,400	46.9
<= 380	<= 138,700	47.1
<= 400	<= 146,000	47.4
<= 420	<= 153,300	47.6
<= 440	<= 160,600	47.8
<= 460	<= 167,900	48.0
<= 480	<= 175,200	48.2
<= 500	<= 182,500	48.3

SOURCE: ESA, 2024.

Table 10. Estimated Noise Exposure Directly Under Overflights

Altitude of Overflight	SEL for One Overflight (dB)	DNL for One Overflight Between 7 A.M. and 10 P.M. (dB)	DNL Equation for the Number of DNL Equivalent Overflights
115 feet AGL	69.7	20.3	$10 \times \log_{10}(No) + 20.3$
160 feet AGL	67.9	18.5	$10 \times \log_{10}(No) + 18.5$
165 feet AGL	67.7	18.3	$10 \times \log_{10}(No) + 18.3$
180 feet AGL	67.2	17.9	$10 \times \log_{10}(No) + 17.9$
300 feet AGL	64.5	15.1	$10 \times \log_{10}(No) + 15.1$
N Feet AGL	$12.5 \times \log_{10}(165/N_{ft}) + 67.7$	$SEL_1 – 49.4$	$10 \times \log_{10}(No) + DNL_1$

SOURCE: ESA, 2024.

Notes:

1. The DNL value for a given number of average DNL Equivalent Operations, N_o, can be found by using the equations associated with operation of the drone at a specified altitude and speed interval. In this case, one operation represents a single overflight.
2. All values in this table are for level flight at maximum weight and 52.4 knots.

5.3 Noise Exposure for Operations at Delivery Point

Table 11 presents the estimated DNL values for a range of potential daily average DNL equivalent delivery counts at a delivery point. Also included in **Table 11** is the equation for calculating the estimated DNL for a specific number of daily average DNL equivalent delivery counts at a delivery point, defined as N_d, for instances where the number of deliveries may fall between the range of presented delivery count intervals.

The DNL values include the transition from en route speed to vertical flight at en route altitude, the delivery maneuver, and the transition from vertical flight at en route altitude to en route speed as discussed in Section 4.4.3. The minimum listener distance is 16.4 feet from the delivery point and corresponds to minimum distance between a person and delivery point. Values are also presented at 32.8 feet from the delivery point which corresponds to minimum distance from the available measurement data and analysis presented by FAA. Values were also calculated at distances of 50 feet, 75 feet, 100 feet, and 125 feet from the delivery point and are representative of distances from which nearby properties may experience noise from a delivery.[10]

[10] The 2022 US Census national average lot size for single-family sold homes was 15,265 square feet. This is representative of a property with dimensions of a 123.55 x 123.55-foot square. 125 feet represents a 125-foot lateral width of the parcel rounded up to the nearest 25 feet. https://www.census.gov/construction/chars/ See file "Soldlotsize_cust.xls" sheet MALotSizeSold. Accessed January 18, 2024.

Table 11. Estimated Noise Exposure at Various Distances from a Delivery Point per Number of DNL Equivalent Deliveries

Average Daily Deliveries	Annual Deliveries	DNL at 16.4 feet[1]	DNL at 32.8 feet[2]	DNL at 50 feet	DNL at 75 feet	DNL at 100 feet	DNL at 125 feet
<= 1	<= 365	51.0	47.2	46.1	44.3	41.6	39.1
<= 5	<= 1,825	57.9	54.2	53.1	51.3	48.6	46.1
<= 10	<= 3,650	61.0	57.2	56.1	54.3	51.6	49.1
<= 15	<= 5,475	62.7	58.9	57.9	56.1	53.3	50.8
<= 20	<= 7,300	64.0	60.2	59.1	57.3	54.6	52.1
<= 40	<= 14,600	67.0	63.2	62.1	60.3	57.6	55.1
<= 60	<= 21,900	68.7	65.0	63.9	62.1	59.3	56.9
<= 80	<= 29,200	70.0	66.2	65.1	63.3	60.6	58.1
<= 100	<= 36,500	71.0	67.2	66.1	64.3	61.6	59.1
<= 120	<= 43,800	71.7	68.0	66.9	65.1	62.4	59.9
<= 140	<= 51,100	72.4	68.6	67.6	65.8	63.0	60.5
<= 160	<= 58,400	73.0	69.2	68.2	66.3	63.6	61.1
<= 180	<= 65,700	73.5	69.7	68.7	66.9	64.1	61.6
<= 200	<= 73,000	74.0	70.2	69.1	67.3	64.6	62.1
<= 220	<= 80,300	74.4	70.6	69.5	67.7	65.0	62.5
<= 240	<= 87,600	74.8	71.0	69.9	68.1	65.4	62.9
<= 260	<= 94,900	75.1	71.3	70.3	68.5	65.7	63.2
<= 280	<= 102,200	75.4	71.7	70.6	68.8	66.0	63.6
<= 300	<= 109,500	75.7	72.0	70.9	69.1	66.3	63.9
<= 340	<= 124,100	76.3	72.5	71.4	69.6	66.9	64.4
<= 360	<= 131,400	76.5	72.8	71.7	69.9	67.1	64.6
<= 380	<= 138,700	76.8	73.0	71.9	70.1	67.4	64.9
<= 400	<= 146,000	77.0	73.2	72.1	70.3	67.6	65.1
<= 420	<= 153,300	77.2	73.4	72.4	70.5	67.8	65.3
<= 440	<= 160,600	77.4	73.6	72.6	70.7	68.0	65.5
<= 460	<= 167,900	77.6	73.8	72.7	70.9	68.2	65.7
<= 480	<= 175,200	77.8	74.0	72.9	71.1	68.4	65.9
<= 500	<= 182,500	77.9	74.2	73.1	71.3	68.6	66.1

SOURCE: ESA, 2024.

Notes:

1. Minimum possible listener distance from drone.
2. Minimum measured distance to listener from drone.
3. The DNL values presented in this table only reflect the drone conducting descent and climb flight maneuvers associated with a delivery. DNL values associated with en route flight to and from a PADDC to a delivery point associated with a delivery, or nearby en route overflights, should be added to these values utilizing the DNL presented in Table 9.
4. If a value for deliveries is not specifically defined in this table, use the next highest value. For example, if there are 50 average daily DNL equivalent deliveries, use the entry for 60 average daily DNL equivalent deliveries.

6 Results

The DNL 50-, 55-, 60-, and 65-dB contours for Proposed Action are presented in **Figure 7**. These contours represent the 24-hour drone noise exposure to areas surrounding the Tolleson PADDC on an average annual day. Note that the DNL 65 dB contour does not extend beyond the Prime Air property line and is expected that no noise impacts to non-compatible land uses would occur.

As described Section 4.3.1, the drone is expected to fly the same outbound flight path between the PADDC and the delivery point and inbound flight path back to the PADDC. While the average daily deliveries from the PADCC is 469, the number of overflights in a day will be dispersed because the PADCC is centrally located in the proposed operating area and delivery locations would be distributed throughout the proposed operating area. A conservative estimate for the maximum number of overflights over any one location would not be anticipated to exceed half, or 235 daily overflights, which would result in en route noise levels of DNL 45.1 dB at any location within the action area. The en route overflight noise exposure is determined by referencing **Table 9**

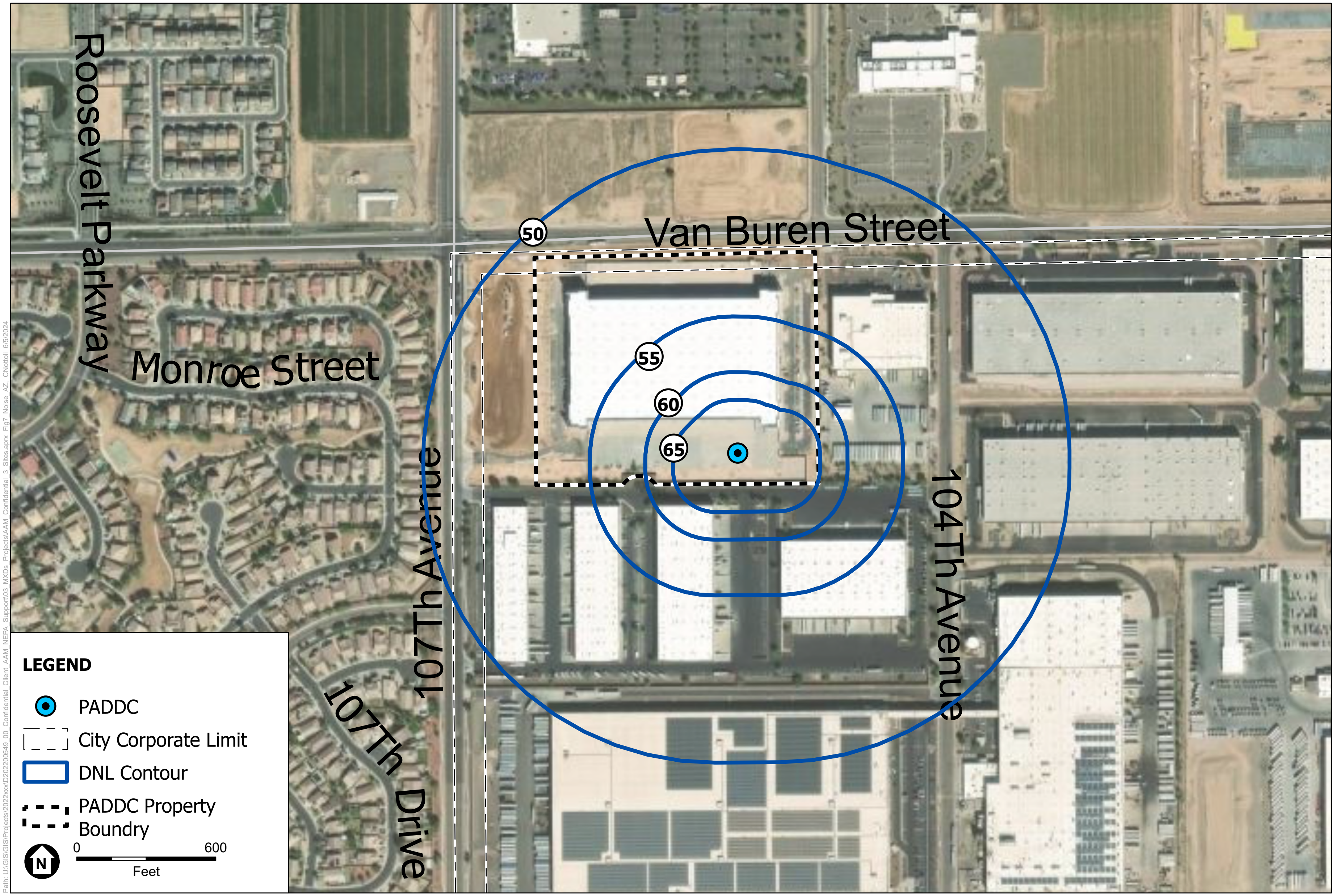
Due to the inherent uncertainty of the exact delivery site locations, the noise analysis developed a minimum and maximum representative distribution of deliveries in the action area. The noise analysis conservatively assumes the minimum and maximum distribution of average daily deliveries that could occur at a single delivery location. The distribution of average annual daily deliveries ranges from 0.1 to 4.0 deliveries per operating day. The resulting DNL values, provided in **Table 12**, include the descent and climb flight maneuvers associated with a delivery. The noise exposure for delivery operations also includes the en route overflight at the typical operating altitude of 165 feet AGL as presented in **Table 9** and discussed above. The resulting noise exposure for delivery site locations is DNL 58.1 dB. Noise exposure from deliveries is shown graphically in **Figure 8**. The noise exposure is depicted over the PADDC but is only representative of a maximum of five deliveries at any one delivery point.

Table 12. DNL for Delivery Locations Based on Maximum Deliveries Per Location

Average Daily DNL Equivalent Deliveries	Annual DNL Equivalent Deliveries	Estimated Delivery DNL at 16 Feet[1]	Estimated Delivery DNL at 32.8 Feet[2]	Estimated Delivery DNL at 50 Feet	Estimated Delivery DNL at 75 Feet	Estimated Delivery DNL at 100 Feet	Estimated Delivery DNL at 125 Feet
≤5	≤1,825	58.1	54.7	53.7	52.2	50.2	48.6

NOTES:
1. Minimum possible listener distance from drone.
2. Minimum measured listener distance.
3. Assumes conservative estimate of 235 overflights over any one delivery location as mentioned above.

SOURCE: ESA, 2024.



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

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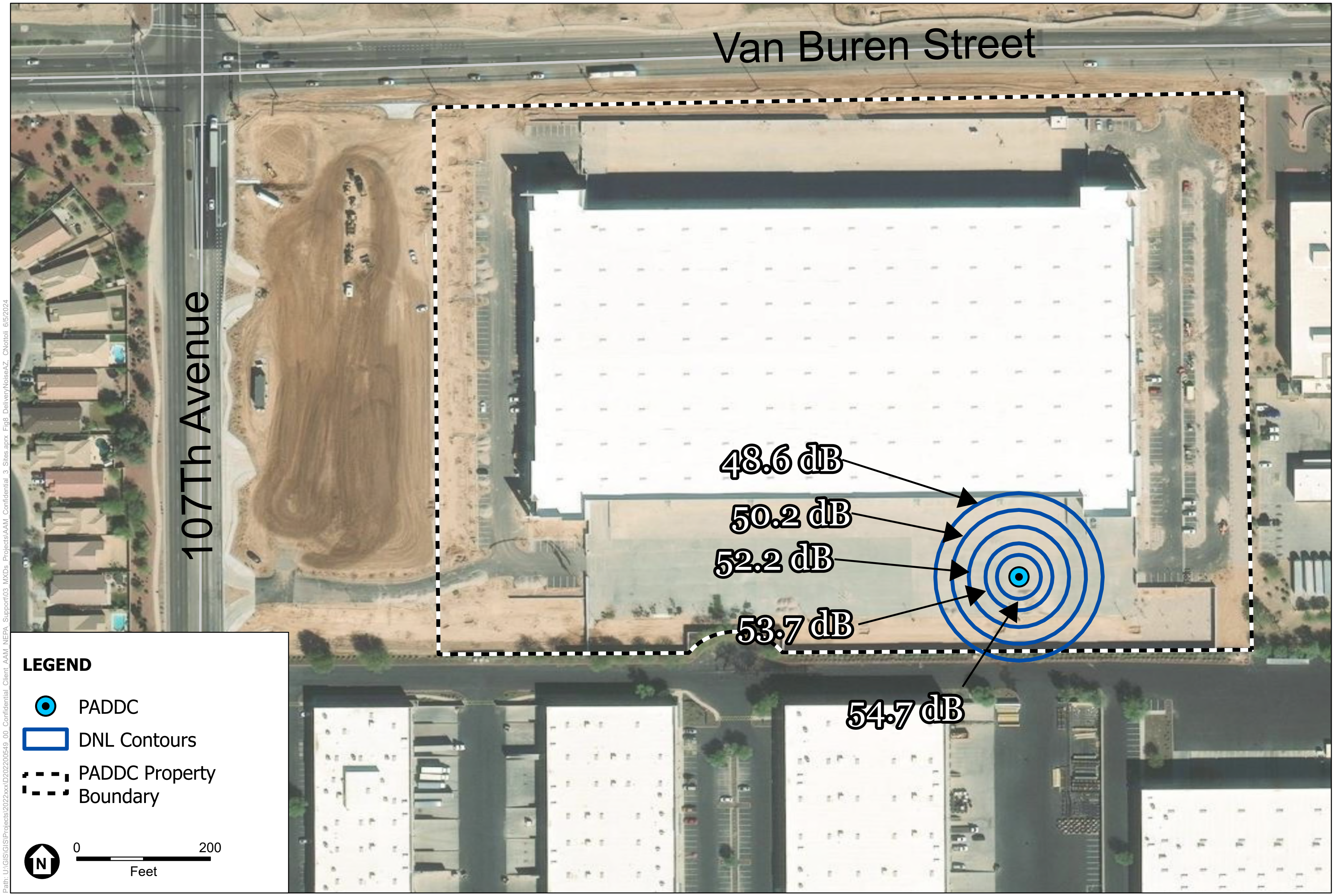
Figure 7
PADDC Noise Exposure Contours
Tolleson, AZ

ESA



SOURCE: ESA, 2023; Maxar, 2022; County of Maricopa, 2023; Maricopa Association of Governments, 2023.

Figure 8
Noise Exposure Contours Based on Maximum Deliveries Per Location
Tolleson, AZ

ESA

6.1 Cumulative Noise

It is necessary to evaluate the cumulative noise exposure that would result from other aviation noise sources present in Tolleson. This may occur in the vicinity of Phoenix-Goodyear Airport (KGYR), located approximately 4.5 miles west of the PADDC, Glendale Municipal Airport (KGEU), located approximately 5 miles north of the PADDC, or Luke Air Force Base (KLUF) approximately 7 miles to the northwest of the PADDC.

FAA has an established noise significance threshold, defined in FAA Order 1050.1F Environmental Impacts: Policies and Procedures and the associated 1050.1F Desk Reference, which is used when assessing noise impacts in a particular project area that are considered reportable and/or significant. A significant noise impact is defined as an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure or a noise exposure at or above the 65 dB level due to a DNL 1.5 dB or greater increase. For example, an increase from DNL 63.5 dB to 65.0 dB is considered a significant impact.

FAA Order 1050.1F requires additional reporting where the action area is larger than the immediate vicinity of an airport. These noise exposure assessments should identify where noise will change by the following specified amounts:

- For DNL 65 dB and greater: +1.5 dB ("Significant" impact)
- Between DNL 60 dB to <65 dB: +3 dB ("Reportable" impact)
- Between DNL 45 dB to <60 dB: +5 dB ("Reportable" impact)

Each aforementioned airport, which is located in a portion of the drone's proposed area of operations, operates with controlled surface area Class D airspace. For areas where the drone operating area does not overlap with each Class D airspace, there would be little potential for the cumulative effect of traditional aircraft noise combined with drone noise. Based on calculations presented in **Table 13**, the potential for noise and compatible land use cumulative effects could result from drones and traditional aircraft operating within an airport's DNL 55 dB contour (overlapping inside Class D airspace). However, the potential for cumulative effects would be minimized because Amazon Prime Air's PADDC is not located near the vicinity of any airports DNL 55 dB contour[11,12,13,14].

Prime Air's delivery route planning would take into account air traffic to avoid dense airspace restrictions such as airport runways. This would help avoid potential noise cumulative effects of the air traffic near each airport. There are no other known Part 135 commercial drone package delivery operators conducting operations in proximity to Amazon Prime Air's proposed MK30 operations area or PADDC, which is located in an area zoned for commercial activities. As such, the addition of Amazon Prime Air's commercial delivery service is not expected to result in cumulative effects with other potential Part 135 commercial drone operations. Any future Part 135 operators would be required to complete an environmental review before beginning operations, ensuring that any

[11] Good Year Airport Disclosure Map: https://azre.gov/sites/default/files/AirportMaps/Public_Airports/Phoenix_Goodyear_Airport_Noise&Traffic.pdf. Accessed: May 2, 2024.

[12] Glendale Disclosure Maps, https://cdnsm5-hosted.civiclive.com/UserFiles/Servers/Server_15209001/File/Departments/Airport/Public%20DisclosureglnPADM8x11.pdf. Accessed: May 2, 2024.

[13] Luke AFB Disclosure Map: https://assets.pubpub.org/lqz96eru/21523983199201.pdf. Accessed: May 2, 2024.

[14] Disclosure maps present DNL contours based on data on or before 2015. While the DNL 60 dB extends several thousand feet from the main runway ends at each airport, it can be expected that the current fleet operating at the airport would result in a smaller noise exposure due to changes in fleet mix. As such, it was assumed that drone activity could be possible within the DNL 55 dB

potential cumulative effects are properly analyzed and disclosed, and the appropriate siting of potential drone operating facilities would be considered to avoid a significant impact on the environment. Therefore, no significant cumulative noise impacts are expected.

Table 13. Potential Cumulative Noise Exposure

Noise Source	Description	DNL (dB)	Energy $10^{(DNL/10)}$	Combine Noise Sources in DNL (dB)
1	Proposed Action[1]	58.1	645654.2	-
2	Airports within Action Area	55.0	316227.8	-
1+2	Proposed Action + Airports	-	961882.0	59.8
Delta	Change in Cumulative Noise	-	-	4.8

SOURCE: ESA, 2024.

Notes:

1. Proposed Action DNL based off exposure at delivery site location to assume conservative estimates.

Attachment A

MK30 to MK27-2 Noise Flight Test Comparison Report

REVISION LOG

Revision Number	Notes	Author [First and last name + Alias]	Date Released [YYYY-MM-DD]
1	Initial revision	Arvin Shajanian	2024-04-16

APPROVING AUTHORITY

Amazon Approvals ID	Name [First and last name]	Role
28010954	Tonya Del Maestro	Regulatory
	Arvin Shajanian	Flight Sciences

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1. INTRODUCTION

This document contains the data gathered during the noise flight test campaign performed in February 2024. The purpose of the testing was to provide noise profiles of the MK27-2 drone and the MK30 drone when flown back-to-back under the same environmental conditions to demonstrate that the MK30 is quieter than the MK27-2. This enables the use of previously collected MK27-2 National Environmental Policy Act (NEPA) noise data for the NEPA assessment of the MK30 drone for operations at College Station, TX and Tolleson, AZ. The results from this test campaign demonstrate that the MK30 is equivalent or quieter when compared to the MK27-2, which supports the use of the MK27-2 noise data as a more conservative representation of the MK30 noise profile for NEPA evaluation of MK30 operations. The MK27-2 and MK30 flight profiles are similar in nature, in that they both perform a VTOL climb, a transition to fixed-wing flight en route to the customer backyard, transition back to VTOL for descent into the backyard area for delivery at 4m (12 feet) Above Ground Level (AGL), followed by the same maneuvers to return to the Prime Air Drone Delivery Center (PADDC). The difference between these profiles is that the MK30 flies higher and faster than the MK27-2, which contributes to the reduction of the overall Sound Exposure Level (SEL) for the MK30. A comparison of the typical operational flight parameters can be seen below in Table 1. Additionally, a comparison of the MK27-2 and MK30 flight profiles can be seen below in Figure 1. Note that these are the flight profiles for operational flights and not the flight test profiles for this noise flight test campaign. The data gathered during this testing, detailed in section 3, was collected with both the MK27-2 and the MK30 flying at similar AGLs between 31 and 44 meters (102 to 145 feet), in order to review the data at a consistent distance.

Phase of Flight	Altitude (feet AGL)		Ground Speed (knots)		Duration (seconds)	
	MK27-2	MK30	MK27-2	MK30	MK27-2	MK30
Takeoff and Vertical Ascent	Ascent from 0 to 130	Ascent from 0 to 115	0	0	21	15
Transition and Outbound Climb	130 to 160	115 to 200	0 to 52.4	0 to 58.3	20	30
Fixed Wing Outbound Cruise	160	200	52.4	58.3	Variable*	Variable*
Delivery Descent and Transition	Descent from 160 to 130	Descent from 200 to 115	52.4 to 0	58.3 to 0	20	30
Backyard Descent	Descent from 130 to 13	Descent from 115 to 13	0	0	32	21
Delivery	13	13	0	0	2	2
Backyard Ascent	Ascent from 13 to 130	Ascent from 13 to 197	0	0	24	26
Transition and Inbound Climb	Ascent from 130 to 160	Ascent from 197 to 345	0 to 52.4	0 to 58.3	20	30
Fixed-wing Inbound Cruise	160	345	52.4	58.3	Variable*	Variable*
Landing Descent and Transition	Descent from 160 to 130	Descent from 345 to 197	52.4 to 0	58.3 to 0	20	30
Vertical Descent and landing	Descent from 130 to 0	Descent from 197 to 0	0	0	38	35

*Duration of fixed-wing flight time varies based on distance to customer

Table 1: Comparison of Typical MK27-2 and MK30 Operational Flight Profiles

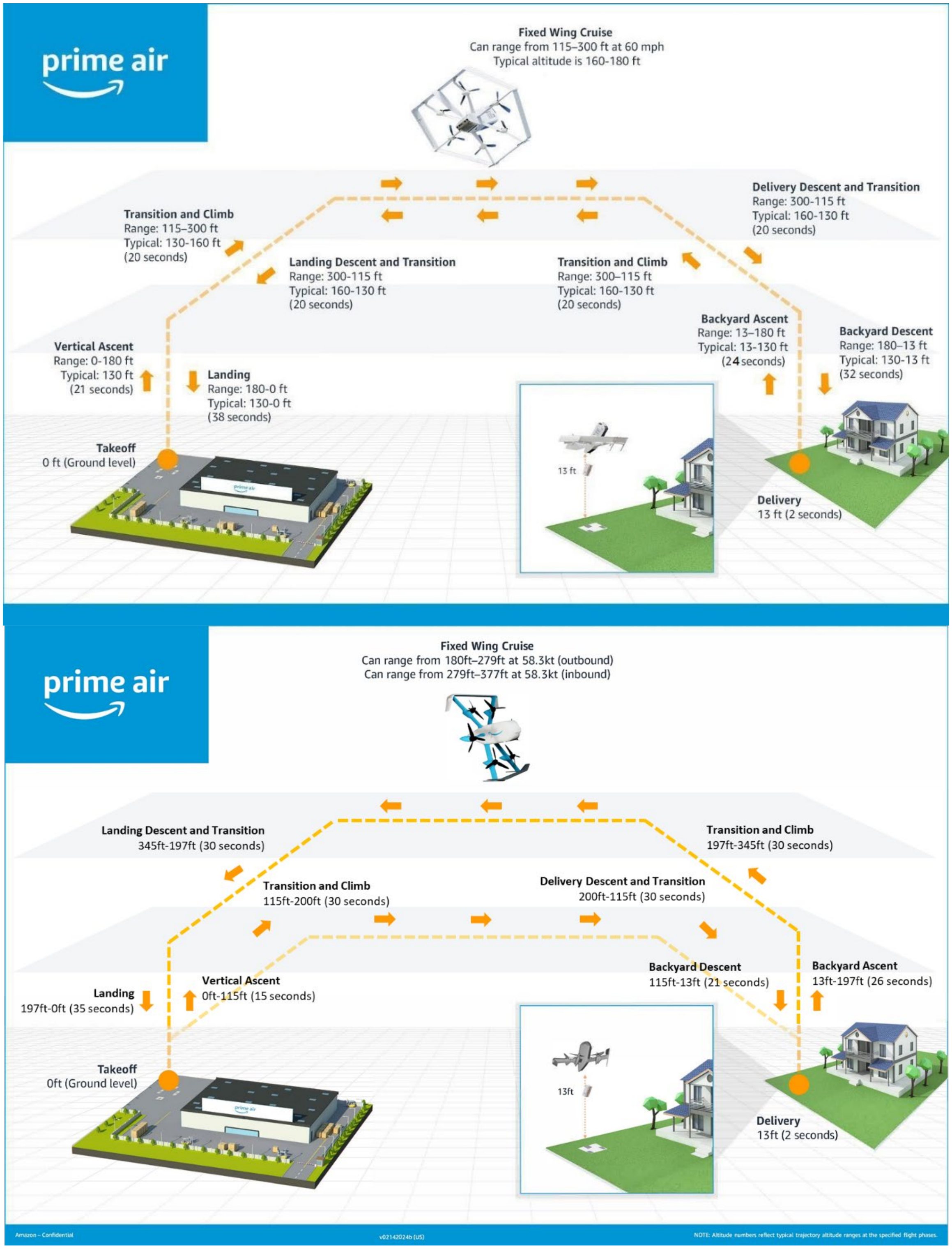


Figure 1: MK27-2 (Top) and MK30 (Bottom) Example Operational Flight Profiles

2. TEST METHODOLOGY

2.1. Overview

The data gathered during this test campaign utilized the same test methodology, instrumentation, and analysis methods as those utilized to support the MK27-2 NEPA evaluation conducted in April 2022 as described in the Prime Air Noise Measurement Report for the MK27-2 and the MK27-2 NEPA reports for College Station, TX and Lockeford, CA.

2.2. Instrumentation

An internally developed system for gathering acoustic data measurements was utilized in this campaign. This system provides time synchronized audio and location data with respect to the drone. The audio, drone-synchronized time and location data allow accurate determination of sound pressure level (SPL), distance, and incidence angle required for post-processing.

The system is composed of commercially available hardware with internal and external calibrations. The data acquisition system (DAQ) is a National Instruments cDAQ-9171 with a NI- 9234 analog unit capable of 51.2 kHz sampling rate at 24-bit resolution. New and calibrated GRAS 46AO ½" CCP Pressure Standard Microphones were used with the factory sensitivity values for the test. Calibration tones of the microphones were collected using a GRAS 42AG sound calibrator at 1000 Hz/114dB and 1000Hz/94dB at the start of each day.

2.3. Test Description

2.3.1. Overview

The flight profiles flown by the MK27-2 and the MK30 consisted of clockwise racetracks, with the microphone array positioned adjacent to the takeoff/landing pad to capture data for the VTOL/transition flight phases, and under a segment of straight and level flight to capture data for the fixed wing flight phase (See Figures 2 & 3). Both vehicles' flight profiles utilized the same takeoff/landing pad as well as the same overflight location in order to keep vehicle flight conditions the same at the acoustic measurement points.

For both vehicles' flight profiles, the drones performed a VTOL climb to an AGL between 27 and 40 meters (89 to 131 feet), began a Westbound transition to fixed-wing flight, continued in fixed wing flight until passing beyond the overflight microphone array, performed a right hand 180 degree turn, flew Eastbound, performed another right 180 degree turn, transitioned back to VTOL flight, and landed back at the pad. Both drones remained at a constant cruising altitude throughout the cruise segments. A package delivery segment was not performed, but is represented by the VTOL landing segment.

The MK27-2 flew a total of 1km westbound prior to its initial 180 degree turn, and 1.3km eastbound prior to its turn back to return to the pad. The MK30 flew 0.8km westbound prior to its initial turn, and 1.6km eastbound prior to its turn back to return to the pad. The difference in the racetrack geometry flown by the MK30 seen in Figure 2 is due to differences in the drone design and flight performance characteristics for turn radius and transition distances. However, as can be seen in Figure 2, the microphone array was set up below a flight segment with at least 150m (500 feet) of straight and level flight on both sides of the microphone array, which is more than was found to be required during prior testing to cover the 10dB down interval (as described in 14 CFR 36).

2.3.2. Microphone Locations

Microphones were placed on a North/South line perpendicular to the flight path. For both the overflight (Microphone Setup #1 in Figure 2) and takeoff/landing (Microphone Setup #2 in Figure 2) measurement locations, microphones were placed at a 5 ft height and oriented for a proper incidence angle with the aircraft during both phases of flight. Figure 3 shows the placement of the four microphones at each of the two setup locations. Tables 2 and 3 show the GPS coordinates of the microphones and the distances between them.

Note that some of the signals were not usable due to interference and were excluded from this analysis.

Figure 2: MK27-2 Racetrack (Blue) and MK30 Racetrack (Red) Overlay

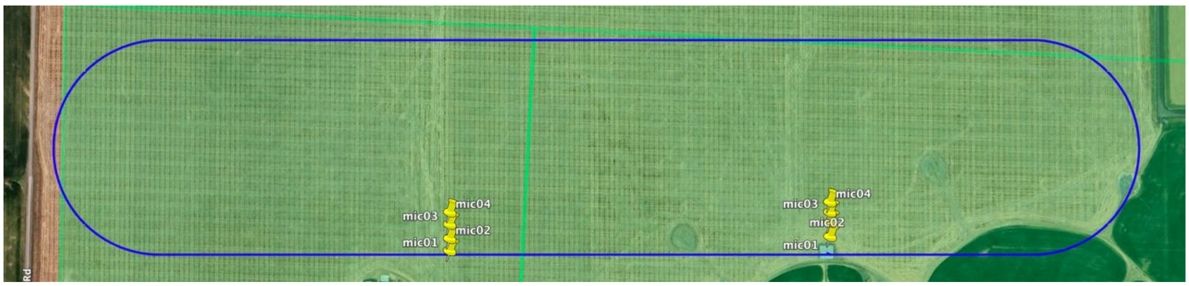


Figure 3: MK27 Flight Path with Microphone Locations

Location	Mic 1	Mic 2	Mic 3	Mic 4
Takeoff/Landing	45°42'09.2"N 118°51'20.1"W	45°42'09.9"N 118°51'20.1"W	45°42'10.4"N 118°51'20.1"W	45°42'10.9"N 118°51'20.1"W
Overflight	45°42'08.5"N 118°51'46.9"W	45°42'09.1"N 118°51'46.9"W	45°42'09.8"N 118°51'46.9"W	45°42'10.4"N 118°51'46.9"W

Table 2: GPS Coordinates for each microphone

Location	**Pad Center to Mic 1**	**Pad Center to Mic 2**	**Pad Center to Mic 3**	**Pad Center to Mic 4**
Takeoff/Landing	10m	26.67m	43.33m	60m
Location	**Flight Path Center to Mic 1**	**Mic 1 to Mic 2**	**Mic 1 to Mic 3**	**Mic 1 to Mic 4**
Overflight	0m	20m	40m	60m

Table 3: Microphone placement summary

3. RESULTS

The following section contains the test data comparing the noise signatures of the MK27-2 and MK30, as well as the ambient atmospheric conditions of each recording. A total of 12 flights were flown, comprising six total pairs of back-to-back flights (each pair having one MK27-2 flight and one MK30 flight). Of the six pairs, three were flown to collect data for VTOL, and three were flown to collect data for flyover.

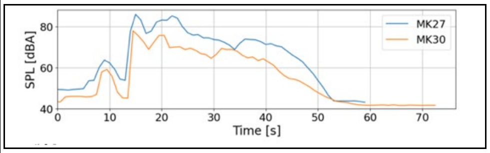
3.1. VTOL

This section contains the test data for each of the three pairs of VTOL flights having both a takeoff and landing segment.

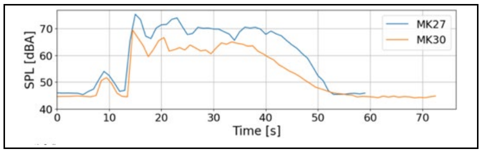
3.1.1. Pair 1

Drone	MK27-2	MK30
Temperature [C]	12.4	11.4
Wind 10 Min Average Speed [kts]	4.3	1.6
Wind 10 Min Average Direction [deg]	296	24.3
Wind 10 Min Gust Average [kts]	6.6	2.1
Density Altitude [ft]	1461	1331

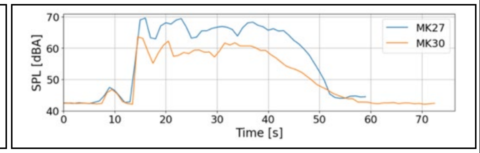
Takeoff



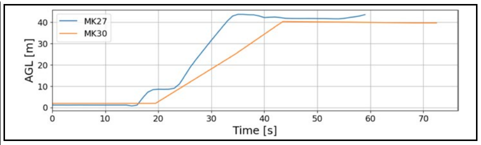
Mic 1



Mic 2



Mic 3



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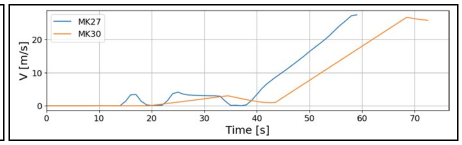
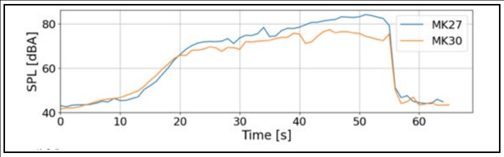


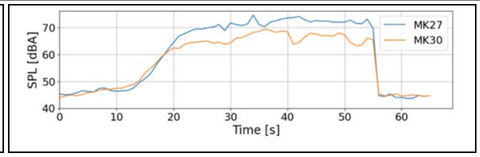
Velocity

	Drone	Mic 1	Mic 2	Mic 3
L_{max}	**MK27-2**	86.1	75.4	69.6
	MK30	78.1	69.4	63.5
SEL	**MK27-2**	94.0	85.3	81.7
	MK30	85.4	78.4	74.8

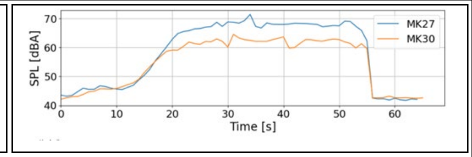
Landing



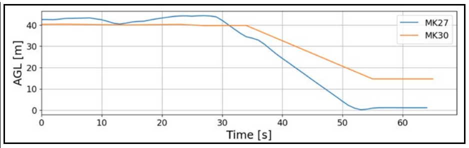
Mic 1



Mic 2



Mic 3



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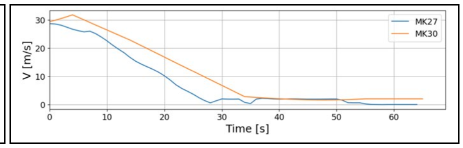


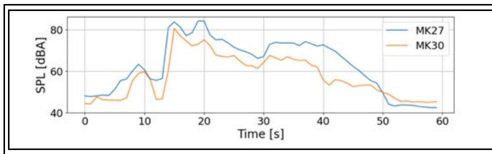
Velocity

	Drone	Mic 1	Mic 2	Mic 3
L_{max}	**MK27-2**	84.2	74.6	71.4
	MK30	77.4	69.3	64.5
SEL	**MK27-2**	95.1	87.2	83.3
	MK30	89.0	82.0	77.8

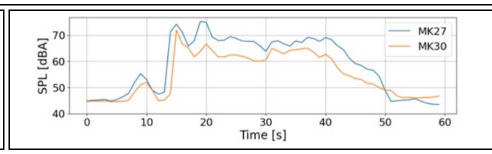
3.1.2. Pair 2

Drone	MK27-2	MK30
Temperature [C]	3.9	2
Wind 10 Min Average Speed [kts]	3.5	3.1
Wind 10 Min Average Direction [deg]	134	144.1
Wind 10 Min Gust Average [kts]	5.2	4.5
Density Altitude [ft]	380	140.2

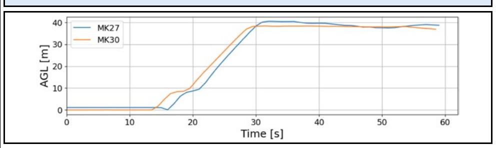
Takeoff



Mic 1



Mic 2



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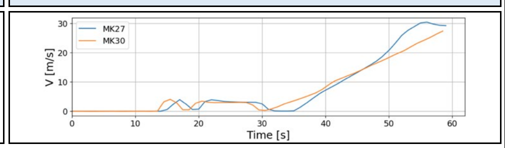
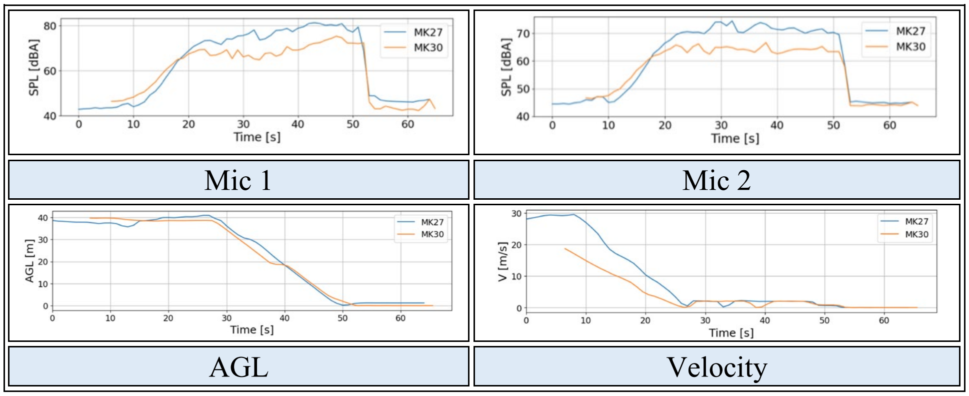


Velocity

	Drone	Mic 1	Mic 2
L_{max}	**MK27-2**	84.2	75.2
	MK30	80.6	72.0
SEL	**MK27-2**	92.0	84.3
	MK30	85.5	78.8

Landing

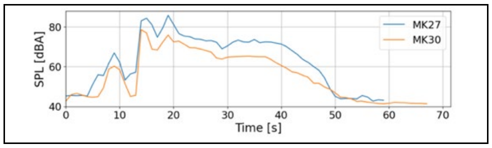


	Drone	Mic 1	Mic 2
L_{max}	MK27-2	81.2	74.5
	MK30	75.2	66.6
SEL	MK27-2	92.7	86.6
	MK30	85.7	79.8

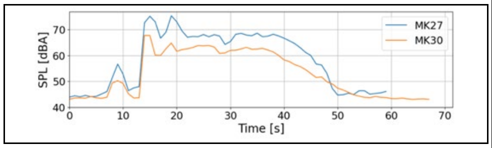
3.1.3. Pair 3

Drone	MK27-2	MK30
Temperature [C]	8.1	8.3
Wind 10 Min Average Speed [kts]	9.1	9.5
Wind 10 Min Average Direction [deg]	5	354
Wind 10 Min Gust Average [kts]	13.6	12.4
Density Altitude [ft]	964	994

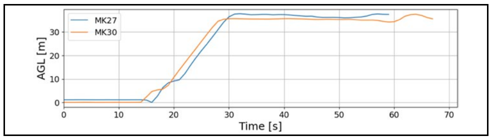
Takeoff



Mic 1



Mic 2



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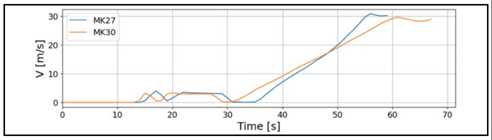
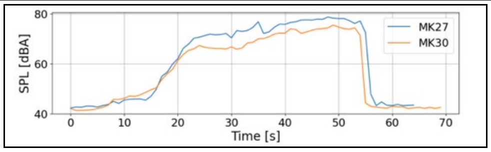


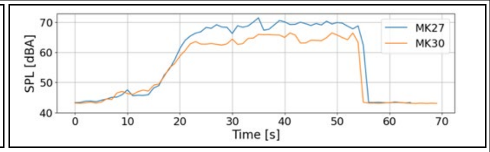
Velocity

	Drone	Mic 1	Mic 2
L_{max}	MK27-2	85.8	75.4
	MK30	78.6	67.8
SEL	MK27-2	92.3	84.3
	MK30	85.1	77.7

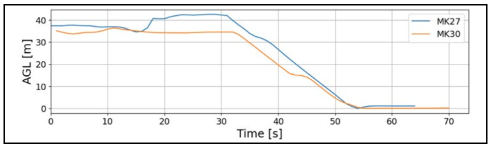
Landing



Mic 1



Mic 2



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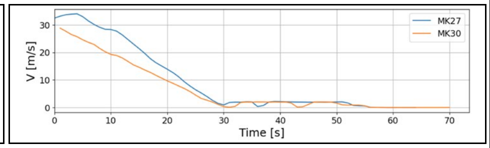


Velocity

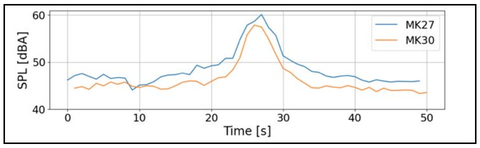
	Drone	Mic 1	Mic 2
L_{max}	**MK27-2**	78.8	71.4
	MK30	75.5	66.4
SEL	**MK27-2**	90.9	84.2
	MK30	86.9	79.8

3.2. Forward Flight (Flyover)

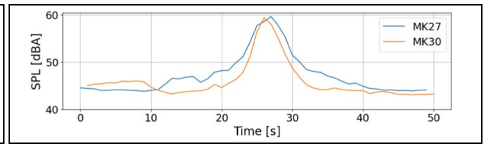
This section contains the test data for each of the three pairs of forward flight (flyover) flights.

3.2.1. Pair 1

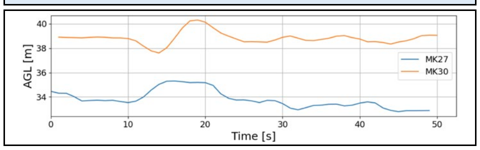
Drone	MK27-2	MK30
Temperature [C]	8	8.8
Wind 10 Min Average Speed [kts]	2	5.7
Wind 10 Min Average Direction [deg]	169	259
Wind 10 Min Gust Average [kts]	5.1	8
Density Altitude [ft]	856	987



Mic 1



Mic 2



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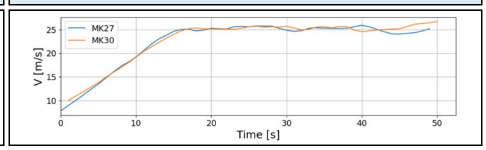
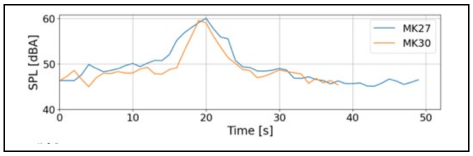


Velocity

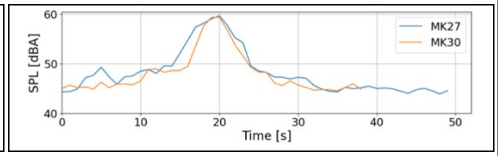
	Drone	Mic 1	Mic 2
L_{max}	**MK27-2**	60.1	59.6
	MK30	57.9	59.4
SEL	**MK27-2**	66.1	65.7
	MK30	63.7	64.3

3.2.2. Pair 2

Drone	MK27-2	MK30
Temperature [C]	9	9.6
Wind 10 Min Average Speed [kts]	11.7	14.4
Wind 10 Min Average Direction [deg]	264	264
Wind 10 Min Gust Average [kts]	15.7	18.5
Density Altitude [ft]	1015	1083



Mic 1



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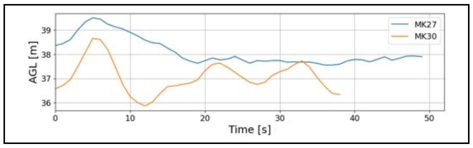

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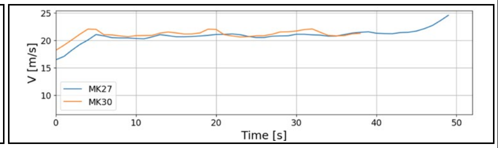
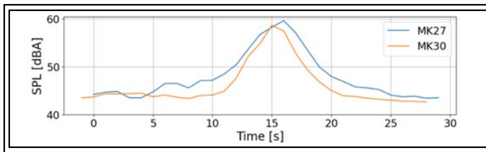


Velocity

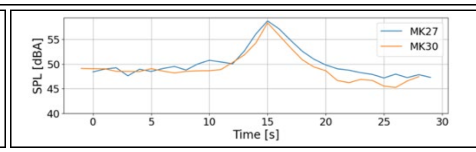
	Drone	Mic 1	Mic 2
L_{max}	MK27-2	60.0	59.7
	MK30	59.5	59.4
SEL	MK27-2	67.0	66.8
	MK30	65.1	65.5

3.2.3. Pair 3

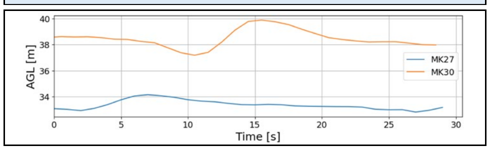
Drone	MK27-2	MK30
Temperature [C]	7	5.4
Wind 10 Min Average Speed [kts]	11.7	6.8
Wind 10 Min Average Direction [deg]	359	15.4
Wind 10 Min Gust Average [kts]	14.6	9.9
Density Altitude [ft]	840	640



Mic 2



Mic 4



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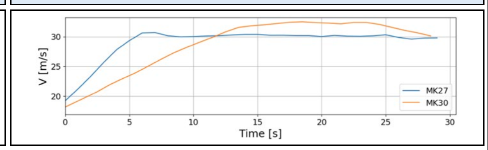

Velocity

	Drone	Mic 2	Mic 4
L_{max}	**MK27-2**	59.6	58.8
	MK30	58.6	58.4
SEL	**MK27-2**	65.3	64.4
	MK30	63.4	63.2

4. CONCLUSIONS

The data in Section 3.1 shows that the MK30 noise is 5-7 dB lower in maximum noise levels than the MK27-2 in the takeoff/landing phases of flight. In some localized portions of the flight noise data, the MK30 was recorded at higher SPL, but these occurred outside the peak noise event regions. The SEL in all cases is lower for the MK30.

The data in Section 3.2 showed that the MK30 maximum noise levels in the flyover phase are equivalent or lower when compared to the MK27-2. The difference in L_{max} between the MK30 and the MK27-2 is expected to be smaller in the flyover phase versus the takeoff/landing phase. However, given that the MK30 flies faster and higher than the MK27-2 in actual operation (detailed in Table 1), the SEL in operational flyover will still be lower for the MK30 due to the shorter event duration.

The data in Section 3 shows that in all flights, the MK30 is equivalent to or quieter than the MK27-2 in terms of maximum noise levels. It also shows that the SEL for the MK30 is lower in all cases. This supports the approach of using the previously collected MK27-2 NEPA noise data as a conservative representation of the MK30 noise profile for the purpose of the NEPA evaluation of MK30 operations.

Attachment B

Federal Aviation Administration

Memorandum

Date: June 26, 2024

To: Dave Senzig (Acting), Noise Division Manager, Office of Environment and Energy (AEE-100)

From: Chris Hurst, Flight Standards (AFS), General Aviation and Commercial Branch, AFS-752

CHRISTOPHER A HURST Digitally signed by CHRISTOPHER A HURST Date: 2024.06.26 15:10:17 -05'00'

Subject: Environmental Assessment (EA) Noise Methodology Approval Request for MK-30 Amazon Prime Air Operations in Tolleson, AZ

AFS requests AEE approval of the noise methodology to be used for the Environmental Assessment (EA) for Amazon Prime Air (Amazon) operations using the Amazon MK30 unmanned aircraft (UA) in Tolleson, AZ to expand its package delivery services as a 14 CFR Part 135 operator as described below.

As required under the National Environmental Policy Act (NEPA), the FAA must consider the potential for environmental impacts in informing the agency's decision to approve Federal actions, including the potential for noise impacts as detailed in FAA Order 1050.1F.

As the FAA does not currently have a standard approved noise model for UA, this letter serves as a request for written approval from AEE to use the methodology proposed in the following sections to support the noise analysis for the EA.

Description of Aircraft and Proposed Operations

AFS is evaluating Amazon's proposal to conduct package delivery operations from one Prime Air Drone Delivery Center (PADCC) located in Tolleson, AZ and an associated operating area under its existing Part 135 air carrier certificate and related operating authorizations using the MK30 UA. Amazon is proposing to perform package delivery operations from the PADCC within the proposed Tolleson, AZ operating area to transport packages to delivery sites including residential homes.

The MK30 UA has six (6) propulsors allowing it to take-off and land vertically and transition to wing borne flight (WBF). Its airframe is composed of staggered tandem wings for stable WBF. The drone weighs 77.9 lbs. (35.5 kg) and has a maximum takeoff weight of 83.2 lbs. (37.8 kg), which includes a maximum payload of 5 lbs. (3 kg). It has a maximum operating range of 7.5 mi (12 km). It is a hybrid multicopter fixed-wing UA that uses electric power from rechargeable lithium- ion batteries and can fly up to 400 ft (122 m) above ground level (AGL) at a maximum cruise speed of 73 mph (64 knots) during WBF. It is launched vertically using powered lift and converts to using wing lift during en route flight. A typical flight profile can be broken into the following general flight phases: launch, en route outbound, delivery, en route inbound, and landing. After launch, Amazon's MK30 UA would rise to an altitude of less than 400 ft (122 m) AGL and follow a predefined route to its delivery site. Aircraft would typically fly en route at between approximately 180 to 377 ft (55 to 115 m) AGL, except when descending to drop a package. Packages would be carried internally in the UA's fuselage. When making a delivery, the UA descends, opens a set of payload doors, and drops the package to the ground from approximately 13 ft (4 m) AGL. Amazon's UA would not touch the ground in any place other than the PADDC (except during safe contingent landings) and will remain airborne throughout the operation including the delivery stage. After the package is dropped, the MK30 UA climbs vertically and follows its predefined route back to the PADDC at its assigned altitude.

Amazon is seeking to amend its current Operation Specifications (OpSpec) and other Federal Aviation Administration (FAA) authorizations needed to integrate the MK30 and expand drone commercial package delivery operations. Amazon is proposing to amend its OpsSpec to add a single PADDC located in Tolleson, AZ and an associated approved area of operations. Amazon projects operating 171,329 annual deliveries, no nighttime flights (10 PM – 7 AM), with 469 total deliveries on an Average Annual Day (AAD) basis from the Tolleson PADCC. Based on those overall levels Amazon expects deliveries to be distributed among delivery locations throughout the operating area with a minimum number of 0.1 deliveries per day or less and maximum of 4.0 per day at any one location on an AAD basis.

Noise Analysis Methodology

AFS requests to use the noise analysis methodology described in ESA Report No. 202200549.03 for the "Noise Assessment Amazon Prime Air MK27-2 Unmanned Aircraft Operations at Tolleson, AZ Noise Technical Report" dated May 2024.

Federal Aviation Administration

Memorandum

Date: June 27, 2024

To: Chris Hurst, Flight Standards (AFS), General Aviation and Commercial Branch (AFS-752)

From: David Senzig, Manager (Acting), Noise Division, Office of Environment and Energy (AEE-100)

Digitally signed by DAVID ALAN SENZIG Date: 2024.06.27 15:23:55 -04'00'

Subject: Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air Commercial Package Delivery Operations with the MK30 Unmanned Aircraft (UA) from Tolleson, Arizona

The Office of Environment and Energy (AEE) has reviewed the proposed non-standard noise modeling methodology to be used for Amazon Prime Air (Amazon) operations using the MK30 unmanned aircraft (UA) from Tolleson, Arizona. This request is in support of an Environmental Assessment (EA) for Amazon to provide package delivery services as a 14 CFR Part 135 operator in Tolleson and a surrounding operating area.

The Proposed Action is for Amazon to use the MK30 UA to conduct package delivery operations under its existing Part 135 air carrier certificate from a single Prime Air Drone Delivery Center (PADCC) to potential delivery locations such as residential homes within a proposed operating area in Tolleson. Typical operations of the MK30 UA will consist of departure from a launch/takeoff pad at the PADCC followed by a vertical climb to a typical en route altitude of 180 to 377 feet above ground level (AGL). The UA then transitions from vertical to horizontal wing borne flight (WBF) for transit to a delivery location. Approaching the delivery location, the UA will transition from horizontal WBF to vertical flight, and then descend vertically over the delivery point. At 13 feet AGL, the UA drops the package at the delivery point, and ascends vertically back to en route altitude. Once back at en route altitude, the UA again transitions from vertical to horizontal WBF for transit back to its originating PADDC. When the UA arrives at the PADDC, the UA will transition from horizontal WBF to vertical flight and vertically descends to its assigned landing pad. Once it lands, the UA is serviced and prepared for the next delivery.

Under the scope of the Proposed Action Amazon projects conducting a maximum of 171,329 annual deliveries during daytime hours, no nighttime flights (10 PM – 7 AM), with 469 total deliveries on an average annual daily (AAD) basis. Based on those overall levels Amazon expects deliveries to be distributed among delivery locations with a minimum number of 0.1 deliveries per day or less and maximum of 4.0 per day at any one location within the proposed operating area on an AAD basis.

The MK30 UA is still under development and final noise data for the vehicle is not yet available. To assess the noise exposure of MK30 UA operations for the Proposed Action being considered in this EA, Amazon in coordination with AEE conducted noise measurements in February 2024 of the MK30 and

MK27-2 UAs. The purpose of these measurements was to evaluate if the MK30 is quieter than the MK27-2 and determine if the noise measurement data and analysis methodology developed for the MK27-2 as detailed in the December 2022 EA for evaluating Amazon's initial package delivery operations in College Station could be used as a surrogate for evaluating the noise exposure of the MK30. Overall, the noise measurement data showed that the MK27-2 UA has an equivalent or louder noise profile compared to the MK30 and use of the previously developed noise analysis methodology and measurement data from the MK27-2 represents a conservative surrogate for evaluating the noise exposure from proposed MK30 operations.

As the FAA does not currently have a standard approved noise model for assessing UA, and in accordance with FAA Order 1050.1F, all non-standard noise analysis in support of the noise impact analysis for the National Environmental Policy Act (NEPA) must be approved by AEE. This letter serves as AEE's response to the method developed in ESA Report No. 202200549.03 for the "Noise Assessment Amazon Prime Air MK27-2 Unmanned Aircraft Operations at Tolleson Arizona Noise Technical Report" dated May 2024.

The proposed methodology appears to be adequate for this analysis; therefore, AEE concurs with the methodology proposed for this project. Please understand that this approval is limited to this particular Environmental Review, location, vehicle, and circumstances. Any additional projects using this or other methodologies or variations in the vehicle will require separate approval.

Attachment C

Federal Aviation Administration

Date: August 4, 2022

To: Donald Scata, Manager, Noise Division,
Office of Environment and Energy (AEE-100)

From: Christopher Hobbs, General Engineer, Noise Division,
Office of Environment and Energy (AEE-100)

Subject: Estimated Noise Levels for Amazon Prime Air MK27-2 UA

This memo presents an analysis of noise measurements of the Amazon Prime Air MK27-2 Unmanned Aircraft (UA) by Amazon Prime Air (Amazon), measured between April 1 and April 16, 2022 at the Pendleton UAS Range located at the Eastern Oregon Regional Airport (KPDT) in Pendleton, Oregon. The purpose of the analysis is to provide estimates of expected sound exposure levels resulting from typical operations of the Amazon MK27-2 UA by Amazon and provides the methods used to create the noise estimates. Any deviation of the expected flight profile from those measured at Pendleton will need to be accounted for in the noise estimates using appropriate methodology.

1. Flight Profile and Segment Noise

The phases of a typical flight profile from takeoff to landing from a Prime Air Drone Delivery Center (PADDC) with an included delivery are listed in Table 1 for the MK27-2 UA. For the purposes of this analysis, the point on the ground that the UA takes off of (launch pad), delivers to (delivery point), and lands on (landing pad) will be referred to as the PADDC. For normal operations Amazon will be basing the UA at a PADDC containing the landing and takeoff pad infrastructure, and delivery will be completed at a remote location using a target on the ground at the delivery location to mark the specific delivery point. All noise measurements at Pendleton were made with the UA carrying a 5 lbs package representative of the UA operating at the max takeoff weight of 91.5 lbs. The package was not released during the delivery phase of the flight profile. It is assumed that the noise generated during the climb out after delivery with the package will be greater than if the package had been released; therefore, the noise measurements presented here are a conservative estimate of those during actual operations.

The method used to estimate the noise on the ground during each phase of flight is listed below. The methodology presented for estimating the noise for each flight phase uses the best available information from available measurement data for the MK27-2 UA and represents a conservative estimate of the noise levels resulting from operations of this UA.

Table 1. Phases of Flight for Typical Flight Profile of MK27-2 UA

Phase of Flight	Description
Takeoff	Vertical launch from PADDC on ground to en route altitude (165 ft Above Ground Level (AGL)) in vertical flight mode (pointed upward)
Transition to Outbound En Route Flight	Transition from zero speed above PADDC at en route altitude to cruise speed (52.4 kts) while changing from vertical flight mode to fixed-wing flight mode (pointed horizontally)
Outbound En Route Flight	Fixed-wing flight mode at operational en route altitude and cruise speed
Transition to Delivery	Transition from cruise speed at en route altitude and fixed-wing flight mode to zero speed above PADDC/delivery point at en route altitude and in vertical flight mode
Delivery	Vertically descend from en route altitude to 13 ft AGL delivery altitude, drop a package at the PADCC/delivery point, and vertical ascent back to en route altitude in vertical flight mode
Transition to Inbound En Route Flight	Transition from zero speed above PADDC/delivery point at en route altitude to cruise speed while changing from vertical flight mode to fixed-wing flight mode
Inbound En Route Flight	Fixed-wing flight mode at operational en route altitude and cruise speed
Transition to Landing	Transition from cruise speed at en route altitude and fixed-wing flight mode to zero speed above PADDC at en route altitude and in vertical flight mode
Landing	Descend from en route altitude to PADDC on ground in vertical flight mode

1.1 Transition Noise

Because the transition phase from vertical to fixed-wing flight mode or vice versa is involved in the takeoff, delivery, and landing phases of flight it will be discussed first. The measurements made by Amazon were done with the microphones oriented normal to the flight track as shown in Figure 1. As the figure shows, the UA did not fly over the microphones after takeoff. The same is true for the transitions before and after delivery and the transition before landing. To estimate the maximum noise at a distance from the takeoff/landing pad or delivery point on the ground one must combine the noise emitted from the UA during the vertical portion of the trajectory (descent or ascent) and the noise the UA make as it transitions from the vertical flight mode (pointed up) to fixed-wing flight mode (pointed horizontally). The microphones were not positioned to capture the majority of the transition noise; thus, an estimate of the noise made by the UA while transitioning had to be made based on the overflight measurements as discussed below.

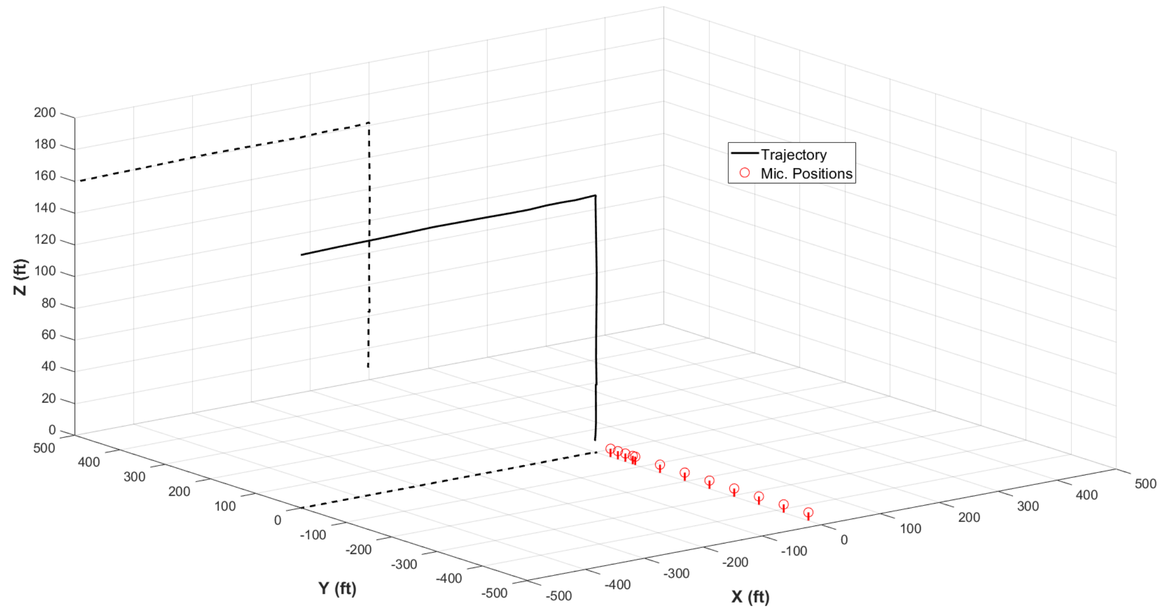

Figure 1. Microphone locations for takeoff, delivery, and landing measurements for MK27-2 UA with example takeoff trajectory.

The duration of the transition of the UA from vertical to fixed-wing flight mode was measured using the time it took the UA to reach cruise speed after it reached the top of the vertical climb during takeoff and post-delivery. The start of the duration for both phases was set as the time the UA began having non-zero ground speed. For the duration of the transition of the UA from fixed-wing flight mode to vertical flight during landing and pre-delivery, the transition duration was measured from the time the UA began to decelerate from cruise speed to zero ground speed. In all cases the acceleration was noted as being nearly constant. The pitch of the UA from vertical to horizontal fixed-wing flight mode was shown to coincide with this time as well. Table 2 shows the average durations for the UA to transition to and from fixed-wing flight mode. As presented in Table 2, the average duration for transition during takeoff and landing was the same 20 seconds. Assuming a constant acceleration to and from a 52.4 knot cruise speed, the distance to transition from vertical to fixed-wing flight mode is approximately 884 ft. It is the same approximate distance to transition from fixed-wing to vertical flight mode.

Table 2. Description of Transition to and from Fixed-Wing Flight Mode

Phase	Description	Altitude (ft AGL)	Ground Speed (kts)	Duration (s)
Transition to Fixed-Wing Mode	Transition from vertical to horizontal fixed-wing flight	165	0 accelerating to 52.4	20
Transition from Fixed-Wing Mode	Transition from horizontal fixed-wing flight to vertical flight	165	52.4 decelerating to 0	20

In order to estimate the noise made by the UA at positions undertrack as it transitions to or from fixed-wing flight mode, the following assumption has been made:

The noise of the UA in fixed-wing flight mode is approximately the same it transitions; furthermore, the noise radiated from the UAS is assumed to be omnidirectional. That is to say that the noise level measured a fixed distance from the UA will be the same in all directions.

To calculate the noise from the transition phase of the flight profile at distances from the PADDC undertrack, the following steps were performed:

1. The maximum noise level from measured overflights was corrected to the en route altitude distance (165 ft) using spherical spreading.
2. At each distance from the PADDC undertrack the estimated sound pressure level was calculated from 25 ft segments along the transition flight trajectory based on the maximum sound level measured during the overflight corrected to the distance between using spherical spreading. The duration applied to each respective segment's sound pressure level was found from the calculated motion of the UA as a function of time to / from a cruise speed of 52.4 kts to / from zero kts using constant acceleration.
3. The sound pressure level duration products were summed to find the estimated sound exposure level at each position.
4. The estimate of the sound exposure levels were corrected to match the overflight sound exposure level once past the effects of the transition at approximately 1600 ft from the PADDC.

The levels in Table 3 are the results of the calculations. It is recommended to use linear interpolation to find values between the distances in the table for the transition flight phases. This estimate of the transition phase of flight can be used for the transition from zero speed to the cruise speed as well as the transition from cruise speed to zero speed. The calculation was done for an estimated altitude of 165 ft AGL.

Table 3. Estimated Sound Exposure Levels from Transition Phase of Flight Profile

Distance from PADDC (ft)	Sound Exposure Level (dBA)[1]
0	69.9
100	70.6
200	70.3
400	69.4
800	68.2
1600	67.7
3200	67.7

Notes: 1) Applicable to either profile described in Table 2.

The sound exposure levels presented in Table 3 show that beyond 1600 ft from the PADDC the transition profile (Table 2) does not differ from the en route levels (Section 1.3); therefore, the transition phase noise levels present in Table 2 should be added to the noise created by the UA during takeoff, delivery, and landing out to a distance of 1,600 feet. The sound exposure levels from the overflight measurements should be combined with the other phases of flight for distances greater than 1,600 feet from the PADDC.

1.2 Takeoff and Landing Noise

There are two flight activities that generate noise in the vicinity of the takeoff and landing pads at the PADCC. The vertical portion of the trajectory (i.e., the climb or descent to/from the en route altitude), and the transition from vertical flight mode to horizontal fixed-wing flight mode as described above. During takeoff, the MK27-2 will climb from the ground vertically to an operational altitude of 165 feet AGL, then transition from vertical to fixed-wing flight for transit to the delivery location. After completing delivery, the UA returns from the delivery location at 165 feet AGL in fixed-wing flight, transitions to vertical flight, and then descends vertically to the ground at the landing pad. Table 4 details the takeoff and landing phases of the flight profile. The durations in the table are the average time it took the UA to ascend or descend from the cruise altitude.

Table 4. MK27-2 UA Takeoff and Landing Profile Details

Phase of Flight	Flight Description	Altitude (ft AGL)	Ground Speed (kts)	Duration (s)
Takeoff	Vertical ascent to cruise altitude	0 ascend to 165	0	21
Landing	Descent from cruise altitude to land	165 descend to 0	0	38

To estimate the sound exposure level from the takeoff and landing phases of the flight profile, measurements of the noise emissions of the MK27-2 UA were made when the UA was at maximum weight and was following a simulated takeoff and landing profile representative of typical operations. The profile included the vehicle climbing vertically from the PADDC to en route altitude where it transitioned to fixed-wing mode for en route flight, flying an oval “racetrack” pattern at en route altitude to simulate outbound en-route flight, and transitioning from en-route altitude in fixed-wing flight mode to the vertical flight mode for a descent to landing. The microphone positions relative to the takeoff and landing pad are shown in Figure 1. The PADDC is located at the origin in the plot. It is important to note that only 4 microphones were used for each flight. They were moved to different positions between flights.

The sound exposure level was calculated from the data collected by each microphone for each flight. The sound exposure level was calculated from the entire A-weighted time history of the event. Because the microphone array is normal to the flight track, the noise during transition between en route fixed-wing flight to vertical flight mode is not completely captured as it would be under the vehicle for the inbound and outbound phases of the flight profile and is assumed to not be accounted for in the following tables. Because of this, the sound exposure values versus distance measured from the PADDC must be supplemented to estimate the most conservative sound exposure as detailed below.

There were a total of nine flights where the UA performed a takeoff, delivery, and landing. The microphones were moved for some of the flights. The number of flights for each positioning of the four microphone was not equal; however, the available data represents a good range of distance from the PADDC and has a behavior that can be used to adequately represent the noise emissions from the vertical portion of the flight profile. There were two other flights performed for overflight measurements. Because the aircraft's flight track on takeoff and landing was not the same orientation to the microphone array as the first nine flights, metrics for those four events were not included in the averages. Table 5 presents the averaged results at each microphone for all takeoff events, and Table 6 presents the averaged results for averaged landing events.

Table 5. Average Sound Exposure Levels of MK27-2 UA during Takeoff versus Distance

Position	Distance (ft)	Sound Exposure Level (dBA)1
1	32.8	95.7
2	49.2	94.1
3	65.6	92.1
4	82.0	90.1
5	87.5	88.3
6	142.2	83.0
7	196.9	78.7
8	251.5	77.7
9	306.2	75.8
10	360.9	73.8
11	415.6	72.4
16	689.0	69.1
17	743.7	65.6
18	798.4	64.7
19	853.0	64.0

Notes: 1) Applicable for the takeoff profile presented in Table 4.

Table 6. Average Sound Exposure Levels of MK27-2 during Landing versus Distance

Position	Distance (ft)	Sound Exposure Level (dBA)[1]
1	32.8	94.8
2	49.2	93.2
3	65.6	92.1
4	82.0	90.2
5	87.5	90.1
6	142.2	85.0
7	196.9	80.7
8	251.5	79.0
9	306.2	77.3
10	360.9	74.9
11	415.6	73.7
16	689.0	69.7
17	743.7	67.6
18	798.4	67.0
19	853.0	66.2

Notes: 1) Applicable for the landing profile presented in Table 4.

The measured data are presented in the following figures. The curve fits in the Tables below represent the best estimates of the sound levels for the distance ranges listed. It is recommended to use the curve fit equations to calculate the sound exposure levels representing only the vertical portion of the flight profile noise emissions for the takeoff and landing phases. Positions four and five were averaged together and the effective distance weight-averaged because of their proximity. The distance of 149 feet from the PADDC is the minimum distance for which the behavior of the noise levels versus distance is consistently decreasing by approximately 6 dB per doubling of distance for the takeoff, delivery, and landing phases of flight. The same distance was chosen to begin the curve fit for consistency. The coefficients in the table for distance less than 149 feet are effectively linear interpolations between the average, measured values.

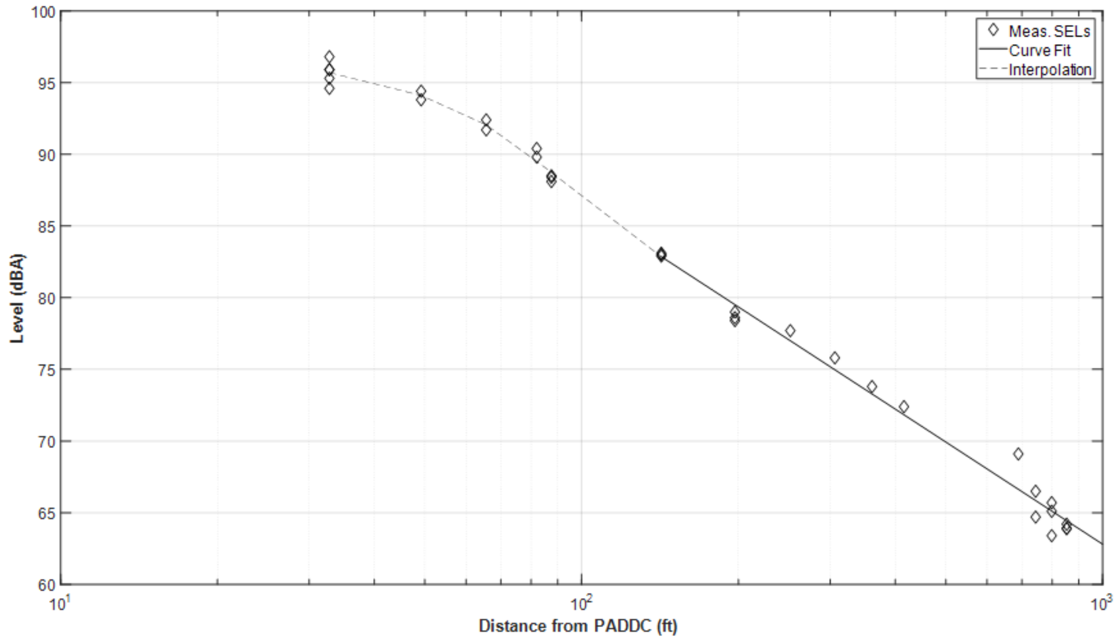

Figure 2. Measured sound exposure levels during takeoffs as described in Table 4.

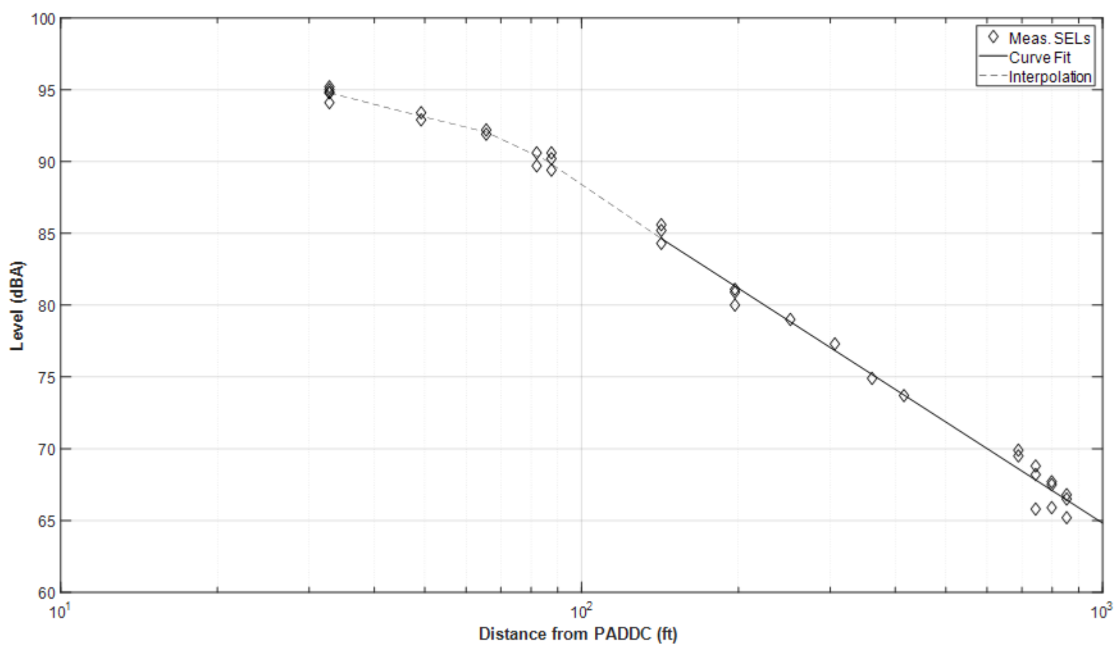

Figure 3. Measured sound exposure levels during landings as described in Table 4.

The following equation governs how to estimate the sound exposure level for a given distance, *d*, in feet from the PADDC resulting from the vertical portion of the takeoff, delivery, or landing portion of the flight profile of the UA. The constants m and b are to be used in Eq. 1 for the appropriate row in the tables based on the Range. These estimates assume the UA reaches an en route altitude of 165 feet AGL.

$$SEL = m * \log_{10}(d + b) \qquad (dB) \qquad (1)$$

Table 7. Parameters for Estimating Sound Exposure Level for Takeoff versus Distance[2]

Range for *d* (ft from PADDC)	m	b
32.8 to 49.2	-9.09	109.47
49.2 to 65.6	-16.41	121.86
65.6 to 85.3[1]	-26.39	140.00
85.3[1] to 142.2	-27.79	142.71
Greater than 142.2	-23.39	134.99

Notes: 1) Average, weighted distance for the 82 and 87.5 ft position measurements
2) Applicable for the takeoff profile in Table 4

Table 8. Parameters for Estimating Sound Exposure Level for Landing versus Distance[2]

Range for *d* (ft from PADDC)	m	b
32.8 to 49.2	-9.26	108.81
49.2 to 65.6	-8.80	108.05
65.6 to 85.3[1]	-17.10	123.12
85.3[1] to 142.2	-24.56	137.53
Greater than 142.2	-23.39	134.99

Notes: 1) Average, weighted distance for the 82 and 87.5 ft position measurements
2) Applicable for the landing profile in Table 4

1.3 En Route Noise

Two flights were flown to measure noise from the en route phase of flight. The UA flew in a "dog bone" pattern in order to overfly the lead microphone in the array three times traveling in each direction. The microphone array was not moved between the flights and the four positions were the only distances measured from undertrack. A cross wind may be responsible for the microphone undertrack not measuring the highest noise level. The 12 sound exposure levels measured from the two flights were averaged at each of the positions and results presented in Table 9. The slant range column presented in Table 9 is the distance between the UA and position at the closest point of approach during the overflight.

It is recommended that 67.7 dBA sound exposure level be used to represent the noise generated by the UA at cruise speed of 52.4 kts and en route altitude of 165 ft AGL because it is the highest level measured; therefore, it is the most conservative estimate.

Table 9. Average Sound Exposure Levels Measured During Level Overflights

Position	Sound Exposure Level[1] (dBA)	Maximum Level (dBA)	Distance from Undertrack (ft)	Slant Range (ft)	Sound Exposure Level Normalized to 165 ft[2] (dBA)	Maximum Level Normalized to 165 ft[3] (dBA)
1	66.0	59.2	0	165	66.0	59.2
5	67.0	60.3	88	187	67.7	61.4
6	65.1	57.8	142	218	66.6	60.2
7	63.0	55.2	197	257	65.4	59.1

Notes: 1) Measured levels normalized to 52.4 kts before averaging.
*2) Using 12.5*log10(Slant/Distance)*
*3) Using 20*log10(Slant/Distance)*

To estimate the sound exposure level of the UA traveling at speed v_1 when the measured sound exposure level for a level overflight was done when the UA was traveling at speed v_{ref} add the value *del1* calculated with Eq. 2 to the sound exposure level measured with the speed v_{ref}.

$$del1 = 10 * \log_{10}\left(v_1 / v_{ref} \right) \quad (dB) \quad (2)$$

To estimate the sound exposure level of the UA traveling at a height, h_1 ft, above the ground different than 165 ft AGL, add the value *del2* calculated with Eq. 3 to the 67.7 dBA sound exposure level.

$$del2 = 12.5 * \log_{10}\left(h_{ref} / h_1 \right) \quad (dB) \quad (3)$$

1.4 Delivery Noise

There are five flight activities that generate noise in the vicinity of a delivery location. The MK27-2 will approach the delivery location from fixed-wing en route flight at 165 feet AGL, transition to vertical flight, and then descend vertically to a delivery altitude of 13 ft AGL. At delivery altitude, the UA will drop the package while in hover which takes approximately 2 seconds. At completion of the delivery, the UA will climb from the delivery altitude vertically back to an en route altitude of 165 feet AGL, and then transition from vertical to fixed-wing flight mode for en route flight back to the PADDC. This section considers only the noise generated from the vertical phases of the flight profile during delivery. Table 10 details the vertical portion of the delivery procedure starting at en route altitude and positioned over the delivery point to return to en route altitude. Within this portion of the procedure, Table 10 details the average durations for the descent, delivery, and ascent portions of the profile.

Table 10. MK27-2 UA Delivery Profile Details

Phase	Flight Description	Altitude (ft AGL)	Ground Speed (kts)	Duration (s)
Descent	After transition to above PADDC, descend to delivery height	165 to 13	0	32
Delivery	Drop package on PADDC	13	0	2
Ascent	Ascend to en route altitude before transitioning to en route flight	13 to 165	0	24

To estimate the sound exposure level at a delivery location, measurements of the noise emissions of the MK27-2 UA were made when the UA was at maximum weight utilizing a simulated delivery profile representative of typical operations. The profile included the vehicle flying an oval “racetrack” pattern in fixed-wing mode flight at en route altitude to simulate outbound en route flight, transition from fixed-wing flight mode to vertical flight for descent and delivery at the PADDC, vertical descent to delivery altitude, delivery, vertical climb back to en-route altitude, and transition back to fixed-wing flight mode to simulate inbound en route flight. The microphone locations utilized for the delivery measurements are the same as shown Figure 1. As with the takeoff and landing measurements, the 4 microphones were moved between flights in order to measure the noise at different distances from the PADDC. As with the takeoff and landing measurements, the transition noise was not fully captured by the microphones because the UA did not perform the transition above them.

The average sound exposure level for the entire vertical portions of the delivery phase (descent, delivery, and ascent) were then calculated at each of the microphones. As with the takeoff and landing measurements each position did not have the same number of measurements. The results were then averaged together for each microphone position. Table 11 presents the averaged results at each microphone for all delivery events. Figure 4 shows a plot of the measurements versus distance along with lines showing the methods of estimating the levels between and beyond positions. Table 12 contains the parameters suggested for use in Eq. 1 for estimating the sound exposure level at distances from the delivery location for the noise emitted from the UA during the vertical portion of the delivery. As was the case for the takeoff and landing flight phases, it is recommended for the delivery phase to use the appropriate parameters in Table 12 for the required distance. In order to estimate the noise levels near the delivery location the transition noise would need to be logarithmically added to this noise in order to properly estimate the maximum levels expected for undertrack locations.

Table 11. Average Sound Exposure Level of MK27-2 UA during Delivery versus Distance

Position	Distance (ft)	Sound Exposure Level (dBA)[1]
1	32.8	96.5
2	49.2	95.5
3	65.6	94.6
4	82.0	93.1
5	87.5	92.3
6	142.2	87.4
7	196.9	82.8
8	251.5	81.6
9	306.2	79.8
10	360.9	77.9
11	415.6	76.3
16	689.0	72.3
17	743.7	70.9
18	798.4	70.4
19	853.0	69.6

Notes: 1) Applicable for the delivery profile presented in Table 10

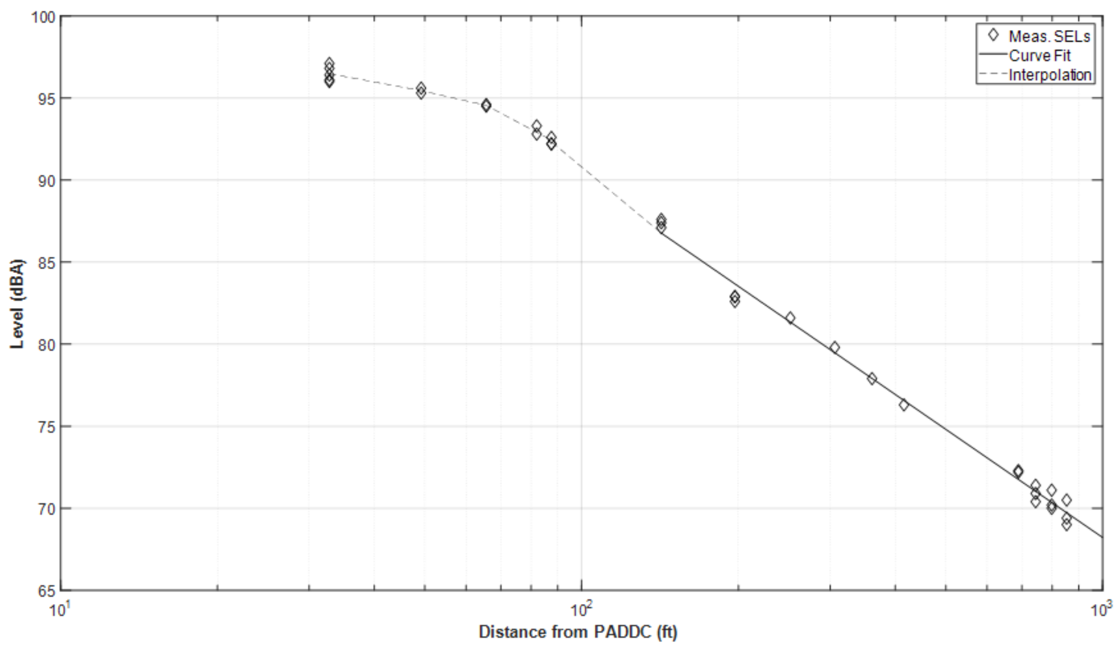

Figure 4. Measured Sound Exposure Levels during deliveries as described in Table 10.

Table 12. Parameters for Estimating Sound Exposure Level for Delivery versus Distance[2]

Range for *d* (ft from PADDC)	m	b
32.8 to 49.2	-5.85	105.35
49.2 to 65.6	-7.20	107.64
65.6 to 85.3[1]	-16.92	125.30
85.3[1] to 142.2	-26.31	143.42
Greater than 142.2	-21.90	133.91

Notes: 1) Average, weighted distance for the 82 and 87.5 ft position measurements
2) Applicable for the delivery profile presented in Table 10

2. Analysis

The analysis of the measurements performed while the MK27-2 flew a typical profile can be used for estimating the noise created for each phase of flight. It is important to combine the transition noise with the takeoff, delivery, and landing phases in order to estimate the maximum noise expected undertrack for those portions of the flight profile. In order to estimate the noise from a flight profile with different speed or altitude, utilization of the correction for different cruise speed using equation 2 and a different en route altitude using equation 3 should be used. It is not expected that the contribution to the noise levels around the takeoff, delivery, or landing sites from the vertical part of the flight profile will change if the cruise speed or altitude are different.

3. Conclusion

This memo provides the means to estimate the sound exposure level from the typical flight profile for the MK27-2 delivering a package. By combining the transition noise with the noise from the vertical phases of the flight profile a conservative estimate of the noise created by the UA is achieved in that the estimate should be greater than the actual noise levels. The means for adjusting the provided noise levels for different flight profile parameters are provided with the assumption that minor changes to the en route altitudes will not change the noise levels for the takeoff, delivery, and landing phases of flight.

Appendix F
Environmental Justice

APPENDIX F

TABLE F-1
SELECTED DEMOGRAPHIC CHARACTERISTICS (RACE) BY CENSUS BLOCK GROUP

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040130610101	1,759	897	51%	862	49%
Census Block Group 040130610102	1,671	1,370	82%	301	18%
Census Block Group 040130610103	2,750	1,881	68%	869	32%
Census Block Group 040130610111	3,462	1,168	34%	2,294	66%
Census Block Group 040130610112	1,461	453	31%	1,008	69%
Census Block Group 040130610113	3,174	1,180	37%	1,994	63%
Census Block Group 040130610131	2,450	1,221	50%	1,229	50%
Census Block Group 040130610132	4,523	2,533	56%	1,990	44%
Census Block Group 040130610141	2,579	1,199	46%	1,380	54%
Census Block Group 040130610142	2,688	783	29%	1,905	71%
Census Block Group 040130610143	998	568	57%	430	43%
Census Block Group 040130610151	2,281	1,297	57%	984	43%
Census Block Group 040130610152	497	262	53%	235	47%
Census Block Group 040130610153	2,647	762	29%	1,885	71%
Census Block Group 040130610181	2,344	2,208	94%	136	6%
Census Block Group 040130610182	1,647	1,427	87%	220	13%
Census Block Group 040130610183	1,521	1,360	89%	161	11%
Census Block Group 040130610201	905	574	63%	331	37%
Census Block Group 040130610202	1,165	592	51%	573	49%
Census Block Group 040130610203	1,506	566	38%	940	62%
Census Block Group 040130610211	1,843	803	44%	1,040	56%
Census Block Group 040130610241	2,237	1,151	51%	1,086	49%
Census Block Group 040130610433	369	169	46%	200	54%
Census Block Group 040130610452	1,889	857	45%	1,032	55%
Census Block Group 040130610461	2,657	836	31%	1,821	69%
Census Block Group 040130610462	1,758	484	28%	1,274	72%
Census Block Group 040130610463	1,773	721	41%	1,052	59%
Census Block Group 040130610471	2,485	1,565	63%	920	37%
Census Block Group 040130610472	1,541	483	31%	1,058	69%
Census Block Group 040130610481	2,629	1,358	52%	1,271	48%
Census Block Group 040130610482	1,741	1,209	69%	532	31%
Census Block Group 040130610491	2,668	932	35%	1,736	65%
Census Block Group 040130610492	3,147	1,428	45%	1,719	55%
Census Block Group 040130610503	3,506	1,444	41%	2,062	59%
Census Block Group 040130610511	3,398	1,007	30%	2,391	70%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040130610521	3,975	1,178	30%	2,797	70%
Census Block Group 040130610522	4,046	1,235	31%	2,811	69%
Census Block Group 040130610523	497	250	50%	247	50%
Census Block Group 040130610531	3,951	938	24%	3,013	76%
Census Block Group 040130610532	1,861	848	46%	1,013	54%
Census Block Group 040130610533	1,692	868	51%	824	49%
Census Block Group 040130610541	1,763	1,131	64%	632	36%
Census Block Group 040130610542	2,327	2,132	92%	195	8%
Census Block Group 040130610543	2,675	1,252	47%	1,423	53%
Census Block Group 040130610551	2,918	1,560	53%	1,358	47%
Census Block Group 040130610552	3,074	1,659	54%	1,415	46%
Census Block Group 040130610582	3,050	1,254	41%	1,796	59%
Census Block Group 040130610631	1,421	583	41%	838	59%
Census Block Group 040130610641	2,688	1,460	54%	1,228	46%
Census Block Group 040130611001	784	363	46%	421	54%
Census Block Group 040130611002	682	387	57%	295	43%
Census Block Group 040130611003	1,107	733	66%	374	34%
Census Block Group 040130612001	731	112	15%	619	85%
Census Block Group 040130612002	1,994	946	47%	1,048	53%
Census Block Group 040130612003	1,721	109	6%	1,612	94%
Census Block Group 040130612004	459	261	57%	198	43%
Census Block Group 040130612005	1,004	29	3%	975	97%
Census Block Group 040130613001	2,380	611	26%	1,769	74%
Census Block Group 040130614011	610	139	23%	471	77%
Census Block Group 040130614012	1,465	215	15%	1,250	85%
Census Block Group 040130614021	2,203	123	6%	2,080	94%
Census Block Group 040130614022	1,838	126	7%	1,712	93%
Census Block Group 040130614023	2,469	367	15%	2,102	85%
Census Block Group 040130820021	2,475	665	27%	1,810	73%
Census Block Group 040130820022	1,857	524	28%	1,333	72%
Census Block Group 040130820023	1,933	536	28%	1,397	72%
Census Block Group 040130820071	1,783	495	28%	1,288	72%
Census Block Group 040130820072	2,036	238	12%	1,798	88%
Census Block Group 040130820081	1,413	192	14%	1,221	86%
Census Block Group 040130820082	2,823	314	11%	2,509	89%
Census Block Group 040130820083	1,584	226	14%	1,358	86%
Census Block Group 040130820091	2,251	254	11%	1,997	89%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040130820092	2,848	390	14%	2,458	86%
Census Block Group 040130820101	2,041	340	17%	1,701	83%
Census Block Group 040130820102	3,476	685	20%	2,791	80%
Census Block Group 040130820121	1,804	759	42%	1,045	58%
Census Block Group 040130820122	3,398	605	18%	2,793	82%
Census Block Group 040130820123	1,937	492	25%	1,445	75%
Census Block Group 040130820161	0	0	0%	0	0%
Census Block Group 040130820162	3,178	744	23%	2,434	77%
Census Block Group 040130820171	2,398	114	5%	2,284	95%
Census Block Group 040130820172	0	0	0%	0	0%
Census Block Group 040130820173	2,748	433	16%	2,315	84%
Census Block Group 040130820181	2,655	458	17%	2,197	83%
Census Block Group 040130820182	2,738	178	7%	2,560	93%
Census Block Group 040130820191	707	361	51%	346	49%
Census Block Group 040130820192	1,818	540	30%	1,278	70%
Census Block Group 040130820201	2,016	816	40%	1,200	60%
Census Block Group 040130820202	2,688	1,230	46%	1,458	54%
Census Block Group 040130820211	1,587	417	26%	1,170	74%
Census Block Group 040130820212	1,040	443	43%	597	57%
Census Block Group 040130820221	4,191	969	23%	3,222	77%
Census Block Group 040130820222	1,523	531	35%	992	65%
Census Block Group 040130820231	1,146	409	36%	737	64%
Census Block Group 040130820232	2,420	649	27%	1,771	73%
Census Block Group 040130820233	2,062	770	37%	1,292	63%
Census Block Group 040130820241	1,306	425	33%	881	67%
Census Block Group 040130820242	2,956	961	33%	1,995	67%
Census Block Group 040130820251	3,253	1,260	39%	1,993	61%
Census Block Group 040130820261	3,214	1,232	38%	1,982	62%
Census Block Group 040130820262	2,006	627	31%	1,379	69%
Census Block Group 040130820263	1,858	568	31%	1,290	69%
Census Block Group 040130820271	1,718	392	23%	1,326	77%
Census Block Group 040130820272	318	60	19%	258	81%
Census Block Group 040130820273	3,363	837	25%	2,526	75%
Census Block Group 040130820281	1,951	88	5%	1,863	95%
Census Block Group 040130820282	2,846	192	7%	2,654	93%
Census Block Group 040130822041	4,409	520	12%	3,889	88%
Census Block Group 040130822042	1,015	153	15%	862	85%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040130822043	1,680	269	16%	1,411	84%
Census Block Group 040130822051	2,731	501	18%	2,230	82%
Census Block Group 040130822052	1,558	226	15%	1,332	85%
Census Block Group 040130822053	2,678	299	11%	2,379	89%
Census Block Group 040130822061	781	69	9%	712	91%
Census Block Group 040130822062	1,110	126	11%	984	89%
Census Block Group 040130822063	2,538	268	11%	2,270	89%
Census Block Group 040130822071	1,201	258	21%	943	79%
Census Block Group 040130822072	2,367	686	29%	1,681	71%
Census Block Group 040130822081	1,787	83	5%	1,704	95%
Census Block Group 040130822082	858	124	14%	734	86%
Census Block Group 040130822083	876	190	22%	686	78%
Census Block Group 040130822091	1,009	116	11%	893	89%
Census Block Group 040130822092	2,137	27	1%	2,110	99%
Census Block Group 040130822101	2,487	625	25%	1,862	75%
Census Block Group 040130822102	987	108	11%	879	89%
Census Block Group 040130822103	1,641	292	18%	1,349	82%
Census Block Group 040130822111	740	121	16%	619	84%
Census Block Group 040130822112	3,399	573	17%	2,826	83%
Census Block Group 040130822113	2,794	422	15%	2,372	85%
Census Block Group 040130822114	945	207	22%	738	78%
Census Block Group 040130822121	2,035	308	15%	1,727	85%
Census Block Group 040130822122	4,176	449	11%	3,727	89%
Census Block Group 040130822131	1,845	148	8%	1,697	92%
Census Block Group 040130822132	3,555	671	19%	2,884	81%
Census Block Group 040130822133	1,573	143	9%	1,430	91%
Census Block Group 040130830001	2,928	421	14%	2,507	86%
Census Block Group 040130830002	1,638	19	1%	1,619	99%
Census Block Group 040130830003	0	0	0%	0	0%
Census Block Group 040130830004	1,088	193	18%	895	82%
Census Block Group 040130830005	1,567	0	0%	1,567	100%
Census Block Group 040130927051	2,062	313	15%	1,749	85%
Census Block Group 040130927081	214	34	16%	180	84%
Census Block Group 040130927082	1,907	839	44%	1,068	56%
Census Block Group 040130927093	889	548	62%	341	38%
Census Block Group 040130927101	2,705	912	34%	1,793	66%
Census Block Group 040130927102	2,996	1,280	43%	1,716	57%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040130927111	2,556	929	36%	1,627	64%
Census Block Group 040130927112	1,581	385	24%	1,196	76%
Census Block Group 040130927121	3,097	471	15%	2,626	85%
Census Block Group 040130927122	2,214	800	36%	1,414	64%
Census Block Group 040130927131	2,952	889	30%	2,063	70%
Census Block Group 040130927132	2,142	387	18%	1,755	82%
Census Block Group 040130927151	774	132	17%	642	83%
Census Block Group 040130927152	1,602	418	26%	1,184	74%
Census Block Group 040130927153	2,002	335	17%	1,667	83%
Census Block Group 040130927161	1,037	170	16%	867	84%
Census Block Group 040130927162	1,979	417	21%	1,562	79%
Census Block Group 040130927163	956	292	31%	664	69%
Census Block Group 040130927171	3,918	306	8%	3,612	92%
Census Block Group 040130927172	2,214	418	19%	1,796	81%
Census Block Group 040130927181	1,855	375	20%	1,480	80%
Census Block Group 040130927182	2,662	262	10%	2,400	90%
Census Block Group 040130927191	2,980	1,192	40%	1,788	60%
Census Block Group 040130927192	1,915	606	32%	1,309	68%
Census Block Group 040130927201	1,217	389	32%	828	68%
Census Block Group 040130927202	1,700	360	21%	1,340	79%
Census Block Group 040130927203	2,165	1,346	62%	819	38%
Census Block Group 040130927204	1,838	571	31%	1,267	69%
Census Block Group 040130927211	2,183	829	38%	1,354	62%
Census Block Group 040130927212	1,421	598	42%	823	58%
Census Block Group 040130927231	2,923	1,332	46%	1,591	54%
Census Block Group 040130927232	1,442	540	37%	902	63%
Census Block Group 040130927241	2,505	1,373	55%	1,132	45%
Census Block Group 040130927242	1,522	734	48%	788	52%
Census Block Group 040130928021	2,059	334	16%	1,725	84%
Census Block Group 040130928022	1,027	137	13%	890	87%
Census Block Group 040130931041	1,694	322	19%	1,372	81%
Census Block Group 040130931043	2,120	299	14%	1,821	86%
Census Block Group 040130931051	1,133	291	26%	842	74%
Census Block Group 040130931052	299	22	7%	277	93%
Census Block Group 040130931053	2,535	682	27%	1,853	73%
Census Block Group 040130931054	1,289	102	8%	1,187	92%
Census Block Group 040130931061	1,374	390	28%	984	72%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040130931062	1,049	107	10%	942	90%
Census Block Group 040130931063	1,922	275	14%	1,647	86%
Census Block Group 040131094011	931	71	8%	860	92%
Census Block Group 040131094012	1,782	446	25%	1,336	75%
Census Block Group 040131094013	670	93	14%	577	86%
Census Block Group 040131094021	2,229	350	16%	1,879	84%
Census Block Group 040131094022	1,360	138	10%	1,222	90%
Census Block Group 040131095001	2,308	459	20%	1,849	80%
Census Block Group 040131095002	1,362	73	5%	1,289	95%
Census Block Group 040131095003	2,198	99	5%	2,099	95%
Census Block Group 040131096011	2,153	175	8%	1,978	92%
Census Block Group 040131096012	895	271	30%	624	70%
Census Block Group 040131096013	1,504	379	25%	1,125	75%
Census Block Group 040131096021	1,972	152	8%	1,820	92%
Census Block Group 040131096022	3,084	29	1%	3,055	99%
Census Block Group 040131096023	2,785	186	7%	2,599	93%
Census Block Group 040131096031	1,214	142	12%	1,072	88%
Census Block Group 040131096032	427	53	12%	374	88%
Census Block Group 040131096033	1,337	173	13%	1,164	87%
Census Block Group 040131096034	1,138	214	19%	924	81%
Census Block Group 040131096041	3,318	97	3%	3,221	97%
Census Block Group 040131096042	1,110	110	10%	1,000	90%
Census Block Group 040131097021	1,767	232	13%	1,535	87%
Census Block Group 040131097022	2,355	758	32%	1,597	68%
Census Block Group 040131097023	1,796	137	8%	1,659	92%
Census Block Group 040131097031	1,191	24	2%	1,167	98%
Census Block Group 040131097032	1,789	465	26%	1,324	74%
Census Block Group 040131097041	1,736	93	5%	1,643	95%
Census Block Group 040131097042	783	147	19%	636	81%
Census Block Group 040131097051	871	142	16%	729	84%
Census Block Group 040131097052	998	77	8%	921	92%
Census Block Group 040131097061	3,241	153	5%	3,088	95%
Census Block Group 040131097071	1,405	382	27%	1,023	73%
Census Block Group 040131097072	1,090	137	13%	953	87%
Census Block Group 040131097073	2,543	382	15%	2,161	85%
Census Block Group 040131098011	3,749	173	5%	3,576	95%
Census Block Group 040131098012	1,279	74	6%	1,205	94%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040131098021	1,696	187	11%	1,509	89%
Census Block Group 040131098022	1,494	133	9%	1,361	91%
Census Block Group 040131098023	1,439	115	8%	1,324	92%
Census Block Group 040131099001	2,256	187	8%	2,069	92%
Census Block Group 040131099002	1,746	392	22%	1,354	78%
Census Block Group 040131099003	2,173	311	14%	1,862	86%
Census Block Group 040131099004	1,501	41	3%	1,460	97%
Census Block Group 040131100011	2,485	129	5%	2,356	95%
Census Block Group 040131100021	1,786	61	3%	1,725	97%
Census Block Group 040131123011	1,662	69	4%	1,593	96%
Census Block Group 040131123012	2,074	156	8%	1,918	92%
Census Block Group 040131123013	2,253	0	0%	2,253	100%
Census Block Group 040131123021	1,486	29	2%	1,457	98%
Census Block Group 040131123022	1,765	247	14%	1,518	86%
Census Block Group 040131123025	1,436	281	20%	1,155	80%
Census Block Group 040131124011	1,452	98	7%	1,354	93%
Census Block Group 040131124012	2,273	137	6%	2,136	94%
Census Block Group 040131124013	2,469	204	8%	2,265	92%
Census Block Group 040131124021	3,196	57	2%	3,139	98%
Census Block Group 040131124022	1,413	35	2%	1,378	98%
Census Block Group 040131124023	1,622	39	2%	1,583	98%
Census Block Group 040131125021	3,126	124	4%	3,002	96%
Census Block Group 040131125022	1,091	58	5%	1,033	95%
Census Block Group 040131125023	1,780	33	2%	1,747	98%
Census Block Group 040131125041	2,278	335	15%	1,943	85%
Census Block Group 040131125042	1,746	151	9%	1,595	91%
Census Block Group 040131125071	1,804	66	4%	1,738	96%
Census Block Group 040131125072	1,488	95	6%	1,393	94%
Census Block Group 040131125081	2,412	165	7%	2,247	93%
Census Block Group 040131125101	1,023	102	10%	921	90%
Census Block Group 040131125102	1,478	239	16%	1,239	84%
Census Block Group 040131125103	2,242	62	3%	2,180	97%
Census Block Group 040131125121	440	114	26%	326	74%
Census Block Group 040131125122	220	4	2%	216	98%
Census Block Group 040131125141	2,427	367	15%	2,060	85%
Census Block Group 040131125142	2,106	644	31%	1,462	69%
Census Block Group 040131125151	1,074	173	16%	901	84%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040131125152	1,735	341	20%	1,394	80%
Census Block Group 040131125153	1,785	246	14%	1,539	86%
Census Block Group 040131125161	0	0	0%	0	0%
Census Block Group 040131125162	2,696	99	4%	2,597	96%
Census Block Group 040131125163	2,025	155	8%	1,870	92%
Census Block Group 040131125171	1,838	318	17%	1,520	83%
Census Block Group 040131125172	1,623	498	31%	1,125	69%
Census Block Group 040131125173	1,809	268	15%	1,541	85%
Census Block Group 040131125181	2,053	128	6%	1,925	94%
Census Block Group 040131125182	3,116	418	13%	2,698	87%
Census Block Group 040131125191	3,056	95	3%	2,961	97%
Census Block Group 040131125192	2,117	5	0%	2,112	100%
Census Block Group 040131125201	1,764	192	11%	1,572	89%
Census Block Group 040131125202	2,399	329	14%	2,070	86%
Census Block Group 040131125211	2,129	37	2%	2,092	98%
Census Block Group 040131125212	930	118	13%	812	87%
Census Block Group 040131125221	3,060	17	1%	3,043	99%
Census Block Group 040131125222	996	158	16%	838	84%
Census Block Group 040131125223	2,787	232	8%	2,555	92%
Census Block Group 040131125231	2,396	290	12%	2,106	88%
Census Block Group 040131125232	0	0	0%	0	0%
Census Block Group 040131125233	2,039	169	8%	1,870	92%
Census Block Group 040131125241	3,079	543	18%	2,536	82%
Census Block Group 040131125242	1,979	82	4%	1,897	96%
Census Block Group 040131125243	2	2	100%	0	0%
Census Block Group 040131166181	2,865	700	24%	2,165	76%
Census Block Group 040131166182	2,551	739	29%	1,812	71%
Census Block Group 040131166191	1,708	534	31%	1,174	69%
Census Block Group 040131166201	644	340	53%	304	47%
Census Block Group 040131166202	1,721	699	41%	1,022	59%
Census Block Group 040131166203	1,541	273	18%	1,268	82%
Census Block Group 040131166204	2,479	658	27%	1,821	73%
Census Block Group 040131166205	1,661	664	40%	997	60%
Census Block Group 040131166211	3,489	1,087	31%	2,402	69%
Census Block Group 040131166212	2,309	754	33%	1,555	67%
Census Block Group 040137233041	1,527	656	43%	871	57%
Census Block Group 040137233071	2,341	1,577	67%	764	33%

Geographic Area	Total Population	White (Non-Hispanic) Population	% White	Minority Population	% Minority
Census Block Group 040139410001	2,968	43	1%	2,925	99%
Census Block Group 040139809001	315	233	74%	82	26%
Aggregate Reference Area	**573,490**	**138,817**	**24%**	**434,673**	**76%**
Arizona	**7,172,282**	**3,801,121**	**53%**	**3,371,161**	**47%**
United States	**331,097,593**	**194,886,464**	**59%**	**136,211,129**	**41%**

SOURCE: US Census Bureau, 2018-2022 American Community Survey 5-Year Estimates.

APPENDIX F

TABLE F-2
SELECTED DEMOGRAPHIC CHARACTERISTIC (POVERTY) BY CENSUS BLOCK GROUP

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040130610101	676	2.60	$23,668	6%
Census Block Group 040130610102	633	2.64	$23,883	8%
Census Block Group 040130610103	1,219	2.26	$21,839	9%
Census Block Group 040130610111	1,126	3.07	$26,197	3%
Census Block Group 040130610112	568	2.57	$23,507	6%
Census Block Group 040130610113	930	3.41	$28,026	4%
Census Block Group 040130610131	818	2.99	$25,766	12%
Census Block Group 040130610132	1,275	3.55	$28,779	13%
Census Block Group 040130610141	857	3.01	$25,874	2%
Census Block Group 040130610142	1,169	2.30	$22,054	3%
Census Block Group 040130610143	507	1.97	$20,279	6%
Census Block Group 040130610151	888	2.57	$23,507	10%
Census Block Group 040130610152	230	2.16	$21,301	4%
Census Block Group 040130610153	782	3.38	$27,864	5%
Census Block Group 040130610181	1,355	1.72	$18,934	1%
Census Block Group 040130610182	966	1.70	$18,826	5%
Census Block Group 040130610183	877	1.73	$18,987	2%
Census Block Group 040130610201	341	2.65	$23,937	9%
Census Block Group 040130610202	349	3.33	$27,595	0%
Census Block Group 040130610203	531	2.84	$24,959	10%
Census Block Group 040130610211	548	3.36	$27,757	5%
Census Block Group 040130610241	717	3.07	$26,197	3%
Census Block Group 040130610433	143	2.53	$23,291	5%
Census Block Group 040130610452	713	2.58	$23,560	2%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040130610461	1,047	2.54	$23,345	22%
Census Block Group 040130610462	618	2.84	$24,959	35%
Census Block Group 040130610463	487	3.64	$29,263	0%
Census Block Group 040130610471	794	3.11	$26,412	4%
Census Block Group 040130610472	426	3.62	$29,156	0%
Census Block Group 040130610481	824	3.07	$26,197	15%
Census Block Group 040130610482	624	2.79	$24,690	3%
Census Block Group 040130610491	850	3.14	$26,573	2%
Census Block Group 040130610492	945	3.33	$27,595	6%
Census Block Group 040130610503	934	3.75	$29,855	16%
Census Block Group 040130610511	955	3.56	$28,833	2%
Census Block Group 040130610521	1,095	3.63	$29,209	5%
Census Block Group 040130610522	1,534	2.64	$23,883	6%
Census Block Group 040130610523	163	3.05	$26,089	11%
Census Block Group 040130610531	1,293	3.05	$26,089	4%
Census Block Group 040130610532	699	2.60	$23,668	13%
Census Block Group 040130610533	431	3.93	$30,823	14%
Census Block Group 040130610541	650	2.71	$24,260	3%
Census Block Group 040130610542	1,290	1.80	$19,364	6%
Census Block Group 040130610543	1,140	2.28	$21,946	7%
Census Block Group 040130610551	951	3.05	$26,089	10%
Census Block Group 040130610552	878	3.47	$28,349	4%
Census Block Group 040130610582	1,219	2.50	$23,130	0%
Census Block Group 040130610631	597	2.38	$22,484	13%
Census Block Group 040130610641	987	2.72	$24,314	9%
Census Block Group 040130611001	0	0	N/A	0%
Census Block Group 040130611002	186	3.54	$28,725	0%
Census Block Group 040130611003	416	2.66	$23,991	0%
Census Block Group 040130612001	230	3.18	$26,788	18%
Census Block Group 040130612002	924	1.97	$20,279	22%
Census Block Group 040130612003	358	4.81	$35,558	4%
Census Block Group 040130612004	218	2.11	$21,032	5%
Census Block Group 040130612005	449	2.24	$21,731	15%
Census Block Group 040130613001	731	3.26	$27,219	10%
Census Block Group 040130614011	222	2.75	$24,475	43%
Census Block Group 040130614012	486	3.01	$25,874	23%
Census Block Group 040130614021	655	3.36	$27,757	21%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040130614022	505	3.64	$29,263	4%
Census Block Group 040130614023	880	2.81	$24,798	30%
Census Block Group 040130820021	817	3.03	$25,981	21%
Census Block Group 040130820022	839	2.21	$21,570	11%
Census Block Group 040130820023	785	2.46	$22,915	12%
Census Block Group 040130820071	587	3.03	$25,981	17%
Census Block Group 040130820072	581	3.50	$28,510	4%
Census Block Group 040130820081	327	4.32	$32,922	0%
Census Block Group 040130820082	712	3.96	$30,985	5%
Census Block Group 040130820083	545	2.89	$25,228	8%
Census Block Group 040130820091	667	3.37	$27,811	31%
Census Block Group 040130820092	660	4.32	$32,922	5%
Census Block Group 040130820101	513	3.98	$31,092	12%
Census Block Group 040130820102	827	4.20	$32,276	4%
Census Block Group 040130820121	431	4.18	$32,168	7%
Census Block Group 040130820122	920	3.69	$29,532	11%
Census Block Group 040130820123	583	3.32	$27,542	11%
Census Block Group 040130820161	0	0	N/A	0%
Census Block Group 040130820162	925	3.40	$27,972	16%
Census Block Group 040130820171	598	3.98	$31,092	35%
Census Block Group 040130820172	0	0	N/A	0%
Census Block Group 040130820173	918	2.99	$25,766	5%
Census Block Group 040130820181	793	3.33	$27,595	9%
Census Block Group 040130820182	810	3.38	$27,864	3%
Census Block Group 040130820191	288	2.45	$22,861	5%
Census Block Group 040130820192	533	3.41	$28,026	9%
Census Block Group 040130820201	648	3.11	$26,412	6%
Census Block Group 040130820202	898	2.99	$25,766	4%
Census Block Group 040130820211	493	3.22	$27,004	2%
Census Block Group 040130820212	322	3.22	$27,004	3%
Census Block Group 040130820221	1,002	4.18	$32,168	7%
Census Block Group 040130820222	884	1.72	$18,934	9%
Census Block Group 040130820231	421	2.72	$24,314	7%
Census Block Group 040130820232	801	3.02	$25,928	12%
Census Block Group 040130820233	669	3.08	$26,250	4%
Census Block Group 040130820241	377	3.46	$28,295	24%
Census Block Group 040130820242	1,335	2.20	$21,516	6%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040130820251	1,085	2.99	$25,766	6%
Census Block Group 040130820261	1,119	2.87	$25,121	6%
Census Block Group 040130820262	417	4.81	$35,558	14%
Census Block Group 040130820263	570	3.25	$27,165	0%
Census Block Group 040130820271	545	3.15	$26,627	15%
Census Block Group 040130820272	106	2.98	$25,712	11%
Census Block Group 040130820273	934	3.60	$29,048	17%
Census Block Group 040130820281	692	2.82	$24,852	24%
Census Block Group 040130820282	793	3.59	$28,994	12%
Census Block Group 040130822041	851	5.18	$36,580	16%
Census Block Group 040130822042	260	3.90	$30,662	12%
Census Block Group 040130822043	437	3.84	$30,339	4%
Census Block Group 040130822051	613	4.46	$33,675	4%
Census Block Group 040130822052	377	4.13	$31,899	8%
Census Block Group 040130822053	810	3.31	$27,488	14%
Census Block Group 040130822061	227	3.44	$28,187	5%
Census Block Group 040130822062	252	4.40	$33,352	13%
Census Block Group 040130822063	547	4.64	$34,643	6%
Census Block Group 040130822071	310	3.87	$30,501	25%
Census Block Group 040130822072	607	3.90	$30,662	3%
Census Block Group 040130822081	484	3.69	$29,532	26%
Census Block Group 040130822082	213	4.03	$31,361	0%
Census Block Group 040130822083	234	3.74	$29,801	8%
Census Block Group 040130822091	257	3.93	$30,823	34%
Census Block Group 040130822092	725	2.95	$25,551	19%
Census Block Group 040130822101	589	4.22	$32,384	4%
Census Block Group 040130822102	314	3.14	$26,573	25%
Census Block Group 040130822103	467	3.51	$28,564	2%
Census Block Group 040130822111	204	3.63	$29,209	25%
Census Block Group 040130822112	968	3.51	$28,564	7%
Census Block Group 040130822113	747	3.74	$29,801	5%
Census Block Group 040130822114	295	3.20	$26,896	0%
Census Block Group 040130822121	651	3.13	$26,519	23%
Census Block Group 040130822122	1,024	4.08	$31,630	0%
Census Block Group 040130822131	391	4.72	$35,074	0%
Census Block Group 040130822132	839	4.24	$32,491	15%
Census Block Group 040130822133	528	2.98	$25,712	0%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040130830001	951	3.08	$26,250	29%
Census Block Group 040130830002	539	3.04	$26,035	19%
Census Block Group 040130830003	0	0	N/A	0%
Census Block Group 040130830004	448	2.43	$22,753	19%
Census Block Group 040130830005	631	2.48	$23,022	24%
Census Block Group 040130927051	779	2.65	$23,937	18%
Census Block Group 040130927081	74	2.89	$25,228	16%
Census Block Group 040130927082	670	2.82	$24,852	8%
Census Block Group 040130927093	316	2.81	$24,798	0%
Census Block Group 040130927101	769	3.51	$28,564	4%
Census Block Group 040130927102	919	3.25	$27,165	8%
Census Block Group 040130927111	682	3.65	$29,317	4%
Census Block Group 040130927112	478	3.31	$27,488	9%
Census Block Group 040130927121	927	3.34	$27,649	7%
Census Block Group 040130927122	667	3.29	$27,380	4%
Census Block Group 040130927131	798	3.67	$29,425	5%
Census Block Group 040130927132	660	3.24	$27,111	5%
Census Block Group 040130927151	267	2.90	$25,282	4%
Census Block Group 040130927152	494	3.24	$27,111	13%
Census Block Group 040130927153	566	3.53	$28,671	1%
Census Block Group 040130927161	308	3.37	$27,811	43%
Census Block Group 040130927162	546	3.62	$29,156	12%
Census Block Group 040130927163	274	3.45	$28,241	24%
Census Block Group 040130927171	1,030	3.80	$30,124	24%
Census Block Group 040130927172	600	3.68	$29,478	13%
Census Block Group 040130927181	477	3.85	$30,393	18%
Census Block Group 040130927182	806	3.30	$27,434	47%
Census Block Group 040130927191	1,155	2.58	$23,560	10%
Census Block Group 040130927192	566	3.37	$27,811	5%
Census Block Group 040130927201	470	2.59	$23,614	0%
Census Block Group 040130927202	419	4.02	$31,308	12%
Census Block Group 040130927203	717	3.00	$25,820	12%
Census Block Group 040130927204	781	2.35	$22,323	1%
Census Block Group 040130927211	684	3.19	$26,842	6%
Census Block Group 040130927212	388	3.66	$29,371	6%
Census Block Group 040130927231	1,126	2.58	$23,560	5%
Census Block Group 040130927232	559	2.58	$23,560	11%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040130927241	794	3.15	$26,627	16%
Census Block Group 040130927242	544	2.57	$23,507	2%
Census Block Group 040130928021	791	2.60	$23,668	32%
Census Block Group 040130928022	272	3.78	$30,016	30%
Census Block Group 040130931041	714	2.37	$22,431	37%
Census Block Group 040130931043	504	3.87	$30,501	22%
Census Block Group 040130931051	341	3.32	$27,542	24%
Census Block Group 040130931052	210	1.42	$17,320	13%
Census Block Group 040130931053	1,085	2.34	$22,269	44%
Census Block Group 040130931054	370	3.48	$28,402	21%
Census Block Group 040130931061	325	4.23	$32,437	13%
Census Block Group 040130931062	448	2.34	$22,269	40%
Census Block Group 040130931063	292	6.50	$41,960	46%
Census Block Group 040131094011	262	3.55	$28,779	8%
Census Block Group 040131094012	724	2.46	$22,915	25%
Census Block Group 040131094013	244	2.75	$24,475	23%
Census Block Group 040131094021	488	4.55	$34,159	15%
Census Block Group 040131094022	292	4.63	$34,589	0%
Census Block Group 040131095001	577	4.00	$31,200	10%
Census Block Group 040131095002	366	3.72	$29,694	13%
Census Block Group 040131095003	525	4.17	$32,115	7%
Census Block Group 040131096011	558	3.86	$30,447	32%
Census Block Group 040131096012	378	2.37	$22,431	40%
Census Block Group 040131096013	420	3.58	$28,940	3%
Census Block Group 040131096021	516	3.82	$30,232	12%
Census Block Group 040131096022	1,001	3.08	$26,250	12%
Census Block Group 040131096023	570	4.86	$35,827	12%
Census Block Group 040131096031	272	4.46	$33,675	5%
Census Block Group 040131096032	170	2.51	$23,184	14%
Census Block Group 040131096033	408	3.28	$27,326	9%
Census Block Group 040131096034	298	3.82	$30,232	3%
Census Block Group 040131096041	789	4.21	$32,330	12%
Census Block Group 040131096042	336	3.30	$27,434	27%
Census Block Group 040131097021	478	3.70	$29,586	22%
Census Block Group 040131097022	504	4.67	$34,805	7%
Census Block Group 040131097023	431	4.17	$32,115	22%
Census Block Group 040131097031	377	3.16	$26,681	5%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040131097032	629	2.84	$24,959	21%
Census Block Group 040131097041	410	4.23	$32,437	12%
Census Block Group 040131097042	224	3.50	$28,510	17%
Census Block Group 040131097051	267	3.26	$27,219	2%
Census Block Group 040131097052	242	4.12	$31,846	15%
Census Block Group 040131097061	906	3.58	$28,940	26%
Census Block Group 040131097071	403	3.49	$28,456	36%
Census Block Group 040131097072	352	3.10	$26,358	21%
Census Block Group 040131097073	860	2.96	$25,605	32%
Census Block Group 040131098011	924	4.06	$31,523	19%
Census Block Group 040131098012	394	3.25	$27,165	26%
Census Block Group 040131098021	471	3.59	$28,994	11%
Census Block Group 040131098022	360	4.14	$31,953	29%
Census Block Group 040131098023	364	3.95	$30,931	7%
Census Block Group 040131099001	519	4.35	$33,083	16%
Census Block Group 040131099002	540	3.23	$27,057	21%
Census Block Group 040131099003	563	3.86	$30,447	17%
Census Block Group 040131099004	313	4.77	$35,343	0%
Census Block Group 040131100011	561	4.43	$33,513	35%
Census Block Group 040131100021	416	4.29	$32,760	6%
Census Block Group 040131123011	1,015	1.64	$18,503	28%
Census Block Group 040131123012	600	3.46	$28,295	4%
Census Block Group 040131123013	513	4.39	$33,298	3%
Census Block Group 040131123021	386	3.85	$30,393	15%
Census Block Group 040131123022	555	3.17	$26,735	45%
Census Block Group 040131123025	372	3.86	$30,447	15%
Census Block Group 040131124011	440	3.30	$27,434	24%
Census Block Group 040131124012	668	3.40	$27,972	7%
Census Block Group 040131124013	675	3.66	$29,371	10%
Census Block Group 040131124021	663	4.82	$35,612	21%
Census Block Group 040131124022	320	4.42	$33,460	6%
Census Block Group 040131124023	393	4.13	$31,899	18%
Census Block Group 040131125021	740	4.22	$32,384	15%
Census Block Group 040131125022	309	3.53	$28,671	30%
Census Block Group 040131125023	354	5.03	$36,580	8%
Census Block Group 040131125041	587	3.86	$30,447	15%
Census Block Group 040131125042	597	2.92	$25,390	30%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040131125071	598	3.02	$25,928	9%
Census Block Group 040131125072	485	3.07	$26,197	19%
Census Block Group 040131125081	736	3.28	$27,326	19%
Census Block Group 040131125101	262	3.90	$30,662	3%
Census Block Group 040131125102	398	3.71	$29,640	0%
Census Block Group 040131125103	530	4.23	$32,437	16%
Census Block Group 040131125121	138	3.19	$26,842	1%
Census Block Group 040131125122	69	3.19	$26,842	72%
Census Block Group 040131125141	720	3.37	$27,811	14%
Census Block Group 040131125142	741	2.84	$24,959	2%
Census Block Group 040131125151	321	3.35	$27,703	0%
Census Block Group 040131125152	456	3.80	$30,124	4%
Census Block Group 040131125153	533	3.35	$27,703	16%
Census Block Group 040131125161	0	0	N/A	0%
Census Block Group 040131125162	766	3.52	$28,618	7%
Census Block Group 040131125163	528	3.83	$30,285	2%
Census Block Group 040131125171	499	3.68	$29,478	7%
Census Block Group 040131125172	516	3.15	$26,627	14%
Census Block Group 040131125173	446	4.06	$31,523	13%
Census Block Group 040131125181	491	4.18	$32,168	10%
Census Block Group 040131125182	768	4.04	$31,415	14%
Census Block Group 040131125191	634	4.82	$35,612	35%
Census Block Group 040131125192	532	3.98	$31,092	41%
Census Block Group 040131125201	394	4.48	$33,782	22%
Census Block Group 040131125202	773	3.10	$26,358	21%
Census Block Group 040131125211	795	2.68	$24,098	14%
Census Block Group 040131125212	486	1.91	$19,956	3%
Census Block Group 040131125221	719	4.26	$32,599	15%
Census Block Group 040131125222	333	2.99	$25,766	22%
Census Block Group 040131125223	599	4.65	$34,697	2%
Census Block Group 040131125231	846	2.83	$24,905	12%
Census Block Group 040131125232	0	0	N/A	0%
Census Block Group 040131125233	651	3.13	$26,519	6%
Census Block Group 040131125241	1,415	2.18	$21,408	16%
Census Block Group 040131125242	613	3.23	$27,057	19%
Census Block Group 040131125243	0	0	N/A	0%
Census Block Group 040131166181	860	3.33	$27,595	1%

Geographic Area	Number of Households	Average Household Size	2024 HHS Poverty Guideline	% of Households Below Poverty
Census Block Group 040131166182	834	3.05	$26,089	10%
Census Block Group 040131166191	422	4.05	$31,469	3%
Census Block Group 040131166201	199	3.24	$27,111	8%
Census Block Group 040131166202	436	3.94	$30,877	1%
Census Block Group 040131166203	394	3.90	$30,662	0%
Census Block Group 040131166204	584	4.24	$32,491	12%
Census Block Group 040131166205	449	3.69	$29,532	6%
Census Block Group 040131166211	785	4.44	$33,567	4%
Census Block Group 040131166212	659	3.50	$28,510	13%
Census Block Group 040137233041	507	3.01	$25,874	28%
Census Block Group 040137233071	876	2.67	$24,045	3%
Census Block Group 040139410001	688	4.31	$32,868	40%
Census Block Group 040139809001	66	4.77	$35,343	0%
Aggregate Reference Area	**174,570**	**3.37**	**$27,830**	**12%**
Arizona	**2,739,136**	**2.56**	**$23,453**	**12%**
United States	**125,736,353**	**2.57**	**$23,507**	**12%**

SOURCE: US Census Bureau, 2022; US Department of Health and Human Services, 2024.

APPENDIX F

TABLE F-3
COMMUNITIES OF ENVIRONMENTAL JUSTICE CONCERN

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040130610111	66%	X
Census Block Group 040130610112	69%	X
Census Block Group 040130610113	63%	X
Census Block Group 040130610131	50%	12%
Census Block Group 040130610132	X	13%
Census Block Group 040130610141	54%	X
Census Block Group 040130610142	71%	X
Census Block Group 040130610153	71%	X
Census Block Group 040130610203	62%	X
Census Block Group 040130610211	56%	X
Census Block Group 040130610433	54%	X
Census Block Group 040130610452	55%	X
Census Block Group 040130610461	69%	22%
Census Block Group 040130610462	72%	35%
Census Block Group 040130610463	59%	X
Census Block Group 040130610472	69%	X
Census Block Group 040130610481	X	15%
Census Block Group 040130610491	65%	X
Census Block Group 040130610492	55%	X
Census Block Group 040130610503	59%	16%
Census Block Group 040130610511	70%	X
Census Block Group 040130610521	70%	X
Census Block Group 040130610522	69%	X
Census Block Group 040130610531	76%	X
Census Block Group 040130610532	54%	13%
Census Block Group 040130610533	X	14%
Census Block Group 040130610543	53%	X
Census Block Group 040130610582	59%	X
Census Block Group 040130610631	59%	13%
Census Block Group 040130611001	54%	X
Census Block Group 040130612001	85%	18%
Census Block Group 040130612002	53%	22%
Census Block Group 040130612003	94%	X
Census Block Group 040130612005	97%	15%
Census Block Group 040130613001	74%	X

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040130614011	77%	43%
Census Block Group 040130614012	85%	23%
Census Block Group 040130614021	94%	21%
Census Block Group 040130614022	93%	X
Census Block Group 040130614023	85%	30%
Census Block Group 040130820021	73%	21%
Census Block Group 040130820022	72%	X
Census Block Group 040130820023	72%	X
Census Block Group 040130820071	72%	17%
Census Block Group 040130820072	88%	X
Census Block Group 040130820081	86%	X
Census Block Group 040130820082	89%	X
Census Block Group 040130820083	86%	X
Census Block Group 040130820091	89%	31%
Census Block Group 040130820092	86%	X
Census Block Group 040130820101	83%	12%
Census Block Group 040130820102	80%	X
Census Block Group 040130820121	58%	X
Census Block Group 040130820122	82%	X
Census Block Group 040130820123	75%	X
Census Block Group 040130820162	77%	16%
Census Block Group 040130820171	95%	35%
Census Block Group 040130820173	84%	X
Census Block Group 040130820181	83%	X
Census Block Group 040130820182	93%	X
Census Block Group 040130820192	70%	X
Census Block Group 040130820201	60%	X
Census Block Group 040130820202	54%	X
Census Block Group 040130820211	74%	X
Census Block Group 040130820212	57%	X
Census Block Group 040130820221	77%	X
Census Block Group 040130820222	65%	X
Census Block Group 040130820231	64%	X
Census Block Group 040130820232	73%	12%
Census Block Group 040130820233	63%	X
Census Block Group 040130820241	67%	24%
Census Block Group 040130820242	67%	X
Census Block Group 040130820251	61%	X

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040130820261	62%	X
Census Block Group 040130820262	69%	14%
Census Block Group 040130820263	69%	X
Census Block Group 040130820271	77%	15%
Census Block Group 040130820272	81%	X
Census Block Group 040130820273	75%	17%
Census Block Group 040130820281	95%	24%
Census Block Group 040130820282	93%	12%
Census Block Group 040130822041	88%	16%
Census Block Group 040130822042	85%	X
Census Block Group 040130822043	84%	X
Census Block Group 040130822051	82%	X
Census Block Group 040130822052	85%	X
Census Block Group 040130822053	89%	14%
Census Block Group 040130822061	91%	X
Census Block Group 040130822062	89%	13%
Census Block Group 040130822063	89%	X
Census Block Group 040130822071	79%	25%
Census Block Group 040130822072	71%	X
Census Block Group 040130822081	95%	26%
Census Block Group 040130822082	86%	X
Census Block Group 040130822083	78%	X
Census Block Group 040130822091	89%	34%
Census Block Group 040130822092	99%	19%
Census Block Group 040130822101	75%	X
Census Block Group 040130822102	89%	25%
Census Block Group 040130822103	82%	X
Census Block Group 040130822111	84%	25%
Census Block Group 040130822112	83%	X
Census Block Group 040130822113	85%	X
Census Block Group 040130822114	78%	X
Census Block Group 040130822121	85%	23%
Census Block Group 040130822122	89%	X
Census Block Group 040130822131	92%	X
Census Block Group 040130822132	81%	15%
Census Block Group 040130822133	91%	X
Census Block Group 040130830001	86%	29%
Census Block Group 040130830002	99%	19%

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040130830004	82%	19%
Census Block Group 040130830005	100%	24%
Census Block Group 040130927051	85%	18%
Census Block Group 040130927081	84%	16%
Census Block Group 040130927082	56%	X
Census Block Group 040130927101	66%	X
Census Block Group 040130927102	57%	X
Census Block Group 040130927111	64%	X
Census Block Group 040130927112	76%	X
Census Block Group 040130927121	85%	X
Census Block Group 040130927122	64%	X
Census Block Group 040130927131	70%	X
Census Block Group 040130927132	82%	X
Census Block Group 040130927151	83%	X
Census Block Group 040130927152	74%	13%
Census Block Group 040130927153	83%	X
Census Block Group 040130927161	84%	43%
Census Block Group 040130927162	79%	X
Census Block Group 040130927163	69%	24%
Census Block Group 040130927171	92%	24%
Census Block Group 040130927172	81%	13%
Census Block Group 040130927181	80%	18%
Census Block Group 040130927182	90%	47%
Census Block Group 040130927191	60%	X
Census Block Group 040130927192	68%	X
Census Block Group 040130927201	68%	X
Census Block Group 040130927202	79%	X
Census Block Group 040130927204	69%	X
Census Block Group 040130927211	62%	X
Census Block Group 040130927212	58%	X
Census Block Group 040130927231	54%	X
Census Block Group 040130927232	63%	X
Census Block Group 040130927241	X	16%
Census Block Group 040130927242	52%	X
Census Block Group 040130928021	84%	32%
Census Block Group 040130928022	87%	30%
Census Block Group 040130931041	81%	37%
Census Block Group 040130931043	86%	22%

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040130931051	74%	24%
Census Block Group 040130931052	93%	13%
Census Block Group 040130931053	73%	44%
Census Block Group 040130931054	92%	21%
Census Block Group 040130931061	72%	13%
Census Block Group 040130931062	90%	40%
Census Block Group 040130931063	86%	46%
Census Block Group 040131094011	92%	X
Census Block Group 040131094012	75%	25%
Census Block Group 040131094013	86%	23%
Census Block Group 040131094021	84%	15%
Census Block Group 040131094022	90%	X
Census Block Group 040131095001	80%	X
Census Block Group 040131095002	95%	13%
Census Block Group 040131095003	95%	X
Census Block Group 040131096011	92%	32%
Census Block Group 040131096012	70%	40%
Census Block Group 040131096013	75%	X
Census Block Group 040131096021	92%	12%
Census Block Group 040131096022	99%	X
Census Block Group 040131096023	93%	12%
Census Block Group 040131096031	88%	X
Census Block Group 040131096032	88%	14%
Census Block Group 040131096033	87%	X
Census Block Group 040131096034	81%	X
Census Block Group 040131096041	97%	X
Census Block Group 040131096042	90%	27%
Census Block Group 040131097021	87%	22%
Census Block Group 040131097022	68%	X
Census Block Group 040131097023	92%	22%
Census Block Group 040131097031	98%	X
Census Block Group 040131097032	74%	21%
Census Block Group 040131097041	95%	12%
Census Block Group 040131097042	81%	17%
Census Block Group 040131097051	84%	X
Census Block Group 040131097052	92%	15%
Census Block Group 040131097061	95%	26%
Census Block Group 040131097071	73%	36%

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040131097072	87%	21%
Census Block Group 040131097073	85%	32%
Census Block Group 040131098011	95%	19%
Census Block Group 040131098012	94%	26%
Census Block Group 040131098021	89%	X
Census Block Group 040131098022	91%	29%
Census Block Group 040131098023	92%	X
Census Block Group 040131099001	92%	16%
Census Block Group 040131099002	78%	21%
Census Block Group 040131099003	86%	17%
Census Block Group 040131099004	97%	X
Census Block Group 040131100011	95%	35%
Census Block Group 040131100021	97%	X
Census Block Group 040131123011	96%	28%
Census Block Group 040131123012	92%	X
Census Block Group 040131123013	100%	X
Census Block Group 040131123021	98%	15%
Census Block Group 040131123022	86%	45%
Census Block Group 040131123025	80%	15%
Census Block Group 040131124011	93%	24%
Census Block Group 040131124012	94%	X
Census Block Group 040131124013	92%	X
Census Block Group 040131124021	98%	21%
Census Block Group 040131124022	98%	X
Census Block Group 040131124023	98%	18%
Census Block Group 040131125021	96%	15%
Census Block Group 040131125022	95%	30%
Census Block Group 040131125023	98%	X
Census Block Group 040131125041	85%	15%
Census Block Group 040131125042	91%	30%
Census Block Group 040131125071	96%	X
Census Block Group 040131125072	94%	19%
Census Block Group 040131125081	93%	19%
Census Block Group 040131125101	90%	X
Census Block Group 040131125102	84%	X
Census Block Group 040131125103	97%	16%
Census Block Group 040131125121	74%	X
Census Block Group 040131125122	98%	72%

Geographic Area	% Minority	% Households Below Poverty
Census Block Group 040131125141	85%	14%
Census Block Group 040131125142	69%	X
Census Block Group 040131125151	84%	X
Census Block Group 040131125152	80%	X
Census Block Group 040131125153	86%	16%
Census Block Group 040131125162	96%	X
Census Block Group 040131125163	92%	X
Census Block Group 040131125171	83%	X
Census Block Group 040131125172	69%	14%
Census Block Group 040131125173	85%	13%
Census Block Group 040131125181	94%	X
Census Block Group 040131125182	87%	14%
Census Block Group 040131125191	97%	35%
Census Block Group 040131125192	100%	41%
Census Block Group 040131125201	89%	22%
Census Block Group 040131125202	86%	21%
Census Block Group 040131125211	98%	14%
Census Block Group 040131125212	87%	X
Census Block Group 040131125221	99%	15%
Census Block Group 040131125222	84%	22%
Census Block Group 040131125223	92%	X
Census Block Group 040131125231	88%	X
Census Block Group 040131125233	92%	X
Census Block Group 040131125241	82%	16%
Census Block Group 040131125242	96%	19%
Census Block Group 040131166181	76%	X
Census Block Group 040131166182	71%	X
Census Block Group 040131166191	69%	X
Census Block Group 040131166202	59%	X
Census Block Group 040131166203	82%	X
Census Block Group 040131166204	73%	X
Census Block Group 040131166205	60%	X
Census Block Group 040131166211	69%	X
Census Block Group 040131166212	67%	13%
Census Block Group 040137233041	57%	28%
Census Block Group 040139410001	99%	40%
Aggregate Reference Area	**76%**	**12%**

SOURCE: US Census Bureau, 2022; US Department of Health and Human Services, 2024.