REEVALUATION OF THE 2022 FINAL ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT/RECORD OF DECISION FOR ZIPLINE INTERNATIONAL INC. DRONE PACKAGE DELIVERY OPERATIONS IN PEA RIDGE, ARKANSAS AND SURROUNDING AREA

ZIPLINE INTERNATIONAL INC. AMENDMENT TO OPERATIONS SPECIFICATIONS (OPSPECS)

Introduction and Background

Introduction

This reevaluation evaluates whether supplemental environmental analysis is needed to support the Federal Aviation Administration (FAA) Office of Safety Standards, Flight Standards Service decision to amend Zipline International Inc.'s (Zipline) OpSpecs to allow for up to 400 delivery trips per day and operating 24 hours per day (95% daytime operations and 5% nighttime operations) for operations in Pea Ridge, Arkansas and surrounding area. The affected environment and environmental impacts of Zipline drone package delivery in Pea Ridge, Arkansas and surrounding area were analyzed in the 2022 *Final Environmental Assessment, Zipline International Inc. Drone Package Delivery Operations in Pea Ridge, Arkansas and Surrounding Area* (2022 EA). The FAA's Finding of No Significant Impact (FONSI) and Record of Decision (ROD) were issued for this action on July 14, 2022. This reevaluation evaluates whether supplemental environmental analysis is needed to support the FAA's decision to amend Zipline's OpSpecs.

The FAA's issuance of an amended OpSpecs is a major federal action subject to the requirements of the National Environmental Policy Act of 1969 (NEPA). As such, the FAA must assess the potential environmental impacts of issuing the amended OpSpecs. Department of Transportation (DOT) Order 5610.1D, *DOT's Procedures for Considering Environmental Impacts*, Section 18.c, provides that the FAA may prepare a reevaluation to evaluate an existing NEPA document to determine whether it remains adequate, accurate, and valid, or whether a supplemental analysis is needed. The reevaluation must be done prior to the FAA's completion of an action if there are changes in the proposed action that are relevant to environmental concerns or if there are new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts. In accordance with FAA Order 1050.1G, *FAA National Environmental Policy Act Implementing Procedures*, Section 3.6, the preparation of a supplemental EA is necessary only if a major Federal action remains to occur and (a) the FAA makes substantial changes to the proposed action that are relevant to environmental concerns; or (b) the FAA decides, in its discretion, that there are substantial new circumstances or information about the significance of the adverse effects bearing on the proposed action or its effects.

This reevaluation provides documentation for the above three factors as well as the FAA's conclusion that the contents of the 2022 EA remain current and substantially valid and that the decision to amend the OpSpecs does not require the preparation of a new or supplemental EA or EIS.

<u>Background</u>

The 2022 EA analyzed the potential environmental impacts of Zipline conducting commercial package delivery from one hub location in Pea Ridge, Arkansas (depicted in Figure 1) using the Platform 1 drone ("P1 Zip"). The 2022 EA assessed up to 20 P1 Zip delivery flights per day during daylight hours up to seven days per week, with no flights on holidays. The 2022 EA did not consider nighttime operations. The FAA published a Notice of Availability (NOA) for the draft 2022 EA on June 13, 2022. The FAA received six comment submissions during the 14-day public comment period. These comments were addressed in the final EA. On July 14, 2022, the FAA published a NOA for the final EA and FONSI/ROD.

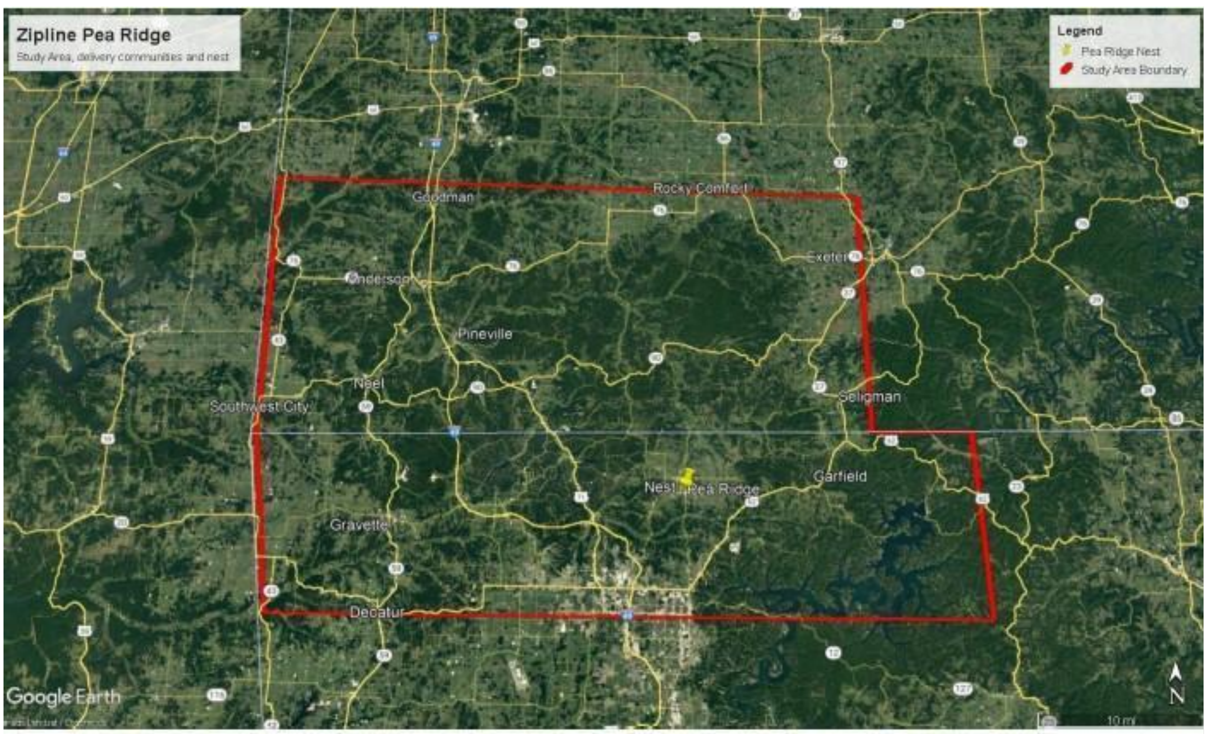

Figure 1. Zipline Operating Area in Arkansas and Missouri

The Zipline P1 Zip used for delivery operations has a maximum takeoff weight of less than 55 pounds, including a maximum payload of approximately 4 pounds. The fixed wing flight platform uses electric power from rechargeable lithium-ion batteries and is launched from the central nest location via a launching system. Returning drones are retrieved using a wire capture line on a recovery system. The aircraft includes a parachute safety system that can be deployed in cases of emergency.

After launch, Zipline's P1 Zip will rise to a cruising altitude between 130 feet and 400 feet above ground level (AGL) and follow a preplanned route to its delivery site. Aircraft will typically fly en route between 250 feet and 400 feet AGL and will always stay above 130 feet AGL except when descending to drop a package or in response to an emergency scenario. The aircraft descends into its delivery loop and releases a package from approximately 60 feet AGL. Packages are carried internally in the aircraft's fuselage and are dropped by opening a set of payload doors on the aircraft. Packages descend to its delivery site under a small parachute. Zipline's aircraft will not touch the ground in any other place than the nest (except during emergency landings) since it remains aerial while conducting deliveries.

A reevaluation was prepared in 2023 to evaluate whether supplemental environmental analysis was needed to support the FAA's decision to amend Zipline's OpSpecs to permit the following actions:

(1) An increase in operations from 20 delivery flights per day to 100 delivery flights per day,

(2) Delivery flights on holidays, and

(3) Delivery flights from 0700 (7:00 AM) to 2200 (10:00 PM) local time.

Based on the 2023 WR and in conformity with FAA Order 1050.1F, Paragraph 9-2.c, the FAA concluded that Zipline's amendment to its OpSpecs conformed to the prior environmental documentation and that the data contained in the 2022 EA remained substantially valid. The preparation of a supplemental or new EA or EIS was not required.

Additionally, a reevaluation was prepared in May 2025 to evaluate whether supplemental environmental analysis was needed to support the FAA's decision to amend Zipline's OpSpecs to permit the following actions:

(1) The scope of operations to include the use of the P2 Zip.

Based on the previous 2025 WR and in conformity with FAA Order 1050.G, the FAA concluded that Zipline's amendment to its OpSpecs conformed to the prior environmental documentation and that the data contained in the 2022 EA remained substantially valid. The preparation of a supplemental or new EA or EIS was not required.

Proposed Action

Zipline has requested an OpSpecs amendment to include up to 400 delivery trips per day and operating 24 hours per day (95% daytime operations and 5% nighttime operations). The operating area and days of operations would remain the same as what was previously analyzed in the 2022 EA, 2023 reevaluation (refer to Chapter 2 of the 2022 EA), and May 2025 reevaluation. The differences are analyzed below under the re-evaluation of environmental consequences.

<u>Unmanned Aircraft Specifications</u>

Zipline's P2 Zip is a highly-automated, electrically-powered vertical takeoff and landing aircraft capable of hover and forward flight. The Zip features a multi-rotor design with 5 propellers and weighs under 63 pounds when combined with its maximum payload weight of 8 pounds.

Zipline locates P2 Zips and their associated docks at Zipline partner sites. Once an order is placed, a package is loaded into a "droid." The droid is stored in the P2 Zip's payload bay and the P2 Zip undocks and flies to the delivery site where it lowers the droid via winch line to a pre-selected delivery site. The P2 Zip has a wingspan of approximately 7.8 feet, a height of approximately 1.8 feet, and a length of approximately 8 feet. P2 Zips are equipped with high-visibility red (left wingtip) and green (right wingtip) LED lights, and aft-directed strobe lights (white) on each wingtip. These lights run continuously during P2 Zip operation, day or night, and are visible for at least 3 statute miles (see Figure 2).

As compared to the P1 Zip, the P2 Zip offers hyper-precise delivery and a larger allowable payload size and introduces the ability to take off and dock automatically. All Zipline aircraft use electric power from rechargeable lithium-ion batteries.

P2 Zips would generally be operated at an altitude of 150–400 feet above ground level (AGL) and always below an altitude of 400 feet AGL while en route to and from delivery locations. At a delivery location, the P2 Zip would descend vertically to a stationary hover approximately 100-400 feet AGL (depending on terrain/airspace) and lower the droid to the ground for delivery of the payload through the droid's bay doors. Once the payload has been released, the P2 Zip would then retract the droid, ascend vertically to a cruise altitude, and depart the delivery area en route back to a site.

The P2 Zip would fly a predefined flight path that is set prior to takeoff. Flight missions are automatically planned by Zipline's flight planning software. A mission originates from a dock, and Zipline's software automatically assigns, deconflicts, and routes each flight to the delivery location and back to a dock. Exclusion zones are designed to keep operations clear from nearby non-participating people and vehicles. Pedestrians or vehicles are not permitted in these areas when Zips are docking or undocking.

As part of normal operations, the P2 Zip may be assigned one of the following missions:

- Delivery. Requires a droid to deliver a payload to a prescribed location.
- Reposition. A P2 Zip moving from one dock to another.

Zipline operations begin with order processing followed by flight phases. A typical flight profile can be broken into the following general flight phases: takeoff, en route outbound, delivery, en route inbound, and landing. Figure 3 depicts these stages, each of which is explained in the following sections.

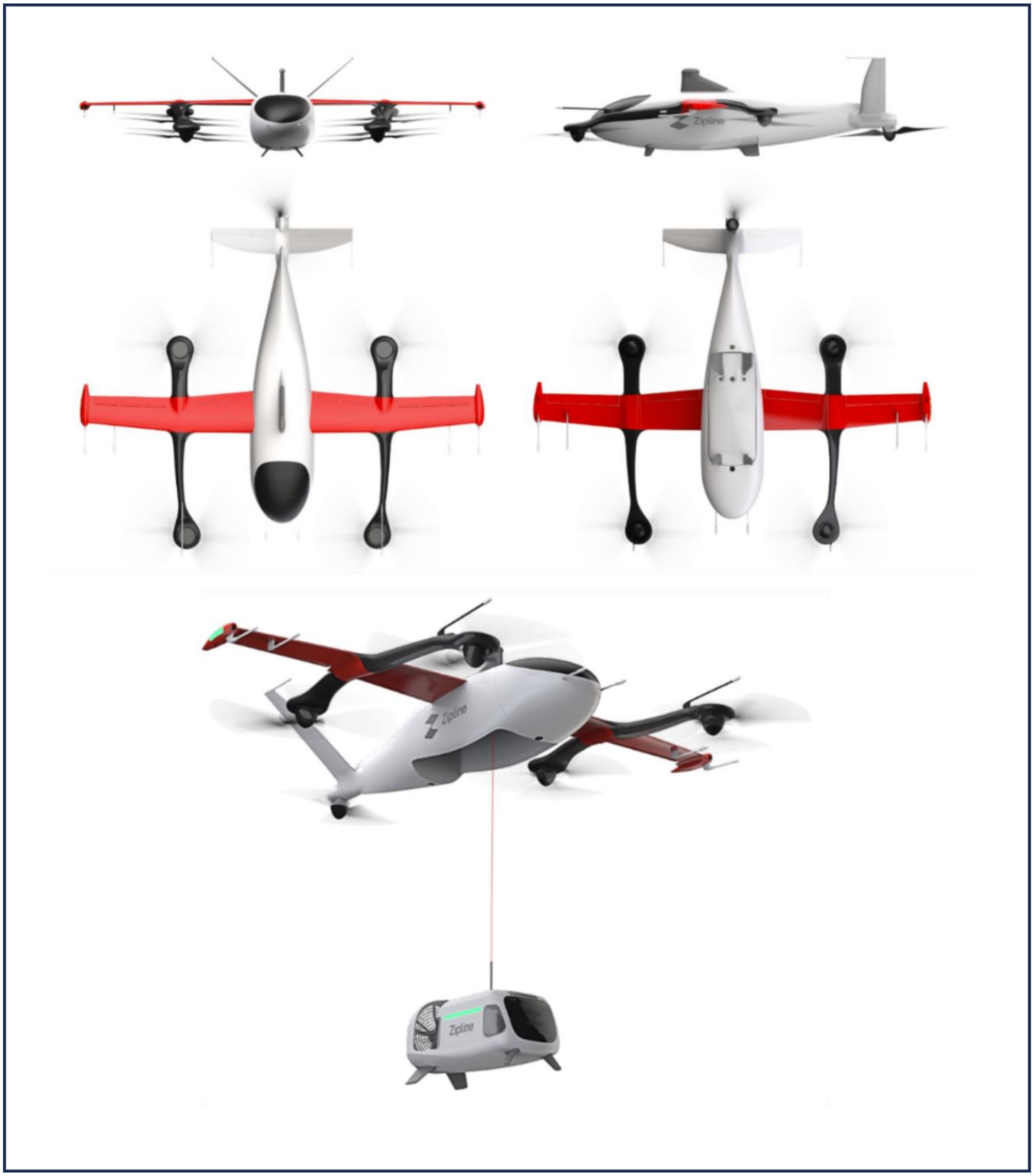

Figure 2. Zipline P2 Zip Profile Views (above) and Droid (below)

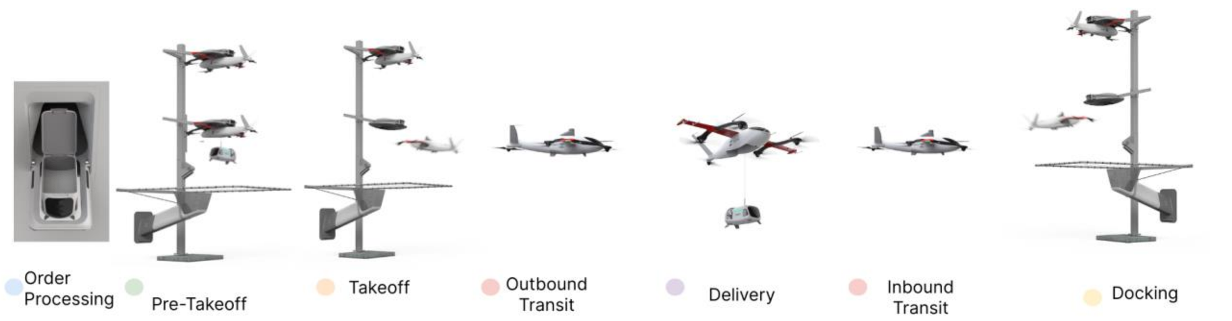

Figure 3. Zipline P2 Zip Mission Profile

Flight Operations

Order Processing

During order processing, Zipline's partner loads the package into the droid.

Pre-Takeoff

During the pre-takeoff process, Zipline's system would ensure an airworthiness release is available and would complete automated preflight checks of the UAS and airspace. If on a delivery operation, the shipping partner would then load a package.

Takeoff

Once cleared for takeoff from a dock, the P2 Zip undocks and ascends vertically to the en route altitude (330 feet AGL) on its pre-planned flight path.

En Route Outbound

The en route outbound phase is the part of flight in which the fully loaded P2 Zip transits from the dock to a delivery point on a predefined flight path. During this flight phase, the P2 Zip transitions from vertical rotor flight for takeoff to horizontal wing-borne flight for outbound flight. The P2 Zip would typically transit at an altitude of 330 ft AGL and an airspeed of 47 miles per hour (mph). The Zip would not exceed 76 mph at any point during the flight.

Delivery

The delivery phase consists of descent from the en route altitude to a delivery point, such as a residential yard, driveway, parking lot, or common area. The P2 Zip transitions from horizontal wing-borne flight for horizontal flight to vertical rotor flight for hovering. The P2 Zip hovers at 330 feet AGL while maintaining position over the delivery point. The droid is unstowed from the P2 Zip and lowered to the ground via the winch line. As the droid descends, the system will attempt to identify and evaluate the target delivery point. If the droid detects an obstacle at or near the delivery point, an adjusted delivery point may be automatically identified. If there is an issue with delivery, the droid may be automatically retracted back into the Zip. Nominally, the droid descends to ground level, delivers the package at the delivery target, and then is retracted back into the Zip. The P2 Zip would then proceed to climb vertically back to en route altitude. The total hover time for delivery operations would be approximately 75 seconds.

En route Inbound

The P2 Zip transitions from vertical rotor flight for hovering to horizontal wing-borne flight for horizontal flight. The P2 Zip flies at an altitude of 330 feet AGL and a speed of 47 mph towards the dock.

Landing

Upon reaching the dock, the P2 Zip transitions from horizontal wing-borne flight for horizontal flight to vertical rotor flight for descent. The P2 Zip slowly descends and maneuvers into the dock area. The P2 Zip then attaches to the dock from below using its docking fin. Hover motors are disengaged after the P2 Zip has registered secure connection with the dock.

Affected Environment

The affected environment under the proposed action is similar to what was included in the 2022 EA. No substantial changes or alterations have occurred to the environmental impact categories or the study area. Thus, the EA remains a valid discussion of the affected environment for the proposed action.

Re-evaluation of Environmental Consequences

<u>Resources Not Analyzed in Detail</u>

The following environmental impact categories were reviewed and dismissed from detailed analysis in the 2022 EA: air quality; coastal resources; farmlands; hazardous materials, solid waste, and pollution prevention; land use; natural resources and energy supply; socioeconomics; children's environmental health and safety risks; and water resources (wetlands, floodplains, and groundwater). Refer to Section 3.1 of the 2022 EA for the rationale for dismissing these impact categories. The changes to the action analyzed in the 2022 EA, up to 400 delivery trips per day and operating to 24 hours per day (95% daytime operations and 5% nighttime operations), do not change the rationale for dismissing those impact categories, other than light emissions. Therefore, all impact categories originally dismissed, other than visual effects, are not analyzed in detail in this reevaluation. The impact categories that were analyzed in detail in the 2022 EA are re-evaluated below in the context of the changes to the action.

<u>Biological Resources (including fish, wildlife, and plants)</u>

Potential impacts to biological resources under the proposed action would be comparable to those impacts described in the 2022 EA. ***The study area the FAA analyzed for biological resources in the 2022 EA would not change under the proposed action.***

The FAA determined the action assessed in the 2022 EA would have *no effect* on species listed by the Endangered Species Act (ESA). Furthermore, Zipline established a half-mile buffer around Crystal Cave in Bella Vista, AR from March 15 to October 1 to avoid disturbance to roosting gray bats (*Myotis grisciens*). Flight restriction areas are accomplished via Zipline flight planning software.

As described in the 2022 EA, adverse impacts to migratory birds are not expected; some birds may be briefly disturbed by UA operations but would not experience adverse energy expenditure or stress outside the range of natural variation. Zipline has also agreed to a monitoring plan for bald eagle nests that integrates multiple strategies and resources, including iNaturalist observations. If Zipline identifies a bald eagle nest or is notified of the presence of a nest, Zipline will establish an avoidance area such that there is a 1,000 feet vertical and horizontal separation distance between the vehicle's flight path and the nest. This avoidance area will be maintained until the end of the breeding season (September 1 through July 31 in the study area) or until a qualified biologist indicates the nest has been vacated.

As described in the 2022 EA, Zipline's operations do not involve ground construction or habitat modification, as the landing and takeoff location is in a lot that is already developed. No impacts to fish, reptiles, or terrestrial mammal species are expected. All UA operations would occur within airspace, and typically well above the tree line and away from sensitive habitats. Given the altitude of the flights and low recurrence of delivery operations at any individual location within the approximately 1,200-square mile operating area, UA operations are not expected to significantly influence wildlife.

The proposed action would not substantially change the potential impacts on biological resources. The proposed changes may produce marginally greater levels of noise, light, and human activity at the existing hub location. However, the hub is located in a Walmart parking lot and is surrounded by low quality, edge habitat. Any common, urban species in the vicinity of the hub site are likely habituated to human disturbance and would not be adversely affected by the proposed operational changes. Biological resources within the operating area would not experience a substantially greater number of overflights; any additional disturbance caused by overflights would not increase stress, reduce reproductive success, or induce injury or mortality outside the range of natural variation for any species.

Although operating in darkness involves emission of additional lighting for aircraft identification and safety, these lights are not expected to substantially impact biological resources. Zipline's UAs are equipped with two lights on each wing tip, directional red and green position lights, and a white strobe. These lights are automatically powered during operations and are visible from three statute miles to allow other aircraft to identify operating UAs in low-light conditions. Prolonged exposure to artificial lighting can affect foraging, susceptibility to predation, activity rates, and behavior of many wildlife species (Beier 2006). However, given the relatively low frequency of overflight of any given area and the large size of the operating area, operation of safety lights would not substantially alter the light environment for biological resources or induce behavioral changes in any exposed species. Any temporary disturbance from safety light exposure would only last the duration of the overflight and would not alter energy expenditure or reproductive success outside the range of natural variation.

As described above, Zipline has been operating under Part 135 in the study area at a frequency higher than the 20 daytime flights per day that was analyzed in the 2022 EA. After completion of the 2023 and 2025 WRs, Zipline has been operating seven days a week, including holidays, with up to 100 flights per day in the Pea Ridge operating area under Part 135. Thus, the proposed action is similar to existing conditions and is not expected to result in impacts that are dramatically different than those potential impacts described in the 2022 EA.

The FAA reviewed the U.S. Fish and Wildlife Service (USFWS's) Information for Planning and Consultation (IPaC) online system on November 12, 2025, to determine if any additional species have been listed under the ESA for the study area (Attachment 1). The IPaC report includes three additional species that is proposed for federal listing: tricolored Bat (*Perimyotis subflavus*), proposed endangered, and Alligator Snapping Turtle (*Macrochelys temminckii*) and Western Regal Fritiallary (*Argynnis idalia occidentalis*), all proposed threatened. Although these species may occur within the study area, they likely would not be affected by the proposed action. The proposed action would not physically affect tricolored bat, alligator snapping turtle, or western regal fritillary habitats or food sources. As assessed in the 2022 EA, bats may exhibit disturbance behaviors and change their flight paths to avoid drones. However, research also suggests that drones have "minimal impact on bat behavior" and do not appear to be disturbed by drones. As with other flying insects, western regal fritillaries could be struck by drones en route to and from delivery; however, strikes are not likely given the species' mobility. Information regarding drone impacts on insects is limited, and there have been no widespread negative impacts identified in scientific literature. Any small amount of stress or disturbance experienced by the species would be well within the range of natural variation. The proposed action will not involve ground construction or habitat modification, thus no impacts to reptiles including the alligator snapping turtle are expected. As such, the FAA has determined the changes to the action would have *no effect* to the tricolored bat, alligator snapping turtle, and western regal fritillary.

Accordingly, the data and analyses contained in the 2022 EA and updates from the 2023 WR and May 2025 WR remain substantially valid, and the proposed action is not expected to have a significant impact on biological resources.

Department of Transportation Act, Section 4(f)

Impacts on Section 4(f) properties under the proposed action would be comparable to those impacts described in the 2022 EA. As described in the 2022 EA, the FAA identified many properties that could meet the definition of a Section 4(f) property, including public parks, recreation areas, and historic sites. Potential Section 4(f) resources within the operating area include, but are not limited to, the Charlie Craig State Fish Hatchery, Indian Creek Park, Memorial Park, Tanyard Creek Nature Trail, Pea Ridge National Military Park, Buffalo Hills Natural Area, Big Sugar Creek State Park, Flag Spring Conservation Area, and Huckleberry Ridge Conservation Area. No wildlife refuges were identified within the operating area. The 2022 EA determined the proposed action would not result in physical or constructive use (i.e., substantial impairment) of any of the potential Section 4(f) resources or properties in the operating area.

Under the proposed action, there would be no change to the study area that was reviewed in the 2022 EA, and no new Section 4(f) resources that would require further analysis. The changes to the action analyzed in the 2022 EA would not substantially change the impacts on potential Section 4(f) properties. There are no significant new circumstances or information relevant to environmental concerns under the current action.

Accordingly, the data and analyses contained in the 2022 EA and updates from the 2023 WR and May 2025 WR remain substantially valid, and the proposed action would not be expected to have a significant impact on Section 4(f) properties.

Historical, Architectural, Archeological, and Cultural Resources

Historical, architectural, archaeological, and cultural resource impacts under the proposed action would be comparable to those impacts described in the 2022 EA. The Area of Potential Effects (APE) previously analyzed in the 2022 EA would not change under the proposed action.

The FAA previously consulted with the Arkansas and Missouri State Historic Preservation Officers (SHPOs) and with six Tribal Historic Preservation Officers (THPOs) for tribes that may potentially attach religious or cultural significance to resources in the APE for specific sample routes from the Pea Ridge hub instead of a broader area approval contemplated in the 2022 EA. The previous consultation included a letter to the Arkansas SHPO on June 15, 2021, where the Arkansas SHPO responded on July 7, 2021, concurring with FAA's determination that no historic properties would be adversely affected by the proposed project. The previous consultation also included a letter to the Missouri SHPO on June 15, 2021, where the Missouri SHPO responded on June 28, 2021, concurring with the FAA's determination that no historic properties would be affected by the proposed project.

Additionally, in June 2021, the FAA consulted with the Apache Tribe, Caddo Nation, Delaware Nation, Delaware Tribe of Indians, Osage Nation, and Seneca-Cayuga THPOs, and did not receive any responses or objections. As stated previously, while the SHPO and THPO outreach that the FAA conducted in 2021 was for specific sample routes from the Pea Ridge hub instead of a broader area approval, the UA flight characteristics and approximate number of operations would not be significantly different under the proposed action that was the subject of the 2022 EA; however, there would be more routes as Zipline conducts operations to approved delivery locations in 12 communities across the operating area. The UA flight characteristics and approximate number of operations would not be significantly different under the proposed action compared to the action previously consulted on; instead, the operations will be more dispersed over the same area and via more routes.

Based on the nature of potential UA effects on historic properties - namely limited to non-physical, reversible impacts from visual presence and noise of transiting UAs - and the limited number of daily flights in conjunction with the FAA's noise exposure analysis, the FAA has determined that this undertaking has no potential to affect historic properties. Additionally, there would be no known effect on cultural resources from this action. Therefore, the action will not have a significant impact to historic, architectural, archaeological, or cultural resources. While not required under 36 CFR §

800.3(a)(1), the FAA notified the Arkansas and Missouri SHPOs of the availability of the Draft EA on June 13, 2022.

Although concurrence is not required under 36 CFR § 800.3(a)(1), on June 27, 2022, the Arkansas SHPO responded to the FAA's notice stating that the SHPO "still concurs with the finding of no adverse effect to historic properties pursuant to 36 CFR § 800.5(b)(1) as a result of this undertaking.

Accordingly, the data and analyses contained in the 2022 EA and updates from the 2023 WR and May 2025 remain substantially valid, and the proposed action (undertaking) would not change the effects on historic properties.

Noise and Noise-Compatible Land Use

Impacts related to noise and noise-compatible land use under the proposed action would be comparable to those impacts described in the 2022 EA. During the preparation of the 2022 EA, the FAA analyzed potential noise exposure in the area that could result from implementation of the proposed action. The Day-Night Average Sound Level (DNL) noise exposure analysis concluded that for all P1 Zip flight phases, and even in areas with the highest noise exposure (i.e., at the nest), noise levels would still be well below FAA's DNL 65 decibel (dB) threshold for noise compatible land use.

A noise analysis conducted in 2025 for the P2 Zip (ICF 2025) found that, similar to the P1, even in areas with the highest noise exposure, noise levels would still be well below FAA's DNL 65 dB threshold for noise compatible land use. The 2025 noise analysis assumed that 5% of operations would occur during acoustic night, which is consistent with the new proposed action. The 2025 noise analysis also included 400 delivery trips per day, which is consistent with the new proposed action. The FAA's Office of Environment and Energy approved the proposed noise methodology (see Attachment 2).

Noise Exposure for Dock Operations

The proposed action includes up to 400 delivery trips per day and operating 24 hours per day (95% daytime operations and 5% nighttime operations). Table 1 provides the most conservative extent of daily noise exposure for dock operations. P1 Zip operations for 100 deliveries a day are also included as a point of comparison to the 2022 EA analysis. Although P2 Zip dock operations are generally louder than those of the P1 Zip, they still would not exceed significance criteria under any delivery scenario and are not expected to contribute adverse effects to the overall noise environment of the study area.

Table 1. Estimated Extent of Noise Exposure from Dock

Vehicle	Annual Average Daily Deliveries	DNL 65 dB	DNL 60 dB	DNL 55 dB	DNL 50 dB
P2 Zip	400	70 feet	150 feet	325 feet	En Route[1]
P1 Zip	100	25 feet	25 feet	50 feet	75 feet

Source: ICF 2025

Note: Distances are the worst-case noise scenario (longest set back distances).
dB = decibel; DNL = day-night average sound level
[1] Noise exposure would exceed 50 DNL along the flight path for an operation with 400 or more deliveries per day, and 45 DNL along the flight path for an operation with 150 or more deliveries per day.

Noise Exposure for En Route Operations

It is expected that the P2 Zip would generally cruise at or above an altitude of 330 feet AGL and travel at a ground speed of 47 mph (41 knots) during en route flight. The en route noise exposure for a single point exposed to 400 delivery trips (800 flights total) would be DNL 50.3 dBA. In comparison, the 2022 EA assumed the P1 Zip would cruise at an altitude of 250 ft AGL at 64 mph. The en route noise exposure for a single point exposed to 100 P1 Zip delivery and return flights (200 flights total) would be DNL 34.1 dBA. Although en route noise of the P2 Zip is greater than that of the P1 Zip, it still would not exceed significance criteria under any delivery scenario and is not expected to contribute adverse effects to the overall noise environment of the study area.

Noise Exposure for Delivery Operations

The noise exposure for delivery operations includes the noise exposure for the delivery point itself, based on maximum daily deliveries to any one location. The DNL delivery noise exposures assume an arrival and departure flight path restricted to a single trajectory over a receiver array with distances of 25 to 2,000 feet. The maximum noise exposure for any one delivery point is summarized in Table 2 for various DNL levels. At the level of five daily DNL equivalent deliveries, significant noise effects would not be expected anywhere beyond the immediate point of delivery.

Although delivery noise of the P2 Zip is greater than that of the P1 Zip and the average daily deliveries would increase under the proposed action, it still would not exceed significance criteria under any delivery scenario and is not expected to contribute adverse effects to the overall noise environment of the study area.

Table 2. DNL for Delivery Locations Based on Maximum Deliveries per Location

Average Daily Deliveries	DNL 65 dB Distance, Feet	DNL 60 dB Distance, Feet	DNL 55 dB Distance, Feet	DNL 50 dB Distance, Feet
400	<50	<50	90	En Route[1]
5	<50	<50	<50	<50

Source: ICF 2025.
Note: Distances are the worst-case noise scenario (longest set back distances).
DNL = day-night average sound level.
[1] Noise exposure would exceed 50 DNL along the flight path for an operation with 400 or more deliveries per day

Overall Noise Exposure Results

Zipline would generally avoid flying through established flight paths in controlled airspace around airports. Any noise from Zipline's level of operations would not add to the existing aircraft noise levels in these areas and would not expose new areas to DNL 65 dB as a result of a DNL 1.5 dB increase. Dock operations, en route noise, and delivery noise for the P2 Zip are louder than that of P1 Zip considered in the 2022 EA. However, the additional noise presented by proposed action is well below the significance criteria presented above and would not change the conclusions of the 2022 EA.

Accordingly, the data and analyses contained in the 2022 EA and updates from the 2023 WR and May 2025 WR remain substantially valid, and the proposed action would not be expected to have a significant impact related to noise and noise-compatible land use. The proposed action considered in this reevaluation would not have a significant impact on noise or noise-compatible land use.

Visual Effects (including light emissions)

The FAA has not established a significance threshold for Visual Resources / Visual Character, nor has the FAA established a significance threshold for Light Emissions.

The proposed action is not expected to have the potential to:

- Affect the nature of the visual character of the area, including the importance, uniqueness, and aesthetic value of the affected visual resources,
- Contrast with the visual resources and/or visual character in the study area,
- Block or obstruct the views of visual resources, including whether these resources would still be viewable from other locations,
- Create annoyance or interfere with normal activities from light emissions, and
- Affect the visual character of the area due to the light emissions, including the importance, uniqueness, and aesthetic value of the affected visual resources.

Visual effects under the proposed action would be comparable to those emissions and impacts described in the 2022 EA including the no action alternative. Zipline's UAs are equipped with two lights on each wing tip, directional red and green position lights, and a strobe. These lights are automatically powered during operations after civil twilight and are visible from three statute miles to allow other aircraft to identify operating UAs in low-light conditions. However, given the relatively low frequency of overflight of any given area and the large size of the operating area, operation of safety lights would not substantially alter the light environment. Furthermore, Zipline has already been operating at night under Part 107 and Part 135. As such, the proposed action does not represent a substantial change to current lighting conditions already present within the operating area.

The proposed action makes no changes to any landforms, or land uses, thus there would be no effect to the visual character of the area. The proposed action involves airspace operations that could result in visual impacts to sensitive areas where the visual setting is an important resource of the property. However, Zipline has confirmed to the FAA that it will generally not conduct operations over potentially sensitive properties during the scope of operations covered by this proposed action. Some of these properties are certain types of resources that could be valued for aesthetic, including visual, attributes, such as schools, sports arenas, outdoor recreation areas, and playgrounds. Further, the short duration that each UA flight could be seen from any particular resource in the operating area combined with the low number of proposed flights per day minimizes any potential for significant impacts. Accordingly, any potential impact of the proposed action on visual resources and visual character would not be significant.

Accordingly, the data and analyses contained in the 2022 EA and updates from the 2023 WR and May 2025 remain substantially valid, and the proposed action would not be expected to have a significant impact related to visual resources and visual character.

Water Resources (including surface waters)

Impacts related to surface waters under the proposed action would be comparable to those impacts described in the 2022 EA. There would be no changes to the study area under the proposed action and no construction activities that could impact Waters of the U.S. The 2022 EA analyzed potential water resource impacts that could occur as a result of Zipline's proposed operations throughout the study area. Based on the analysis in the 2022 EA, the proposed action would not result in significant effects. There are no substantial changes in the proposed action that are relevant to environmental findings, and there are no significant new circumstances or information relevant to environmental concerns under the current action.

Accordingly, the data and analyses contained in the 2022 EA and updates from the 2023 WR and May 2025 remain substantially valid, and the proposed action would not be expected to have a significant impact related to water resources.

Conclusion

The FAA prepared the attached reevaluation to analyze the potential for significant environmental impacts and defined the regulatory setting associated with FAA's approval of the Part 135 air carrier OpSpecs amendments and other approvals requested by Zipline to conduct commercial package delivery operations in Pea Ridge, Arkansas and the surrounding area with the P2 UA. The areas evaluated for updated environmental impacts include biological resources (including fish, wildlife, and plants); Department of Transportation Act, Section 4(f); historical, architectural, archeological, and cultural resources; noise and noise-compatible land use; visual effects (including light emissions); and water resources (including surface waters).

Based on the above review and in conformity with DOT Order 5610.1D, Section 18.c, the FAA has concluded Zipline International Inc.'s amendment to its OpSpecs in Pea Ridge, Arkansas and the surrounding area conforms to the prior environmental documentation, and that the data contained in the 2022 EA remain adequate, accurate, and valid. In addition, based on the above review and conformity with FAA Order 1050.1G, Section 3.6, there are no substantial changes to the Proposed Action that are relevant to environmental concerns and there are not substantial new circumstances or information about the significance of adverse effects bearing on the Proposed Action or its effects. Therefore, the preparation of a supplemental environmental document is not necessary.

Decision and Order

The FAA recognizes its responsibilities under NEPA and its own directives. Recognizing these responsibilities, I have carefully considered the FAA's goals and objectives in reviewing the environmental aspects of the proposed action to approve Zipline's request to amend Zipline's OpSpecs to allow changes to its UA commercial package delivery operations in Pea Ridge, Arkansas and the surrounding area. Based upon the above analysis, the FAA has determined that the proposed action meets the purpose and need.

This reevaluation considered the original 2022 environmental review, which included the purpose and need to be served by the proposed action, alternatives to achieving them, the environmental impacts of these alternatives, and conditions to preserve and enhance the human environment. This decision is based on a comparative examination of the environmental impacts for each of these alternatives. The attached reevaluation provides a fair and full discussion of the impacts of the current proposed action. The NEPA process included appropriate consideration for avoidance and minimization of impacts, as required by NEPA and other special purpose environmental laws, and appropriate FAA environmental orders and guidance.

Through this reevaluation, the FAA has determined that environmental concerns presented by interested agencies and the general public were addressed in the EA. The FAA believes that, with respect to the proposed action, the NEPA requirements have been met. FAA approval of this environmental review document indicates that applicable federal requirements for environmental review of the proposed action have been met.

Having carefully considered and being properly advised as to the anticipated environmental impacts of the proposal as described in the 2022 EA and the FONSI, under the authority delegated by the Administrator of the FAA, I find the OpSpecs amendment, and other approvals necessary to enable Zipline's requested operations in Pea Ridge, Arkansas and the surrounding area is consistent with existing national environmental policies and objectives as set forth in Section 101 of NEPA and other applicable environmental requirements, and will not significantly affect the quality of the human environment or otherwise include any condition requiring consultation pursuant to Section 102(2)(C) of NEPA. I further find that the action is the type of action that does not require an Environmental Impact Statement under NEPA.

Responsible FAA Official: DEREK W HUFTY Digitally signed by DEREK W HUFTY Date: 2026.03.24 10:38:10 -04'00'

Derek Hufty
Manager, General Aviation and Commercial Operations Branch
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Right of Appeal

This reevaluation constitutes a final agency action and a final order taken pursuant to 49 U.S.C. §§ 40101 et seq., and constitutes a final order of the FAA Administrator, which is subject to exclusive judicial review by the Courts of Appeals of the United States in accordance with the provisions of 49 U.S.C. § 46110. Any party having substantial interest in this order may apply for a review of the decision by filing a petition for review in the appropriate U.S. Court of Appeals no later than 60 days after the order is issued in accordance with the provisions of 49 U.S.C. § 46110.

The FAA is aware of the November 12, 2024, decision in *Marin Audubon Society v. Federal Aviation Administration*, No. 23-1067 (D.C. Cir. Nov. 12, 2024). To the extent that a court may conclude that the Council on Environmental Quality (CEQ) regulations implementing NEPA are not judicially enforceable or binding on this agency action, the FAA has elected to follow those regulations at 40 CFR parts 1500–1508, in addition to the FAA's policies and procedures implementing NEPA at FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (July 16, 2015), to meet the agency's obligations under NEPA, 42 U.S.C. §§ 4321 *et seq*.

References

Beir, 2006. Effects of Artificial Night Lighting on Terrestrial Mammals. Ecological consequences of night lighting on terrestrial mammals, 19-42.

ICF. 2025. Technical Noise Study Report: Zipline Platform 2 Unmanned Aircraft Package Delivery Operations. Report Number 021925. Prepared for the Federal Aviation Administration Unmanned Aircraft Systems Integration Office.

August & Moore, 2019. Autonomous drones are a viable tool for acoustic bat surveys. BioRxiv. https://doi.org/10.1101/673772.

Attachment 1

USFWS IPaC Species List Report

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Arkansas, Missouri, and Oklahoma

Local offices

Oklahoma Ecological Services Field Office

(918) 581-7458
(918) 581-7467

9014 East 21st Street
Tulsa, OK 74129-1428

Missouri Ecological Services Field Office

(573) 234-2132
(573) 234-2181

MAILING ADDRESS
101 Park Deville Drive
Suite A
Columbia, MO 65203-0057

PHYSICAL ADDRESS
101 Park Deville Drive
Suite A}
Columbia, MO 65203-0057

Arkansas Ecological Services Field Office

(501) 513-4470
(501) 513-4480

110 South Amity Suite 300
Conway, AR 72032-8975

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. 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.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Gray Bat Myotis grisescens Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6329	Endangered
Indiana Bat Myotis sodalis Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/5949	Endangered
Northern Long-eared Bat Myotis septentrionalis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat Perimyotis subflavus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

Birds

NAME | STATUS

Eastern Black Rail Lateralius jamaicensis ssp. jamaicensis — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/10477

Piping Plover Charadrius melodus — Threatened
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/6039

Rufa Red Knot Calidris canutus rufa — Threatened
Wherever found
There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/1864

Reptiles

NAME | STATUS

Alligator Snapping Turtle Macrochelys temminckii — Proposed Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4658

Fishes

NAME | STATUS

Ozark Cavefish Amblyopsis rosae — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6490

Clams

NAME | STATUS

Neosho Mucket Lampsilis rafinesqueana — Endangered
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/3788

Insects

NAME | STATUS

Monarch Butterfly Danaus plexippus — Proposed Threatened
Wherever found
There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/9743

Western Regal Fritillary Argynnis idalia occidentalis — Proposed Threatened
Wherever found
No critical habitat has been designated for this species.

Crustaceans

NAME | STATUS

Benton County Cave Crayfish Cambarus aculabrum — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5011

Flowering Plants

NAME	STATUS
Missouri Bladderpod Physaria filiformis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5361	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Neosho Mucket Lampsilis rafinesqueana https://ecos.fws.gov/ecp/species/3788#crithab	Final

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their nests, should follow appropriate regulations and implement required avoidance and minimization measures, as described in the various links on this page.

The data in this location indicates that no eagles have been observed in this area. This does not mean eagles are not present in your project area, especially if the area is difficult to survey. Please review the 'Steps to Take When No Results Are Returned' section of the Supplemental Information on Migratory Birds and Eagles document to determine if your project is in a poorly surveyed area. If it is, you may need to rely on other resources to determine if eagles may be present (e.g. your local FWS field office, state surveys, your own surveys).

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 avoidance and minimization 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

Bald and Golden Eagle information is not available at this time

Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report
On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your "IPaC

PROBABILITY OF PRESENCE SUMMARY" at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate 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.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (FWS).

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

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 avoidance and minimization measures for birds
- 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 bird information is not available at this time

Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as "Vulnerable". See the FAQ "What are the levels of concern for migratory birds?" for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your "IPaC PROBABILITY OF PRESENCE SUMMARY" at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ "Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:

The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate 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.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Facilities

National Wildlife Refuge lands

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 at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

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.

Wetland information is not available at this time

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Attachment 2

Technical Noise Study Report

TECHNICAL NOISE STUDY REPORT: ZIPLINE PLATFORM 2 UNMANNED AIRCRAFT PACKAGE DELIVERY OPERATIONS

REPORT NO. 021925

PREPARED FOR:

Federal Aviation Administration
Unmanned Aircraft Systems Integration Office (AUS)
950 L'Enfant Plaza SW, Suite 500
Washington, D.C. 20024

PREPARED BY:

ICF

May 2025

ICF. 2025. *Technical Noise Study Report: Zipline P2 Zip Unmanned Aircraft Package Delivery Operations.* Report No. 021925. May. Seatle, WA. Prepared for the Federal Aviation Administration. Washington, DC.

Contents

List of Tables

Acronyms and Abbreviations

Acronyms and Abbreviations

AGL	above ground level
CONOPS	Concept of Operations
dB	decibel
dBA	A-weighted decibel
DNL	day night average sound level
FAA	Federal Aviation Administration
Lmax	maximum sound level
MTOW	maximum takeoff weight
SEL	sound exposure level
UA	unmanned aircraft

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Chapter 1
Introduction

1.1 Purpose

The purpose of this report is to provide calculations of noise exposure for package delivery operations by unmanned aircraft (UA) developed by Zipline International, Inc. Noise exposure estimates are provided for the Platform 2 UA (P2 Zip) based on sound level testing data collected by Zipline (2025).

The analysis in this report provides a methodology of estimating noise levels from UA operation that is specific to the Zipline P2 Zip. Because the methods used in this report are based on collected measurements, they should not be applied to other UA models. The analysis accounts for source levels only and does not include a site-specific geographic component, nor does it account for the presence of structures in urban areas.

The sound level measurements presented in this report are based closely on the concept of operations (CONOPS) for all modes of UA package delivery and associated operations. Passby exposure levels at different distances from an origination or delivery point are based on as-tested conditions, which were intended to simulate all operation types in the P2 Zip. Testing simulations consisted of the following operations:

- Undocking and departure from an origination point (dock)
- Package offloading via Droid at a delivery point using the P2 Zip and departure back to dock
- Returning and landing at a dock
- Hovering in place
- En route (with a package)

Total DNL noise exposures are calculated based on various scales of package delivery and associated activities using passby exposure levels for the types of operation applicable to docks, delivery points and en route locations.

1.2 Fundamental Concepts

Various noise descriptors or metrics have been developed to describe time-varying noise levels. The following metrics are used in this evaluation.

- Sound Exposure Level (SEL): SEL represents the total sound energy occurring over a specified period compressed into a one-second time interval. The SEL metric has broad utility in noise prediction and is a primary metric calculated from Leq values collected from sound level testing of UAs.
- Day Night Average Sound Level (DNL): DNL is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10 decibel (dB) penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m. The DNL is used in this

analysis to describe noise exposure for daily operations from a dock, en route, or a delivery point.

- Maximum Sound Level (Lmax): Lmax is the highest sound level measured during a specified period.
- Community Noise Equivalent Level (CNEL): Similar to DNL, CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m. and a 5 dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

1.3 Regulatory Context

The noise exposure estimates in this document are intended to be used for environmental assessments of operations involving the Zipline P2 Zip, for compliance with the National Environmental Policy Act, and operational requirements for a commercial carrier under 14 Code of Federal Regulations Part 135. The analysis method used in this report does not apply standard models such as the Aviation Environmental Design Tool but instead applies an estimation method based on collected noise measurements. As such the application of this method is only applicable to the Zipline P2 Zip. 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 Zipline P2 Zip package delivery operations.

Chapter 2
Methods

2.1 Sound Level Testing of the P2 Zip

The analysis in this report used sound level testing data described in the *P2 Zip Noise Assessment Test Plan and Report Revision D* prepared by Zipline (2025).

Sound level testing was conducted at the Zipline test facility in Esparto, California in November 2024. The testing protocol followed FAA direction given in the document, *Measuring Drone Noise for Environmental Review Process*, dated October 2023 (FAA 2023).

The typical operational profile of the UA can be broken into Undocking, En route (outbound), Delivery, En route (inbound) and Docking. The following subsections provide a narrative description of these flight phases.

2.1.1 Undocking

Typical sequence of undocking operation from the dock:

1. Load package into the Droid and stow the Droid into the P2 Zip prior to undocking.
2. Complete Automated and visual pre-flight checks.
3. Conduct pre-flight motor start (approximately 25 seconds).
4. Conduct an undocking maneuver and ascend vertically from dock until reaching approximately 330 feet above ground level (AGL) (approximately 75 seconds).
5. Begin horizontal flight at constant acceleration until a speed of 41 knots is reached (approximately 10 seconds).
6. Maintain horizontal flight at constant velocity of 41 knots.

2.1.2 En route (Outbound)

Typical sequence of en route operation:

1. Cruise at a typical speed of approximately 41 knots towards the delivery location, at approximately 330 ft AGL.

2.1.3 Delivery

Typical sequence of delivery operation:

1. P2 Zip with package approaches at 330 feet AGL.
2. Decelerate from 41 knots to zero speed (approximately 20 seconds).
3. Maintain hover at 330 feet AGL as Droid is un-stowed from the P2 Zip, Droid is winched down to the ground at the delivery point, and Droid is re-stowed once delivery is complete (approximately 75 seconds).

4. Begin return horizontal flight at constant acceleration until a speed of 41 knots is reached. (approximately 10 seconds).

2.1.4 Enroute (Inbound)

Typical sequence of en route operation:

1. Cruise at a typical speed of approximately 41 knots to the dock, at approximately 330 ft AGL.

2.1.5 Docking

Sequence of docking operation:

1. P2 Zip approaches at approximately 330 feet AGL.
2. Decelerate from approximately 41 knots to zero (approximately 20 seconds).
3. Descend to the dock and complete the docking maneuver (approximately 75 seconds).
4. Shutdown propellers and aircraft systems.

2.2 Sound Exposure Levels from Sound Level Measurements

A brief summary of sound exposure levels from test results is shown in Table 1. The test results that include en route operation assume a nominal cruise speed of 41 knots (Zipline 2025). All tests were conducted with payload at maximum takeoff weight (MTOW). The total weight of the P2 Zip with payload was 63 pounds (55 pounds of aircraft weight and 8 pounds of payload). No flights without payload were conducted. The test flights were conducted at altitude and speed of planned takeoff and delivery operations. As such, no adjustments for speed or altitude were added to SEL values. Durations of test flights used for calculating SEL are shown in Table 2.

Table 1. Summary of Sound Exposure Levels, P2 Zip

Test Series	Altitude	Microphone Position	Average SEL at the 50-foot undertrack microphone (dBA)
Leaving dock with payload at MTOW and takeoff	Ascend to 330 feet AGL, then forward flight at 330 feet AGL	Under flight path, 50 feet away from dock	85.0
Arrival with payload at MTOW and landing at dock	Arrive at 330 feet AGL and descend to dock	Under flight path, 50 feet away from dock	86.2
Delivery hover with payload at MTOW	Hover at 330 feet AGL	Under flight path, 50 feet away from delivery point	74.1
En Route with Payload at MTOW	330 feet AGL at a forward flight speed of 41 knots	50 feet perpendicular distance from undertrack line of flight[1]	69.1

Source: Zipline 2025.
AGL = above ground level
MTOW = maximum takeoff weight
dBA = A-weighted decibel
[1] The maximum SEL was measured at a 50-foot offset position during the en route tests. This should be used to represent the undertrack SEL value for en route overflights.

Table 2. Durations from Sound Level Testing used to Derive Sound Exposure Levels, P2 Zip

Operation	Test series	Test #	Start time (seconds)	End time (seconds)	Duration (seconds)
Depart from dock	Docking/Docking A	1	46	180	134
Depart from dock	Docking/Docking A	2	44	168	124
Depart from dock	Docking/Docking A	3	45	171	126
Depart from dock	Docking/Docking A	4	44	170	126
Depart from dock	Docking/Docking A	5	47	174	127
Depart from dock	Docking/Docking A	6	45	171	126
Depart from dock	Docking/Docking B	1	47	171	124
Depart from dock	Docking/Docking B	2	43	167	124
Depart from dock	Docking/Docking B	3	48	172	124
Depart from dock	Docking/Docking B	4	47	171	124
Depart from dock	Docking/Docking B	5	51	175	124
Depart from dock	Docking/Docking B	6	49	172	123
Depart from dock	Docking/Docking C	1	48	171	123
Depart from dock	Docking/Docking C	2	44	169	125
Depart from dock	Docking/Docking C	3	45	168	123
Depart from dock	Docking/Docking C	4	48	172	124
Depart from dock	Docking/Docking C	5	44	168	124
Depart from dock	Docking/Docking C	6	43	169	126

Operation	Test series	Test #	Start time (seconds)	End time (seconds)	Duration (seconds)
Arrive at dock	Docking/Docking A	1	238	359	121
Arrive at dock	Docking/Docking A	2	230	350	120
Arrive at dock	Docking/Docking A	3	229	351	122
Arrive at dock	Docking/Docking A	4	228	350	122
Arrive at dock	Docking/Docking A	5	232	354	122
Arrive at dock	Docking/Docking A	6	230	350	120
Arrive at dock	Docking/Docking B	1	236	352	116
Arrive at dock	Docking/Docking B	2	228	349	121
Arrive at dock	Docking/Docking B	3	232	355	123
Arrive at dock	Docking/Docking B	4	232	355	123
Arrive at dock	Docking/Docking B	5	235	358	123
Arrive at dock	Docking/Docking B	6	233	353	120
Arrive at dock	Docking/Docking C	1	234	353	119
Arrive at dock	Docking/Docking C	2	230	351	121
Arrive at dock	Docking/Docking C	3	231	350	119
Arrive at dock	Docking/Docking C	4	234	354	120
Arrive at dock	Docking/Docking C	5	230	351	121
Arrive at dock	Docking/Docking C	6	231	350	119
Transition/Deceleration	Docking/Docking A	1	253	274	21
Transition/Deceleration	Docking/Docking A	2	246	266	20
Transition/Deceleration	Docking/Docking A	3	245	266	21
Transition/Deceleration	Docking/Docking A	4	235	265	30
Transition/Deceleration	Docking/Docking A	5	249	269	20
Transition/Deceleration	Docking/Docking A	6	245	266	21
Transition/Deceleration	Docking/Docking B	1	246	267	21
Transition/Deceleration	Docking/Docking B	2	245	265	20
Transition/Deceleration	Docking/Docking B	3	251	270	19
Transition/Deceleration	Docking/Docking B	4	254	271	17
Transition/Deceleration	Docking/Docking B	5	254	273	19
Transition/Deceleration	Docking/Docking B	6	249	268	19
Transition/Deceleration	Docking/Docking C	1	248	268	20
Transition/Deceleration	Docking/Docking C	2	244	265	21
Transition/Deceleration	Docking/Docking C	3	244	265	21
Transition/Deceleration	Docking/Docking C	4	248	268	20
Transition/Deceleration	Docking/Docking C	5	245	266	21
Transition/Deceleration	Docking/Docking C	6	246	266	20
Transition/Acceleration	Docking/Docking A	1	152	162	10
Transition/Acceleration	Docking/Docking A	2	143	153	10
Transition/Acceleration	Docking/Docking A	3	141	154	13
Transition/Acceleration	Docking/Docking A	4	139	153	14

Operation	Test series	Test #	Start time (seconds)	End time (seconds)	Duration (seconds)
Transition/Acceleration	Docking/Docking A	5	144	158	14
Transition/Acceleration	Docking/Docking A	6	141	154	13
Transition/Acceleration	Docking/Docking B	1	143	156	13
Transition/Acceleration	Docking/Docking B	2	138	151	13
Transition/Acceleration	Docking/Docking B	3	143	157	14
Transition/Acceleration	Docking/Docking B	4	143	156	13
Transition/Acceleration	Docking/Docking B	5	146	159	13
Transition/Acceleration	Docking/Docking B	6	142	156	14
Transition/Acceleration	Docking/Docking C	1	143	156	13
Transition/Acceleration	Docking/Docking C	2	140	153	13
Transition/Acceleration	Docking/Docking C	3	141	154	13
Transition/Acceleration	Docking/Docking C	4	143	157	14
Transition/Acceleration	Docking/Docking C	5	140	154	14
Transition/Acceleration	Docking/Docking C	6	139	153	14
Transit southbound	En Route	1	259	351	92
Transit southbound	En Route	2	245	329	84
Transit southbound	En Route	3	243	326	83
Transit northbound	En Route	1	420	473	53
Transit northbound	En Route	2	397	451	54
Transit northbound	En Route	3	393	449	56
Delivery Fading away	Delivery	1	185	215	30
Delivery Fading away	Delivery	2	185	215	30
Delivery Fading away	Delivery	3	185	215	30
Delivery Fading away	Delivery	4	180	210	30
Delivery Fading away	Delivery	5	180	210	30
Delivery Fading away	Delivery	6	185	215	30
Delivery Starboard side	Delivery	1	230	260	30
Delivery Starboard side	Delivery	2	230	260	30
Delivery Starboard side	Delivery	3	235	265	30
Delivery Starboard side	Delivery	4	225	255	30
Delivery Starboard side	Delivery	5	225	255	30
Delivery Starboard side	Delivery	6	235	265	30
Delivery Fading toward	Delivery	1	280	310	30
Delivery Fading toward	Delivery	2	280	310	30
Delivery Fading toward	Delivery	3	280	310	30
Delivery Fading toward	Delivery	4	275	305	30
Delivery Fading toward	Delivery	5	275	305	30
Delivery Fading toward	Delivery	6	280	310	30
Delivery Port side	Delivery	1	325	355	30
Delivery Port side	Delivery	2	325	355	30

Operation	Test series	Test #	Start time (seconds)	End time (seconds)	Duration (seconds)
Delivery Port side	Delivery	3	325	355	30
Delivery Port side	Delivery	4	315	345	30
Delivery Port side	Delivery	5	315	345	30
Delivery Port side	Delivery	6	325	355	30
Depart from dock	Docking/Docking A	1	46	180	134
Depart from dock	Docking/Docking A	2	44	168	124
Depart from dock	Docking/Docking A	3	45	171	126
Depart from dock	Docking/Docking A	4	44	170	126
Depart from dock	Docking/Docking A	5	47	174	127
Depart from dock	Docking/Docking A	6	45	171	126

Source: Zipline 2025, ICF 2025.
Note: Time stamp values are rounded to whole numbers.

2.2.1 Dock Sound Exposure Levels

During testing, sound levels were measured continuously for a simulated delivery cycle from the dock. The tests were conducted for three microphone array orientations, each using five microphones on a linear track. The microphones were set at distances of zero, 50, 100, 200 and 400 feet from the dock. The zero-foot position was located under the docking cradle. Microphone array A was oriented directly below the flight track for departure and arrival. Microphone array B was oriented perpendicularly from the dock at a 90-degree angle from the flight track, and Microphone array C was oriented opposite the direction of flight (Zipline 2025). Six (6) tests were conducted for each of the microphone orientations. Sound exposure level (SEL) values were then calculated from measured time history data for each of the arrays.

Undocking SEL calculations include all phases of departure from a dock, including undocking, ascent to cruising altitude, acceleration and transition to cruising speed. All SEL values include payload at MTOW. The results of SEL calculations for each test are shown in Table 3. A plot of SEL values for the three microphone arrays is shown in Figure 1. The adjusted undocking SEL is based on the maximum sound exposure level among the three tested microphone arrays at each distance. The aircraft had to start decelerating almost immediately after reaching its cruise speed over the Microphone Array A 400-foot microphone due to testing site limitations. To account for this test limitation and transition noise to cruising speed at en route altitude, the deceleration noise data was included in the SEL, and additionally one half of en route noise emission was added to the SEL. This method represents the SEL value of the full undocking operation.

Table 3. Sound Exposure Levels for Undocking at MTOW, P2 Zip

Microphone Position, Distance from Dock (feet)	Test 1 SEL (dBA)	Test 2 SEL (dBA)	Test 3 SEL (dBA)	Test 4 SEL (dBA)	Test 5 SEL (dBA)	Test 6 SEL (dBA)	Average SEL (dBA)
Microphone Array A – Under flight track							
0	97.1	96.6	95.8	95.2	97.6	95.1	96.2
50	86.3	85.2	85.0	83.7	85.5	84.4	85.0
100	79.7	78.7	78.7	77.6	79.6	78.2	78.8
200	74.0	73.9	73.7	73.0	73.9	74.1	73.8
400	71.9	71.2	71.4	70.5	71.4	70.8	71.2
Microphone Array B – Perpendicular to flight track							
0	99.0	98.2	97.4	98.6	98.7	97.7	98.3
50	83.4	83.2	81.9	84.2	83.7	83.2	83.3
100	80.8	80.9	79.1	81.5	80.9	80.5	80.6
200	73.8	74.3	73.3	74.9	74.1	74.1	74.1
400	68.8	69.1	69.3	71.0	69.7	68.7	69.4
Microphone Array C – Behind dock relative to flight track							
0	94.4	95.4	96.1	96.4	95.9	95.8	95.7
50	83.7	84.0	84.6	84.6	84.7	84.9	84.4
100	80.0	80.7	81.0	81.0	81.2	81.5	80.9
200	75.7	76.0	76.0	76.0	75.6	75.8	75.8
400	71.4	71.5	71.6	71.9	71.3	71.6	71.5
Maximum Adjusted SEL from Microphone Arrays A, B, and C (dBA)[1]							
0	98.3						
50	85.1						
100	81.0						
200	76.3						
400	72.6						

Source: Zipline 2025, ICF 2025.

dBA = A-weighted decibel

[1] The undocking SEL is adjusted to include one half of the en route SEL (i.e. 66.1 dBA) to include sound energy for transition from acceleration away from the dock to cruise speed.

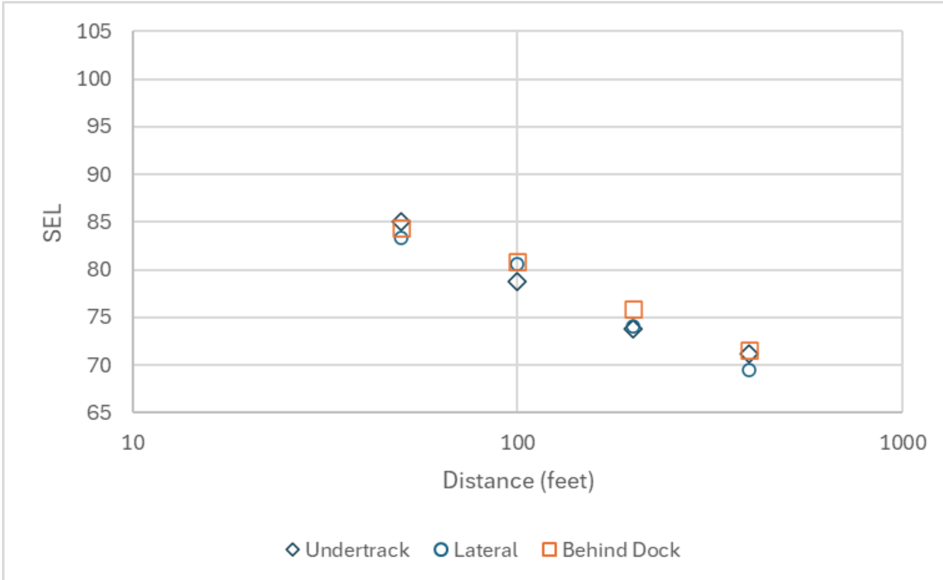

Figure 1. Plot of Average Measured SEL Values at the Three Microphone Arrays for UA Undocking

Docking SEL calculations include all phases of arrival including approach at cruise speed, deceleration, descent, and docking. The results of SEL calculations for each test are shown in Table 4. A plot of SEL values for the three microphone arrays is shown in Figure 2. Similar to the undocking SEL, the adjusted docking SEL is based on the maximum sound exposure level among the three tested microphone arrays. To account for transition noise from cruising speed at altitude to stationary flight, one half of en route noise emission was added to the SEL. This was added due to testing site constraints that only allowed a limited amount of time for the UA to travel at cruise speed when returning to the dock and the aircraft beginning to decelerate shortly after passing over the Microphone Array A 400-foot microphone.

Table 4. Sound Exposure Levels for Docking at MTOW, P2 Zip

Microphone Position, Distance from Dock (feet)	Test 1 SEL (dBA)	Test 2 SEL (dBA)	Test 3 SEL (dBA)	Test 4 SEL (dBA)	Test 5 SEL (dBA)	Test 6 SEL (dBA)	Average SEL (dBA)
Microphone Array A – Under flight track							
0	97.3	95.3	95.5	96.9	96.9	95.3	96.2
50	87.3	84.6	86.1	86.7	86.8	85.9	86.2
100	80.9	79.1	80.3	81.1	81.3	80.2	80.5
200	76.0	73.8	74.6	75.2	76.3	74.5	75.1
400	72.7	70.9	71.8	71.9	73.0	71.4	71.9
Microphone Array B – Perpendicular to flight track							
0	97.4	98.3	98.7	99.7	99.0	98.8	98.6
50	83.6	85.8	85.8	86.1	86.3	85.4	85.5
100	81.0	82.8	82.8	83.3	83.5	81.8	82.5
200	74.3	75.4	75.9	76.1	76.0	74.5	75.4
400	71.3	70.4	70.7	70.8	70.5	69.3	70.5

Microphone Position, Distance from Dock (feet)	Test 1 SEL (dBA)	Test 2 SEL (dBA)	Test 3 SEL (dBA)	Test 4 SEL (dBA)	Test 5 SEL (dBA)	Test 6 SEL (dBA)	Average SEL (dBA)
Microphone Array C – Behind dock relative to flight track							
0	94.8	95.5	95.4	95.7	95.4	96.6	95.6
50	84.9	84.9	86.0	86.6	85.3	85.8	85.6
100	81.6	81.0	83.1	83.1	82.0	82.1	82.1
200	76.4	76.2	77.2	77.1	76.2	75.9	76.5
400	71.1	71.1	71.8	71.7	71.3	71.1	71.3
Maximum Adjusted SEL from Microphone Arrays A, B, and C (dBA)[1]							
0	98.7						
50	86.3						
100	82.7						
200	76.9						
400	73.0						

Source: Zipline 2025, ICF 2025.
dBA = A-weighted decibel
[1] The docking SEL is adjusted to include one half of the en route SEL (i.e. 66.1 dBA) to include sound energy for transition from cruise speed to deceleration toward the dock.

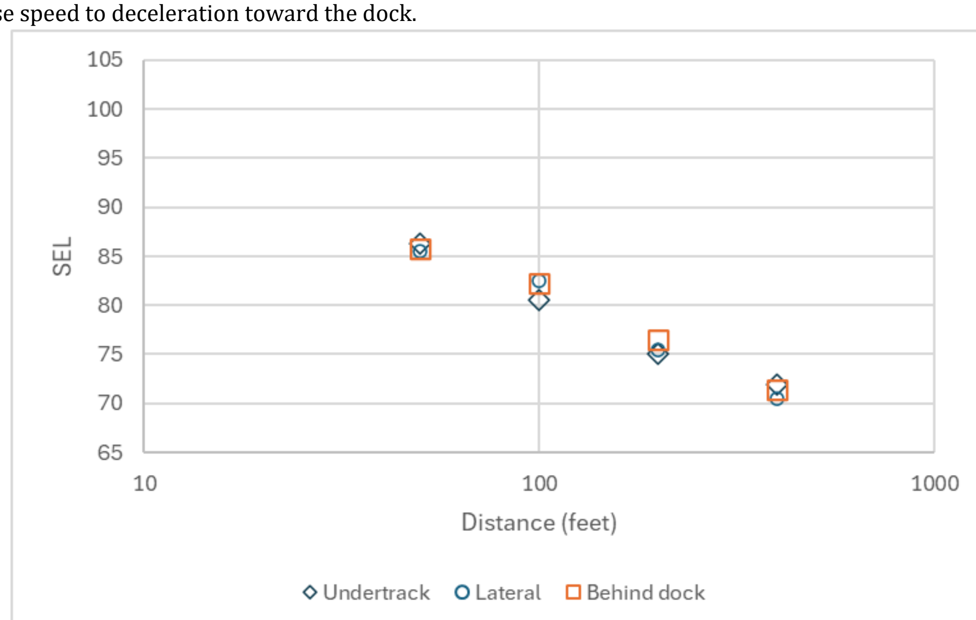

Figure 2. Plot of Average Measured SEL Values at the Three Microphone Arrays for UA docking

2.2.2 Delivery Sound Exposure Levels

During testing, sound levels were measured during hover at a simulated delivery point. The tests were conducted for one microphone array using five microphones on a linear track. The microphones were set at distances of zero, 50, 100, 200 and 400 feet from the delivery point (Zipline 2025). Six (6) tests were conducted for four (4) different hover orientations to measure different acoustic directivities from the UA during delivery hover. Hover was tested at 330 feet AGL. Sound exposure level (SEL) values were then calculated from measured time history data for each of the UA orientations. The results of SEL calculations for each hover test are shown in Table 5. According to the data, the loudest average SEL occurs at the 50-foot microphone position for all hover orientations. Among the hover orientations, the port side of the P2 yielded the highest SEL values. A plot of SEL values from measurements for port side hover is shown in Figure 3.

The adjusted delivery SEL shown in Table 4 accounts for hover time during delivery operations, which would occur for a longer time than as-tested conditions. A time correction factor is added to scale up the sound energy to time required for delivery. The correction factor is given by:

$$K_{hover} = 10 * \text{Log}\ (75\ \text{seconds}/30\ \text{seconds}) \quad (1)$$

Sound energy for deceleration upon arrival to the delivery site and acceleration away upon completion of a delivery is included from docking and undocking time history test data. This is discussed further in Section 3.2.

Table 5. Sound Exposure Levels from Sound Level Testing for Delivery Hover at MTOW, P2 Zip

Microphone Position, Distance from Delivery Point (feet)	Test 1 SEL (dBA)	Test 2 SEL (dBA)	Test 3 SEL (dBA)	Test 4 SEL (dBA)	Test 5 SEL (dBA)	Test 6 SEL (dBA)	Average SEL (dBA)
Delivery Hover Oriented Toward Microphone Array							
0	72.0	72.4	71.4	71.1	72.0	71.7	71.8
50	74.2	74.6	73.4	73.2	73.8	73.4	73.8
100	70.5	70.1	69.4	68.8	69.2	69.0	69.5
200	68.6	68.2	68.0	67.4	67.2	67.8	67.9
400	61.1	62.1	62.4	62.1	62.2	62.2	62.0
Delivery Hover Oriented Away from Microphone Array							
0	71.5	71.3	72.2	71.0	69.2	69.8	70.8
50	74.0	72.2	72.5	71.2	68.9	70.5	71.5
100	68.3	68.3	69.3	68.1	65.2	67.0	67.7
200	66.9	66.7	67.7	67.0	64.7	66.1	66.5
400	61.4	61.3	62.4	61.8	61.3	61.7	61.7
Delivery Hover Oriented Starboard Toward Microphone Array							
0	72.0	69.4	69.7	69.1	68.8	70.5	69.9
50	74.6	71.4	72.3	70.8	70.7	71.8	71.9
100	70.1	67.4	68.1	66.9	66.8	67.2	67.7
200	68.5	66.6	67.0	66.2	66.0	65.6	66.7
400	62.8	61.0	62.2	61.6	62.0	63.5	62.2
Delivery Hover Oriented Port Toward Microphone Array							
0	73.3	72.6	72.3	71.2	72.1	72.1	72.3
50	75.5	74.5	74.5	72.5	73.4	74.3	74.1
100	70.8	70.7	70.1	68.6	69.0	70.3	69.9
200	69.0	69.5	68.7	67.0	67.9	68.6	68.4
400	62.8	62.8	63.6	63.8	63.1	64.1	63.4

Microphone Position, Distance from Delivery Point (feet)	Test 1 SEL (dBA)	Test 2 SEL (dBA)	Test 3 SEL (dBA)	Test 4 SEL (dBA)	Test 5 SEL (dBA)	Test 6 SEL (dBA)	Average SEL (dBA)
Maximum Adjusted SEL from Microphone Array (dBA)[1]							
0	77.3						
50	79.0						
100	76.3						
200	75.3						
400	73.4						

Source: Zipline 2025, ICF 2025.

dBA = A-weighted decibel

[1] The delivery hover is adjusted to include deceleration from en route to a delivery site, a time correction for delivery operations (75 seconds) to scale sound energy from as-tested conditions (30 seconds), and acceleration away from a delivery site. Acceleration and deceleration sound energy is from portions of docking and undocking tests at cruising altitude. This is shown in Section 3.2, Table 7.

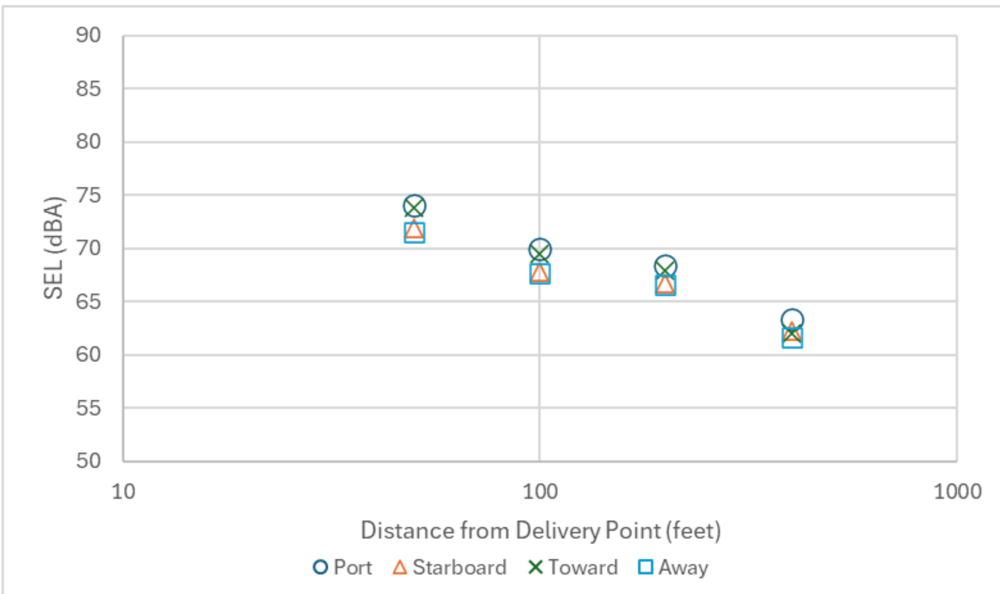

Figure 3. Plot of Average Measured SEL Values for Delivery Hover

2.2.3 En Route Sound Exposure Levels

During testing, sound levels were measured to simulate noise exposure at undertrack locations between dock and delivery points while the UA is at cruising speed. The tests were conducted for one microphone array using five microphones perpendicular to the flight track. The microphones were set at distances of zero, 50, 100, 200 and 400 feet perpendicular to the flight trajectory (Zipline 2025). Six (6) tests were conducted for en route operations, three downwind (Tests 1, 2 and 3) and three upwind (Test 4, 5, and 6). Sound exposure level (SEL) values were then calculated from measured time history data for each en route event. The results of SEL calculations for each test are shown in Table 6. According to the data, the loudest average SEL of 69.1 dBA during en route occurs at the 50-foot microphone position perpendicular to the flight track.

Table 6. Sound Exposure Levels from Sound Level Testing for En Route Test Series, P2 Zip

Microphone Position, Perpendicular Distance from flight track (feet)	Test 1 SEL (dBA)	Test 2 SEL (dBA)	Test 3 SEL (dBA)	Test 4 SEL (dBA)	Test 5 SEL (dBA)	Test 6 SEL (dBA)	Average SEL (dBA)
Microphone Array A – Under flight track							
0	68.5	68.4	68.1	66.4	66.3	66.9	67.4
50	70.4	70.1	69.7	67.9	68.2	68.2	69.1
100	68.3	68.7	67.9	65.8	67.3	66.3	67.4
200	68.0	67.7	67.2	64.7	65.4	65.8	66.5
400	66.3	65.0	64.9	63.3	62.6	62.4	64.1

Source: Zipline 2025, ICF 2025.
dBA = A-weighted decibel

2.3 Analysis Procedure Methodology

To calculate SEL for receptors located near a dock or delivery point, a combination of actions are evaluated to define different types of operations as a UA transitions between different operating modes. The types of operations evaluated are the following:

- Docking
- Undocking
- Package delivery at a delivery point
- En Route inbound and outbound from delivery point

The SEL calculation for each of these operation types involves the use of sound level data as measured by an array of microphones during simulation testing of each operation, as described in the noise measurement test report (Zipline 2025). Microphones placed on a linear path relative to the dock collected sound level data at distances of 0 feet, 50 feet, 100 feet, 200 feet, and 400 feet. The incident SEL values were used to determine attenuation rates between microphone positions, which were influenced by different degrees of en route and vertical or hover portions of the flight profile depending on the type of operation tested. For distances greater than 400 feet from the dock, the falloff rate from the 200-foot to 400-foot microphone position is used to determine the distance at which UA sound emission values are equal to en route conditions. This is described further in the data presentation in the next chapter.

DNL values are calculated for three categories of locations: 1) a dock, 2) a delivery point, and 3) the en route inbound and outbound path. The DNL values at a dock are calculated by summing the sound energy for undocking and departure from the dock with a return to the dock. The DNL value for a single delivery cycle at each of the three types of locations is scaled for multiple UA operations using a logarithmic multiplier (i.e., log of the number of events multiplied by 10) adjusted by a factor of 49.4 to convert from SEL to DNL. The equation to calculate DNL from SEL is:

$$DNL = 10*\log(10^{(SEL/10)} * [\text{deliveries per day}]) - 49.4 \quad (2)$$

Chapter 3
Sound Levels of UA Operations

3.1 Undocking and Docking Sound Levels

Calculated sound levels for P2 Zip undocking and docking at the dock are shown in Table 6. Undocking and docking SEL values also include the portions of the en route cycle as the UA departs from and arrives back at the dock. Once the UA has traveled far enough away from the dock, the undertrack sound level is equal to en route conditions as measured during testing. The SEL values are based on the maximum value measured among the undertrack, lateral and behind-dock microphone arrays. As shown in Table 1, the average measured level for en route conditions is 69.1 dBA SEL. This occurs at different distances for departure and arrival. For undocking, the SEL is equal to the en route sound level of 69.1 dBA SEL at 1,600 feet from the dock, while for docking this occurs at 1,425 feet, as shown in Table 7. The flights include the maximum payload on board. The docking and undocking SEL values are given by Equation 3, which includes one-half en route SEL in each direction, i.e. equivalent to one full en route SEL:

$$SEL_{dock} = 10 * \text{Log}\ (10\text{^}(SEL_{departure}/10) + 10\text{^}(SEL_{en\ route}/10) + 10\text{^}(SEL_{arrival}/10)) \qquad (3)$$

which is the logarithmic sum of departure and arrival sound energy, and sound energy from inbound/outbound portions of the flight profile equivalent to one half of en route SEL in each direction. Note that Equation 3 includes one-half en route SEL in each direction to adjust for testing site limitations, as described in Section 2.2.1. Since this is included for a roundtrip from the dock for one delivery cycle, this is equivalent to one full en route SEL.

Table 7. Calculated SEL values for Undocking and Docking at Dock

Distance between Dock and Receiver	Undocking and Departure, dBA SEL	Arrival and Docking, dBA SEL	Docking and Undocking Cycle, dBA SEL
0	98.3	98.7	101.5
50	85.1	86.3	88.7
75	82.4	83.9	86.2
100	81.0	82.7	84.9
125	79.5	80.6	83.1
150	78.2	79.1	81.7
175	77.2	77.9	80.6
200	76.3	76.9	79.6
225	75.6	76.1	78.9
250	75.1	75.4	78.3
275	74.5	74.8	77.7
300	74.1	74.2	77.2
325	73.7	73.7	76.7
350	73.3	73.4	76.4
375	72.9	73.2	76.1
400	72.6	73.0	75.8

Distance between Dock and Receiver	Undocking and Departure, dBA SEL	Arrival and Docking, dBA SEL	Docking and Undocking Cycle, dBA SEL
425	72.3	72.7	75.5
450	72.1	72.5	75.3
475	71.9	72.3	75.1
500	71.8	72.2	75.0
525	71.6	72.0	74.8
550	71.5	71.8	74.7
575	71.4	71.7	74.6
600	71.3	71.6	74.4
625	71.2	71.4	74.3
650	71.1	71.3	74.2
675	71.0	71.2	74.1
700	70.9	71.1	74.0
725	70.8	71.0	73.9
750	70.7	70.8	73.8
775	70.7	70.7	73.7
800	70.6	70.7	73.6
825	70.5	70.6	73.6
850	70.4	70.5	73.5
875	70.4	70.4	73.4
900	70.3	70.3	73.3
925	70.3	70.2	73.3
950	70.2	70.2	73.2
975	70.1	70.1	73.1
1,000	70.1	70.0	73.1
1,025	70.0	70.0	73.0
1,050	70.0	69.9	72.9
1,075	69.9	69.8	72.9
1,100	69.9	69.8	72.8
1,125	69.8	69.7	72.8
1,150	69.8	69.7	72.7
1,175	69.7	69.6	72.7
1,200	69.7	69.5	72.6
1,225	69.6	69.5	72.6
1,250	69.6	69.4	72.5
1,275	69.6	69.4	72.5
1,300	69.5	69.4	72.5
1,325	69.5	69.3	72.4
1,350	69.5	69.3	72.4
1,375	69.4	69.2	72.3
1,400	69.4	69.2	72.3
1,425	69.3	69.1	72.3
1,450	69.3	69.1	72.2

Distance between Dock and Receiver	Undocking and Departure, dBA SEL	Arrival and Docking, dBA SEL	Docking and Undocking Cycle, dBA SEL
1,475	69.3	69.1	72.2
1,500	69.2	69.1	72.2
1,525	69.2	69.1	72.2
1,550	69.2	69.1	72.1
1,575	69.2	69.1	72.1
1,600	69.1	69.1	72.1
Greater than 1,600	69.1	69.1	72.1

Source: Zipline 2025, ICF 2025.
dBA = A-weighted decibel; SEL = sound exposure level

3.2 Delivery

During a delivery, the P2 Zip hovers in place above the delivery point at its cruising altitude. The onboard delivery service, referred to as a Droid carrying a payload is lowered to the delivery point via a winch line (Zipline 2025). The noise exposure at a delivery point consists of deceleration on arrival, hover in place, and departure acceleration. As discussed in Chapter 2, a time correction was added to hover sound levels to account for hover time during a delivery (75 seconds) vs. the as-tested condition (30 seconds). The hover SEL levels are based on measurements from hover orientation to the port side, which yielded the highest SEL values from the four orientations tested. SEL values for each of these segments of a delivery cycle are shown in Table 8, with a total SEL exposure for a delivery point cycle in the rightmost column of values. The arrival deceleration and departure acceleration have a minimum value equivalent to the en route SEL value of 69.1 dBA. This occurs at distances of 50 feet and greater from the delivery point for deceleration toward the delivery point, and at distances of 125 feet or greater for acceleration away from the delivery point.

The delivery SEL values are given by Equation 4:

$$SEL_{delivery} = 10 * Log\left(10\text{^}(SEL_{deceleration}/10) + 10\text{^}(SEL_{hover,port}/10) + K_{hover} + 10\text{^}(SEL_{acceleration}/10)\right) \quad (4)$$

which is the logarithmic sum of sound energy from deceleration to the delivery point, hover above the delivery point, hover time correction given by K_{hover} in Equation 1, and acceleration away from the delivery point.

Table 8. Calculated SEL Values for Delivery Operations

Distance between Delivery Point and Receiver	Arrival Deceleration, dBA SEL	Hover, dBA SEL[1]	Departure Acceleration, dBA SEL	Delivery Cycle, dBA SEL
0	67.0	76.3	67.8	77.3
50	69.1	78.1	68.4	79.0
75	69.1	75.6	69.3	77.3
100	69.1	73.9	69.9	76.3
125	69.1	73.4	69.1	75.8
150	69.1	73.0	69.1	75.6

Distance between Delivery Point and Receiver	Arrival Deceleration, dBA SEL	Hover, dBA SEL[1]	Departure Acceleration, dBA SEL	Delivery Cycle, dBA SEL
175	69.1	72.7	69.1	75.4
200	69.1	72.4	69.1	75.3
225	69.1	71.6	69.1	74.8
250	69.1	70.8	69.1	74.5
275	69.1	70.1	69.1	74.2
300	69.1	69.5	69.1	74.0
325	69.1	68.9	69.1	73.8
350	69.1	68.3	69.1	73.6
375	69.1	67.8	69.1	73.5
400	69.1	67.4	69.1	73.4
425	69.1	66.9	69.1	73.2
450	69.1	66.5	69.1	73.2
475	69.1	66.1	69.1	73.1
500	69.1	65.7	69.1	73.0
525	69.1	65.4	69.1	72.9
550	69.1	65.0	69.1	72.9
575	69.1	64.7	69.1	72.8
600	69.1	64.4	69.1	72.8
625	69.1	64.1	69.1	72.7
650	69.1	63.8	69.1	72.7
675	69.1	63.5	69.1	72.7
700	69.1	63.3	69.1	72.6
725	69.1	63.0	69.1	72.6
750	69.1	62.8	69.1	72.6
775	69.1	62.5	69.1	72.6
800	69.1	62.3	69.1	72.5
825	69.1	62.1	69.1	72.5
850	69.1	61.9	69.1	72.5
875	69.1	61.6	69.1	72.5
900	69.1	61.4	69.1	72.5
925	69.1	61.2	69.1	72.4
950	69.1	61.0	69.1	72.4
975	69.1	60.9	69.1	72.4
1,000	69.1	60.7	69.1	72.4
1,025	69.1	60.5	69.1	72.4
1,050	69.1	60.3	69.1	72.4
1,075	69.1	60.1	69.1	72.4
1,100	69.1	60.0	69.1	72.4
1,125	69.1	59.8	69.1	72.3
1,150	69.1	59.7	69.1	72.3
1,175	69.1	59.5	69.1	72.3
1,200	69.1	59.3	69.1	72.3

Distance between Delivery Point and Receiver	Arrival Deceleration, dBA SEL	Hover, dBA SEL[1]	Departure Acceleration, dBA SEL	Delivery Cycle, dBA SEL
1,225	69.1	59.2	69.1	72.3
1,250	69.1	59.0	69.1	72.3
1,275	69.1	58.9	69.1	72.3
1,300	69.1	58.8	69.1	72.3
1,325	69.1	58.6	69.1	72.3
1,350	69.1	58.5	69.1	72.3
1,375	69.1	58.3	69.1	72.3
1,400	69.1	58.2	69.1	72.3
1,425	69.1	58.1	69.1	72.3
1,450	69.1	58.0	69.1	72.3
1,475	69.1	57.8	69.1	72.3
1,500	69.1	57.7	69.1	72.3
1,525	69.1	57.6	69.1	72.3
1,550	69.1	57.5	69.1	72.2
1,575	69.1	57.4	69.1	72.2
1,600	69.1	57.2	69.1	72.2
1,625	69.1	57.1	69.1	72.2
1,650	69.1	57.0	69.1	72.2
1,675	69.1	56.9	69.1	72.2
1,700	69.1	56.8	69.1	72.2
1,725	69.1	56.7	69.1	72.2
1,750	69.1	56.6	69.1	72.2
1,775	69.1	56.5	69.1	72.2
1,800	69.1	56.4	69.1	72.2
1,825	69.1	56.3	69.1	72.2
1,850	69.1	56.3	69.1	72.2
1,875	69.1	56.2	69.1	72.2
1,900	69.1	56.1	69.1	72.2
1,925	69.1	56.0	69.1	72.2
1,950	69.1	55.9	69.1	72.2
1,975	69.1	55.8	69.1	72.2
2,000	69.1	55.8	69.1	72.2

Source: Zipline 2025, ICF 2025.

dBA = A-weighted decibel; SEL = sound exposure level

[1] Hover sound levels are corrected to a 75 second duration from the as-tested duration of 30 seconds. The 75 second duration is the estimated time required for the droid to deliver a package. Noise from the droid is negligible and as such is not included in the delivery cycle SEL (see Section 5.3 of *P2 Zip Noise Assessment Test Plan and Report* (Zipline 2025).

3.3 En Route

As shown in Table 1, the average en route sound level was calculated to be 69.1 dBA SEL. For inbound and outbound flights occurring along the same trajectory, a single round trip en route SEL would be 72.1 dBA SEL. For a single flight, this level represents the loudest case for areas within 50 feet of an undertrack location relative to a P2 Zip in flight between a dock and a delivery point.

Chapter 4
Noise Exposure from UA Operations

This chapter presents estimated DNL values for package delivery operations for various daily rates of delivery for a P2 Zip operation. This analysis assumes 95% of package deliveries would occur during daytime hours only (7:00 a.m. to 10:00 p.m.), and 5% would be done during night hours (10:00 p.m. to 7:00 a.m.) Night operations include a 10 dB penalty for the purpose of calculating DNL. The analysis assumes there would be at least one night delivery for all scenarios. The number of daytime and nighttime deliveries for different delivery scenarios is shown in Table 9.

Table 9. Number of Daytime and Nighttime Deliveries for Different Delivery Scenarios

Average Daily Deliveries per Dock	Number of Daytime Deliveries	Number of Nighttime Deliveries	Number of Daytime Equivalent Deliveries
1	0	1	10
5	4	1	14
10	9	1	19
15	14	1	24
20	19	1	29
25	23	2	43
50	47	3	77
75	71	4	111
100	95	5	145
150	142	8	222
200	190	10	290
300	285	15	435
400	380	20	580

4.1 Noise Exposure from a Dock Location

A single delivery operation consists of undocking, departure, return to dock and landing phases, and the full cycle of these actions are accounted for in noise exposure at a dock location, as discussed in Section 3.1.

Estimated DNL noise exposure distances at a dock operating P2 Zip UAs are shown in Table 10. Noise exposure DNL values are shown at different operational scales: from 1 delivery per day up to 400 deliveries per day. The noise exposure values assume a departure and return flight path restricted to a single trajectory over a receiver array with distances of 50 to 2,000 feet from the dock. According to the calculations, undocking and docking operations would equal or exceed 65 DNL at less than 50 feet from a dock location up to a rate of 200 package loading operations per day. At a rate of 400 deliveries per day including up to 20 nighttime deliveries, package loading operations would equal or exceed 65 DNL up to 70 feet from a dock location.

Table 10. DNL Noise Exposure Distances at a Dock for P2 Zip for Different Scales of Operation

Average Daily Deliveries per Dock[1]	65 DNL Distance, feet	60 DNL Distance, feet	55 DNL Distance, feet	50 DNL Distance, feet	45 DNL Distance, feet
1	<50	<50	<50	<50	110
5	<50	<50	<50	60	130
10	<50	<50	<50	75	155
15	<50	<50	<50	90	175
20	<50	<50	<50	105	200
25	<50	<50	60	125	260
50	<50	<50	90	180	430
75	<50	<50	115	225	715
100	<50	60	135	275	1,125
150	<50	85	170	390	En Route[2]
200	<50	105	200	535	En Route
300	60	130	265	1,020	En Route
400	70	150	325	En Route[2]	En Route

Note: [1] The CONOPS assumes 95% of UA operations would be done between the hours of 7:00 a.m. and 10:00 p.m. and 5% would be done between 10:00 p.m. and 7:00 a.m. The number of average daily deliveries per dock in this table include 5% of deliveries occurring between 10:00 p.m. and 7:00 a.m. consistent with the CONOPS and Table 9.

[2] Noise exposure would exceed 50 DNL along the flight path for an operation with 400 or more deliveries per day, and 45 DNL along the flight path for an operation with 150 or more deliveries per day.

DNL = day/night average sound level

4.2 Noise Exposure from a Delivery Site

Estimated DNL noise exposure distances at a delivery point for the P2 Zip are shown in Table 11. The DNL exposures assume an arrival and departure flight path restricted to a single trajectory over a receiver array with distances of 25 to 2,000 feet. A single delivery operation consists of arrival, package delivery, and departure phases, as described in Section 3.2. According to the calculations, package loading operations would equal or exceed 65 DNL at less than 50 feet from a dock location up to a rate of 400 package loading operations per day.

Table 11. DNL Noise Exposure Distances at a Delivery Point for P2 Zip for Different Scales of Operation

Average Daily Deliveries at Delivery Point[1]	65 DNL Distance, feet	60 DNL Distance, feet	55 DNL Distance, feet	50 DNL Distance, feet	45 DNL Distance, feet
1	<50	<50	<50	<50	<50
5	<50	<50	<50	<50	<50
10	<50	<50	<50	<50	<50
15	<50	<50	<50	<50	<50
20	<50	<50	<50	<50	<50
25	<50	<50	<50	<50	65
50	<50	<50	<50	<50	160

Average Daily Deliveries at Delivery Point[1]	65 DNL Distance, feet	60 DNL Distance, feet	55 DNL Distance, feet	50 DNL Distance, feet	45 DNL Distance, feet
75	<50	<50	<50	55	310
100	<50	<50	<50	70	600
150	<50	<50	<50	120	En Route[2]
200	<50	<50	<50	235	En Route
300	<50	<50	65	500	En Route
400	<50	<50	90	En Route[2]	En Route

Note: [1] The CONOPS assumes 95% of UA operations would be done between the hours of 7:00 a.m. and 10:00 p.m. and 5% would be done between 10:00 p.m. and 7:00 a.m. The number of average daily deliveries per dock in this table include 5% of deliveries occurring between 10:00 p.m. and 7:00 a.m. consistent with the CONOPS and Table 9.

[2] Noise exposure would exceed 50 DNL along the flight path for an operation with 400 or more deliveries per day, and 45 DNL along the flight path for an operation with 150 or more deliveries per day.

DNL = day/night average sound level

4.3 En Route Noise Exposure

Noise exposure from UA en route trajectories would be loudest within 50 feet of the flight path, as described in Chapter 2. In practice, UAs would serve many delivery points from a point of origin, however in areas where there is a high demand for deliveries, en route UA noise may be intermittently noticeable depending on the level of existing ambient noise. In addition, an undertrack location would receive noise exposure from two en route events representing both outbound and inbound portions of a round trip for a delivery cycle. Along a single flight trajectory, en route noise levels would exceed 45 DNL at 150 or more deliveries per day, as shown in Table 12. Since test flights were conducted at the operating altitude of 330 feet AGL with MTOW, no altitude correction factors were used.

Table 12. En Route DNL Exposure for P2 Zip for Different Scales of Operation

Average Daily Deliveries per Dock[1]	En Route DNL
1	32.7
5	34.2
10	35.5
15	36.5
20	37.3
25	39.0
50	41.6
75	43.2
100	44.3
150	46.2
200	47.3
300	49.1
400	50.3

Note: [1] The CONOPS assumes 95% of UA operations would be done between the hours of 7:00 a.m. and 10:00 p.m. and 5% would be done between 10:00 p.m. and 7:00 a.m. The number of average daily deliveries per dock in this table include 5% of deliveries occurring between 10:00 p.m. and 7:00 a.m. consistent with the CONOPS and Table 9.
DNL = day/night average sound level

4.4 Cumulative Noise Exposure

Criteria for significance of impacts and changes in noise exposure are defined in FAA Order 1050.1F *Environmental Impacts: Policies and Procedures* (FAA 2015). Order 1050.1F Exhibit 4-1 states the following with respect to threshold of significance for a proposed action:

> *The action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dB to 65 dB.*

A cumulative increase in noise from a proposed action can be calculated using the difference between the additional noise exposure introduced by a proposed action and the no action alternative. The cumulative DNL increase associated with different values of the proposed action is shown in Table 13.

Table 13. Cumulative Increase in DNL due to a Proposed Action

Proposed Action minus No Action (x)	Cumulative Increase in DNL (Δ)
x < -3.8 dB	Δ < 1.5 dB
-3.8 dB < x < 0.0 dB	1.5 dB < Δ < 3 dB
0.0 dB < x < 3.3 dB	3 dB < Δ < 5 dB
3.3 dB < x	5 dB < Δ

For air traffic airspace and procedure actions where the study area is larger than the immediate vicinity of an airport, Order 1050.1F specifies the following change-of-exposure criteria to identify locations where noise exposure levels will increase by a magnitude considered reportable. An action that would increase noise exposure by 3 dB where no action is between 60 and 65 DNL, or by 5 dB where no action is between 45 and 60 DNL would be considered reportable.

Chapter 5
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