



Connecticut Department of
Energy & Environmental Protection
Bureau of Water Protection & Land Reuse
Office of Long Island Sound Programs

Coastal Management Consistency Review Form for Federal Activities

Use of this form, although not mandatory, will facilitate coastal consistency review analysis by the Federal agency and result in submission of sufficient information for comprehensive review by the Department of Energy and Environmental Protection (DEEP) Office of Long Island Sound Programs (OLISP). It is anticipated that submittal of a completed form with indicated supplemental materials will, in most instances, eliminate the need for further information. The form should be used in conjunction with the *Reference Guide to Coastal Policies and Definitions* (DEEP-OLISP-GUID-200). The *Instructions and Guidance for Completing the Federal Coastal Consistency Review Form for Federal Activities* (DEEP-OLISP-INST-300) explains how to complete this form and provides several critical definitions and pertinent guidance. Once completed, please submit this form with the appropriate supporting documentation to: CT DEEP-OLISP, 79 Elm Street, Hartford, CT 06106-5127. For further information or assistance in completing this form, please contact us at the address above or by phone at 860-424-3034.

Part I: Federal Agency and Contact Identification

Agency Name: **Federal Aviation Administration**

Mailing Address: **Federal Aviation Administration, Suite 802W c/o AVS Environmental 800 Independence Ave SW**

City/Town: **Washington**

State: **DC**

Zip Code: **20591**

Business Phone: **202-267-9700**

ext.

Fax:

Agency Contact: **Joseph Hemler**

Title:

E-Mail: **9-FAA-Drone-Environmental@faa.gov**

Identification of Primary Contact for correspondence if other than Agency Contact noted above:

Company Name: **Amazon Prime Air, LLC**

Mailing Address:

City/Town: **Seattle**

State: **WA**

Zip Code:

Business Phone:

ext.

Fax:

Contact Person: **Jim Fitzpatrick**

Title:

E-Mail: **fitzpkja@amazon.com**

Part II: Review Type and Project Title

Type of Review (check one):

☐ Federal Development Project

☐ Negative Determination

☒ Other Federal agency activity (specify general type): **Approval of Operational Specification**

Project Title or Other Identification:

Consistency Determination under CZMA §307(c)(1)/(2) for Proposed Electric Drone Package Delivery Operations – North Haven, Connecticut

Part III: Other DEEP Involvement with the Project

Is any component of this activity directly regulated by DEEP separate from the Federal Coastal Consistency Process (e.g., 401 Water Quality Certification)? ☐ Yes ☒ No

If yes, list below all DEEP permits, certifications, or other authorizations being pursued for this activity, and describe the regulated activity/ies:

☐ Check if additional sheets are attached to this page

Has any other unit of the DEEP been contacted regarding this activity? ☐ Yes ☒ No

If yes, please identify other Departmental contacts:

☐ Check if additional sheets are attached to this page

Part IV: Detailed Project Information

1. Description of Proposed Activity

Describe the proposed federal activity including its purpose and all related actions. For site-specific activities, such actions might include: site clearing, grading, demolition, and other site preparations; percentage of increase or decrease in impervious cover from existing conditions resulting from the activity; phasing, timing, and method of proposed construction; and new uses and changes from existing uses. For site-specific activities proposed at waterfront sites, provide detailed information regarding any water-dependent uses proposed. For non-site specific activities, include a complete description of the proposed activity and its purpose.

Please find detailed project information included in the accompanying consistency determination letter.

☒ Check if additional sheets are attached to this page

Part IV: Detailed Project Information (cont.)

2. Is the Project Site-Specific?

- ☒ Yes Please continue with Part IV and fill out all subsequent parts of the form.
☐ No Skip to Part V: Identification of Applicable Enforceable Policies

3. Location Information

a. Project Address, Location, or Affected Area: **409 Washington Avenue**

City/Town: **New Haven**

State: **CT**

Zip Code: **06473**

b. Agency's interest in property, if any:

- ☐ fee simple ☐ option ☐ lessee ☐ easement ☒ not applicable
☐ other (specify):

c. Is the activity proposed at a waterfront site (includes tidal wetlands frontage) or within coastal, tidal or navigable waters? ☐ Yes ☒ No

If yes, name the affected coastal, tidal or navigable waters:

d. If off-site effects on coastal uses and/or resources are anticipated, identify the address or location(s) of such effects and attach a map (8 1/2" x 11" format) indicating this area:

- ☐ Check if additional sheets are attached to this page
☒ Check here to indicate map is enclosed.

e. If the Federal project is site specific, identify and describe the existing land use on and adjacent to the site of the proposed activity and any anticipated location(s) of off-site effects on coastal resources or uses. Clearly differentiate between the descriptions of on-site and off-site areas. Include any existing structures and significant features at either location.

The project site is located at 409 Washington Avenue, New Haven, CT, is zoned IL-80 (Industrial Light), and is located between Vly Service Road and Washington Avenue. The properties adjacent to the the project site are a mix of proviately-owned commercial, industrial, and residetial land uses.

- ☐ Check if additional sheets are attached to this page

f. Indicate the area of the project site: **0.321** ☒ acres or ☐ square feet

g. Indicate the area of any anticipated off-site effects: **174**

- ☐ acres or ☐ square feet or ☐ other units (specify units): **square miles**

Part IV: Detailed Project Information (cont.)

4. Project Plans

If the proposed Federal activity is a "Federal Development Project", or other site specific activity, please provide project plans in 8 ½" x 11" format that clearly and accurately depict the following items, and check the appropriate boxes to indicate that the information is included in this review package:

- ☐ Project location
- ☐ Existing and proposed conditions, including buildings and grading
- ☐ Coastal resources on and contiguous to the site
- ☐ High Tide Line [as defined in CGS § 22a-359(c)], Mean High Water, and Mean Low Water elevations and contours (for parcels abutting coastal waters and/or tidal wetlands only)
- ☐ Soil erosion and sediment controls
- ☐ Stormwater management measures
- ☐ Ownership and type of use on adjacent properties
- ☐ Reference datum (i.e., National Geodetic Vertical Datum, Mean Sea Level, etc.)

If a Spill Prevention, Control, and Containment Plan (SPCC) has been developed for this site, please provide a copy in the review package and check here to indicate its inclusion ☐

Part V: Identification of the Applicable Enforceable Policies

In this Part, there are four tables which should be completed by checking the appropriate boxes in each. Table 1: *Coastal Resources and Associated Enforceable Policies*, is to identify on-site, adjacent, and/or potentially affected State-statutorily defined coastal resources. Table 2: *Coastal Uses and Associated Enforceable Policies*, is to identify existing and proposed State-statutorily defined coastal uses potentially affected by the project. Table 3a: *Potential Adverse Impacts on Coastal Resources* and Table 3b: *Potential Adverse Impacts on Water-dependent Uses and Opportunities* is to identify State-statutorily-defined adverse impacts.

Table 1

Coastal Resources and Associated Enforceable Policies	On-site	Adjacent	Affected by the proposed Federal activity**
General Coastal Resources* - Definition: CGS § 22a-93(7) Policy: CGS § 22a-92(a)(2)	☒	☒	☒
Beaches & Dunes - Definition: CGS § 22a-93(7)(C) Policies: CGS §§ 22a-92(b)(2)(C) and 22a-92(c)(1)(K)	☐	☐	☐
Bluffs & Escarpments - Definition: CGS § 22a-93(7)(A) Policy: CGS § 22a-92(b)(2)(A)	☐	☐	☐
Coastal Hazard Area - Definition: CGS § 22a-93(7)(H); Policies: CGS §§ 22a-92(a)(2), 22a-92(a)(5), 22a-92(b)(2)(F), 22a-92(b)(2)(J), 22a-92(c)(1)(K), and 22a-92(c)(2)(B)	☐	☐	☐
Coastal Waters, Estuarine Embayments, Nearshore Waters, Offshore Waters - Definitions: CGS §§ 22a-93(5), 22a-93(7)(G), 22a-93(7)(K), and 22a-93(7)(L); Policies: CGS §§ 22a-92(a)(2) and 22a-92(c)(2)(A)	☐	☐	☐
Developed Shorefront - Definition: CGS § 22a-93(7)(I); Policy: CGS § 22a-92(b)(2)(G)	☐	☐	☐
Freshwater Wetlands and Watercourses - Definition: CGS § 22a-93(7)(F) Policy: CGS § 22a-92(a)(2)	☐	☐	☐
Intertidal Flats - Definition: CGS § 22a-93(7)(D) Policies: CGS § 22a-92(b)(2)(D) and 22a-92(c)(1)(K)	☐	☐	☐
Islands - Definition: CGS § 22a-93(7)(J) Policy: CGS § 22a-92(b)(2)(H)	☐	☐	☐
Rocky Shorefront - Definition: CGS § 22a-93(7)(B) Policy: CGS § 22a-92(b)(2)(B)	☐	☐	☐
Shellfish Concentration Areas - Definition: CGS § 22a-93(7)(N) Policy: CGS § 22a-92(c)(1)(I)	☐	☐	☐
Shorelands - Definition: CGS § 22a-93(7)(M) Policy: CGS § 22a-92(b)(2)(I)	☐	☐	☐
Tidal Wetlands - Definition: CGS § 22a-93(7)(E) Policies: CGS §§ 22a-92(a)(2), 22a-92(b)(2)(E), and 22a-92(c)(1)(B)	☐	☐	☐

* The General Coastal Resource Policy is applicable to all proposed activities within Connecticut's coastal boundary and coastal area.

** The coastal resources affected by the project can be on-site, adjacent, or further removed from the project site.

Table 2

Coastal Uses and Associated Enforceable Policies	
☒	General Development* - CGS §§ 22a-92(a)(1), 22a-92(a)(4), and 22a-92(a)(9)
☐	Boating - CGS § 22a-92(b)(1)(G), 22a-92(b)(1)(H), and 22a-92(b)(1)(I)
☐	Coastal Recreation and Access - CGS §§ 22a-92(a)(2), 22a-92(a)(6), 22a-92(c)(1)(J), and 22a-92(c)(1)(K)
☐	Coastal Structures and Filling - CGS § 22a-92(a)(2), 22a-92(b)(1)(D), 22a-92(c)(1)(B), 22a-92(c)(1)(K), and 22a-92(c)(2)(B)
☐	Cultural Resources – CGS § 22a-92(b)(1)(J)
☐	Dams, Dikes and Reservoirs - CGS § 22a-92(a)(2)
☐	Dredging and Navigation - CGS §§ 22a-92(a)(2), 22a-92(c)(1)(C), 22a-92(c)(1)(D), and 22a-92(c)(1)(E)
☐	Energy Facilities - CGS §§ 16-50g and 16-50p(a)
☐	Fisheries - CGS § 22a-92(c)(1)(I)
☐	Flooding and Erosion - CGS § 22a-92(a)(5)
☐	Fuel, Chemicals and Hazardous Materials - CGS §§ 22a-92(a)(2), 22a-92(b)(1)(C), 22a-92(b)(1)(E) and 22a-92(c)(1)(A)
☐	Facilities and Resources which are in the National Interest - Definition CGS § 22a-93(14) - Policy CGS 22a-92(a)(10)
☐	Intergovernmental Coordination - CGS § 22a-92(a)(9)
☐	Open Space and Agricultural Lands - CGS § 22a-92(a)(2)
☐	Ports and Harbors – CGS § 22a-92(b)(1)(C)
☐	Sewer and Water Lines - CGS § 22a-92(b)(1)(B)
☐	Solid Waste - CGS § 22a-92(a)(2)
☐	Transportation - CGS §§ 22a-92(b)(1)(F), 22a-92(c)(1)(F), 22a-92(c)(1)(G), and 22a-92(c)(1)(H)
☐	Water-dependent Uses** - Definition CGS § 22a-93(16) - Policies CGS §§ 22a-92(a)(3) and 22a-92(b)(1)(A)

* The General Development Policy is applicable to all proposed activities within Connecticut's coastal boundary and coastal area.

** The Water-Dependent Uses Policies are applicable to all activities proposed at waterfront sites, including those sites with only tidal wetlands frontage.

Identification of State Statutorily Defined Potential Adverse Impacts

In Tables 3a and 3b, identify the adverse impact categories that apply to the proposed Federal activity. The "Applicable" column **must be checked** if the proposed activity has the **potential** to generate any of the State-statutorily defined adverse impacts, even if the activity is designed to avoid such impacts. Also indicate, by checking the appropriate boxes, whether the potential adverse impacts have been avoided or minimized and whether any resource compensation is proposed.

Table 3a

Potential Adverse Impacts on Coastal Resources	Applicable	Impacts Are Avoided	Impacts Are Minimized	Compensation Is Proposed	Not Applicable
Characteristics and Functions of Resources - CGS § 22a-93(15)(H)	☐	☐	☐	☐	☒
Coastal Flooding - CGS § 22a-93(15)(E)	☐	☐	☐	☐	☒
Coastal Waters Circulation Patterns - CGS § 22a-93(15)(B)	☐	☐	☐	☐	☒
Drainage Patterns - CGS § 22a-93(15)(D)	☐	☐	☐	☐	☒
Patterns of Shoreline Erosion and Accretion - CGS § 22a-93(15)(C)	☐	☐	☐	☐	☒
Visual Quality - CGS § 22a-93(15)(F)	☐	☐	☐	☐	☒
Water Quality - CGS § 22a-93(15)(A)	☐	☐	☐	☐	☒
Wildlife, Finfish, Shellfish Habitat - CGS § 22a-93(15)(G)	☐	☐	☐	☐	☒

Table 3b

Potential Adverse Impacts on Water-dependent Uses and Opportunities	Applicable	Impacts Are Avoided	Impacts Are Minimized	Compensation Is Proposed	Not Applicable
Locating a non-water-dependent use at a site physically suited for, or planned for location of, a water-dependent use - CGS § 22a-93(17)	☐	☐	☐	☐	☒
Replacing an existing water-dependent use with a non-water-dependent use - CGS § 22a-93(17)	☐	☐	☐	☐	☒
Siting a non-water-dependent use which would substantially reduce or inhibit existing public access to marine or tidal waters - CGS § 22a-93(17)	☐	☐	☐	☐	☒

Part VI: Consistency Analysis

Explain how the proposed activity is consistent with all of the applicable enforceable policies identified in Part V, why any remaining adverse impacts resulting from the proposed activity or use have not been mitigated, and why the project as proposed is consistent with the enforceable policies of Connecticut's Coastal Management Program. If an adverse impact **may** result from the proposed Federal activity, describe what project design features may be used to eliminate, minimize, or mitigate the potential for adverse impacts. For proposed Federal Development Projects, please describe the stormwater best management practices that will be utilized. Such systems should be designed to meet the guidance provided in the accompanying instructions.

The proposed activity is consistent with all applicable enforceable policies identified in Part V of Connecticut's Coastal Management Program. The site of the proposed project is located inland and outside the coastal boundary, involves no construction, discharge, or physical modification within the coastal zone, and therefore will not result in adverse impacts to coastal resources or water dependent uses. Drone overflights within the broader 7.5-mile drone operating radius are transitory and do not involve landing, takeoff, discharge, or physical interaction with coastal resources. All potential adverse impact categories listed in Tables 3a and 3b have been reviewed and determined to be Not Applicable. Any cultural or environmental resources identified within the drone operating radius will be documented and evaluated under the FAA's concurrent NEPA review process. Accordingly, the proposed activity is fully consistent with the enforceable policies of Connecticut's Coastal Management Program.

☐ Check if additional sheets are attached to this page

Part VII: Level of Consistency and Identification of Legal Authority that Prohibits Full Consistency, if Applicable

Federal regulations allow Federal activities to be less than fully consistent with a State's enforceable policies **only** if "full consistency is prohibited by existing law applicable to the Federal Agency" [15 CFR 930.32]. Please check the appropriate box below to indicate the activities degree of consistency.

☒ Project is *fully* consistent with Connecticut's enforceable policies

☐ Project is *not fully* consistent with Connecticut's enforceable policies, but is consistent to the maximum extent practicable

If the proposed Federal Activity described in this form is not *fully* consistent with Connecticut's enforceable policies, but only consistent to the maximum extent practicable, in accordance with 15 CFR 930.32, please identify and describe the statutory provisions, legislative history, or other legal authority which limits the federal agency's discretion to comply fully with Connecticut's Coastal Management Program. Please attach additional pages if necessary. Attach copies of the relevant statutory provisions, legislative history, or other legal authority cited.

The proposed activity is fully consistent with Connecticut's enforceable coastal management policies. The project is located inland and outside the coastal boundary, involves no construction or discharge within the coastal zone, and does not affect coastal resources or water dependent uses. Drone overflights within the broader 7.5-mile operating radius are transitory and do not result in coastal effects. No statutory provisions, legislative history, or other legal authority limit the federal agency's ability to comply fully with Connecticut's Coastal Management Program.

☐ Check if additional sheets are attached to this page

Part VIII: Coastal Zone Management Act Consistency Statement

Note: This Part *must* be completed for all submissions

In this Statement "Federal Agency" means:

Federal Aviation Administration

and "the project" means:

Proposed Electric Drone Package Delivery Operations – New Haven, Connecticut

This document provides the State of Connecticut Coastal Management Program with the required Consistency Determination under CZMA Section 307(c)(1) [or (2)] and 15 CFR Part 930, Subpart C, for the project described in this *Coastal Management Consistency Review Form for Federal Activities*. This determination is provided by the Federal Agency identified above. The information in this Consistency Determination is provided pursuant to 15 CFR Section 930.39. The Federal Agency has determined that the project affects the land or water uses or natural resources of Connecticut as described above. Based on the information, data, and analysis included in the *Coastal Management Consistency Review Form for Federal Activities* for the project, the Federal Agency has determined that the proposed activity is consistent to the maximum extent practicable with the enforceable policies of the Connecticut Coastal Management Program as evaluated in this form.

Pursuant to 15 CFR Section 930.41, the Connecticut Coastal Management Program has 60 days from receipt of this form in which to concur with or object to this Consistency Determination, or to request an extension under 15 CFR Section 930.41(b).

Part IX: Certifying Signatures

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that based on reasonable investigation, including my inquiry of the individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief."

Signature of Certifier

Joseph Hemler

Name of Certifier (print or type)

Date

**Manager, AFS-752
Emerging Technologies Division
Federal Aviation Administration**

Title (if applicable)

Signature of Preparer

Date

Name of Preparer (print or type)

Title (if applicable)



U.S. Department
of Transportation

**Federal Aviation
Administration**

Aviation Safety

800 Independence Ave., SW.

Washington, DC 20591

Federal Consistency Coordinator
Connecticut Department of Energy & Environmental Protection (DEEP)
Office of Long Island Sound Programs (OLISP)
79 Elm Street
Hartford, CT 06106

**Re: Consistency Determination under CZMA §307(c)(1)/(2) for Proposed Electric Drone Package
Delivery Operations – New Haven, Connecticut**

To Ms. Mia L. Smith:

In accordance with the Coastal Zone Management Act (CZMA) of 1972, as amended, and the implementing regulations at **15 CFR Part 930, Subpart C**, the Federal Aviation Administration (FAA) provides this Consistency Determination for the proposed electric drone package delivery operations in the New Haven, CT area (the Proposed Action). The applicant for this action is Amazon Prime Air, LLC.

Part I: Project Name/Information

Project Name:

Proposed Electric Drone Package Delivery Operations – North Haven, Connecticut

Applicant:

Jim Fitzpatrick
Amazon Prime Air
Regulatory Affairs
fitzpkja@amazon.com
253-651-3978

Federal Agency Contact:

Joseph (Jody) Hemler
Manager, AFS-752
202-267-9700
9-FAA-Drone-Environmental@faa.gov

Consultant:

Neal Wolfe
Environmental Science Associates
nwolfe@esassoc.com
859-757-5317

Part II: Review Type and Project Title

The federal action is the Federal Aviation Administration (FAA) approval of Prime Air's Operational Specifications to conduct beyond visual line of sight drone commercial package delivery in the New Haven, CT area.

Part III: Other DEEP Involvement with the Project

As indicated on the DEEP CMC review form, no components of the proposed action are subject to DEEP regulation separate from the federal consistency process. Accordingly, no other DEEP units have been contacted regarding this application.

Part IV: Detailed Project Information

IV.1: Description of Proposed Action

Prime Air proposes to operate up to 1,000 MK30 drone delivery flights per operating day at a Prime Air Drone Delivery Center (PADDC) over the course of 365 operating days per year, resulting in roughly 365,000 annual delivery operations. Commercial delivery operations from the PADDC would occur between 6 a.m. and 10:30 p.m., up to seven days per week, with up to 100 of the 1,000 daily delivery flights (10%) expected to occur during the period from 6 a.m. to 7 a.m. and 10 p.m. to 10:30 p.m. The MK30 drone's proposed operating range is 7.5 miles (mi) from the PADDC, each with a potential operating area of 174 square (sq) mi.

The general location of the proposed PADDC is depicted in Attachment A. The PADDC facility would be located on the same property as and adjacent to an existing Amazon warehouse building with office space, a ground control station, an aircraft maintenance area, a battery storage area, paved departure and arrival pads, and perimeter fencing. All drone operations would originate from and terminate at the PADDC. The specific street addresses for the proposed PADDC location is:

- BDL3: 409 Washington Avenue, New Haven, CT 06473

As depicted in Attachment A, the MK30 drone is an electric powered drone that has a vertical take-off and landing, and transitions to wing-borne flight using wing lift during en route flight. Its systems include hardware and software designed for safety and efficiency. The airframe is composed of staggered wings; the propulsion system includes a rechargeable lithium-ion battery and six motors that include propellers designed for noise reduction; the package delivery system contains the package in a two-door interior receptacle; and a camera and avionics system that has redundancy for critical systems. The MK30 drone weighs approximately 78 lbs. and has a maximum takeoff weight of 83.2 lbs., which includes a maximum payload of 5 lbs. It has a maximum operating range of 7.5 mi and can fly up to 400 ft above ground level (AGL) at a maximum cruise speed of 73 mph (64 knots) during horizontal flight.

As shown in Attachment A, a typical flight profile can be broken into the following general flight phases: launch, en route outbound, delivery, en route inbound, and landing. After launch, Prime Air's MK30 drone would rise to an altitude of less than 400 ft AGL and follow a predefined route to its delivery site. Drones would typically fly en route at between approximately 205 and 370 ft AGL, except when descending to drop a package. Packages would be carried internally in the drone's fuselage. When making a delivery, the drone descends, opens a set of payload doors, and drops the package to the ground from approximately 13 ft AGL. Prime Air restricts items deliverable by drone to those which can

safely be dropped from this height. Prime Air's MK30 drone would not touch the ground in any place other than the PADDC (except during safe contingent landings) and will remain airborne throughout the operation including the delivery stage. After the package is dropped, the MK30 drone climbs vertically and follows its predefined route back to the PADDC at its assigned altitude.

IV.2: Is Project Site Specific?

Affirmative

IV.3: Location Information

- a) 409 Washington Avenue, New Haven, CT 06473
- b) N/A
- c) Negative
- d) Drone operation range map depicting NOAA's CZMA included in Attachment A
- e) Existing and adjacent land uses included on the DEEP CMC review form.
- f) Included on the DEEP CMC review form.
- g) Included on the DEEP CMC review form.

IV.4: Project Plans

The proposed action is not a Federal Development Project as defined under 15 CFR §930.31 and does not involve federal construction, land acquisition, or physical development within Connecticut's coastal zone; therefore, none of the associated requirements or enforceable policies for Federal Development Projects are applicable.

Part V: Identification of the Applicable Enforceable Policies

Table 1

V.1.1: General Coastal Resources

The project is located inland and outside Connecticut's coastal boundary. No coastal resources occur within or adjacent to the project area, and the proposed action does not involve construction, land disturbance, or discharge that could affect coastal systems. Although drone overflights may occur within the broader 7.5-mile operating radius, these transitory flights do not involve landing, takeoff, discharge, or physical interaction with coastal resources and therefore do not result in coastal effects.

V.1.2: Beaches and Dunes

The project is located inland and outside Connecticut's coastal boundary. No coastal beaches or dune systems occur within or near the project area. Although drone overflights may occur within the broader 7.5-mile operating radius, these transitory flights do not involve landing, takeoff, discharge, or physical interaction with coastal resources and therefore do not result in coastal effects.

V.1.3: Bluffs and Escarpments

No coastal bluffs or escarpments exist within or adjacent to the project area. Any potential drone overflight is transitory and does not create physical disturbance or coastal effects.

V.1.4: Rocky Shorefront

The project is not located near any rocky shorefront areas. Overflight does not constitute a coastal effect because no landing, takeoff, or physical interaction occurs.

V.1.5: Sandy Shorefront

No sandy shorefront areas occur near the project location. Drone overflight within the operating radius does not affect this resource.

V.1.6: Tidal Wetlands

The project area contains no tidal wetlands and is not adjacent to any mapped tidal wetland systems. While drones may overfly tidal wetlands within the operating radius, such flights are transitory and do not involve any physical interaction or disturbance.

V.1.7: Freshwater Wetlands

No freshwater wetlands occur within or immediately adjacent to the project footprint. Overflight does not alter or disturb freshwater wetlands and therefore does not result in coastal effects.

V.1.8: Coastal Hazard Areas

The project is located inland and outside any mapped coastal hazard areas. Drone overflight does not constitute use or modification of a coastal hazard area.

V.1.9: Coastal Flood Hazard Areas

The project is not located within FEMA coastal flood zones or DEEP-designated coastal flood hazard areas. Transitory overflight does not affect flood hazard functions or conditions.

V.1.10: Coastal Waters

The project is not located near coastal waters, estuarine systems, or tidal waterbodies. Drone overflight does not involve landing, takeoff, discharge, or any interaction with coastal waters.

V.1.11: Estuarine Embayments

No estuarine embayments occur near the project area. Overflight does not create coastal effects because no physical interaction occurs.

V.1.12: Intertidal Flats

The project is inland and not adjacent to any intertidal flats. Drone overflight does not disturb or modify intertidal flats.

V.1.13: Shellfish Concentration Areas

No mapped shellfish concentration areas occur near the project location. Overflight does not affect shellfish resources or habitat.

V.1.14: Coastal Hazardous Waste Sites

The project area does not contain or adjoin any coastal hazardous waste sites. Drone overflight does not interact with or affect these sites.

V.1.15: Developed Shorefront

The project is not located near developed shorefront areas. Overflight does not constitute use or modification of developed shorefront.

V.1.16: Island Resources

No coastal islands occur near the project area. Drone overflight does not affect island resources and does not constitute a coastal use.

Table 2

V.2.1: General Development

The project is located inland and outside Connecticut's coastal boundary. It does not involve coastal construction, shoreline modification, or land development within the coastal zone. Although drone overflights may occur within the broader 7.5-mile operating radius, these transitory flights do not involve landing, takeoff, discharge, or physical interaction with coastal resources and therefore do not result in coastal effects.

V.2.2: Boating

The project is not located near navigable coastal waters or boating facilities. Drone overflight does not involve landing, takeoff, or physical interaction with boating activities and therefore does not affect this use.

V.2.3: Coastal Recreation and Access

No coastal recreation areas or public access points occur near the project location. Drone overflight does not restrict or alter public access or recreational use of coastal resources.

V.2.4: Coastal Structures and Filling

The project does not involve construction, alteration, or filling of coastal structures. Drone overflight does not interact with or modify coastal structures.

V.2.5: Cultural Resources

No coastal cultural or historic resources occur near the project area. Drone overflights within the broader 7.5-mile operating radius are transitory and do not involve landing, takeoff, discharge, or physical interaction with cultural resources. Any cultural resources identified within the operating radius will be documented and evaluated as part of the FAA's concurrent NEPA review process, ensuring appropriate consideration and compliance.

V.2.6: Dams, Kikes, and Reservoirs

The project does not involve or affect dams, dikes, or reservoirs. Drone overflight does not alter or interact with these structures.

V.2.7: Dredging and Navigation

The project does not involve dredging, dredged-material disposal, or navigation maintenance. Drone overflight does not interfere with navigation or dredging operations.

V2.8: Energy Facilities

No energy facilities occur near the project area. Drone overflight does not affect energy infrastructure or operations.

V2.9: Fisheries

The project is inland and does not affect fisheries or aquaculture resources. Drone overflight is transitory and does not interact with fishing activities or habitats.

V2.10: Flooding and Erosion

The project is outside any mapped coastal flood or erosion hazard areas. Drone overflight does not influence shoreline processes or flood-control structures.

V2.11: Fuel, Chemicals, and Hazardous Materials

The project does not involve the use, storage, or transport of fuel, chemicals, or hazardous materials within the coastal zone. Drone overflight does not interact with such materials or facilities.

V2.12: Facilities and Resources in the National Interest

The project does not occur near or affect facilities or resources identified as being in the national interest. Drone overflight does not alter or interfere with these resources.

V2.13: Intergovernmental Coordination

No intergovernmental coordination issues arise because the project is inland and outside the coastal boundary.

V2.14: Open Space and Agricultural Lands

The project does not involve or affect coastal open space or agricultural lands. Drone overflight does not disturb these land uses.

V2.15: Ports and Harbors

The project is not located near any port or harbor facilities. Drone overflight does not interact with port operations or maritime commerce.

V2.16: Sewer and Water Lines

The project does not involve installation or modification of sewer or water lines within the coastal zone. Drone overflight does not affect these utilities.

V2.17: Solid Waste

The project does not involve solid-waste management activities within the coastal zone. Drone overflight does not interact with or affect waste-handling facilities.

V2.18: Transportation

The project does not involve coastal transportation infrastructure or facilities. Drone overflight does not interfere with transportation operations.

V2.19: Water-Dependent Uses

The project does not introduce, modify, or affect any water-dependent uses. Drone overflight is transitory and does not create coastal effects.

Tables 3a and 3b

All categories listed in Tables 3a and 3b have been reviewed and determined to be Not Applicable. The proposed action is located inland and outside Connecticut's coastal boundary, involves no construction or discharge, and does not affect coastal resources or water-dependent uses. Drone overflights within the broader 7.5-mile operating radius are transitory and do not result in coastal effects.

Part VI: Consistency Analysis

Included on the DEEP CMC review form.

Part VII: Level of Consistency and Identification of Legal Authority that Prohibits Full Consistency, if Applicable

Included on the DEEP CMC review form.

Part VIII: Coastal Zone Management Act Consistency Statement

The FAA certifies that the Proposed Action, "Proposed Electric Drone Package Delivery Operations – New Haven, Connecticut," complies with the enforceable policies of Connecticut's Coastal Management Program (CCMP) and will be conducted in a matter consistent with the CCMP program. This Consistency Determination is provided pursuant to 15 CFR § 930.39 and reflects the FAA's finding that the proposed action is consistent to the maximum extent practicable with the enforceable policies of the Connecticut Coastal Management Program.

The FAA requests your concurrence with the FAA's finding of consistency with Connecticut's CMP for the Proposed Action. Your response within the next 60 days will greatly assist us in our environmental review process. If you would like to consult with the FAA about this project, please contact Christopher Hurst via email at 9-faa-drone-environmental@faa.gov.

Sincerely,

Joseph Hemler
Manager, General Aviation and Commercial Branch (AFS-752)
Emerging Technologies Division
Office of Safety Standards, Flight Standards Service

Attachment A
Additional Project Information



Amazon Prime Air MK30 Drone

Weight – 78 lbs.

Payload – 5 lbs.

Cruise Speed – 62 mph

Ceiling – 400 ft

Range – 7.5 mi (15 min)

Operations – 365,000/yr (1,000/day)

Operating Times – 6am – 10:30pm

Electrically powered

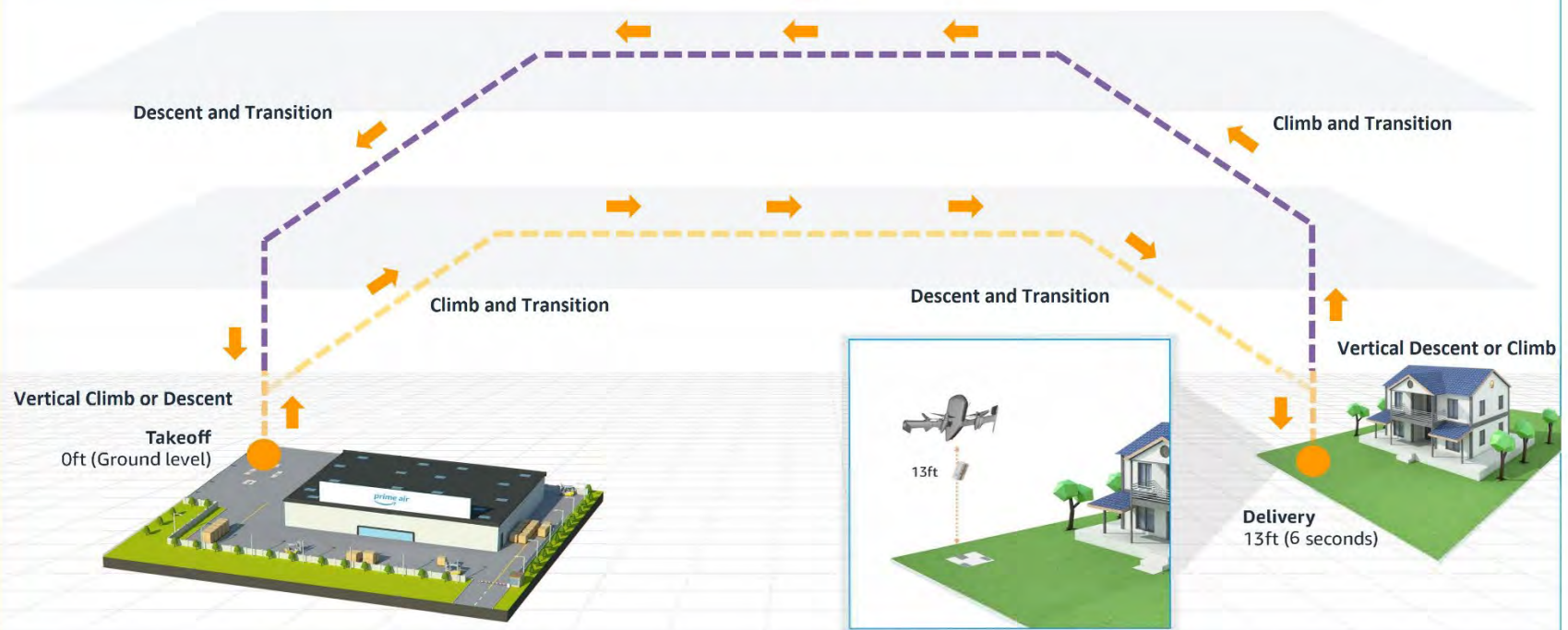
Operate from a PADDC – Prime Air Drone Delivery Center



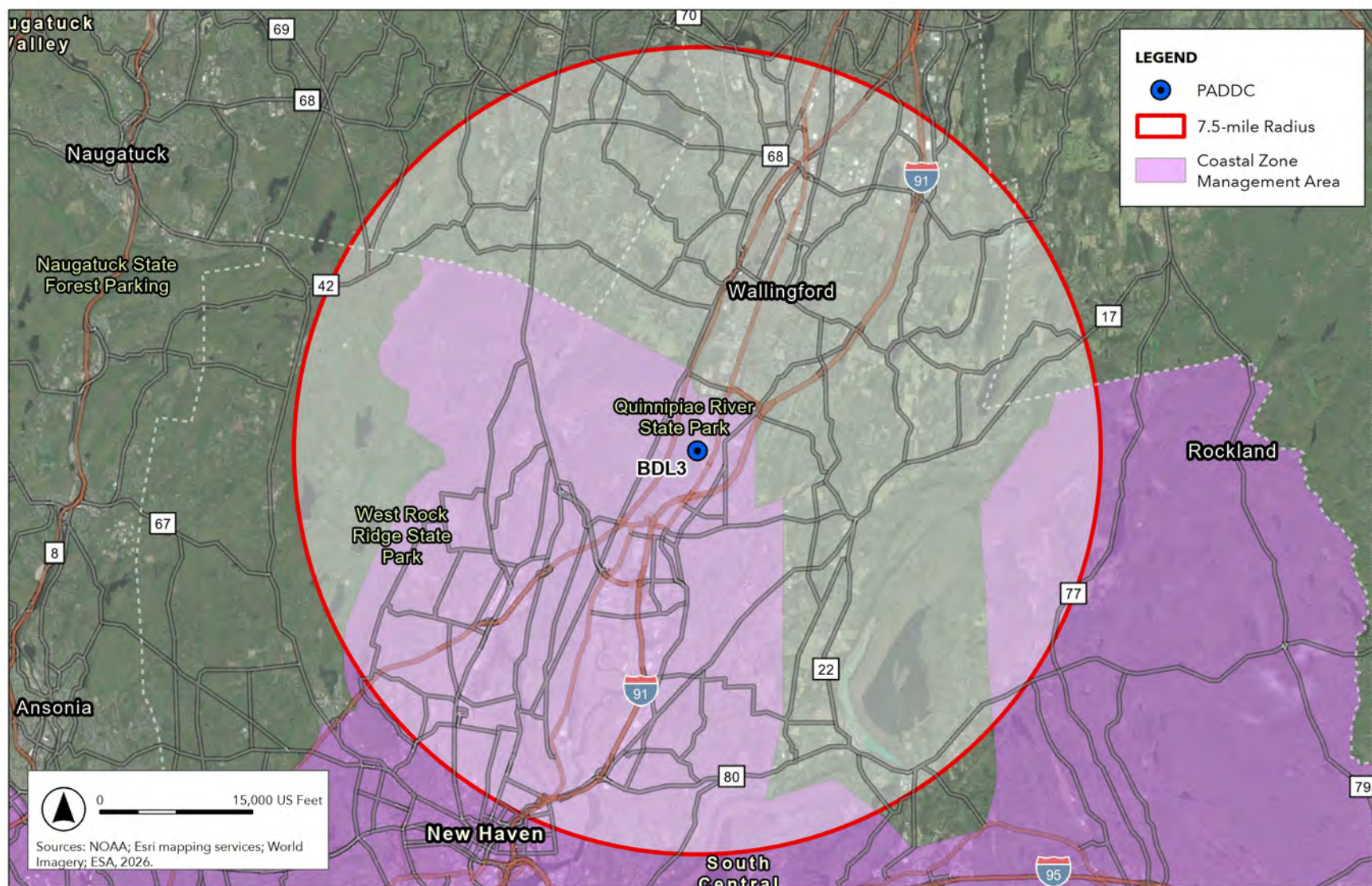
Fixed Wing Cruise

Can range from 205ft – 250ft at 58kts (inbound to customer)

Can range from 325ft -370ft at 58kts (outbound to PADDCC)



MK30 Drone Flight Profile



Coastal Zone Management Area
BDL3 PADD

ESTIMATED NOISE LEVELS FOR AMAZON PRIME AIR MK30 DRONE

Technical Noise Report

April 2025



ESTIMATED NOISE LEVELS FOR AMAZON PRIME AIR MK30 DRONE

Technical Noise Report

April 2025

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1 Introduction

This document presents the methodology and estimation of noise exposure of Amazon Prime Air (Prime Air) package delivery operations under 14 CFR Part 135. Prime Air is proposing to conduct package delivery operations with the MK30 drone at selected distribution hubs (the Prime Air Drone Delivery Center, or PADDC).

The MK30 is an electric powered drone that uses a vertical take-off and landing (VTOL) then transitions to fixed-wing flight using wing lift during en route flight. The drone systems include hardware and software designed for safety and efficiency. The airframe is composed of staggered wings, the propulsion system includes a rechargeable lithium-ion battery, and six (6) motors that include propellers designed for noise reduction. The package delivery system contains the package in a two-door interior receptacle, and a camera and avionics system that has redundancy for critical systems. The drone weighs approximately 78 lbs. and has a maximum takeoff weight of 83.2 lbs., which includes a maximum payload of 5 lbs. It has a maximum operating range of 7.5 mi and can fly up to 400 ft above ground level (AGL) at a maximum cruise speed of 73 mph (64 knots) during horizontal flight. An image of the MK30 drone is shown in **Figure 1**.

The MK30 operational flight profiles can be broken into the following general flight phases: launch, en route outbound, delivery, en route inbound, and landing. After launch, the MK30 would ascend to an altitude of less than 400 ft AGL and follow a predefined route to its delivery site.¹ The MK30 would typically fly en route at between approximately 180 to 377 ft AGL, except when descending to drop a package. Packages would be carried internally in the drone's fuselage. When making a delivery, the drone descends, opens a set of payload doors, and drops the package to the ground from approximately 13 ft AGL. Prime Air's drone would not touch the ground in any place other than the PADDC (except during safe contingent landings) and will remain airborne throughout the operation including the delivery phase.² After the package is dropped, the MK30 drone climbs vertically and follows its predefined route back to the PADDC at its assigned altitude.

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

¹ Prime Air may modify operations, if warranted, to avoid or minimize any negative impacts.

² The MK30 vehicle is built with multiple redundant safety features and "detect and avoid" technology. The drone is designed to handle unexpected situations; it is independently safe.

³ Environmental Assessment (EA) Noise Methodology Approval Request for Amazon Prime Air Commercial Package Delivery Operations with the MK30 Unmanned Aircraft (UA) from Tampa, Florida, May 2025. (See Attachment A).

⁴ See FAA Order 1050.1F, July 16, 2015,

Appendix B, Section B-1.2, for discussion on the use of "equivalent methodology", available online at

https://www.faa.gov/documentLibrary/media/Order/FAA_Order_1050_1F.pdf#page=113

Figure 1. Amazon Prime Air MK30 Drone



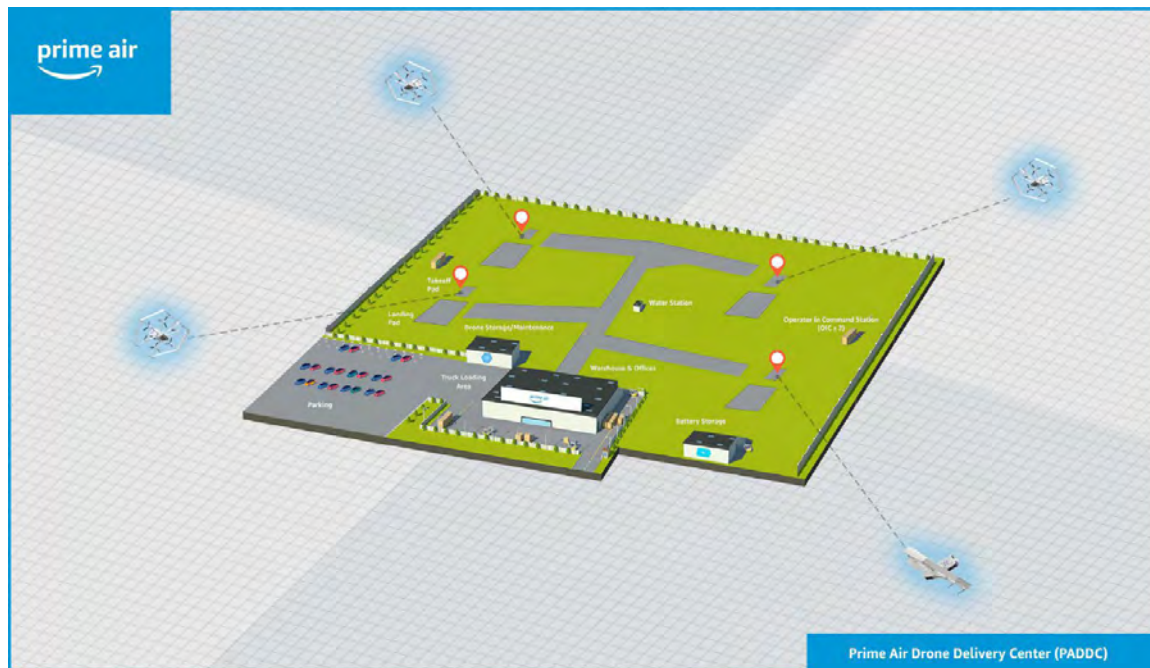
Source: Amazon Prime Air, 2023.

2 Drone Delivery Operations

The PADDC and its associated flight routes are determined by Prime Air's business and operational needs. Takeoff pads at the PADDC are four meters by four meters. Landing pads are eight meters by eight meters. Both pads are contained within a launch area approximately 35 meters by 45 meters. A diagram of a representative PADDC layout is presented in **Figure 2**.

The MK30 drone is capable of vertical ascent and descent, hovering, and flying upright with forward-facing propellers for en route travel. Airspeeds during normal en route flight are expected to be approximately 58.3 knots. A typical flight will commence with a vertical ascent from the launch pad to the transition altitude of approximately 115 feet, from which it will continue a forward-facing climb to an outbound en route altitude between 180 and 279 feet AGL. The drone then maintains altitude and follows a predetermined route, traveling at 58.3 knots toward the designated delivery point. Prior to arrival at the delivery point, the drone will begin its descent down to a transition altitude of 140 feet and decelerate to zero-speed at which time it will arrive at the delivery point. The drone then begins a vertical descent to 13 feet AGL at which time the package is released. The drone will ascend back to a transition altitude of 197 feet, begin the outbound transition and climb phase to 345 feet, while accelerating to 58.3 knots until it reaches the inbound en route altitude between 279 and 377 feet along the predetermined route back to the PADDC. Prior to arriving at the PADDC, the drone will descend to the transition altitude of 197 feet, decelerate to zero speed, and begin a vertical descent to the landing pad.

Figure 2. Representative PADDC Layout



Source: Amazon Prime Air, 2022.

2.1 Flight Profiles

Flight profiles of drone operations are broken into five general phases: takeoff, transitions to and from vertical and horizontal flight, en route, delivery, and landing. These phases can be combined to represent the typical operational profile of the drone as outlined below. A graphical representation of the operational profile is presented in **Figure 3** and each phase is summarized in **Table 1**.

Takeoff, Vertical Ascent, Transition, and Outbound Climb

The drone departs from the launch pad once cleared for takeoff. It will ascend vertically to the transition altitude of 115 feet AGL in vertical flight mode.

Upon reaching the transition altitude, and while still positioned above the launch pad, the drone transitions from zero speed to its cruise speed of 58.3 knots and continues an outbound climb to the typical cruise altitude of 200 feet AGL (ranges from 180 and 279 feet AGL). This transition is accompanied by a shift from vertical flight mode to horizontal flight mode.

Fixed-wing Outbound Cruise

The drone proceeds to fly at the typical cruise altitude of 200 feet AGL (ranges from 180 to 279 feet AGL) and 58.3 knots to the backyard descent and transition.

Backyard Descent, Delivery, Ascent, Transition, and Inbound Climb

The drone decelerates from the en route speed of 58.3 knots and descends from the typical outbound cruise altitude of 200 feet AGL (ranges from 180 to 279 feet AGL) to a transition altitude of 140 feet AGL. The drone then transitions to vertical flight mode, where it will be positioned over the delivery point at zero speed.

The drone begins a vertical descent from the transition altitude to 13 feet AGL while maintaining position above the delivery point. Once at 13 feet AGL, the drone drops the package and ascends vertically back to the transition altitude of 197 feet AGL. The nearest allowable proximity of any individual, animal, or other obstacles to the delivery point during this maneuver is 16.4 feet.

Once at the transition altitude and positioned above the delivery point, the drone transitions from zero speed to en route speed while changing from vertical flight to horizontal flight and continues to climb to the typical inbound cruise altitude of 345 feet AGL (ranges from 279 to 377 feet AGL).

Fixed-wing Inbound Cruise

The drone continues to fly at the typical en route altitude of 345 feet AGL (ranges from 279 to 377 feet AGL) and speed of 58.3 knots towards the PADDC.

Landing Descent, Transition, Vertical Descent, and Landing

The drone decelerates as it approaches the PADDC and descends to the transition altitude of 197 feet AGL and where it transitions from horizontal flight to vertical flight, coming to a zero-speed position over its assigned landing pad.

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

Table 1. Representative Operational Profile by Phase of Flight

Phase of Flight	Altitude (feet AGL)	Ground Speed (knots)	Duration (seconds)
Takeoff and Vertical Ascent	Ascent from 0 to 115	0	15
Transition and Outbound Climb	115 to 279	0 to 58.3	40
Fixed Wing Outbound Cruise	200 ¹	58.3	Variable ³
Delivery Descent and Transition	Descent from 200 to 140	58.3 to 0	30
Backyard Descent	Descent from 140 to 13	0	27
Delivery	13	0	4
Backyard Ascent	Ascent from 13 to 197	0	30
Transition and Inbound Climb	Ascent from 197 to 377	0 to 58.3	40
Fixed-Wing Inbound Cruise	377 ²	58.3	Variable ³
Landing Descent and Transition	Descent from 377 to 197	58.3 to 0	30
Vertical Descent and landing	Descent from 197 to 0	0	35

SOURCE: Amazon Prime Air, February 2025

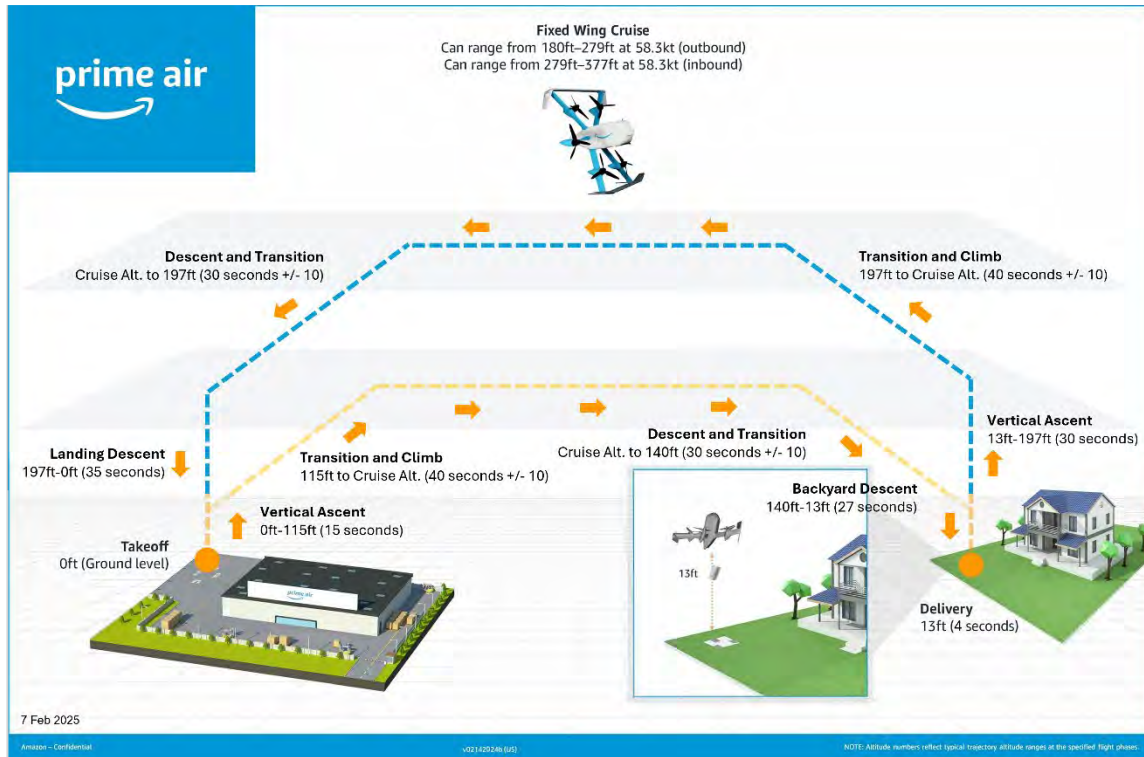
Notes:

¹ The outbound enroute altitude may range from 180 – 279 feet. For this analysis the outbound cruise altitude was assumed to be 200 feet.

² The inbound enroute altitude may range from 279 – 377 feet. For this analysis the inbound cruise altitude was assumed to be 345 feet.

³ Duration of inbound and outbound cruise flight time varies based on distance to customer.

Figure 3. Representative Operational Profile of the MK30



Source: Prime Air, 2025.

3 Methodology

As previously mentioned, there is not a standardized process for drone noise assessments. Therefore, ESA is applying technical guidance that was previously approved by the FAA Office of Environment and Energy for past analyses. The following subsections outline this methodology.

Prime Air conducted noise measurements of the MK30 drone in October 2024 at the Pendleton UAS Range located at the Eastern Oregon Regional Airport (KPDT). ESA, in coordination with the FAA, processed and analyzed the measurement data and calculated the noise levels for each of the flight phases.⁵ The following subsections show either the A-weighted Sound Exposure Levels (SEL) or formulas to calculate the SELs used for this analysis, which can be matched to each flight phase detailed in **Table 1**.

3.1 Daytime Equivalent Operations and DNL

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

⁵ Prime Air MK30 Drone Noise Measurement Report, Environmental Science Associates, April 2025. (See Attachment B).

$$eq. 1. N_{Equiv,i} = W_{Day} \times N_{Day,i} + W_{Eve} \times N_{Eve,i} + W_{Night} \times N_{Night,i}$$

Where:

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

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

$$eq. 2. N_{DNL,i} = N_{Day,i} + N_{Eve,i} + 10 \times N_{Night,i}$$

3.2 PADDC Infrastructure

Each PADDC accommodates four sets of launch and landing pads. In the context of this noise analysis, it is assumed that all operations would occur at one launch/landing pad, where it would be the closest to the noise-sensitive areas. This assumption is considered acoustically conservative. If the precise location of the nearest single launch or landing pad is unknown, the respective PADDC boundary should be used for the analysis.

3.3 Application of Acoustical Data

The summation of the SELs presented in subsequent sections are used to estimate the DNL for Prime Air's drone operations covered in this report. SEL results are detailed in the measurement report found in **Attachment B**.

For calculating SEL, four specific activities are considered:

- The drone taking off from the PADDC (includes transition between vertical and horizontal flight)
- En route travel of the drone in horizontal flight between the PADDC and the delivery point
- Delivery
- The drone landing at the PADDC (includes transition between vertical and horizontal flight)

3.3.1 Takeoff

The process for estimating SELs associated with takeoff as a function of distance from the PADDC is presented in Equation 3 and incorporates the parameters detailed in **Table 2**.

$$eq. 3. SEL = m \times \log_{10}(d) + b(dB)$$

Where:

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

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

Range for d (feet from launch pad)	m	b
20 to 76	-14.51	109.35
76 to 195	-13.51	107.46
195 to 372	-14.66	110.09
372 to 772	-17.08	116.32
772 to 1,205	-17.05	116.23
1,205 and greater	0.00	63.7

SOURCE: ESA, 2025.
Note: Distance is along ground from launch pad to receiver.

Application of the SEL is based on the position of the launch/landing pad, where it would be the closest to the noise-sensitive areas. However, if the exact location of the launch pad is not known, the outer boundary of the PADDC, at a point closest to the receiver, should be used as it considered to be acoustically conservative. It should be noted that the SEL values include the transition to horizontal flight and the acceleration to en route speed that would occur during the climb.

3.3.2 En Route

The anticipated outbound flight speed of the drone en route is 58.3 knots at a cruise altitude of 200 feet AGL. For inbound flight the anticipated cruise altitude is 345 feet AGL with the same 58.3 knot flight speed. As discussed in **Appendix B**, adjustments were applied to the measured data to account for how the varying speed impacts the duration of the overflight at the stationary receptor.

As shown in **Table 3**, the SEL is 63.7 dB when the drone is at maximum weight, at 200 feet from the stationary receiver and traveling at approximately 58.3 knots. The SEL is 60.9 dB when the drone is at empty weight, 345 feet from the stationary receiver, and traveling at approximately 58.3 knots.

Table 3. Estimates of En Route Sound Exposure Level

Aircraft Configuration	Reference Air Speed (knots)	Reference Altitude (feet AGL)	Uncorrected Speed (knots)	Uncorrected Altitude (feet AGL)	Uncorrected SEL (dBA)	Corrected SEL (dBA)
Maximum Weight	58.3	200	60.8	116	66.1	63.7
Empty Wight	58.3	345	60.8	98	66.9	60.9

SOURCE: ESA, 2025.

3.3.3 Delivery

The process for estimating SELs associated with delivery as a function of distance from a receiver relative to the position of the delivery point is presented in Equation 3 and incorporates the parameters detailed in **Table 4**.

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

Range for d (feet from launch pad)	m	b
25 to 76	-13.18	110.56
76 to 175	-18.65	120.84
175 to 372	-13.86	110.11
372 to 772	-15.63	114.67
772 to 1,396	-15.63	114.66
1,396	0.00	65.5

SOURCE: ESA, 2025.
Note: Distance is along ground from delivery point to receiver.

The minimum distance used for calculation between the delivery point and a person is 16.4 feet.⁶ The values in **Table 4** are valid for distances from the delivery point of 25 feet or greater. SEL values for distances between 16 and 25 feet are adjusted by distance to the delivery point and sound level adjustment of a stationary source as provided by Equation 4.

$$eq. 4. SEL_{Delivery} = 92.1 + 12.5 \times \log_{10} \frac{25}{Distance \text{ from Delivery Point (ft)}}$$

It should be noted that the SEL values include the noise contribution from the horizontal flight associated with the drone transition from en route to descent and transition, including the transition to vertical flight and transition back to en route altitude.

3.3.4 Landing

The process for estimating SELs associated with landing as a function of distance from the PADDC is presented in Equation 3 and incorporates the parameters detailed in **Table 5**.

Table 5. Parameters for Estimating Landing Sound Exposure Level versus Distance

Range for d (feet from launch pad)	m	b
20 to 76	-14.95	111.28
76 to 195	-16.17	113.58
195 to 375	-21.10	124.86
375 to 1,074	-21.10	124.87
1,074	0.00	60.9

SOURCE: ESA, 2025.
Note: Distance is along ground from launch pad to receiver.

If the location of the landing pad is known, the outer boundary of the PADDC (at a point closest to the noise sensitive receiver), should be used for the modeling location as a conservative approach. It should be noted that the SEL values include the descent from en route altitude and the deceleration from en route speed, and the transition to vertical flight that would occur after the initial descent.

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

3.4 DNL Estimation Methodology

The number of operations flying over a specific receiver's ground location will fluctuate depending on the proposed operating area and demand. For a given receiver location, i , and a single instance of sound source, A , the SEL for that sound source SEL_{iA} is (energy) summed for the average annual daily number of DNL daytime equivalent operations ($N_{DNL,iA}$) to compute the equivalent DNL in Equation 5.

$$eq. 5. DNL_{iA} = SEL_{iA} + 10 \times \log_{10}(N_{DNL,iA}) - 49.4, dB$$

The above equation applies to an SEL value representing one noise source such as a drone takeoff or landing. For cases where a receiver would be exposed to multiple noise sources (e.g. takeoff, transiting, en route, and departure), the complete DNL at that point was calculated with Equation 6.

$$eq. 6. DNL_i = 10 \times \log_{10} \left(10^{\left(\frac{DNL_{ia}}{10}\right)} + 10^{\left(\frac{DNL_{ib}}{10}\right)} + \dots + 10^{\left(\frac{DNL_{iz}}{10}\right)} \right), dB$$

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

3.4.1 DNL at PADDCC

The takeoff and landing operations are anticipated to occur at one PADDCC for this analysis. Therefore, the results at the PADDCC will be calculated for a single set of receptors. Operations were assumed to takeoff and land along the same flight path.

Takeoff operations are represented by two phases of flight. The drone will take off and climb to the transition altitude as discussed in **Section 2**. The drone will then transition from vertical flight to horizontal flight and accelerate to en route speed of 58.3 knots and climb to en route altitude.

Landing operations are also represented by two phases of flight. The drone flies to the PADDCC at en route altitude until it begins to descend to the transition altitude while slowing down and transitions from horizontal to vertical flight as described in **Section 2**. Then the drone descends from the transition altitude to the ground and shuts down.

The two noise sources representing the complete takeoff and landing cycle associated with a single delivery departing and returning at the PADDCC were added together using Equation 6.

3.4.2 DNL for En Route

A receiver will be positioned directly under the flight path, and the DNL will be calculated based on the altitude and speed-adjusted delivery SEL presented in **Table 3**. The number of operations would be based on relevant materials and assume that a drone directly overflies the receiver while at maximum and empty weight for outbound and inbound flight, respectively, for a single delivery. The en route outbound and inbound noise level are added together with Equation 6.

3.4.3 DNL for Delivery Points

Delivery operations are represented by the deceleration of the drone from en route speed and transition from horizontal flight to vertical flight over the delivery point at the transition altitude of 140 feet AGL. The drone then begins a vertical descent to where the package is dropped at the delivery point at 13 feet AGL. The drone then climbs back to the transition altitude of 197 feet AGL where it will transition from vertical flight to horizontal flight, accelerating to en route speed.

4 Estimated Noise Exposure

This section outlines the estimated noise exposure for Prime Air's proposed operations for any given number of average annual day (AAD) deliveries. Results are based off the estimated number of DNL equivalent deliveries associated with the PADDC and presented in tabular format. Deliveries will not occur during nighttime hours (10 P.M. – 7 A.M.). Note that one delivery includes the outbound takeoff and inbound landing and is representative of two operations.

The DNL equivalent deliveries, $N_{DNL,i}$ as described in **Section 4.1**, is presented below as Equation 7.

$$eq. 7. Deliveries_{DNL,i} = Deliveries_{Day} + 10 \times Deliveries_{Night}$$

$Deliveries_{Day}$ are between 7 A.M. and 10 P.M. and $Deliveries_{Night}$ are between 10 P.M. and 7 A.M. If a portion of a delivery (either takeoff or landing) occurs in the nighttime hours, then it is counted within $Deliveries_{Night}$.

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

4.1 Noise Exposure for Operations at the PADDC

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

Table 6 presents estimated extent of noise exposure for the number of average daily DNL equivalent deliveries (including the takeoff and climb, transition to en route outbound, transition from en route inbound, and descent and landing as detailed in **Section 2**) under the flight path for the PADDC. The analyses presented were rounded up conservatively to the nearest interval available from the data outlined in this section.

Table 6. Estimated Extent of Noise Exposure from PADDC per Number of Deliveries

Number of DNL Equivalent Deliveries		Estimated Extent of Noise Exposure (feet)				
Average Daily	Annual	DNL 45	DNL 50	DNL 55	DNL 60	DNL 65
<= 1	<= 365	21	21	21	21	21
<= 5	<= 1,825	50	21	21	21	21
<= 10	<= 3,650	100	50	21	21	21
<= 15	<= 5,475	100	50	21	21	21
<= 20	<= 7,300	100	50	21	21	21
<= 40	<= 14,600	150	100	50	21	21
<= 60	<= 21,900	200	100	50	21	21
<= 80	<= 29,200	250	150	50	21	21
<= 100	<= 36,500	300	150	100	50	21
<= 120	<= 43,800	350	150	100	50	21
<= 140	<= 51,100	350	200	100	50	21
<= 160	<= 58,400	400	200	100	50	21
<= 180	<= 65,700	450	200	100	50	21
<= 200	<= 73,000	450	200	100	50	21
<= 220	<= 80,300	500	250	100	50	21
<= 240	<= 87,600	500	250	100	50	21
<= 260	<= 94,900	500	250	150	50	21
<= 280	<= 102,200	550	300	150	50	50
<= 300	<= 109,500	550	300	150	100	50
<= 320	<= 116,800	600	300	150	100	50
<= 340	<= 124,100	600	300	150	100	50
<= 360	<= 131,400	600	300	150	100	50
<= 380	<= 138,700	650	350	150	100	50
<= 400	<= 146,000	650	350	150	100	50
<= 420	<= 153,300	700	350	150	100	50
<= 440	<= 160,600	700	350	200	100	50
<= 460	<= 167,900	700	400	200	100	50
<= 480	<= 175,200	750	400	200	100	50
<= 500	<= 182,500	750	400	200	100	50
<= 520	<= 189,800	750	400	200	100	50
<= 540	<= 197,100	800	400	200	100	50
<= 560	<= 204,400	800	400	200	100	50
<= 580	<= 211,700	800	450	200	100	50
<= 600	<= 219,000	850	450	200	100	50
<= 620	<= 226,300	850	450	200	100	50
<= 640	<= 233,600	850	450	250	100	50
<= 660	<= 240,900	900	450	250	100	50
<= 680	<= 248,200	900	450	250	100	50
<= 700	<= 255,500	900	500	250	100	50
<= 720	<= 262,800	950	500	250	100	50
<= 740	<= 270,100	950	500	250	100	50
<= 760	<= 277,400	950	500	250	100	50
<= 780	<= 284,700	950	500	250	100	50
<= 800	<= 292,000	1,000	500	250	150	50
<= 820	<= 299,300	1,000	500	250	150	50

Number of DNL Equivalent Deliveries		Estimated Extent of Noise Exposure (feet)				
Average Daily	Annual	DNL 45	DNL 50	DNL 55	DNL 60	DNL 65
<= 840	<= 306,600	1,000	550	250	150	50
<= 860	<= 313,900	1,050	550	250	150	50
<= 880	<= 321,200	1,050	550	250	150	50
<= 900	<= 328,500	1,050	550	300	150	50
<= 920	<= 335,800	1,050	550	300	150	50
<= 940	<= 343,100	Note 3	550	300	150	50
<= 960	<= 350,400	Note 3	550	300	150	100
<= 980	<= 357,700	Note 3	600	300	150	100
<= 1,000	<= 365,000	Note 3	600	300	150	100

SOURCE: ESA, 2025.

Notes:

1. One delivery accounts for the outbound takeoff and inbound landing and is representative of two operations.
2. If a value for deliveries is not specifically defined in this table, use the next highest value. For example, if there are 50 average daily DNL equivalent deliveries, use the entry for 60 average daily DNL equivalent deliveries.
3. The DNL noise level extends more than 1,074 feet from the PADDC based on the level of operations specified as the aircraft continues along its en route flight path. En route results in Section 4.2 may be more applicable in these instances for determining noise levels.

4.2 Noise Exposure under En Route Paths

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

Table 7 provides the estimated DNL for a receiver on the ground directly under an en route path for various counts of daily average DNL equivalent deliveries. The en route noise calculated for each delivery includes both the outbound traversal of the en route path at 200 feet AGL and a ground speed of 58.3 knots and the inbound traversal of the en route path at 345 feet AGL and the same ground speed of 58.3 knots.

The drone may overfly locations at operational levels that differ from both an inbound and outbound traversal of the en route path by the drone as described above and presented in **Table 7**. For these circumstances, **Table 8** presents the equations for calculating the estimated DNL for a receiver directly under a specified given number of DNL equivalent average daily individual overflights, defined as N_o .

Table 7. Estimated Noise Exposure Directly Under En Route Flight Paths

Number of DNL Equivalent Deliveries		Estimated Extent of Noise Exposure		
Average Daily	Annual	Outbound DNL ¹	Inbound DNL ²	Total En Route DNL
<= 1	<= 365	14.3	11.5	16.1
<= 5	<= 1,825	21.3	18.5	23.1
<= 10	<= 3,650	24.3	21.5	26.1
<= 15	<= 5,475	26.1	23.3	27.9
<= 20	<= 7,300	27.3	24.5	29.1
<= 40	<= 14,600	30.3	27.5	32.2
<= 60	<= 21,900	32.1	29.3	33.9
<= 80	<= 29,200	33.3	30.5	35.2
<= 100	<= 36,500	34.3	31.5	36.1
<= 120	<= 43,800	35.1	32.3	36.9
<= 140	<= 51,100	35.8	33.0	37.6
<= 160	<= 58,400	36.3	33.5	38.2
<= 180	<= 65,700	36.9	34.1	38.7
<= 200	<= 73,000	37.3	34.5	39.1
<= 220	<= 80,300	37.7	34.9	39.6
<= 240	<= 87,600	38.1	35.3	39.9
<= 260	<= 94,900	38.4	35.6	40.3
<= 280	<= 102,200	38.8	36.0	40.6
<= 300	<= 109,500	39.1	36.3	40.9
<=320	<= 116,800	39.4	36.6	41.2
<= 340	<= 124,100	39.6	36.8	41.4
<= 360	<= 131,400	39.9	37.1	41.7
<= 380	<= 138,700	40.1	37.3	41.9
<= 400	<= 146,000	40.3	37.5	42.2
<= 420	<= 153,300	40.5	37.7	42.4
<= 440	<= 160,600	40.7	37.9	42.6
<= 460	<= 167,900	40.9	38.1	42.8
<= 480	<= 175,200	41.1	38.3	42.9
<= 500	<= 182,500	41.3	38.5	43.1
<= 520	<= 189,800	41.5	38.7	43.3
<= 540	<= 197,100	41.6	38.8	43.5
<= 560	<= 204,400	41.8	39.0	43.6
<= 580	<= 211,700	41.9	39.1	43.8
<= 600	<= 219,000	42.1	39.3	43.9
<= 620	<= 226,300	42.2	39.4	44.1
<= 640	<= 233,600	42.4	39.6	44.2
<= 660	<= 240,900	42.5	39.7	44.3
<= 680	<= 248,200	42.6	39.8	44.5
<= 700	<= 255,500	42.8	40.0	44.6
<= 720	<= 262,800	42.9	40.1	44.7
<= 740	<= 270,100	43.0	40.2	44.8
<= 760	<= 277,400	43.1	40.3	44.9
<= 780	<= 284,700	43.2	40.4	45.1
<= 800	<= 292,000	43.3	40.5	45.2
<= 820	<= 299,300	43.4	40.6	45.3

Number of DNL Equivalent Deliveries		Estimated Extent of Noise Exposure		
Average Daily	Annual	Outbound DNL ¹	Inbound DNL ²	Total En Route DNL
<= 840	<= 306,600	43.5	40.7	45.4
<= 860	<= 313,900	43.6	40.8	45.5
<= 880	<= 321,200	43.7	40.9	45.6
<= 900	<= 328,500	43.8	41.0	45.7
<= 920	<= 335,800	43.9	41.1	45.8
<= 940	<= 343,100	44.0	41.2	45.9
<= 960	<= 350,400	44.1	41.3	46.0
<= 980	<= 357,700	44.2	41.4	46.0
<= 1,000	<= 365,000	44.3	41.5	46.1

SOURCE: ESA, 2025.

Notes:

1. The max weight en route noise calculated for each delivery includes both the outbound traversal of the en route path at 200 feet AGL and a ground speed of 58.3 knots.

2. The empty weight en route noise calculated for each delivery includes both the inbound traversal of the en route path at 345 feet AGL and a ground speed of 58.3 knots.

Table 8. Estimated Noise Exposure Directly Under Overflights

Altitude of Overflight	SEL for One Overflight (dB)	DNL for One Overflight Between 7 A.M. and 10 P.M. (dB)	DNL Equation for the Number of DNL Equivalent Overflights
115 feet AGL	66.7	17.5	$10 \times \log_{10}(No) + 17.5$
160 feet AGL	64.9	15.7	$10 \times \log_{10}(No) + 15.5$
165 feet AGL	64.7	15.5	$10 \times \log_{10}(No) + 15.5$
180 feet AGL	64.3	15.1	$10 \times \log_{10}(No) + 15.1$
200 feet AGL	63.7	14.5	$10 \times \log_{10}(No) + 14.5$
300 feet AGL	61.5	12.3	$10 \times \log_{10}(No) + 12.3$
345 feet AGL	60.7	11.5	$10 \times \log_{10}(No) + 11.5$
N Feet AGL	$12.5 \times \log_{10}(200/N_R) + 63.7$	$SEL_1 - 49.4$	$10 \times \log_{10}(No) + DNL_1$

SOURCE: ESA, 2025.

Notes:

1. The DNL value for a given number of average DNL Equivalent Operations, N_o , can be found by using the equations associated with operation of the drone at a specified altitude and speed interval. In this case, one operation represents a single overflight.

2. All values in this table are for level flight at maximum weight and 58.3 knots.

4.3 Noise Exposure for Operations at Delivery Point

Table 9 presents the estimated DNL values for a range of potential daily average DNL equivalent delivery counts at a delivery point. The DNL values include the transition from en route speed to vertical flight at transition altitude, the delivery maneuver, and the transition from vertical flight at transition altitude to en route speed as discussed in **Section 3.4.3**. The minimum listener distance is 16.4 feet from the delivery point and corresponds to minimum distance between a person and delivery point. Values are also presented at 25 feet from the delivery point which corresponds to minimum distance from the available measurement data and analysis. Values were also calculated at distances

of 50 feet, 75 feet, 100 feet, and 125 feet from the delivery point and are representative of distances from which nearby properties may experience noise from a delivery.⁷

Table 9. Estimated Noise Exposure at Various Distances from a Delivery Point per Number of DNL Equivalent Deliveries

Average Daily Deliveries	Annual Deliveries	DNL at 16.4 feet ¹	DNL at 25 feet ²	DNL at 50 feet	DNL at 75 feet	DNL at 100 feet	DNL at 125 feet
<= 1	<= 365	45.0	42.7	38.8	36.4	34.1	32.3
<= 5	<= 1,825	52.0	49.7	45.8	43.4	41.1	39.3
<= 10	<= 3,650	55.0	52.7	48.8	46.4	44.1	42.3
<= 15	<= 5,475	56.7	54.5	50.5	48.2	45.9	44.1
<= 20	<= 7,300	58.0	55.7	51.8	49.5	47.2	45.3
<= 40	<= 14,600	61.0	58.7	54.8	52.5	50.2	48.4
<= 60	<= 21,900	62.8	60.5	56.5	54.2	51.9	50.1
<= 80	<= 29,200	64.0	61.7	57.8	55.5	53.2	51.4
<= 100	<= 36,500	65.0	62.7	58.8	56.4	54.1	52.3
<= 120	<= 43,800	65.8	63.5	59.6	57.2	54.9	53.1
<= 140	<= 51,100	66.4	64.2	60.2	57.9	55.6	53.8
<= 160	<= 58,400	67.0	64.7	60.8	58.5	56.2	54.4
<= 180	<= 65,700	67.5	65.3	61.3	59.0	56.7	54.9
<= 200	<= 73,000	68.0	65.7	61.8	59.5	57.2	55.3
<= 220	<= 80,300	68.4	66.1	62.2	59.9	57.6	55.8
<= 240	<= 87,600	68.8	66.5	62.6	60.2	57.9	56.1
<= 260	<= 94,900	69.1	66.8	62.9	60.6	58.3	56.5
<= 280	<= 102,200	69.5	67.2	63.2	60.9	58.6	56.8
<= 300	<= 109,500	69.8	67.5	63.5	61.2	58.9	57.1
<=320	<=116,800	70.0	67.8	63.8	61.5	59.2	57.4
<= 340	<= 124,100	70.3	68.0	64.1	61.8	59.5	57.6
<= 360	<= 131,400	70.6	68.3	64.3	62.0	59.7	57.9
<= 380	<= 138,700	70.8	68.5	64.6	62.2	59.9	58.1
<= 400	<= 146,000	71.0	68.7	64.8	62.5	60.2	58.4
<= 420	<= 153,300	71.2	68.9	65.0	62.7	60.4	58.6
<= 440	<= 160,600	71.4	69.1	65.2	62.9	60.6	58.8
<= 460	<= 167,900	71.6	69.3	65.4	63.1	60.8	59.0
<= 480	<= 175,200	71.8	69.5	65.6	63.3	61.0	59.1
<= 500	<= 182,500	72.0	69.7	65.8	63.4	61.1	59.3
<= 520	<= 189,800	72.1	69.9	65.9	63.6	61.3	59.5
<= 540	<= 197,100	72.3	70.0	66.1	63.8	61.5	59.7
<= 560	<= 204,400	72.5	70.2	66.2	63.9	61.6	59.8
<= 580	<= 211,700	72.6	70.3	66.4	64.1	61.8	60.0
<= 600	<= 219,000	72.8	70.5	66.5	64.2	61.9	60.1
<= 620	<= 226,300	72.9	70.6	66.7	64.4	62.1	60.3
<= 640	<= 233,600	73.1	70.8	66.8	64.5	62.2	60.4
<= 660	<= 240,900	73.2	70.9	67.0	64.6	62.3	60.5

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

Average Daily Deliveries	Annual Deliveries	DNL at 16.4 feet ¹	DNL at 25 feet ²	DNL at 50 feet	DNL at 75 feet	DNL at 100 feet	DNL at 125 feet
<= 680	<= 248,200	73.3	71.0	67.1	64.8	62.5	60.7
<= 700	<= 255,500	73.4	71.2	67.2	64.9	62.6	60.8
<= 720	<= 262,800	73.6	71.3	67.3	65.0	62.7	60.9
<= 740	<= 270,100	73.7	71.4	67.5	65.1	62.8	61.0
<= 760	<= 277,400	73.8	71.5	67.6	65.3	62.9	61.1
<= 780	<= 284,700	73.9	71.6	67.7	65.4	63.1	61.3
<= 800	<= 292,000	74.0	71.7	67.8	65.5	63.2	61.4
<= 820	<= 299,300	74.1	71.8	67.9	65.6	63.3	61.5
<= 840	<= 306,600	74.2	71.9	68.0	65.7	63.4	61.6
<= 860	<= 313,900	74.3	72.0	68.1	65.8	63.5	61.7
<= 880	<= 321,200	74.4	72.1	68.2	65.9	63.6	61.8
<= 900	<= 328,500	74.5	72.2	68.3	66.0	63.7	61.9
<= 920	<= 335,800	74.6	72.3	68.4	66.1	63.8	62.0
<= 940	<= 343,100	74.7	72.4	68.5	66.2	63.9	62.1
<= 960	<= 350,400	74.8	72.5	68.6	66.3	64.0	62.2
<= 980	<= 357,700	74.9	72.6	68.7	66.4	64.1	62.2
<= 1,000	<= 365,000	75.0	72.7	68.8	66.4	64.1	62.3

SOURCE: ESA, 2025.

Notes:

1. Minimum possible listener distance from drone.
2. Minimum measured distance to listener from drone.
3. The DNL values presented in this table reflect the drone conducting delivery descent and transition, backyard descent, delivery, backyard ascent, and transition and inbound climb flight maneuvers associated with a delivery.
4. If a value for deliveries is not specifically defined in this table, use the next highest value. For example, if there are 50 average daily DNL equivalent deliveries, use the entry for 60 average daily DNL equivalent deliveries.

Attachment A

Attachment B

PRIME AIR MK30 DRONE NOISE MEASUREMENT REPORT

Technical Report

April 2025



PRIME AIR MK30 DRONE NOISE MEASUREMENT REPORT

Technical Report

April 2025

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1 Introduction

This document details Amazon Prime Air's (Prime Air's) recent National Environmental Policy Act (NEPA) Noise Data Collection Campaign, aimed at estimating the noise signature of the MK30 drone. The collected data will be used to evaluate operations under NEPA. The test campaign took place at the Pendleton UAS Range, situated at the Eastern Oregon Regional Airport (KPDT) in Pendleton, Oregon. The data analyzed in this report comes from flights conducted on October 11, 12, 15, 16, 19, and 23, 2024.

Prime Air's package delivery operations are managed through a network of Prime Air Drone Delivery Centers (PADDCs). Each PADDC serves a specific area, preventing an over-concentration of flights around any single center. The MK30 drone has a round-trip range of approximately 15 miles. PADDCs are strategically located in established, and planned development, parking lots of Amazon Prime warehouses, and adhere to local zoning and land use regulations.

The MK30 is an electric powered drone that uses a vertical take-off and landing (VTOL) then transitions to fixed-wing flight using wing lift during en route flight. The drone systems include hardware and software designed for safety and efficiency. The airframe is composed of staggered wings, the propulsion system includes a rechargeable lithium-ion battery, and six (6) motors that include propellers designed for noise reduction. The package delivery system contains the package in a two-door interior receptacle, and a camera and avionics system that has redundancy for critical systems. The drone weighs approximately 78 lbs. and has a maximum takeoff weight of 83.2 lbs., which includes a maximum payload of 5 lbs. It has a maximum operating range of 7.5 mi and can fly up to 400 ft above ground level (AGL) at a maximum cruise speed of 73 mph (64 knots) during horizontal flight. An image of the MK30 drone is shown in **Figure 1**.

The MK30 operational flight profiles can be broken into the following general flight phases: launch, en route outbound, delivery, en route inbound, and landing. After launch, the MK30 would ascend to an altitude of less than 400 ft AGL and follow a predefined route to its delivery site.¹ The MK30 would typically fly en route at between approximately 180 to 377 ft AGL, except when descending to drop a package. Packages would be carried internally in the drone's fuselage. When making a delivery, the drone descends, opens a set of payload doors, and drops the package to the ground from approximately 13 ft AGL. Prime Air's drone would not touch the ground in any place other than the PADDC (except during safe contingent landings) and will remain airborne throughout the operation including the delivery stage.² After the package is dropped, the MK30 drone climbs vertically and follows its predefined route back to the PADDC at its assigned altitude. The typical operational flight parameters can be seen below in **Table 1** and **Figure 2**. Note that these are the flight profiles for operational flights and not the flight test profiles for this noise flight test campaign.

¹ Prime Air may modify operations, if warranted, to avoid or minimize any negative impacts.

² The MK30 vehicle is built with multiple redundant safety features and "detect and avoid" technology. The drone is designed to handle unexpected situations; it is independently safe.

A custom measurement system was utilized, employing GRAS 46AO 1/2" pressure microphones and National Instruments data acquisition hardware, following the FAA's draft UA package delivery noise measurement protocol.³ Flights were conducted across three flight profiles, which included takeoff/landing/delivery, hover, and overflight, to characterize the sound exposure levels (SEL) of the MK30 drone. These SEL values will be a key input to the NEPA Environmental Assessment for assessing the potential noise impact of Prime Air's proposed drone package delivery operations.

Figure 1. Amazon Prime Air MK30 Drone



Source: Amazon Prime Air, 2024.

³ Measuring Drone Noise for Environmental Review Process, October 2023.

Table 1. Phases of Flight for Typical Flight Profile of the MK30 Drone

Phase of Flight	Altitude (feet AGL)	Ground Speed (knots)	Duration (seconds)
Takeoff and Vertical Ascent	Ascent from 0 to 115	0	15
Transition and Outbound Climb	115 to 200	0 to 58.3	40
Fixed Wing Outbound Cruise	200 ¹	58.3	Variable ³
Delivery Descent and Transition	Descent from 200 to 140	58.3 to 0	30
Backyard Descent	Descent from 140 to 13	0	27
Delivery	13	0	4
Backyard Ascent	Ascent from 13 to 197	0	30
Transition and Inbound Climb	Ascent from 197 to 345	0 to 58.3	40
Fixed-Wing Inbound Cruise	377 ²	58.3	Variable ³
Landing Descent and Transition	Descent from 345 to 197	58.3 to 0	30
Vertical Descent and landing	Descent from 197 to 0	0	35

Source: Prime Air, 2025.

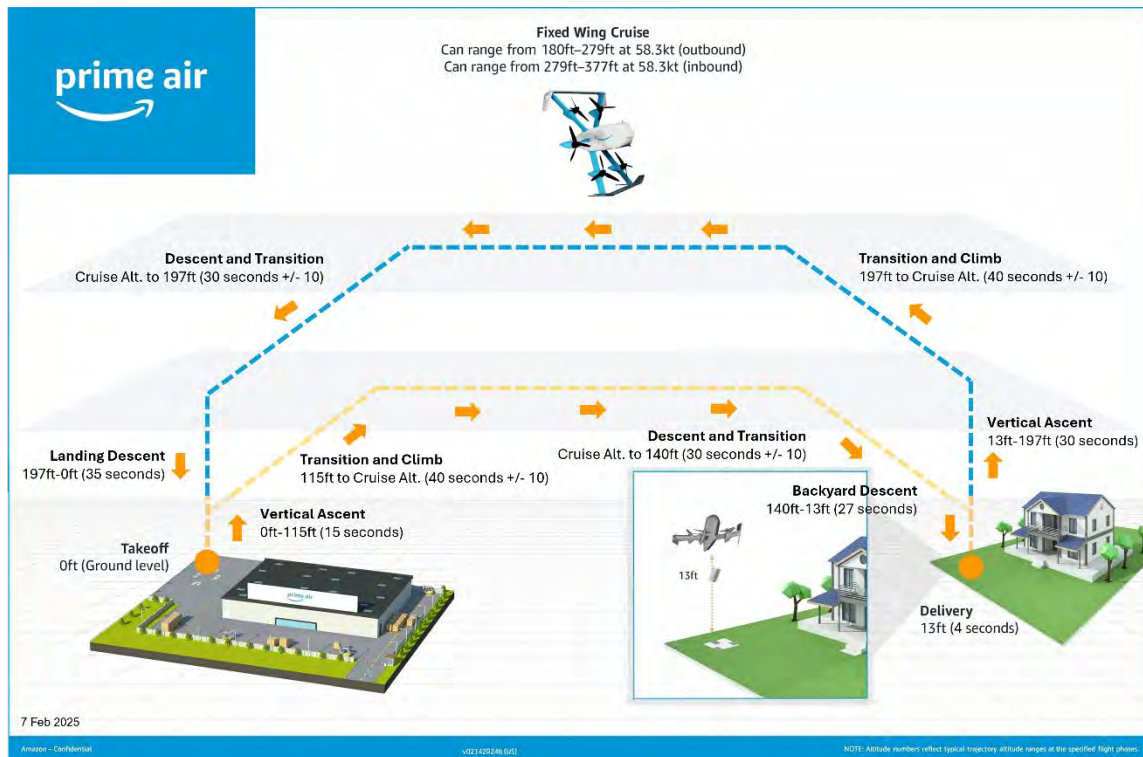
Notes:

¹ The outbound enroute altitude may range from 180 – 279 feet. For this analysis the outbound cruise altitude was assumed to be 200 feet.

² The inbound enroute altitude may range from 279 – 377 feet. For this analysis the inbound cruise altitude was assumed to be 345 feet.

³ Duration of inbound and outbound cruise flight time varies based on distance to customer.

Figure 2. Representative Operational Profile of the MK30



Source: Prime Air, 2025.

2 Test Descriptions

2.1 Overview

This section describes the methodology utilized to characterize the noise signature of the MK30 drone. The following sections describe the measurement system, and detailed description of the test plan, including flight trajectories and microphone locations.

2.2 Measurement System

Prime Air utilized a proprietary Mobile Acoustic Noise Test Array (MANTA) system for experimental measurements. This system provides time synchronized audio with respect to the drone. Microphone locations are surveyed for accurate positioning. The audio, drone-synchronized time and location data allow accurate determination of sound pressure level (SPL), distance, and incidence angle required for post-processing.

The system is composed of commercially available hardware with internal and external calibrations. The data acquisition system (DAQ) is a series of daisy-chained National Instruments cDAQ-9185 units and cDAQ-9189 units with NI-9234 analog modules capable of 51.2 kHz sampling rate at 24-bit resolution. New and calibrated GRAS 46AO ½” CCP Pressure Standard Microphones were used with the factory sensitivity values for the test. Calibration tones of the microphones were collected using a GRAS 42AG sound calibrator with a 1000 Hz signal at 114dB at the start and completion of each flight. Sensitivity values can be found in **Table 2**. While the primary components of the system are detailed above, the complete system hardware can be found in **Table 3**.

Measurement accuracy can be decomposed into system and field-installation components. Although MANTA has a GPS assigned to each microphone unit, only the time solution is used in the final product. By assigning a separate GPS unit to each microphone, the system is able to time synchronize with the on-board vehicle system to within 1 ms accuracy. Although the GPS location solution is not part of the delivered data product, it is used to confirm microphone placement with respect to desired survey locations using a nearest neighbor algorithm. This reduces geographic microphone placement from ± 1 m to ± 5 mm before installation error. When including a $\pm 30^\circ$ installation error via a 1.6m tall tripod on non-level ground, horizontal and vertical location accuracy approach ± 0.8 m and ± 0.1 m, respectively.

Table 2. Microphone Data

Microphone ID	Hardware	Serial Number	Sensitivity (mV/Pa)
00	GRAS 46AO	573631	10.77
01	GRAS 46AO	573508	9.47
02	GRAS 46AO	573632	11.60
03	GRAS 46AO	573507	12.54
04	GRAS 46AO	573633	10.81
05	GRAS 46AO	573636	10.41
06	GRAS 46AO	573506	11.12
07	GRAS 46AO	573505	12.78
08	GRAS 46AO	573504	9.39
08	GRAS 46AO	573504	9.39
10	GRAS 46AO	573521	10.10
11	GRAS 46AO	573626	10.19
12	GRAS 46AO	573639	9.78

Source: Prime Air, 2024.

Note: Microphones calibrated with GRAS 42AG; Serial Number: 282324.

Table 3. Measurement System Hardware

Hardware	Quantity	Description
National Instruments cDAQ-9185	7	National Instruments cDAQ chassis with 4 module slots. 1 slot was utilized and populated with a NI-9234 4 channel Sound and Vibration module. 1 channel input was used for the GRAS 46AO microphone input.
National Instruments cDAQ-9189	3	National Instruments cDAQ chassis with 8 module slots. 1 slot was utilized and populated with a NI-9234 4 channel Sound and Vibration module. 2 channel inputs were used for the GRAS 46AO microphone input.
National Instruments Sound and Vibration Module NI-9234	10	The Sound and Vibration module used for microphone input to the system. The nidaqmx task was configured to capture microphone input at 51.2kHz at 24bits.

Source: Prime Air, 2024.

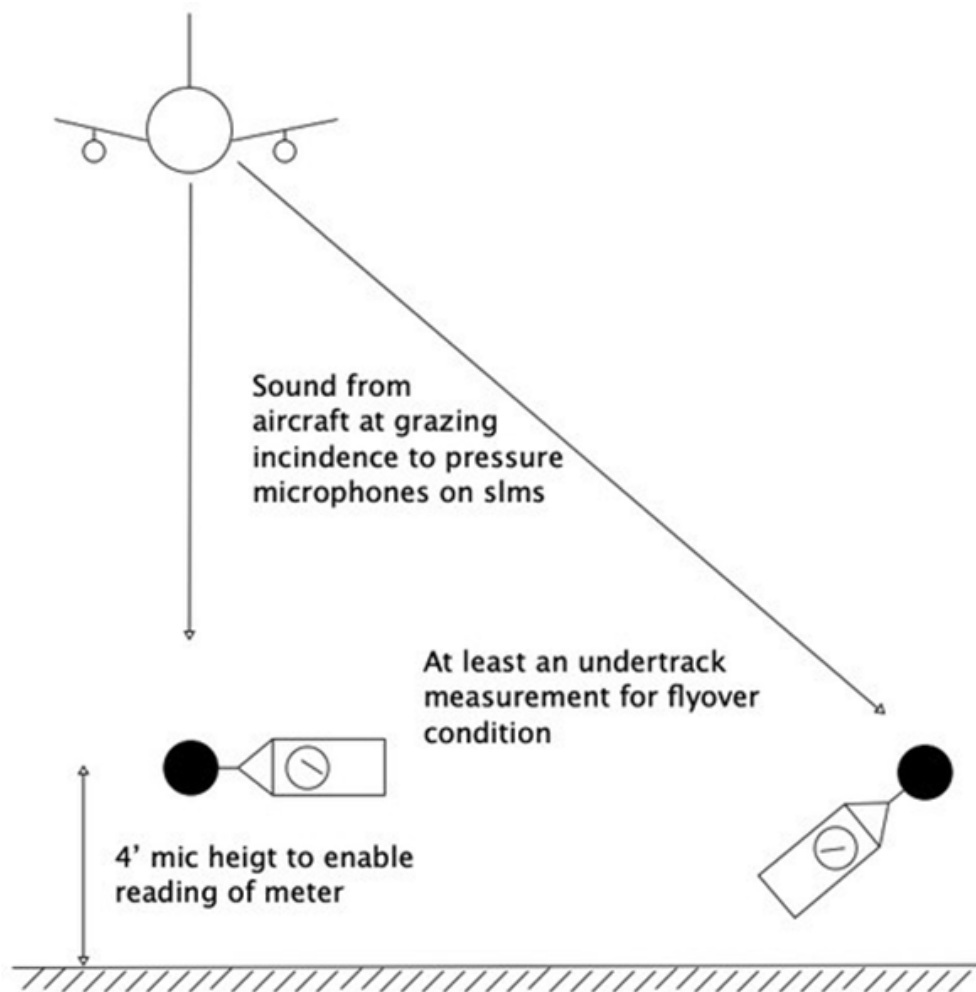
Note: All cDAQs were daisy chained together and utilized the Time-Sensitive Networking protocol to keep all data synchronized.

2.3 Microphone Locations

The microphone setup consisted of 13 pressure field microphones. In accordance with the FAA guidelines, each microphone was placed at 90 degree incidence to the sound source (drone) and is illustrated in **Figure 3**. There were no corrections applied to the measurement data due to the orientation of the microphones.

As shown in **Table 4**, microphones 00-04 were located under the takeoff, delivery, and landing flight trajectory. Microphones 05-08 were located behind the flight trajectory. Microphones 09-12 were located lateral to the flight trajectory. The table identifies the microphones used in calculating the various flight profiles. **Figure 4** provides the layout of microphones over an aerial basemap.

Figure 3. Microphone Orientation



Source: FAA.

Table 4. Microphone Location and Applicable Flight Profile

Microphone ID (position)	Distance from VTOL / Delivery (ft)	Latitude	Longitude	Applicable Flight Profile		
				Takeoff/ Landing	Delivery	Enroute/ Overflight
00 (Undertrack)	772	45.70246	-118.8586	Yes	Yes	No
01 (Undertrack)	372	45.70247	-118.8571	Yes	Yes	No
02 (Undertrack)	195	45.70247	-118.8563	Yes	Yes	No
03 (Undertrack)	75	45.70247	-118.8559	Yes	Yes	No
04 (Undertrack)	20	45.70247	-118.8557	Yes	Yes	No
05 (Behind)	19	45.70246	-118.8555	Yes	Yes	No
06 (Behind)	79	45.70247	-118.8553	Yes	Yes	No
07 (Behind)	176	45.70247	-118.8549	Yes	Yes	No
08 (Behind)	375	45.70247	-118.8541	Yes	Yes	No
09 (Lateral)	25	45.7024	-118.8556	Yes	Yes	Yes
10 (Lateral)	76	45.70227	-118.8556	Yes	Yes	Yes
11 (Lateral)	175	45.70199	-118.8556	Yes	Yes	Yes
12 (Lateral)	375	45.70144	-118.8556	Yes	Yes	Yes

Source: Prime Air, 2024.

Figure 4. Location of Microphones to Launch Pad



Source: Prime Air, 2024; ESA, 2025.

2.4 Test Limitations

The test plan consists of flights with a “dog-bone” and “half dog-bone” trajectory while the MANTA (detailed in 2.2) is positioned at the vicinity of the delivery/takeoff/landing PADDC and along a parallel and perpendicular line to the flyover trajectory. Close-in and distant measurements were captured for all VTOL phases of flight.

Additionally, some phases of the test flight profiles were slightly modified from typical operations. The duration of the delivery backyard climb was, on average, 16 seconds shorter than expected for typical operation. During the test flight the drone also climbed to a lower altitude of approximately 200 feet AGL, compared to the typical 345-foot AGL ceiling. To adjust, noise measurements were manually added at the point just before the MK30 stops climbing, where the climb rate is constant, to account for the total missing duration.

Similarly, for the return to the PADDC, the VTOL descent was, on average, 10 seconds shorter than typical operations. To adjust, noise measurements were manually added at the point just after the MK30 starts its vertical descent, where the descent rate is constant, to account for the total missing duration. Both adjustments provided a conservative (i.e., louder) approach to assessing noise exposure of the MK30.

3 Measurement Profiles

3.1 Overview

The noise measurement data for each test was reviewed and takeoff, delivery, landing, and overflight events were hand-selected for each test flight based on the drone’s altitude, speed, location, and distance from the PADDC and MANTA. Events were reviewed for each test flight and each microphone in the MANTA was checked for data quality, and were discarded based on the following criteria:

- Ambient noise level of the microphone is not reasonably close to the other microphones in the MANTA array.
- Average wind speed exceeding 5 knots during the event.
- Maximum sound level as measured by the 1-second Leq time history of the noise event not exceeding 10 dBA above the ambient noise level.
- Suspected contamination of the noise data (e.g. elevated or inconsistent ambient, sharp spikes in noise level, etc.).
- For overflight tests, data from the undertrack microphones (parallel to the direction of flight) were discarded.

3.3 Test Condition: Takeoff (Max Weight)

3.3.1 Weather Conditions

The average weather conditions for each test at max weight are shown in **Table 5**. There were no weather exceedances that would deem measurements invalid.

Table 5. Takeoff (Max Weight) Weather Conditions

Test Number	Temperature (°F)	Average Wind Speed (knots)	Wind Direction (Degrees)	Average Wind Gust Speed (knots)	Relative Humidity (%)
1	49.3	4.4	114	6.2	56.5
2	55.5	2.0	165	3.5	43.9
3	59.7	4.0	275	7.4	36.4
4	60.1	3.6	233	7.0	35.6
5	50.0	3.4	101	4.3	52.7
6	45.8	4.0	90	4.9	62.5
7	47.8	4.0	121	6.2	60.2

Source: Prime Air, 2024; ESA, 2025.

3.3.2 Test Points and Validity

Appendix B and **Appendix C** present the tabulated and time history results, respectively, for all measurements. Out of the 91 data points, 17 were identified as invalid, as detailed in the **Table 6**. Therefore, 74 data points were deemed valid.

Table 6. Takeoff (Max Weight) Excluded Measurements

Microphone ID (position)	Test Number	Reason Not Included
Mic 00 (Undertrack)	7	Measurement too close to ambient
Mic 05 (Behind)	4	Elevated ambient levels across measurement
Mic 08 (Behind)	1, 5, 6, 7	Measurement too close to ambient
Mic 09 (Lateral)	1, 2, 3, 4, 5	Elevated ambient levels across measurement
Mic 12 (Lateral)	2, 3, 4, 5, 6, 7	Measurement too close to ambient

Source: Prime Air, 2024; ESA, 2025.

Notes: Measurement data that has been excluded under this noise analysis are presented in Appendix B and Appendix C.

3.4 Test Condition: Delivery (Max Weight)

3.4.1 Weather Conditions

The average weather conditions for each test at max weight are shown in **Table 7**. There were no weather exceedances that would deem measurements invalid.

Table 7. Delivery (Max Weight) Weather Conditions

Test Number	Temperature (°F)	Average Wind Speed (knots)	Wind Direction (Degrees)	Average Wind Gust Speed (knots)	Relative Humidity (%)
1	49.1	4.1	123	6.0	56.6
2	55.6	1.2	260	3.7	43.5
3	59.8	5.0	283	7.4	36.3
4	60.3	4.6	222	6.2	35.2
5	50.6	2.9	92	4.3	52.3
6	45.8	4.5	93	4.9	62.8
7	47.9	4.2	112	6.2	59.7

Source: Prime Air, 2024; ESA, 2025.

3.4.2 Test Points and Validity

Appendix B and **Appendix C** present the tabulated and time history results, respectively, for all measurements. Out of the 91 data points, 14 were identified as invalid, as detailed in **Table 8**. Therefore, 77 data points were deemed valid.

Table 8. Delivery (Max Weight) Excluded Measurements

Microphone ID (position)	Test Number	Reason Not Included
Mic 00 (Undertrack)	7	Elevated ambient levels across measurement
Mic 08 (Behind)	5, 6, 7	Measurement too close to ambient
Mic 09 (Lateral)	1, 2, 3, 4, 5	Elevated ambient levels across measurement
Mic 12 (Lateral)	2, 3, 4	Elevated ambient levels across measurement
Mic 12 (Lateral)	5, 6	Measurement too close to ambient

Source: Prime Air, 2024; ESA, 2025.

Notes: Measurement data that has been excluded under this noise analysis are presented in Appendix B and Appendix C.

3.5 Test Condition: Landing (Empty Weight)

3.5.1 Weather Conditions

The average weather conditions for each test at empty weight are in **Table 9**. Test 3 wind speed exceeded the weather threshold for wind and would invalidate the measurement.

Table 9. Landing (Empty Weight) Weather Conditions

Test Number	Temperature (°F)	Average Wind Speed (knots)	Wind Direction (Degrees)	Average Wind Gust Speed (knots)	Relative Humidity (%)
1	51.5	3.4	309	6.8	61.3
2	62.4	1.2	298	6.0	33.0
3	61.4	5.2	321	7.8	34.7
4	59.9	3.4	271	5.2	44.6
5	42.6	4.8	118	5.6	83.0
6	56.8	1.0	108	2.1	51.1

Source: Prime Air, 2024; ESA, 2025.

3.5.2 Test Points and Validity

Appendix B and **Appendix C** present the tabulated and time history results, respectively, for all measurements. Out of the 78 data points, 35 were identified as invalid, as detailed in **Table 10**. Therefore, 43 data points were deemed valid.

Table 10. Landing (Empty Weight) Excluded Measurements

Microphone ID (position)	Test Number	Reason Not Included
Mic 00-12 (all)	3 ¹	Exceeds crosswind component
Mic 01	4	Elevated ambient levels across measurement
Mic 05	1, 4, 6	Elevated ambient levels across measurement
Mic 08	4, 5, 6	Elevated ambient levels across measurement
Mic 09	1, 6	Elevated ambient levels across measurement
Mic 10	2	Elevated ambient levels across measurement
Mic 12	2	Elevated ambient levels across measurement
Mic 00	1, 2, 4, 5, 6	Measurement too close to ambient
Mic 01	5	Measurement too close to ambient
Mic 08	1	Measurement too close to ambient
Mic 11	5	Measurement too close to ambient
Mic 12	1, 4, 6	Measurement too close to ambient

Source: Prime Air, 2024; ESA, 2025.

Notes:

Measurement data that has been excluded under this noise analysis are presented in Appendix B and Appendix C.

¹ Test 3 was invalid for all microphone positions and accounts for 13 data points.

3.6 Test Condition: Flyover (Empty Weight)

3.6.1 Weather Conditions

The average weather conditions for each test at empty weight are shown in **Table 11**. Test 3-1, 3-2, and 4-2 wind speeds exceeded the weather threshold for wind and would invalidate the measurement.

Table 11. Flyover (Empty Weight) Weather Conditions

Test Number	Temperature (°F)	Average Wind Speed (knots)	Wind Direction (Degrees)	Average Wind Gust Speed (knots)	Relative Humidity (%)
1-1	45.3	4.0	102	4.5	62.8
1-2	45.5	3.8	93	4.5	62.2
2-1	65.1	2.4	177	4.1	38.7
2-2	65.1	3.0	213	4.1	38.4
3-1	62.2	5.9	326.2	10.9	34.6
3-2	62.8	7.5	312.6	10.9	35.6
4-1	63.3	4.3	300	11.1	34.1
4-2	63.9	6.4	353.4	10.7	33.9
5-1	61.3	2.2	320	9.9	37.8
5-2	61.7	3.0	341	9.9	37.4
6-1	61.3	4.4	34	9.1	37.3
6-2	61.0	2.6	22	7.4	37.0
7-1	45.5	4.2	102	4.7	61.5
7-2	45.7	3.9	105	4.7	61.3

Source: Prime Air, 2024; ESA, 2025.

3.6.2 Test Points and Validity

Appendix B and **Appendix C** present the tabulated and time history results, respectively, for all measurements. Out of the 56 data points, 25 were identified as invalid, as detailed in **Table 12**. Therefore, 31 data points were deemed valid.

Table 12. Flyover (Empty Weight) Excluded Measurements

Microphone ID (position)	Test Number	Reason Not Included
Mic 09 - 12	3-1, 3-2, 4-2	Exceeds crosswind component
Mic 09	4-1	Measurement too close to ambient
Mic 10	6-2	Measurement too close to ambient
Mic 11	6-1	Elevated ambient levels across measurement
Mic 12	1-1, 1-2, 2-2, 4-1, 5-1, 5-2, 6-1, 6-2, 7-1, 7-2	Measurement too close to ambient

Source: Prime Air, 2024; ESA, 2025.

Notes: Measurement data that has been excluded under this noise analysis are presented in Appendix B and Appendix C.

3.7 Test Condition: Flyover (Max Weight)

3.7.1 Weather Conditions

The average weather conditions for each test at max weight are shown in **Table 13**. There were no weather exceedances that would deem measurements invalid.

Table 13. Flyover (Max Weight) Weather Conditions

Test Number	Temperature (°F)	Average Wind Speed (knots)	Wind Direction (Degrees)	Average Wind Gust Speed (knots)	Relative Humidity (%)
1-1	53.4	1.6	96.6	4.4	53.8
1-2	53.2	2.9	82.3	4.1	53.6
2-1	48.4	3.3	77.3	5.8	62.8
2-2	49.3	3.6	123.5	5.8	60.9
3-1	54.5	1.7	132.1	3.5	52.2
3-2	54.9	2.2	306.5	3.5	51.3
4-1	56.7	2.1	170.8	3.9	48.7
4-2	56.1	1.9	214.0	4.1	49.2
5-1	50.9	3.3	116.9	4.7	59.1
5-2	51.1	2.7	131.5	4.7	58.6
6-1	65.5	1.6	191.3	4.1	53.5
6-2	65.3	3.7	245.7	7.0	56.7

Source: Prime Air, 2024; ESA, 2025.

3.7.2 Test Points and Validity

Appendix B and **Appendix C** present the tabulated and time history results, respectively, for all measurements. Out of the 48 data points, 12 were identified as invalid, as detailed in **Table 14**. Therefore, 36 data points were deemed valid.

Table 14. Flyover (Max Weight) Excluded Measurements

Microphone ID (position)	Test Number	Reason Not Included
Mic 12	All	Measurement too close to ambient

Source: Prime Air, 2024; ESA, 2025.

Notes: Measurement data that has been excluded under this noise analysis are presented in Appendix B and Appendix C.

4 Measurement Analysis

A range of metrics were calculated for each event and at each microphone. These metrics include ambient noise level (defined as the noise level when the drone’s rotors are not powered), Leq, Maximum Sound Level (Lmax), and SEL. Additional parameters regarding flight performance and weather conditions were also considered. It should be noted that the empty weight takeoff and max weight landing cases are not used in any subsequent analyses.

4.1 Overflight Analysis

As noted in the previous section, only the microphones positioned perpendicular to the flight path were utilized for analyzing the overflight data. For each event and microphone, the measured SEL was adjusted using correction factors to normalize the noise to the speed and distances specified by Prime Air’s typical flight profile, as described in Section 1. **Table 15** below outlines the parameters used for normalization.

Table 15. Enroute Normalization Parameters

Test Case	Normalization Speed (knots)	Normalization Distance (ft)
Empty Weight	58.3	345
Max Weight	58.3	200

Source: Prime Air, 2024; ESA, 2025.

The SELs for each microphone were averaged and the highest resulting SEL was selected for use as the computed en route noise level. The results of this analysis are presented in **Table 16** below along with the undertrack distance and point of closest approach (POCA) slant distance. The most conservative empty-weight en route noise level was computed to be 61.0 dBA. The most conservative max-weight en route noise level was computed to be 63.9 dBA. **Figure 7** and **Figure 8** present the range of measured en route SEL’s for empty weight and max weight, respectively.

Table 16. En Route Averaged A-Weighted SELs (Empty and Max Weight)

Test Case	Microphone ID (Position)	Undertrack Distance (ft)	POCA Slant Distance (ft)	Normalized SEL ¹ (dBA)
Empty Weight	09 (Lateral)	18.4	99.3	60.4
	10 (Lateral)	57.8	112.8	60.9
	11 (Lateral)	152.8	180.8	59.1
Max Weight	09 (Lateral)	20.0	118.4	63.0
	10 (Lateral)	56.0	128.9	63.7
	11 (Lateral)	152.7	191.7	61.7

Source: Prime Air, 2024; ESA, 2025.

Notes: Microphone ID 12 (lateral) is excluded as results were not sufficiently above ambient noise levels.

¹ Measured levels normalized to 58.3 kts before averaging. Using $12.5 \cdot \log_{10}(\text{POCA Slant} / \text{Normalized Adjustment Slant})$; empty weight normalized to 345 feet; max weight normalized to 200 feet.

Figure 7. Range of MK30 Averaged A-Weighted SELs from En Route at Empty Weight

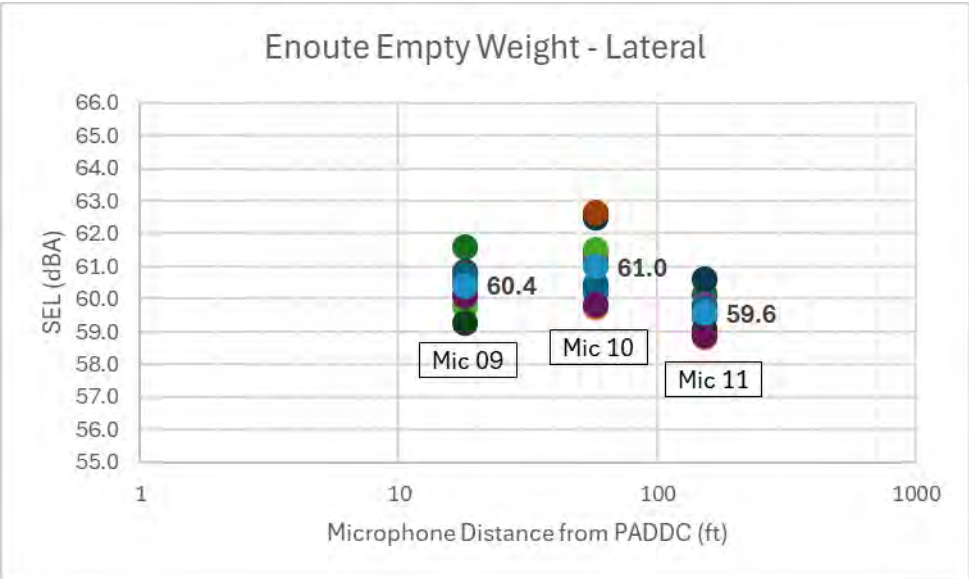
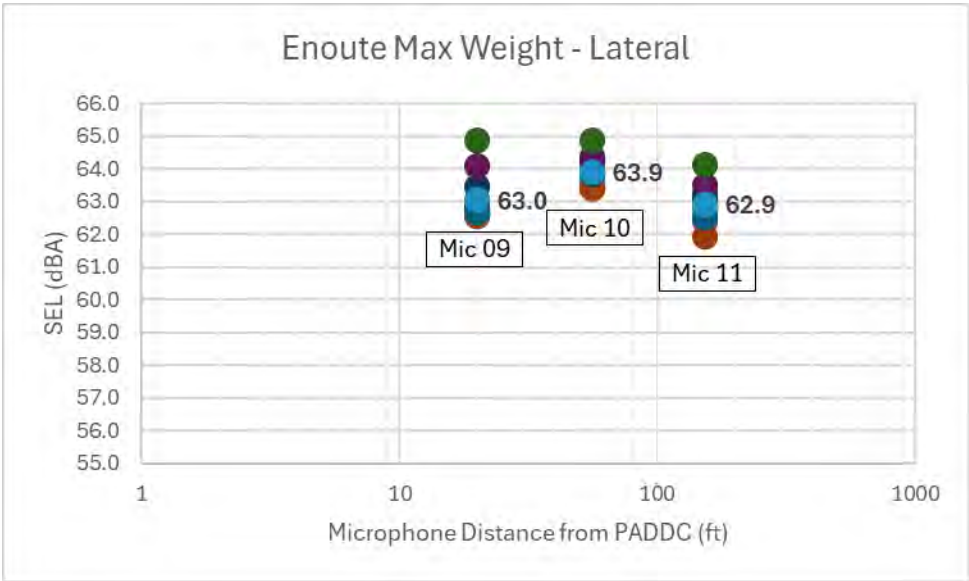


Figure 8. Range of MK30 Averaged A-Weighted SELs from En Route at Max Weight



4.2 VTOL Analysis

For each microphone and each test flight, the takeoff, delivery, and landing SELs were averaged. **Table 17** presents the results for takeoff, delivery, and landing. Scatter plots for these measurements are shown in **Figure 9** through **Figure 17**.

Table 17. Takeoff, Delivery, and Landing Averaged A-Weighted SELs

Distance to PADDC (ft)	Max Weight		Empty Weight
	Takeoff	Delivery	Landing
Undertrack			
20	90.5	91.7	91.8
75	81.6	83.7	82.8
195	76.5	78.8	76.5
372	72.4	74.5	70.4
772	-	69.5	-
Behind			
19	89.8	92.0	91.2
79	80.0	83.2	81.6
176	73.5	77.3	75.3
375	67.3	71.3	70.5
Lateral			
25	88.8	92.1	89.9
76	82.1	85.8	83.2
175	75.5	79.0	76.3
375	68.2	71.1	-

Source: Prime Air, 2024; ESA, 2025.

Figure 9. Range of MK30 Averaged A-Weighted SELs from Takeoff at Max Weight – Undertrack

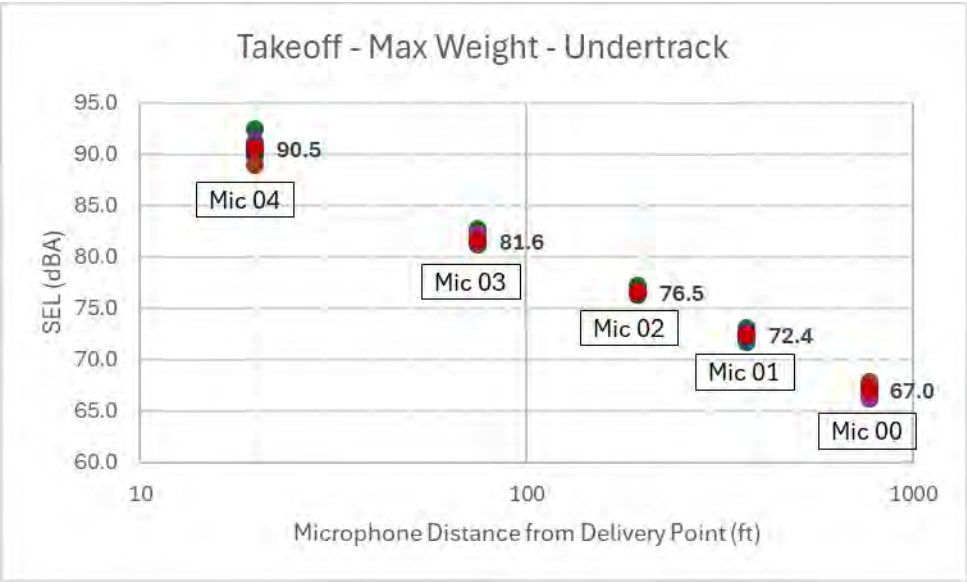


Figure 10. Range of MK30 Averaged A-Weighted SELs from Takeoff at Max Weight – Behind

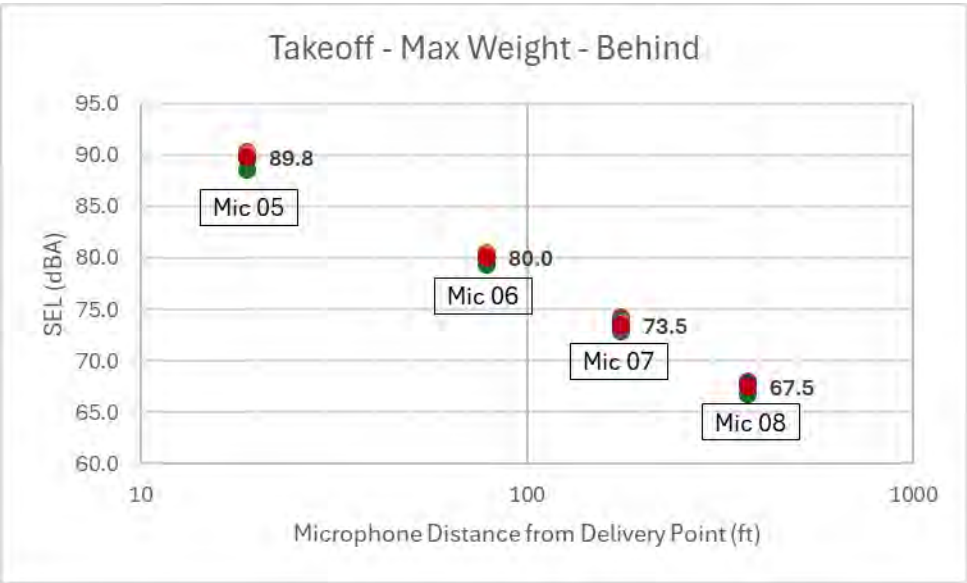


Figure 11. Range of MK30 Averaged A-Weighted SELs from Takeoff at Max Weight – Lateral

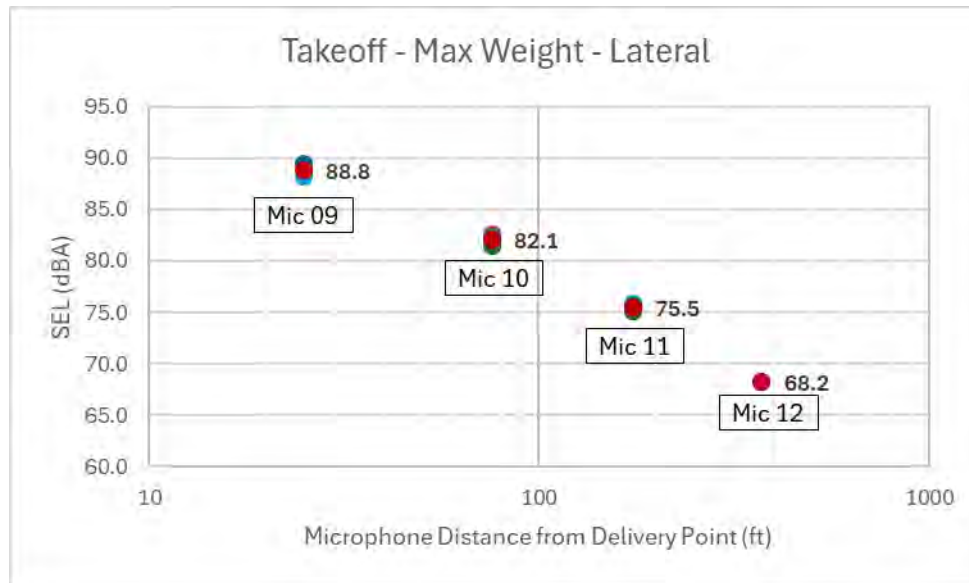


Figure 12. Range of MK30 Averaged A-Weighted SELs from Landing at Empty Weight – Undertrack

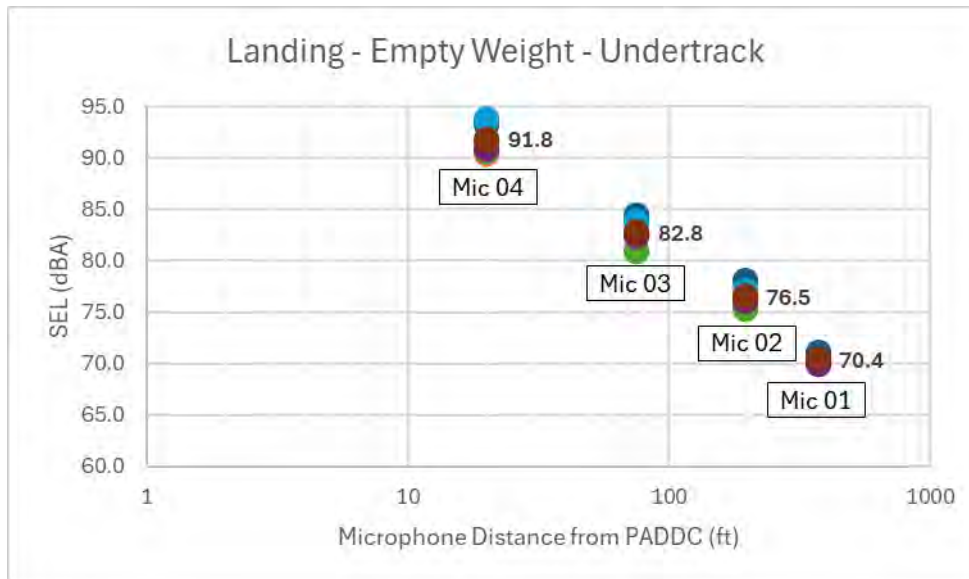


Figure 13. Range of MK30 Averaged A-Weighted SELs from Landing at Empty Weight – Behind

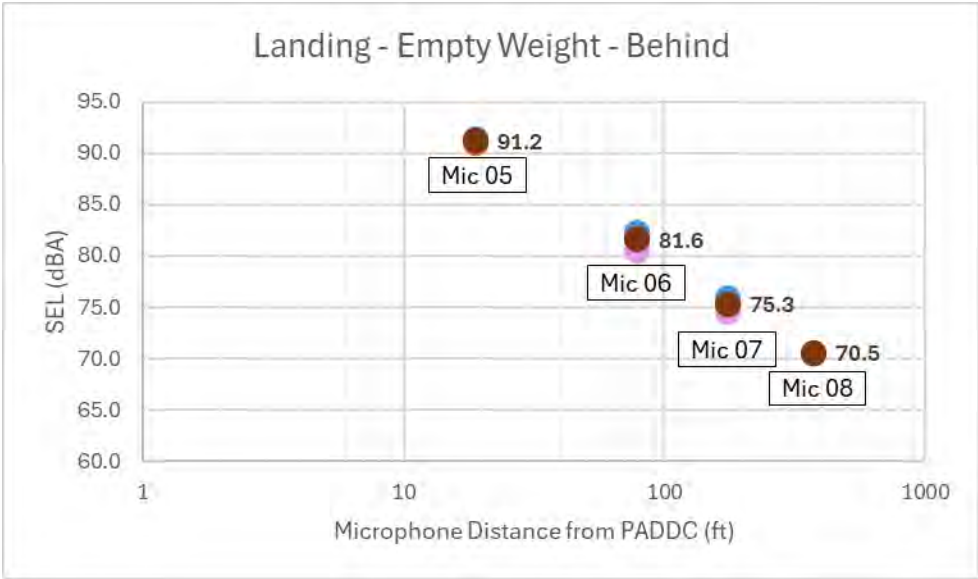


Figure 14. Range of MK30 Averaged A-Weighted SELs from Landing at Empty Weight – Lateral

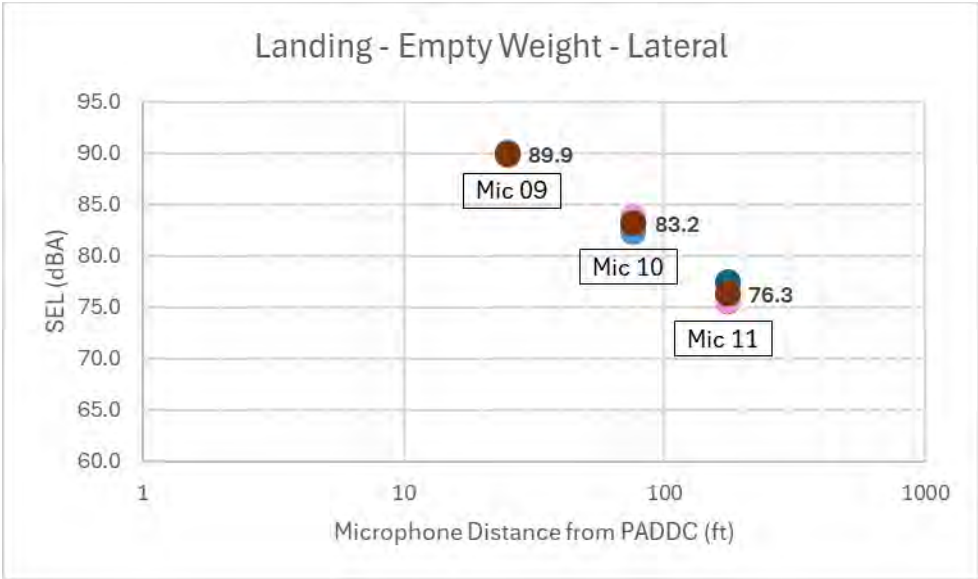


Figure 15. Range of MK30 Averaged A-Weighted SELs from Delivery at Max Weight – Undertrack

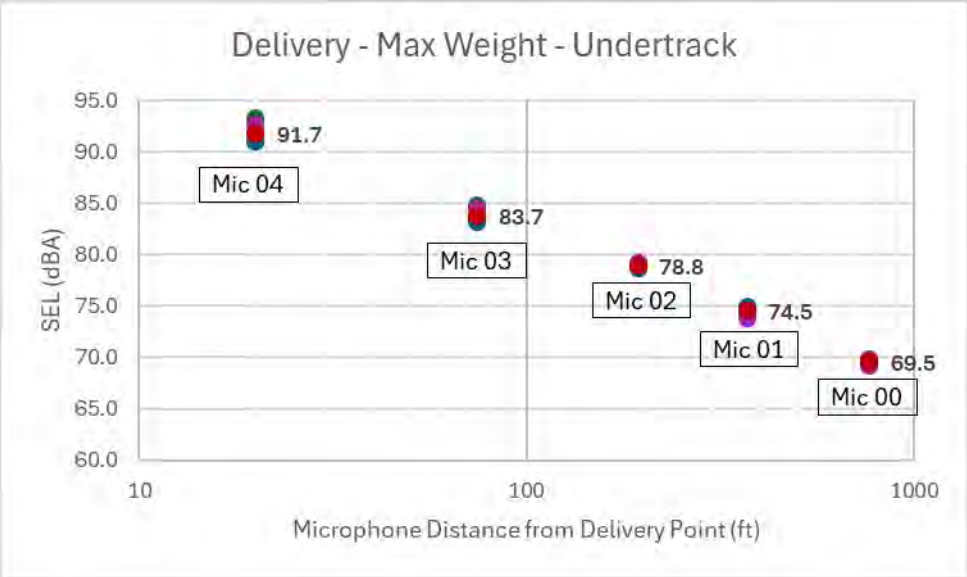


Figure 16. Range of MK30 Averaged A-Weighted SELs from Delivery at Max Weight – Behind

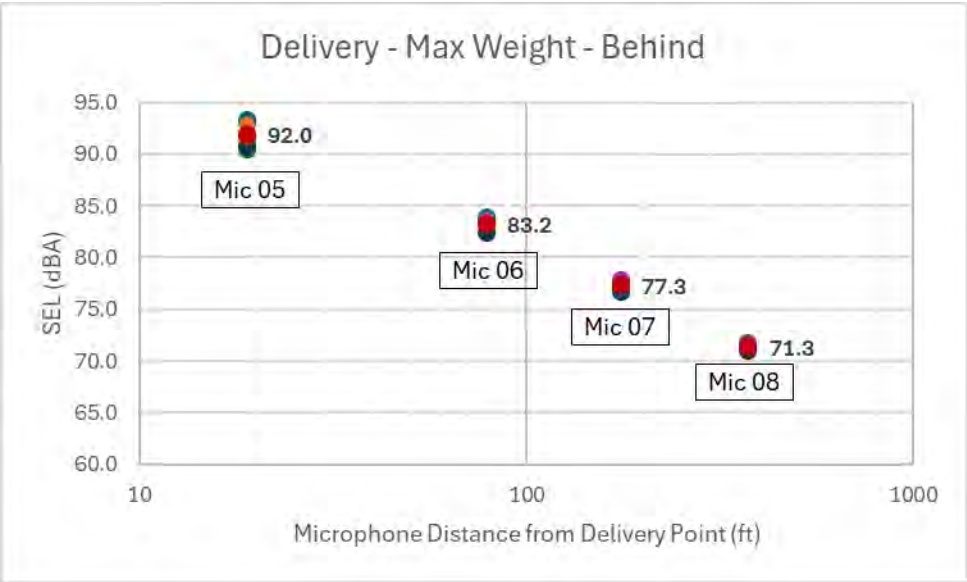
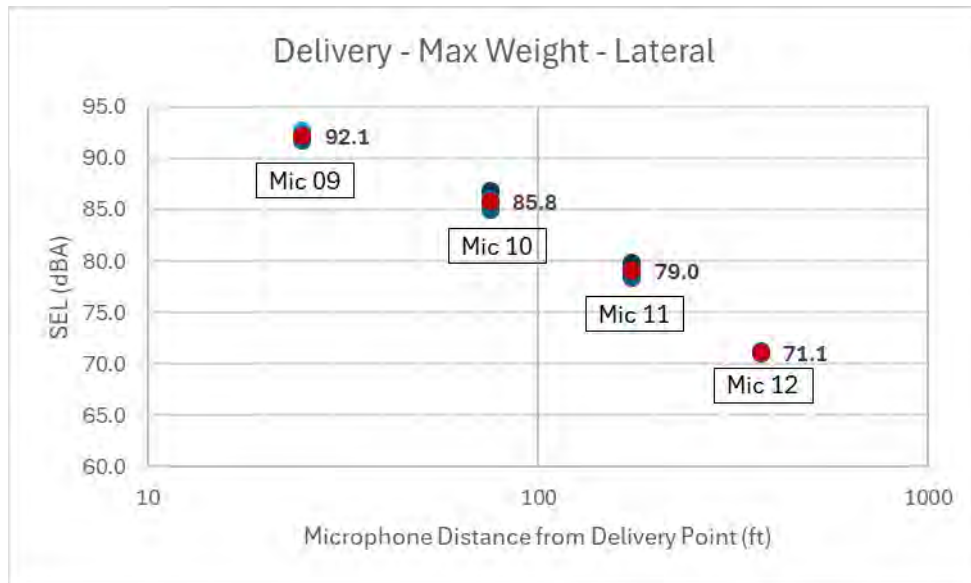


Figure 17. Range of MK30 Averaged A-Weighted SELs from Delivery at Max Weight – Lateral



The maximum SEL values from each test outline in **Table 17** were utilized to determine the composite, maximum A-weight SELs for takeoff, delivery, and landings, as shown in **Table 18** through **Table 20**. Additionally, speed- and altitude-corrected en route noise was factored in to calculate the interpolated distances to the PADDCs. **Figure 18** illustrates the noise levels and corresponding distances associated with takeoff, delivery, and landing.

Table 18. Maximum Takeoff A-Weighted SELs

Distance to PADDC (ft)	Max Weight Delivery
	SEL ¹
20	90.5
76	82.1
195	76.5
372	72.4
772	67.0
1,205 ²	63.7 ²

Source: Prime Air, 2024; ESA, 2025.

Notes:

¹ Maximum SEL derived from Table 17.

² Calculated distanced to the PADDC derived from the altitude and speed corrected max weight enroute measurement.

Table 19. Maximum A-Weighted SELs - Delivery

Distance to PADDC (ft)	Max Weight Delivery
	SEL ¹
25	92.1
76	85.8
175	79.0
372	74.5
772	69.5
1,396 ²	65.5 ²

Source: Prime Air, 2024; ESA, 2025.

Notes:

¹ Maximum SEL derived from Table 17.

² Calculated distanced to the PADDC derived from the altitude and speed corrected max weight and empty wight enroute measurement.

Table 20. Maximum A-Weighted SELs - Landing

Distance to PADDC (ft)	Empty Weight Landing
	SEL ¹
20	91.8
76	83.2
195	76.5
375	70.5
1,074 ²	60.9 ²

Source: Prime Air, 2024; ESA, 2025.

Notes:

¹ Maximum SEL derived from Table 17.

² Calculated distanced to the PADDC derived from the speed and altitude corrected empty weight enroute measurement.

Figure 18. MK30 Maximum A-Weighted SELs



Using the maximum A-weight SELs from takeoff, delivery, and landing, parameters were determined to estimate SELs as a function of distance from the PADDAC launch pad and delivery location. **Table 21** provides parameters to estimate SELs associated with takeoff as a function of distance from the PADDAC launch pad to the receiver. **Table 22** provides parameters to estimate the SEL associated with delivery, as a function of distance from the delivery point to the receiver. **Table 23** provides parameters to estimate SELs associated with landing as a function of distance from the PADDAC launch pad to the receiver. In these tables, constants “m” and “b” are components of the slope intercept linear equation $y = mx + b$. Constant “m” represents the slope of the line. Constant “b” represents the point at which the slope crosses the y-axis.

Table 21. Parameters for Estimating Sound Exposure Level for Takeoff versus Distance

Range for Distance (feet from launch pad)	m	b
20 to 76	-14.51	109.30
76 to 195	-13.51	107.46
195 to 372	-14.66	110.09
372 to 772	-17.08	116.32
772 to 1,205	-17.05	116.23
1,205 and greater	0.00	63.7

Source: Prime Air, 2024; ESA, 2025.

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

Table 22. Parameters for Estimating Sound Exposure Level for Delivery versus Distance

Range for Distance (feet from delivery point)	m	b
25 to 76	-13.18	110.56
76 to 175	-18.65	120.84
175 to 372	-13.86	110.11
372 to 772	-15.63	114.67
772 to 1,396	-15.63	114.66
1,396 and greater	0.00	65.5

Source: Prime Air, 2024; ESA, 2025.

Notes: Distance is along ground from delivery point to receiver.

Table 23. Parameters for Estimating Sound Exposure Level for Landing versus Distance

Range for Distance (feet from launch pad)	m	b
20 to 76	-14.95	111.28
76 to 195	-16.17	113.58
195 to 375	-21.10	124.86
375 to 1,074	-21.10	124.87
1,074 and greater	0.00	60.9

Source: Prime Air, 2024; ESA, 2025.

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

Appendix A: Flight Profile Measurements

Phase of Flight	Minimum Altitude (ft AGL)	Maximum Altitude (ft AGL)	Average Altitude (ft AGL)	Minimum Duration (seconds)	Maximum Duration (seconds)	Average Duration (seconds)	Minimum True Airspeed (knots)	Maximum True Airspeed (knots)	Average True Airspeed (knots)
Takeoff and Vertical Ascent	3.2	137.4	64.9	19	24	20	0.7	9.4	5.5
Transition and Outbound Climb	132.1	201.2	160.7	58	63	60	0.8	62.4	42.9
Fixed Wing Outbound Cruise	194.7	205.9	200.5	Variable	Variable	Variable	57.6	62.6	59.7
Delivery Descent and Transition	130.6	202.8	158.1	30	36	34	0.6	60.2	36.9
Backyard Descent	17.7	135.8	77.6	18	22	19	1.5	7.7	5.4
Delivery	14.4	23.0	18.5	2	2	2	2.8	7.2	4.5
Backyard Ascent	16.4	138.6	105.8	24	30	29	1.1	8.9	7.1
Transition and Inbound Climb	133.0	203.3	160.9	57	62	60	1.4	62.5	43.0
Fixed-wing Inbound Cruise	194.8	207.8	201.2	Variable	Variable	Variable	66.0	71.0	68.7
Landing Descent and Transition	133.7	201.9	160.3	32	39	36	1.5	70.5	42.7
Vertical Descent and Landing	1.1	134.6	78.3	33	34	34	0.2	6.7	5.1

Source: Prime Air, 2024; ESA, 2025.

Appendix B:
Noise Event Tables

Appendix B:
Noise Event Tables

Table B-1. Max Weight Takeoff Measurements

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
Mic 00 (Undertrack)															
772	1-1	45.2	50.6	60.1	68.1	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
772	2-1	42.3	48.6	57.2	66.2	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
772	3-1	42.4	48.4	57.8	66.4	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
772	4-1	42.4	48.4	57.7	66.3	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
772	5-1	47.3	49.7	59.1	67.2	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
772	6-1	44.5	50.4	59.6	67.8	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
772	7-1	46.0	51.6	60.8	69.7	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	No
Mic 00 Average		44.3	49.7	58.9	67.4	200.5	59.7								
Mic 01 (Undertrack)															
372	1-1	45.5	55.3	64.2	72.8	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
372	2-1	43.5	54.0	62.8	71.6	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
372	3-1	43.7	54.4	62.5	72.4	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
372	4-1	43.6	54.3	63.1	72.1	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
372	5-1	48.3	54.8	64.1	72.3	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
372	6-1	45.7	55.3	64.1	72.7	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
372	7-1	45.9	54.9	64.4	73.0	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 01 Average		45.2	54.7	63.6	72.4	200.5	59.7								
Mic 02 (Undertrack)															
195	1-1	44.2	59.0	65.2	76.5	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
195	2-1	42.0	58.7	65.0	76.3	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
195	3-1	42.0	59.2	65.6	77.2	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
195	4-1	42.3	58.5	63.9	76.4	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
195	5-1	47.8	58.8	64.1	76.3	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
195	6-1	45.4	59.1	64.4	76.5	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
195	7-1	44.4	58.4	65.0	76.5	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 02 Average		44.0	58.8	64.7	76.5	200.5	59.7								
Mic 03 (Undertrack)															
75	1-1	43.9	63.7	71.1	81.2	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
75	2-1	42.3	63.6	69.1	81.2	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
75	3-1	41.7	64.6	70.3	82.6	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
75	4-1	43.1	64.3	70.5	82.1	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
75	5-1	48.2	63.6	71.6	81.1	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
75	6-1	45.3	63.9	71.0	81.3	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
75	7-1	44.3	63.3	70.6	81.3	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 03 Average		44.1	63.8	70.6	81.6	200.5	59.7								
Mic 04 (Undertrack)															
20	1-1	48.0	72.6	82.1	90.0	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
20	2-1	47.0	72.1	81.0	89.8	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
20	3-1	45.9	74.4	81.9	92.4	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
20	4-1	47.4	73.3	81.8	91.2	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
20	5-1	51.3	72.8	82.0	90.3	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
20	6-1	49.0	71.4	81.9	88.8	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
20	7-1	47.4	72.7	81.7	90.8	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 04 Average		48.0	72.8	81.8	90.5	200.5	59.7								
Mic 05 (Behind)															
19	1-1	48.1	72.2	81.6	89.7	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
19	2-1	47.0	70.9	79.6	88.5	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
19	3-1	46.1	72.3	80.1	90.3	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
19	4-1	50.8	72.0	79.9	89.9	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	No
19	5-1	50.5	72.7	81.3	90.2	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
19	6-1	49.2	72.3	81.3	89.7	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
19	7-1	47.4	72.3	80.8	90.3	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 05 Average		48.1	72.1	80.8	89.8	200.2	59.7								
Mic 06 (Behind)															
79	1-1	44.7	62.5	70.7	80.0	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
79	2-1	43.4	61.7	68.8	79.3	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
79	3-1	42.7	61.9	69.1	79.9	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
79	4-1	43.3	62.2	69.4	80.0	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
79	5-1	48.6	62.9	70.5	80.4	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
79	6-1	46.0	62.6	70.2	80.0	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
79	7-1	45.0	62.4	70.4	80.4	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 06 Average		44.8	62.3	69.9	80.0	200.5	59.7								
Mic 07 (Behind)															
176	1-1	43.5	55.9	61.4	73.4	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
176	2-1	41.7	55.2	61.1	72.8	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
176	3-1	41.2	55.0	60.3	73.0	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
176	4-1	45.0	55.6	60.6	73.4	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
176	5-1	48.1	56.7	62.5	74.1	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
176	6-1	44.5	56.5	61.4	73.9	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
176	7-1	43.9	55.8	62.5	73.9	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
Mic 07 Average		44.0	55.8	61.4	73.5	200.5	59.7								
Mic 08 (Behind)															
375	1-1	45.0	49.7	53.5	67.1	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	No
375	2-1	43.7	49.1	53.5	66.7	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
375	3-1	45.0	49.9	54.3	67.9	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
375	4-1	44.6	49.9	54.1	67.8	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
375	5-1	51.3	51.5	55.5	69.0	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	No
375	6-1	47.6	51.5	55.6	68.9	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	No
375	7-1	50.8	54.3	58.1	72.4	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	No
Mic 08 (Average)		44.4	49.6	54.0	67.5	200.8	59.7								
Mic 09 (Lateral)															
25	1-1	51.4	70.8	80.1	88.3	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	No
25	2-1	50.6	70.6	78.8	88.3	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	No
25	3-1	49.8	71.3	79.6	89.3	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	No
25	4-1	51.4	70.4	79.0	88.2	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	No
25	5-1	53.5	71.0	79.9	88.5	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	No
25	6-1	52.8	70.7	79.9	88.1	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
25	7-1	50.4	71.4	80.1	89.4	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 09 (Average)		51.6	71.0	80.0	88.8	200.2	59.7								
Mic 10 (Lateral)															
76	1-1	46.1	64.4	70.3	81.9	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
76	2-1	44.5	63.8	71.0	81.4	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
76	3-1	43.7	64.5	71.0	82.5	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
76	4-1	44.4	64.4	70.2	82.2	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
76	5-1	49.6	64.6	70.0	82.1	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
76	6-1	47.5	64.6	70.7	82.0	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
76	7-1	45.6	64.2	70.9	82.2	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 10 (Average)		45.9	64.4	70.6	82.1	200.5	59.7								
Mic 11 (Lateral)															
175	1-1	44.9	58.1	63.4	75.5	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes
175	2-1	43.5	57.4	61.9	75.0	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	Yes
175	3-1	43.2	57.4	62.6	75.4	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	Yes
175	4-1	43.5	57.5	62.2	75.4	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	Yes
175	5-1	48.7	58.0	63.1	75.5	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	Yes
175	6-1	46.6	58.5	64.4	75.9	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	Yes
175	7-1	45.2	57.5	62.5	75.5	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	Yes
Mic 11 (Average)		45.1	57.8	62.9	75.5	200.5	59.7								
Mic 12 (Lateral)															
375	1-1	45.1	50.7	55.6	68.2	200.3	59.7	242	-0.7	4.3	112	6.2	49.3	56.5	Yes

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
375	2-1	44.8	50.8	54.5	68.4	201.5	59.7	335	-1.4	2.0	173	3.5	55.5	43.9	No
375	3-1	50.0	52.2	55.5	70.2	198.7	59.7	332	-1.9	4.1	274	7.4	59.7	36.4	No
375	4-1	45.3	50.6	53.8	68.5	202.1	59.8	339	-2.8	3.5	233	7.0	60.1	35.6	No
375	5-1	48.7	51.2	55.9	68.6	200.4	59.7	251	0.8	3.4	101	4.3	50.0	52.7	No
375	6-1	47.3	51.7	56.1	69.1	202.0	59.7	247	0.2	4.0	90	4.9	45.8	62.5	No
375	7-1	45.7	50.7	54.4	68.7	198.4	59.7	246	-0.9	4.0	121	6.2	47.8	60.2	No
Mic 12 (Average)		45.1	50.7	55.6	68.2	200.3	59.7								

Source: Prime Air, 2024; ESA, 2025.

Notes: Greyed out cells we determined to not be valid measurements and were not included in SEL calculations.

Table B-2. Max Weight Delivery Measurements

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
Mic 00 (Undertrack)															
772	1-1	45.2	49.6	59.3	70.0	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
772	2-1	42.3	48.9	59.4	69.7	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
772	3-1	42.4	49.1	57.4	69.2	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
772	4-1	42.4	48.9	57.5	69.1	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
772	5-1	47.3	49.3	59.0	69.5	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
772	6-1	44.5	49.8	60.2	69.8	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
772	7-1	46.0	50.2	60.5	70.4	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	No
Mic 00 Average		44.0	49.3	58.8	69.5	94.6	6.0								
Mic 01 (Undertrack)															
372	1-1	45.5	54.3	64.0	74.7	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
372	2-1	43.5	53.5	62.2	74.3	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
372	3-1	43.7	54.4	62.8	74.5	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
372	4-1	43.6	53.6	62.3	73.8	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
372	5-1	48.3	54.4	63.7	74.5	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
372	6-1	45.7	54.7	64.2	74.7	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
372	7-1	45.9	54.8	64.9	74.9	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 01 Average		45.2	54.2	63.4	74.5	94.6	6.1								
Mic 02 (Undertrack)															
195	1-1	44.2	58.4	64.9	78.7	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
195	2-1	42.0	57.9	64.9	78.7	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
195	3-1	42.0	58.9	64.6	79.1	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
195	4-1	42.3	58.9	64.6	79.1	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
195	5-1	47.8	58.7	65.0	78.8	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
195	6-1	45.4	58.8	65.0	78.8	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
195	7-1	44.4	58.5	64.7	78.6	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 02 Average		44.0	58.6	64.8	78.8	94.6	6.1								
Mic 03 (Undertrack)															
75	1-1	43.9	63.2	69.1	83.5	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
75	2-1	42.3	62.5	67.9	83.3	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
75	3-1	41.7	64.6	71.5	84.8	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
75	4-1	43.1	64.2	69.5	84.4	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
75	5-1	48.2	63.5	68.6	83.6	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
75	6-1	45.3	63.2	68.5	83.2	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
75	7-1	44.3	62.9	68.8	83.0	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 03 Average		44.1	63.4	69.1	83.7	94.6	6.1								
Mic 04 (Undertrack)															

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
20	1-1	48.0	71.1	82.9	91.4	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
20	2-1	47.0	71.0	80.8	91.8	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
20	3-1	45.9	73.1	83.7	93.3	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
20	4-1	47.4	72.4	83.8	92.6	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
20	5-1	51.3	70.8	81.8	90.9	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
20	6-1	49.0	71.0	82.0	91.0	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
20	7-1	47.4	70.8	81.9	90.9	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 04 Average		48.0	71.5	82.4	91.7	94.6	6.1								
Mic 05 (Behind)															
19	1-1	48.1	72.7	84.1	93.0	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
19	2-1	47.0	69.6	80.7	90.4	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
19	3-1	46.1	71.5	81.7	91.6	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
19	4-1	50.8	70.6	81.5	90.8	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
19	5-1	50.5	71.6	81.4	91.7	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
19	6-1	49.2	73.3	84.2	93.3	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
19	7-1	47.4	72.7	84.0	92.9	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 05 Average		48.5	71.7	82.5	92.0	94.6	6.1								
Mic 06 (Behind)															
79	1-1	44.7	63.6	70.4	83.9	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
79	2-1	43.4	62.2	68.8	83.0	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
79	3-1	42.7	63.1	68.9	83.2	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
79	4-1	43.3	62.1	67.8	82.3	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
79	5-1	48.6	63.0	68.4	83.2	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
79	6-1	46.0	63.4	69.1	83.4	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
79	7-1	45.0	63.5	69.8	83.6	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 06 Average		44.8	63.0	69.0	83.2	94.6	6.1								
Mic 07 (Behind)															
176	1-1	43.5	57.3	62.5	77.7	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
176	2-1	41.7	56.9	61.1	77.7	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
176	3-1	41.2	57.6	62.0	77.7	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
176	4-1	45.0	56.5	62.2	76.7	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
176	5-1	48.1	57.0	61.1	77.1	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
176	6-1	44.5	57.1	62.0	77.1	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
176	7-1	43.9	57.1	62.8	77.3	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 07 Average		44.0	57.1	61.9	77.3	94.6	6.1								
Mic 08 (Behind)															
375	1-1	45.0	50.9	56.9	71.2	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
375	2-1	43.7	50.8	55.3	71.6	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
375	3-1	45.0	51.4	54.4	71.5	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
375	4-1	44.6	50.7	55.0	70.9	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
375	5-1	51.3	51.1	56.1	71.3	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	No
375	6-1	47.6	51.6	56.0	71.6	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	No
375	7-1	50.8	51.7	55.1	71.8	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	No
Mic 08 Average		44.6	51.0	55.4	71.3	97.0	6.0								
Mic 09 (Lateral)															
25	1-1	51.4	71.5	83.1	91.8	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	No
25	2-1	50.6	71.1	82.4	91.9	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	No
25	3-1	49.8	70.8	82.3	90.9	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	No
25	4-1	51.4	72.7	83.9	92.9	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	No
25	5-1	53.5	73.5	84.4	93.6	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	No
25	6-1	52.8	72.7	83.2	92.7	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
25	7-1	50.4	71.4	82.4	91.6	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 09 Average		51.6	72.1	82.8	92.1	92.0	6.7								
Mic 10 (Lateral)															
76	1-1	46.1	65.1	71.0	85.4	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
76	2-1	44.5	65.1	71.1	86.0	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
76	3-1	43.7	64.9	71.2	85.0	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
76	4-1	44.4	66.3	71.7	86.4	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
76	5-1	49.6	66.6	72.6	86.7	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
76	6-1	47.5	65.9	70.9	85.9	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
76	7-1	45.6	64.8	70.4	85.0	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 10 Average		45.9	65.5	71.3	85.8	94.6	6.1								
Mic 11 (Lateral)															
175	1-1	44.9	58.5	63.9	78.8	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
175	2-1	43.5	58.4	64.1	79.2	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	Yes
175	3-1	43.2	58.2	63.2	78.4	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	Yes
175	4-1	43.5	59.3	63.4	79.5	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	Yes
175	5-1	48.7	59.7	65.2	79.8	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	Yes
175	6-1	46.6	59.0	63.2	79.0	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	Yes
175	7-1	45.2	58.2	62.8	78.4	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 11 Average		45.1	58.8	63.7	79.0	94.6	6.1								
Mic 12 (Lateral)															
375	1-1	45.1	50.9	55.7	71.2	96.6	6.0	127	-0.5	4.1	123	6.0	49.1	56.6	Yes
375	2-1	44.8	53.3	58.9	74.1	95.5	5.0	84	0.0	1.2	260	3.7	55.6	43.5	No
375	3-1	50.0	53.6	57.6	73.7	96.7	5.6	31	-3.0	5.0	283	7.4	59.8	36.3	No
375	4-1	45.3	52.0	57.1	72.2	99.4	7.5	271	-2.6	4.6	222	6.2	60.3	35.2	No
375	5-1	48.7	51.6	57.3	71.7	90.3	5.5	115	-0.6	2.9	92	4.3	50.6	52.3	No
375	6-1	47.3	52.1	56.0	72.1	89.3	6.1	115	-1.4	4.5	93	4.9	45.8	62.8	No

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
375	7-1	45.7	50.8	55.5	70.9	94.7	7.3	117	-0.2	4.2	112	6.2	47.9	59.7	Yes
Mic 12 Average		45.4	50.8	55.6	71.1	95.6	6.6								

Source: Prime Air, 2024; ESA, 2025.

Notes: Greyed out cells we determined to not be valid measurements and were not included in SEL calculations.

Table B-3. Empty Weight Landing Measurements

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
Mic 00 (Undertrack)															
772	1-1	42.4	48.3	55.7	66.2	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	No
772	2-1	42.3	46.4	51.9	64.2	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	No
772	3-1	42.3	47.6	55.8	65.8	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
772	4-1	44.3	49.0	55.7	67.2	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	No
772	5-1	47.6	48.3	53.8	66.2	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	No
772	6-1	43.3	48.1	55.9	66.0	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	No
Mic 00 Average		-	-	-	-	-	-								
Mic 01 (Undertrack)															
372	1-1	45.0	53.2	60.4	71.1	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
372	2-1	43.6	52.5	59.3	70.3	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
372	3-1	43.5	52.4	59.8	70.6	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
372	4-1	44.9	52.9	59.5	71.1	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	No
372	5-1	47.9	52.3	58.4	70.2	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	No
372	6-1	44.4	52.0	60.0	69.9	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 01 Average		44.3	52.6	59.9	70.4	200.7	68.7								
Mic 02 (Undertrack)															
195	1-1	42.0	60.1	63.1	78.0	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
195	2-1	42.1	58.5	62.2	76.3	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
195	3-1	42.0	58.9	62.4	77.1	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
195	4-1	43.5	58.8	62.9	77.0	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
195	5-1	47.0	57.5	62.2	75.3	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
195	6-1	43.5	58.1	63.0	76.0	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 02 Average		43.6	58.6	62.7	76.5	201.0	68.7								
Mic 03 (Undertrack)															
75	1-1	41.9	66.5	70.7	84.4	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
75	2-1	42.0	64.6	68.7	82.4	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
75	3-1	43.0	65.7	71.2	83.9	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
75	4-1	43.5	65.7	70.4	83.9	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
75	5-1	46.0	63.1	67.9	81.0	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
75	6-1	43.4	64.5	69.7	82.4	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 03 Average		43.4	64.9	69.5	82.8	201.0	68.7								
Mic 04 (Undertrack)															
20	1-1	46.1	75.4	83.1	93.3	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
20	2-1	46.1	72.7	80.6	90.5	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
20	3-1	45.7	75.0	83.5	93.2	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
20	4-1	46.5	75.6	84.1	93.8	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
20	5-1	49.0	72.8	81.0	90.7	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
20	6-1	46.7	73.0	80.3	90.9	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 04 Average		46.9	73.9	81.8	91.8	201.0	68.7								
Mic 05 (Behind)															
19	1-1	52.0	72.6	80.1	90.6	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	No
19	2-1	46.5	73.2	81.3	91.0	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
19	3-1	45.8	72.3	79.9	90.5	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
19	4-1	51.9	77.4	91.2	95.6	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	No
19	5-1	49.3	73.5	81.5	91.4	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
19	6-1	59.4	72.4	81.7	90.3	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	No
Mic 05 Average		47.9	73.4	81.4	91.2	201.0	68.7								
Mic 06 (Behind)															
79	1-1	42.8	63.8	67.8	81.7	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
79	2-1	43.0	64.2	68.0	82.0	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
79	3-1	42.7	63.7	69.2	81.9	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
79	4-1	43.7	63.3	68.2	81.5	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
79	5-1	47.2	64.4	68.8	82.3	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
79	6-1	44.0	62.5	66.8	80.5	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 06 Average		44.1	63.6	67.9	81.6	201.0	68.7								
Mic 07 (Behind)															
176	1-1	41.2	57.5	61.6	75.5	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
176	2-1	43.4	57.6	61.4	75.4	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
176	3-1	41.4	57.4	62.0	75.6	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
176	4-1	43.8	56.9	60.1	75.1	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
176	5-1	46.8	58.0	62.4	75.8	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
176	6-1	43.2	56.6	60.9	74.5	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 07 Average		43.7	57.3	61.3	75.3	201.0	68.7								
Mic 08 (Behind)															
375	1-1	43.6	50.4	53.6	68.3	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	No
375	2-1	44.7	52.8	57.4	70.5	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
375	3-1	46.7	55.7	57.4	73.9	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
375	4-1	46.7	65.6	80.6	83.8	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	No
375	5-1	52.1	51.2	53.9	69.0	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	No
375	6-1	48.6	69.8	84.7	87.7	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	No
Mic 08 Average		44.7	52.8	57.4	70.5	200.6	68.7								
Mic 09 (Lateral)															
25	1-1	48.3	72.2	80.6	90.2	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	No
25	2-1	50.1	72.0	79.7	89.8	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
25	3-1	49.7	72.4	80.8	90.6	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No

Distance to PADDC (ft)	Test#	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
25	4-1	50.1	71.7	81.1	89.9	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
25	5-1	49.8	72.2	80.2	90.1	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
25	6-1	49.7	73.4	81.5	91.4	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	No
Mic 09 Average		50.0	72.0	80.4	89.9	201.2	68.7								
Mic 10 (Lateral)															
76	1-1	43.6	65.3	70.0	83.2	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
76	2-1	44.8	65.1	69.1	82.9	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	No
76	3-1	43.8	65.4	69.7	83.6	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
76	4-1	44.8	65.1	69.2	83.3	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
76	5-1	47.5	64.5	70.0	82.4	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	Yes
76	6-1	44.7	65.9	70.8	83.8	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 10 Average		45.2	65.2	70.0	83.2	201.1	68.7								
Mic 11 (Lateral)															
175	1-1	43.2	59.5	63.3	77.4	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	Yes
175	2-1	43.4	57.8	62.5	75.6	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	Yes
175	3-1	43.2	58.3	61.2	76.4	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
175	4-1	44.8	58.2	61.1	76.4	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	Yes
175	5-1	47.5	57.2	60.4	75.1	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	No
175	6-1	44.2	57.8	61.5	75.8	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	Yes
Mic 11 Average		43.9	58.3	62.1	76.3	200.9	68.7								
Mic 12 (Lateral)															
375	1-1	44.2	51.1	55.1	69.1	202.5	68.7	24	-3.1	3.4	309	6.8	51.5	61.3	No
375	2-1	47.9	51.9	55.3	69.7	200.6	68.7	166	0.3	1.2	298	6.0	62.4	33.0	No
375	3-1	58.2	54.2	56.9	72.4	201.7	68.8	23	-4.1	5.2	321	7.8	61.4	34.7	No
375	4-1	45.5	50.9	55.1	69.1	201.4	68.7	38	-2.4	3.4	271	5.2	59.9	44.6	No
375	5-1	51.3	58.8	72.3	76.6	201.5	68.7	152	-1.2	4.8	118	5.6	42.6	83.0	No
375	6-1	44.6	50.1	52.8	68.0	198.9	68.7	225	-0.3	1.0	108	2.1	56.8	51.1	No
Mic 12 Average		-	-	-	-	-	-								

Source: Prime Air, 2024; ESA, 2025.

Notes: Greyed out cells we determined to not be valid measurements and were not included in SEL calculations.

Table B-4. Max Weight En Route Measurements

Distance to PADDC (ft)	Test#	Undertrack Distance (ft)	POCA Slant (ft)	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Median Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
Mic 09 (Lateral)																	
25	1-1	17.5	117.1	46.7	56.1	60.3	65.7	122.2	60.2	77	0.6	1.6	96.6	4.4	53.4	53.8	Yes
25	1-2	6.1	117.7	46.7	55.9	60.1	65.4	122.9	60.1	255	-0.4	2.9	82.3	4.1	53.2	53.6	Yes
25	2-1	9.5	117.6	45.8	55.7	59.7	65.3	122.4	61.6	77	0.0	3.3	77.3	5.8	48.4	62.8	Yes
25	2-2	33.8	120.4	45.8	56.1	60.1	65.1	121.0	60.9	252	-2.8	3.6	123.5	5.8	49.3	60.9	Yes
25	3-1	43.8	122.8	46.3	55.7	59.7	65.3	121.8	60.1	76	1.3	1.7	132.1	3.5	54.5	52.2	Yes
25	3-2	5.5	115.3	46.3	55.9	60.0	65.4	121.3	60.8	255	1.7	2.2	306.5	3.5	54.9	51.3	Yes
25	4-1	24.8	119.7	47.8	56.0	60.4	66.0	122.3	61.3	74	2.1	2.1	170.8	3.9	56.7	48.7	Yes
25	4-2	13.4	117.6	47.8	55.2	59.5	65.2	125.5	61.7	258	-1.3	1.9	214.0	4.1	56.1	49.2	Yes
25	5-1	17.1	118.2	46.9	55.5	59.7	65.5	123.0	60.8	78	2.0	3.3	116.9	4.7	50.9	59.1	Yes
25	5-2	7.9	116.4	46.9	55.9	60.1	65.4	122.3	60.6	254	-2.2	2.7	131.5	4.7	51.1	58.6	Yes
25	6-1	16.9	117.3	50.9	57.7	61.8	66.8	123.6	61.4	74	1.5	1.6	191.3	4.1	65.5	53.5	Yes
25	6-2	43.2	120.2	50.9	57.5	61.7	67.5	121.5	59.9	256	-0.6	3.7	245.7	7.0	65.3	56.7	Yes
Mic 09 Average		20.0	118.4	47.4	56.1	60.3	65.7	122.5	60.8								
Mic 10 (Lateral)																	
76	1-1	54.2	127.8	50.0	57.0	61.3	66.5	122.2	60.2	77	0.6	1.6	96.6	4.4	53.4	53.8	Yes
76	1-2	50.9	128.1	50.0	56.1	60.2	65.7	122.9	60.1	255	-0.4	2.9	82.3	4.1	53.2	53.6	Yes
76	2-1	52.6	128.5	49.0	56.2	60.1	65.7	122.4	61.6	77	0.0	3.3	77.3	5.8	48.4	62.8	Yes
76	2-2	60.6	130.5	49.0	56.8	60.7	65.8	121.0	60.9	252	-2.8	3.6	123.5	5.8	49.3	60.9	Yes
76	3-1	69.3	134.0	50.2	56.4	60.5	65.9	121.8	60.1	76	1.3	1.7	132.1	3.5	54.5	52.2	Yes
76	3-2	49.6	125.4	50.2	56.2	60.2	65.8	121.3	60.8	255	1.7	2.2	306.5	3.5	54.9	51.3	Yes
76	4-1	57.5	130.5	50.5	56.4	61.2	66.4	122.3	61.3	74	2.1	2.1	170.8	3.9	56.7	48.7	Yes
76	4-2	52.3	128.1	50.5	55.6	59.7	65.6	125.5	61.7	258	-1.3	1.9	214.0	4.1	56.1	49.2	Yes
76	5-1	54.1	128.9	49.9	56.1	60.5	66.1	123.0	60.8	78	2.0	3.3	116.9	4.7	50.9	59.1	Yes
76	5-2	52.7	127.5	49.9	56.7	61.0	66.2	122.3	60.6	254	-2.2	2.7	131.5	4.7	51.1	58.6	Yes
76	6-1	51.1	126.8	47.5	57.4	61.6	66.5	123.6	61.4	74	1.5	1.6	191.3	4.1	65.5	53.5	Yes
76	6-2	66.8	130.5	47.5	57.1	61.2	67.1	121.5	59.9	256	-0.6	3.7	245.7	7.0	65.3	56.7	Yes
Mic 10 Average		56.0	128.9	49.5	56.5	60.7	66.1	122.5	60.8								
Mic 11 (Lateral)																	
175	1-1	152.4	191.4	44.9	53.3	57.1	62.9	122.2	60.2	77	0.6	1.6	96.6	4.4	53.4	53.8	Yes
175	1-2	150.4	190.9	44.9	53.5	57.3	63.0	122.9	60.1	255	-0.4	2.9	82.3	4.1	53.2	53.6	Yes
175	2-1	151.7	191.7	43.7	53.3	57.4	62.8	122.4	61.6	77	0.0	3.3	77.3	5.8	48.4	62.8	Yes
175	2-2	154.5	192.9	43.7	53.8	57.4	62.8	121.0	60.9	252	-2.8	3.6	123.5	5.8	49.3	60.9	Yes
175	3-1	158.9	196.0	43.4	52.8	56.5	62.4	121.8	60.1	76	1.3	1.7	132.1	3.5	54.5	52.2	Yes
175	3-2	149.1	188.4	43.4	53.4	57.2	62.9	121.3	60.8	255	1.7	2.2	306.5	3.5	54.9	51.3	Yes
175	4-1	154.2	193.6	43.3	53.2	57.6	63.2	122.3	61.3	74	2.1	2.1	170.8	3.9	56.7	48.7	Yes

Distance to PADDC (ft)	Test#	Undertrack Distance (ft)	POCA Slant (ft)	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Median Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
175	4-2	151.2	191.1	43.3	51.9	55.7	61.9	125.5	61.7	258	-1.3	1.9	214.0	4.1	56.1	49.2	Yes
175	5-1	151.8	191.6	44.3	53.1	57.0	63.1	123.0	60.8	78	2.0	3.3	116.9	4.7	50.9	59.1	Yes
175	5-2	152.0	191.2	44.3	53.0	56.9	62.6	122.3	60.6	254	-2.2	2.7	131.5	4.7	51.1	58.6	Yes
175	6-1	148.7	188.6	46.5	54.5	58.3	63.6	123.6	61.4	74	1.5	1.6	191.3	4.1	65.5	53.5	Yes
175	6-2	157.5	193.4	46.5	54.2	57.8	64.2	121.5	59.9	256	-0.6	3.7	245.7	7.0	65.3	56.7	Yes
Mic 11 Average		152.7	191.7	44.4	53.3	57.2	62.9	122.5	60.8								
Mic 12 (Lateral)																	
375	1-1	351.5	370.1	45.2	48.6	50.0	58.1	122.2	60.2	77	0.6	1.6	96.6	4.4	53.4	53.8	No
375	1-2	349.8	369.0	45.2	48.8	50.3	58.3	122.9	60.1	255	-0.4	2.9	82.3	4.1	53.2	53.6	No
375	2-1	351.0	370.1	44.2	48.2	49.3	57.7	122.4	61.6	77	0.0	3.3	77.3	5.8	48.4	62.8	No
375	2-2	352.2	370.6	44.2	49.2	50.5	58.2	121.0	60.9	252	-2.8	3.6	123.5	5.8	49.3	60.9	No
375	3-1	354.8	372.9	44.4	48.2	49.8	57.7	121.8	60.1	76	1.3	1.7	132.1	3.5	54.5	52.2	No
375	3-2	348.6	367.1	44.4	48.7	49.9	58.3	121.3	60.8	255	1.7	2.2	306.5	3.5	54.9	51.3	No
375	4-1	352.7	371.6	44.3	48.5	50.1	58.5	122.3	61.3	74	2.1	2.1	170.8	3.9	56.7	48.7	No
375	4-2	350.5	369.5	44.3	47.8	48.5	57.8	125.5	61.7	258	-1.3	1.9	214.0	4.1	56.1	49.2	No
375	5-1	350.7	369.7	45.2	50.4	51.5	60.4	123.0	60.8	78	2.0	3.3	116.9	4.7	50.9	59.1	No
375	5-2	351.4	370.0	45.2	52.0	52.9	61.5	122.3	60.6	254	-2.2	2.7	131.5	4.7	51.1	58.6	No
375	6-1	347.6	366.4	49.6	50.2	51.4	59.3	123.6	61.4	74	1.5	1.6	191.3	4.1	65.5	53.5	No
375	6-2	354.0	371.3	49.6	50.5	51.6	60.5	121.5	59.9	256	-0.6	3.7	245.7	7.0	65.3	56.7	No
Mic 12 Average		351.2	369.9	-	-	-	-	-	-								

Source: Prime Air, 2024; ESA, 2025.

Notes: Greyed out cells we determined to not be valid measurements and were not included in SEL calculations.

Table B-5. Empty Weight En Route Measurements

Distance to PADDC (ft)	Test#	Undertrack Distance (ft)	POCA Slant (ft)	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Median Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
Mic 09 (Lateral)																	
25	1-1	0.4	101.8	50.8	57.5	62.1	67.1	107.2	59.8	76	1.8	4.0	102.4	4.5	45.3	62.8	Yes
25	1-2	17.6	103.4	50.8	57.0	61.6	66.6	107.6	59.7	254	-1.2	3.8	93.1	4.5	45.5	62.2	Yes
25	2-1	44.8	94.2	50.1	59.3	63.6	68.4	90.4	61.9	76	2.4	2.4	177.4	4.1	65.1	38.7	Yes
25	2-2	5.7	81.4	50.1	58.6	63.3	68.1	90.1	60.4	255	-2.0	3.0	212.8	4.1	65.1	38.4	Yes
25	3-1	36.0	107.7	46.8	56.9	61.2	66.5	110.3	61.5	68	-5.7	5.9	326.2	10.9	62.2	34.6	No
25	3-2	20.1	103.3	46.8	56.1	60.8	66.1	109.7	61.1	261	6.0	7.5	312.6	10.9	62.8	35.6	No
25	4-1	43.9	110.3	62.9	62.9	64.3	73.3	107.0	62.4	68	-3.1	4.3	300.5	11.1	63.3	34.1	No
25	4-2	52.4	112.5	62.9	64.8	65.9	74.3	105.2	60.3	264	6.4	6.4	353.4	10.7	63.9	33.9	No
25	5-1	3.6	96.7	47.0	57.5	61.7	66.5	104.3	60.6	69	-2.0	2.2	319.7	9.9	61.3	37.8	Yes
25	5-2	8.5	94.9	47.0	57.7	62.7	67.7	102.3	60.8	257	3.0	3.0	341.0	9.9	61.7	37.4	Yes
25	6-1	48.9	110.8	47.6	55.6	60.5	66.8	106.5	60.7	71	-2.5	4.4	34.0	9.1	61.3	37.3	Yes
25	6-2	9.2	100.6	47.6	55.2	60.1	65.6	107.7	63.2	258	2.2	2.6	21.8	7.4	61.0	37.0	Yes
25	7-1	22.4	104.3	50.7	57.1	61.5	67.1	107.2	59.6	78	1.7	4.2	102.3	4.7	45.5	61.5	Yes
25	7-2	23.1	105.2	50.7	56.9	61.3	66.4	107.9	59.9	252	-2.1	3.9	104.6	4.7	45.7	61.3	Yes
Mic 09 Average		18.4	99.3	49.2	57.2	61.8	67.0	103.1	60.7								
Mic 10 (Lateral)																	
76	1-1	50.7	113.7	44.9	56.6	61.1	66.1	107.2	59.8	76	1.8	4.0	102.4	4.5	45.3	62.8	Yes
76	1-2	54.7	115.6	44.9	56.1	60.8	65.6	107.6	59.7	254	-1.2	3.8	93.1	4.5	45.5	62.2	Yes
76	2-1	69.0	107.9	44.5	58.3	62.6	67.3	90.4	61.9	76	2.4	2.4	177.4	4.1	65.1	38.7	Yes
76	2-2	51.4	96.1	44.5	57.6	62.4	67.2	90.1	60.4	255	-2.0	3.0	212.8	4.1	65.1	38.4	Yes
76	3-1	63.0	119.5	51.1	58.0	62.3	67.6	110.3	61.5	68	-5.7	5.9	326.2	10.9	62.2	34.6	No
76	3-2	56.0	115.8	51.1	56.9	61.2	66.9	109.7	61.1	261	6.0	7.5	312.6	10.9	62.8	35.6	No
76	4-1	66.9	121.3	49.1	56.4	60.9	66.8	107.0	62.4	68	-3.1	4.3	300.5	11.1	63.3	34.1	Yes
76	4-2	72.9	123.5	49.1	58.0	62.4	67.5	105.2	60.3	264	6.4	6.4	353.4	10.7	63.9	33.9	No
76	5-1	50.5	109.1	50.6	58.6	62.5	67.6	104.3	60.6	69	-2.0	2.2	319.7	9.9	61.3	37.8	Yes
76	5-2	52.4	108.1	50.6	58.6	63.5	68.6	102.3	60.8	257	3.0	3.0	341.0	9.9	61.7	37.4	Yes
76	6-1	70.0	122.6	51.7	56.9	61.6	68.1	106.5	60.7	71	-2.5	4.4	34.0	9.1	61.3	37.3	Yes
76	6-2	53.1	113.4	51.7	56.2	60.7	66.7	107.7	63.2	258	2.2	2.6	21.8	7.4	61.0	37.0	No
76	7-1	56.8	116.6	45.3	56.2	60.7	66.2	107.2	59.6	78	1.7	4.2	102.3	4.7	45.5	61.5	Yes
76	7-2	55.9	116.8	45.3	56.0	60.7	65.6	107.9	59.9	252	-2.1	3.9	104.6	4.7	45.7	61.3	Yes
Mic 10 Average		57.8	112.8	47.1	57.1	61.7	66.9	103.0	60.6								
Mic 11 (Lateral)																	
175	1-1	150.5	181.7	44.5	53.3	57.1	62.8	107.2	59.8	76	1.8	4.0	102.4	4.5	45.3	62.8	Yes
175	1-2	152.3	183.2	44.5	52.6	56.7	62.2	107.6	59.7	254	-1.2	3.8	93.1	4.5	45.5	62.2	Yes
175	2-1	158.0	178.4	43.8	54.4	57.9	63.5	90.4	61.9	76	2.4	2.4	177.4	4.1	65.1	38.7	Yes

Distance to PADDC (ft)	Test#	Undertrack Distance (ft)	POCA Slant (ft)	Ambient (dBA)	LAEQ (dBA)	LMAX (dBA)	SEL (dBA)	Average Altitude (ft)	Average True Air Speed (kts)	Median Drone Heading (deg.)	Cross Wind (kts)	Wind Speed (kts)	Wind Direction (deg.)	Wind Gust Speed (kts)	Temp (°f)	Relative Humidity (%)	Valid
175	2-2	150.9	171.3	43.8	53.6	57.3	63.2	90.1	60.4	255	-2.0	3.0	212.8	4.1	65.1	38.4	Yes
175	3-1	155.1	185.4	44.9	53.7	57.4	63.3	110.3	61.5	68	-5.7	5.9	326.2	10.9	62.2	34.6	No
175	3-2	153.7	184.1	44.9	53.0	56.8	63.0	109.7	61.1	261	6.0	7.5	312.6	10.9	62.8	35.6	No
175	4-1	155.6	185.7	43.0	52.5	56.6	62.9	107.0	62.4	68	-3.1	4.3	300.5	11.1	63.3	34.1	Yes
175	4-2	159.4	188.0	43.0	53.8	57.9	63.3	105.2	60.3	264	6.4	6.4	353.4	10.7	63.9	33.9	No
175	5-1	150.3	178.7	45.7	54.0	57.7	63.1	104.3	60.6	69	-2.0	2.2	319.7	9.9	61.3	37.8	Yes
175	5-2	151.6	178.6	45.7	54.0	58.3	64.0	102.3	60.8	257	3.0	3.0	341.0	9.9	61.7	37.4	Yes
175	6-1	158.5	187.6	45.2	53.5	57.5	64.7	106.5	60.7	71	-2.5	4.4	34.0	9.1	61.3	37.3	No
175	6-2	152.5	182.5	45.2	51.8	55.7	62.2	107.7	63.2	258	2.2	2.6	21.8	7.4	61.0	37.0	Yes
175	7-1	153.2	184.0	44.7	53.0	56.7	63.0	107.2	59.6	78	1.7	4.2	102.3	4.7	45.5	61.5	Yes
175	7-2	152.9	184.1	44.7	52.6	56.6	62.2	107.9	59.9	252	-2.1	3.9	104.6	4.7	45.7	61.3	Yes
Mic 11 Average		152.8	180.8	44.6	53.2	57.1	62.9	103.2	60.8								
Mic 12 (Lateral)																	
375	1-1	350.1	364.5	45.5	48.7	49.9	58.2	107.2	59.8	76	1.8	4.0	102.4	4.5	45.3	62.8	No
375	1-2	351.1	365.6	45.5	48.4	49.4	57.9	107.6	59.7	254	-1.2	3.8	93.1	4.5	45.5	62.2	No
375	2-1	353.6	363.2	45.7	49.7	51.1	58.7	90.4	61.9	76	2.4	2.4	177.4	4.1	65.1	38.7	No
375	2-2	350.3	359.6	45.7	49.5	50.7	59.0	90.1	60.4	255	-2.0	3.0	212.8	4.1	65.1	38.4	No
375	3-1	352.0	366.4	46.7	49.1	50.2	58.7	110.3	61.5	68	-5.7	5.9	326.2	10.9	62.2	34.6	No
375	3-2	352.7	366.9	46.7	50.4	51.8	60.4	109.7	61.1	261	6.0	7.5	312.6	10.9	62.8	35.6	No
375	4-1	351.3	365.6	44.6	49.2	50.2	59.7	107.0	62.4	68	-3.1	4.3	300.5	11.1	63.3	34.1	No
375	4-2	354.0	367.8	44.6	49.6	51.1	59.2	105.2	60.3	264	6.4	6.4	353.4	10.7	63.9	33.9	No
375	5-1	349.8	362.9	49.7	49.2	50.4	58.2	104.3	60.6	69	-2.0	2.2	319.7	9.9	61.3	37.8	No
375	5-2	350.9	363.4	49.7	55.9	56.7	65.9	102.3	60.8	257	3.0	3.0	341.0	9.9	61.7	37.4	No
375	6-1	354.1	367.7	49.1	51.0	52.4	62.1	106.5	60.7	71	-2.5	4.4	34.0	9.1	61.3	37.3	No
375	6-2	352.0	366.0	49.1	48.7	49.5	59.2	107.7	63.2	258	2.2	2.6	21.8	7.4	61.0	37.0	No
375	7-1	351.7	366.1	45.2	49.5	50.5	59.5	107.2	59.6	78	1.7	4.2	102.3	4.7	45.5	61.5	No
375	7-2	351.6	366.2	45.2	48.3	49.5	57.9	107.9	59.9	252	-2.1	3.9	104.6	4.7	45.7	61.3	No
Mic 12 Average		-	-	-	-	-	-	-	-								

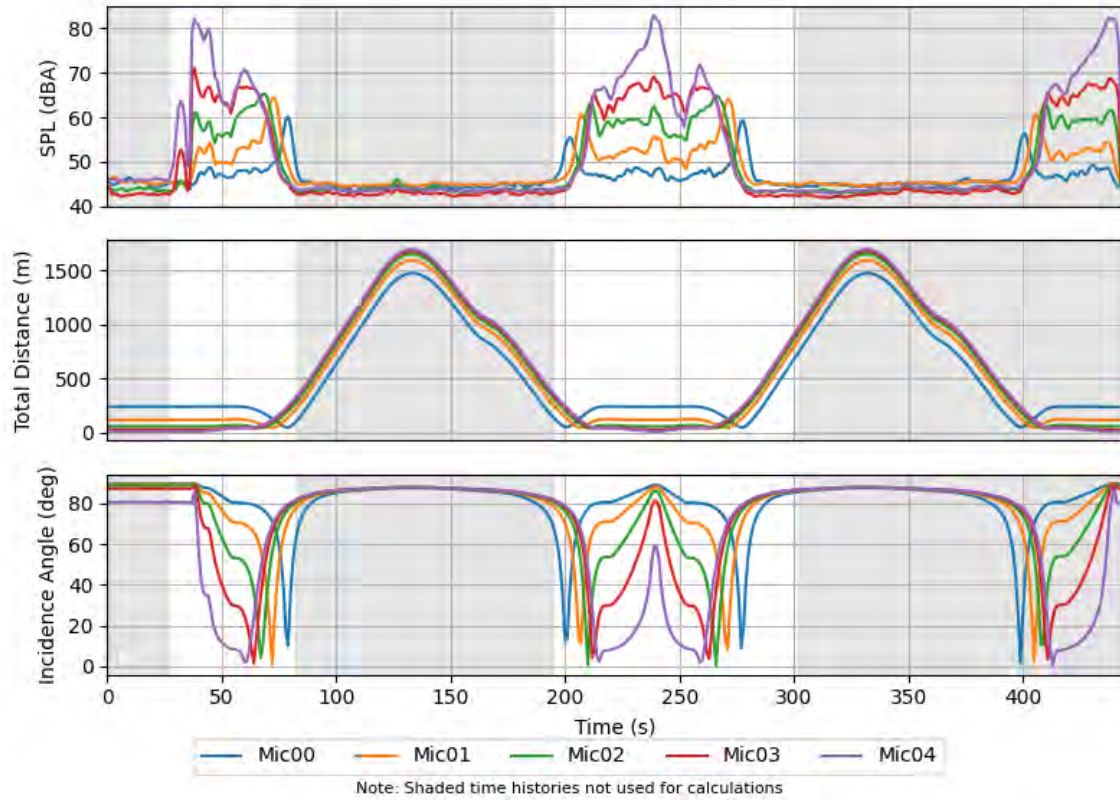
Source: Prime Air, 2024; ESA, 2025.

Notes: Greyed out cells we determined to not be valid measurements and were not included in SEL calculations.

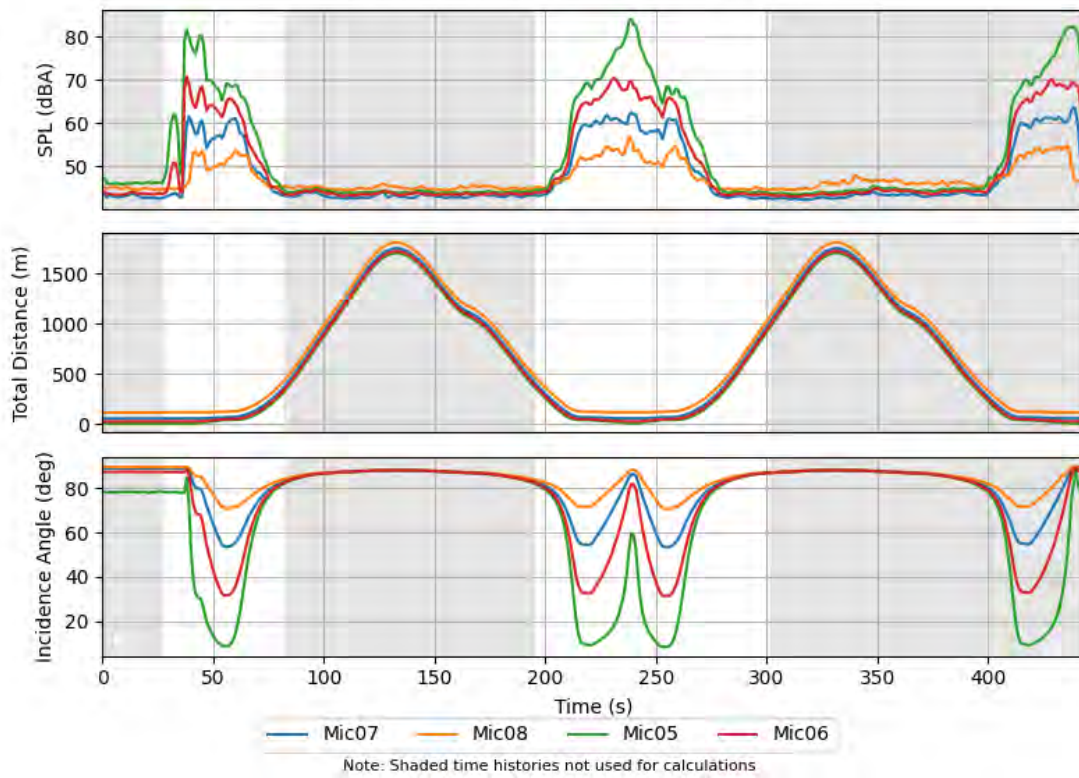
Appendix C: Time History Graphs

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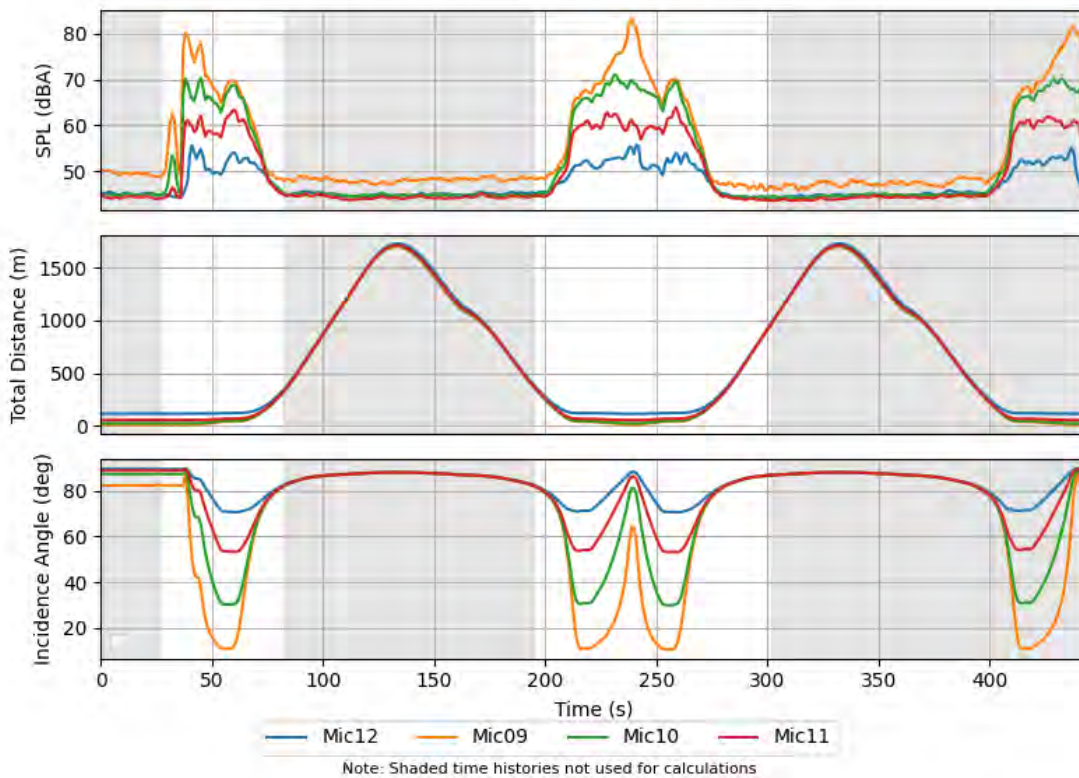
Takeoff and Delivery - MTOW - Test 1 Undertrack



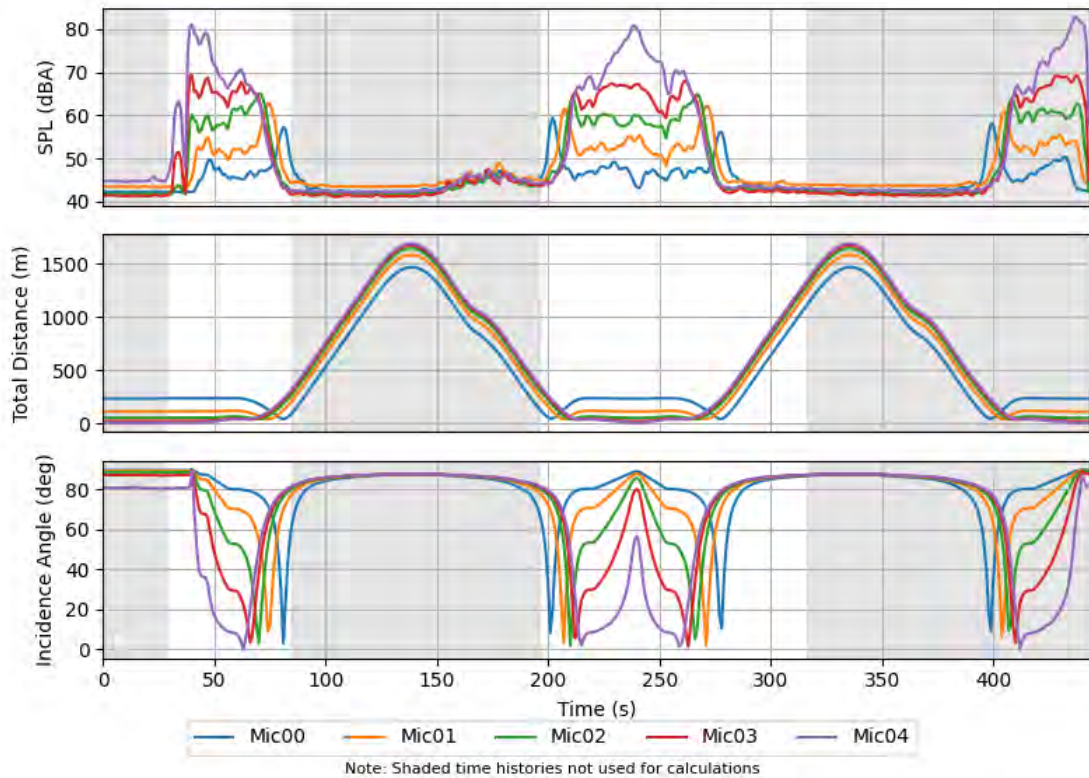
Takeoff and Delivery - MTOW - Test 1 Behind



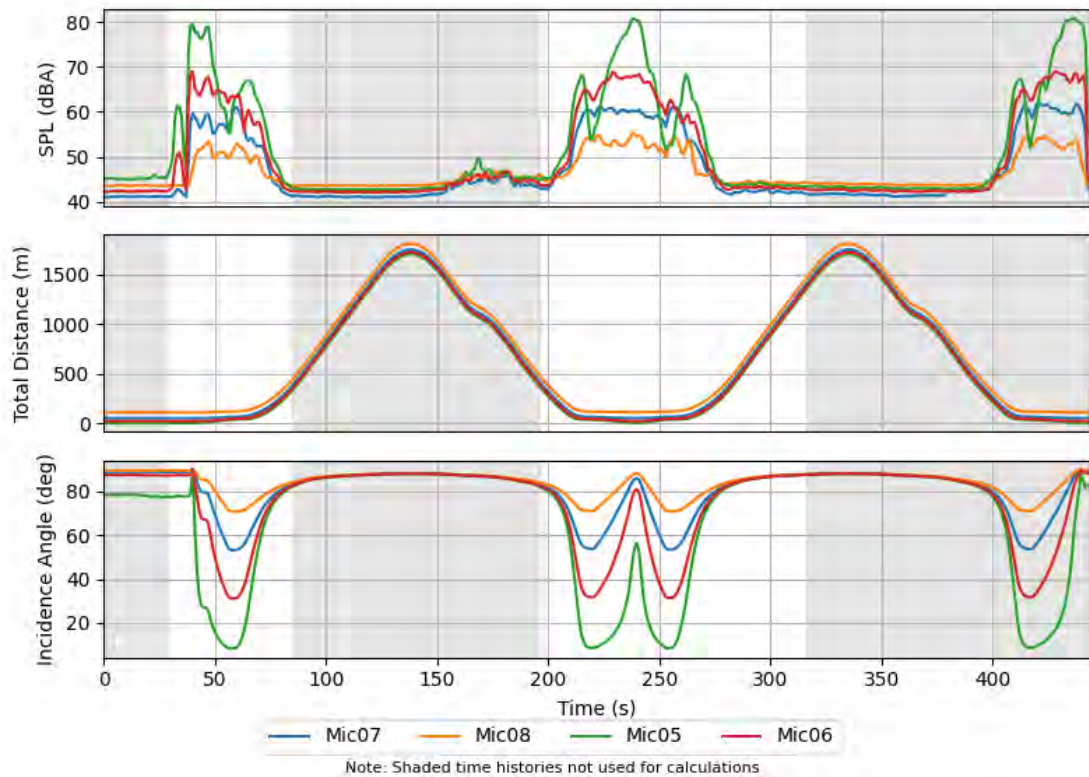
Takeoff and Delivery - MTOW - Test 1 Lateral



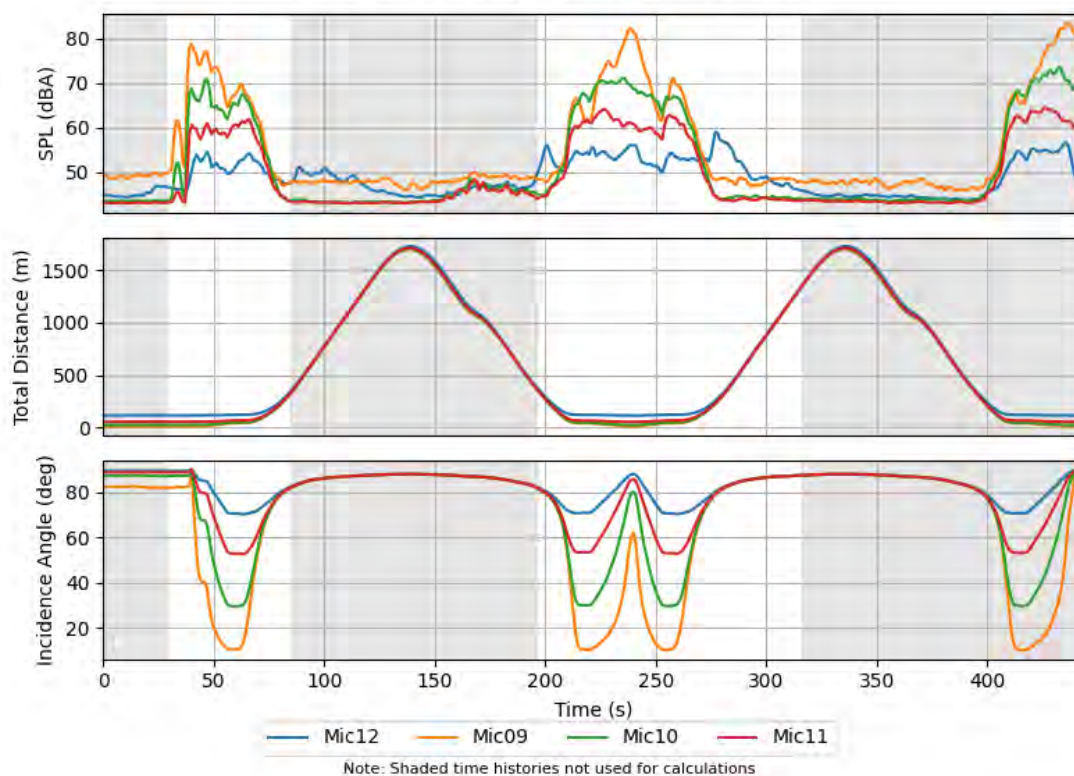
Takeoff and Delivery - MTOW - Test 2 Undertrack



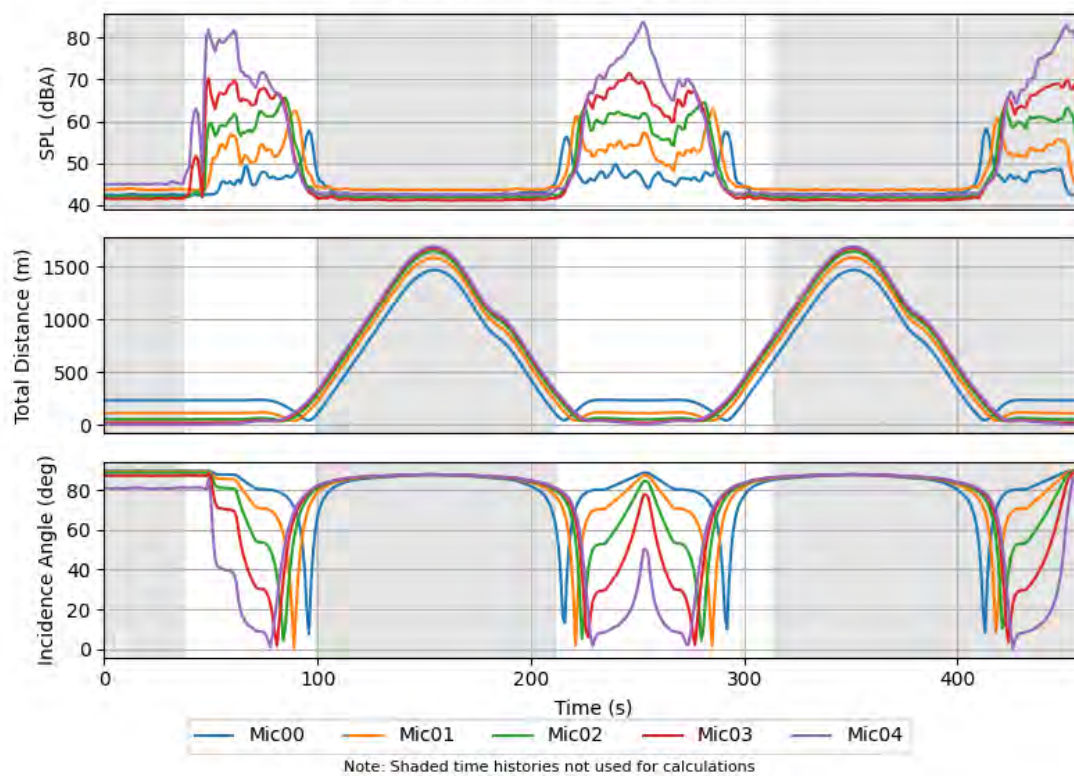
Takeoff and Delivery - MTOW - Test 2 Behind



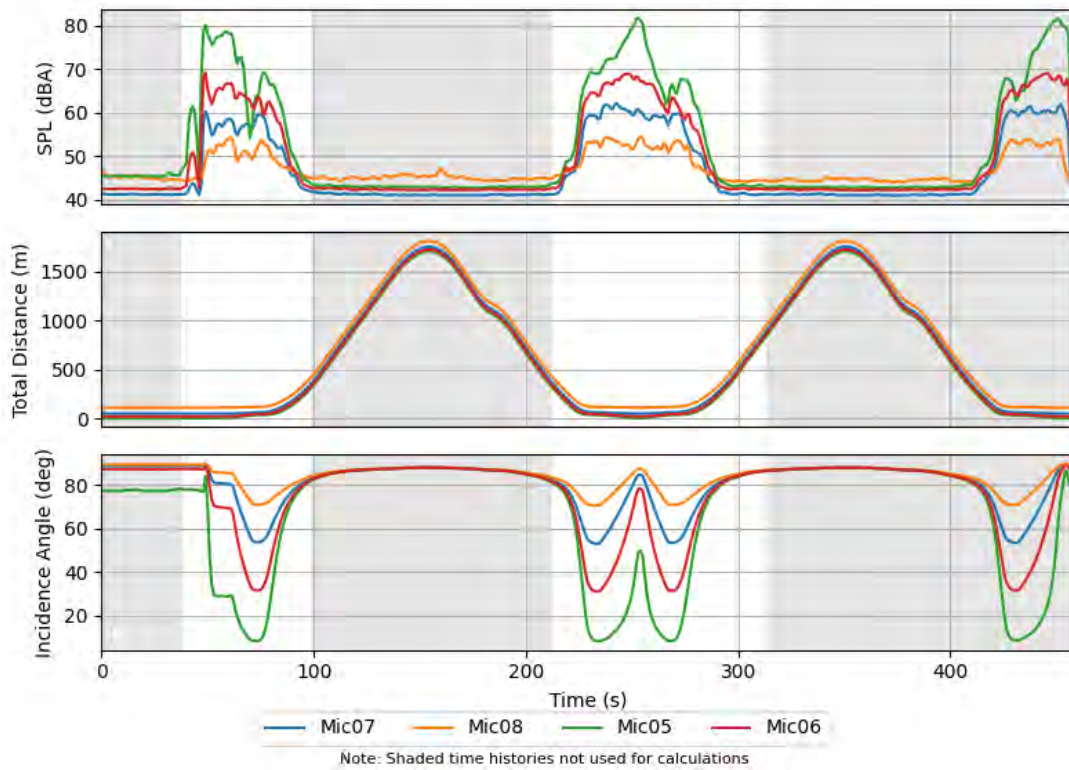
Takeoff and Delivery - MTOW - Test 2 Lateral



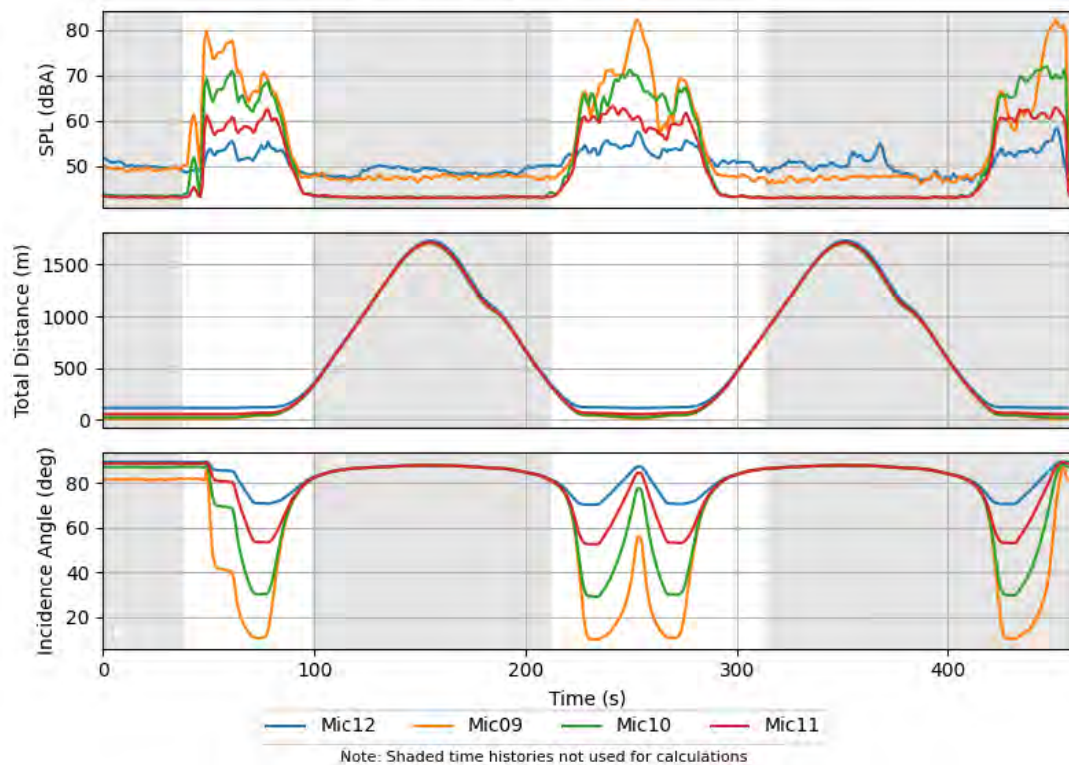
Takeoff and Delivery - MTOW - Test 3 Undertrack



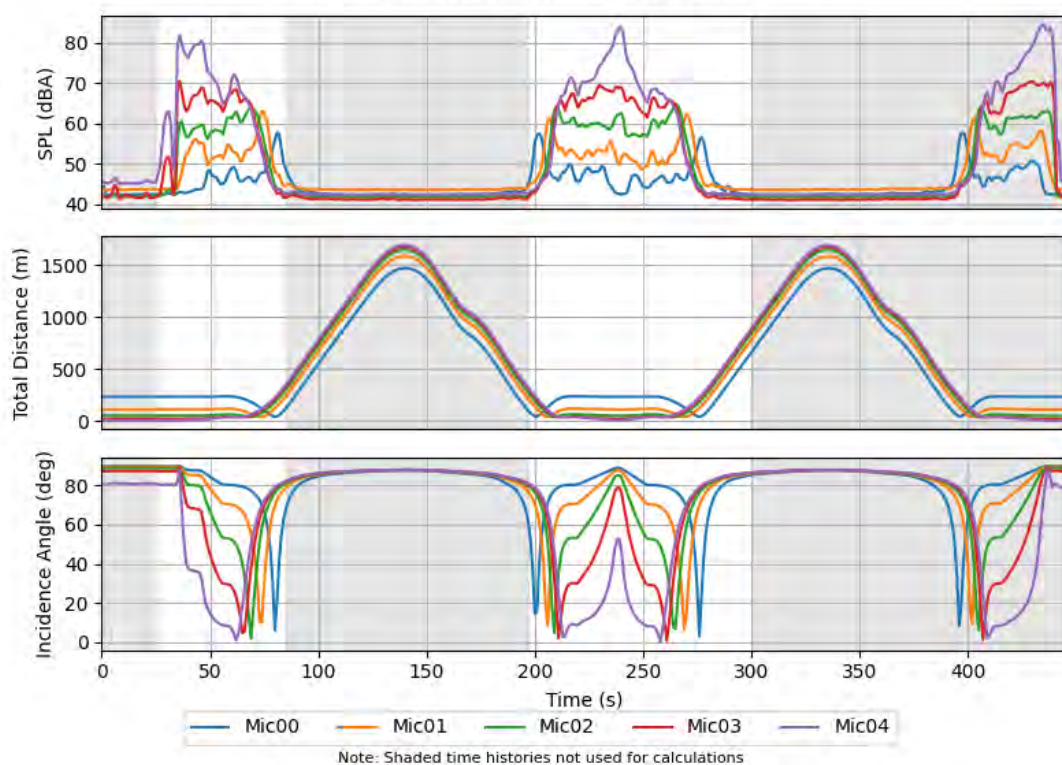
Takeoff and Delivery - MTOW - Test 3 Behind



Takeoff and Delivery - MTOW - Test 3 Lateral



Takeoff and Delivery - MTOW - Test 4 Undertrack



Takeoff and Delivery - MTOW - Test 4 Behind

