

ATTACHMENT to FAA FORM 7711-1**ISSUED TO:** NASA DFRC Operations**ADDRESS:** NASA DFRC
P.O. Box 273
Edwards, CA 93523-0273
ATTN: Phil Hall**NAME:** Federal Aviation Administration (FAA) Certificate of Authorization (COA) for NASA Global Hawk Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) outside of restricted/warning area airspace.**ACTIVITY:** Operation of the NASA Global Hawk UAS in Class A and E (above FL600) airspace under the jurisdiction of Los Angeles Air Route Traffic Control Center (ARTCC), Oakland Flight Information Region/Ocean Control Area (FIR/OCA) and Anchorage Control Area (CTA)/FIR, and within Honolulu Control Facility (HCF). See Attachments 1-8.**PURPOSE:** To prescribe operating requirements in the NAS (outside of restricted and/or warning area airspace) for the purpose of supporting science objectives including validation and collaboration with NASA earth monitoring satellite missions, observation of stratospheric trace gases, sampling of polar stratospheric air, measurements of dust, smoke and pollution and measures of streamers of moist air in these regions.**DATES OF USE:** This COA (2009-WSA-72) is valid from May 22, 2009 through May 21, 2010. Should a renewal become necessary, the proponent shall advise the FAA, in writing, no later than 60 days prior to the requested effective date.**GENERAL PROVISIONS:**

- The review of this activity is based on our current understanding of the UAS operations, and the impact of such operations in the NAS, and therefore should not be considered a precedent for future operations. As changes occur in the UAS industry, or in our understanding of it, there may be changes to the limitations and conditions for similar operations.
- All personnel connected with the UAS operation must comply with the contents of this authorization and its special provisions.
- This COA will be reviewed and amended as necessary to conform to changing UAS policy and guidance.

SAFETY PROVISIONS:

Unmanned Aircraft (UA) have no on-board pilot to perform see-and-avoid responsibilities, and therefore, when operating outside of restricted/warning/Class A airspace areas, special provisions must be made to ensure an equivalent level of safety exists for operations had a pilot been on board. In accordance with 14 CFR Part 91, General Operating and Flight Rules, Subpart J-Waivers, 91.903, Policy and

Procedures, the following provisions provide acceptable mitigation of 14 CFR Part 91.113 and must be complied with:

- Visual Observers, either ground-based or airborne, must be used.
- The applicant and/or its representatives are responsible for collision avoidance with all aircraft, other aviation operations, and the safety of persons or property on the surface.

AIRWORTHINESS CERTIFICATION PROVISIONS:

- UA must be shown to be airworthy to conduct flight operations in the NAS.
- Public Use Aircraft applications must contain one of the following:
 - A civil airworthiness certification from the FAA, or
 - A statement specifying that the Department of Defense Handbook “Airworthiness Certification Criteria” (MIL-HDBK-516), as amended, was used to certify the aircraft or equivalent method of certification.

PILOT / OBSERVER PROVISIONS:

- **Pilot Qualifications:** UA pilots interacting with Air Traffic Control (ATC) shall have sufficient expertise to perform that task readily. Pilots must have an understanding of and comply with Federal Aviation Regulations and Military Regulations applicable to the airspace where the UAS will operate. Pilots must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA pilots.
- **Observer Qualifications:** Observers must have been provided with sufficient training to communicate clearly to the pilot any turning instructions required to stay clear of conflicting traffic. Observers will receive training on rules and responsibilities described in 14 CFR 91.111, *Operating Near Other Aircraft*, and 14 CFR 91.113, *Right-of-Way Rules*. Observers must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA observers.
- **Pilot-in-Command (PIC) – Visual Flight Rules (VFR):**
 - The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
 - The PIC must pass the required knowledge test for a private pilot certificate, or military equivalent, as stated in 14 CFR 61.105, and must keep their aeronautical knowledge up to date.
 - There is no intent to suggest that there is any requirement for the UAS PIC to be qualified as a crewmember of a manned aircraft.

- **Pilot-in-Command (PIC) – Instrument Flight Rules (IFR):**

- The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
- The PIC must be a certified pilot of manned aircraft (FAA or military equivalent) in category and class of aircraft flown.
- The PIC must also have an appropriate instrument rating (manned aircraft, FAA or military equivalent) for the category and class of aircraft flown.

- **Pilot Proficiency – VFR/IFR:**

- Pilots will not act as a VFR/IFR PIC unless they have had three qualified proficiency events within the preceding 90 days.
 - The term “qualified proficiency event” is a UAS-specific term necessary due to the diversity of UAS types and control systems.
 - A qualified proficiency event is an event requiring the pilot to exercise the training and skills unique to the UAS in which proficiency is maintained.
- Pilots will not act as an IFR PIC unless they have had six instrument qualifying events in the preceding six calendar months (an event that requires the PIC to exercise instrument flight skills unique to the UAS).
- Pilots flying UAS on other than instrument flight plans must pass the required knowledge test for a private pilot certificate, or military equivalent, as stated in 14 CFR 61.105.

PIC Responsibilities:

- Pilots are responsible for a thorough preflight inspection of the UAS. Flight operations will not be undertaken unless the UAS is airworthy. The airworthiness provisions of 14 CFR 91.7, Civil Aircraft Airworthiness, or the military equivalent, apply.
- One PIC must be designated at all times and is responsible for the safety of the UA and persons and property along the UA flight path.
- The UAS pilot will be held accountable for controlling their aircraft to the same standards as the pilot of a manned aircraft. The provisions of 14 CFR 91.13, *Careless and Reckless Operation*, apply to UAS pilots.

Pilot/ATC Instructions: The PIC will maintain direct two-way communications with ATC, except oceanic flight – then the PIC will use ARINC (see procedures in Special Provisions) to relay all position and other reporting requirements and have the ability to maneuver the UA per their instructions as applicable.

Standard Provisions: These provisions are applicable to all operations unless indicated otherwise in the Special Provisions section.

- The UA PIC will maintain direct two-way communications with ATC and have the ability to maneuver the UA per their instructions, unless specified otherwise in the Special Provisions section. The PIC shall comply with all ATC instructions and/or clearances.
- If equipped, the UA shall operate with an operational mode 3/A transponder, with altitude encoding, or mode S transponder (preferred) set to an ATC assigned squawk.
- If equipped, the UA shall operate with position/navigation lights on at all times during flight.
- The UA PIC shall not accept any ATC clearance requiring the use of visual separation or sequencing.
- VFR cloud clearances and visibilities for Class E airspace will be used regardless of class of airspace the UAS is operating in.
- Special VFR is not authorized.
- Operations (including lost link procedures) shall not be conducted over populated areas, heavily trafficked roads, or an open-air assembly of people.
- Operations outside of restricted areas, warning areas, prohibited areas (designated for aviation use) and/or Class A airspace may only be conducted during daylight hours, unless authorized in the Special Provisions section.
- Operations shall not loiter on Victor airways. When necessary, transit of Victor airways shall be conducted as expeditiously as possible.
- Operations conducted under VFR rules shall operate at appropriate VFR altitudes for direction of flight (14 CFR 91.159).
- All operators that use GPS as a sole source, must check all NOTAM's and Receiver Autonomous Integrity Monitoring (RAIM). Flight into GPS test area or degraded RAIM is prohibited without specific approval in the special provisions.
- The UA PIC or chase plane PIC (whichever is applicable) will notify ATC of any in flight emergency or aircraft accident as soon as practical.
- The NASA ARC, and/or its representatives, is responsible at all times for collision avoidance with non-participating aircraft and the safety of persons or property on the surface with respect to the UAS.

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SPECIAL PROVISIONS:

The FAA recognizes that, by nature, UAS have no on-board pilot to perform see-and-avoid responsibilities. Therefore, when operating outside of Restricted Airspace, special provisions must be made to ensure an equivalent level of safety exists for operations had a pilot been on board. Listed below are the special provisions that must be complied with. All personnel connected with this UAS operation shall comply with the contents of this authorization and its special provisions.

Overview

1. NASA Global Hawk UAS flight operations COA approval does not constitute FAA approval for use of planned scientific instruments which require additional, separate FAA approval for their use. Specifically, the Cloud Physics LIDAR (CPL) laser can not be used on operational flights until specific FAA approval for its use is obtained by NASA. The approval for its use when granted will be an addendum to this COA and may be used operationally at that time.

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4.2. Operations outside of restricted airspace may only be conducted on an IFR flight plan.

2.3. The UAS transponder and position/navigation/anti-collision strobe lights shall be activated at all times during flight.

3.4. All flight plan route of flight and turn points will be a minimum of 60NM from adjacent international FIR boundaries.

4.5. NASA is responsible to de-conflict mission parameters with GPS Jamming/Testing activities. Additionally, NASA shall not allow a mission to pass through an area affected by planned GPS testing, solar storms or RAIM activity on aircraft where GPS is sole source for navigation.

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5.6. NASA is responsible and will verify that coordination with other organizations for flight above FL600 has been accomplished for each flight.

6.7. NASA is responsible and must coordinate with military operating units to preclude more than one UAS, including lost link procedures, from operating simultaneously in the same ATC facilities airspace. For this COA, UAS operations within Oakland ARTCC domestic airspace and Oakland FIR/OCA airspace are considered to be in separate facilities.

7.8. NASA must ensure flights transiting W-291 (Surface to FL800) are coordinated with the appropriate agency.

- a. The using agency, Fleet Area Control and Surveillance Facility (FACSFAC), San Diego, is responsible for scheduling activities in W-291.
- b. The controlling agency for W-291 west of 120°00'W longitude and the Mexico FIR is Oakland ARTCC. Through a joint-use letter of procedure, Oakland ARTCC has continuous use of that portion of W-291 west of 121°00'W longitude at and above FL280. FACSFAC, San Diego only schedules activities in that portion of the warning area below FL280.
- c. The controlling agency for W-291 north of the Mexico FIR is Los Angeles ARTCC.
- d. For scheduling of W-291 through any portion east of 121°00'W longitude and west of 121°00' W longitude below FL280, contact FACSFAC Scheduling at 619-545-1757.
- e. For real-time coordination, contact the FACSFAC operations supervisor at 619-545-1775

8.9. NASA must send mission schedules and coordinate airspace requirements prior to flight with all affected facilities for that flight:

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- a. Hi Desert TRACON - One business day: alan.e.staabs@faa.gov
- b. Los Angeles ARTCC MOS - One business day: 9-awp-zla-mos@faa.gov
- c. Oakland ARTCC MOS - One business day: fax: 510-745-3339
- d. Oakland Oceanic Airspace and Procedures - One business day: wayne.winningham@faa.gov
- e. Anchorage ARTCC and Oceanic - One business day - Lari Belisle 907-269-1124, email: lari.belisle@faa.gov and cheryl.hampton@faa.gov.
- f. HCF (Oceanic only) – (see Attachment 9) - When flight will transit HCF airspace, coordination must be initiated seven (7) business days prior to flight. Flight plan data will be distributed three (3) business days prior to flight for Global Hawk flights transiting HCF: diane.tom@faa.gov, neal.kurosaki@faa.gov, Moses.Akana@faa.gov, Clyde.Fuse@faa.gov, fax: 808-840-6110.
- g. FACSAC San Diego - Three business days: fax: 619-545-4711
- h. FACSAC Pearl Harbor - Three business days: 619-545-1757, fax: 808-472-7317

- | ~~9-10.~~ NASA must coordinate with HCF when any portion of the planned route of flight transits airspace under their control jurisdiction. (see Attachment 9)
- | ~~10-11.~~ NASA must coordinate with Anchorage ARTCC when any portion of the planned route of flight transits Anchorage CTA/FIRs. Coordination must be initiated seven (7) business days prior to flight. Flight plan data will be distributed one (1) business day prior to flight for Global Hawk flights in Anchorage ARTCC airspace. The point of contact for mission schedule distribution and flight plan data will be: Lari Belisle 907-269-1124, email: lari.belisle@faa.gov and cheryl.hampton@faa.gov.
- | ~~11-12.~~ Entering or exiting R2508 the UAS must be at or above FL450. Ingress and egress of R2508 will be at coordination point CHADS (PMD314045 or 35°15'N/118°35'W).
- | ~~12-13.~~ Global Hawk will report reaching the altitude block of FL500-650 to ATC.
- | ~~13-14.~~ While operating in Los Angeles ARTCC airspace between DINTY and R2508 the UAS must be programmed to follow a course emulating the track of IR425/IR200 between CHADS and GVO189019. Between GVO189019 and the Ocean Control Boundary, the UAS must be programmed over waypoints DINTY and 32°50'N/124°23'W.
- | ~~14-15.~~ The emergency divert airfields identified by NASA for Global Hawk Pacific (GloPac) missions have GH approach procedures to these fields. The fields identified by NASA are:
 - a. Barking Sands- Kauai HI. - BKH – 22°01'29"N/159°47'22"W (attachment 10)
 - b. San Nicolas Island, CA. – NSI – 33°14'06"/119°27'30"W (attachment 11)
 - c. Eielson- Fairbanks, AK. - EIL – 64°39'14"N/147°05'38"W (attachment 12)

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- ~~45-16.~~ NASA must provide Western Service Center, Operations Support Group with current approved emergency divert locations and approach procedures that are identified for that flight and documentation of NASA coordination with divert airfields for emergency recovery, no later than three business days prior to each flight. The Western Service Center point of contact for this information is Mark Dillon at 425-203-4522, Mark.CTR.Dillon@faa.gov , if unavailable Mike Connor 202-267-9255, Mike.CTR.Connor@faa.gov or Deb Trindle 623-856-9596, Debra.Trindle@faa.gov.
- ~~46-17.~~ These identified emergency divert airfields will not be used until all coordination with effected ATC facilities has been completed. When written procedures for emergency divert sites have been approved and coordinated, they will be included as an addendums to this COA. When addendum is attached to the COA, the emergency divert site will be available for operational use by NASA for Global Hawk recovery to an emergency divert airport.
- ~~47-18.~~ NASA Global Hawk operating areas for the Global Hawk Pacific (GloPac) missions are in the following attachments to this document:
- 1) Departure from Edwards AFB to DINTY
 - 2) Arrival from DINTY to Edwards AFB
 - 3) GloPac 1.6
 - 4) GloPac 2.6
 - 5) GloPac 3.6
 - 6) GloPac 4.6
 - 7) GloPac 5.6
 - 8) GloPac 6.6 – Alaska Arctic

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Flight Plans: (call sign: NASA872, type: RQ4)

1. The planned GloPac operating area and anticipated departure time must be submitted to affected facilities no later than one (1) business day prior to flight for facility coordination. Three (3) business days prior to flight for Global Hawk flights through Honolulu Control Facility airspace.
2. Global Hawk flight plan will be submitted and transmitted as an ICAO IFR flight plan a minimum of 2 hours prior to flight.
3. Global Hawk will file for the altitude block of FL500-650.
4. The flight plan will also be distributed in Excel format with the following columns to the each ATC facility through which the aircraft will fly.
 - a. Waypoint Name
 - b. Latitude (DDmm)
 - c. Longitude (DDDmm)
 - d. Waypoint/ Fix Radial Distance (Magnetic FRD)
 - e. Altitude
 - f. ETA
 - g. Vertical profile nominal locations and times
 - h. Emergency divert location if other than NONE

5. Between Edwards AFB and DINTY the flight plan route elements will be in FRD (Magnetic Fix Radial Distance) format or published waypoint names.
6. (b) (3) (A), (b) (3) (B)
7. For Mission 6 routing to ZAN will be filed over 32°50'N/124°23'W..BOSKE..HMPTN and meet the requirements listed below.
8. On Attachments 3-8, waypoint labeled Lost Link is 32°50'N/124°23'W.
9. In oceanic airspace, flight plan way points will be defined using latitude/longitude in degrees and minutes or published waypoint name.
10. When defining the route of flight through oceanic airspace, the distance between waypoints must not exceed eighty (80) minutes flight time. Additional waypoints must be established to define significant course changes along the filed route and as otherwise deemed necessary by the pilot.
11. In HCF airspace, flight plan route elements will be in FRD (Magnetic Fix Radial Distance) format, published waypoint names or Latitude (DDmm)/ Longitude (DDDmm).

Oakland Oceanic Requirements:

1. Primary communications when operating in oceanic airspace must be with the San Francisco Aeronautical Radio Inc. (ARINC). The pilot and mission coordinator should anticipate some delays in response to clearance requests due to the use of a third party for relay of requests/clearances. The commercial telephone numbers for San Francisco ARINC are 925-294-8400 or 800-621-0140. At least one hour prior to departure, the pilot must contact San Francisco ARINC to establish appropriate telephone contact procedures for that particular mission.
2. When a contingency is experienced, or whenever the pilot believes that direct communications with ATC would be prudent, the pilot may contact the Oakland oceanic area at one of the following numbers:
 - a. 510-745-3342
 - b. 510-745-3218
 - c. 510-745-3219
3. Vertical profile requests from cruise altitude to FL430 and return to cruise altitude will take approximately one hour of time (Descent 6 minutes, 10 minute hold at altitude FL430, climb to cruise altitude 36 minutes). Requests shall be annotated on the final flight plan. At least fifteen (15) minutes prior to where the pilot intends to initiate the vertical profile, the pilot should alert the controller of the upcoming request. Coordination must include the latitude/longitude position or waypoint name where the vertical profile will begin and the estimated time or position where the vertical profile will be completed. When ready to execute the vertical profile, the pilot should make a request to maintain 430B650. The sector controller will, traffic permitting, issue the appropriate ATC clearance. Once the aircraft has completed the profile and is established at or above FL500, the pilot must state the aircraft altitude and request to maintain 500B650.

4. When the mission dictates that the aircraft varies from the assigned route to align with a particular satellite track or conduct a science experiment, the pilot may elect to request one of two methods for accomplishing the desired course change:
 - a. Request for a “*lateral offset*” clearance of up to 128NM left and/or right of the filed route may be made when the pilot intends to parallel the filed route for a time and then return to the cleared flight plan route.
 - b. Request for a revised route clearance may be made when either the lateral offset needed will exceed 128NM or when the mission requires a geographical change of location. The pilot must formulate the route request to include waypoint positions that are not greater than eighty (80) minutes apart with the final waypoint being a position on the original filed route. An estimate for the first requested waypoint must also be included in the request.

Anchorage ARTCC/Oceanic/Arctic requirements:

1. When a contingency is experienced, or whenever the pilot believes that direct communications with ATC would be prudent, the pilot may contact the Anchorage ARTCC, oceanic, arctic area at one of the following numbers:
 - a. 907-269-1103
 - b. 907-269-1108
2. For Anchorage CTA/FIRs GloPac flights, the following routes will be filed:
 - a. Inbound to Anchorage CTA/FIRs - Direct HMPTN direct to the first waypoint/FRD in the mission plan.
 - b. Outbound from Anchorage CTA/FIRs - Direct HMPTN direct to the first waypoint in Oakland FIR/OCA.
3. Between HMPTN and 70°N latitude the route of flight will be defined using either FRD (Magnetic Fix Radial Distance) or published waypoint names.
4. North of 70°N latitude the route of flight will be defined using latitude/longitude in degrees and minutes or published waypoint name.
5. North of 70°N latitude vertical profile requests and route change requests will be done using the Oakland Oceanic requirements listed above.
6. Anchorage ARTCC will advise Global Hawk of when to use ARINC for ATC communication in the Arctic, this can be expected north of waypoint ARBEZ.
7. Vertical Profile requests and course change requests will be done in the same manner as required in Oakland Oceanic Requirements.

Departure, Arrival and Missed Approach Procedures:

1. Departures and arrivals at Edwards AFB are via locally established Global Hawk procedures.
2. (C4) Aborted Take-off/Refusal to Land (Go Around):
 - a. For an aborted take-off, the pilot will immediately advise ATC of intentions.

- b. For a go around, the pilot will advise ATC of the missed approach and execute established Global Hawk missed approach procedures.

ATC Frequency assignments: primary/secondary:

1. High Desert TRACON - 133.65/348.7
2. Los Angeles ARTCC - 128.37/263.0, 135.3/372.0, 126.52/346.3
3. HCF – 119.9 west of HNL, 127.6/126.6 east of HNL
4. Anchorage ARTCC - MDO 124.05/279.55, JOH 119.3, GKN 119.5/317.5, BIG 135.3/322.5, FYU 135.5/284.7, SCC 134.4/370.9

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(b) (3) (A), (b) (3) (B)

c. During operations within the Oakland FIR/OCA:

- i. The lost link timer will be set at 45 minutes. During that time, the aircraft will continue on its programmed flight path. After 45 minutes, the aircraft will execute a preprogrammed lost link return route for recovery at Edwards AFB.
- ii. The aircraft will proceed direct to waypoint 32°50'N/124°23'W and then via the preprogrammed routing to Edwards AFB.
- iii. If the aircraft had been established in a vertical profile prior to loss of link, it will climb to 500B650. However, due to the lost-link condition, the actual altitude will not be known and cannot be reported, therefore the altitude block being protected will be 430B650.

d. During operations within Anchorage CTA/FIRs:

- i. The lost link timer will be set at 30 minutes. During that time, the aircraft will continue on programmed flight path. After 30 minutes, the aircraft will execute a preprogrammed lost link return route for recovery at Edwards AFB.
- ii. The aircraft will proceed via the programmed flight path or reverse course and follow the reciprocal of the programmed flight path until waypoint HMPTN..BOSKE..32°50'N/124°23'W and via the preprogrammed routing to Edwards AFB.
- iii. If the aircraft had been established in a vertical profile prior to loss of link, it will climb to 500B650. However, due to the lost-link condition, the actual altitude will not be known and cannot be reported. Mode C readout without verbal confirmation is of no value in this instance and therefore the altitude block being protected will be 430B650.

4. Descent for landing will occur once established within R2508/2515.
5. Lost communications between pilot and ATC. Aircraft will squawk 7600 and comply with CFR14 §91.185, contact ATC via landline numbers listed below and coordinate action.

Lost Link/ Lost Communication Facility Landline numbers:

1. High Desert TRACON: 661-277-3843
2. Los Angeles ARTCC: 661-265-8287 (MOS)/ 661-265-8231, 661-265-8205
3. Oakland FIR/OCA: 510-745-3342/ 510-745-3218/ 510-745-3219
4. Anchorage CTA/FIRs: 907-269-1103

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Incident / Accident Reporting: The following information is required to document unusual occurrences associated with UAS activities in the NAS.

1. The proponent for the COA shall provide the following information to Donald.E.Grampp@faa.gov on a monthly/annual basis:
 - a. Number of flights conducted under this COA.
 - b. Pilot duty time per flight.
 - c. Unusual equipment malfunctions (hardware/software).
 - d. Deviations from ATC instructions.
 - e. Operational/coordination issues.
 - f. All periods of Loss of Communications.
2. The following shall be submitted via email or phone (202-385-4542, (b) (6) [REDACTED]) to Donald.E.Grampp@faa.gov within 24 hours:
 - a. All accidents or incidents involving the UAS as defined in 49 CFR 830
 - b. All periods of Loss-of-Link, including duration.
 - c. Deviations from the "Special Provisions" contained in the COA

This COA does not, in itself, waive any Federal Aviation Regulation (FAR) nor any state law or local ordinance. Should the proposed operation conflict with any state law or local ordinance, or require permission of local authorities or property owners, it is the responsibility of the NASA to resolve the matter. This COA does not authorize flight within Special Use Airspace without approval from the Using Agency. NASA is hereby authorized to operate the Global Hawk UAS in the operations area depicted in the attachments to this document.

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Attachments:

Note: On Attachments 3-8 (b) (3) (A), (b) (3) (B)

1. Departure from Edwards AFB to DINTY
2. Arrival from DINTY to Edwards AFB
3. GloPac 1.6
4. GloPac 2.6
5. GloPac 3.6
6. GloPac 4.6
7. GloPac 5.6
8. GloPac 6.6– Alaska Arctic
9. HCF airspace

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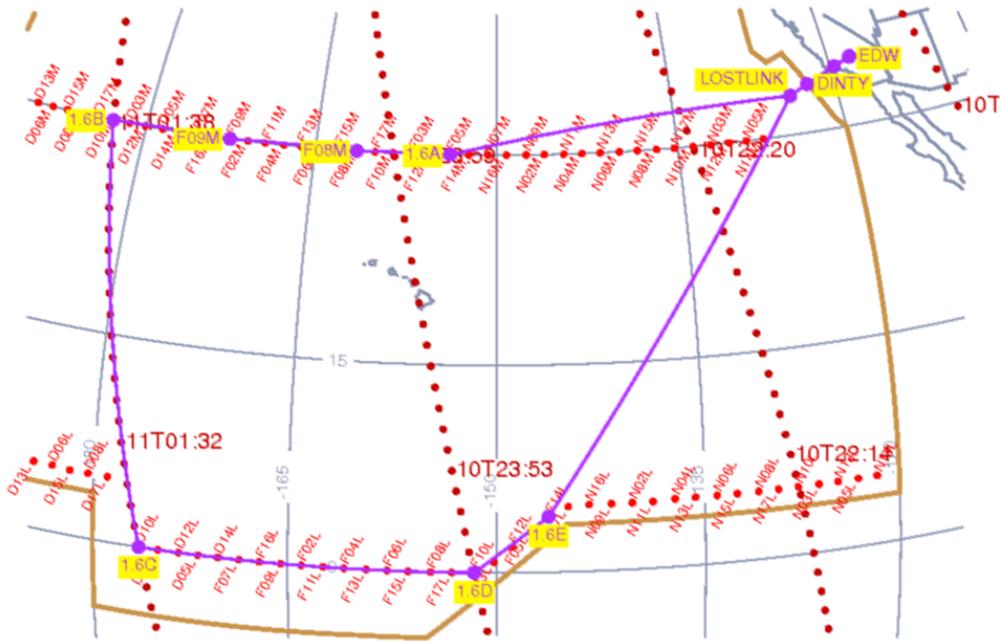
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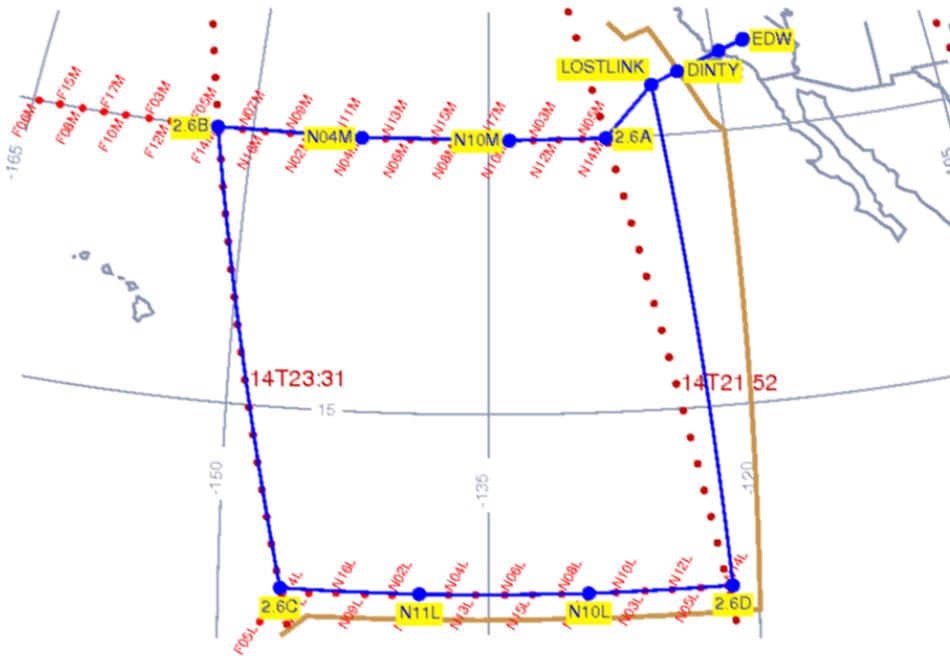
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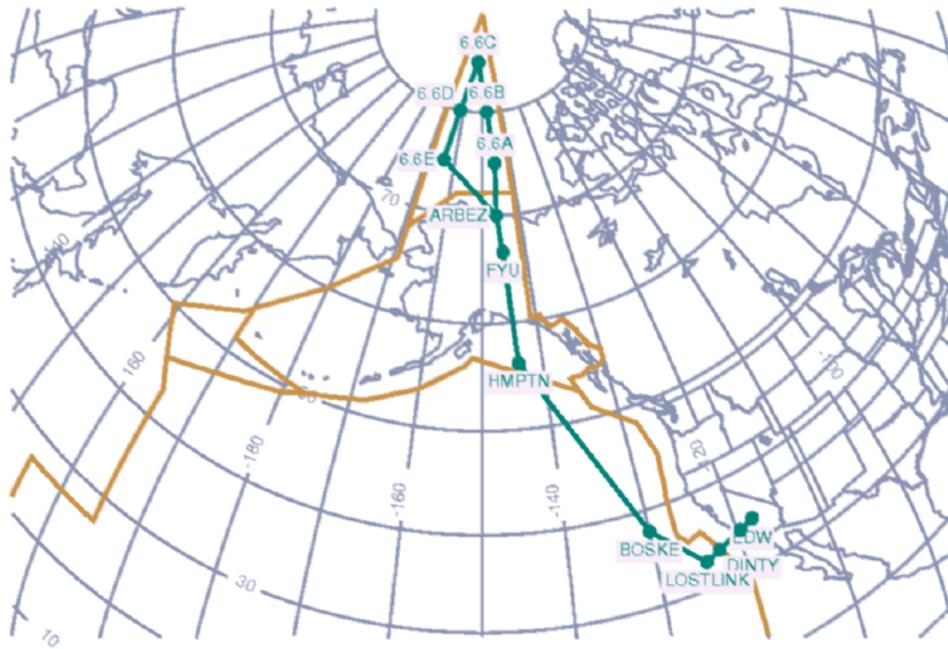
Attachment 3. GloPac 1.6



Attachment 4. GloPac 2.6



Attachment 8. GloPac 6.6



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