

Nominal Mission and Lost Link Procedures Description

NASA DFRC 2008 - Fire Mission
UAS COA Application Attachment

NASA Dryden Flight Research Center (DFRC) has procured from General Atomics – Aeronautical Systems Incorporated, an MQ-9 Reaper aircraft and a Ground Control Station (GCS). DFRC has assigned the number “NASA 870” to the aircraft, registered it as N870NA, and renamed it “Ikhana” (pronounced ee-kah-nah, a Native American word from the Choctaw Nation meaning intelligent, conscious, or aware).

“Track changes” is used in this document to highlight the significant differences in this attachment between the 2008 Rev. A WSFM plans versus the 2008 Rev. B WSFM plans. Change tracking (and hence “change bars”) have been suppressed for editorial and non-philosophical changes.

The NASA 2008 Western States Fire Mission (WSFM) flights will start and end at Edwards Air Force Base (EAFB) within the R-2508/R-2515 special use airspace (SUA). During these missions, there is no planned flight or maneuver in the National Air Space (NAS) below FL180 (Class A airspace).

Table of Contents

1. NASA 2008 Western States Fire Mission (WSFM) Overview	2
Specific 2008 WSFM Objectives.....	3
2. WSFM 2008 COA Application Mission and Lost Link Procedure Attachments.....	3
3. Number, Duration, and Timing of Flights	4
4. Airspace	4
5. Regulations Requesting Waiver or Authorization	4
6. Flight Altitude.....	4
7. COA Region.....	5
8. Flight Zones	6
8.1. Zone A	7
8.2. Zone B.....	7
8.3. Zone C.....	8
9. Range Safety Keep-out Zones and Population Centers	8
10. Flight Routes.....	10
10.1. Route A	10
10.2. Route B	11
10.3. Route C	12
11. Incident Areas	13
12. Flight Plan Submission	14
13. Lost Link Procedures	14
13.1. Automatic MQ-9 Lost Link Responses	14
13.2. 2008 WSFM Specific Lost Link Procedures	15
14. Typical Flight Profile.....	16
15. Glossary	17

1. NASA 2008 Western States Fire Mission (WSFM) Overview –

The National Interagency Fire Center (NIFC) in Boise, Idaho is responsible for tracking and deciding appropriate responses to wildfires in the United States. To perform this function NIFC requires information about where wildfires are, how big they are, and what the fires are doing. NIFC uses several sources to gather this information, including a small fleet of manned aircraft with infra-red (IR) imagers. The 2008 WSFM is designed to provide a demonstration to NIFC of a more capable IR imager on an unmanned aircraft. This demonstration will help NIFC determine whether upgraded imagers and unmanned aircraft will be useful tools in the future. Typically NIFC is tracking 300 – 500 active fires during any time during the western United States fire season.

The fire season for the western United States spans several months and a very large geographic region consisting of all or parts of 11 western states. Within this geographic region, wildfires of interest can be located anywhere from the geographic border of Canada to the geographic border of Mexico, and even cross over the borders. To demonstrate the capability of the aircraft platform, the aircraft has to be able to fly to

almost any location within this large geographic region. The unique endurance capabilities of unmanned aerial systems (UAS) may allow a single aircraft to gather imagery for NIFC on many different fires during a single mission.

Firefighter interest in wildfires revolves around “what will happen next”. Imagery information can help answer this question best in two timeframes. The first timeframe is when the wildfire is newly discovered (will the wildfire grow?, will the wildfire threaten human population?). The second timeframe is for established fires that are near populations, when the imagery can help to answer the same questions.

Specific 2008 WSFM Objectives – The NIFC customer for the WSFM has the following objectives:

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

1.2. Image fires within the COA boundary to the international borders of Canada and Mexico (requires flying 2 nm from the international borders in specified areas). Imaging targets over the western United States. The fires can be anywhere and their precise location can not be predicted well.

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

- 1.4. Image 10 to 15 wildfire incidents of the up to 500 that are burning at a time.
- 1.5. Image a few (1-2) fires for several hours at a time. Does not have to occur on every mission.
- 1.6. Identify or image emerging wildfires.
- 1.7. Provide “high resolution data” from below RVSM airspace. Identify small wildfire hotspots that are outside the primary burn area. These hotspots can flare-up unexpectedly and be very dangerous to firefighters and the general population.

2. WSFM 2008 COA Application Mission and Lost Link Procedure Attachments -
The following attachments are necessary to describe the NASA 2008 WSFM and are associated with this Nominal Mission and Lost Link Procedures description document:

- 2.1. NASA 2008 Fire Mission - Classes of Airspace
- 2.2. NASA 2008 Fire Mission – Regulations Requesting Waiver or Authorization
- 2.3. NASA 2008 Fire Mission - Outer Boundary for [ABC_08-13-08.pdf \(graphic\)](#)
- 2.4. NASA 2008 Fire Mission - Outer Boundary for ABC Coordinates [08-13-08](#) (lat/lon points)
- 2.5. NASA 2008 Fire Mission - Zone ABC Keep Out 2007 08-28-07.pdf (graphic)
- 2.6. NASA 2006 Fire Mission - Coordinates and Dimensions of 2006 Keepouts 02-09-07.doc

Comment [D1]: Boundary change due to the addition of area near Yellow Stone in the NE

Deleted: 02-08-07

Deleted: 03-13-08

- 2.7. NASA 2008 Fire Mission - Zone A 02-07-07 Coordinates.doc (lat/lon points)
- 2.8. NASA 2008 Fire Mission - Zone B 08-13-08 Coordinates.doc (lat/lon points)
- 2.9. NASA 2008 Fire Mission - Zone C 02-08-07 Coordinates.doc (lat/lon points)
- 2.10. NASA 2008 Fire Mission - Zone A - Route A 08-06-08.pdf (route/zone graphic)
- 2.11. NASA 2008 Fire Mission - Route A 08-06-08 Lat-Lon.doc (lat/lon points)
- 2.12. NASA 2008 Fire Mission - Zone B - Route B 08-06-08.pdf (route/zone graphic)
- 2.13. NASA 2008 Fire Mission - Route B 08-06-08 Lat-Lon.doc (lat/lon points)
- 2.14. NASA 2008 Fire Mission - Zone C - Route C 08-07-08.pdf (route/zone graphic)
- 2.15. NASA 2008 Fire Mission - Route C 08-07-08 Lat-Lon.doc (lat/lon points)
- 2.16. NASA 2008 Fire Mission - Aircraft Equipment Suffix Description.doc
- 2.17. NASA 2008 Fire Mission - Lost Link Datalink Recovery
- 2.18. NASA 2008 Fire Mission - Lost Link Aircraft Maneuvers

3. **Number, Duration, and Timing of Flights -**

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

- 3.2. Flights are planned to take-off on Thursday or Friday mornings or anytime on Saturday or Sunday because of the long duration, and the need to submit flight plans to FAA HQ UAS office before each flight. Thus, approximately 5 weeks will be required to fly all the missions.
- 3.3. Because of wildfire emergencies (like the 2006 Esperanza fire and 2007 Southern California fires), it is possible that NASA DFRC will be requested to fly more often than once per week, and possibly for more than 5 flights - these requests will be passed on to the FAA HQ UAS office as quickly as possible for consideration.

- 4. **Airspace** - For a description of the required Classes of Airspace, reference attachment: NASA 2008 Fire Mission - Classes of Airspace
- 5. **Regulations Requesting Waiver or Authorization** - For a listing of requested waivers to specific Part 91 sections, reference attachment: NASA 2008 Fire Mission - Regulations Requesting Waiver or Authorization.

6. **Flight Altitude** -

- 6.1. All flight in the NAS shall be above FL180.

Comment [D2]: Boundary change due to the addition of area near Yellow Stone in the NE

Deleted: 02-08-07

Comment [D3]: Routes changed to leverage restricted airspace and MOAs

Deleted: 05-21-07

Deleted: 05-21-07

Comment [D4]: Products of EFB no longer in use have been deleted

Deleted: <#>NASA 2008 Fire Mission - Route A 05-21-07 Trip Kit, Sectionals pdf (Sectional chart)¶
 <#>NASA 2008 Fire Mission - Route A 05-21-07 Trip Kit, Hi IFR pdf (IFR chart)¶
 <#>NASA 2008 Fire Mission - Route A 05-21-07 Trip Kit, Low IFR pdf (IFR chart)¶
 <#>NASA 2008 Fire Mission - Route A 05-21-07 Trip Kit, WAC pdf (WAC chart)¶
 <#>¶

Deleted: 08-21-07

Formatted: Bullets and Numbering

Deleted: 08-21-07

Deleted: NASA 2008 Fire Mission - Route B 08-21-07 Trip Kit, Sectionals pdf (Sectional chart)¶
 NASA 2008 Fire Mission - Route B 08-21-07 Trip Kit, Hi IFR pdf (IFR chart)¶
 NASA 2008 Fire Mission - Route B 08-21-07 Trip Kit, Low IFR pdf (IFR chart)¶
 NASA 2008 Fire Mission - Route B 08-21-07 Trip Kit, WAC pdf (WAC chart)¶
 ¶

Deleted: 05-21-07

Deleted: 05-21-07

Deleted: NASA 2008 Fire Mission - Route C 05-21-07 Trip Kit, Sectionals pdf (Sectional chart)¶
 NASA 2008 Fire Mission - Route C 05-21-07 Trip Kit, Hi IFR pdf (IFR chart)¶
 NASA 2008 Fire Mission - Route C 05-21-07 Trip Kit, Low IFR pdf (IFR chart)¶
 NASA 2008 Fire Mission - Route C 05-21-07 Trip Kit, WAC pdf (WAC chart)¶
 ¶

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



7. **COA Region** (Overall COA boundary) – The overall COA boundary encompasses all of the forested parts of the western United States that the NIFC is interested in. This includes parts of 11 western states and 6 FAA ARTCC’s. A graphical depiction of the overall COA boundary can be seen in [Figure 1 – Overall COA boundary](#), and in the NASA 2008 Fire Mission - Outer Boundary for ABC [08-13-08.pdf](#) attachment file. This includes flying to within 2 nm of the geographic international borders of Canada and Mexico (with a 6 nm swath width, this gives data coverage to the geographic international border).

Deleted: Figure 1 – Overall COA boundary

Deleted: 02-08-07

The COA boundary has been split into 3 zones along Air Route Traffic Control Center (ARTCC) boundaries. Each zone contains airspace controlled by no more than 3 ARTCC’s. The Los Angeles Center ARTCC airspace is common to all 3 zones.

- 7.1. A text version of the lat/lon coordinates (DD MM.MM and DD MM SS) for the overall COA boundary can be found in the attachment file NASA 2008 Fire Mission - Outer Boundary for ABC Coordinates [08-13-08.doc](#).

Deleted: 03-13-08

- 7.2. The portion of the COA boundary along the Canadian border being requested to fly within 2 nm of is partially in Zone A and partially in Zone B and runs from N 49° 0’ 0” W 121° 45’ 0” to N 49° 0’ 0” W 113° 30’ 0” (i.e. along the border from about 30 nm east of Bellingham International Airport, Washington to about 30 nm east of Glacier Park International Airport, Montana).
 - 7.2.1. The Zone A portion is from N 49° 0’ 0” W 121° 45’ 0” to N 49° 0’ 0” W 114° 40’ 0” (i.e. along the border from about 30 nm east of Bellingham International Airport, Washington to about 20 nm west of Glacier Park International Airport, Montana).
 - 7.2.2. The Zone B portion is from N 49° 0’ 0” W 114° 40’ 0” to N 49° 0’ 0” W 113° 30’ 0” (i.e. along the border from about 20 nm west of Glacier Park International Airport, Montana to about 30 nm east of Glacier Park International Airport, Montana).

- 7.3. The portion of the COA boundary along the Mexican border being requested to fly within 2 nm of is shared by Zone A, Zone B, and Zone C (because it is within the ZLA ARTCC area, which is also common to all three Zones) and runs from approximately N 32° 32' 05" W 117° 07' 40" to N 32° 43' 07" W 114° 43' 07" (i.e. along the border from the Pacific Ocean to Yuma, Arizona).

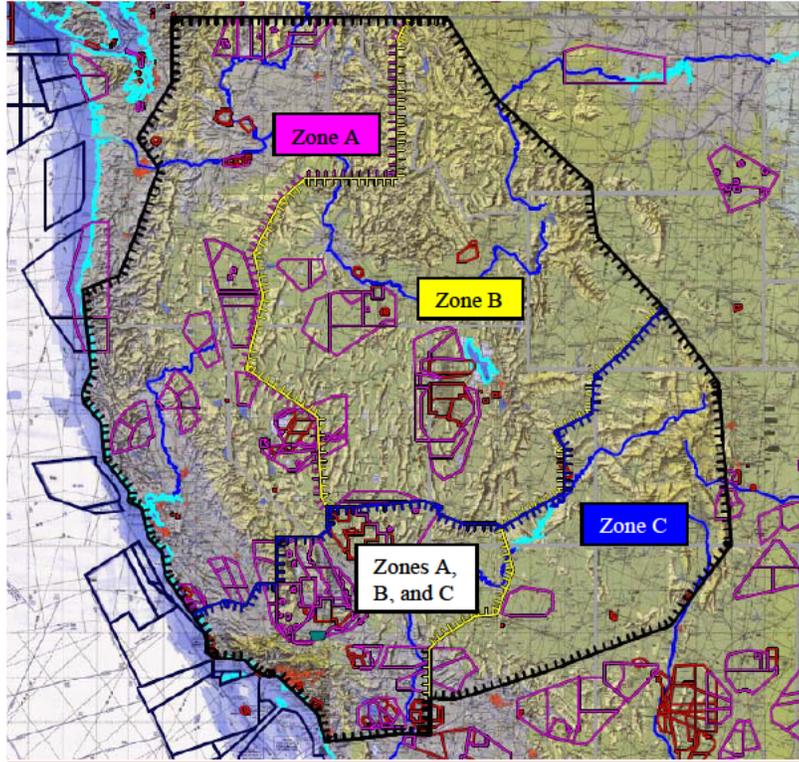


Figure 1 – Overall COA boundary

8. **Flight Zones** – The overall COA area was divided up into 3 zones for several reasons. First, the overall COA area is so big that the Ikhana aircraft does not have the endurance to fly a single flight over the entire COA region. Second, NASA DFRC recognizes that it will be a significant coordination effort on the part of the FAA HQ UAS office with the appropriate FAA centers to communicate our flight plan request.

The area was divided into 3 zones based on the existing limits of FAA ARTCC's. Although the overall COA area includes parts of 6 ARTCC's, each single zone only includes a maximum of 3 ARTCC's. The resulting zones correspond reasonably well with the endurance capabilities of the aircraft, and provide some reduction of FAA HQ coordination for a flight plan submitted into a selected zone. Because flights will

originate and terminate at Edwards AFB (EDW runway 22/04), California, the FAA Los Angeles ARTCC area is included in each of the 3 zones.

A wildfire event that the NIFC wants imaged can be anywhere within the boundaries of a zone. It is recognized that within each zone, the FAA desires the aircraft to keep a 5 nm buffer zone to the edge of the zone/ARTCC boundary. The scan width of the imaging hardware (~3 nm on each side of the aircraft at ~FL200) requires the aircraft be allowed to fly within 2 nm of an ARTCC boundary to image a wildfire that is on the zone/ARTCC boundary.

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



Deleted: Figure 1 – Overall COA boundary
Figure 1 – Overall COA boundary

Deleted: Figure 3 – Zone A - Route A Graphic Description
Figure 3 – Zone A - Route A Graphic Description

Deleted: 05-21-07



Deleted: Figure 1 – Overall COA boundary

Deleted: Figure 4 – Zone B - Route B Graphic Description

Deleted: 08-21-07

Deleted: 02-08-07

8.2.2. The portion of the COA boundary along the Mexican border being requested to fly within 2 nm of is shared by Zone A, Zone B, and Zone C (because it is within the ZLA area) and runs from approximately N 32° 32' 05" W 117° 07' 40" to N 32° 43' 07" W 114° 43' 07" (i.e. along the border from the Pacific Ocean to Yuma, Arizona).

8.3. **Zone C** – Zone C contains Los Angeles Center, part of Albuquerque Center and part of Denver Center airspace. Zone C can be seen in [Figure 1 – Overall COA boundary](#), (above), or in [Figure 5 – Zone C - Route C Graphic Description](#), (also in attachment NASA 2008 Fire Mission - Zone C - Route C [08-06-08.pdf](#)). Reference the NASA 2008 Fire Mission - Zone C 02-08-07 Coordinates.doc file for the specific lat/lon points that describe Zone C.

Deleted: Figure 1 – Overall COA boundary

Deleted: Figure 5 – Zone C - Route C Graphic Description

Deleted: 05-21-07

8.3.1. The portion of the COA boundary along the Mexican border being requested to fly within 2 nm of is shared by Zone A, Zone B, and Zone C (because it is within the ZLA area) and runs from approximately N 32° 32' 05" W 117° 07' 40" to N 32° 43' 07" W 114° 43' 07" (i.e. along the border from the Pacific Ocean to Yuma, Arizona).

9. **Range Safety Keep-out Zones and Population Centers** – The NASA DFRC Range Safety Office (DFRC-RSO) has defined a set of keep-out zones within the overall COA boundary area. These keep-out zones may or may not be divided up by Zone A, Zone B, or Zone C designations. The DFRC-RSO has determined that particular population densities must be protected to different degrees from the hazards of the aircraft flying over it.

9.1. Route A, Route B, and Route C have been defined in cooperation with the DFRC-RSO and do not overfly any keep-out zones.

9.2. The aircraft will not fly into any area that the DFRC-RSO has defined as a “Red” keep-out zone.

9.3. The aircraft may fly into an area that the DFRC-RSO has defined as a “Yellow” keep-out zone, as long as the pilot has direct, real-time control of the aircraft. These keep-out zones may be displayed to the pilot in “white”.

9.4. The DFRC-RSO has generated several hundred keep-out zones for the WFSM, and these are graphically displayed in [Figure 2 – 2007 WFSM Keep-out Zones \(Red and Yellow\)](#), (graphic attachment file NASA 2008 Fire Mission - Zone ABC Keep Out 2007 08-28-07.pdf). The lat/lon. coordinates and attributes for each of these keep-out zones is maintained by the DFRC RSO. This graphical representation is provided with this COA Application to demonstrate to the FAA that NASA-DFRC is following DFRC Range Safety procedures on this subject. Because of the changing nature of the general population (increasing, decreasing, and moving), and the large size of the overall COA boundary, the DFRC-RSO will continue to analyze, modify, and refine the keep-out zones prior to each flight, and if necessary, during the flight to ensure proper protection for the general population. It is noted that the NIFC will probably have a high priority/interest to image wildfires that

Deleted: Figure 2 – 2007 WFSM Keep-out Zones (Red and Yellow)

threaten population in areas that may be within previously defined keep-out zones. The DFRC-RSO will analyze these situations and modify keep-out zones and flight paths as necessary with the intent to protect the population, and at a lower priority, to obtain the desired imagery. This is the same process that was used during the 2006 Esperanza Fire mission and the 2007 Western States Fire Missions, including those over southern California.

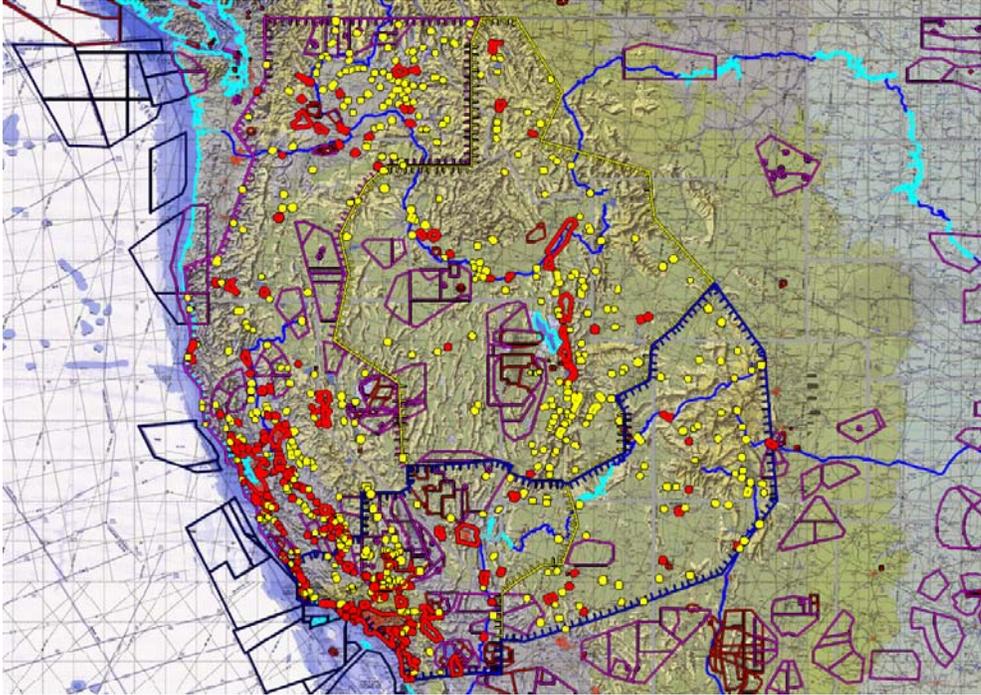


Figure 2 – 2007 WFSM Keep-out Zones (Red and Yellow)

- 9.5. The lost link mission may not be programmed to fly over a “Yellow” keep-out zone since the pilot does not have direct, real-time control of the aircraft.
- 9.6. During real-time maintenance of the lost link mission, the pilot will avoid putting the aircraft into a situation where it would overfly keep-out zones. The pilot will use the appropriate capabilities of the MQ-9 system to implement this, such as additional lost link waypoints and Initial Lost Link Heading (ILLH).
- 9.7. During flights, all keep-out zones will be displayed with current aircraft position to the pilot with the appropriate “Red” and “Yellow” designations, either by color or name.
- 9.8. A NASA DFRC Range Safety Officer will be available during all missions for any Range Safety consultations that may be required.

10. **Flight Routes** – A “route” has been chosen for each flight zone to provide the FAA with an “example” of what a mission in a particular Zone might look like. These routes are not anticipated to be used on any mission because it is highly unlikely they will overfly areas of interest to the NIFC. They are provided to demonstrate the process that DFRC will perform to define an actual flight path to overfly a particular set of fires that NIFC is interested in.

All routes and flights will take-off from Edwards AFB, follow routes out to the fires, then turn around and follow those routes back to Edwards AFB for landing.

Each of the defined routes have been analyzed and designed by the DFRC Range Safety Office to not overfly population centers they have identified (see the section on Keep-out Zones) and to avoid flying along mountain ridge weather conditions. Routes for specific flights will also follow this same process.

These basic flight routes are named “Route A”, “Route B”, and “Route C” to correspond to Zone A, Zone B, and Zone C.

10.1. **Route A** – Route A is designed to fly over generally unpopulated mountainous terrain of the Sierra Nevada mountain range. See [Figure 3 – Zone A - Route A Graphic Description](#), (also in attachment NASA 2008 Fire Mission - Zone A - Route A [08-06-08.pdf](#)).

10.1.1. Reference the NASA 2008 Fire Mission - Route A [08-06-08 Lat-Lon.doc](#) file for the specific lat/lon points that describe Route A.

Deleted: Figure 3 – Zone A - Route A Graphic Description

Deleted: 05-21-07

Deleted: 05-21-07

Deleted: Reference the NASA 2008 Fire Mission - Route A 05-21-07 Trip Kit, Sectionals pdf (Sectional charts), Route A 05-21-07 Trip Kit, Hi (and Low) IFR pdf (IFR charts), and Route A 05-21-07 Trip Kit, WAC pdf (WAC chart) for graphic representations of Route A

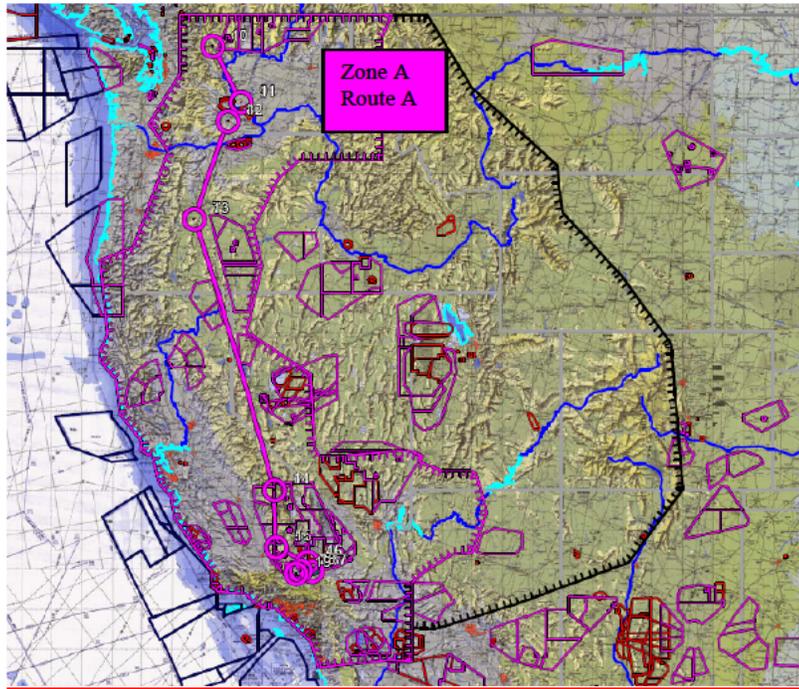


Figure 3 – Zone A - Route A Graphic Description



10.2. **Route B** – Route B differs from the other 2 routes since it is essentially a “loop”. See [Figure 4 – Zone B - Route B Graphic Description](#), (also in attachment NASA 2008 Fire Mission - Zone B - Route B [08-06-08.pdf](#)).

10.2.1. Depending on the wildfire imaging requirements and priorities from NIFC, the filed flight plan may request to fly this loop forward or backward, or to only fly one side of the loop (there and back) because the aircraft may not have the endurance to traverse the entire loop. The pilots will adjust the lost link profile accordingly, and will include the logic for the aircraft to fly “forward around the loop” in case of a lost link event after the halfway point.

10.2.2. Reference the NASA 2008 Fire Mission - Route B [08-06-08](#) Lat-Lon.doc file for the specific lat/lon points that describe Route B.

Deleted: Figure 4 – Zone B - Route B Graphic Description

Deleted: 08-21-07

Deleted: 08-21-07

Deleted: Reference the NASA 2008 Fire Mission - Route B 08-21-07 Trip Kit, Sectionals pdf (Sectional charts), Route B 08-21-07 Trip Kit, Hi (and Low) IFR pdf (IFR charts), and Route B 08-21-07 Trip Kit, WAC pdf (WAC chart) for graphic representations of Route B

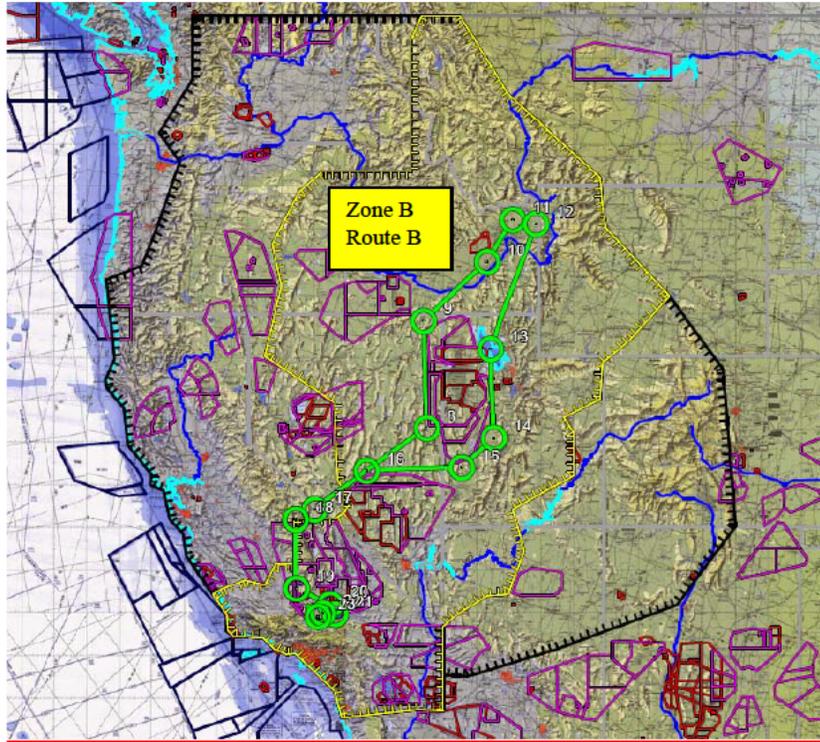


Figure 4 – Zone B - Route B Graphic Description



10.3. **Route C** – See [Figure 5 – Zone C - Route C Graphic Description](#) (also in attachment NASA 2008 Fire Mission - Zone C - Route C [08-06-08.pdf](#)).

10.3.1. Reference the NASA 2008 Fire Mission - Route C [08-06-08 Lat-Lon.doc](#) file for the specific lat/lon points that describe Route C.

Deleted: Figure 5 – Zone C - Route C Graphic Description

Deleted: 05-21-07

Deleted: 05-21-07

Deleted: Reference the NASA 2008 Fire Mission - Route C 05-21-07 Trip Kit, Sectionals pdf (Sectional charts), Route C 05-21-07 Trip Kit, Hi (and Low) IFR pdf (IFR charts), and Route C 05-21-07 Trip Kit, WAC pdf (WAC chart) for graphic representations of Route C

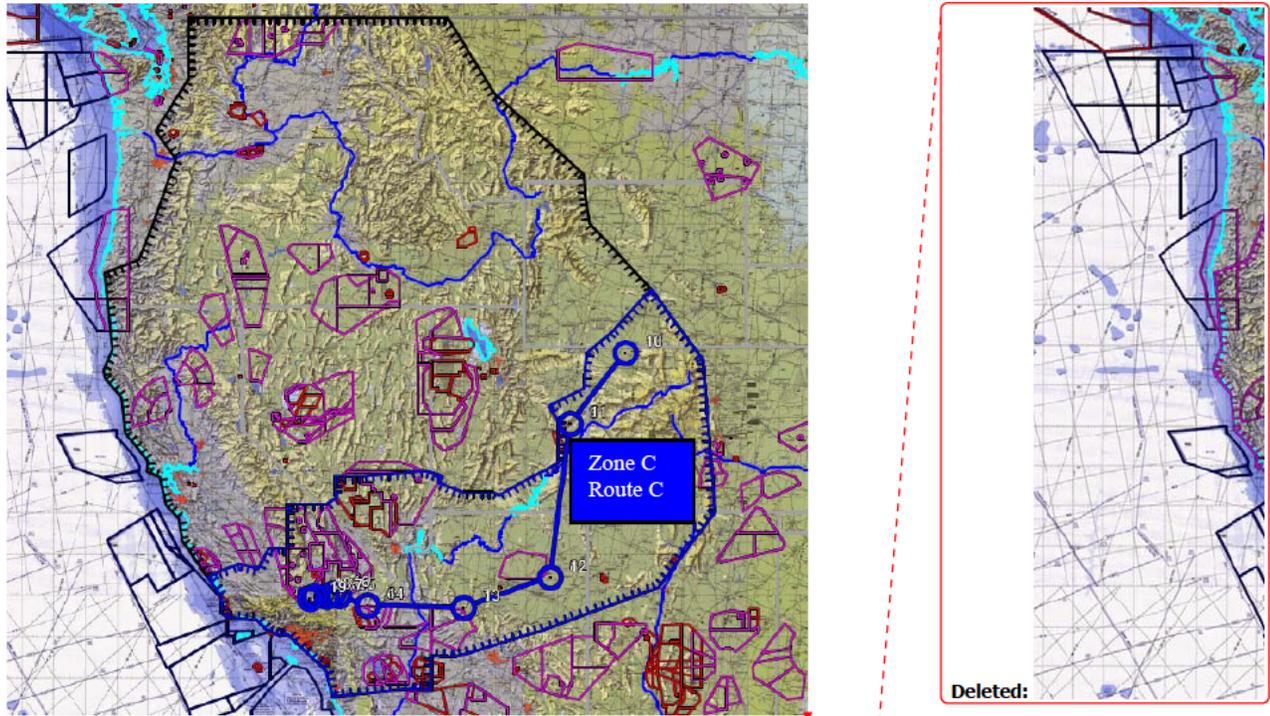


Figure 5 – Zone C - Route C Graphic Description

11. **Incident Areas** – Incident areas will be defined by NASA DFRC that encompass a large enough airspace so that the aircraft can maneuver within the area, and the IR imager on the aircraft can obtain appropriate data on the wildfire that NIFC has identified. In most cases, the IR imager will be able to obtain the data in 1 or 2 passes (swaths). A typical size will be a circle with 15 nm radius.
 - 11.1. The shape of each incident area will be determined by the particular wildfire event it is meant to image. Simple circles and possibly rectangles are expected in most cases.
 - 11.2. The size of each incident area will be large enough so that the aircraft can perform the required turns to exit the area, perform any additional passes required to fully image the wildfire, and have a sufficient buffer for a lost link event to provide a predictable path to ATC and ensure the aircraft will not “spillover” from the incident area.
 - 11.3. For large wildfires that require multiple passes, the incident areas will be defined large enough for the aircraft to complete an entire set of imaging swaths.
 - 11.4. The preferred method of defining incident areas to the FAA is via a fix radial/DME point and a specified radius from that point. A secondary means is via lat/lon points that describe the shape.
 - 11.5. 10 to 15 incident areas are expected for each mission.

(b)
(3)
(B)

12. **Flight Plan Submission** –

- 12.1. The flight plan will be submitted with a “/I” Aircraft equipment suffix per the rationale contained in the attachment: NASA 2008 Fire Mission – Aircraft Equipment Suffix Description.
- 12.2. NASA DFRC will provide the FAA HQ UAS office with flight plan proposals by the prescribed times and will take into account the time zone difference between Washington, DC and Edwards, Ca.
- 12.3. The FAA HQ UAS office has the authority to accept or reject all, or any portion of the NASA DFRC flight plan proposals.
- 12.4. In the event that all or parts of a proposal are to be rejected, both organizations will attempt to find a workable solution.

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

Comment [D5]: Reduced notification to align with verbally agreed upon 2 working days notification
Deleted: 3

- 12.6. NLT L – 1 work day: NASA DFRC will notify the FAA HQ UAS office and affected ARTCC’s of there are any proposed changes to the Zone/Route combination, and describe those proposed changes. Included with the proposed changes will be all proposed changes to the route, incident areas, and lost link mission routing (see description under “Route” section).
- 12.7. NLT L – 2 hours: NASA DFRC will file the flight plan per normal procedures with the Edwards, AFB, Ca Operations office.

12.8. Definitions for flight plan Submission.

- 12.8.1. NLT: No later Than
- 12.8.2. L – 2 work days: 48 hours prior to take-off time, not including Saturday, nor Sunday.
- 12.8.3. L – 1 work day: 24 hours prior to take-off time, not including Saturday, nor Sunday.

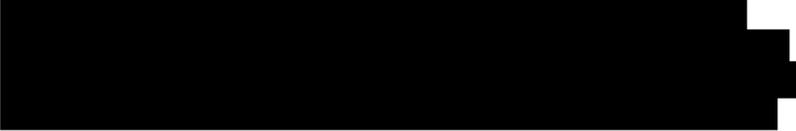
Deleted: 3
Deleted: 72

13. **Lost Link Procedures** – The overriding concern in any lost link situation is to maintain the safety of the NAS for other aircraft and for people on the ground. The aircraft is designed by General Atomics to perform several operations automatically.

- 13.1. **Automatic MQ-9 Lost Link Responses** – The aircraft is designed to perform two tasks automatically when the aircraft detects a lost command link situation.

- 13.1.1. **Regain the Command Link** – The aircraft will automatically perform actions with the onboard communications system to maximize the probability that the command/Datalink will be recovered. Reference attachment NASA 2008 Fire Mission - Lost Link Datalink Recovery
- 13.1.2. **Aircraft Maneuvers** – The aircraft will automatically perform specified actions with respect to aircraft maneuvers in the event of a loss of command link. Reference attachment NASA 2008 Fire Mission - Lost Link Aircraft Maneuvers. The pilot also maintains a “lost link” mission in real-time to direct the aircraft as a part of this process.
- 13.2. **2008 WSFM Specific Lost Link Procedures** – The aircraft needs to have a lost link mission defined for the aircraft to perform as expected during a lost link situation. The overriding concern in any lost link situation is to maintain the safety of the NAS for other aircraft. Normally this is done by programming the aircraft to proceed on an existing course, or route, for several minutes until ATC can be informed by phone, and then ATC can take appropriate actions with other aircraft to ensure aircraft separation.
 - 13.2.1. The pilot will define and maintain a lost link mission throughout the flight that returns the aircraft to R-2508 and Edwards, AFB and follows the rules in this section and applicable Special Provisions.
 - 13.2.2. The lost link mission will be defined to return to R-2508 along the filed flight plan the aircraft is currently on.
 - 13.2.3. The lost link mission will be programmed to squawk 7600 (per FAA HQ UAS office request) whenever the aircraft enters the lost link mission.
 - 13.2.4. In the event of a lost link situation, the pilot or other personnel in the GCS will contact the appropriate FAA ATC facility supervisor by telephone to notify them of the situation. The pilot/GCS and appropriate FAA ATC facility supervisor(s) shall remain in phone contact throughout the lost link situation (this may involve several FAA ARTCC’s, depending on the location of the aircraft when it enters the lost link mission.)
 - 13.2.5. If the aircraft recovers a command link from the GCS, and the cause of the lost link event is well understood and can be prevented during the remainder of the mission, the mission is not required to return to R-2508 and Edwards, AFB, but may proceed as planned.

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


 - 13.2.7. The aircraft will maintain the filed flight plan for ~15 min after a lost link event before proceeding back to R-2508 and Edwards AFB, Ca. on the filed flight plan route.

- 13.2.8. During the ~15 minute timeframe at the beginning of the lost link event, the aircraft will make turns to stay on the filed flight plan.
- 13.2.9. While in lost link, the aircraft may or may not have to make a 180° on the filed flight plan to proceed to R-2508 and Edwards AFB, Ca. (i.e. it may be headed away from, or towards R-2508 when the lost link event occurs). A 180° turn of this type will be delayed per stated time limits after the start of the lost link event.
- 13.2.10. Any 180° turn to reverse the aircraft direction will be made/initiated “to the right”.
- 13.2.11. Altitude changes specified premission by ATC will be programmed into the lost link mission by the pilot for the aircraft to automatically execute during a lost link event.
- 13.2.12. Any real-time specified altitude changes specified by ATC prior to the lost link event will not be programmed into the lost link mission by the pilot.
- 13.2.13. In the event of a lost link within an incident/loiter area, the aircraft will stay within the incident/loiter area boundaries for at least ~15 min.
- 13.2.14. Route, Lost Link and Incident Area Proposed Changes at L-1 days – Changes to a route and associated lost link mission will follow the same rules as specified in this section.

14. Typical Flight Profile - The typical flight profile will consist of the following:

- 14.1. Within R-2508 airspace (Edwards, AFB, Ca.)
 - 14.1.1. Take-off from EDW 22/04
 - 14.1.2. Climb to mission altitude (FL200 or FL430)
 - 14.1.3. Transit to R-2508 boundary (Route A, B, or C)
- 14.2. Enter NAS at R-2508 boundary (Route A, B, or C)
 - 14.2.1. Follow filed IFR flight plan to Incident/loiter Area
 - 14.2.2. Image wildfire in Incident Area
 - Typically will image 10-15 Incident Areas each mission. Usually 1-3 passes imaging passes totaling <30 minutes in each area. Downlink imagery data to NIFC in near real-time. Some wildfires may be imaged in the outbound and return directions.
 - 14.2.3. Exit the Incident/loiter area
 - 14.2.4. Proceed to next point on the filed IFR flight plan
 - 14.2.5. Repeat above steps until last Incident/loiter Area is imaged
 - 14.2.6. Return to R-2508/R-2515 per filed flight plan
- 14.3. Enter R-2508/R-2515 at NAS boundary (Route A, B, or C)
 - 14.3.1. Descend from mission altitude
 - 14.3.2. Land at EDW 22/04

15. Glossary -

Incident Areas – Area that contains a NIFC defined wildfire event underneath.

NIFC - National Interagency Fire Center. Located in Boise, Idaho. Members include: Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Fish and Wildlife Service (FWS), National Park Service (NPS), United States Forest Service (USFS), National Oceanic and Atmospheric Administration (NOAA), Department of the Interior – Aviation Management Directorate (AMD), National Association of State Foresters (NASF), and the United States Fire Administration (USFA).

Overall COA Boundary – Boundary authorized by the COA that includes Zones A, B, and C.

Pilot – Pilot-in-Command (PIC)

Route - Defined flight paths within each Zone

Zone - Subset of the overall boundary authorized by the COA.