

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

Unmanned Aircraft System (UAS) Aerial Imagery Factual Report

May 28, 2020

A. ACCIDENT WPR19FA230

Location: Oroville, California
Date: August 21, 2019

B. PERSONNEL

UAS RPIC:¹ Michael Bauer
National Transportation Safety Board
Washington, D.C.

C. ACCIDENT SUMMARY

On August 21, 2019, about 1132 Pacific daylight time, a Cessna 560XL airplane, N91GY, overran the departure end of runway 2 following a rejected takeoff from Oroville Municipal Airport (OVE), Oroville, California. The two airline-transport pilots and 8 passengers were not injured. The airplane was destroyed by a post-crash fire that consumed a majority of the airplane. The airplane was registered to Jotts LLC, and was operated by Delta Private Jets, as a Title 14 Code of Federal Regulations Part 135 on-demand charter flight. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight was originating at the time of the accident and was destined for Portland International Airport (PDX), Portland, Oregon.

D. DETAILS OF IMAGERY

1.0 Equipment and Procedures

Equipment

Mapping and viewpoint flights of and around the accident site were conducted on August 22nd and 24th, 2019, using the DJI Phantom 4 Professional V2 (P4PV2) small UAS (sUAS, commonly known as a drone). The drone was equipped with a dual GPS/GLONASS receiver which provides georeferenced information on all still photos. The drone was also equipped with an FC6310 camera using the Sony Exmor 1-inch CMOS sensor with a focal length of 8.8 mm. Still photo resolution was 20 megapixels in JPG or RAW format. Videos were taken in MP4 format with 4K resolution.

¹ RPIC – Remote pilot-in-command

Multiple ground control points (GCP), check points and paths (or trails) were taken with a Trimble GEO7X differential GPS receiver in the mapped area.

Procedures

The accident site was located on the property of Oroville Municipal Airport (KOVE) in Oroville, California. The accident site was in class G airspace on the KOVE property. A visual observer and a two-way handheld radio were used to monitor and communicate with traffic. The RPIC used standard radio communications to announce flight intentions during all operations. Flights were conducted under the provisions of 14 CFR Part 107.

The sUAS was flown in a series of grids, orbits and free flight at various altitudes around the aircraft and along runway 02-20 to obtain imagery.

The grid flown over the aircraft was a double grid using Pix4D Capture software at a target altitude of 75ft AGL. After completion of the grid, an orbit around the aircraft wreckage was flown around the aircraft wreckage at 50ft AGL.

Multiple single grids were flown over the runway, starting at the departure end of runway 02 along the full length of the runway, from the approximate point where the accident aircraft initiated the takeoff roll to the accident site. The flights were flown at an altitude of 200ft AGL.

Additional sets of still images were taken for additional viewpoints and videos around the runway environment. A total of 7 flights, approximately 1,680 photos and 4 videos were accomplished over the two days on site. Total flight time was approximately 1 hour and 30 minutes.

Accident Site Processing

Geo-referenced still imagery was processed using Pix4D photogrammetry software to produce two three-dimensional (3D) point clouds and orthomosaic maps of the accident site and the runway areas. Relative accuracy (within the map) for the accident site map was calculated at 0.51 inches, twice the average ground sample distance. Relative accuracy (within the map) for the accident site map and runway 02-20 was calculated at 1.48 inches, twice the average ground sample distance.

DGPS data was used to correct for any UAS elevation data errors and provide positional data for ground control points and checkpoints. DGPS data was corrected using the continuously operating reference station (CORS) at Oroville, California (ORVB). Horizontal and vertical positional accuracy (when compared to features outside the 3D point cloud) was calculated at 4.1 inches horizontally and vertically for the accident site only map. Horizontal and vertical positional accuracy (when compared to features outside the 3D point cloud) was calculated at 31.9 inches horizontally and 52.2 inches vertically for the accident site map and runway 02-20 map.

3.0 Accident Site Imagery products

About 1,680 high resolution photos and four videos were gathered. Select photos (compressed to a lower resolution) and excerpts from the 3D modelling products are included in this report and detailed in the following paragraphs. Selected output products for the figures included this report are contained in the docket for this accident and listed in section 4.0.

Figure 1 contains a still image of the aircraft wreckage taken from looking towards the aircraft with the departure runway 02/20 in the background.



Figure 1 - View of aircraft wreckage

Section 6.0 contains an overhead image (Figure 12), of the accident site and main wreckage area. The images have been annotated with key components as found in the wreckage path.

Figure 2 contains a screen capture from the three-dimensional point cloud generated of the main wreckage site.

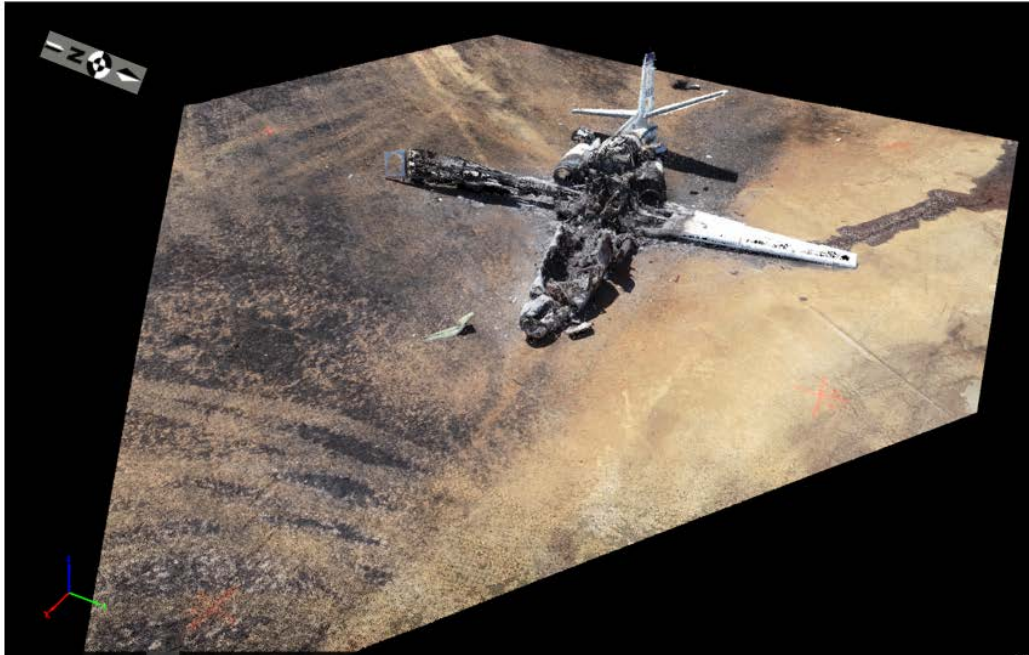
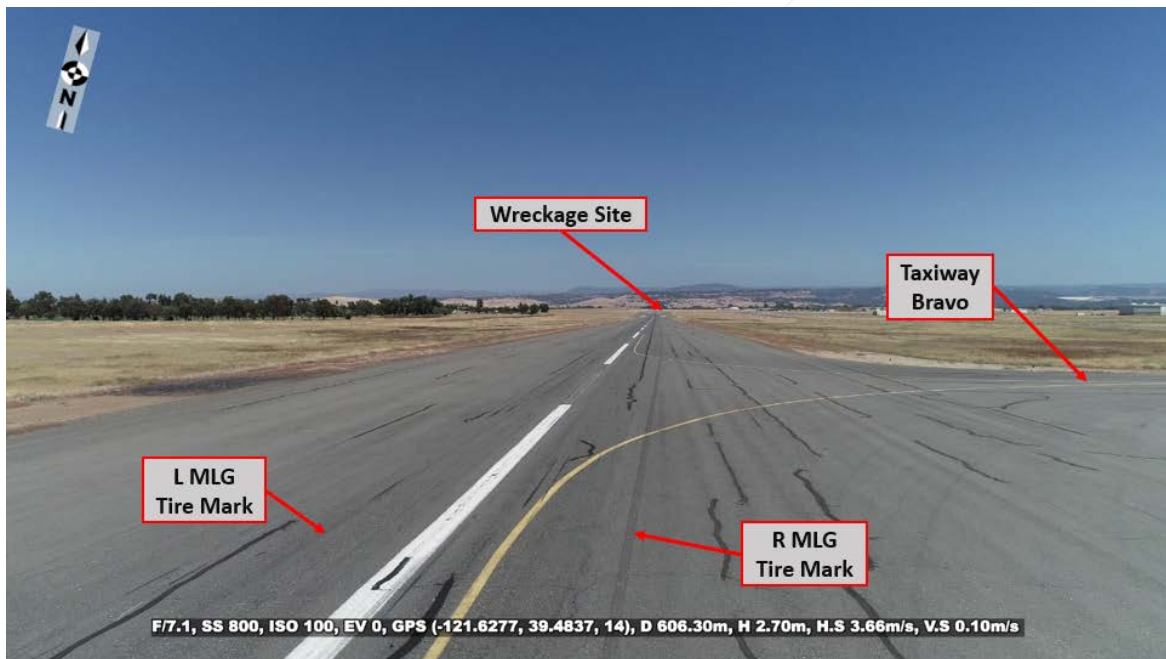
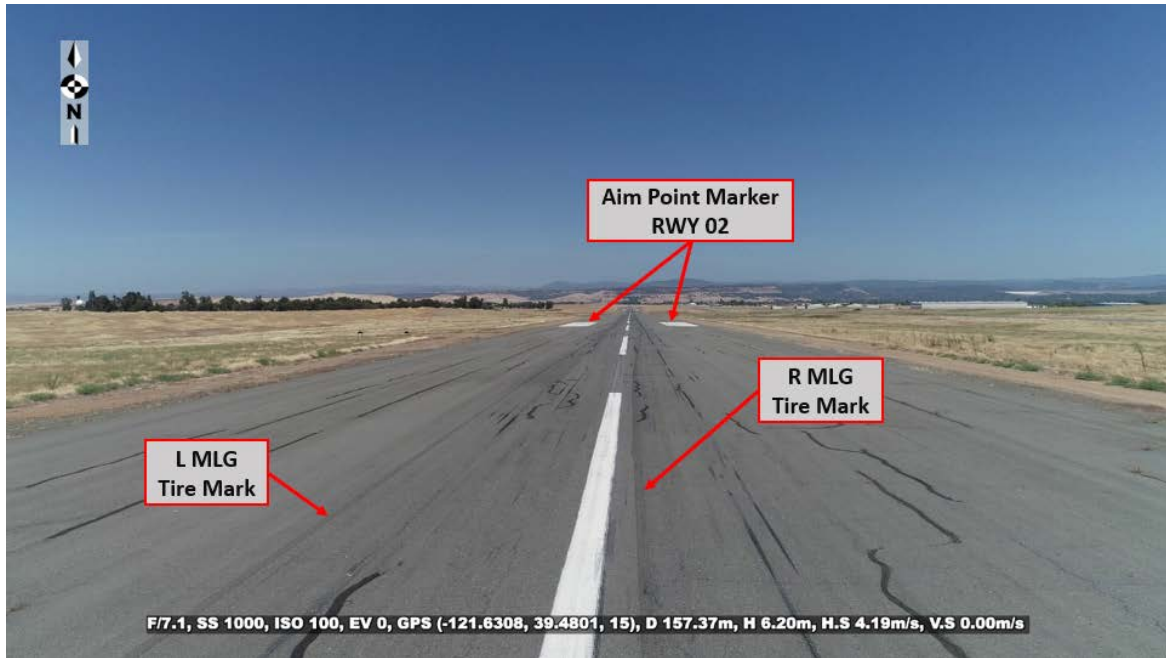


Figure 2 – Screenshot of point cloud of accident site.

Figure 3 through Figure 8 contain screen captures from video was taken using the drone as it was flown down runway 02-20.



Figure 3 – Runway 02 at start of take-off point with R MLG tire mark



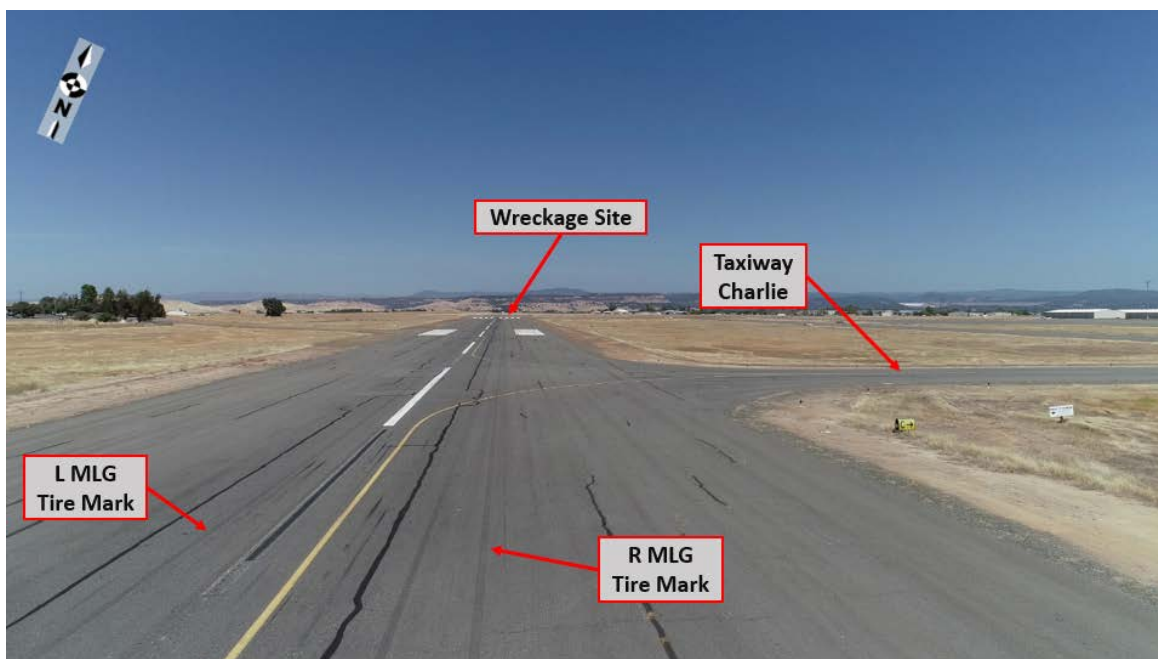


Figure 6 - Runway 02-20 tire marks approaching taxiway Charlie

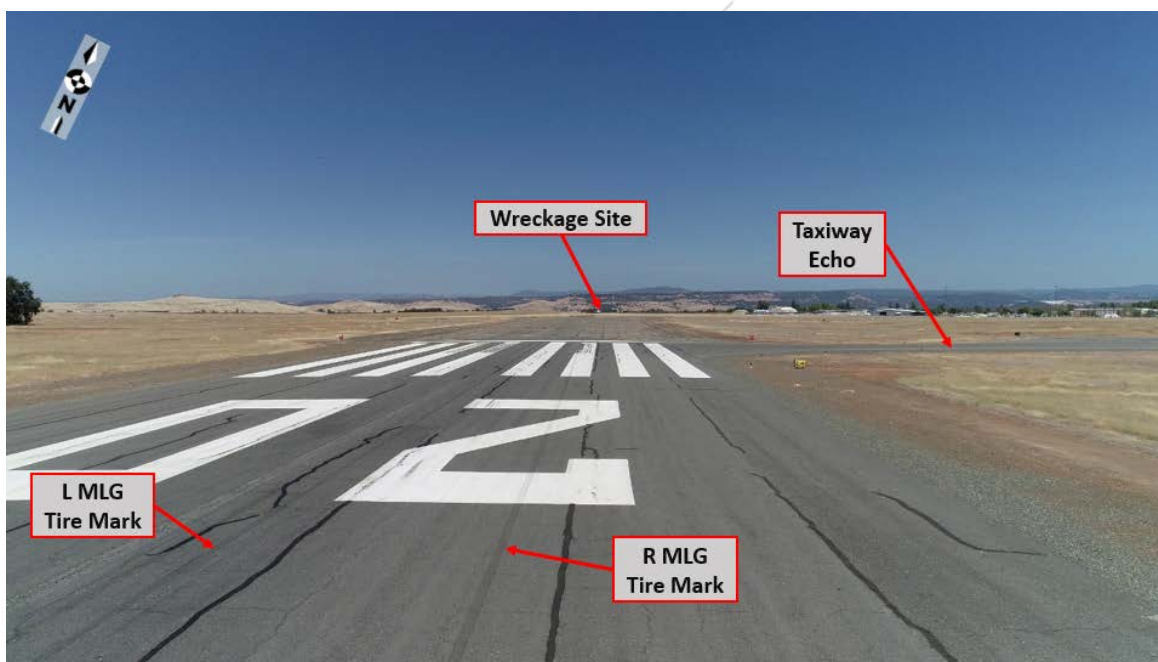


Figure 7 - Runway 02-20 tire marks approaching taxiway Echo



Figure 8 - Runway 02-20 tire marks nearest runway 13-31

4.0 Additional GPS Trail and Point Information

Additional GPS data was gathered from the tire marks from the nose and main landing gear (MLG). The trail for each respective gear was started at the first discernable tire mark and would end when the tire marks were no longer visible to the unaided eye on the paved runway areas.

The right MLG tire mark was faintly noticeable on taxiway Alpha (A) around the hold short line. The tire mark became more noticeable on the runway 02-20 threshold markings and continued along runway 02-20. The tire mark was continuous the length of the runway and along the displaced threshold and across runway 13-31. A groove consistent with the right MLG tire continued across the terrain between runway 13-31 and taxiway Romeo (R). A second right MLG tire mark was identified on the paved portion of taxiway R and continued to where the aircraft departed the paved surface. The marks were 6,944 ft and 149 ft, respectively.

The left MLG tire mark was faintly noticeable on taxiway Alpha (A) but was not measurable. The tire mark was more noticeable on runway 02-20 where the measurement was started. The tire mark was continuous the length of the runway and along the displaced threshold and across runway 13-31. A groove consistent with the left MLG tire continued across the terrain between runway 13-31 and taxiway Romeo (R). A second left MLG tire mark was identified on the paved portion of taxiway R and continued to where the aircraft departed the paved surface. The marks were 6,881 ft and 151 ft, respectively.

The nose tire mark was first identified on the paved portion of taxiway R and continued to where the aircraft departed the paved surface. The mark was 78.2 ft.

Figure 9, Figure 10 and Figure 11 shows the tire marks overlaid on a Google Earth image of the accident site.



Figure 9 - Tire mark trails from accident site GPS trail.



Figure 10 - Tire mark trails from accident site GPS trail at beginning of runway.

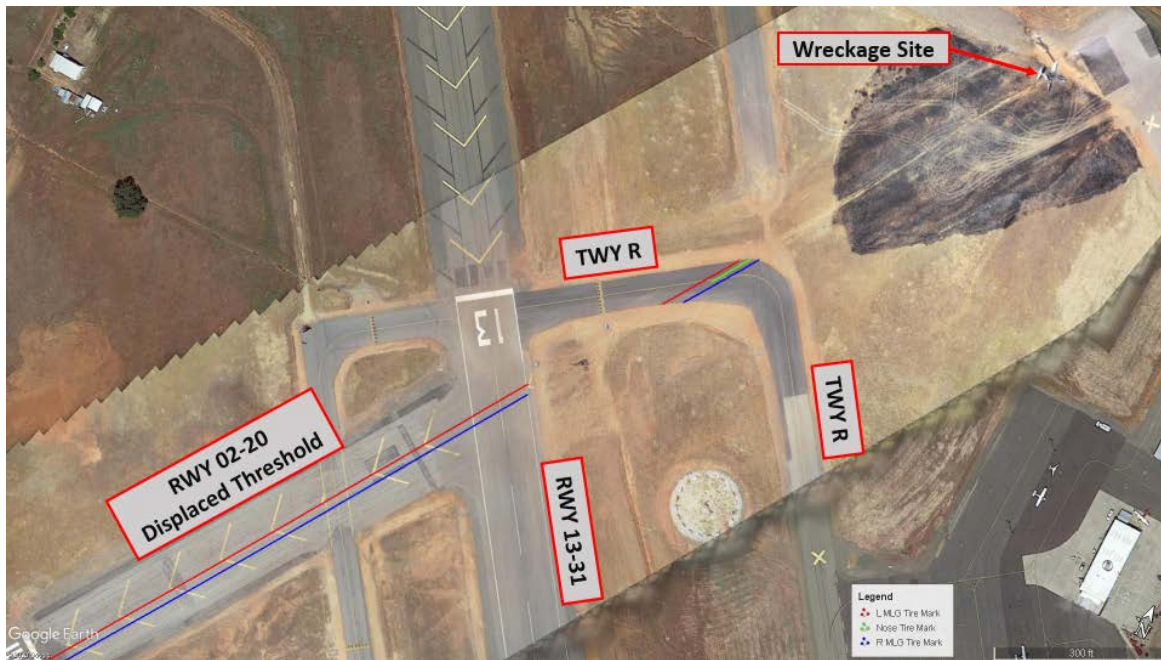


Figure 11 - Tire mark trails from accident site GPS trail at end of runway.

During the on-scene phase of the investigation and review of the airport surveillance video, a point was marked on the displaced threshold of runway 20. The point corresponded to the approximate location in the fixed view containing runway 02-20 and when the aircraft departed the video frame. The point identified was 241.6 ft (as measured using 3D point cloud) from the end of the paved surface between runway 13-31 and taxiway Romeo. Refer to the image in Section 6.0 that contains an oversized image of the mark looking towards the security camera location.

5.0 Attachments

Attachment 1 – Orthomosaic map in Google Earth .zip format (ref. Figure 9 through Figure 12)

Attachment 2 – Google Earth file in .kmz format containing tire trails and marked items (ref. Figure 9 through Figure 12)

Attachment 3 – Video from runway overflight (ref. Figure 3 through Figure 8)

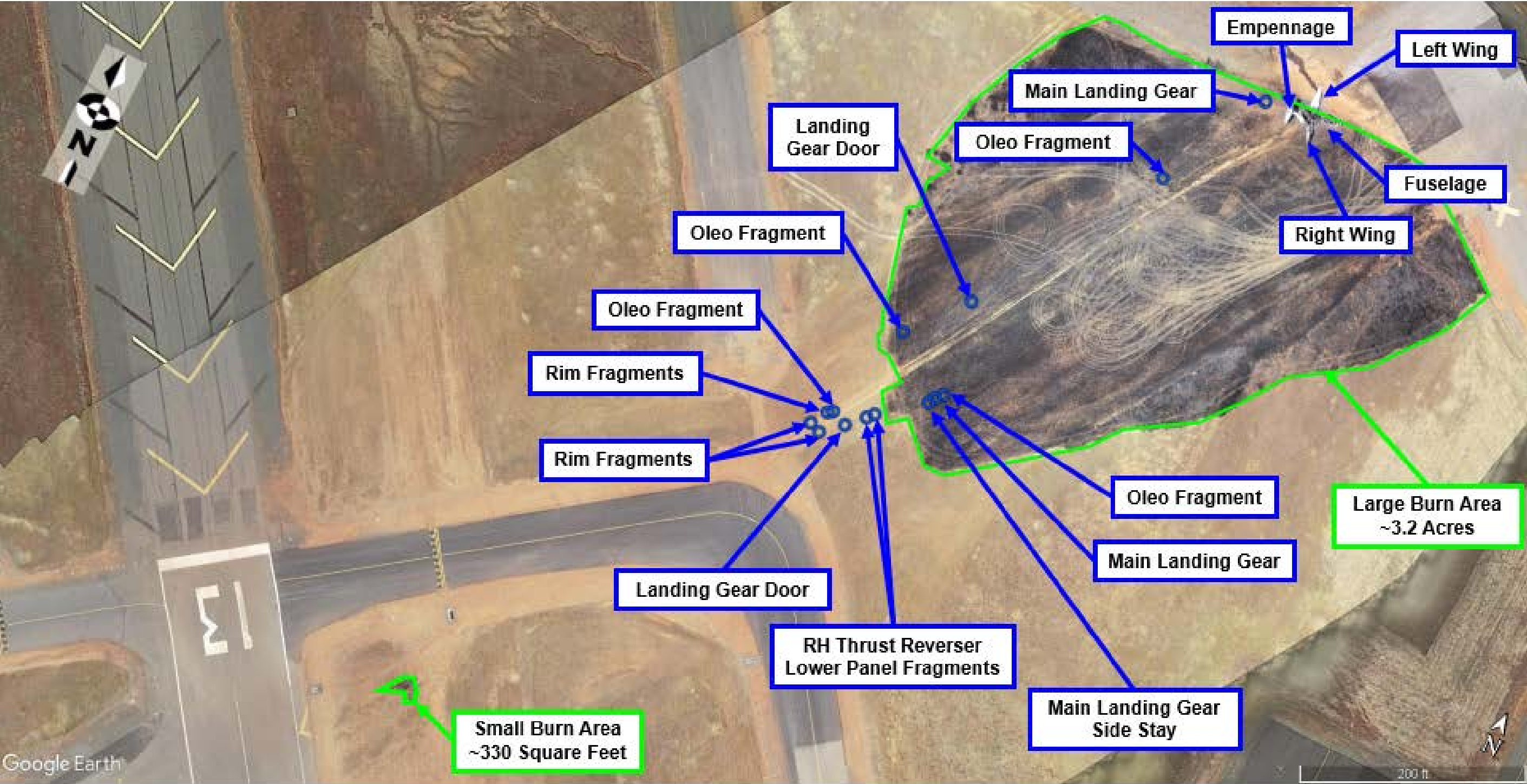


Figure 12 - Overhead view of orthomosaic of aircraft wreckage site

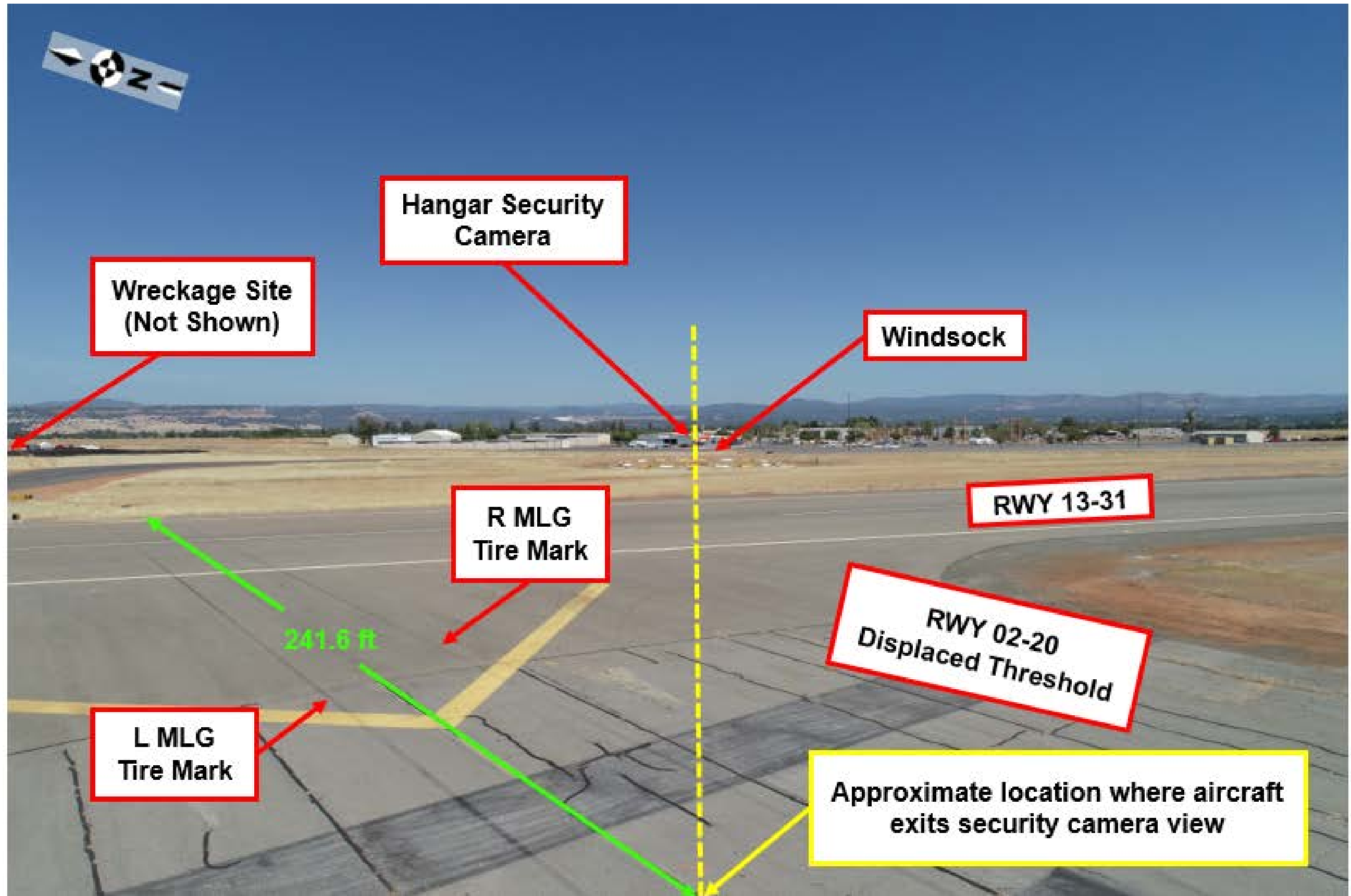


Figure 13 – Image looking back from approximate location where aircraft left security camera view towards the security camera