

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR23FA153

INVESTIGATIVE SUPPLEMENTAL MATERIAL

ACCIDENT

Location: Cal-Nev-Ari, Nevada
Date: 04.11.2023
Time: 0419 Pacific standard time
Airplane: Glastar GS-1

INVESTIGATIVE SUPPLEMENTAL MATERIAL

IIC Zoë Keliher
National Transportation Safety Board
Portland, Oregon

HISTORY OF FLIGHT

On April 11, 2023, about 0419 Pacific daylight time, a Glastar homebuilt airplane, N8488, was substantially damaged when it was involved in an accident near Cal-Nev-Ari, Nevada. The pilot and passenger were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The purpose of the flight was for the pilot and his spouse to depart from their winter residence in Nevada and fly to their primary residence in Iowa. The presumed plan was for the first leg of the flight to terminate in Dalhart, Texas, where they would overnight and refuel. The pilot's friend filmed the departure on his cellular phone and was in radio contact over the common traffic advisory frequency (CTAF). A review of the video revealed that the airplane departed runway 33 at 0406 and made a left turn followed by a right turn where the airplane's light indicated that the attitude was level and the airplane continued east until disappearing from the frame.

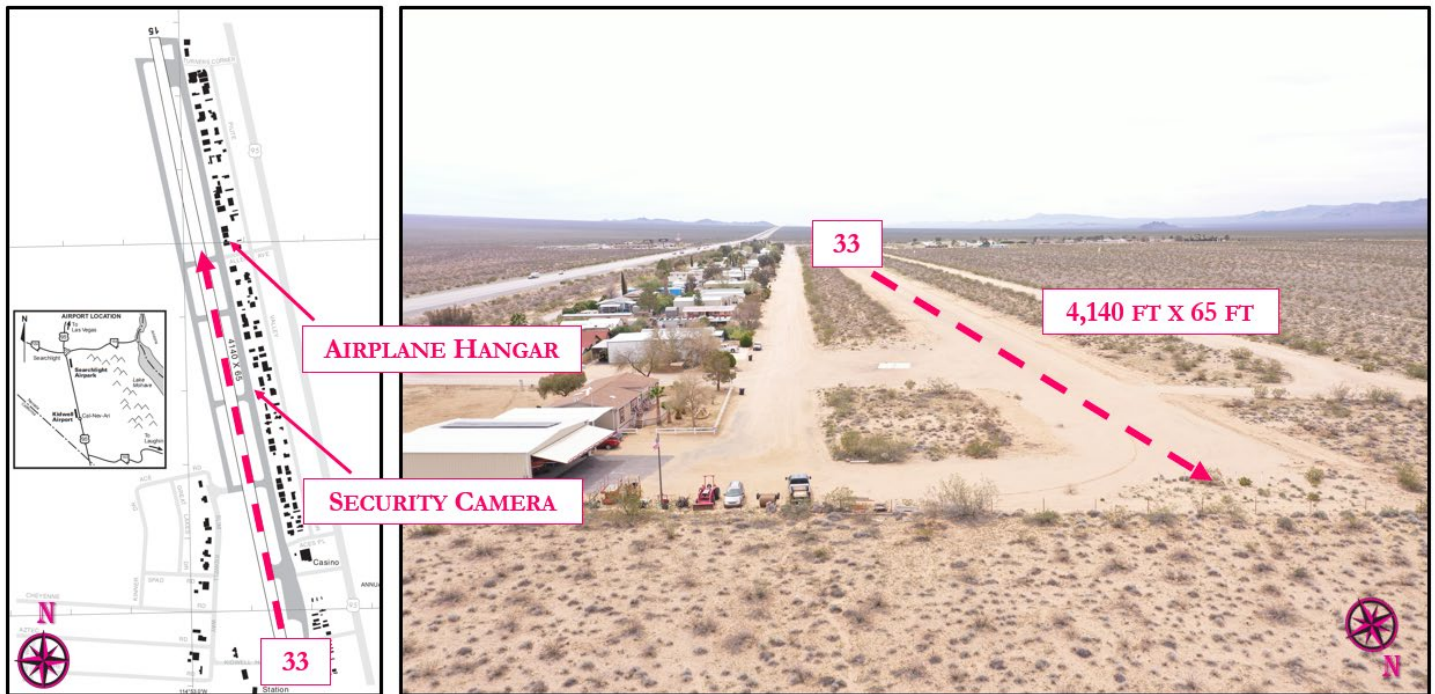


Figure 1: Departure airport

A good friend of the pilot, who was also the mechanic that signed off on recent work performed on the airplane, stated that the pilot originally intended to depart the day after the accident. He then changed the plan the day prior and stated that he would leave early in the morning to accommodate more favorable headwinds. He recorded a video of the airplane departing and communicated on the radio with the pilot during the departure. The pilot said bye and he went inside his house adjacent to the runway.

A security camera, located at a private residence at the south side of the airport, recorded grainy footage of the airplane departing and then leaving the frame to the east about one minute later. The airplane then came back into the frame from the east at 0419, equating to about 11 minutes after leaving. The lights appeared higher than when the airplane originally left the frame. The airplane then turned at 0419:17 and rapid descended to the ground presumably crashing at 0419:28.



Figure 2: Security camera composite photo showing runway lights and location.



Figure 3: Video images (combined) showing flight path.

DESTINATION

It is unknown what the planned next destination was from departure, but it was presumed by friends and family that they planned to stay the night in Dalhart, Texas the night of the accident prior to continuing on to Iowa, where the main residence is located. A review of the pilot's paperwork in the airplane revealed that in prior flights, the pilot followed the flight path where he would fly via Kingman, Arizona and Gallup, New Mexico.

Texas			
DHT	Dalhart	122.95	17/35 3/21
TCC		122.95	4065 (6:40)
SXU	Santa Rosa	122.8	4791 (7:33)
OFO	Moriarty	122.9	6204
E98	Mid Valley	122.9	4836
GNT	Grants	122.8	6537 (9:30)
GUP	Gallup	122.95	6472 10:05
PI4	Holbrook	122.8	5262
INW	Winslow	122.8	4941 11:20 11:55
SEZ	Sedona	123.0	4830
IGM	Kingman	122.8	3449
IL4	Ridwell	122.9	2605 1:22

Figure 4: Past flight path paperwork

①	Dalhart Tx.	HYS 122.95	DHT	17/35	
	Tucumcari NM.	122.95	TCC	8/26	1/19
	Santa Rosa	122.8	SXU		
	Moriarty	122.9	OEO	6204 8/26	CC
	Grants - Milan	122.8	KG.N.T.	7172 13/31	CC
②	Gallup N.M.	122.95	KGup	6472 6/24	C.C.
	Winslow	122.8	KINW	7100 11/29	
	Kingman Az.	122.8	KIGM	7499 4/22	
	Sun Valley	122.975	AZO	6725 17/38	
	Cal New Ar.	122.9	IL4	6827 3/21	
				3700 18/36	CC
				15/33	N/A

Figure 5: Past flight paperwork showing flight path.

A Garmin GPSMAP 296, portable GPS receiver was located in the wreckage. The unit included a built-in Jeppesen database and was capable of receiving XM satellite radio for flight information. The unit stored date, route-of-flight, and flight-time information; all recorded data were stored in nonvolatile memory. Recorded data plots were recovered for the timeframe that matched the airplane's anticipated flight track after departing from Cal-Nev-Ari. The track indicated that after becoming airborne, the airplane continued on a north-easterly path while making a gradual climb. After about 7 minutes in-flight (about 8 nautical miles) the airplane reached a peak altitude of about 4,240 ft mean sea level (msl), equating to 2,380 ft above ground level (agl) and made a left 180° turn. The airplane then backtracked to the airport on a south-westerly course.

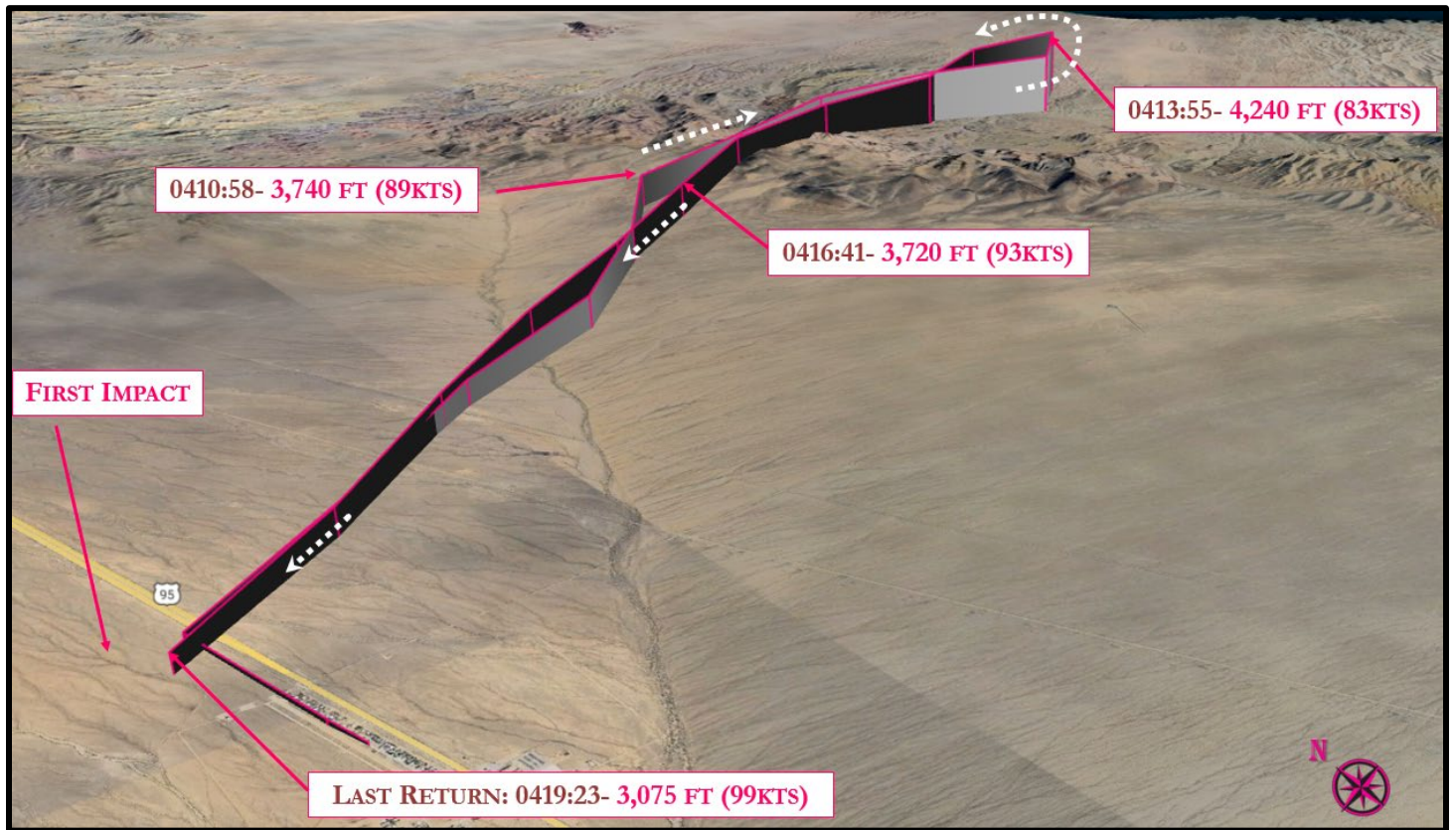


Figure 6: GPS flight path track.

The last recorded position was at 0419:23 and located just west of the runway centerline. The initial impact was 1,560 ft north of the last return.

AIRPLANE INFORMATION

The airplane was a Glastar GS-1, serial number 5434, which was built in January 2006. The airplane was equipped with a Eggenfellner Subaru EL25-160 engine and a Warp Drive 3-bladed C10670 propeller (15° blade angle confirmed 2011).



Figure 7: Airplane prior to the accident.

Manufacturer	EGGENFELLNER SUBARU		Model	EL 25 160	
Serial			Type Certificate	NONE	
This engine is currently installed in aircraft:			GLASTAR GS-1 SERIAL 5434		
N8488					
Minimum Octane Fuel	87 100LL OK	Oil Grade	Summer	5W-30	Winter
Magneto Time	ELECTRONIC	Point Setting	NA		
Spark Plug Gap	.039-.043	CHAMPION	RC10YC4	NGK	BKR5E-11
Manufacturer's Recommended Overhaul at			hours		
			TORQUE 15 FT/LBS (NO LUBE)		
			BKR6E-11		
			Firing Order 1-3-2-4		

Figure 8: Engine information

The experimental Eggenfellner Subaru H4 engine installation was designed and sold by Eggenfellner Aircraft. The design is based on an EL-25, 2.5L Subaru water cooled 4-cylinder engine and is rated at 160 HP and 5400 rpm. The electronic ignition system was adapted by Eggenfellner Aircraft, Inc. Power is transferred from the engine to the propeller speed reduction unit (PSRU) through a spline shaft. One end of the spline shaft is inserted into a drive disk adapter at the engine. The other end is inserted into the PSRU input spline. The spline shaft and related components had not been inspected since installation. The spline shaft and PSRU input spline were hardened. The drive disk adapter that mates to the solid flywheel is not hardened while the drive disk adapter that mates to the dual mass flywheel is hardened.

PSRU – Propeller Speed Reduction Unit – The unit was manufactured by Eggenfellner Aircraft, LLC. The unit was a GEN 3, Ver 4 model. The PSRU is a geared reduction drive that provides for a propeller RPM that is about ½ that of the engine RPM. The PSRU was installed on the engine before the first flight.

The airplane's empty weight was as recorded in 2020 as 1,354 lbs.

WRECKAGE AND IMPACT

The main wreckage was located in the desert terrain about 3,940 ft north-northwest from the end of runway 33 at the coordinates 35°19'23" N 114°53'12" W and an elevation of 2,660 ft. In character, the terrain was composed of dry, soft dirt and dense brush. The wreckage was found distributed over a 920 ft distance on a median magnetic bearing of about 050°.

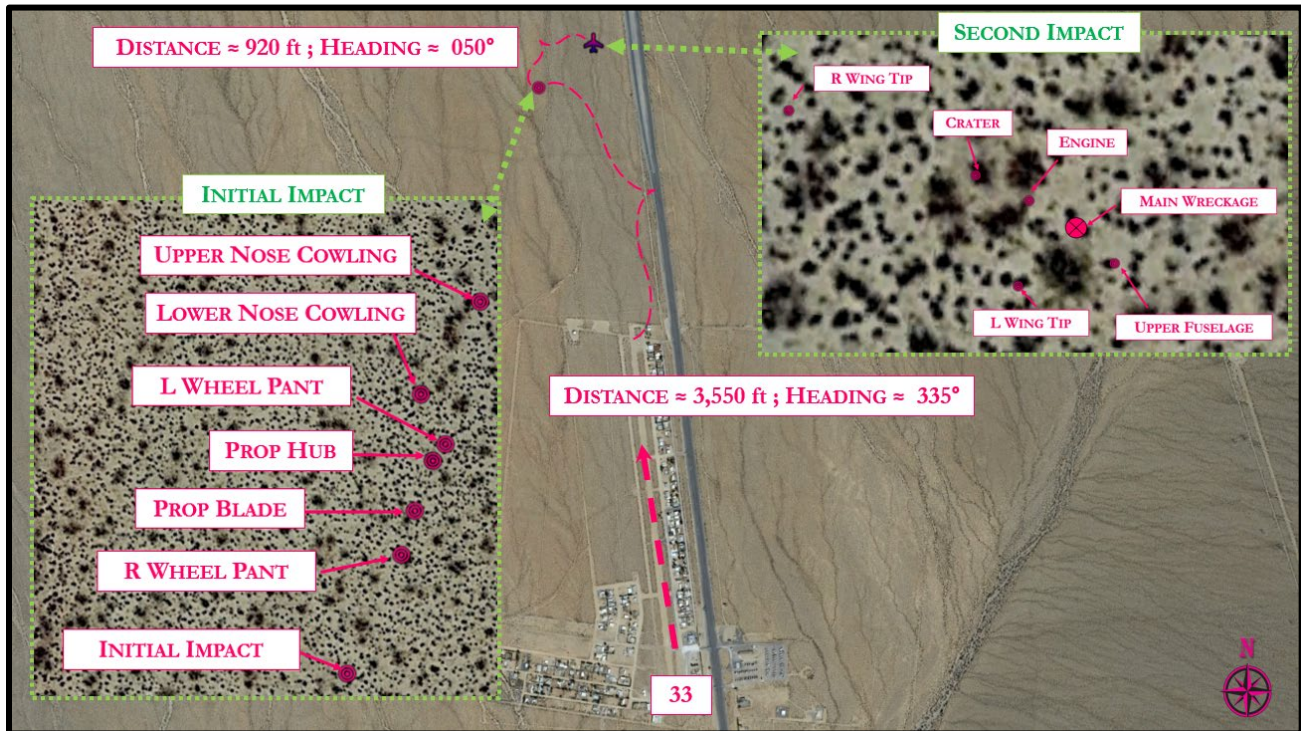


Figure 9: Area of impact in reference to the runway.

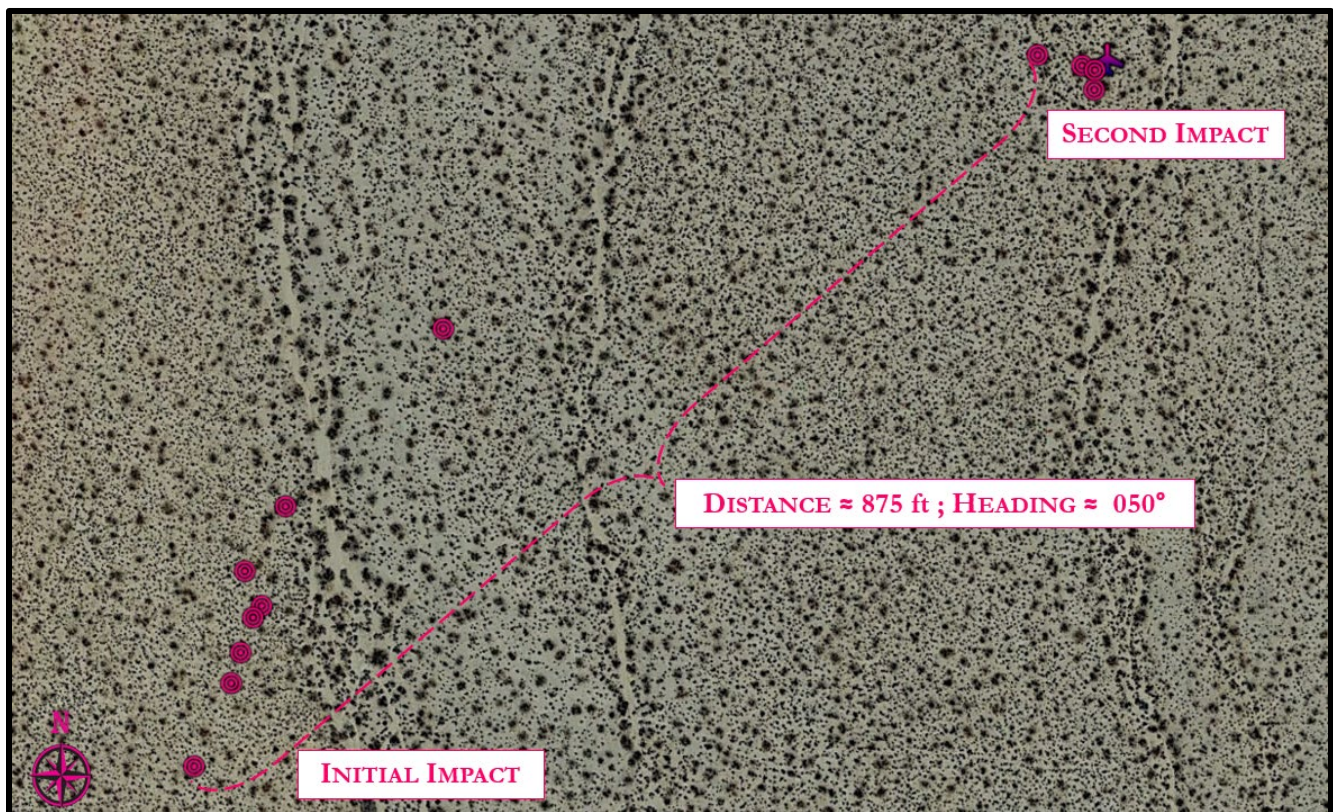


Figure 10: Two impact sites.

The first identified points of contact consisted of disrupted cacti and dirt on the flat desert terrain making up the far southwestern end of the debris field. The markings started as two nearly parallel indentations in the vegetation and dirt spaced about 98 inches apart. The right crater started about 9 ft prior to the left crater and they both continued on a heading of 025°. The indentations were continuous and then merged for 121 ft and at the beginning there were several parallel ground scars located perpendicular to the direction of the center indentation and immediately over it. The size and location was consistent with propeller slashes and fragments of propeller material were found imbedded in the soft dirt.

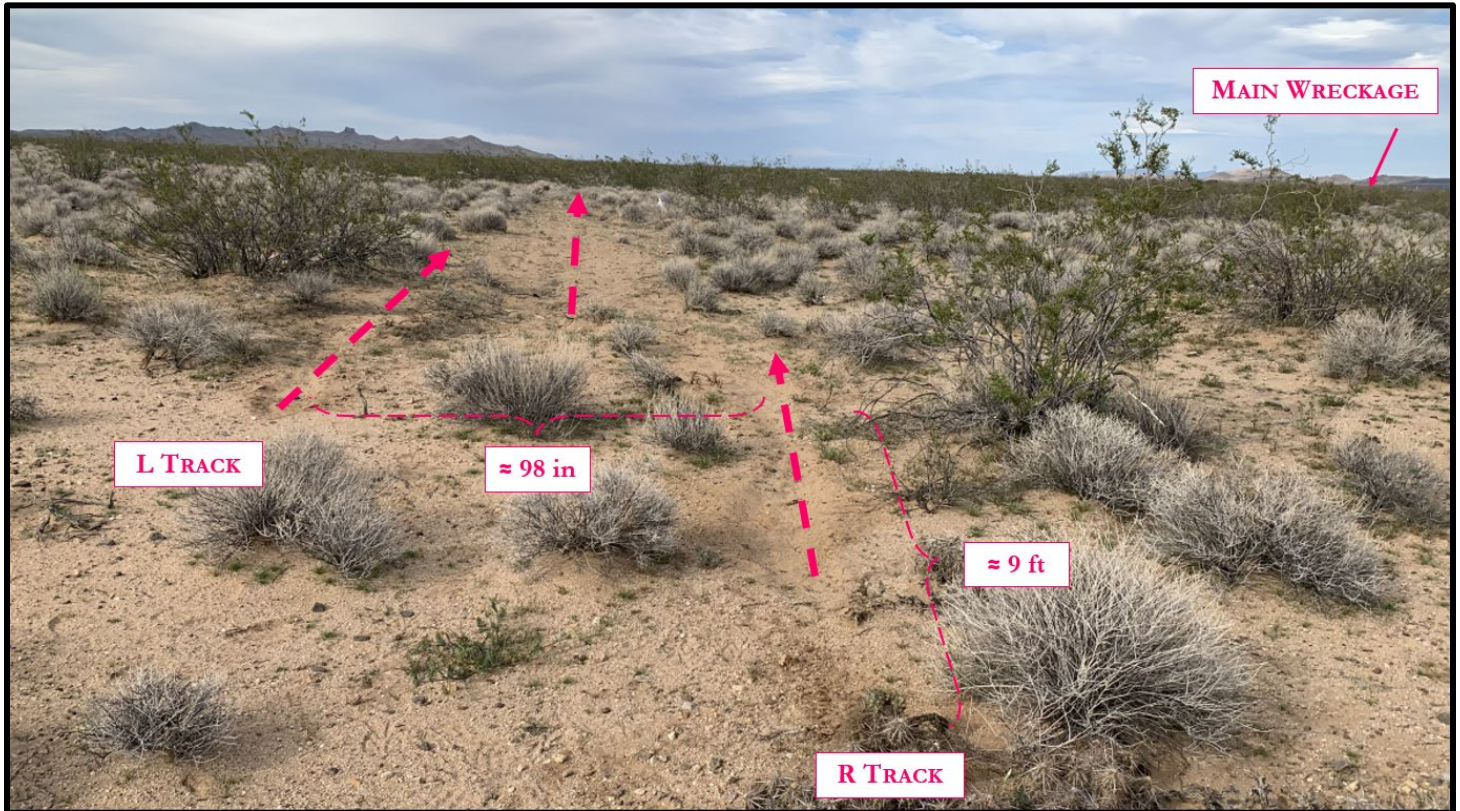


Figure 11: First impact site.

Along the first debris field investigators found the fragmented right wheel pant about 70 ft from the initial wreckage; propeller hub about 125 ft from the initial impact; the left wheel pant about 130 ft from the initial impact; the lower nose cowl was fragmented and found throughout the debris field. The upper nose cowling was at the end of the first debris field and contained two blue paint transfers on the top of the cowling with parallel lines. The bottom of the cowling contained a series of parallel black lines in the aft, left area, consistent with a belt rubbing.

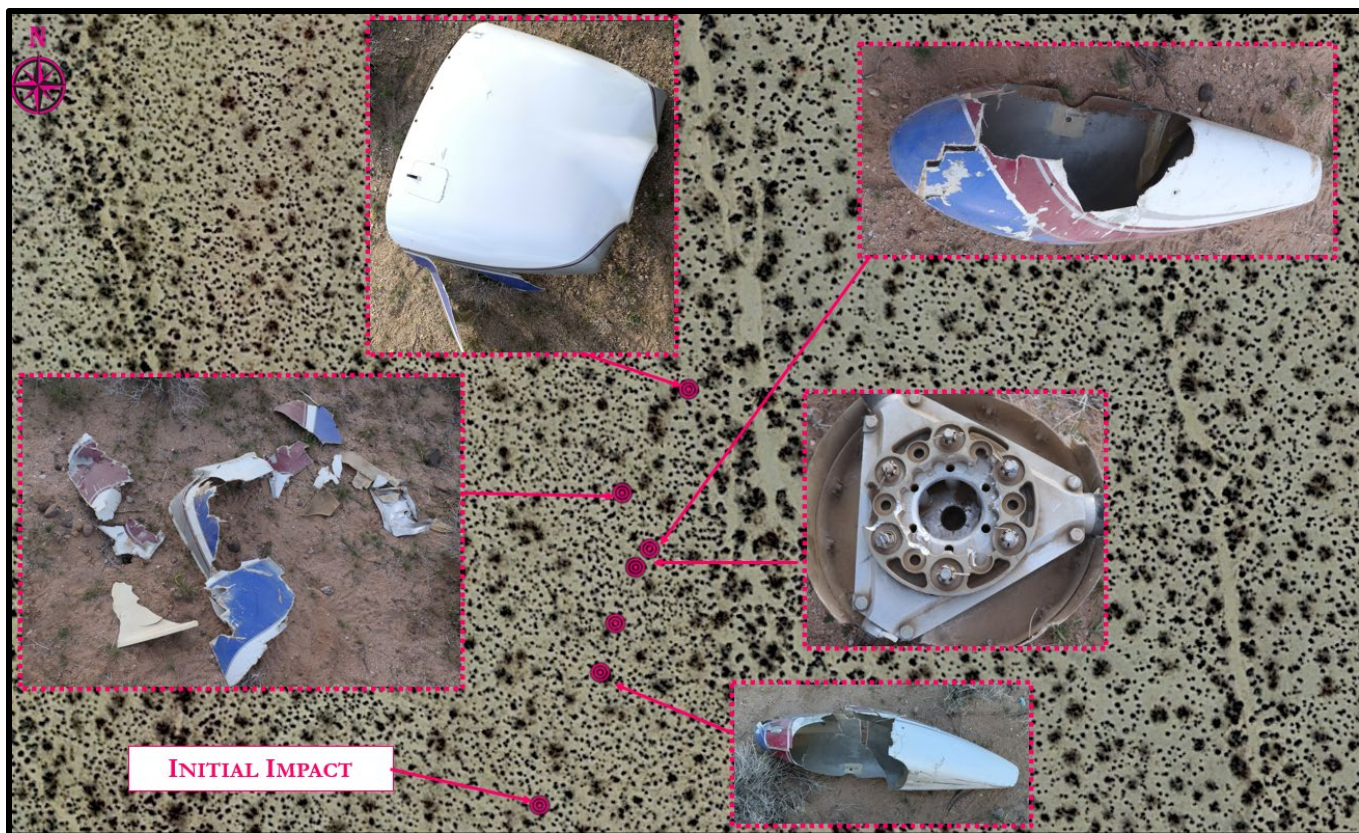


Figure 12: Initial impact site.



Figure 13: Marks on the top of the cowling.

The second debris field consisted of disrupted dirt and vegetation making up northeast end of the debris field. The markings started as an 5 in wide indentation in the vegetation dirt blue/green lens and with almost the entirety of the right wing tip fragments imbedded. The fragmented right wing tip was located immediate adjacent to the initial impact area. There were bushes about 3 ft in height that were on either side of the crater as it extended toward the main wreckage on a heading of 116°. The crater was about 35 feet from the right wing tip and contained the right door and part of the right fuselage just forward of the door.

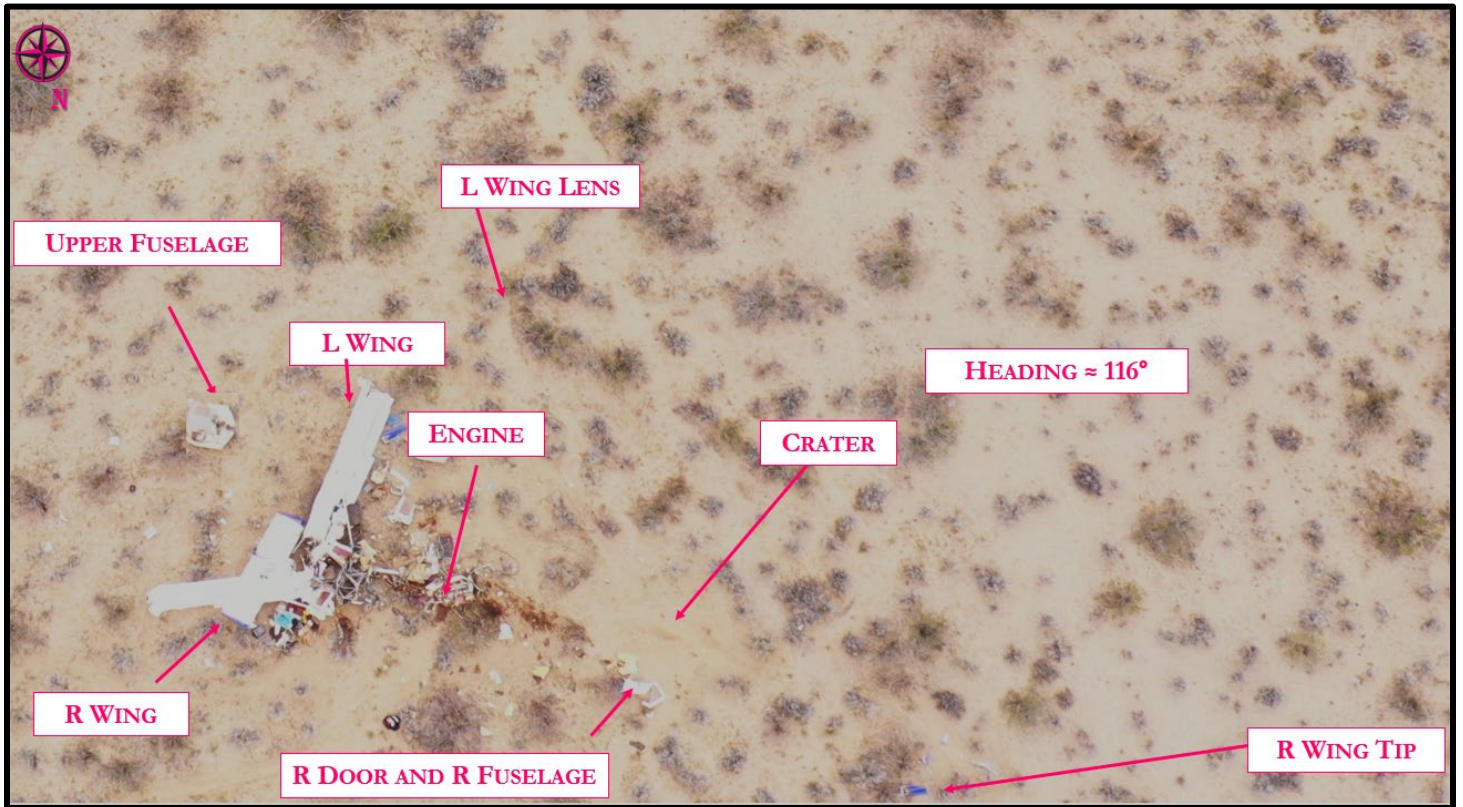


Figure 14: Wreckage at second impact site.

The engine and firewall (with fragments of the front panel) came to rest upright and was located between the crater and the main wreckage. The left door and part of the left forward side fuselage adjacent to the door were entangled in the engine and panel.

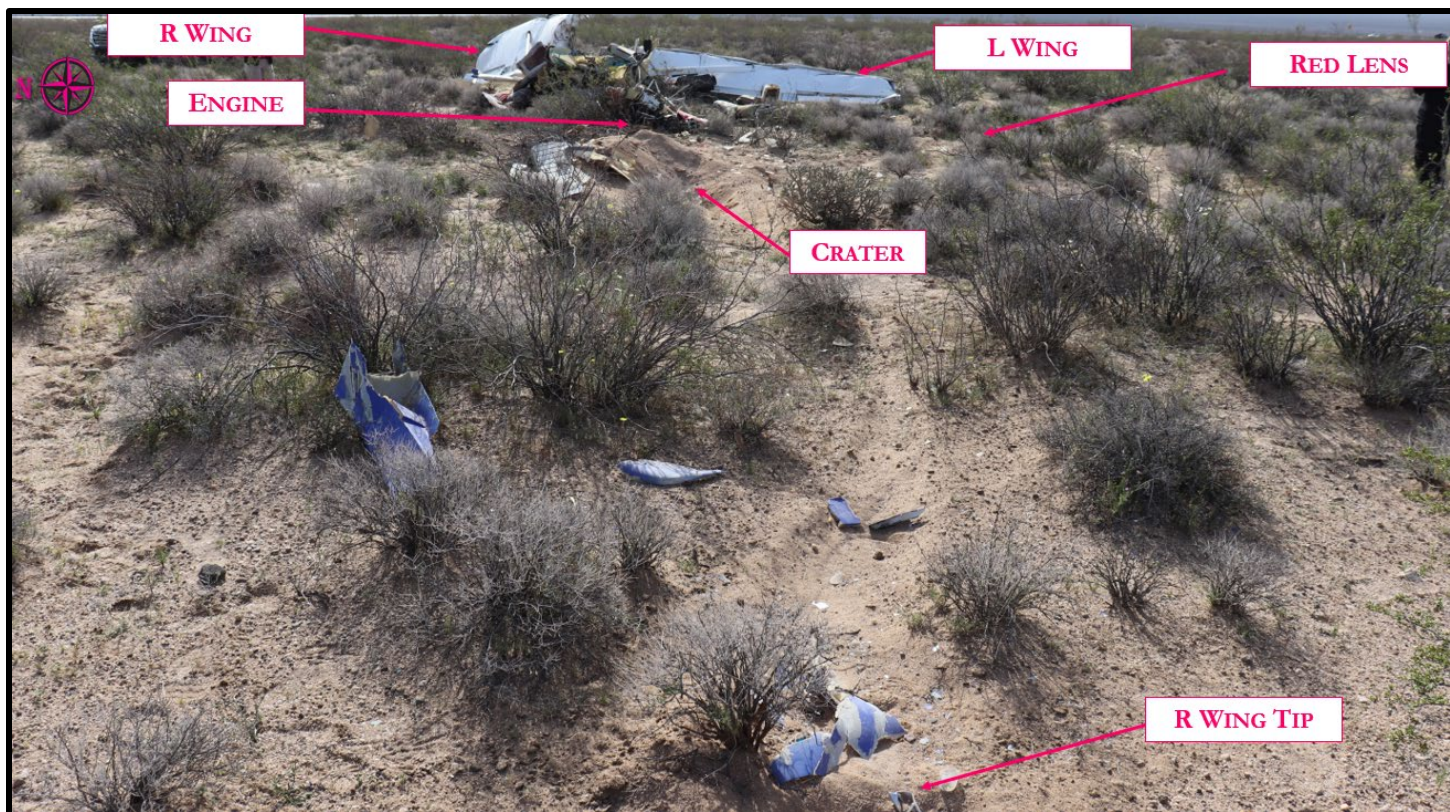


Figure 15: Second impact site.

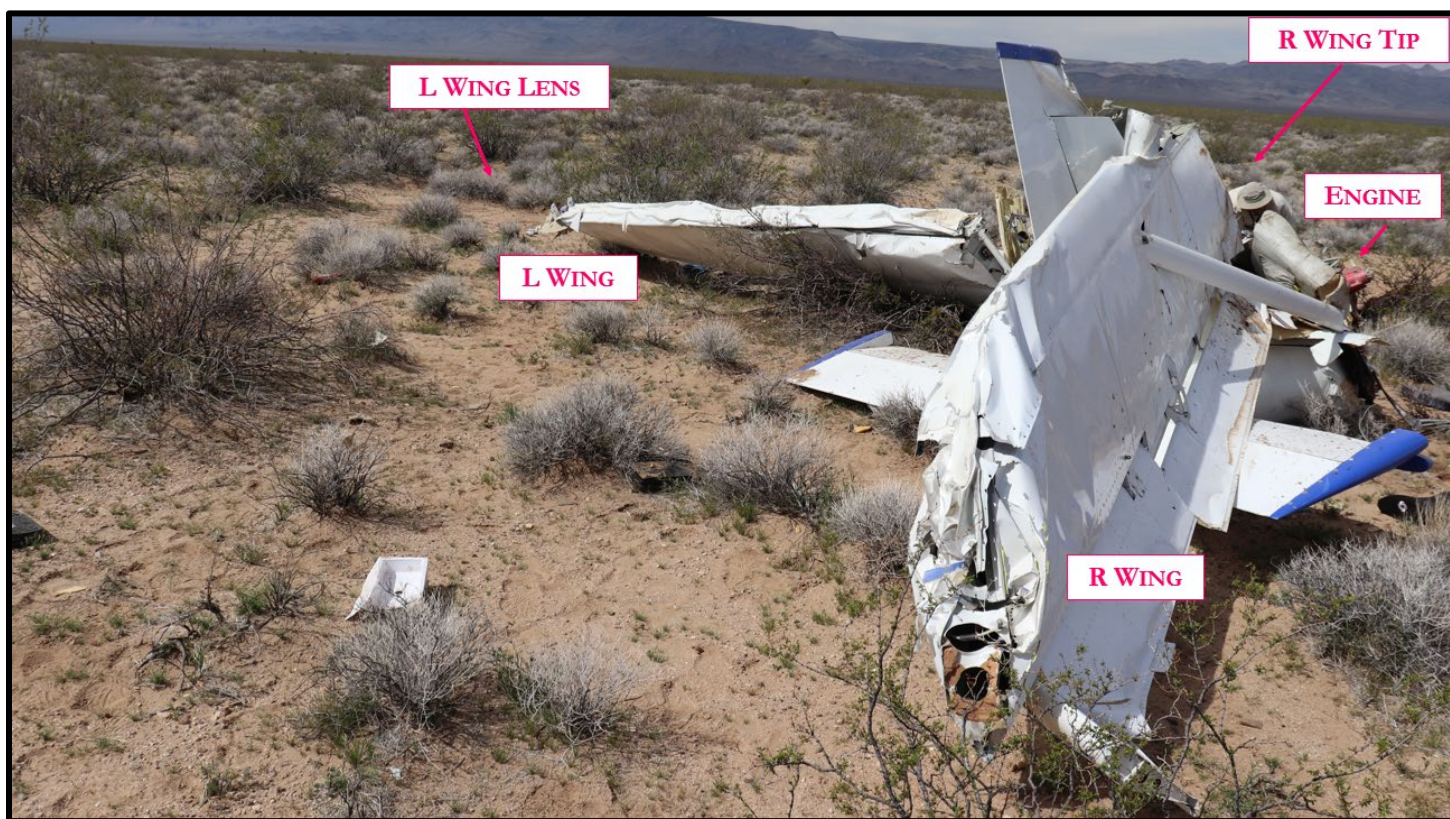


Figure 16: Main wreckage



Figure 17: Second impact area.

AIRFRAME

FUSELAGE

The fuselage came to rest upright oriented in the direction opposite of the debris path.

The left wing was within the main wreckage and the aileron and wing flap control surfaces were still attached at their respective hinges. The majority of the wingtip was immediately below the wing. The flap appeared in a full extended position. The entirety of the leading edge sustained aft crash deformation with the skin folded upon itself in an “accordioned” appearance. The fuel cap was secured. Flap cable continuity was established from the control surface to the cockpit area. The aileron cable continuity was established from the control surfaces to the control yoke assembly.

The right wing was within the main wreckage and the aileron and wing flap control surfaces were still attached at their respective hinges. The flap appeared in an extended position. The right outboard leading edge sustained aft crush deformation for several feet inboard and then the inboard leading edge had numerous punctures. The fuel cap was secured. Flap cable continuity was established from the control surface to the cockpit area and the Johnson bar was located and was frozen in the “full upward” notch. The aileron cable continuity was established from the control surfaces to the control yoke assembly (the control stick on the left side was attached and the right side was found loose in the wreckage).

The rudder control surface remained affixed to the vertical fin structure. The rudder cables were attached to the rudder horn, and continuity was established to the aft baggage compartment through a series of pulleys and runs; the ends were attached to their respective attach points at the rudder pedal mixing control bar. . The

vertical stabilizer was cracked along the center seam leading edge. There were several red paint transfers and repetitive black markings; the upper portion was dented.

The horizontal stabilizer and elevator remained attached to the empennage. The horizontal stabilizer leading edge was intact. The elevator was attached to the aft bellcrank. The elevator cables were attached to their respective bellcrank arms and continuity was established in the aft baggage compartment through a series of pulleys and runs through lightning holes to the control yoke area. Elevator trim tab actuator position could not be determined.

The right door and attached forward fuselage were found on the left side of the crater.

The upper cabin's fuselage was the furthest larger object in the debris field; the upper right (passenger) window frame was adjacent. The fuselage upper windows had both broken out and shards of the front windscreen panel remained. There was no evidence of paint transfers or oil.

SEAT BELTS

The pilot and passenger both appeared to be wearing lap belts, but not the shoulder harnesses.

COCKPIT

The throttle was about a half an inch from full throttle and folded left over the dash.

Several gauges were found within the wreckage and had sustained damage, therefore the readings were unreliable.

Airspeed indicator: pegged at the maximum (over 200).

There were no light bulbs intact.

There was a carbon monoxide detector onboard.

FUEL SYSTEM

The fuel system consisted of two wing tanks that were plumbed to two different header tanks (located on the upper left and right vertical cage structures, respectively). From the header tanks, the fuel lines were routed down to a sump and then were routed to an Andair "RIGHT" "LEFT" and "OFF" selector valve. The fuel line continued forward from the valve to the firewall. At the firewall there was a braided fuel line to a fuel filter (mounted on the firewall). The fuel then continued to rubber fuel lines where it split to two different electric fuel pumps and then was rejoined together. The fuel continued to a paper filter and then was routed to engine rail, where each fuel injector was affixed into its respective cylinder. The fuel return was routed after the engine rails to a fuel pressure sensor. From the sensor, the fuel was routed back to the fuel selector and would return to the tank selected.

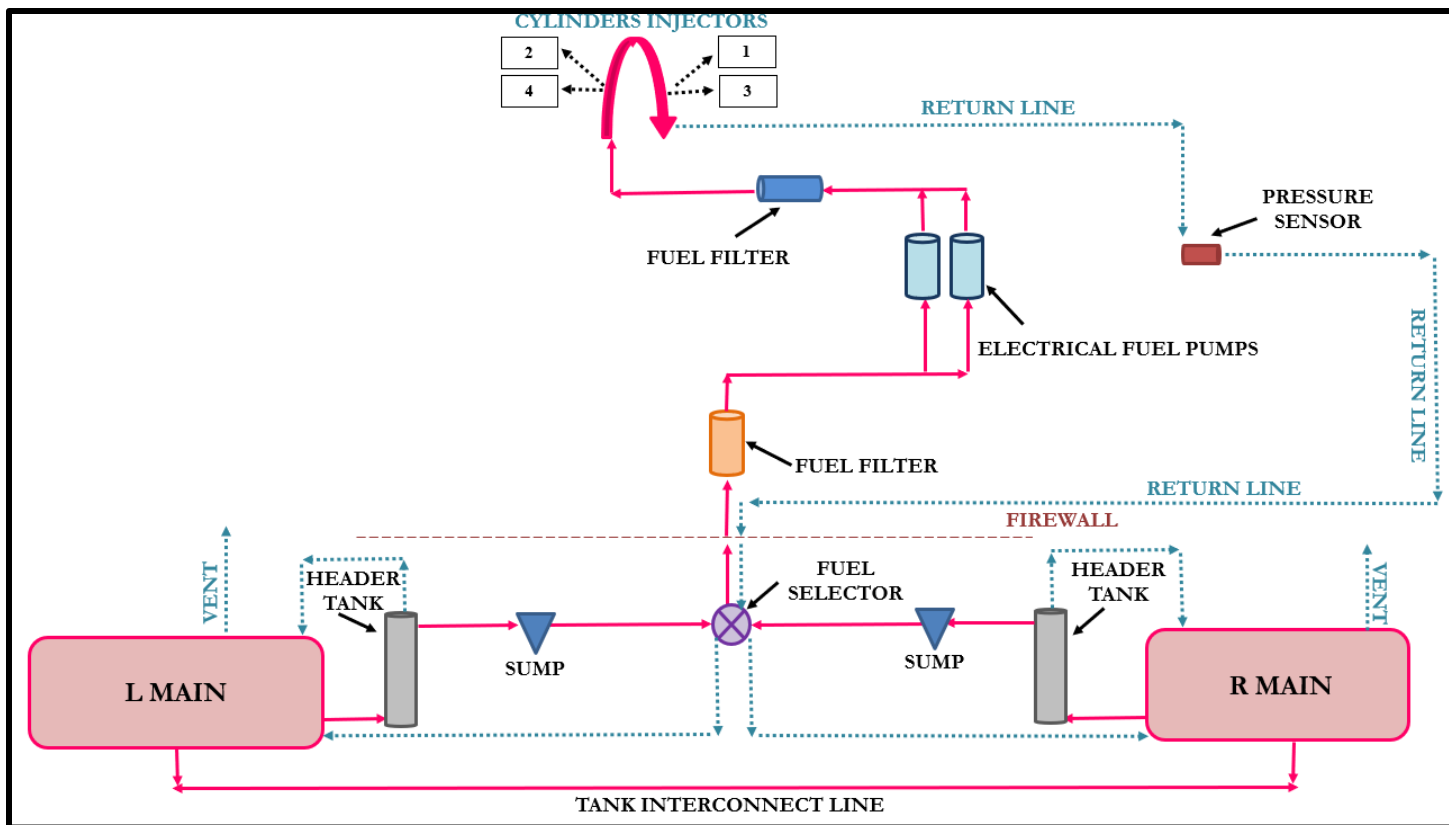


Figure 18: Fuel system schematic

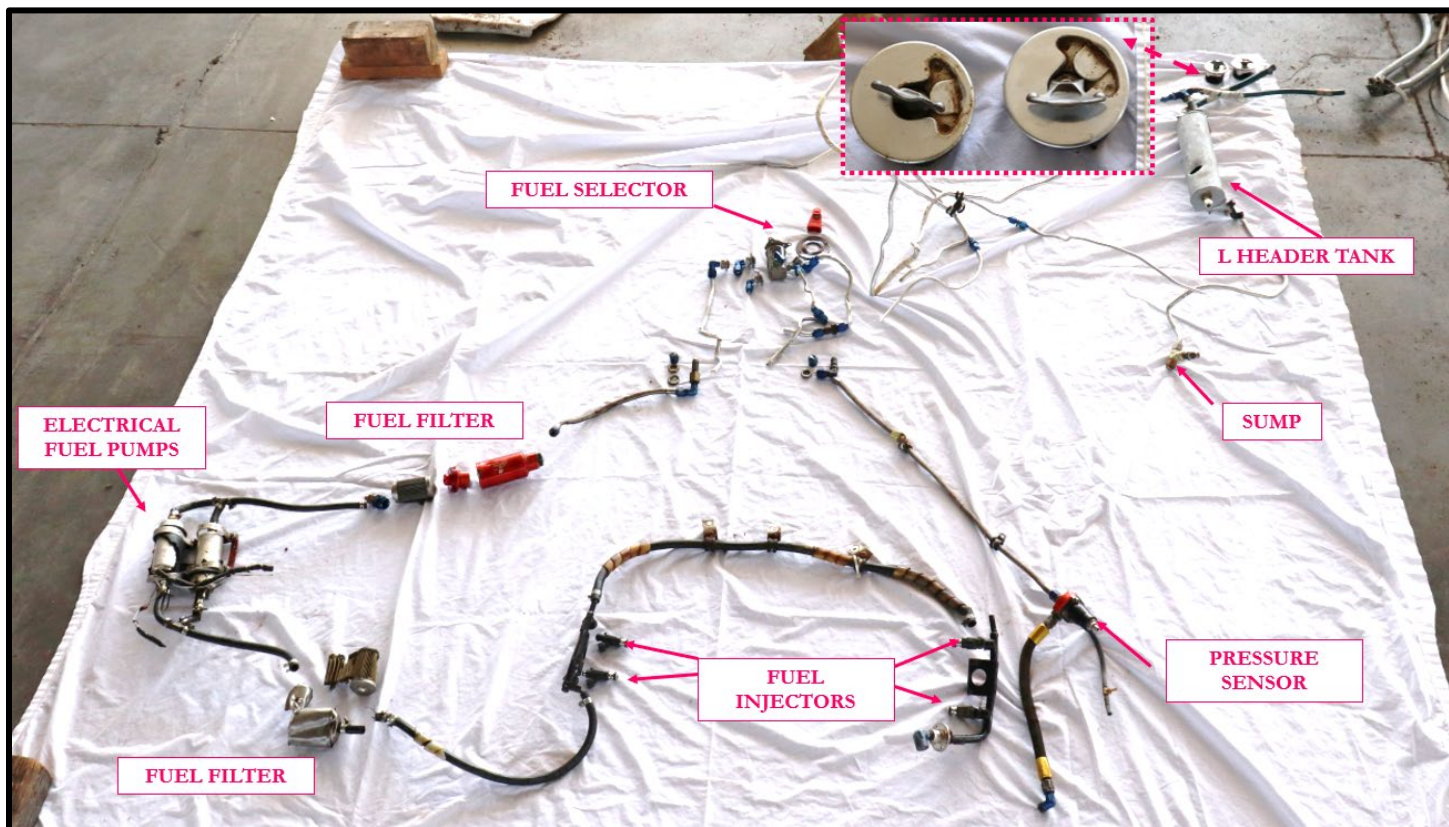


Figure 19: Fuel system examination layout.

There was fluid in both wing tanks consistent in odor and color with that of 100LL Avgas. The fuel selector was in an over-extended position and sustained crush damage with the selector post bent. There were witness marks on the face are consistent with it likely being in the “LEFT” position at the time of impact. There was white

Teflon tape on all the selector fittings that had the appearance of being recently installed. The detents and selector rotated when the post was turned. The fuel lines were all fractured in various places.

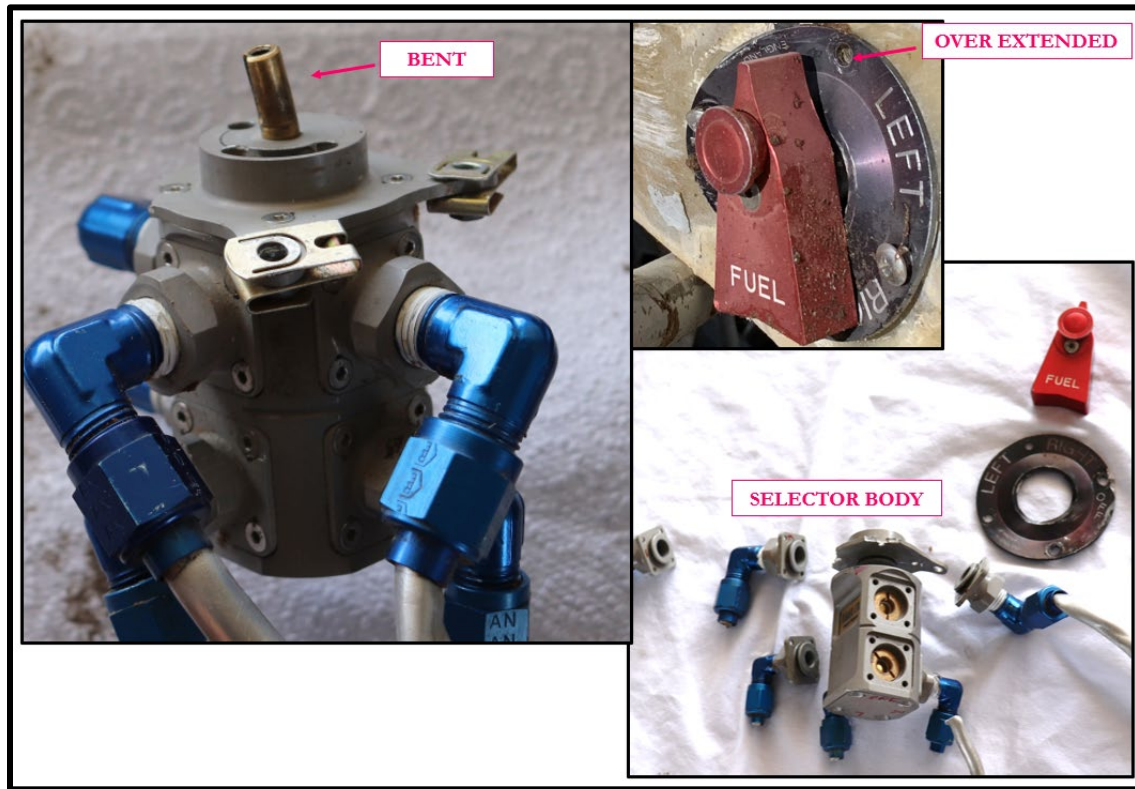


Figure 20: Fuel selector

The fitting from the selector through the firewall was broken and the b-nut was loose; there were scrapes on the nut. It could not be determined if there was odor or wetness in the area of the firewall.

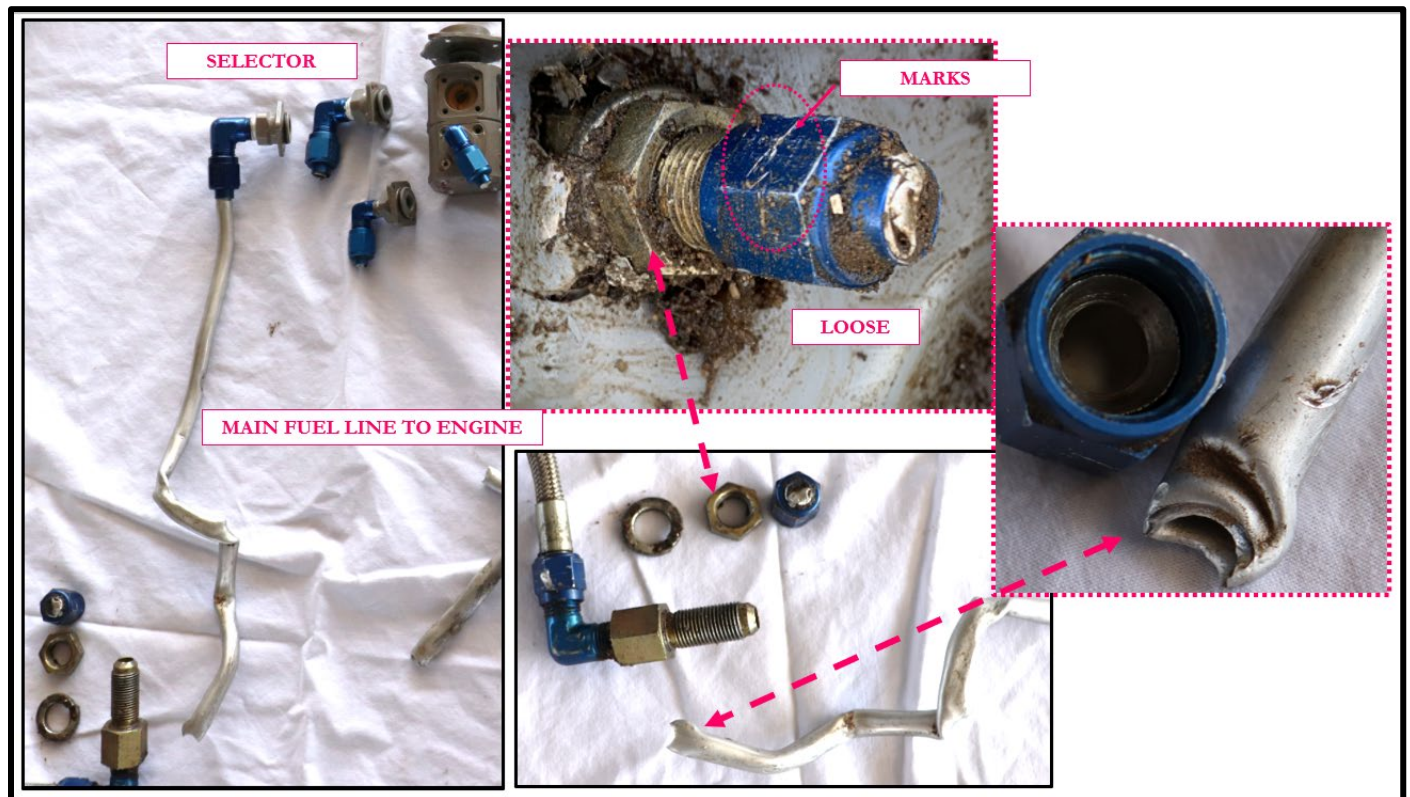


Figure 21: Firewall fitting

The Aermotive fuel filter was punctured open. The fluid inside was grainy and dirty and tested positive for containing water. The cooling reservoir was located above the filter and was punctured. The rubber tubing to the lower fuel pump was ruptured. The pumps were hooked up to power and could be felt clicking and having suction on the inlets. The paper filter was cut open and found to be discolored. Numerous lines had fractures and were not attached.



Figure 22: Fuel filters installed on the firewall.

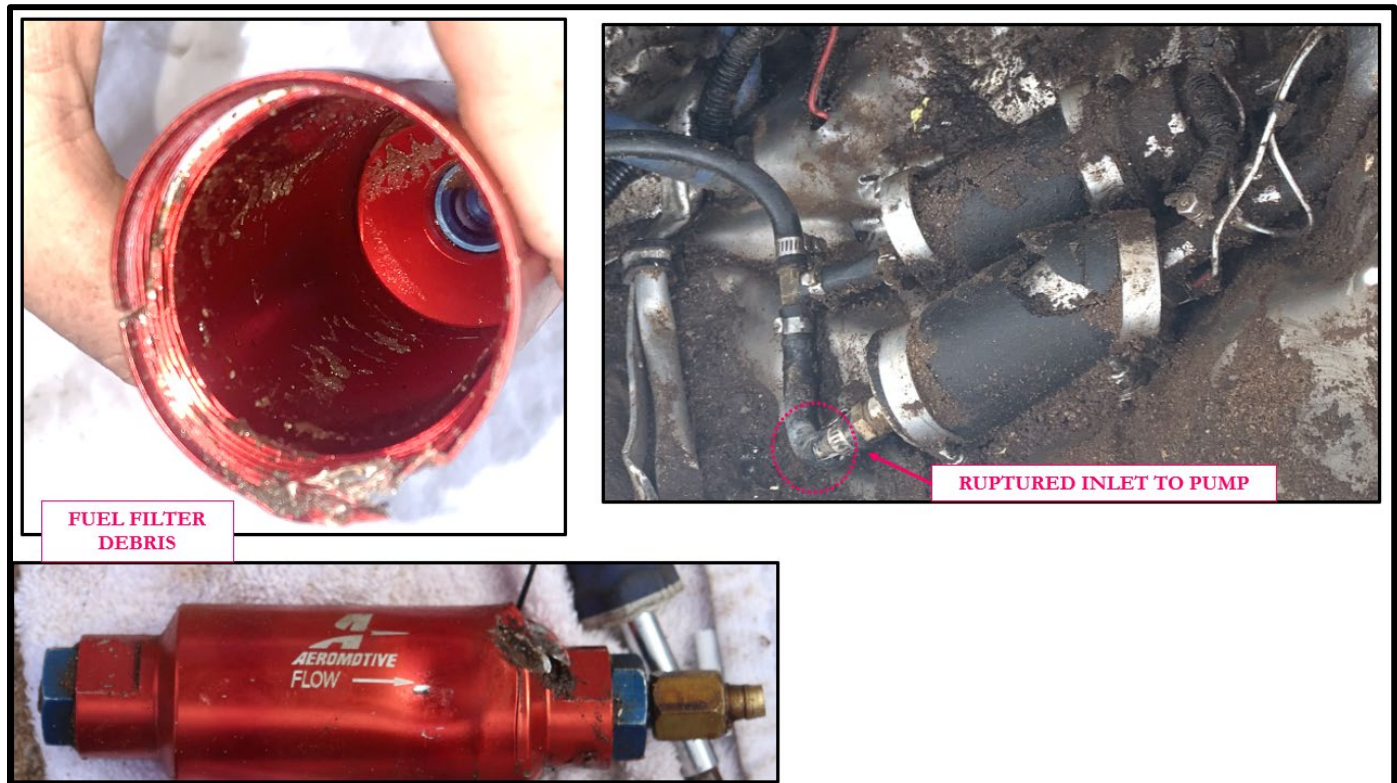


Figure 23: Fuel filter

The rubber hose between the Nos. 1 and 3 cylinder rail and the Nos. 2 and 4 was torn in several areas. Putting power to the injectors revealed that it was clicking.

ENGINE

The Eggenfellner Subaru EL25 was partially intact. Investigators were unable to achieve manual rotation of the crankshaft by rotation the crankshaft spline. The alternator was belt and gear had areas of wear, consistent with it making contact with the nose cowling. The aft plastic gear housing was partially broken at the left (cylinder Nos 1 and 3) camshaft drive. The belt was still intact and on the gears of both camshafts, the crankshaft and through the idler gears including the oil pump.



Figure 24: Engine as found at the accident site.

The experimental Glastar was equipped with a Eggenfellner Subaru H4 engine based on an EL-25, 2.5L Subaru water-cooled 4-cylinder engine that was rated at 160 horsepower. Power is transferred from the engine to the propeller speed reduction unit (PSRU) through a spline shaft. The unit was an Eggenfellner GEN 3, Ver 4 model. The PSRU is a geared reduction drive that provides for a propeller rpm that is about $\frac{1}{2}$ that of the engine rpm.

As part of the postaccident examination, a majority of the engine, the PSRU, and the components were completely disassembled. In pertinent part, there were large plastic shards found in the No. 4 intake (entering into the cylinder) and smaller pieces were in the No. 3, consistent with the plastic connection at the air intake fragmenting while the engine was still running at impact. The entire drive train was intact. The deposits on the pistons and spark plugs were all consistent with normal operation. The PSRU splines and bearings were all intact; fine metallic shavings were found in the oil. The examination of the engine and PSRU revealed no obvious evidence of pre impact anomalies or failures that would have precluded normal operation.



Figure 25: Engine layout at examination.

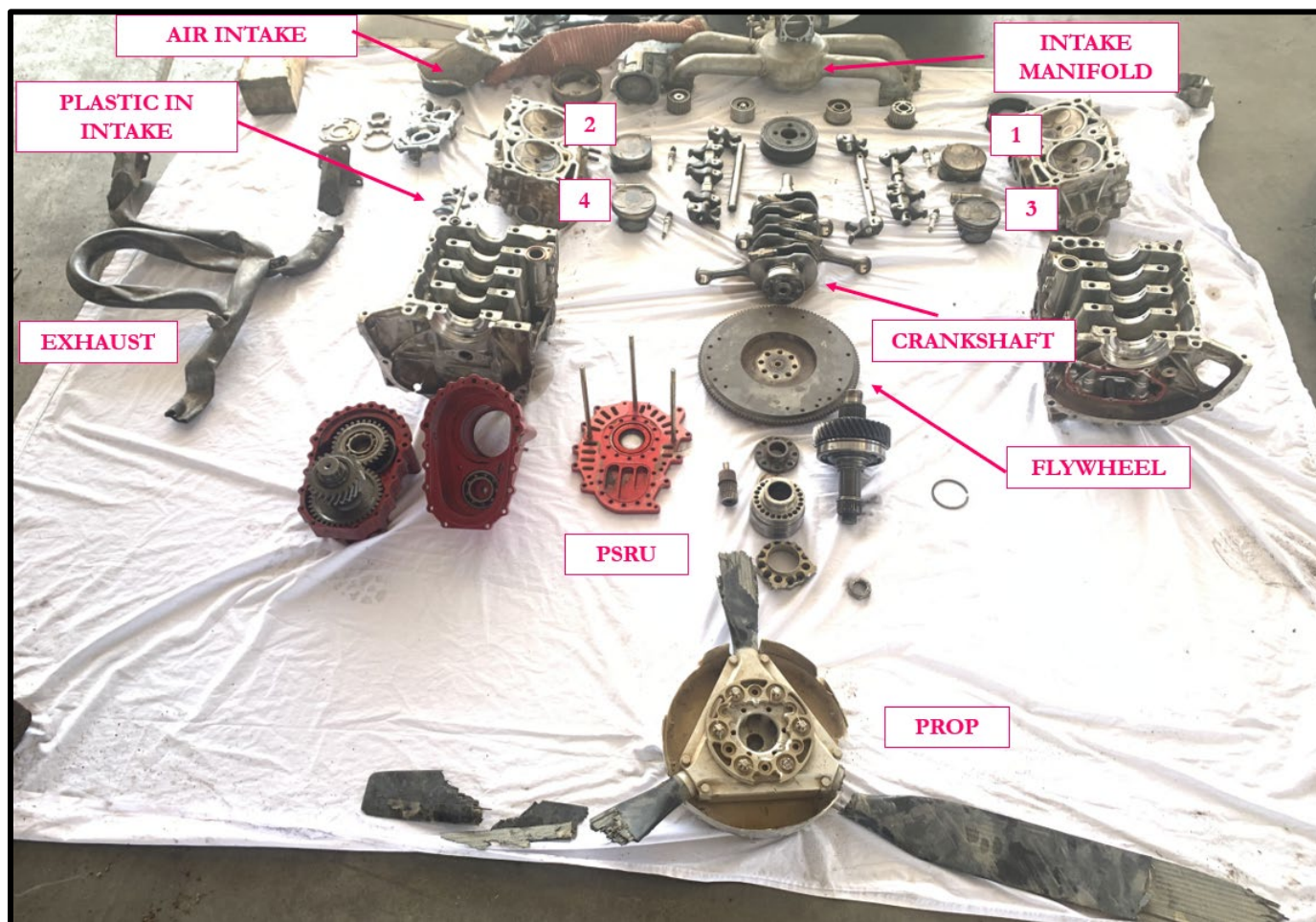


Figure 26: Engine layout at examination with propeller.

PROPELLER BLADES

The three composite propeller blades were found in the debris field.



Figure 27: Propeller at accident site.

RECORDS

The last 100-hr inspection was recorded as being completed on April 05, 2023, equating to 6 days prior to the accident. The mechanic that signed the entry stated that he wasn't familiar with the engine and the pilot performed all the maintenance on the airplane. He was doing the inspection to look for leaks, and overall condition of the airplane. A review of the maintenance records revealed that in the end of March the pilot installed new fuel injectors and changed the manifold, temperature and oxygen sensors.

The tachometer at the accident site was not recovered, but the last inspection indicated the airplane had a total time of 446.6 hours.

YEAR 22 DATE	RECORDING TACH TIME	TODAY'S FLIGHT	TOTAL TIME IN SERVICE	Description Entries must be endorsed with Name, Rating and Certificate Number of Technician or Repair Facility. (See back pages for other specific entries.)
9-26-22				Changed oil & filter with Mobil 1 10-30 synthetic. Removed gear box & Lubed shaft between engine-gearbox
3-27-23				Changed MAP sensor " Temp " " Oxygen "
3-30-23				4 New Fuel Injectors
4-5-2023	446.6			I certify that this engine was inspected IAW FAR Part 43 Appendix D 100hr Inspection and Specific Subaru Maintenance Manuals and found to be in safe condition. - Gregory S. MATUSKY App No. [REDACTED]

11-16	392.0		392.0	Changed oil in Gear box with Amsoil synthetic 75-90
3-15-22	420.9		420.9	Changed both elec. fuel pumps GS-L393-72 & fuel filter

10-13-09	77.1			REPLACED REDUCTION DRIVE Eggerfellner gen 1 removed Replaced w/ Eggerfellner Gen 3
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PILOT INFORMATION

Pilot: Glen McKenna¹

Pilot Certificate 3494235 (PRIVATE PILOT ASEL; REPAIRMAN EXPERIMENTAL AIRCRAFT BUILDER), was a 72-year-old male. This pilot reported civil flight experience that included 64 total and 0 hours in last six months as of exam dated 4/3/2009. The pilot was issued his private pilot certificate in March 2010. This pilot was 72 inches tall and weighed 205 lbs. at the time of the last exam. This pilot was issued a Second Class Medical Certificate with the following limitation: "Must wear corrective lenses."

¹ <https://www.facebook.com/glen.mckenna.73/photos>

[illegible]

Date	Start Time	Duration (H:MM)
11/12/2022	6:58 AM	2:43
11/12/2022	10:08 AM	1:11
11/12/2022	11:42 AM	2:08
12/26/2022	3:14 PM	1:27
1/27/2023	4:38 PM	0:14
2/11/2023	9:17 AM	0:54
2/11/2023	12:03 PM	0:35
2/11/2023	2:00 PM	0:22
2/17/2023	9:24 AM	0:44
3/13/2023	11:05 AM	0:19
4/8/2023	7:45 AM	0:10
4/11/2023	4:01 AM	0:17

Figure 29: Airplane's GPS time and date information

The pilot purchased the airplane in May 2021.

Passenger: Bonnie McKenna² (spouse)

The passenger was not a pilot and would not have been comfortable flying the airplane.

WEATHER/ENVIRONMENTAL INFORMATION

According to the U.S. Naval Observatory, Department of Astronomical Applications, the phase of the moon was waning gibbous (just past full) with 68.1% of the moon's visible disk illuminated. At the time of the accident, the moon was about 16° below the horizon (including refraction) on an azimuth (heading) of 246°.

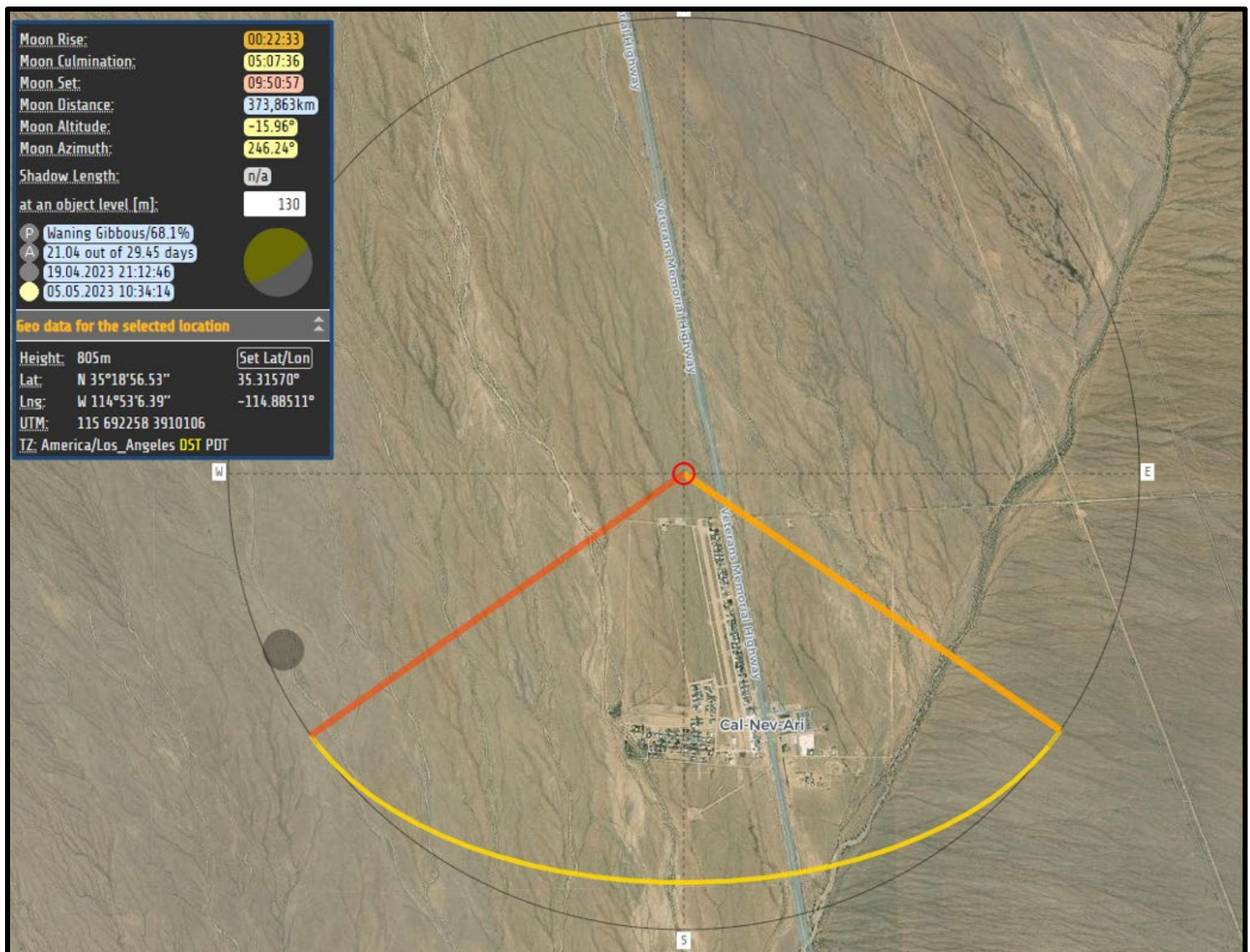


Figure 30: Moon position (courtesy of www.mooncalc.com)

² <https://www.facebook.com/bonnie.mckenna.9085>

AERODROME INFORMATION

Kidwell Airport (K1L4) was an uncontrolled airport at an elevation was 2,605 ft msl. The airport is a privately owned, public-use general aviation (GA) airport located within Cal-Nev-Ari, a small town located approximately 25 miles from the California, Nevada, Arizona Tri-State border in Clark County. The airport is surrounded by Bureau of Land Management (BLM) lands and owned by a private owner. The airport was established in the mid-1960s and has a nearly 4,200-foot-long dirt runway. Since the 1960s the town and the airport have experienced significant growth, with the airport being home to around a dozen based aircraft and experiencing thousands of annual operations, including many from the residential air park located directly adjacent to 1L4.

Runway 15/33

Runway 33 was equipped with non-standard runway edge lights that were pilot-controlled in some touchdown areas. The security camera footage shows the lights were illuminated. The area surrounding the airport was rural, with little terrestrial lighting present.

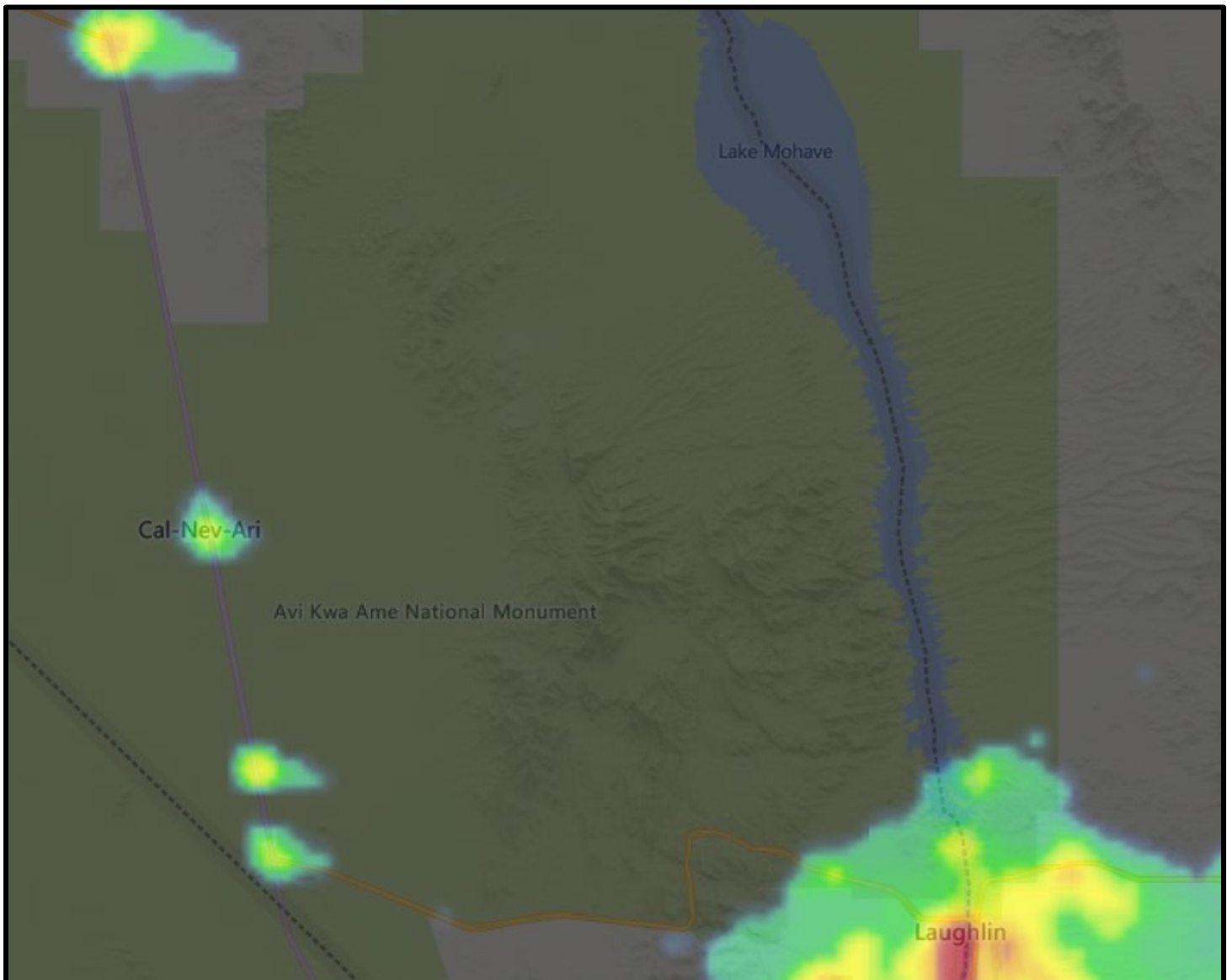


Figure 31: Light pollution map (courtesy of <https://www.lightpollutionmap.com>)

Dark  Bright

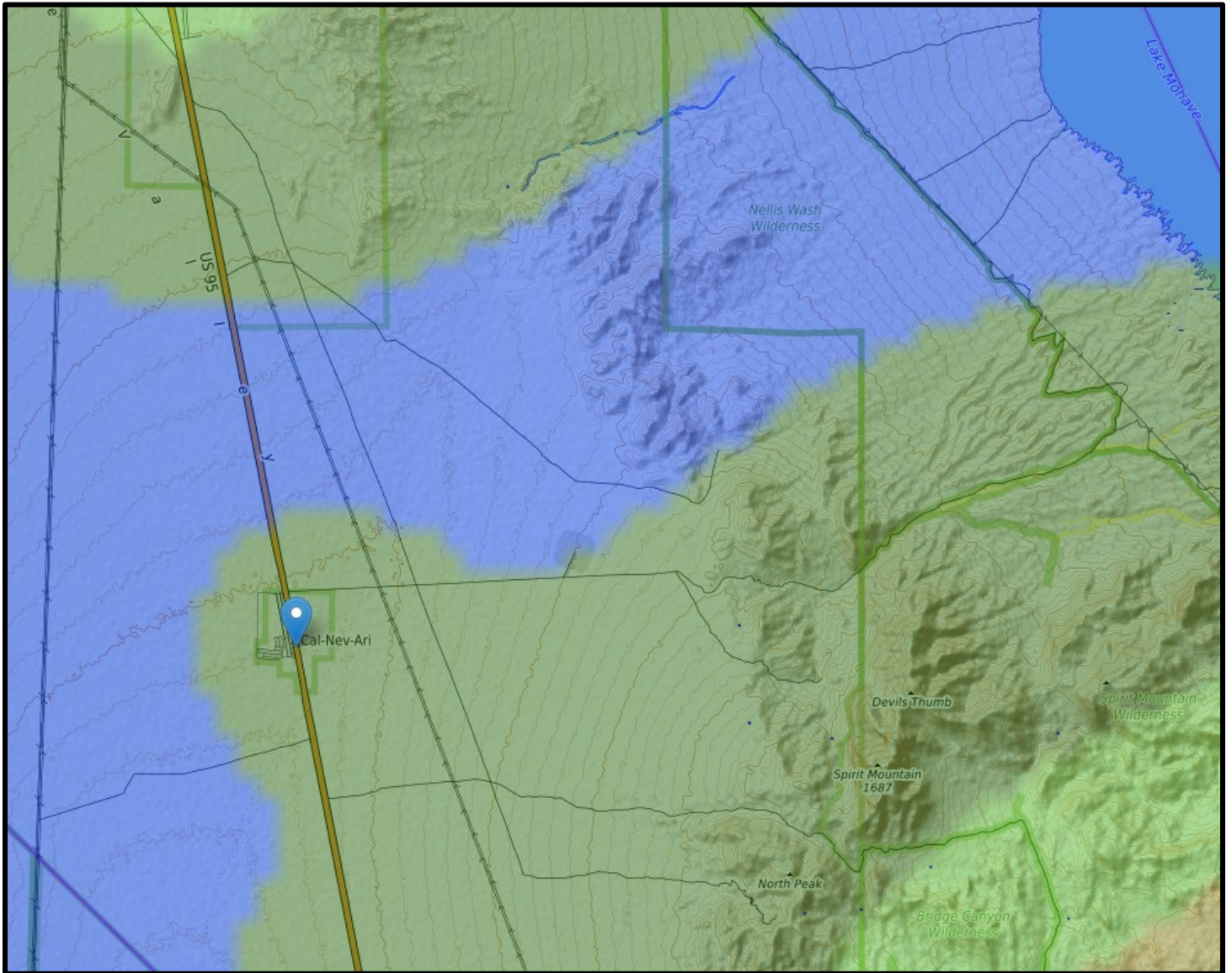


Figure 32: Light pollution map (courtesy of <https://darksitefinder.com>)