NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Aviation Engineering Division
Washington, DC 20594

April 15, 2011

AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

A. **ACCIDENT:** ANC10MA068

LOCATION: Near Aleknagik, Alaska

DATE/TIME: August 9, 2010

AIRCRAFT: DeHavilland Canada DHC-3 "Turbine Otter", N455A

B. GROUP MEMBERS:

Chairman: Robert L. Swaim
Washington, DC

Member: Victoria Anderson
Federal Aviation Administration
Washington, DC

Member: Peter B. Baker
Honeywell (Engine manufacturer)
Phoenix, AZ

Member: Dave Rees
Viking (Holder of DHC-3 Type Certificate)
Sidney, British Columbia, Canada

C. SUMMARY:

On August 9, 2010, about 1445 Alaska daylight time (ADT), a single engine, turbine-powered, amphibious float-equipped de Havilland DHC-3T airplane, N455A, impacted mountainous tree-covered terrain about 10 miles northeast of Aleknagik, Alaska. Of the nine people aboard, the airline transport pilot and four passengers died at the scene, and four passengers sustained serious injuries. The airplane sustained substantial damage. The flight was operated by GCI Communication Corp (GCI), Anchorage, Alaska, under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91. The flight originated at a GCI-owned remote fishing lodge on the shoreline of Lake Nerka at about 1427 ADT and

was en route to a remote sport fishing camp on the banks of the Nushagak River, about 52 miles southeast of the GCI lodge. At the time of the accident marginal visual meteorological conditions were reported at the Dillingham Airport, which was about 18 miles south of the accident site; however, the weather conditions at the accident site at that time are not known. No flight plan was filed.

An Airworthiness Group was convened in Dillingham, Alaska on August 10, 2010, to examine the accident site, document the wreckage as found and after recovery, and to conduct interviews. The airplane was disassembled for recovery from the alder trees that covered the hill to a Government hangar at Dillingham. Activities at the hangar finished on August 13, 2010,[1] and the group activities ended in Dillingham on the next day.

D. DETAILS OF THE INVESTIGATION:

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[1] The alder foilage of twisted trunks and branches was densely grown into a continuous thicket with branches ranging up to about five inches in typical diameter. The foliage was about 8-10 feet in height.

SITE AND GENERAL WRECKAGE ON SCENE:

The location of the wreckage obtained from three sources was:

From a hand-held GPS while on-site: N59° 19.754', W158° 22.809'

From the Garmin GNS530 memory:[2] N59° 19.76’ , W158° 22.87’

Note: The distance between the above locations is 185 feet.

From Google Earth visible features: N59° 19.945', W158° 22.902'

Note: The distance between the visible Google Earth features to the GNS 530 location is 1190 feet.

The airplane was found on the western slope of the Muklung Hills. (See Figure 1)

[2] A Garmin Model GNS-530 GPS was recovered from the instrument panel.

Figure 1. N455A on western slope of Muklung Hills with an unnamed peak at top of the photo. The pass between the Muklung Hills and the unnamed peak is slightly more than a mile wide.

The site was to the left (east) of a pass between the Muklung Hills and an unnamed peak of 1,351 feet in height. A topographic map showed the floor of the pass to be slightly less than 400 feet msl. The tundra between Lake Nerka and the pass was about 100 feet msl. The altitude of the wreckage was 900-1000 feet msl, according to both a USGS topographic map and reference to a handheld GPS altimeter. Two Muklung Hill peaks in front of the airplane were shown on the topographic map to be 2,309 feet and 2,170 feet in elevation; an aviation sectional map showed the Muklung Hills peak to be 2550 feet msl. (See Figure 2)

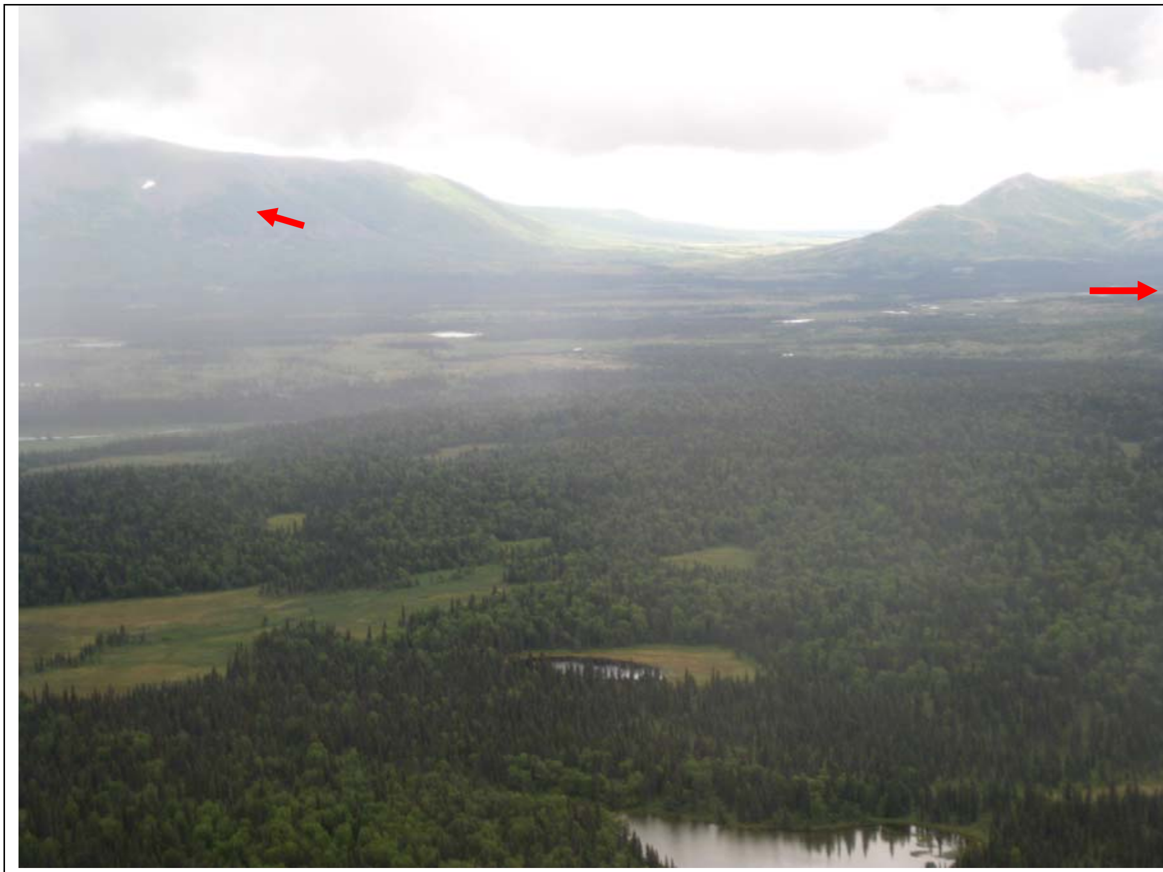

Figure 2. View across tundra toward the accident site and the pass of more than a mile in width. The arrow in the upper left points to the approximate location of the accident site. The arrow at the right is placed on the Muklung River and points toward the user-created Muklung waypoint found in the Garmin GNS-530 GPS. The waypoint is beyond the edge of the photo, to the west of the hill shown. This view is on about a 100 degree magnetic heading, from about 5 miles SSE of Lake Nerka.

The airplane had departed from Lake Nerka and the lake was visible from the wreckage. Looking from the airplane toward Lake Nerka, the land between the lake and hillside was relatively flat tundra with small streams and occasional standing water. Visually, the lake to the accident site was nearly parallel to the western ridge of the Muklung Hills, (see Figures 3 and 4), crossing the north/south orientation of the Muklung River. (See Figure 5)

Figure 3. The large white arrow shows the body of water that the airplane came from, named Lake Nerka. The nearest end of the lake is slightly less than 9 miles away. The GCI Lodge would be off the left edge of the photo, and reachable by flying around the 2,487 foot tall mountain in the upper left. Photo 2 was taken from an airplane flying to the lake and near the small white arrow.

Figure 4. Airplane wreckage on hillside, with arrow at upper left pointing at Lake Nerka, to align with Figure 3.

Using the compass in a helicopter to determine heading into the accident site, the airplane struck the side of the Muklung Hills on a heading of 070 degrees.[3] (See Figure 5)

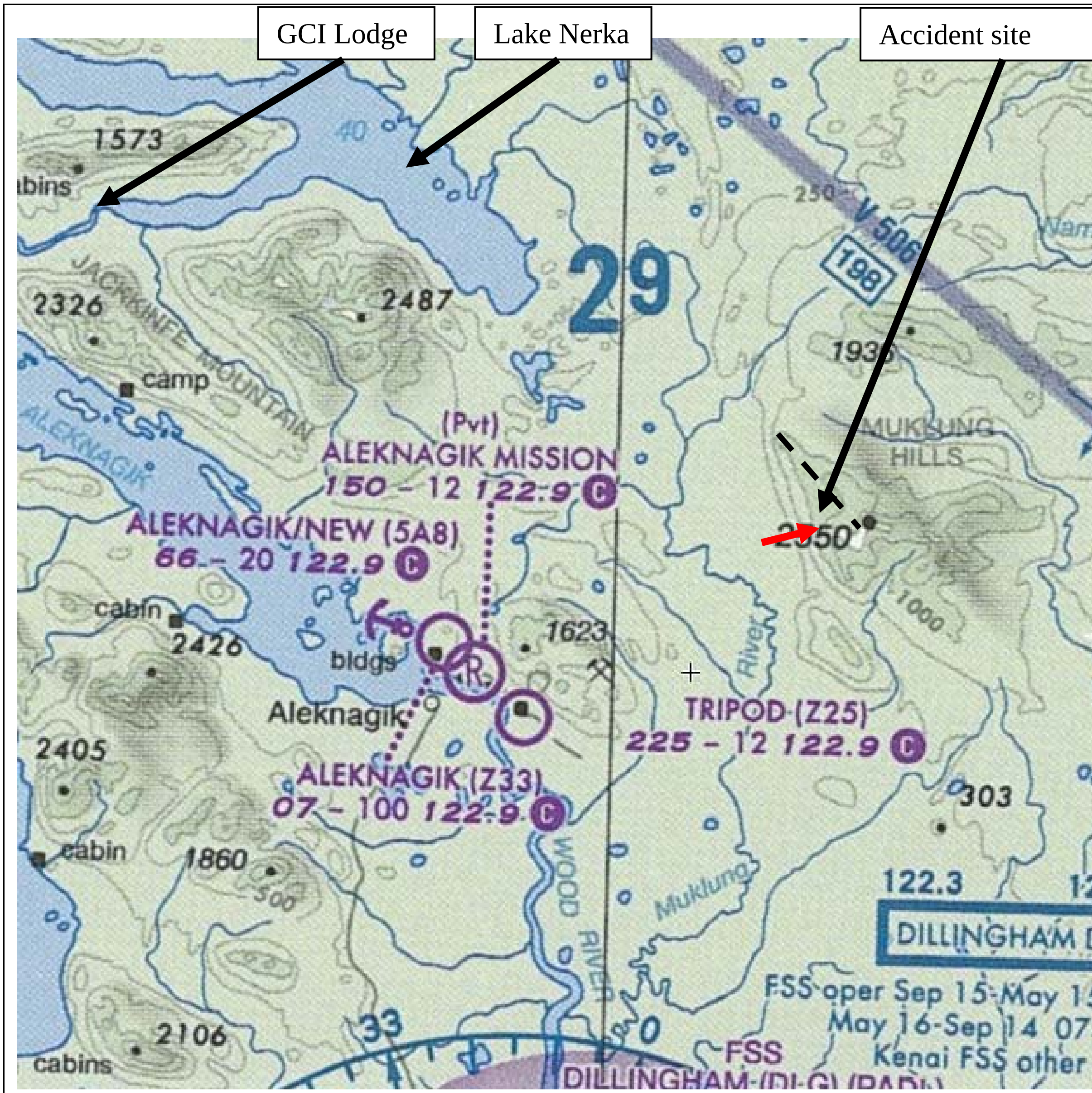

Figure 5. The HRM fish camp is to the lower right of the area shown on this portion of an aviation sectional chart. The thin dashed line depicts the western ridgeline of the Muklung Hills, visible in Figure 4. The short red arrow shows the impact heading and the arrowhead is at about the location of where the wreckage was found. The arrow covers the numbers 2550 for elevation of the mountain peak.

The first point of contact with trees on the hill was in an area of upward slope that was measured to be about 30 degrees. The path crossed a slight ridge, and increased to about

[3] All headings are magnetic, unless otherwise noted.

40 degrees where the airplane came to rest. (The upward slope is visible in Figures 1 through 4.) Broken alder trees of about 8-10 feet in height and the disturbed ground of the hillside began about 100 feet down slope from the tail of the airplane.

The ventral fin from beneath the airplane tailcone was the first piece of debris and was found near the initial damage to the alder trees. This was prior to where the airplane contacted the ground. The leading edge of the ventral fin had tree strike damage. Debris from the forward tips of the floats was not in the area where the ventral fin from beneath the airplane tail was found in the alders. (See Figures 6, 7 and 8)

Figure 6. Left side of N455A ventral fin, showing impact marks on leading edge (left edge of what is visible).

Figure 7. Pre-accident view of the N455A airplane to show the height of the ventral fin above the rear float spreader bar.

Figures 8. Pre-accident view of the N455A airplane to show the height of the ventral fin above the rear float spreader bar. Note the extended flaps and nose above cruise attitude.

Using photographs of another Turbine Otter at the Dillingham airport as a reference, the access to the installed location of the ventral fin was determined. The fin would have been above and aft of the aft float spreader bar. The angle from the spreader bar to the impacts in the ventral fin was 10 degrees, and the ventral fin was 22 degrees above the tails of the floats. The crushed bottoms of the floats also matched a 30 degree reference line (See Figure 9)

Figure 9. This photograph does not convey impact attitude; it was used to find the minimum angle that exposed the ventral fin to potential impacts. The ventral fin is beneath the tail and a float spreader bar is between the rear set of struts that attach the fuselage to the floats. This side view had to be rotated 10 degrees to have the ventral fin lower than the level line drawn aft of the float spreader bar.

The width of the cut alders and subsequent marks in the ground were found to match the spacing of the floats. (See Figure 10) An imprint in the ground led to the left float and that imprint was the first actual ground contact. The imprint was followed immediately by the left nose wheel. (Most of the right nose wheel stayed with the right float.) The heaviest crush damage on the left float was on the bottom, immediately aft of the nose gear mounting, and the damage to the fuselage at the front left float attach point was diagonally up/aft.

Following the ventral fin, the aft float spreader bar was the next identifiable piece of debris and was found to the right side of the right float track. Uphill further and near the right float track were fragments from the inboard side of the right nose wheel. The forward spreader bar was found closer to the main wreckage, about ten feet aft of the right float.

To the left of the wreckage path, about 1/3 of the distance from the bottom of the wreckage path to top, the ground was also displaced and alder trees cut away in what from the air was consistent with an imprint of the left wing. The airplane's left wing tip had corresponding crush damage at the tip and along the leading edge. The left wing had rotated aft more than 45 degrees. The trailing edge of the root displaced the fuselage sidewall to intrude into the cabin occupiable space.

Figure 10. From directly behind the airplane, the small red arrow at the bottom of the photo shows where the first piece of airplane (ventral fin) was found. The white arrows point to the imprints of the floats, the left being the first ground contact. Around the dashed line is a cut in the alders that had the span of the left wing.

Both floats were found with the fuselage and had rolled so that the top surfaces were to the right. The left float was pressed to the left side of the fuselage and the right float was beneath the fuselage, displaced slightly aft and to the left.

The right wing remained roughly perpendicular to the fuselage where the airplane came to rest. The structure that carried the mounting point for the wing strut was damaged, the tip of the wing was down and caught in the alder foliage.

(See sections that pertain to specific portions of the airplane for more detail about each.)

IMPACT ANGLE MEASUREMENTS:

The initial cuts in the alders and roll damage to the floats were found at 29-31 degrees left wing down in bank. (See Figure 11) In pitch, the bottoms of the floats were crushed upward, not the noses. Laying an illustration of the float profiles on a 30 degree line for the measured slope of the hill, the tangent of the damage was at 15 degrees nose up pitch and the heaviest keel twist/crush was between 15-20 degrees, with the rearmost of the keel damage aligning to the 30 degree reference line at about 25 degrees nose up pitch. (See Figure 12)

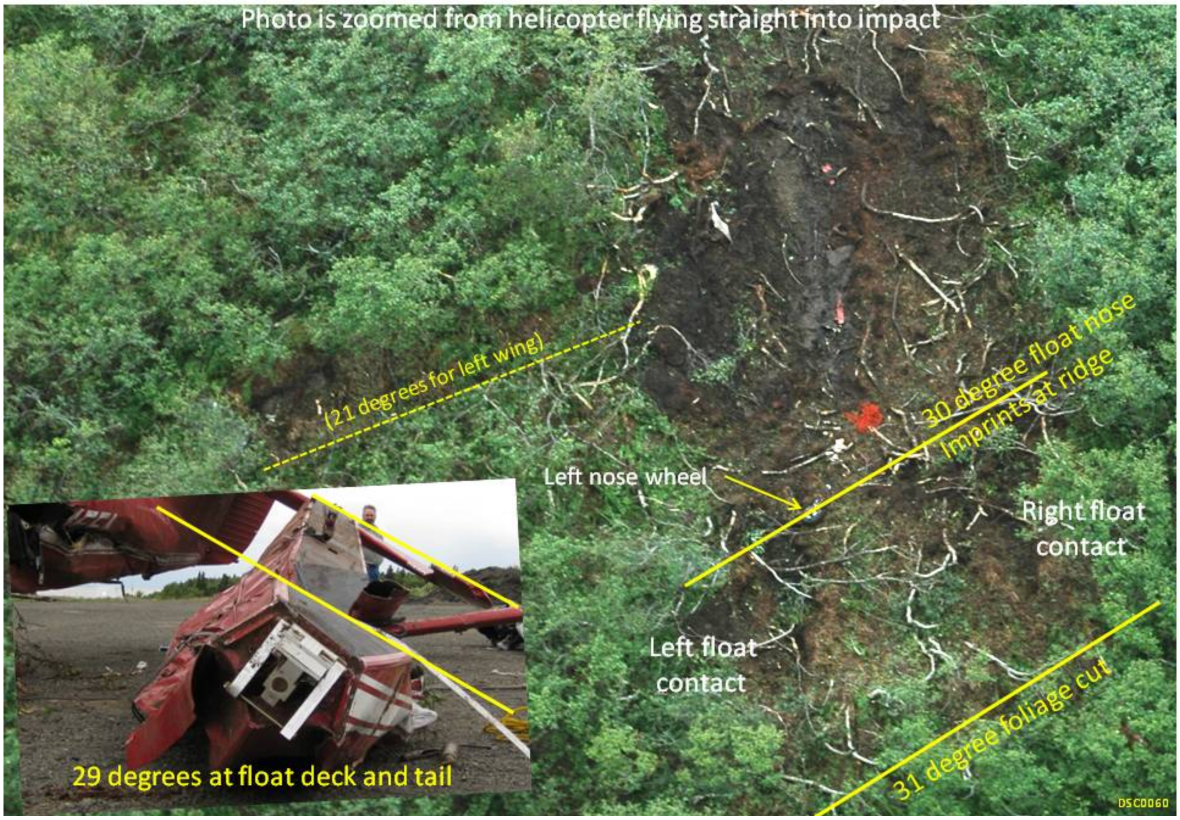

Figure 11. The above figure shows bank angle damage measurements. The float photo is cropped from Figure 13.

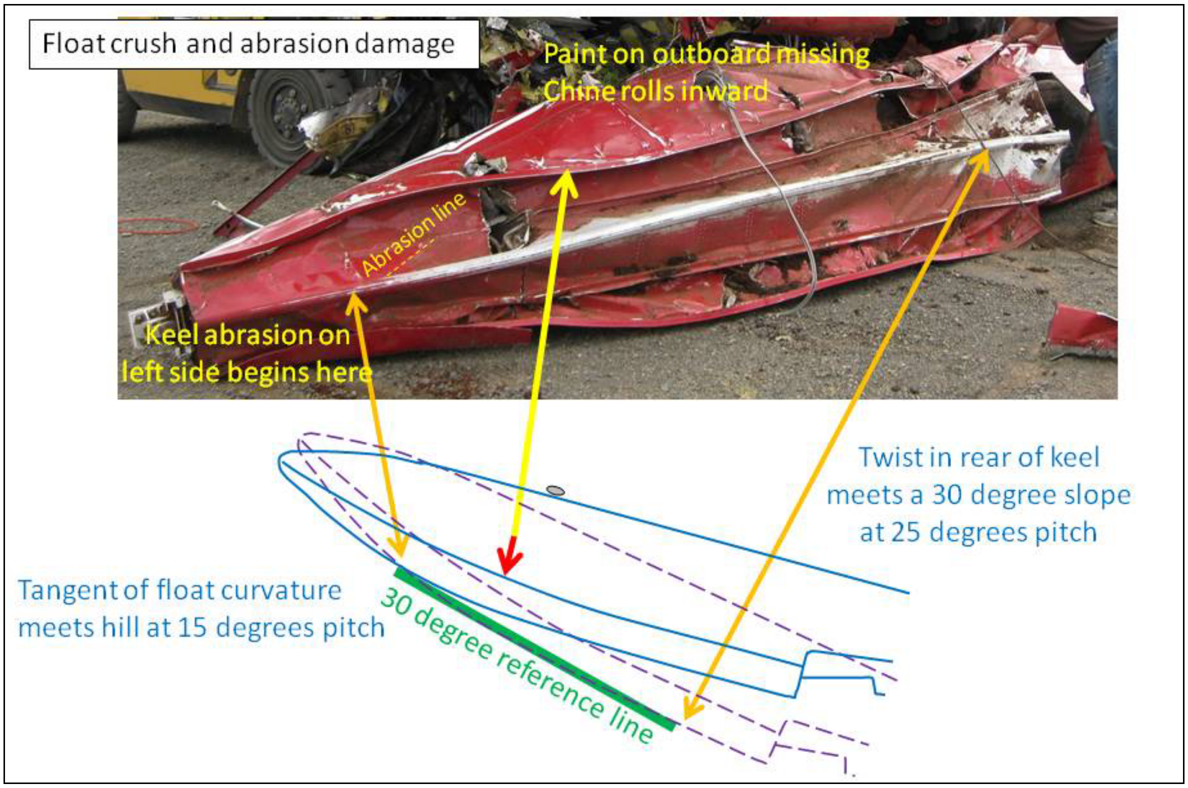

Figure 12. Damage found on bottom of left float, with illustration showing a 30 degree reference line. The heaviest damage is between 15 and 20 degrees pitch, with keel twist extending to about 25 degrees nose up.

FLOATS / LANDING GEAR:

The Wipline Model 8000 floats were manufactured by Wipaire and installed with Supplemental Type Certificate (STC) SA331CH, as approved on April 24, 1995. As installed, the top surfaces of the floats should be approximately level in cruise flight.

The bottom of the left float was extensively flattened. The forward tip of the float was not as crushed aft into the float body and the nose bulkhead deformation was significantly less than the damage found to the bottom of the float. The forward half of the left float had the outboard (lower left) edge rounded and the float had been bent at the change in bottom contour, known as the "step." This location was where the main landing gear were located. The set of two main tires were found in the retracted position. (See Figures 13 and 14)

Figure 13. Left float, showing crush from front.

Figure 14. Left float from the left, resting on the crush line

The upward deformation to the right float was limited to the forward portion of the bottom surface, in the immediate area of the nose tire. The nose bulkhead of the right float was crushed aft without sufficient frontal impact to separate the nosewheel. The nosewheel remained attached and had been displaced upward to crush into the bottom surface of the float body. (See Figure 15)

Figure 15. Forward features of the right float. The left float is behind the right float, illustrating the difference in extent of crush damage to the bottom surfaces.

Otherwise the float was significantly less damaged and the water rudder remained attached. (See Figure 16)

Figure 16. Right float appears to be relatively intact when compared to the bottom of the left float (behind the right float).

FUSELAGE INTEGRITY:

The fuselage had broken at the windshield and down through the cockpit door openings. The instrument panel and engine were loosely held to the rest of the structure by structural remnants at floor level. (See Figure 17) The top of the fuselage had also broken open in the area of the wing spars. (See top of fuselage in Figure 14)

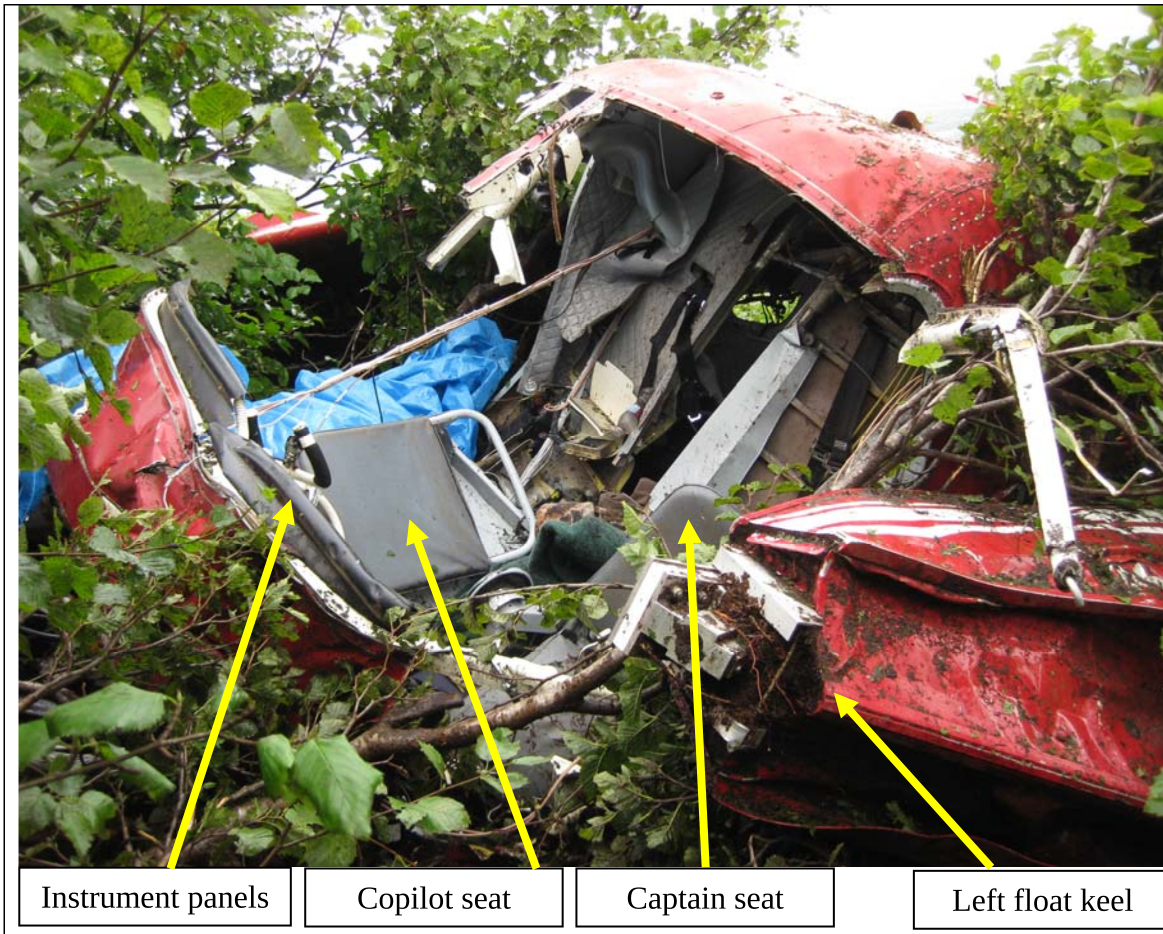

Figure 17. View showing the main fuselage break, across the cockpit to floor level.

The engine and three remaining propeller blades were resting on the ground and caught in the alders, displaced upward from the normal thrust line. The upper left engine mount had separated from the firewall. The instrument panel and firewall could be moved by hand.

In the design of the DHC-3, the aft cockpit bulkhead extended below the floor and to the bottom of the fuselage. This major bulkhead was reinforced to function as the forward attach point for the landing gear or floats. A second reinforced bulkhead existed for attachment of both the lift strut to the wing and for the rearward strut of the wheel landing gear assembly. This second bulkhead was beneath the second and third row of cabin windows on the right. Between the third and fourth rows of cabin windows was a third reinforced bulkhead that had attachment points for the aft float attachment fittings. Between each of the three bulkheads the design included the bladders for the forward, mid, and aft fuel tanks. An escape hatch was located on top of the fuselage and was between the same frames that partitioned the third set of cabin windows. (See Figure 18)

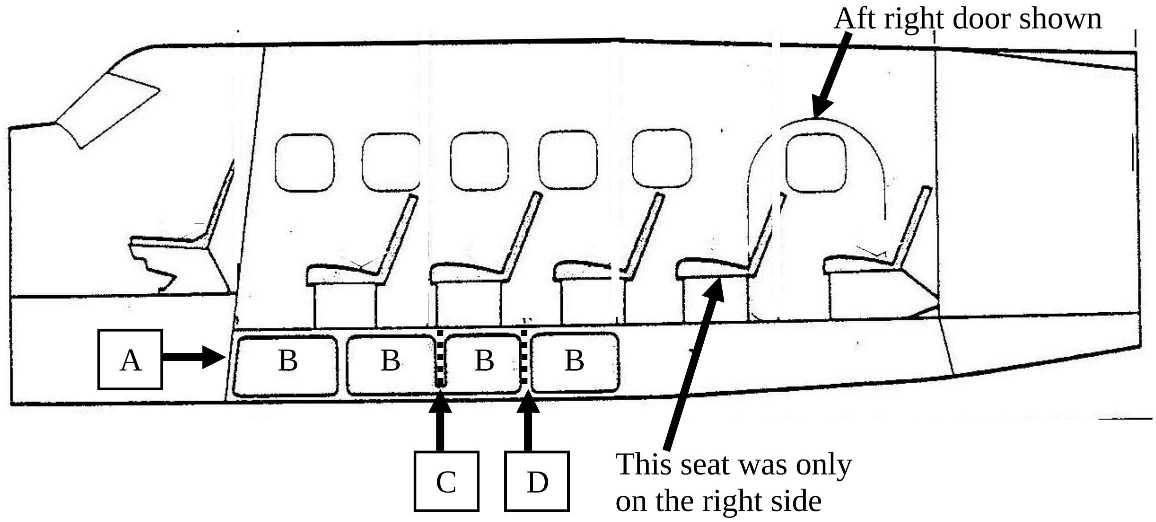

Figure 18. Modified weight and balance diagram shows configuration of canted bulkhead (A) that carries the forward float attachment fitting, fuel cells (B) seats, mid bulkhead (C) that carries the lift strut fitting, aft bulkhead (D) that carries the aft float fitting, and aft right door. The left (main) set of doors is larger and opens where the fourth cabin seat row is shown. The left sidewall does not have the fifth window.

When N455A was to be lifted for recovery, it was learned that little remained of the structure beneath the level of the floor and ahead of the aft bulkhead. The forward cabin floor was completely loose and the fuselage had essentially no remaining integrity. Numerous ratchet straps had to be employed in order to use the left float as a stiffening device for transport. Once at the airport, the ratchet straps were removed and a forklift was used to pick up the fuselage for transport to a hangar. As the fuselage was lifted, the structure hung limply forward and aft of the fork lift, illustrating the lack of remaining integrity to the substructure. (See Figure 19)

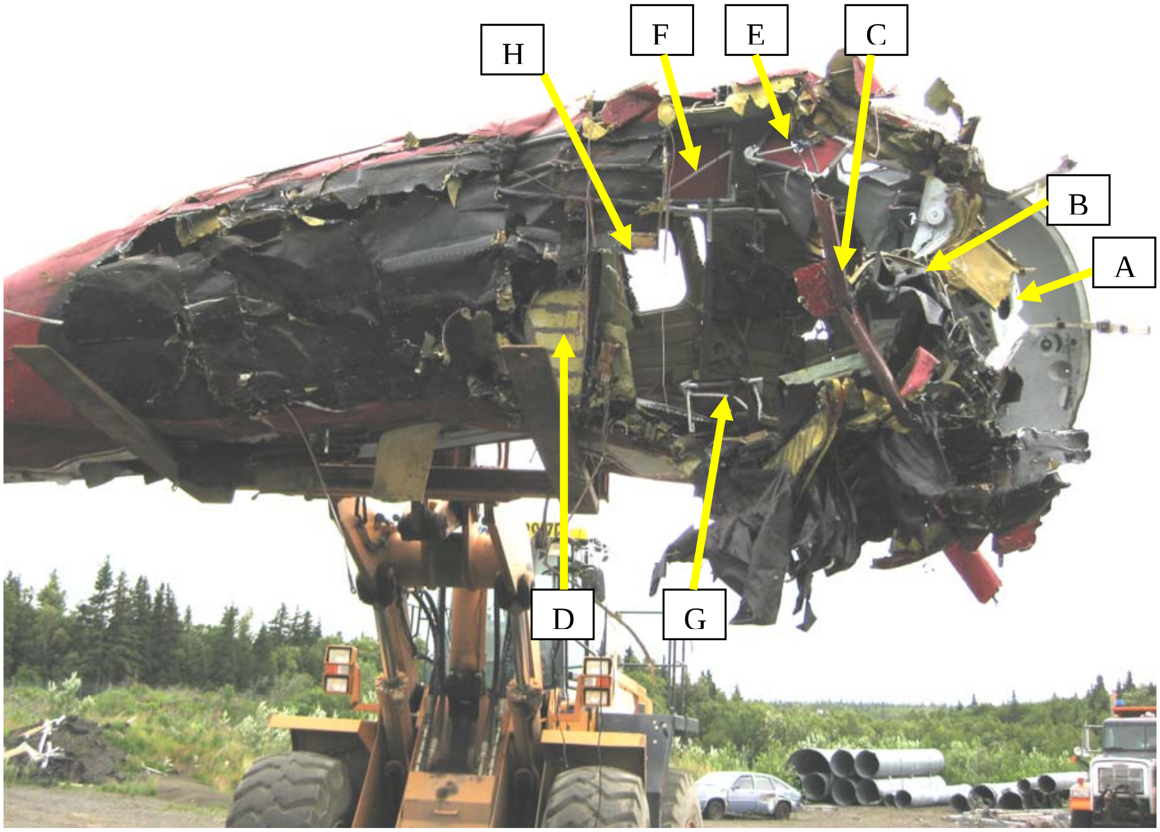

Figure 19. Bottom of fuselage when picked up with forklift, showing the lack of structural integrity. Also visible are: (A) Copilot's seat bottom, (B) twisted bottom edge of cockpit/cabin bulkhead, (C) Right forward landing gear attachment fitting, which is on the end of (B), and (D) the aft bulkhead with float attachment fittings. The forward cabin floor has fallen away, exposing (E) the right forward-most cabin seat (#4), (F) right cabin second seat (#6), (G) left cabin second row seat (#5), and (H) the open roof escape hatch.

The forward (canted) bulkhead had been extensively torn apart, with the lower structural components either missing or twisted aft. The left end of the forward bulkhead had been above the upwardly hydro formed area of the left float. The upward deformation of the fuselage in the area also upwardly displaced the cabin floor and forward-most left cabin seat. (See Figure 20) The airplane had a post-manufacture modification to strengthen the original design around the landing gear attach fitting and the damage destroyed the reinforced structure.

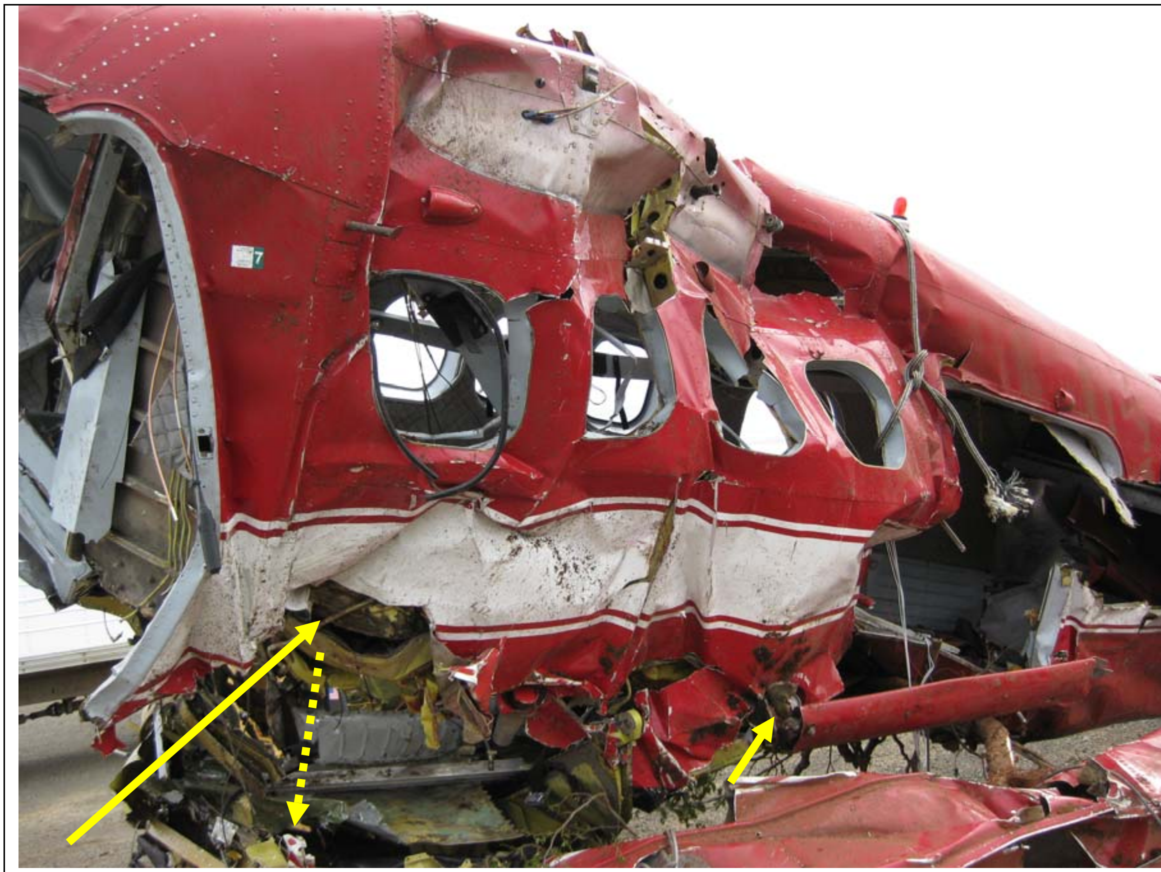

Figure 20. Damage to left side of the cabin. Arrows point to the approximate displacement of the left float fittings. The aft edge of the cockpit door is normally vertical (above long arrow) and the crush aft of it is how far aft the cockpit/cabin bulkhead had been displaced toward the cabin's left forward-most seat. The seat had been above the head of the long arrow. (As the fuselage was lifted, the forward bulkhead remnant and left forward float attachment fell to the end of the dashed line.) Also visible above the windows is the amount of intrusion into the upper fuselage by the trailing edge of the left wing.

The right end of the forward bulkhead and lower aft portion of the right cockpit door were displaced aft. The float fitting had rotated so that the forward end was outboard. Each of these aspects of the damage reduced the space between the bulkhead that had been the forward cabin wall (aft cockpit wall) and the first passenger seat on the right. (See Figure 21)

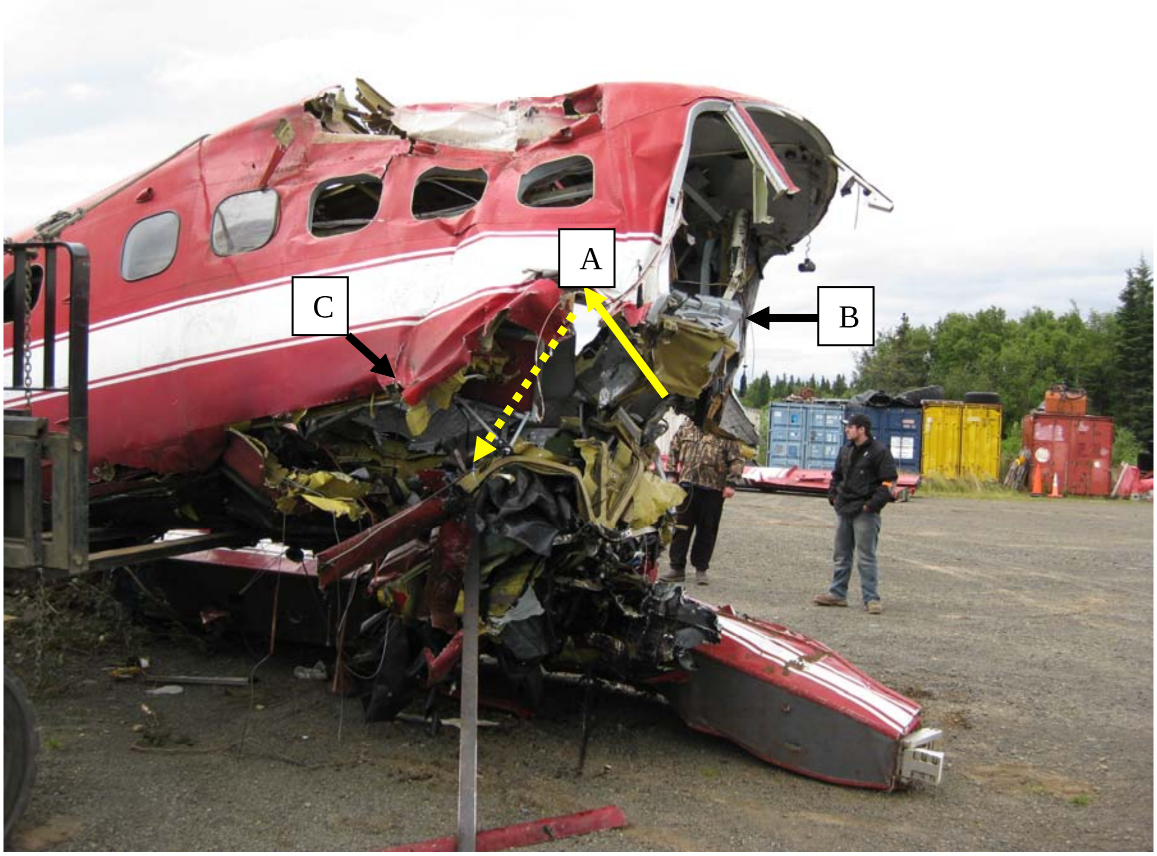

Figure 21. Damage to the right side of the cabin. The forward right float fitting was displaced upward and aft (See A), similar to the left fitting, before falling to where indicated by the dashed arrow. (Origin point of solid arrow is approximate.) Aft displacement of the canted bulkhead is visible as crushed structure that is aft of the cockpit door. The copilot seat is (B) ahead of the bottom of the cockpit door frame. The location of the destroyed wing strut fitting structure is visible (C).

The mid and aft bulkheads were also torn apart and little structure remained beneath the cabin floor. The left cabin wall had buckled in multiple places (Figure 22) and the wing strut fitting was twisted aft. The right cabin wall bent inward through the area of the second cabin window and seat above where the lift strut fitting had been. Between the bulkhead locations were only shreds remaining of the fuel cell bladders.

The fuselage structure had broken above floor level across the cockpit, exposing the two cockpit seats, with the instrument panel displaced forward from the seating positions. The cockpit floor structure was twisted and none of the underlying structure remained intact. The left side of the cockpit was lowest. The front left corner of the captain’s seat pan was near ground level and in the midst of alder tree branches.

With respect to the occupiable space in the general cabin, the root structure of the left wing had moved the left cabin wall inward between the second left cabin seat and the set of main doors. The displacement was especially pronounced above the level of the seat pans. The right wing root and sidewall above the right wing strut fitting intruded to a lesser amount into the upper fuselage structure. (See Figures 22, 23, and 24)

Figure 22. Prior to recovery. The left wall of the cabin can be seen displaced inward, as looking aft from the cockpit.

Figure 23. View from aft of cabin to show disruptions to the left cabin side wall and floor prior to recovery. Figure 22 showing the same features from the other end of the cabin was photographed from the where green foliage can be seen at the top of this photo.

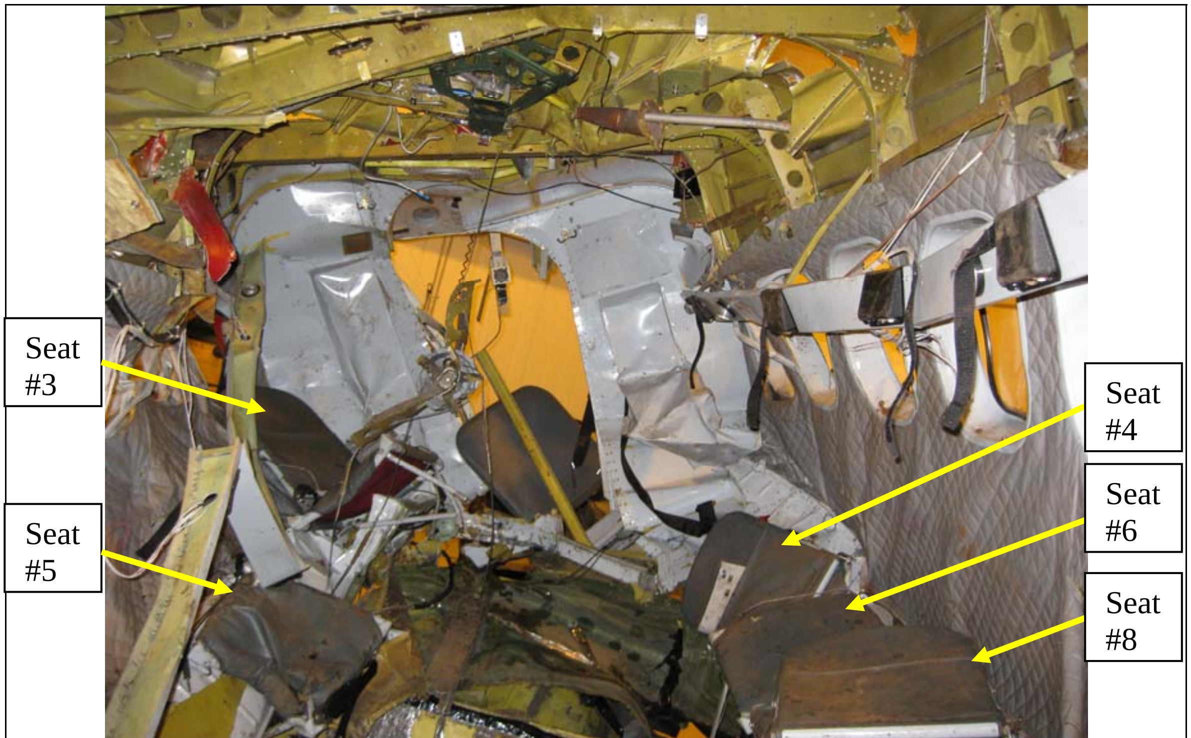

Figure 24. After recovery and removal of loose items. The right cabin wall displacement and buckling of floor, as looking forward toward the cockpit/cabin bulkhead. See section pertaining to seats for seat numbering and damage descriptions.

The cabin floor was missing, fell away, or was extensively buckled where the underlying support no longer existed. At the accident site, an alder branch was found penetrating upward through the left rear fuel bladder and remaining floor structure beneath the third passenger seat on the left cabin wall.

The left sidewall of the fuselage behind the main cabin door was cut open during rescue.

WINGS AND WING CONTROL SURFACES:

Both wings retained the flaps and ailerons. Each had leading edge impact damage consistent with striking the alder trees at the accident site. The depth of the leading edge damage was enough to break the cover for the landing light in the right wing, but not reach the face of the bulb. The tip of the left wing had a crush line that visually resembled the roll and pitch angles of the bottom of the left float. An alder branch penetrated upward through the gap between the left wing and flaperon.
(See Figure 25)

Figure 25. The upper surface of the left wing and bottom of the right wing, shown respectively from the tip ends. The arrow placed on the right wing shows where a broken control rod was found.

Both forward wing spar fittings had broken at the fuselage attachments. Each of the aft spar attachments had twisted. The trailing edges of the flap and flaperon surfaces had a series of upward and downward bends.

The fuselage carry-through structure for the wing spars was disrupted and the mounting for the hydraulic flap actuator and quadrant had been displaced, trapping the quadrant in the flaps up orientation. A connecting rod for the flap/trim interconnection had broken behind the quadrant. The flap control rods to the left wing had broken at the fuselage wall. (See Figure 26)

Figure 26. Extensive component and structural damage at the fuselage breach near the flap actuator and control quadrant above what had been the cabin ceiling.

The design of the wing included flaps and flaperons.[4] During examination of the flaperon system, the flaperon buss cable was found broken near the control quadrant that was hanging from broken structure in the fuselage.

The flaps in each wing were found in the retracted position and the cockpit indicator showed that the flaps were up. The pushrods and bellcrank mechanisms appeared intact through each wing and to where the wing center section had broken above the cabin.

The left flaperon was found trailing edge up and control continuity was established through the wing after recovery.

The right flaperon trailing edge was seen deflected up on-site and was deflected down after recovery. Following recovery, the control pushrod from within the wing to the hinge of the flaperon was found broken. The overload fracture occurred about 1.7 inches from the center of the rod end bearing, where an external rounded impression was found to have about the one inch diameter of a rod end.

A light cross was scribed into the inboard side of the shorter fragment for later reference about how the rod had been installed. Other than the break in the control rod, continuity remained in the control system through the rest of the wing. (For more detail about the break in the control rod, see NTSB Materials Laboratory Report 10-092.)

A records review was conducted into the history of control rod failures. No accidents were found in the DHC-3 fleet and only one was found in the flaperon system of the DHC-6 Twin Otter, which is a more numerous model and uses a similar design. The Canadian Transportation Safety Board Aviation Safety Information System (Record A79P0091) shows that the September 30, 1979 accident happened on approach to Sechelt, Canada, in a Model DHC-6-200 being operated by West Coast Air. The DHC-6 failure happened after "an extensive stress corrosion crack" failed, not in an overload failure. The DHC-6 stress corrosion had not been detected and the rod had separated from the bellcrank end fitting and not in the middle of the rod. The report stated that "This allowed the right aileron to move up, causing asymmetric lift and irretrievable loss of control." Of the 16 occupants, two were fatally injured.

TAIL CONTROL SURFACES:

The Texas Turbine conversion of the DHC-3 retains the trimmable horizontal stabilizer, enlarges the trim tab on the left elevator for the flap/pitch interconnect, and uses the tab on the right elevator as a servotab. The position of the trimmable horizontal stabilizer is indicated by a paint mark on the vertical stabilizer. (See Figure 27)

[4] A flaperon is a form of aileron that partially extends when the wing flaps extend.

Figure 27A. Aft view of airplane, showing tail control surfaces, including trim. The right float is beneath the right side of the fuselage with the keel toward the camera.

In the tail of the accident airplane, the horizontal stabilizer position was near the paint mark that indicated neutral trim. The interconnect trim tab moved in the correct direction when the cable drum was rotated within the tail structure. The servo tab functioned appropriately when the elevator was moved.

Figure 27B. Left side of horizontal stabilizer that is shown in Figure 27A, showing closeup of trim setting found.

The elevator control rod in the tail moved on the bearing, had no contact points in travel (the bolt proximities were checked), and was straight.[5] No anomalies were noted at the elevator control quadrant. The pitch control stops had contact marks, but the painted contact surfaces did not have a beaten appearance and most of the paint was intact.

The right horizontal stabilizer tip was bent downward from wrinkled lower skins mid-span. Other failure of the tailplane structure was not seen.[6]

The rudder trim tab moved with hand rotation of the controlling cable capstan in the tail.

The rudder control rod in the tail moved on the bearing, had no contact points in travel, and was straight. No anomalies were noted at the rudder control quadrant. The rudder control stops had contact marks, but the contact surfaces did not have a beaten appearance.

The bellcrank for the water rudder and tail wheel was found broken immediately above where the shaft would come up from the ventral fin that had been found in the beginning of the debris trail.

A spray can of Prist Cleaner was found within the tail cone next to the supporting structure for the tail wheel steering shaft. The can had creases that matched the angle of a structural flange in the bilge of the supporting structure, which was not near the control rod.

COCKPIT AND CABIN INTERIOR, GENERAL:

The occupiable area within the airplane was divided into the cockpit and cabin sections. (See Figures 28 and 29) The seats in the cabin were a welded steel tube frame, with a hinge at the bottom of the seatback. The design allowed the operator to fold the seatbacks down or the seats could be completely removed.

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[5] Ref: Airworthiness Directive 86-16-12.
[6] Ref: Airworthiness Directive 96-09-04.

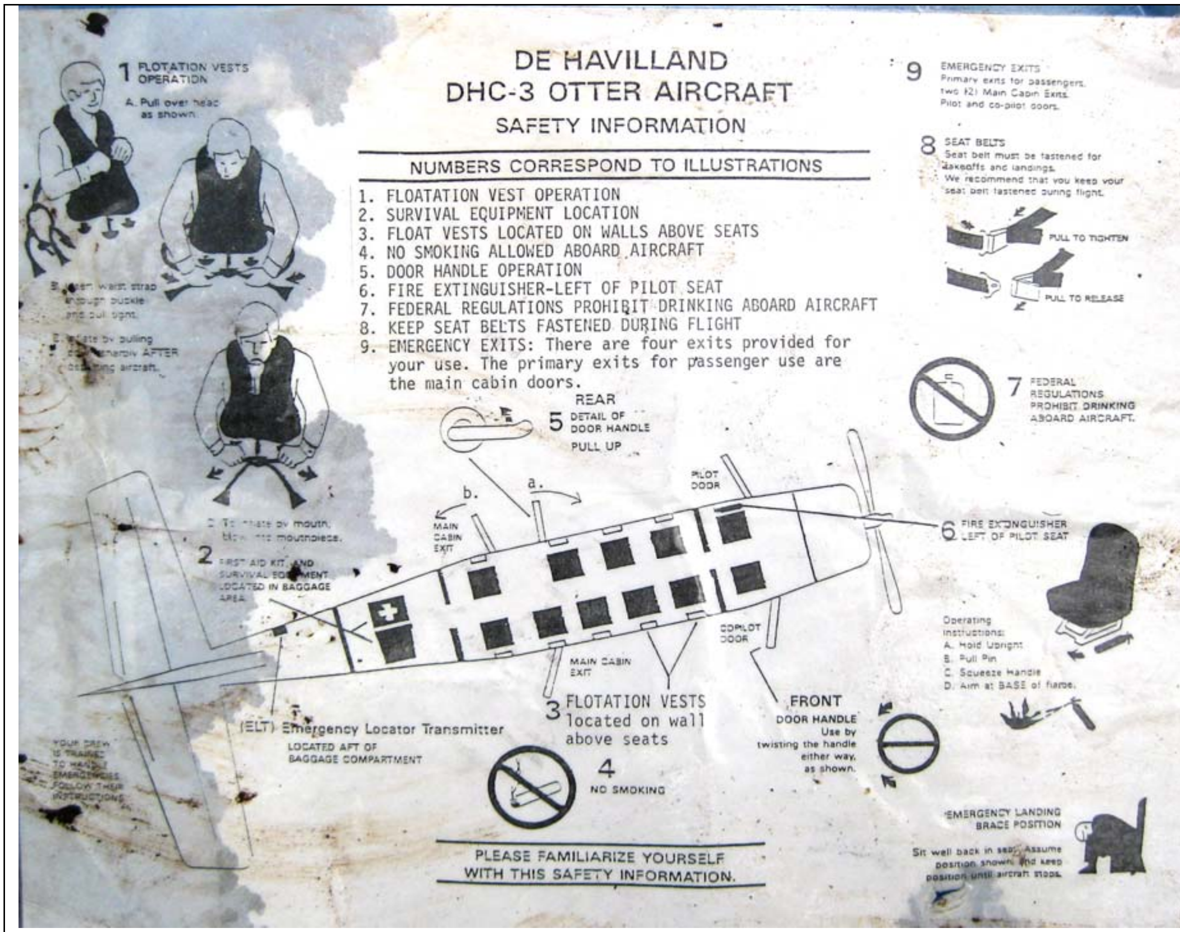


Figure 28. Safety information card found in a seat pocket shows cockpit and cabin arrangements, with approximate relation of seat positions to the windows and doors. The seats are removable and may be omitted from positions shown.

Figure 29. Interior of similar Turbine DHC-3 (N361TT) that was modified by Texas Turbines, with minor trim differences.

SEATS:

The seats were the original style that was described in DeHavilland engineering documents dated January 1954 (AEROC 3.4.FF.2). For the purposes of this report, the seats have been arbitrarily numbered from left to right and front to back, as follows:

FORWARD

1 Captain seat	2 Copilot seat
3 Front left cabin seat	4 Front right cabin seat
5 Second row, left seat	6 Second row, right seat
7 Third row, left seat	8 Third row, right seat
(Door, no seat)	9 Fourth row, right seat
10 Fifth row, left seat, aft of main door set	11 Fifth row, right seat, aft of main door set

AFT

Rescue personnel reported that they had moved seats or seat fragments to make survivors more comfortable. Damage to the seat fragments was pattern-matched to create the seat descriptions in this section.

The cockpit seats had shoulder harnesses; the cabin seats had no shoulder harnesses. The seatbelts were marked with a variety of manufacturer names.

An airworthiness directive (AD 88-15-08) and service bulletin were found that addressed retention of the cabin seats to the floor structure. The AD required inspection of the forward seat legs for retention to the floor structure at a 50 hour interval, unless the modification of Service Bulletin 3/42 was installed to permanently terminate the inspection requirement. There was no intact subfloor structure beneath any of the cabin seats to attach to, except beneath seat #9, which was across from the main cabin doors, and seat #9 was crushed. The legs of seat #8 remained attached to what remained of the floor that had been beneath it. (See individual description about seat #8 for more detail.)

The cabin floor itself was twisted in both roll and slope, especially forward of the left cabin door. (See Figure 20) An alder branch penetrated upward through the fuel tank area and then through the floor immediately forward of the main set of doors. (See description for seat #7) The float attach structure at the lower front corners of the cabin had broken surrounding areas of the fuselage. This left open holes and displaced the floor sharply upward beneath the forward-most set of cabin seats. Ahead of the two forward-most cabin seats were soft body crushing on the aft faces of the bulkheads that separated the cabin from the cockpit.

Note: Almost all of the seat photographs shown were taken after recovery and the cabin was cleared of obscuring personal effects, blankets, and other debris.

Seat 1 - Captain's seat:

The captain's seat of the accident airplane in general had deformed nose down and to the left. The aluminum seat pan had even further deformation in that direction. Removal of the bottom cushion revealed that the forward left corner of the seat pan had upward/aft impact damage. (See Figure 30) The pan of the seat had twisted on the seat subframe so that the leading edge was toward the left.

Figure 30. Captain seat pan after cushion removal.

The back of the captain's seat was built from bent steel tube with aluminum attachments to each aft corner of the pan. The base of the seatback had broken free of the pan at the inboard/left corner, where rivets had sheared. The sheetmetal pan had torn at the attachment of the seat back to the pan on the outboard/left side.

A partially crushed steel tube subframe was between the aluminum seatpan and the floor. The floor had no intact substructure and was buckled downward, especially beneath the front of the seat and items that had been under the seat. A can of electrical spray cleaner, bottle of water, and tools were found in the crushable space beneath the seatpan of N455A. (See Figure 31) When the cockpit doors of a similar float equipped Otter were opened at Dillingham, tools and canned spray cleaner were also found in the space beneath the cockpit seats. The location was convenient for storage of frequently used items. This was located at chest to neck level for a person standing on the float. (See Figure 32)

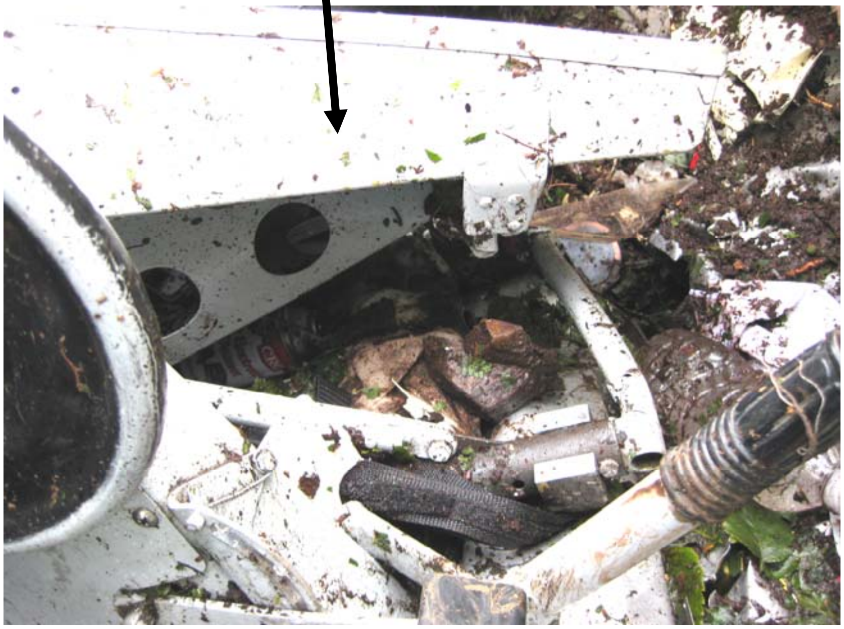


Figure 31. Right side of the captain's seat pan and the area beneath it. Aft is to the left. Visible between the seat pan and floor is a can of CRC spray cleaner, tools, and a water bottle.

Figure 32. Cleaning materials, tool, and other items seen beneath the captain's seat of another Turbine Otter. Note that Figure 31 is a photograph from the area from the other side of the seat.

Seat 2 - Copilot seat:

The subframe had bent the floor structure downward, especially toward the front. The copilot's seat had been constructed with a fiberglass pan on a crushable steel subframe. The steel subframe did not have as much crush damage as that found to the captain seat frame. The fiberglass seat pan had broken where the aluminum supports for the backrest attached. The inboard wall of the seatpan had completely broken away. (See Figure 33) A rusty 18 inch pipe wrench was found immediately ahead of the crushable space that had been beneath the copilot seat.

Figure 33. Copilot seat, showing the fractured and missing portions of the seat pan.

Seat 3 - forward-most on the left in the cabin.

This seat had been above the forward left float fitting and was found up and inward from the original location. The bulkhead in front of the seat had a generalized soft body type of deformation. The lap belts were intact. The seat frame was a welded steel tube assembly that had broken. (See Figure 34)

Figure 34. Seat #3, the forward most left cabin position, showing absence of floor structure and upward deformation beneath the seat.

Seat 4 - forward-most on the right in the cabin.

This seat had been above the right forward float attachment fitting and the area of the seat was not intact. The distance between the seat and bulkhead in front of the seat had been reduced by aft displacement of the bulkhead. The bulkhead had soft body impact damage. The seat lap belt was intact. The right side of the seat remained attached at the rear. The welded structure of the left side of the seat had buckled and collapsed. (See Figure 35)

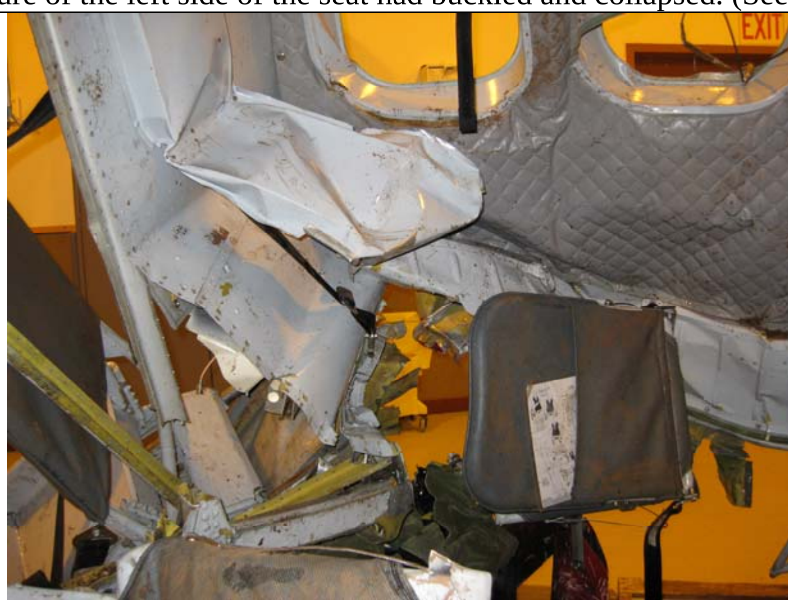


Figure 35. Seat #4, the forward most right cabin position, showing absence of floor structure and upward deformation beneath the seat.

Seat 5 - second row on the left in the cabin.

The floor no longer existed beneath this seat, the welded frame failed, and punch marks were found in the rear tubing. The back of the seat was found separate from the bottom portion of the seat. The left structure failed that the lap belt had attached to. (See Figure 36)

Figure 36. Seat #5, this was the second cabin seat on the left and the photo shows absence of floor structure. Seat #7 had been aft of this seat and fell away during recovery.

Seat 6 - second row on the right in the cabin.

The seat back had separated from the bottom of the seat. The welded tube leg assembly remained without floor to attach to. The seatbelt and structure that the belt had attached to was missing. (See Figure 37)

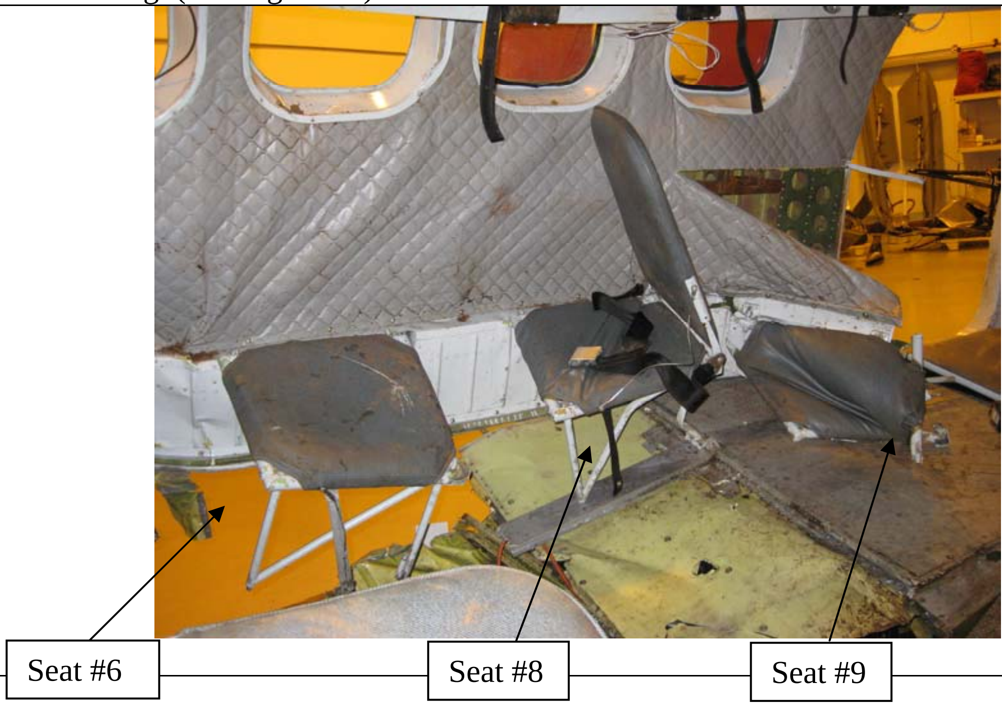


Figure 37. Seats #6, #8, and #9 on right cabin side wall and lack of supporting structure.

Seat 7 - third row on the left in the cabin and immediately in front of the left cabin door.

A branch penetrated upward through the floor and into the rear of seat. The seat remained attached to torn structure and was deformed, with the back separate. (See Figure 38)

Figure 38. Photo taken prior to recovery shows branch (lower left corner of photo) penetrating up from cabin floor and through area of aft outboard hinge for seat #7.

Seat 8 - third row on the right in the cabin.

The seat back had been ripped off. The right lap belt structure remained with the back portion of the seat. The structure that remained was still attached to the front leg of seat #8 (ref AD 88-15-08) (See Figures 37 and 39).

Seat 9 - across from the left entry door.

The seat tubing was attached to sidewall structure that had been torn apart. The steel frame of the seat had broken extensively. A remnant of the aft left leg remained attached to the floor. The upper portion of the seat totally separated from the bottom and the lap belts remained with the detached upper seat portion. (See Figure 39)

Figure 39. Fragments of seat #9. The arrow points to the broken structure that seat #11 had been attached to.

Seats 10 and 11 - aft of the cabin doors.

Both seats were collections of fractured tubing. The attachment points for the seatbelts had broken. (See Figures 40 and 41)

Figure 40. Aft of cabin with seat fragments, prior to recovery.

Figure 41. Aft of cabin, prior to recovery, showing enough seat fragments to account for seats 10 and 11, aft of the cabin doors.

COCKPIT INSTRUMENTS, DISPLAYS, AND CONTROLS:

GENERAL:

The control column was displaced to the left, with the right yoke partially crushing the engine control pedestal. The bottom of the control column had folded above the level of the floor. (See Figure 42A) The mud on the instrument panel had a flattened and evenly pressed appearance. (See Figure 42B)

Figure 42A. Cockpit, as viewed from above right wing root.

Figure 42B. Closer view of the instrument panel as initially found.

Closer examination of the control yokes shown in Figure 42A revealed more of both generalized and localized damage to the yoke on the captain's side. The left handle was found slightly more bent forward than the right handle, with the copilot's yoke otherwise generally intact. The large crossbeam that both control yokes were mounted upon had been bent forward at the captain's end. The lower portions of the welded steel captain's yoke had paint fractures, a switch bracket to the left handle was found bowed, and the foam covering on the right handle had split (not worn). Paint, bending, and twist evidence were extensive where the captain's yoke mounted to the cross beam. The same area of the copilot's mounting had significantly less localized damage.

Figure 42C. A cockpit photo that has been magnified and cropped to show the control yokes.

No records were found to indicate that the airplane had approval for flight in instrument meteorological conditions. The physical instrumentation and radios found in the instrument panel were capable of providing instrument flight capability. (See Figure 43)

Figure 43. Instrument panel about five years prior to the accident, as provided by the company that modified the airplane (TexasTurbines). Hidden behind the captain's yoke

are the artificial horizon and Sandel electronic horizontal situation indicator. Visible also are the GNS-530 Garmin nav/comm/GPS that had terrain awareness capability on the captain's panel, as well as the Garmin GNS-430 in front of the copilot seat.

INSTRUMENTS AND CONTROLS:

The primary flight instruments were found in the left instrument panel. (See Figure 44)

Figure 44. Primary flight instruments, after wiping away some of the mud that is visible in Figure 42B.

The altimeter setting was between 29.51 and 29.52 and the displayed altitude was slightly less than 200 feet. During and after removal, the display needle moved freely between 120 and about 190 feet. The altimeter had been manufactured by United Instruments of Wichita, KS.

The vertical speed indicator displayed 200 feet per minute climb. The Sigmatek primary attitude indicator had no OFF flag in view and the display was oriented to about 22 degrees nose down with a 5 degree right roll. The standby attitude indicator did display an OFF flag and attitude indication of about 30 degrees nose down.

To the left of the engine indicating instruments were two columns of switches in the following positions: (See Figure 45)

Master 1	ON
Para/Series	UP
Auto Ignition	OFF
Anti-Ice (engine inlet)	OFF
Boost Pump	ON
NTS Check	OFF
Fuel On toggle	RUN
Unfeather Pump	OFF

Figure 45. Engine related switches and engine instruments.

Open circuit breakers on the subpanel were marked MAIN POWER and 24V RECEPT. The fuel selector was between the REAR and the OFF positions. (See Figure 46)

Figure 46. Electrical subpanel.

The lower switch area of the forward instrument panel had a soft body impact that was located forward of where the captain's right knee would have been. Switches found in the ON positions were marked for Engine Instrument Backup, Master Radio, and Beacon Lights. The switches in the OFF position were marked for the Pitot Heat and Dome Light.

Forward of the instrument panel in what had originally been the engine compartment, the engine controls remained attached to the engine fuel control by Teleflex cables and the housings of the cables had marks from displacement in mounting clamps. The power and condition levers were found in the full aft positions. The propeller lever was found in the full forward position.

The pitch trim indicator between the cockpit seats was found slightly nose down and matched the position of the pitch trim indication marked on the vertical stabilizer. The control cable hung slack from the drum.

In the overhead, the rudder trim indication was found indicating a position slightly to the right of center.

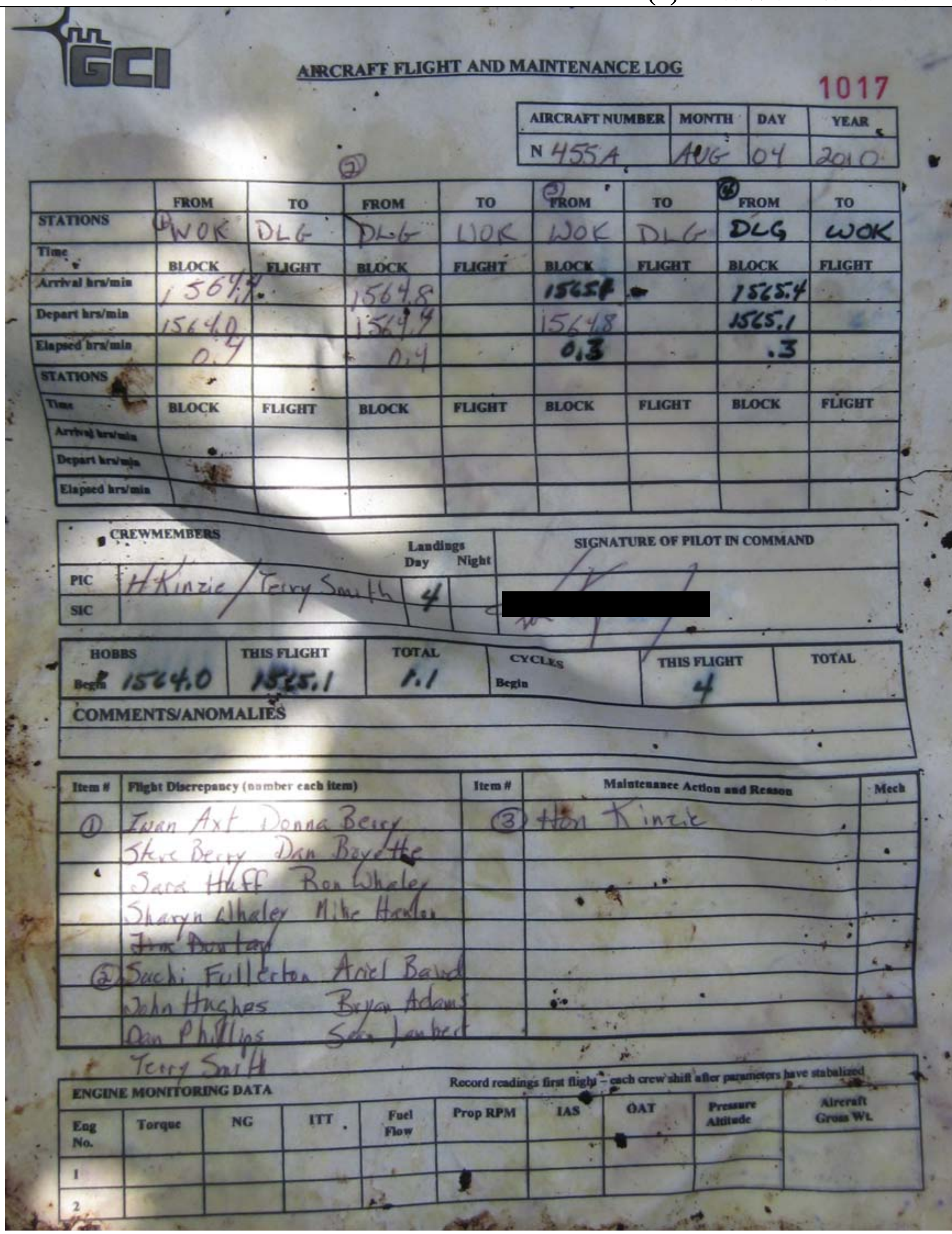
FLIGHT LOG PAGES:

A pad of aircraft log pages was found on the cockpit floor. The final number of flight hours shown was 1,574.4. The top page (#1016, dated August 3, 2010) and page 1021 (dated August 9, 2010) were covered with mud and did not have the clean appearance of the other log pages. The final page (See Figure 51) had the earlier flight of the day completely logged. The entry for the final flight is denoted by a circled “2” and an incomplete list of passenger names.

Log Page:	Date:	Pilot:	Passengers:	Routes and flight time
1016	Aug 3	Kinzie	[blank]	

Figure 49. Log page 1016

Log Page:	Date:	Pilot:	Passengers:	Routes and flight time
1017	Aug 4	Kinzie & Smith	(1) 8 passengers (2) 7 passengers includes Smith 1. Kinzie	(1)WOK/DLG .4 hours (2)DLG/WOK .4 hours (3)WOK/DLG .3 hours (4)DLG/WOK .3 hours



GCI

AIRCRAFT FLIGHT AND MAINTENANCE LOG

1017

AIRCRAFT NUMBER	MONTH	DAY	YEAR
N 455A	AUG	04	2010

	FROM	TO	FROM	TO	FROM	TO	FROM	TO
STATIONS	(1) WOK	DLG	(2) DLG	WOK	(3) WOK	DLG	(4) DLG	WOK
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min	1564.4		1564.8		1565.1		1565.4	
Depart hrs/min	1564.0		1564.4		1564.8		1565.1	
Elapsed hrs/min	0.4		0.4		0.3		.3	
STATIONS								
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min								
Depart hrs/min								
Elapsed hrs/min								

CREWMEMBERS		Landings Day	Landings Night	SIGNATURE OF PILOT IN COMMAND
PIC	H Kinzie / Terry Smith	4		[redacted]
SIC				

HOBBS Begin	THIS FLIGHT	TOTAL	CYCLES Begin	THIS FLIGHT	TOTAL
1564.0	1565.1	1.1		4	

COMMENTS/ANOMALIES

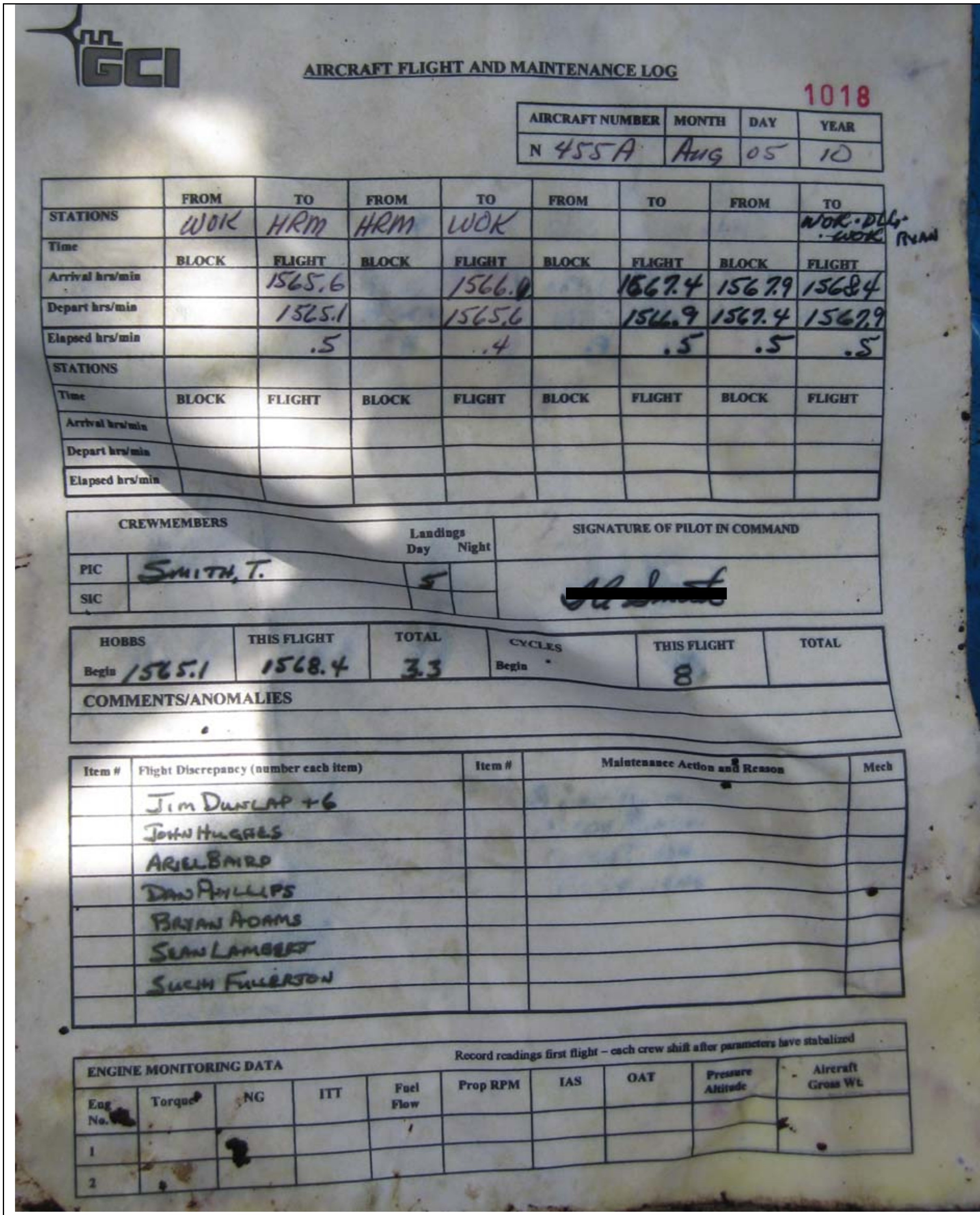
Item #	Flight Discrepancy (number each item)	Item #	Maintenance Action and Reason	Mech
(1)	Ivan Axt Donna Berry	(3)	Hon Kinzie	
	Steve Berry Dan Bayette			
	Sara Huff Ron Whaley			
	Sharyn Whaley Mike Hawley			
	~~Jim Boxley~~			
(2)	Suchi Fullerton Ariel Baird			
	John Hughes Bryan Adams			
	Dan Phillips Sam Lambert			
	Terry Smith			

ENGINE MONITORING DATA — Record readings first flight – each crew shift after parameters have stabilized

Eng No.	Torque	NG	ITT	Fuel Flow	Prop RPM	IAS	OAT	Pressure Altitude	Aircraft Gross Wt.
1									
2									

Figure 47. Log page 1017

Log Page:	Date:	Pilot:	Passengers:	Routes and flight time	
1018	Aug 5	Smith	7 passengers	WOK/HRM	3.3 hours total
				HRM/WOK	
				WOK/DLG	
				DLG/WOK	



GCI

AIRCRAFT FLIGHT AND MAINTENANCE LOG

1018

AIRCRAFT NUMBER	MONTH	DAY	YEAR
N 455A	Aug	05	10

	FROM	TO	FROM	TO	FROM	TO	FROM	TO
STATIONS	WOK	HRM	HRM	WOK				WOK-DLG- -WOK- RYAN
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min		1565.6		1566.0		1567.4	1567.9	1568.4
Depart hrs/min		1565.1		1565.6		1566.9	1567.4	1567.9
Elapsed hrs/min		.5		.4		.5	.5	.5
STATIONS								
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min								
Depart hrs/min								
Elapsed hrs/min								

CREWMEMBERS		Landings Day	Landings Night	SIGNATURE OF PILOT IN COMMAND
PIC	SMITH, T.	5		[redacted]
SIC				

HOBBS	THIS FLIGHT	TOTAL	CYCLES	THIS FLIGHT	TOTAL
Begin 1565.1	1568.4	3.3	Begin	8	

COMMENTS/ANOMALIES

Item #	Flight Discrepancy (number each item)	Item #	Maintenance Action and Reason	Mech
	JIM DUNLAP +6			
	JOHN HUGHES			
	ARIEL BAIRD			
	DAN PHILLIPS			
	BRYAN ADAMS			
	SEAN LAMBERT			
	SUEIM FULLERTON			

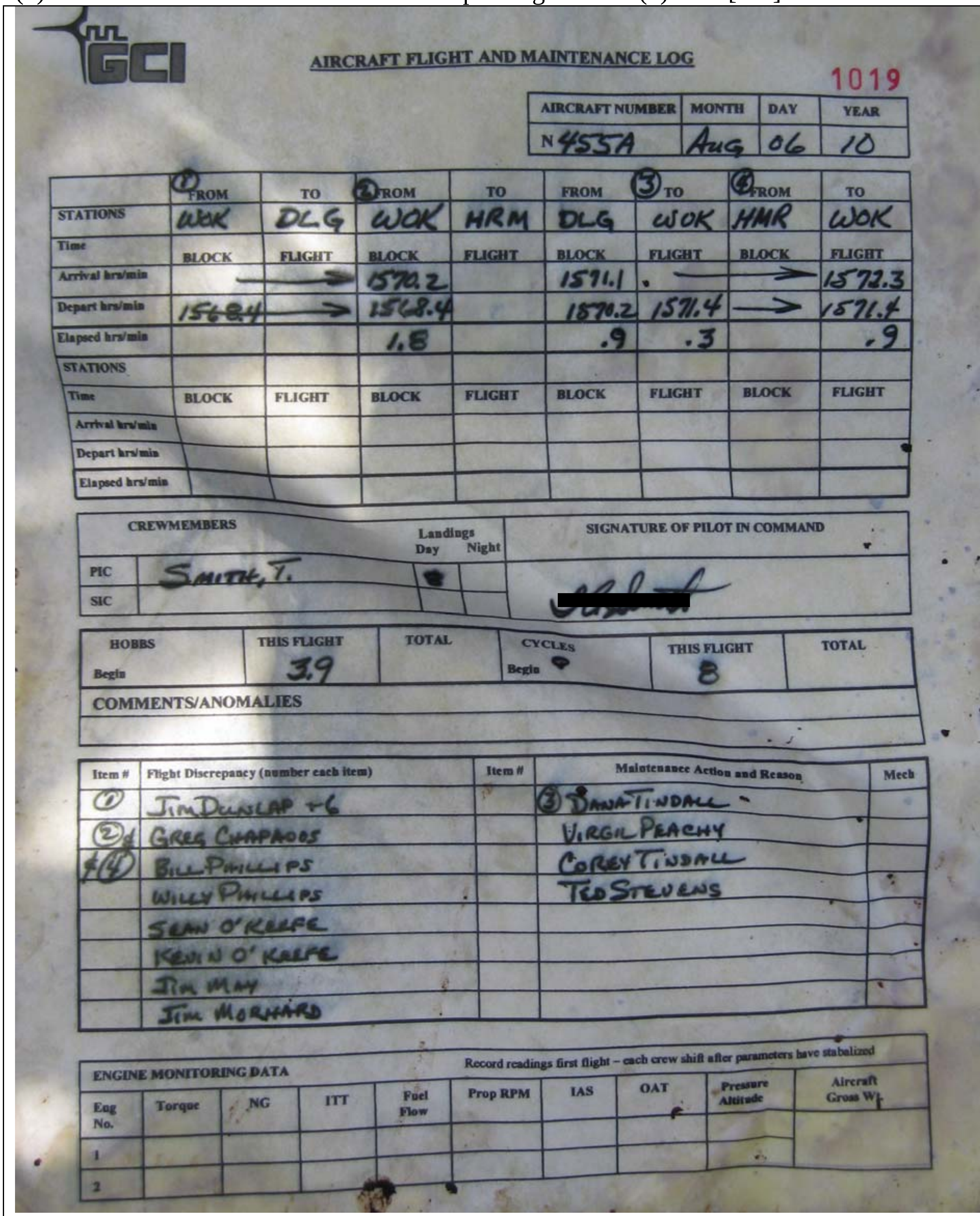
ENGINE MONITORING DATA

Record readings first flight – each crew shift after parameters have stabilized

Eng No.	Torque	NG	ITT	Fuel Flow	Prop RPM	IAS	OAT	Pressure Altitude	Aircraft Gross Wt.
1									
2									

Figure 48. Log page 1018

Log Page:	Date:	Pilot:	Passengers:	Routes and flight time
1019	Aug 6	Smith	(1) 7 passengers	(1)WOK/DLG 3.9 hours total
			(2) 1 passenger	(2)WOK/HRM/DLG
			1. 4 passengers	(3) DLG/WOK
(4)			6 passengers	(4)HMR[stet]/WOK



GCI

AIRCRAFT FLIGHT AND MAINTENANCE LOG

1019

AIRCRAFT NUMBER	MONTH	DAY	YEAR
N455A	Aug	06	10

	(1) FROM	TO	(2) FROM	TO	FROM	(3) TO	(4) FROM	TO
STATIONS	WOK	DLG	WOK	HRM	DLG	WOK	HMR	WOK
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min		→	1570.2		1571.1	. →	→	1572.3
Depart hrs/min	1568.4	→	1568.4		1570.2	1571.4	→	1571.4
Elapsed hrs/min			1.8		.9	.3		.9
STATIONS								
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min								
Depart hrs/min								
Elapsed hrs/min								

CREWMEMBERS		Landings Day	Landings Night	SIGNATURE OF PILOT IN COMMAND
PIC	SMITH, T.			[redacted]
SIC				

HOBBS Begin	THIS FLIGHT	TOTAL	CYCLES Begin	THIS FLIGHT	TOTAL
	3.9			8	

COMMENTS/ANOMALIES

Item #	Flight Discrepancy (number each item)	Item #	Maintenance Action and Reason	Mech
(1)	JIM DUNLAP +6		(3) DANA TINDALL	
(2)	GREG CHAPADOS		VIRGIL PEACHY	
(4)	BILL PHILLIPS		COREY TINDALL	
	WILLY PHILLIPS		TED STEVENS	
	SEAN O'KEEFE			
	KEVIN O'KEEFE			
	JIM MAY			
	JIM MORHARD			

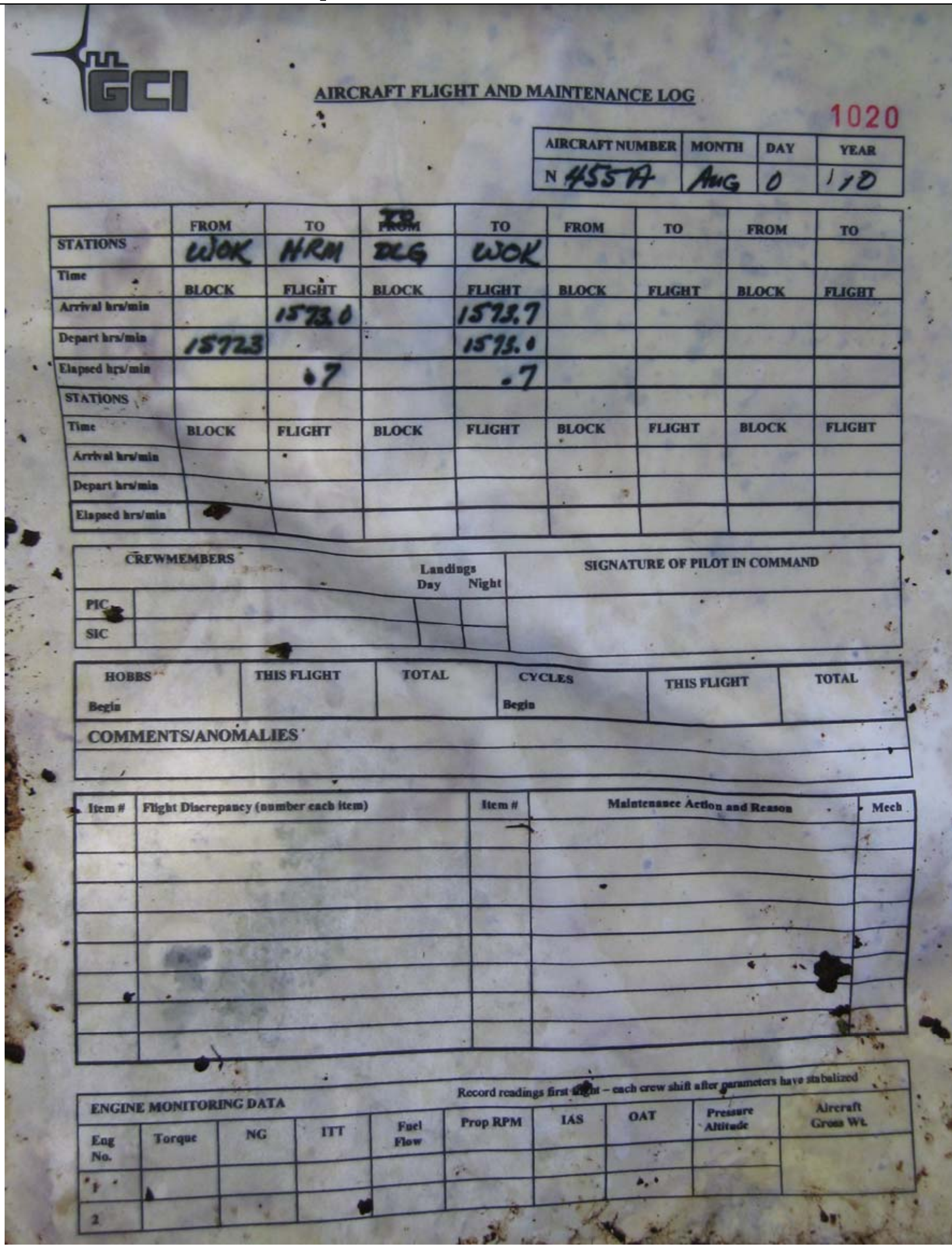
ENGINE MONITORING DATA

Record readings first flight – each crew shift after parameters have stabalized

Eng No.	Torque	NG	ITT	Fuel Flow	Prop RPM	IAS	OAT	Pressure Altitude	Aircraft Gross Wt
1									
2									

Figure 49. Log page 1019

Log Page:	Date:	Pilot:	Passengers:	Routes and flight time
1020	Aug 0 [stet]	[blank writing resembles Smith's]	[blank]	WOK/HRM 1.4 hours total HRM/DLG DLG/WOK



GCI

AIRCRAFT FLIGHT AND MAINTENANCE LOG

1020

AIRCRAFT NUMBER	MONTH	DAY	YEAR
N 455A	AUG	0	10

STATIONS	FROM	TO	TO / FROM	TO	FROM	TO	FROM	TO
	WOK	HRM	DLG	WOK				
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min		1573.0		1573.7				
Depart hrs/min	15723			1573.0				
Elapsed hrs/min		.7		.7				
STATIONS								
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min								
Depart hrs/min								
Elapsed hrs/min								

CREWMEMBERS	Landings Day	Landings Night	SIGNATURE OF PILOT IN COMMAND
PIC			
SIC			

HOBBS	THIS FLIGHT	TOTAL	CYCLES	THIS FLIGHT	TOTAL
Begin			Begin		

COMMENTS/ANOMALIES

Item #	Flight Discrepancy (number each item)	Item #	Maintenance Action and Reason	Mech

ENGINE MONITORING DATA

Record readings first flight – each crew shift after parameters have stabilized

Eng No.	Torque	NG	ITT	Fuel Flow	Prop RPM	IAS	OAT	Pressure Altitude	Aircraft Gross Wt.
1									
2									

Figure 50. Log page 1020

Log Page:	Date:	Pilot:	Passengers:	Routes and flight time
1021	Aug 9	Smith	(1) 1 passenger	(1) WOK/DLG .4 hours DLG/WOK .5 hours
			(2) 3 passengers	(2) [blank]

GCI

AIRCRAFT FLIGHT AND MAINTENANCE LOG

1021

AIRCRAFT NUMBER	MONTH	DAY	YEAR
N 455	Aug	09	10

	① FROM	TO	~~FROM~~ TO	② TO	FROM	TO	FROM	TO
STATIONS	WOK	DLG	WOK					
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min		1574.1	1574.4					
Depart hrs/min		1573.7	1574.1	1574.4				
Elapsed hrs/min		.4	.3					
STATIONS								
Time	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT	BLOCK	FLIGHT
Arrival hrs/min								
Depart hrs/min								
Elapsed hrs/min								

CREWMEMBERS

		Landings Day	Night	SIGNATURE OF PILOT IN COMMAND
PIC	SMITH T.			[redacted]
SIC				

Begin	THIS FLIGHT	TOTAL	CYCLES Begin	THIS FLIGHT	TOTAL

COMMENTS/ANOMALIES

Item #	Flight Discrepancy (number each item)	Item #	Maintenance Action and Reason	Mech
①	VIRGIL PEACHY			
②	DANA TINDAL			
	COREY TINDAL			
	FRED STEVENS			

ENGINE MONITORING DATA — Record readings first flight – each crew shift after parameters have stabilized

Eng No.	Torque		ITT	Fuel Flow	Prop RPM	IAS	OAT	Pressure Altitude	
1									
2									

Figure 51. Log page 1021

Log pages 1022 and subsequent were blank and clean.

AVIONICS:

Maintenance records showed that almost all of the avionics were installed in 2005 when the turbine engine was installed. The forward instrument panel on the captain's side contained a Garmin GNS 530 radio. To the left of the GNS-530 and directly in front of the pilot was a Bendix/King KI-250 radar altimeter display.[7] A Sandel horizontal situation indicator was mounted beneath the captain's primary attitude indicator. On the copilot's side were a GNS 430, GTX 327 communications panel, SkyConnect Mission Module, and a marine radio manufactured by Icom.

RADAR ALTIMETER:

A Bendix/King KRA-10A radar altimeter system was installed in 2005, which included a KI-250 cockpit display. The display had a pilot adjustable setting for decision height (DH) that was found set at 275 feet above ground level (AGL). (See Figure 52)

Figure 52. Radar altimeter setting when found was at 275 feet, after wiping away some mud visible in Figure 42B.

Upon descending through the DH, the design provided for both visual and aural annunciations. The visual annunciation was a yellow illumination of the letters DH in the face of the indicator that would remain lit until the airplane was less than 20 feet above the ground. The aural warning is designed to produce a 1 kHZ tone for two seconds and

[7] Bendix/King has been acquired by the Honeywell Corporation.

the tone could not be muted. King documentation (IMKRA10/10A-3, page 3-2, dated 11/85) contained the following description:

> When the DH is reached, the DH audio will sound a 2 second tone and the DH lamp will light. The DH lamp will remain on until the aircraft descends to approximately 20 feet AGL (the pointer swings CW behind the mask), or until the aircraft climbs approximately 20 feet above the DH setting.

The remnants of the crushed instrument contained three light bulbs. Prior accident investigations and laboratory testing has found that tungsten filaments may stretch when hot and subjected to an impact load. Two bulbs existed for panel lighting and the third was the DH bulb. The filaments of the panel lights had not stretched and were visibly different than the stretched DH filament. (See Figures 53, 54, and 55)

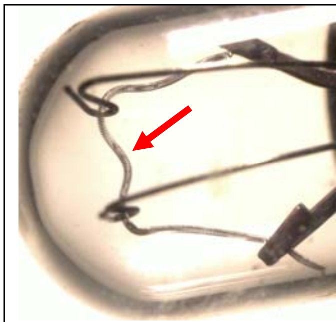


Figure 53. Panel light filament not stretched.

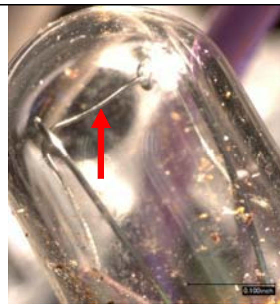


Figure 54. Panel light filament not stretched.

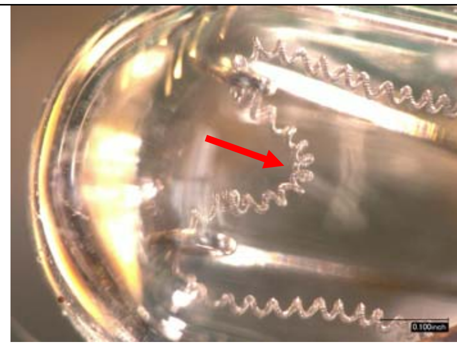


Figure 55. Stretched decision Height (DH) filament from the radio altimeter.

AUDIO PANEL / COCKPIT SPEAKER / HEADSETS:

The airplane was found with a PS Engineering PMA7000B audio panel installed. A cockpit speaker was in the cockpit ceiling. Broken headsets were found in the cockpit. The installation manual for the PMA 7000B contained the following statements:

> There are four unswitched inputs, available for traffic or EGPWS, autopilot disconnect, and/or radar altimeter warning.
>
> [About an avionics electrical connector, number J1] "…pins T, 17, U, and X are unswitched, unmated inputs. These inputs are presented to the pilot and copilot regardless of the audio configuration, and will always mute the entertainment inputs. These 510[?] inputs can be used for altimeter DH audio, GPS waypoint audio, autopilot disconnect tones, or any other critical audio signal. Pin T is provided to the pilot's headset even when the unit is off, or in fail-safe mode.

Unswitched audio, (autopilot disconnect, altimeter warning, etc.) will come through the speaker regardless of the speaker button position.

GARMIN GNS-530 GPS/RADIO:

The Garmin GNS-530 radio was examined twice. The first time was on September 21, 2010, at the NTSB laboratories by Dr. Joseph Greggor, Ronald Price, and Robert Swaim. The unit was first warmed to evaporate potential moisture. A laboratory power supply was used and no other external connections were provided for input of GPS or other antennae, altitude data, etcetera. The following were displayed when power was applied.

GNS 530 TAWS, Copyright 1998-2008
Main software version: 6.04
GPS software version: 3.03
Communication software version: 6.00
VLOC software version: 3.01
G/S software version: 2.03
Aviation database copyright 2008, Jeppesen Sanderson, Inc.
Americas IFR Aviation Database, Cycle 0807, Eff: 03-JUL-08, Exp: 31-JUL-08
Worldwide Land Database, Version 1.01
Land, Terrain, and Obstacle Databases, Copyright 2002-2005
WW Terrain Database, Version 2.01, Cycle 04T2
US Obstacle Database, Version 2.03, Cycle 05B1, Eff: 20-JAN-05, Exp __-__-__
US Airport Terrain Database, Version 2.01, Cycle 04A2

NAV Page #2:   (See Figure 56)
Following display of the information about the unit, this was the first map page displayed when power was first applied after the accident. The display was found on the 35 mile scale, centered near a white square icon labeled MUKLG. White square icons are user-defined waypoints.[8]

---

[8] The term “user-defined” does not imply who created the item or when. The term only means that the reference was added to the software products and data provided by Garmin and Jeppesen.

Figure 56. Map display when power was first applied. Note the display of 35 nautical mile range.

NAV Page #1 (See Figure 57) showed the 10 nm scale, centered just north of a white square icon labeled MUKLG. The DTK, TRK, GS, FROM/TO, ETE, and DIS all showed as blank lines (__ __ __).

Figure 57. The NAV page #1 display of position, after first application of power. The

display range is on the 10 nautical mile scale. The “BAY” waypoint in the upper left may be used to compare this scale with the scale shown in Figure 56. The “5A8” is the Aleknagik airport.

NAV Page #3 (Terrain Awareness Warning System (TAWS): (See Figure 58)
Started on the 10 nm scale
Labeled “TERRAIN NOT AVAILABLE”
Heading information source: GPS [Display in lower left corner of screen]
Compass rose orientation: About 343 degrees.
Altitude display: __ __ __ ft

Note: The TAWS display requires satellite data for altitude, which was not available during this examination. Additional TAWS information was found on February 1, 2011, as described in a later section of this report.

Figure 58. Initial display of TAWS information.

Radio page (See Figure 59)

COM :
122.900 [White letters on blue field]

125.000 [Blue letters on light blue field]
VLOC:
116.40 [White letters on blue field]
111.90 [Light blue letters on blue field]
Annunciations in lower left field:
TER N/A [Black letters on white field]
ENR [Green letters on black field]
INTEG [Black letters on yellow field]
Position: N 59 19.76' W 158 22.87'
Time display: About 4 minutes ahead of actual time.
Satellites shown in circular orbit: 2, 4, 8, 11, 22, 24, 26, 27, 28 (none with bars of signal strength)

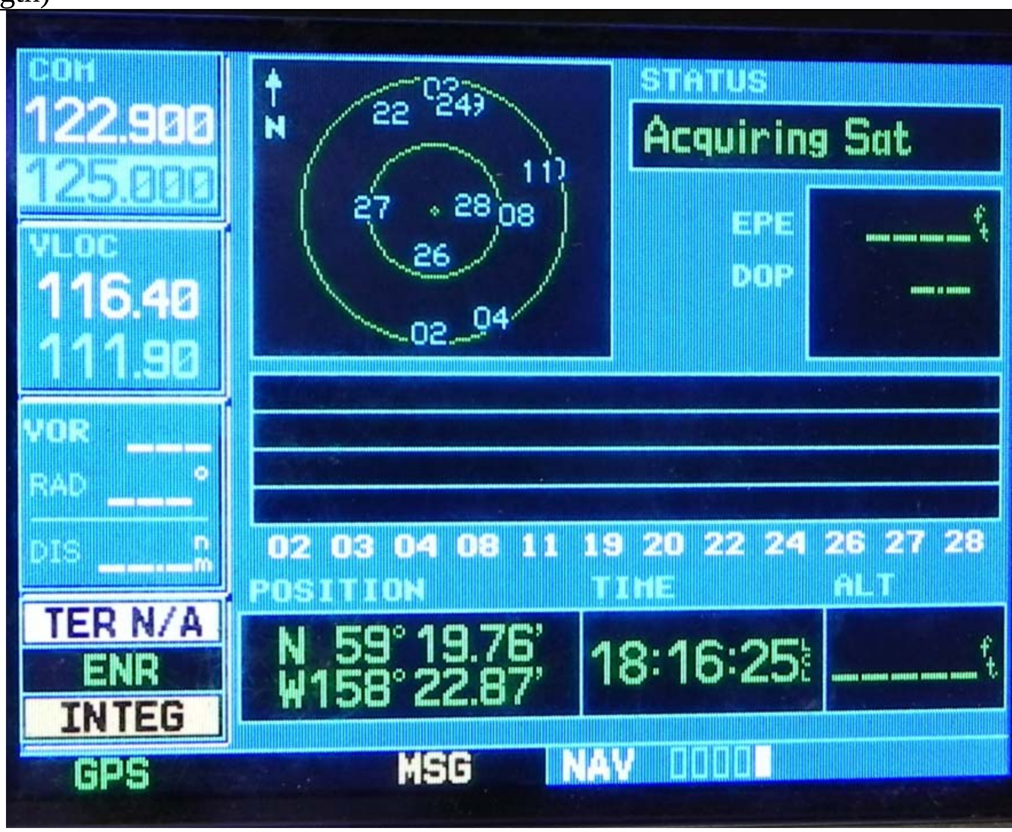


Figure 59. GNS-530 satellite positional display at initial power application.

Pressing the MSG button beneath the bottom of the screen revealed the following text:

No altitude input is being received
Not receiving input data on 429 Channel #1
Not receiving input data on 232 Channel #1
Not receiving input data on 232 Channel #4

The second examination of the GNS-530 happened on February 1, 2011, to extract stored routes and waypoints after a special docking station was obtained. The unit was powered by a Lone Star Aviation Commander docking station, rather than by providing power and ground (only) to the appropriate connector pins.

Following display of the same software revision information seen on the original examination, the NAV page 5 displayed, showing the status as “Simulating.” The word simulating was related to a benefit of using the docking station, in that the station provided an artificial altitude input to the GNS-530, allowing examination of the terrain warning features. This altitude was shown as 1080 feet. The lower left corner of NAV page 5 also showed TER TEST in black letters on a white background and ENR in green letters on a black background. Further details about the terrain warning system are in a following section of this report.

The latitude/longitude location of the unit and the radio frequencies (COM and VLOC) were unchanged from the entries found on September 21, 2010.

Satellites in “view” were 2, 5, 10, 12, 16, 21, 23, 29, 30, 31. The timer began to run when power was applied.

The flight plan page showed no active flight plans. The display was 00 [boxed], followed by _ _ _ _ _ / 5A8. The 5A8 is the designator for the closest airport, which was Aleknagik. The nearest waypoint was 2.7 miles to MUKLG on a bearing of 185 degrees magnetic.

Five stored flight plans were shown, and the order the display showed the five was:

02 PADL / WOK
05 PADL / WOK
03 WOK / HMR
01 WOK / PADL
04 WOK / PADL
_ _ _ _ _ _ _ / _ _ _ _ _ [A blank storage slot]

The individual details about each of the above flight plans follow:

NOTE ABOUT UNITS:
DTK denotes degrees magnetic
DIS denotes nautical miles for the trip leg
CUM denotes cumulative nautical miles for the trip

02 PADL / WOK

WAYPOINT	DTK	DIS	CUM
PADL			
HKLB	324	15.7	15.7
BBWOK	292	8.8	24.5
BWOK	336	1.6	26.1
WOK	044	3.0	29.1

05 PADL / WOK

WAYPOINT	DTK	DIS	CUM
PADL			
SSHOR	324	14.3	14.3
HKLB	316	1.4	15.7
BBWOK	292	8.8	24.5
BWOK	336	1.6	26.1
WOK	044	3.0	29.1

03 WOK / HMR

WAYPOINT	DTK	DIS	CUM
WOK			
BAY	084	8.5	8.5
HMR	122	38.3	46.8

NOTE: The WOK/HMR route was the only route that did not connect the GCI property with the Dillingham airport. Visually, a straight line between the BAY and HMR (fish camp) waypoints passes directly over the peak of the smaller Muklung Hill.

01 WOK / PADL

WAYPOINT	DTK	DIS	CUM
WOK			
BWOK	224	3.0	3.0
HKLB	119	10.0	13.0
PADL	144	15.7	28.7

04 WOK / PADL

WAYPOINT	DTK	DIS	CUM
WOK			
BWOK	224	3.0	3.0
BBWOK	156	1.6	4.5
HKLB	112	8.8	13.4
SSHOR	136	1.4	14.7
PADL	144	14.3	29.1

The unit had 28 user defined waypoints, as alphabetically listed below. Visual landmarks were were found at many of the waypoints and may be too small to see in an attached map, so are inserted.

WAYPOINT	LATITUDE	LONGITUDE
AK51	N 60 11.92	W 154 19.48
BAY	N 59 24.28	W 158 33.90
	BAY landmark: A bay that forms the southeast corner of Lake Nerka, closest to Muklung Hills.	

BBWOK	N 59 22.68	W 158 54.84
	BBWOK landmark: The centerline of Lake Aleknagik, where the lake begins to narrow. The point is also west of a a set of 5 small islands.	
BUTCH	N 59 46.95	W 158 59.10
BWOK	N 59 24.24	W 158 55.33
	BWOK landmark: The intersection of a river that connects Lake Aleknagik with Lake Nerka, to the east. Conspicuous peaks are north and south of the river, forming a valley that the GCI resort is in.	
FENNO	N 59 25.49	W 158 48.27
	FENNO landmark: The center of the large bay between Lake Nerka and the GCI resort.	
GCHAK	N 59 22.14	W 159 48.48
GSHK N	N 59 23.00	W 160 22.00
HKLB	N 59 17.30	W 158 41.22
	HKLB landmark: Eastern tip of an island along the centerline of Lake Aleknagik.	
HMR	N 58 55.89	W 157 44.23
	HMR landmark: The fishcamp is located near the intersection of "Y" shape for two rivers merging.	
KATMI	N 58 33.29	W 155 46.64
KULIK	N 58 58.92	W 155 07.28
LKCKE	N 60 51.13	W 152 14.22
LLKCK	N 60 38.41	W 153 13.58
LTSUE	N 61 15.40	W 150 17.80
MUKLG	N 59 17.28	W 158 24.67
	MUKLG landmark: Top of a small ridge, a mile west of the peak of the small Muklung Hill. Located next to a unique bend in the Muklung River and between several isolated small lakes. A line drawn from HMR in the south, through the MUKLG waypoint, intersects with Lake Nerka, where a mountain meets the water.	
NUSH1	N 58 53.85	W 157 46.66
PAGAT	N 59 52.00	W 160 04.00
PAKB	N 59 35.72	W 158 31.79
PNGLK	N 59 20.00	W 159 50.00
PORTA	N 59 56.92	W 159 09.63
QADL	N 59 25.75	W 158 50.10
	QADL landmark: Center of the water that leads from the GCI buildings into the bay that enters Lake Nerka.	
RIDGE	N 59 22.10	W 158 46.50
	RIDGE landmark: The spine of a tall and long ridge that forms the crest of Jacknife Mountain, separating Lakes Aleknagik and Nerka.	
SSHOR	N 59 16.11	W 158 39.95
	SSHOR landmark: The south shore of Lake Aleknagik, between two prominent points and west of the community of Aleknagik.	

TOGRV	N 59 15.30	W 160.12.59
WOK	N 59 25.76	W 158.50.33
	WOK landmark: GCI resort buildings.	
5Z9	N 58 33.29	W 155 46.64
+MAP	N 59 25.73	W 158 50.14

The AUX page showed the following flight data:

GENERIC: 00:00:00
DEPARTURE: 22:29 local, CRITERIA GS>30 kt
TOTAL TRIP: 13:02, CRITERIA GS>30 kt

The trip odometer showed 9428 nm, an average ground speed of 98.2 knots, and a maximum ground speed of 141.0 knots.

No checklists were found stored.

The above stored waypoints and routes found in the area of Lake Nerka were plotted on a topographic map for visualization, along with the recorded Sky Connect locations. (See Figure 60)

NOTES:

1. The lines that depict the stored routes and the Sky Connect data locations are only provided to relate the sets of data, not as physical locations that the airplane had passed over when between any of the points.

2. The northern portion of the Muklung River lost visibility at the scale shown, so the map includes a tracing of the approximate northern path of the river.

Figure 60. Stored waypoints and routes from the Garmin GNS-530, along with Sky Connect data, are shown for the area of Lakes Nerka and Aleknagik.

GNS-530 TERRAIN AWARENESS WARNING SYSTEM (TAWS):

This section provides a short introduction to the terrain awareness and warning system (TAWS) capability and display design, followed by descriptions of what was found in the accident GNS-530.[9] The complete text of the Garmin Pilot's Guide has not been copied and to differentiate this material it is both double indented and shown with fully justified margins.

> TAWS (Terrain Awareness and Warning System) is a feature to increase situational awareness and aid in reducing controlled flight into terrain (CFIT). TAWS satisfies TSO-C151b Class B requirements for certification. Class B TAWS is required for all Part 91 aircraft operations with six or more passenger seats and for Part 135 turbine aircraft operations with six to nine passenger seats (FAR Parts 91.223, 135.154).
>
> TAWS functionality is an available feature found in GNS 530 TAWS units with main software version 6.01 or above, along with appropriate hardware upgrades. TAWS provides visual and aural annunciations when terrain and obstacles are within the given altitude threshold from the aircraft.
>
> TAWS displays terrain and obstructions relative to the altitude of the aircraft.
>
> TAWS utilizes terrain and obstacle databases that are referenced to mean sea level (MSL). Using the GPS position and GPS-MSL altitude, TAWS displays a 2-D picture of the surrounding terrain and obstacles relative to the position and altitude of the aircraft. Furthermore, the GPS position and GPS-MSL altitude are used to calculate and "predict" the aircraft's flight path in relation to the surrounding terrain and obstacles. In this manner, TAWS can provide advanced alerts of predicted dangerous terrain conditions.
>
> The symbols and colors in Figure 13-1 and Table 13-1 are used to represent obstacles and potential impact points on the TAWS Page. TAWS uses yellow (caution) and red (warning) to depict terrain information relative to aircraft altitude. Each color is associated with an alert severity level. Terrain graphics and visual annunciations also use these color assignments. NOTE: If an obstacle and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest potential point of impact on the TAWS Page.

[9] The complete text and other information about the GNS-530 Garmin Pilot's Guide and Reference are published and available at:
http://www8.garmin.com/manuals/GNS530_PilotsGuide.pdf

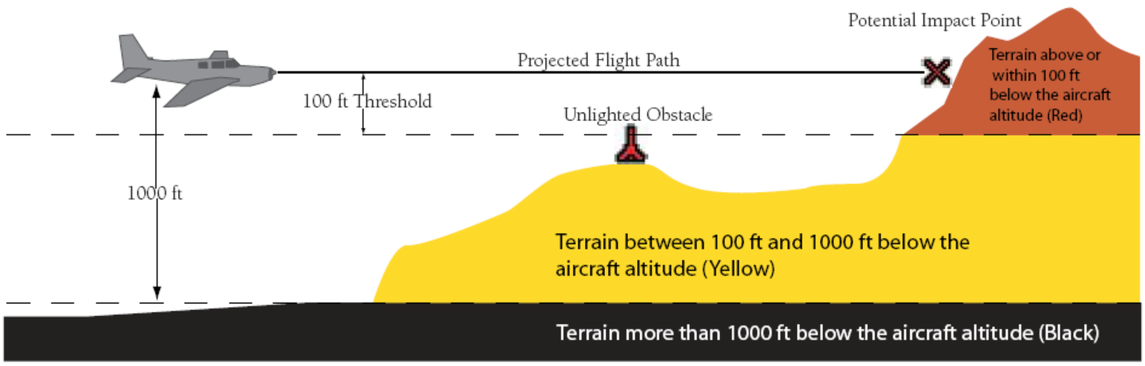


Figure 13-1 Terrain Altitude/Color Correlation for TAWS

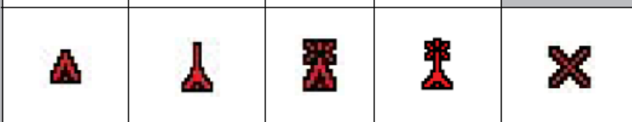
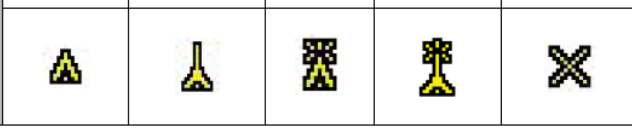
	Unlighted Obstacle		Lighted Obstacle		Potential Impact Points	Obstacle Location	Alert Level
	< 1000′ AGL	> 1000′ AGL	< 1000′ AGL	> 1000′ AGL			
Obstacle Symbol						Obstacle above or within 100′ below current aircraft altitude	WARNING (Red)
						Obstacle between 100′ and 1000′ below current aircraft altitude	CAUTION (Yellow)

Table 13-1 TAWS Terrain/Obstacle Colors and Symbology

Figure 61. Illustrations from Garmin Pilot's Guide.

TAWS Alerts are issued when flight conditions meet parameters that are set within TAWS software algorithms. TAWS alerts typically employ either a CAUTION or a WARNING alert severity level, or both.
When an alert is issued, visual annunciations are displayed. Aural alerts are simultaneously issued.
Annunciations appear in a dedicated field in the lower left corner of the display (Figure 13-2). Annunciations are color-coded according to Table 13-2.

Pop-up terrain alerts (Figures 13-3 & 13-4) can also appear during an alert, but only when the TAWS Page is not displayed.
There are two options when an alert is displayed:
• Press the CLR Key. This acknowledges the pop-up alert and returns to the currently viewed page.
• Press the ENT Key. This acknowledges the pop-up alert and accesses the TAWS Page.
NOTE: To further capture the attention of the pilot, TAWS issues aural (voice) messages that accompany visual annunciations and pop-up alerts.

Figure 13-3 Caution Alert Pop-up

Figure 13-4 Warning Alert Pop-up

Figure 62. Illustrations from Garmin Pilot's Guide.

Table 13-2 shows the possible TAWS alert types with corresponding annunciations and aural messages.

Alert Type	TAWS Page Annunciation	Pop-Up Alert	Aural Message
Excessive Descent Rate (EDR) Warning	PULL UP	PULL-UP	"Pull Up"
Reduced Required Terrain Clearance (RTC) Warning	PULL UP	TERRAIN - PULL-UP * or TERRAIN AHEAD - PULL-UP	"Terrain, Terrain; Pull Up, Pull Up" * or "Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"
Imminent Terrain Impact (ITI) Warning	PULL UP	TERRAIN AHEAD - PULL-UP * or TERRAIN - PULL-UP	Terrain Ahead, Pull Up; Terrain Ahead, Pull Up" * or "Terrain, Terrain; Pull Up, Pull Up"
Reduced Required Obstacle Clearance (ROC) Warning	PULL UP	OBSTACLE - PULL-UP * or OBSTACLE AHEAD - PULL-UP	"Obstacle, Obstacle; Pull Up, Pull Up" * or "Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"
Imminent Obstacle Impact (IOI) Warning	PULL UP	OBSTACLE AHEAD - PULL-UP * or OBSTACLE - PULL-UP	"Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up" * or "Obstacle, Obstacle; Pull Up, Pull Up"
Reduced Required Terrain Clearance (RTC) Caution	TERRAIN	CAUTION - TERRAIN * or TERRAIN AHEAD	"Caution, Terrain; Caution, Terrain" * or "Terrain Ahead; Terrain Ahead"
Imminent Terrain Impact (ITI) Caution	TERRAIN	TERRAIN AHEAD * or CAUTION - TERRAIN	"Terrain Ahead; Terrain Ahead" * or "Caution, Terrain; Caution, Terrain"
Reduced Required Obstacle Clearance (ROC) Caution	TERRAIN	CAUTION - OBSTACLE * or OBSTACLE AHEAD	"Caution, Obstacle; Caution, Obstacle" * or "Obstacle Ahead; Obstacle Ahead"
Imminent Obstacle Impact (IOI) Caution	TERRAIN	OBSTACLE AHEAD * or CAUTION - OBSTACLE	"Obstacle Ahead; Obstacle Ahead" * or "Caution, Obstacle; Caution, Obstacle"
Premature Descent Alert (PDA) Caution	TERRAIN	TOO LOW - TERRAIN	"Too Low, Terrain"
Altitude Callout "500"	None	None	"Five-Hundred"
Excessive Descent Rate (EDR) Caution	TERRAIN	SINK RATE	"Sink Rate"
Negative Climb Rate (NCR) Caution	TERRAIN	DON'T SINK * or TOO LOW - TERRAIN	"Don't Sink" * or "Too Low, Terrain"

Table 13-2 TAWS Alerts Summary

* Indicates the default configuration

Figure 63. Illustration from Garmin Pilot's Guide.

Forward Looking Terrain Avoidance

The Forward Looking Terrain Avoidance (FLTA) alert is used by TAWS and is composed of:

• Reduced Required Terrain Clearance (RTC) and Reduced Required Obstacle Clearance (ROC) -These alerts are issued when the aircraft flight path is above terrain, yet is projected to come within the minimum clearance values in Table 13-4. When an RTC or ROC alert is issued, a potential impact point is displayed on the TAWS Page.

• Imminent Terrain Impact (ITI) and Imminent Obstacle Impact (IOI) - These alerts are issued when the aircraft is below the elevation of a terrain or obstacle cell in the aircraft's projected path. ITI and IOI alerts are accompanied by a potential impact point displayed on the TAWS Page. The alert is annunciated when the projected vertical flight path is calculated to come within minimum clearance altitudes in Table 13-4.

Phase of Flight	Minimum Clearance Altitude Level Flight (ft)	Minimum Clearance Altitude Descending (ft)
Enroute	700	500
Terminal	350	300
Approach	150	100
Departure	100	100

Figure 64. The above data is shown in Garmin Pilot Guide and Reference Table 13-4, titled ***Minimum Terrain and Obstacle Clearance Values for FLTA Alerts***

TAWS Inhibit

TAWS also has an inhibit mode that deactivates the FLTA/PDA aural and visual alerts. Pilots should use discretion when inhibiting TAWS and always remember to enable the system when appropriate. Only the FLTA and PDA alerts are disabled in the inhibit mode.

Inhibiting TAWS:

1) Select the TAWS Page and press the **MENU** Key. 'Inhibit Terrain?' is selected by default (Figure 13-6).

Figure 13-6 TAWS Page Menu

Figure 64. Illustration from Garmin Pilot's Guide.

2) Press the **ENT** Key. The 'TER INHB' annunciation is displayed in the TAWS annunciator field when TAWS is inhibited (Figure 13-7).

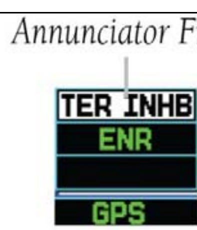


Figure 13-7 Annunciator Field

Figure 65. Illustration from Garmin Pilot's Guide.

Enabling TAWS:
1) Select the TAWS Page and press the **MENU** Key. 'Enable Terrain?' is selected by default.
2) Press the **ENT** Key. The TAWS system is functional again.

'Five-**H**undred**' A**ural**A**lert
The purpose of the aural alert message "Five-Hundred" is to provide an advisory alert to the pilot that the aircraft is 500 feet above terrain. When the aircraft descends within 500 feet of terrain, the aural message "Five-Hundred" is generated. There are no display annunciations or pop-up alerts that accompany the aural message.

The docking station provided an altitude input for the TAWS computation. This only provided an altitude and did not change the position coordinates within the GNS-530. With an input altitude of 1080 feet above sea level, the display was almost entirely red and yellow. Further, both the large and small pass could be seen. (See Figures 66 and 67)

Figure 66. This was the TAWS display shown by the Garmin GNS-530 at a test input altitude of 1080 feet msl. Providing altitude was the only difference between this and the displays shown as Figures 57 and 58. The route to the fish camp would have been on a heading of roughly 125 degrees, to the lower right of this display. At this range, the smaller Muklung pass is not visible.

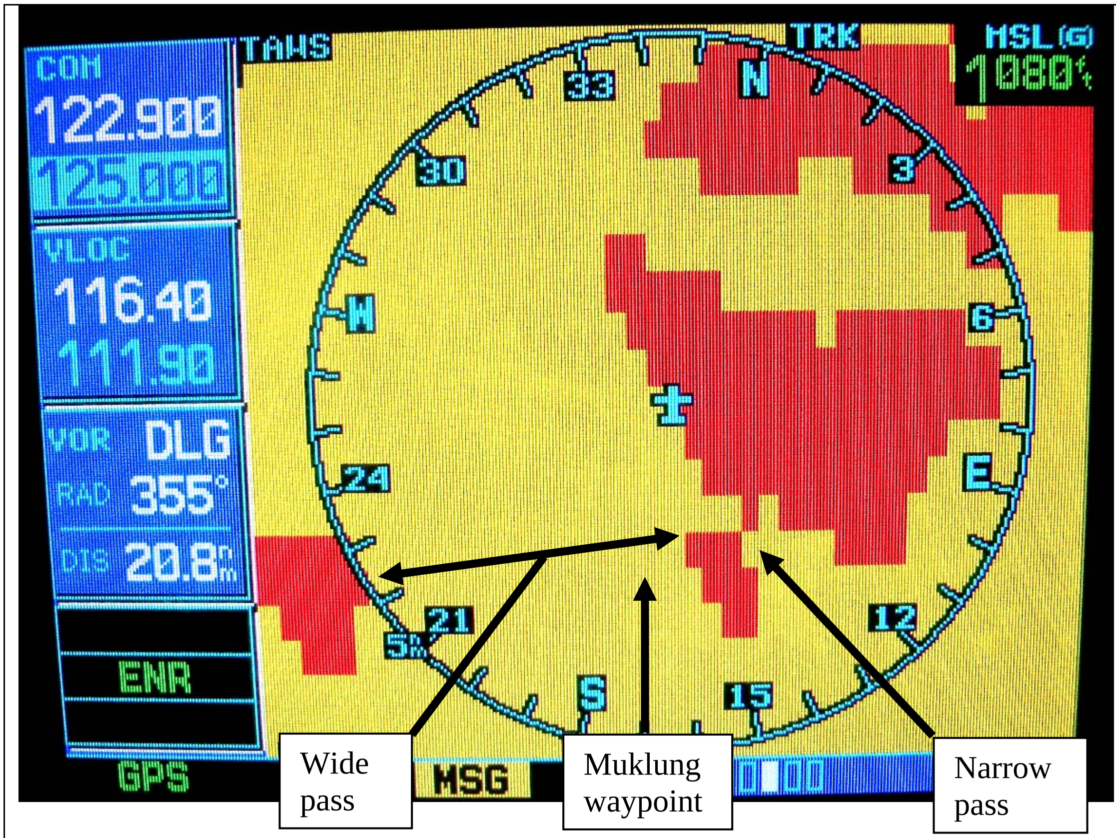


Figure . Figure 67. This was shown when the Figure 60 TAWS display was changed from a range of 10 nm to 5 nm. The smaller Muklung hill is visible in red between the airplane icon and the “15” on the compass rose. The approximate location of the MUKLG waypoint is to the west of the hill and both the narrow and wider passes are visible.

TAWS INHIBIT SWITCH:

Above the Garmin GNS-530 was a Mid-Continent control panel with a TAWS inhibit pushbutton switch. When first found, the panel was covered with mud and the instrument panel had post-impact movement marks in the mud. (See Figure 42B) Nothing was visible to show the position of the pushbutton prior to impact. (See Figures 68 and 69)

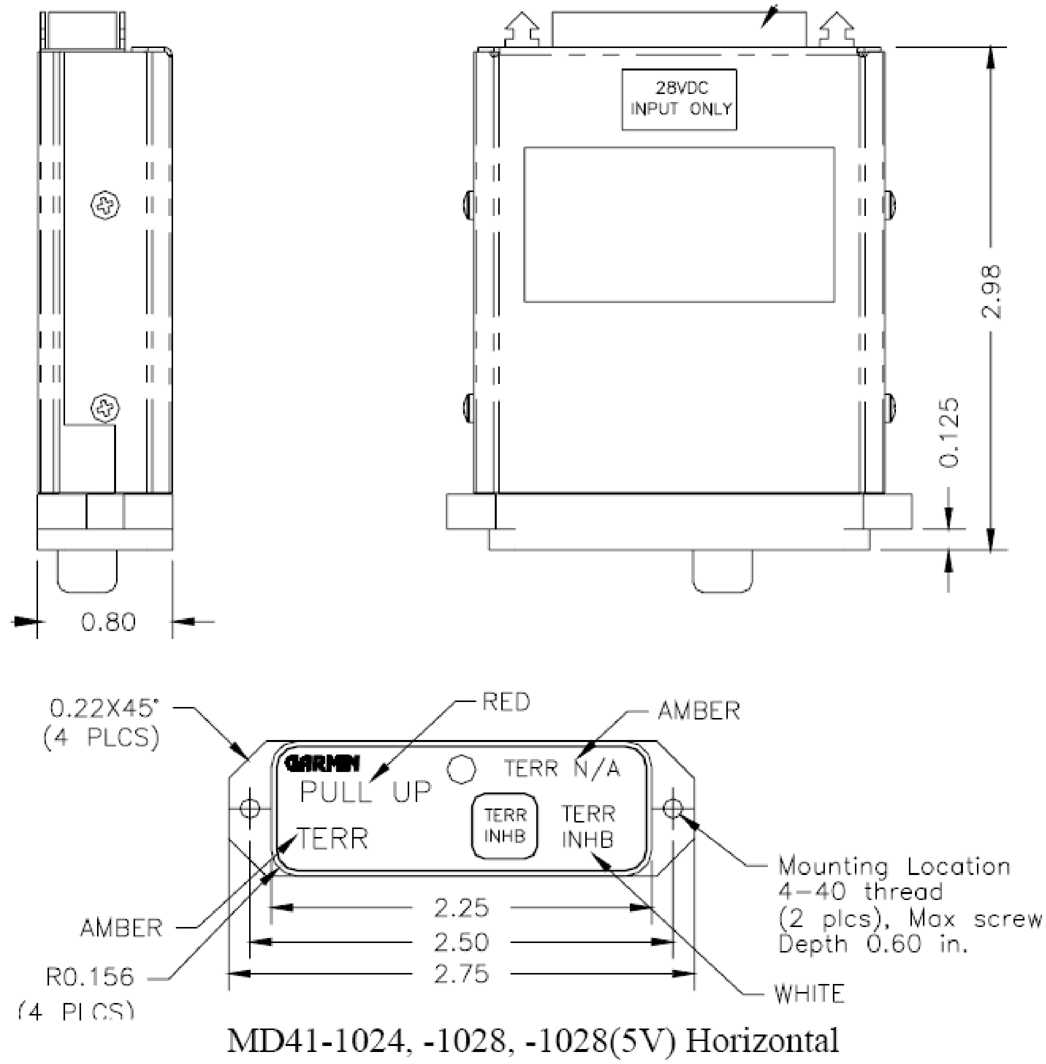


Figure 68. Mid-Continent illustration of the TAWS inhibit pushbutton switch.

Figure 69. Position of finding the TAWS inhibit pushbutton switch depressed (inhibited position), after clearing away mud that covered the portion of the panel.

GARMIN GNS-430 GPS/RADIO:

The GNS-430 radio was examined at the NTSB laboratory. The connector shield was found bent and the front panel was found heavily damaged, requiring replacement before the memory could be accessed. The internal battery charge was measured to be 2.84 volts.

No stored routes were found and the one stored waypoint was for 51K. This was the airport at Olathe, Kansas, the location of Garmin. Zooming the scale out found an airport ABO, Antonio Nery Juarbe Pol Arecibo, at N 18 degrees 27.07 minutes, W 66 degrees 40.53 minutes.

The software version was 4.04.
The COM radio frequencies were: 136.975 / 118.000
The VLOC radio frequencies were: 117.95 / 108.00

SKY CONNECT TRANSCEIVER:

The transceiver contained an internal Garmin GPS device and the intact package was taken to the manufacturer of the transceiver. The latitude and longitude found were for Olathe, Kansas, where Garmin is located. The internal battery was found to have discharged.

EMERGENCY LOCATOR TRANSMITTER (ELT):

The airplane had been equipped with an Artex Model ME406 Emergency Locator Transmitter (ELT, part number 453-6603) and the ELT had been mounted on the right sidewall in the tail cone. The ELT had broken the antenna and electrical connections, as well as making marks on the structure located ahead of the mount. Without the antenna, the ELT could operate, but no signal would be sent for rescue aircraft to receive when the accident initially took place. (See Figure 70)

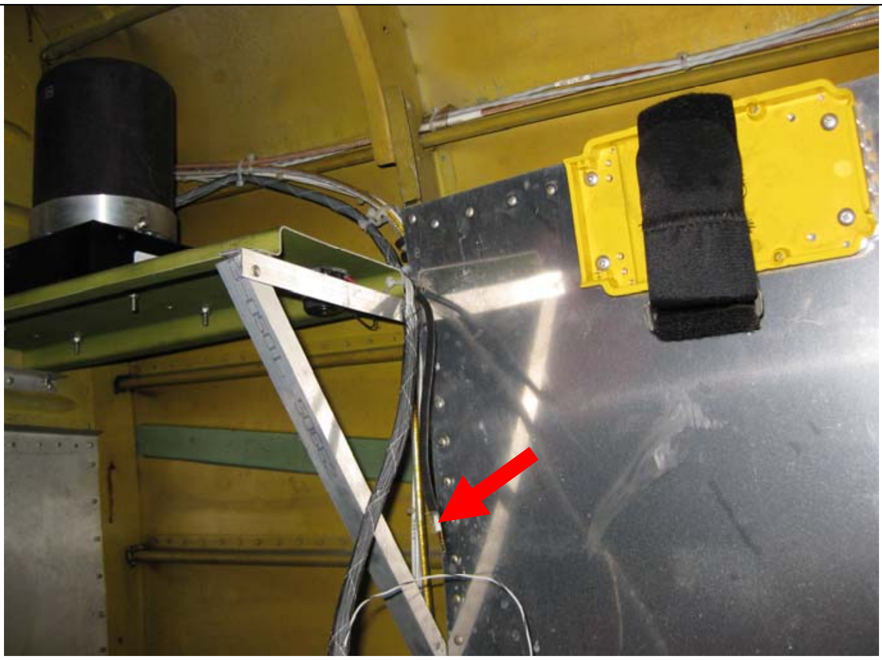


Figure 70. Empty ELT bracket in tail cone. The hook and loop fastening strap closed. To the left is forward in the airplane. The arrow points to the broken antenna connection.

Examination of an identical plastic mount for the ELT on the left (opposite) wall of another DHC-3 Otter found that the electrical portion had contours that matched the mount and was attached by a hook and loop (Velcro) strap. However, the mating contours were shallow and if the installer did not make the strap extremely tight, finger tension could pull the ELT away from the mount. Once the leading edge of the ELT was above the height of the mount, the ELT could be thrown forward by impact, sliding out from beneath the mounting strap and breaking the antenna cable. (See Figure 71)

Figure 71. ELT in another Otter, showing gap between the ELT and mount that was created by finger tension. Forward is to the right.

SATELLITE TELEPHONE:

A generic black plastic case (also known as a Pelican box) contained a satellite telephone and was found at a break in structure, between the cockpit and cabin, amongst other other debris. The Motorolla Iridium satellite telephone had a fully charged battery.

POWERPLANT:

ENGINE:

The airplane had been modified by Kal-Air Repair, Ltd, a Canadian Approved Maintenance Organization (AMO) #129-91, with the work released April 26, 2005. The modification was to install a supplemental type certificate (STC #SA09866SC) developed by Texas Turbines, replacing the original piston engine with a Garrett TPE 331 series turbine engine. The engine had been overhauled by the engine manufacturer prior to installation. Also accomplished were installation of a new cowling, new Hartzell propeller, battery installation, and cockpit instruments that included a set of new Electronics International engine instruments.

The N455A engine and propeller were documented on site and in a hangar, prior to shipment for detailed examination with the following results:

Engine data plate information:

Serial Number: P-37622C
Part Number: 3102170-6
Engine Model Number: TPE331-10R-511C

The propeller was found attached to the propeller shaft. In order to gain access to the engine, numerous camlocks were disengaged along two cowling split-lines. No camlocks were observed to have been in any position other than engaged.

Upon removal of the right and top cowling panels, dirt was observed in the engine area. (See Figure 72) While removing a significant quantity of this dirt, care was taken to ensure that no linkage/control positions were disturbed. Removal of the dirt was required to see the details of the engine and controls.

Figure 72. Engine after the cowling was removed

The oil filter bypass valve was found in the normal (not extended) position. (See Figure 73)

Figure 73. Oil Filter By Pass Valve

The fuel control specific gravity setting was found at setting ".81".

The aircraft-to-engine control linkage appeared to be attached and secured to the Fuel Control Unit (FCU) attach points (Main Metering Valve (MMV) and Underspeed Governor Control (UGC)). Gentle movement by hand of this linkage did not disclose any looseness at the attach points on the FCU. The linkage from the fuel control to the concentric shaft assembly appeared to be attached and secured. Gentle movement by hand of this linkage did not disclose any looseness of it other than what would be found in a normal installation (i.e. normal freedom). The linkage from the concentric shaft assembly to the propeller pitch control appeared to be attached and secured. Gentle movement by hand of this linkage did not disclose any looseness of it other than what is expected of a normal installation (i.e. normal freedom).

The MMV index pointer was pointing to approximately the 4 degree marking on the protractor. The PPC index pointer appeared to be pointing to approximately the 2 degree marking on the protractor. Parallax made it difficult to observe the exact location.

The linkage for the feather valve and the fuel shutoff valve appeared to be attached and secured. This includes the attach points from the aircraft linkage to the attach point on the engine and from this attach point to the controls themselves.

For the level of examination conducted, there were no engine lines or hoses that were observed to be disconnected. The on-scene examination was preliminary and not all lines and hoses were visible.

There were no signs of outward penetration of the engine plenum surfaces that were visible. The underside of the plenum was not visible.

Neither the engine exhaust area nor the inlet area were accessible on-scene for visual observation.

The top engine mount structure at the engine gearbox appeared to be intact. The right hand engine mount structure at the gearbox appeared to be intact. No determination of the integrity of the left engine mount was made due to inaccessibility. It was observed that the mount structure was present in the normal location.

<u>The following are engine observations during removal from the mount on August 13, 2010, at the Alaska Game and Fish Hanger.</u>

A small portion of the engine inlet cowling was removed from the engine gearbox inlet. Removal of this cowling disclosed that the engine gearbox inlet was completely filled with dirt. (See Figure 74) While removing this dirt, two sizable rocks and one bush/tree branch were found in the inlet.

A fractured input shaft was visible after the starter/generator was removed. The fracture surfaces of the input shaft were characteristic in appearance of torsion overload.

There were no provisions noted during the examination for any type of “trend monitoring” system or device for the engine. According to the representative of the engine manufacturer, he is not aware of an aftermarket trend monitoring system for this model TPE331 engine. The engine was not originally equipped with this type of system.

Figure 74. Dirt found in engine inlet

Removal of the dirt and other debris from the engine inlet disclosed that several, non-adjacent, first-stage compressor impeller blades were bent back opposite to the direction of normal rotation. (See Figure 75)

Rotation of the propeller shaft did not produce a corresponding rotation of the components on the engine side of the gearbox prior to removal of the propeller. The TPE331 engine is a “fixed-shaft” design, meaning the power section is mechanically coupled to the propeller such that, normally, any rotation of the propeller will produce a corresponding rotation of the power section.

Safety wire was in place on all propeller mount bolts. Torque was present on all propeller mount bolts prior to removal, however, the torque value was not measured.
A bend to the propeller shaft mount flange was found after the propeller was removed.

An “AN” fitting on the front of the engine’s diaphragm housing was removed to allow visual access to the gyrotor of the gearbox scavenge pump. Rotation of the power section via the compressor rotor produced a corresponding rotation of the gyrotor. This is an indication that the direct drive fuel control gearing is intact.

Figure 75. Damage to the first-stage compressor impeller.

All engine mount structures, gearbox and aft, were intact and all mount bolt nuts were secured with cotter pins. All wiring harness connectors were removed along with all lines and tubes that connected airframe parts to the engine/truss. Oil was noted in the lines to the oil cooler. A clear liquid was found in the main fuel line to the engine low pressure fuel pump. This liquid was drained into a small cup. The smell of this liquid was consistent with aviation fuel that is similar to kerosene.

The aircraft linkage to the engine controls for the Main Metering Valve (Power Lever), to the Underspeed Governor (Speed Lever) and to the Feather Valve/Fuel Shutoff Valve were found to be properly attached with all nuts secured with cotter pins.

All aircraft to engine exhaust duct attachment nuts and bolts were removed to allow for the removal of the aircraft exhaust duct. Removal of this duct disclosed dirt in the engine exhaust duct area (See Figure 76). All third-stage turbine wheel blades were found to be present. Some trailing edge areas of numerous blades were observed to have small areas that were silver in appearance, consistent with the blades having come into contact with foreign material while still rotating.

Figure 76. Engine exhaust area and third-stage turbine wheel.

Areas of the plenum that were not accessible on-scene were observed at this examination. There are no outward penetrations of the plenum.

PROPELLER

The Beta tube position in the propeller piston was photo documented prior to removal. (See Figure 77). An attempt was made to remove the Beta tube by unscrewing it from its receptacle, however, it reached a point where further rotation was not possible. As a result, the Beta tube was removed along with the propeller.

Figure 77. Propeller beta tube position

Three of the four Hartzell propeller blades were visible and these blades were found attached to the hub. The location for a fourth blade in the hub was downward and could not be seen while on site. After removal of the wreckage it was observed that the fourth blade was not with the hub.

Two of the blades exhibited clear indications of multiple bending along the length of the blades. (See Figure 78) One of the two blades was missing an approximately 3” X 3” section at the blade tip leading edge. (See Figure 62). The other blade exhibited a rearward bending of the blade at the leading edge slightly inboard of the outer tip. (See Figure 79)

Figure 78. Bending in Propeller Blade, with leading edge toward camera.

Figure 79. Propeller blade tip damage.

The third blade was bent back but still visible, located underneath the engine nacelle area. There was an area of damage along the trailing edge of the blade, slightly inboard from the tip that was “curled.” (See Figure 80)

Figure 80. Trailing edge damage to propeller blade.

The area of the propeller identification, i.e. serial number and part number, was not accessed. To do so would have required removal of the propeller spinner. The spinner was left in place to allow for examination by the propeller manufacturer at a later date.

RECORD OF INTERVIEW:

PERSONS INTERVIEWED:	David Roseman Mary Nicholas
DATE:	August 12, 2010, mid-day
PLACE:	Agulawok (GCI) Retreat, Lake Nerka, Alaska
PRESENT:	Robert Swaim, NTSB, Washington, DC Larry Lewis, NTSB, Anchorage, Alaska Jason Fieser, Alaska State Trooper, C Barracks Daniel Quinn, Attorney, Anchorage, Alaska

The following is a written record of notes taken by Robert Swaim during an interview of Mr. Roseman and Ms. Nicholas on August 12, 2010, at the Agulawok Retreat which the N455A accident airplane departed on August 9, 2010. The notes are in the approximate sequence that Mr. Roseman and Ms. Nicholas related answers to questions from Lewis, Swaim, and Fieser, resulting in lack of continuity in subject and chronology. Ms. Nicholas had been cleaning a cabin and was not aware of what transpired during the planning of the August 9 trip, or the departure, and nearly all of the following was provided by Mr. Roseman. ***Mr. Roseman was provided the opportunity to comment on the draft of these transposed notes and the comments shown in bold red italicized font are his.***

GCI has been operating a retreat since 1995 and Agulawok is a company property that is only used by those who are invited guests. Examples of guests include sales groups and groups of employees. A person in town makes arrangements for people to get into Dillingham and Mr. Roseman then coordinates with the pilot(s) to have the airplane meet guests.

Agulawok Retreat has 13 staff. Pilots stay at the retreat and have no other real duties. Jim Miller started the season and left near the end of July. GCI then chartered Freshwater Adventures to make flights. Virgil Peachy flew as a fill in pilot. Charlie Pike followed, and then came Terry Smith.

Terry Smith had been at Agulawok Retreat with Hon Kinzie and with Virgil Peachy to familiarize for about 10 days when Charlie went on vacation. Mr. Roseman was not sure without consulting records when Mr. Smith started, but related that it had been toward the end of last month. ***Please see timeline at end of report***

Pilots keep their own flight log. The itinerary can change throughout any day, but essentially Mr. Roseman sets the itinerary sets it and lets the pilot know when and where to be.

Some days the pilot will not fly, but they usually fly once or twice a day. This includes when the pilots are required to make supply flights. ***Agulowok Retreat pilots can sometimes do up to 10 or 12 flight legs per day depending on guest arrivals, departures, activities and supply needs but this would be unusual. A normal day would be 2-4 flight legs per day.***

The retreat has gasoline for the boats to use and has a tank of jet fuel for the airplane. The operation tries to always refuel the airplane at Dillingham.

If guests want to go to a fish camp, Mr. Roseman makes the arrangements. He lets them know that "they'll need to be back by a set time." The tentative plan for August 9 was that the guests would not go to fish camp. The guests made the decision to go after lunch and Terry Smith said that the weather was good enough to go. Mr. Roseman had to communicate by email with the cook at HRM, named Cindy, since the HRM camp had telephone problems. Mr. Roseman told her the arrangments and does not recall the details, but would have the emails. ***I believe the email communications with HRM were made available to NTSB(?)*** Dana Tindal would make arrangments when to leave HRM for dinner. Lunch at the Retreat is normally at 1pm.

Agulawok Retreat uses internet protocol (IP) telephones through a satellite connection. Mr. Roseman has found that the IP telephone system is "pretty darn solid unless the weather is nasty."

Recounting the lunch, the guests had been at HRM on each of the previous two days and Mr. Smith had a flight on the morning of August 9 to drop a passenger at Dillingham. The thought about whether to go to fishcamp again went back and forth.

Mr. Roseman had other duties and about 2:30 in the afternoon of August 9 was walking between those tasks when he saw that the guests had decided to go and were loading the airplane. Mr. Smith was part of the lunch and could have made the coordination to load the airplane. Mr. Roseman saw Mr. Smith regularly check the weather on the computer and assumed that Mr. Smith would also make telephone calls and [make or get] pilot reports prior to a flight. Mr. Roseman and an employee named Taylor pushed the airplane off the beach for the trip. Mr. Roseman did not remember if he notified HRM by email that the flight had departed.

The groups was expected back at dinner, which is generally at 7pm. When groups are at HRM or other locations, those locations don't always let the Agulawok Retreat know when the airplane departed.

When the guests would return was a question that Mr. Roseman got as a call from the Agulawok cook named Chaz and then by Greg Chapados. Mr. Roseman then called a person named John at HRM, who said that the group had never arrived. This was about 6:30 pm.

Mr. Roseman called the Dillingham Flight Service Station (FSS) to ask if Otter N455A had been heard from. The response was that the FSS had no knowledge about the airplane since the first flight, in the morning. When the FSS was asked, they used the radio to ask a pilot coming in from ***[the direction of]*** HRM if an Otter had been seen.

The FSS person asked Mr. Roseman if he wanted to launch a search. Mr. Roseman knew that a search would be a significant event and said that he wanted to check again with HRM, to see if maybe the flight had gone elsewhere. When asked where else the flight may have gone, Mr. Roseman related that since the guests had been to HRM, they may have decided to watch bears in another location. When he learned from the call to HRM that there was no knowledge about the Otter, Mr. Roseman called the FSS again and asked for a search to begin.

Changing of plans would be unusual. This type of group may not call back to the retreat to check in. Executive groups have more autonomy since they control the facility and the retreat has relatively less control when executive groups were present.

The airplane had a satellite phone, but the noise in flight would prevent inflight use. The airplane was also equipped with aviation and marine radios. Mr. Roseman is not a pilot and was not aware of what other radios the airplane was equipped with.

The Agulawok Retreat only has the single Otter, which originally belonged to the Wood River Lodge. GCI had purchased the Wood River Lodge and when the Otter came to GCI, the company had the turine engine installed and a retrofit.

Describing weather at the lake for the accident flight, Mr Roseman related that he could see Jacknife mountain with areas of blue sky. Winds were blowing and Mr. Smith said that the first flight had been turbulent. From observing the surrounding hills, the weather appeared to have a broken sky at about 2000 feet altitude and visibility was good. The three miles across the lake could be seen with no problem and wind was no problem.

If the airplane went to Dillingham, Mr. Roseman related that he would watch the webcam located at Dillingham airport to know when the airplane was returning. Returning to the subject of airplane radios, Mr. Roseman was familiar with the SkyConnect website. When asked about relating the airplane position to the Retreat, Mr. Roseman said that the SkyConnect was used only for one season, and that was about three years ago. He did not know why the company discontinued use of SkyConnect . He did like to have it available and used the ability to track the airplane.

The airplane had mechanical work at Anchorage at the beginning of the season, in June, and the pilots had no problems with the airplane recently.

When asked what written policy documents exist, Mr. Roseman related that he did have a generalized document about pilot duties. The retreat had been operating for 15 years by being selective about who their pilots were. His task was to coordinate with the pilot and he related that further definition about pilot duties would fall under either Bill Bankey **[*Behnke*]**, who was responsible for the aviation activities of GCI, or the Chief Pilot, Hon Kinzie.

Mr. Roseman did not know how many times Mr. Smith had flown by the Muklung Hills. There were other routes available. Mr. Smith had flown into Agulawok Retreat numerous times and seemed familiar with the area. Mr. Smith had also flown for TikChik Lodge **[*this was something Terry Smith mentioned to me but in what capacity he had flown for Tikchik Lodge, I don't know*]**, which was in the same area.

When asked if he was aware that Mr. Smith had any medical issues, the answer from Mr. Roseman was that he had never asked Mr. Smith directly. Mr. Roseman had heard from somebody else that Mr. Smith had a stroke in the past.

At the August 9 lunch, Mr. Smith had been telling stories and been in good spirits. Mr. Smith liked to talk about his experience***[s]***.

When asked about a ball mount on the instrument panel of N455A that gave the potential for use of a hand-held GPS, Mr. Roseman responded that a person named Kenny Morris had a GPS on a ball mount, but he did not know who may have used one recently, if at all. "A handheld GPS would be out of character for GCI. GCI tends to go whole hog on the airplanes."

After notifying the FSS about the airplane missing and initiating the search, Mr. Roseman called a Park Ranger named Johnny Evans and asked if he could look as well. Mr. Roseman does not remember who called or when, to relate that the airplane had been found. Bob Himshute in Dillingham was already at Tucker and ready to search. Mr. Roseman called Hon Kinzie to ask for authorization to send helicopters. Rod Williams called from King Salmon to ask about sending Sam Egli out to search. Again, Mr. Roseman said that he would call Mr. Kinzie. As soon as the airplane was reported missing, Ron Duncan left the Retreat to join the search.

If Agulawok Retreat did not have the Otter available, Freshwater Adventures would be contracted to fly their turbine Otter and/or Grumman Widgeon.

The interview concluded at about 4:30 pm.

<u>GCI Otter pilot timeline</u>

July 5th – Jim Miller departed [quit]

July 5th – July 23rd – Lodge relied on Freshwater Adventures for chartered flights

July 23rd – Charlie Pike arrived

July 26th – Charlie Pike departed / Virgil Peachey and Terry Smith arrived

July 29th – Terry Smith departed [family emergency]

July 31st – Virgil departed / Charlie Pike arrived

August 2nd – Charlie Pike departed [vacation]

August 3rd – Hon Kinzie arrived

August 4th – Terry Smith arrived / Hon Kinzie departed