

**NATIONAL TRANSPORTATION SAFETY BOARD**

Vehicle Recorder Division  
Washington, D.C. 20594

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# **Terrain Awareness Warning System (TAWS) Comparison Class B and Class C**

**Specialist's Study Report  
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## **1. EVENT SUMMARY**

Location: Ketchikan, Alaska  
Date: June 25, 2015  
Aircraft: de Havilland DHC-3  
Registration: N270PA  
Operator: Promech Air, Inc.  
NTSB Number: ANC15MA041

On June 25, 2015, about 1215 Alaska daylight time (AKDT), a single-engine, turbine-powered, float-equipped de Havilland DHC-3 (Otter) airplane, N270PA, sustained substantial damage when it impacted mountainous tree-covered terrain, about 24 miles northeast of Ketchikan, Alaska. The airplane was being operated under the provisions of 14 *Code of Federal Regulations* Part 135, as an on-demand visual flight rules (VFR) sightseeing flight when the accident occurred. The airplane was owned by Pantechonicon Aviation, of Minden, Nevada, and operated by Promech Air, Inc., of Ketchikan. The commercial pilot and eight passengers were fatally injured. Marginal visual meteorological conditions were reported in the area at the time of the accident. The flight departed a floating dock located in Rudyerd Bay about 44 miles northeast of Ketchikan about 1200 for a tour through Misty Fjords National Monument Wilderness. A company VFR flight plan was in effect. At the time of the accident, the flight was returning to the operator's base at the Ketchikan Harbor Seaplane Base, Ketchikan.

## **2. GROUP**

A terrain awareness warning system (TAWS) group was not convened.

## **3. DETAILS OF STUDY**

The Specialist's Factual Report of Cockpit Displays documents the recovery of two Chelton Integrated Display Units (IDUs) (see the public docket for this accident for the report). Historical TAWS alerts were not recorded by the Chelton system (nor were all the data items necessary to determine a TAWS alert). Data and settings recorded by IDU serial number 36519 from the accident flight were modified and replayed through Chelton

proprietary software to compare TAWS B and TAWS C functionality.<sup>1</sup> The video replay of this study is included as attachment 1 to this report.

#### **4. METHODOLOGY**

Addendum 1 of the Specialist's Factual Report of Cockpit Displays (see the public docket for this accident for the report) describes how 330 feet was added to recorded indicated altitude to correct for the accident flight's altimeter setting of 29.56 inches of mercury. This corrected altitude was used for this study.

The corrected altitude was used to produce two replays of the accident flight path:

- TAWS B logic used, consistent with the accident flight TAWS configuration.
- TAWS C logic used, the comparison case for this study.

A screen capture of each replay was sampled once per second to retrieve TAWS alerts from the IDU display (the possible alerts were: none, "Terrain," and "Pull Up").

#### **5. RESULTS**

Figure 1 shows the comparison of TAWS B and TAWS C alerts, including corrected recorded altitude. Figure 2 shows a comparison of TAWS B and TAWS C alert counts for the accident flight. Tabular data used to generate figures 1 and 2 are included as attachment 2 to this report.<sup>2</sup>

A statistical comparison of the counts in figure 2 was performed to determine if the differences in alerts between TAWS B and TAWS C configurations were statistically significant. The Chi-square statistic<sup>3</sup> revealed there was a significant association for the accident flight path (using corrected altitude) between TAWS configuration (that is, B or C) and the number and types of alerts generated,  $\chi^2(2)=14.39$ ,  $p<.001$ . A corresponding logistic regression similarly found the result significant ( $p<.001$ ) and indicated for this accident flight, TAWS B was 67% more likely to produce a "Terrain" or "Pull Up" alert compared to TAWS C.

#### **6. LIMITATIONS OF STUDY**

This study is subject to the following limitations.

- Time alignment between the four displays shown in the video replay in attachment 1 are accurate to within +/-1 second.
- Time alignment between altitude and TAWS alerts in figure 1 and attachment 2 are accurate to within +/-1 second.
- Altitude sampled once per second were provided for the playback, which interpolated the values for a continuous display.

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<sup>1</sup> For a description of TAWS, see the Group Chairman's Operational Factors/Human Performance Factual Report in the public docket for this accident.

<sup>2</sup> Blank means no alert was displayed.

<sup>3</sup> Chi-square statistics (also known as Pearson chi-square test) compares observed frequencies with the expected frequencies collectively (considering the degree of freedom for each of the variables).

- Screen displays shown in the video replay in attachment 1 are not necessarily representative of the screen displays from the accident flight for several reasons, including the pilot may have changed various options on the screen during the flight, which were not recorded in the historical data.
- The altimeter setting shown in attachment 1 was what was recorded in the last sample of the accident flight. This altimeter setting did not affect the playback (other than the displayed altimeter setting), which used the altitudes provided in attachment 2.
- TAWS alerts on an actual flight may vary from those of the playback for several reasons, including software versions, terrain models, and the altitude source.
- The playbacks were performed with no course-to-be-flown entered in the Chelton unit or user waypoints. Furthermore, the data provided to the playback began when the aircraft was about 350 feet MSL and about 90 knots, which may have affected the TAWS logic.

These limitations should be considered when interpreting the results of this study and the video replay.

Figure 1. TAWS B and TAWS C.

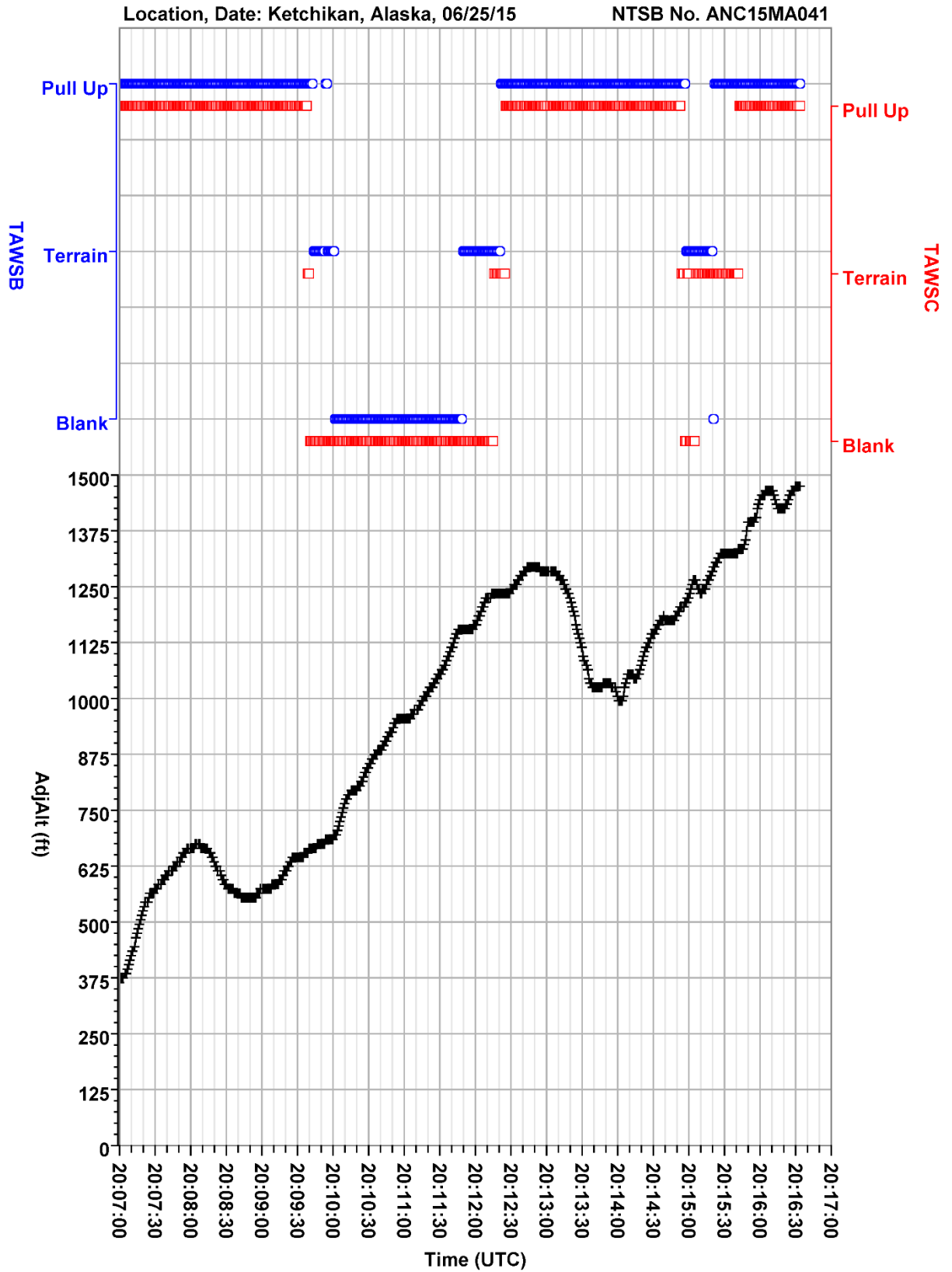


Figure 2. TAWS B and TAWS C alert counts.

