U.S. Geological Survey

Serious Accident Investigation
Factual Report

Fatal Diving Accident at
Torch Bay, Alaska

Date of Accident
August 7, 2019

Location of Accident
In Glacier Bay National Park

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EXECUTIVE SUMMARY

Working under a collaborative agreement (Document 1), scientists from the U.S. Geological Survey (USGS) and University of California – Santa Cruz (UCSC) were diving together in an area of Glacier Bay National Park known as Torch Bay. On the morning of August 7, 2019 an accident occurred which resulted in a fatality to one of the UCSC divers.

On the afternoon of August 7, 2019 investigative teams from the National Park Service and the U. S. Coast Guard began their investigation. On the morning of August 8, 2019, a Serious Accident Investigation Team (SAIT) was formed with representatives from the USGS, National Park Service (NPS), the UCSC and the University of California Consortium for Boating and Diving Safety. The SAIT was comprised of four Diving Safety Officers (DSO). During the investigation, the SAIT collected evidence, conducted interviews, reviewed documents and interviews, developed timelines and collated the information in order to recreate the scene and conditions under which the diving accident occurred. The goal of the SAIT was to gain an understanding of reasons why the accident happened and to recommend corrective actions to prevent similar occurrences in the future.

The Autopsy Report was received from the State of Alaska, State Medical Examiner Office on September 10, 2019. The Autopsy Report officially called this an accident and the findings in the report were consistent with an acute barotrauma sustained while diving.

INTRODUCTION

This Serious Accident Investigation (SAI) Factual Report provides a detailed account of the diving accident which occurred at Torch Bay in Glacier Bay National Park, Alaska (See Figure 1) on August 7, 2019. This report was prepared by a Serious Accident Investigation Team (SAIT) that was appointed by the USGS Designated Agency Safety and Health Official (DASHO). The SAIT members are listed at the beginning of this report.

The SAIT gathered information and evidence about the diving accident with the intent to learn the contributing factors to the accident, and to make recommendations to prevent a similar accident in the future.

On August 7, 2019 USGS Scientific Diving Program Manager, Marc Blouin, received notification, at 1727 Eastern Daylight Time (EDT) of a diving fatality associated with a joint USGS/University of California – Santa Cruz (UCSC) dive project being conducted from the USGS Research Vessel (R/V) *Alaskan Gyre* in Torch Bay, Alaska. Torch Bay is within Glacier Bay National Park and Preserve (GLBA). As a result, the USGS established a SAIT with the following members:

- Marc Blouin, USGS Scientific Diving Program Manager
- Steven Sellers, National Park Service (NPS) National Dive Safety Officer
- Jim Hayward, Dive Safety Officer University of California Berkley, representing the Office of the President, University of California
- Dave Benet, Assistant Dive Safety Officer, University of California – Santa Cruz

The SAIT arrived in Gustavus, Alaska the evening of August 9, 2019 and was met by the Glacier Bay National Park (GLBA) Superintendent and the NPS Law Enforcement Ranger/ investigating officer (Ranger One). Members of the SAIT dispersed to lodging at both the Glacier Bay Lodge and aboard the USGS R/V Alaskan Gyre.

The SAIT assembled at GLBA Headquarters at approximately 0852 on August 10, 2019 to begin the SAI. The SAIT was informed by Ranger One of the following:

- The victim's body had been transported to the Medical Examiner Office in Anchorage, Alaska.
- He had received a preliminary verbal report from the Medical Examiner stating:
    - The victim's drysuit appeared to be too large.
    - The drysuit suspenders used to support the suit for proper fit were not worn by the victim.
    - And that the victim's heart contained a large number of gas bubbles.

Ranger One also outlined other known facts of the incident:

- The incident had occurred in Torch Bay, approximately 50 miles by vessel from the NPS dock at Bartlett Cove.
- The dives were being conducted from a small boat.

- The weather conditions reported at the incident site were clear and calm. Sea state was zero with no noticeable current and in-water visibility was fifteen to twenty feet (4.5 to 6 meters) near the bottom.
- The larger vessel, *Alaskan Gyre*, was in Torch Bay positioned to be able to support the two separate dive teams working from smaller vessels in the Bay. The *Alaskan Gyre* was not directly on station during the incident dive.
- The victim's dive team consisted of three divers:
    - Diver One, Victim, Project Lead, and Lead Diver
    - Diver Two, UCSC Diver
    - Diver Three, USGS Diver
- Three other UCSC divers were part of the project but were on a different smaller boat at a different dive site across Torch Bay:
    - Diver Four
    - Diver Five
    - Diver Six
- The *Alaskan Gyre* is operated by a USGS employee and licensed Captain.
- August 7, 2019, 1140 – Notification to the U.S. Coast Guard (USCG) came in that a diving incident had occurred and cardiopulmonary resuscitation (CPR) had been initiated.
- Radio traffic from the *Alaskan Gyre* to the USCG was initially being relayed by the Fishing Vessel (F/V) *Woodstock* (no additional details available).
- August 7, 2019, 1143 – NPS Dispatch notified that CPR had been initiated.
- August 7, 2019, 1203 – USCG flight surgeon was briefed and determined that the involved subject was deceased. *Alaskan Gyre* crew directed to stop CPR.
- August 7, 2019, 1855-1900 *Alaskan Gyre* arrives at NPS dock, Ranger One takes possession of victim's body and relevant equipment sequestering the body in an NPS building and sealing the evidence aboard the *Alaskan Gyre* with evidence tape.
- August 8, 2019 – NPS Interviews with *Alaskan Gyre* crew and divers conducted and videotaped.
- August 8, 2019 – Initial investigation began.
    - USCG (Lieutenant One and Coast Guardsman One) started a review of the victim's dive equipment then stopped when they were informed that the SAIT was formed and in transit.
    - NPS Law Enforcement began the fatality investigation. Alaska State Troopers who normally conduct fatality investigations deferred to NPS Law Enforcement.
        - Collected evidence:
            - Diver One's dive computer.
            - Diver Two's dive computer.
            - Diver Three's dive computer.
            - Diver One's self-contained underwater breathing apparatus (SCUBA) unit including: Buoyancy Compensator Device (BCD) with power inflator, 100 cubic foot (cf) steel SCUBA cylinder, stainless steel back plate with harness, regulator (first stage,

primary second stage, octopus second stage, submersible pressure gauge with clip, inflator hose for BCD, inflator hose for drysuit).
        - Diver One's personal drysuit (not worn on incident dive).
        - Diver One's underwater camera (attached to BCD right chest D-ring with a brass clip).
        - Diver One's slate (attached to BCD left chest D-ring with a brass clip).
        - Diver One's Diving Unlimited International (DUI) weight harness. Only the right side of two detachable weight pockets was present. It contained 14 pounds (lb.) of soft lead (6.35 kilograms).
        - Diver Three's weight harness which had been used as a do not cross line for the crew.
        - Diver Three's backup drysuit which Diver One was wearing when he was transported to the Medical Examiner's office in Anchorage, AK.
    - Known Missing Items:
        - Diver One's mask.
        - Diver One's left side weight pouch.
        - Diver One's fins.
        - Diver One's ankle weights.
        - Diver Two's quadrat square (white polyvinyl chloride [PVC] sampling device, used to determine the sampling area).

TIME LINE

- 8/4/2019 – Dive team and boat crew arrive in Yakutat, Alaska, load on to *Alaskan Gyre* and depart for Torch Bay.
- 8/5/2019, 1345 ship time, *Alaskan Gyre* Log – *Alaskan Gyre* anchored NE (Northeast) arm Torch Bay.
- 8/5/2019 – Shake down dives were conducted by both three person dive teams. Diver One's drysuit determined to be leaking. Diver One told Diver Three he was surprised the drysuit leaked because he had recently taken it to a dive shop in Monterey, CA for repairs. Aqua Seal is applied to patch the leak. An invoice obtained from Monterey Bay Diving dated 1/9/2019 indicates Diver One had new wrist seals and dive boots installed in January. In an email exchange between UCSC DSO (Diver Eight) and an employee of Monterey Bay Diving on 9/2/2019 Diver Eight asked, "Do you know if the suit was tested for leaks after the boots and seals were replaced?" The Monterey Bay Diving employee indicated "Yes it was, all suits are tested before leaving." (See Document 18.)
- 8/6/2019 – Diver One determined attempted Aqua Seal repair is unsuccessful. Diver One performed four out of five dives performed by his dive team on 8/6/2019 with his leaky drysuit, becoming progressively wetter throughout the dives.

- 8/6/2019 – Diver One indicated to members of his dive team that he had experienced a stuck inflator on his personal drysuit at some point during one of the day's dives and that he had solved the problem by disconnecting inflator hose.
- 8/6/2019 – Diver Three offers to let Diver One use his backup drysuit. Diver One declines and said he would try to make his suit work with further field repairs. Diver Three's backup drysuit is a USGS supplied DUI model CF 200 with user replaceable neck and wrist seals (ZipSeals).
- 8/7/2019 – Diver One performs a leak test on his personal drysuit using an electric air blower and located a leak in the drysuit material he deemed too large to field repair. Diver One accepts Diver Three's offer to use his backup drysuit, replaces the wrist and neck seals, determines the suit will fit, and performs an in water test of seal fit. Diver Three has only one pair of boots to use between the two drysuits he has brought. Both of Diver Three's drysuits are designed to use Rock Boots which fit over soft water proof socks that are attached to the dry suit legs. With no Rock Boots available, Diver One devises a fin retention system by clipping ankle weights onto his legs to use the bump of the weights near the diver's heel to help keep his fin straps in place. (**NOTE**: Drysuit boots, attached or Rock Boots, are designed with a ridge at the heel that helps prevent the diver's fin straps from sliding off the heel which can result in the loss of the diver's fins.) When in place, Diver One's spring strap fin straps were pulled over the ankle weights so that the ankle weight could act as a retainer. Statements made by Diver Four and Diver Six in the post incident interviews with Ranger One specifically reference them witnessing Diver One conducting in water tests of the fit of the drysuit, drysuit seals, and devised fin retention system.
- Diver Tasks and Dive Plan:
    - Diver One was assigned the task of laying out a 30 meter (98.43 feet) transect tape along a predetermined depth contour to designate the sampling areas for the dive team. The zero end of the tape was attached to the vessel's anchor so that the starting point of the transect could be determined and recorded from the surface using a handheld GPS unit at the end of the dive. Diver One would then conduct a "1 meter swath survey" (3.28 feet) looking for sea stars along the transect tape starting from the 30 meter end (98.43 feet), moving toward the zero end of the tape, and then back to the 30 meter end (98.43 feet) of the tape. The 1 meter (3.28 feet) swath indicates Diver One's sample area was the entire length of the transect tape, within 1 meter (3.28 feet) of the tape. Diver One would always keep the tape to his left during the swath survey counting, measuring with calipers, and documenting on his underwater slate the number of sea stars found within one meter (3.28 feet) of the transect tape. Diver One also occasionally photographed a sea star to aid in later identification.
    - Diver Two was assigned the task of identifying the type and estimated the amount of algae located in randomly selected quadrat areas along the transect tape. This involved using a portable PVC quadrat with 0.25 meter sides (0.82 feet) and an underwater slate and pencil to record his findings. The area of the quadrats would be 0.0625 m^2 or 0.673 ft^2.

- Diver Three was assigned the task of identifying, counting, and estimating the size of sea urchins located in randomly selected quadrat areas along the transect tape. This involved using a portable PVC quadrat with 0.25 meter sides (0.82 feet) and an underwater slate and pencil to record his findings. The area of the quadrats would be 0.0625 m^2 or 0.673 ft^2.
- Diver Two and Diver Three would move from the zero end of the tape toward the 30 meter (98.43 feet) end of the tape.
- The diver's progress along the tape was dependent on the number of organisms within their assigned survey areas and the complexity of the area they were surveying.
- There was no predetermined assignment for who would pick up (roll up and remove) the transect tape. This task fell to the last diver finished with their assigned sampling tasks.
- **NOTE**:
    - The planned depth for the sampling transects on all dives during this project was less than 30 feet sea water (fsw) (9.14 meters). A No-Decompression Table gives the maximum time that can be spent at a given depth without the need for decompression stops during a subsequent ascent to the surface. Per U.S. Navy Dive Tables, U.S. Navy Diving Manual, Revision 7, the no-decompression limit for a dive with a maximum depth exposure of 30 fsw is a maximum of 371 minutes. The no-decompression limit for a dive with a maximum depth exposure of 25 fsw is a maximum of 1102 minutes. The no decompression limits on the dive computers used by the divers would have displayed the programed version of virtually unlimited allowed no-decompression time at the depths experienced on these dives.
    - The shallow nature of the dives from a decompression standpoint translated into the dives being limited more by the gas available to the individual divers than by no-decompression time. The divers were using 100 cubic foot (cf) high pressure steel cylinders. When filled to its rated working pressure of 3442 pounds per square inch (psi), the cylinder would contain 100 cf of breathing gas. Using a somewhat average Respiratory Minute Volume (RMV) gas consumption rate of 0.6 cf per minute and holding 300 psi (approximately 8.7 cf) to 500 psi (approximately 14.5 cf) in reserve in these cylinders (as is the general practice within the scientific diving community) would give the divers approximately 86 to 91 cf of gas to conduct these dives. This translates to approximately 74 to 79 minutes at a depth of 30 fsw. The nature of the tasks being performed would indicate a less than average RMV.
- Based on the information provided in the post incident interviews, the assigned tasks took 20 to 45 minutes per dive depending on the complexity of the bottom and the number of organisms in a given sampling area.

- 8/7/2019 - Diver One, Diver Two, and Diver Three begin Dive One at Dive Site One diving from a 16 foot (4.88 meter) Solas rigid hull inflatable, *Solaster* (Site T5 – N 58˚ 19.288’ W 136˚ 48.245’).
    - Diver One’s dive starts 0950 (Dive computer corrected to local time).
    - Diver Two’s dive starts 0951 (Dive Computer corrected to local time).
    - Diver Three’s dive time starts approximately 0951 (Diver Three’s dive computer has no time of day function. Witness statements indicate Diver Three submerged at approximately the same time as Diver Two).
    - Diver One’s dive ends at approximately 1020 (Dive computer corrected to local time).
    - Diver Two’s dive ends at approximately 1024 (Dive computer corrected to local time).
    - Diver Three’s dive ends approximately 1013 (Time computed based on start time. indicated by witness statements and surface to surface time recorded by Diver Three’s dive computer).
    - Diver One’s dive profile 29 feet (8.84 meters) for 30 minutes.
    - Diver Two’s dive profile 28 feet (8.53 meters) for 33 minutes.
    - Diver Three’s dive profile 27 feet (8.23 meters) for 22 minutes.
    - **NOTE**:
        - Dive computers record the maximum depth the computer reaches during a hyperbaric exposure. Dive computers begin recording an in-water exposure (a dive) when the computer reaches its manufacturer programmed start depth and stops recording when the computer reaches its manufacturer programmed stop depth and is generally referred to as “surface to surface time”. This manufacturer programmed start and stop depth can vary slightly between different dive computer models and individual dive computers, but is generally within two or three feet (0.6 – 1 meter) of the surface to avoid recording erroneous dive times due to a dive computer in the water on a diver’s arm or mounted to a diver’s regulator hose recording while the diver floats at the surface.
    - During the surface interval Diver Three and Diver Two noted the waist of Diver One’s drysuit was hanging low and questioned him about it. Diver One opened his suit and discovered he had omitted putting the suit’s suspenders on his shoulders when donning the suit. He was encouraged to remove his head and arms from the suit to allow for donning the suspenders. Diver One declined to don the suspenders during the surface interval stating he would put the suspenders on when the team went back to the *Alaskan Gyre* to fill cylinders after Dive Two.
- 8/7/2019 – Incident Dive (Site T6 – N 58º 19.559’, W 136º 48.463’, **NOTE**: GPS coordinates were determined from the SAIT visit to the dive site post incident and based on GoPro video footage of the site shoreline provided by Diver Two taken prior to the start of the incident dive).
    - Approximately 1053 Diver One’s dive starts (Dive computer corrected to local time).

- Approximately 1053 Diver Two's dive starts (Dive Computer corrected to local time).
- Approximately 1053 Diver Three's dive time starts (Time supported by Diver Two's GoPro video footage).
- Approximately 1117 Diver Three signals Diver Two that he is finished and begins returning to the surface along the transect line and up the anchor line.
- Diver Three observes Diver One along the shore side of transect line at approximately the 20 meter mark (65.62 feet). Diver Three stated Diver One was working and did not appear to be in distress. Diver Three declined to interrupt Diver One and continued to exit the dive. This was approximately 1118 (Time calculation based on Diver Three's estimate of transit time to the surface and back calculating from estimated surfacing time).
- Approximately 1121 Diver Three's dive ends. (Time calculation based on surface to surface time recorded on his dive computer, using the start time supported by Diver Two's GoPro video.) Diver Three surfaces from the dive and exits the water. Diver Three enters the boat facing away from the direction of the transect and comes to rest on the side of the vessel with his back toward the run of the transect tape.
- Approximately 1121 Diver Two finds a set of ankle weights at approximately the 25 meter mark (82.02 feet) of the transect tape, lying within 2 feet of the tape (0.61 meters). The ankle weights were approximately 1.5 feet apart (0.46 meters). Each ankle weight was still clipped, as they would be when worn by a diver. Diver Two picks up the ankle weights, becomes concerned and quickens his exit toward the boat along the transect and up the anchor line.
- Approximately 1124 Diver Two comes to the surface at the boat and asks Diver Three if he has seen Diver One.
- Diver Three scans the dive site over his shoulder (behind him) and notices Diver One's legs floating out of the water approximately 25-30 meters (80 – 100 feet) from the boat. Diver One's drysuit legs were inflated and floating out of the water near the knee patches on the suit. One leg appeared to be slightly shorter than the other. There were no fins or ankle weights visible.
- Diver Three dispatched Diver Two to swim to Diver One. Diver Two dropped the ankle weights and quadrat and swam toward Diver One. Diver Three then pulled up the anchor line to be able to move the vessel. Diver Three placed the anchor and line in the boat and left the transect tape with the zero end attached to the anchor dragging in the water. Diver Three then moves the vessel to Diver Two and Diver One.
- Diver Two found Diver One unresponsive floating upside down below the legs of his drysuit. Diver One's arms were floating along his sides with his hands near his waist. Diver One does not have a mask on his face and does not have a second stage regulator in his mouth.
- Diver Two pulled Diver One's head to the surface and used Diver One's power inflator to fill his BCD with air.

- Diver Three arrived with the boat and reached over the side to support Diver One's head. At the same time, he retrieved the vessel's handheld radio and placed a Mayday call to the *Alaskan Gyre* on channel 82A, a channel designated for U.S. Government use only. Diver Two then opened the quick release buckles at the waist of Diver One's BCD and weight harness and on the right shoulder/chest portion of Diver One's BCD harness to extract him from his SCUBA unit.
- Diver Three and Diver Two then attempted to pull Diver One into the vessel. They experienced resistance when Diver One's SCUBA unit and weight harness hung up on his left arm. The hung item was cleared and Diver One was brought into the vessel. Diver One's SCUBA unit and weight harness were also brought into the vessel.
- After Diver Three and Diver Two got Diver One aboard the vessel, they rolled him on his side and observed lots of water and white foam coming out of his mouth and nose. Diver One was not breathing. Diver Three and Diver Two rolled Diver One onto his back and initiated two person CPR.
- Approximately 1132 ship time *Alaskan Gyre* receives Mayday call from Diver Three and begins steaming to the dive site.
- 1140 ship time, *Alaskan Gyre* Log – *Gyre* arrives alongside the *Solaster* (N 58º 19.588' / W 136º 48.432'). The Automated External Defibrillator (AED) onboard the Gyre is obtained and placed on Diver One. Initially, the battery of the AED is found to be dead. A replacement battery is immediately available and is exchanged. The AED performs its evaluation procedures and indicated "no shock advised, continue CPR."
    - **NOTE:** An AED evaluation resulting in "no shock advised" indicates no shockable heart rhythm has been detected.
- Diver Three and Diver Two continue two person CPR onboard the *Solaster*, rather than taking the time to move Diver One onboard the *Alaskan Gyre*.
- 1140 USCG Transcript – Coast Guard logs initial Mayday notification.
- 1140 USCG Transcript – "SSC JUNEAU RECEIVED A RELAY VIA VHF CH16 FROM THE VESSEL WOODSTOCK FOR THE RESEARCH VESSEL ALASKAN GYRE, OF A DIVER FOUND IN THE WATER, WITHOUT PULSE OR RESPIRATION IN TORCH BAY."
- 1150 USCG Transcript – "[redacted] CALLED SSC JUNEAU TO RELAY ON BEHALF OF THE WOODSTOCK AND THE ALASKAN GYRE. THE DIVER WAS FOUND FACEDOWN IN THE WATER WITHOUT RESPIRATION OR PULSE AT 1932Z IN TORCH BAY, AK. THE DIVER IS 27 YO MALE."
- 1150 ship time, *Alaskan Gyre* Log – *Gyre* Captain established contact with USCG via relay from *F/V Woodstock*. Per *Alaskan Gyre* log: "No breathing detected, AED confirms no detectable heart activity after multiple attempts, flight surgeon advises stop CPR;"
- 1159 USCG Transcript – "SSC BRIEFED D17 FOR DFS."

- 1200 USCG Transcript – "D17 CONFERENCED DFS (CAPT One) FOR MEDICAL BRIEF."
- 1200 USCG Transcript – "A/S SITKA BRIEFED;"
- 1203 USCG Transcript – "D17 RECEIVED NOTIFICATION FROM SCC JUNEAU OF A DIVER WHO WAS FOUND FACE DOWN IN ICY STRAIT/CROSS SOUND AREA. UNKNOWN IDENTITY AND WHERE THE BODY CAME FROM. SCC JUNEAU REQUESTS TO SPEAK WITH THE DFS. DIVER THAT WAS RECOVERED BY F/V WOODSTOCK REPORTS THE DIVER HAS BEEN NON RESPONSIVE FOR OVER 30 MINUTES."
- 1203 USCG Transcript – "FLIGHT SURGEON BRIEFED AND DETERMINED THAT THAT INVOLVED SUBJECT IS DECEASED. DFS RECOMMENDED ALASKAN GYRE DISCONTINUE CPR. SSC GAR L/L."
- 1205 USCG Transcript – "D17 CONDUCTS CONFRENCE CALL WITH DFS. DFS RECOMMENDED PERSONNEL WHO ARE CONDUCTING CPR CAN STOP AND PRONOUNCED THE DIVER DECEASED."
- 1210 USCG Transcript – "SCC ADVISED ALASKAN GYRE VIA CH16 TO DISCONTINUE CPR."
- 1220 ship time, *Alaskan Gyre* Log – Diver Three and Diver Two "cease CPR efforts."
- 1220 USCG Transcript – "NATIONAL PARK SERVICE (NPS) DISPATCH CONTACTED SCC IRT DIVING ACCIDENT. [redacted], OF NPS DISPATCH, ADVISED THERE WAS A RANGER OUT OF GLACIER BAY ON STANDBY, THAT COULD POTENTIALLY BE ONSCENE IN APPROXIMATELY 1.5 HRS."
- 1234 USCG Transcript – "BRIEFED SMC [redacted] ABOUT DIVER BEING FOUND, DIVER WAS FOUND BY F/V WOODSTOCK BUT WAS DIVING FOR ALASKAN GYRE. UNKNOWN IF DIVER WAS TETHERED TO ALASKAN GYRE.SMC [redacted] NOTIFIED D17 SMC IS NATIONAL PARK SERVICE."
- 1235 ship time, *Alaskan Gyre* Log – "Solas stabilized alongside, moving to center bay – Diver One transferred from Solas skiff to *Alaskan Gyre*."
- 1238 USCG Transcript – CAPTAIN OF ALASKAN GYRE CALLED SCC JUNEAU, REQUESTED SCC CONTACT A PERSON ASHORE, Diver Seven (VESSEL MANAGER) AT [redacted]. ALASKAN GYRE ADVISED THERE IS NO CELL PHONE SIGNAL UNTIL THEY REACH CAPE SPENER. THE SHIPS SATELLITE PHONE NUMBER IS [redacted]."
- 1240 USCG Transcript – "USCG VESSEL MANAGER – Diver Seven – BRIEFED. Diver Seven ADVISED ALL DIVE OPERATIONS WILL BE CANCELED PENDING INVESTIGATION. DIVERS ARE FROM UNIVERSITY OF SANTA CRUISE WITH ONE USGS DIVER. THE CAPTAIN OF THE VESSEL IS Captain One. Diver Seven BELIEVES THE VESSEL SHOULD BE IN BARTLETT COVE AT APPROXIMATELY 1800LCL THIS EVENING. THE VESSEL WAS ORIGINALLY SCHEDULED

TO CONTINUE OPERATIONS UNTIL SUNDAY THIS WEEK AND THEN GO TO GUSTAVUS."

- 1245 ship time, *Alaskan Gyre* Log – "Standing off Zodiac skiff, divers down."
- 1255 USCG Transcript – "GLACIER BAY NATIONAL PARK SERVICE IS NOTIFIED THAT THE CG IS STANDING DOWN AND HAS NO FURTHER RESCUE INTENTIONS."
- 1258 USCG Transcript – "SCC REQUESTED CLARIFICATION WHICH PARTY WOULD CONDUCT NOK NOTIFICATIONS. Diver Seven ADVISED THE DECEASED'S NAME IS Diver One 27YOM. Diver One WAS THE LEAD DIVER OF THE STUDENTS, AND A MEMBER OF THE UNIVERSITY. (Statement removed for the Factual Report.) THE DIVERS WERE IN RELATIVELY SHALLOW WATER. APPROXIMATELY 30FT OR LESS AND WERE IN GROUPS OF 3."
- 1305 USCG Transcript – "D17 BRIEFED."
- 1306 USCG Transcript – "NPS RANGER One REQUESTED SCC RELAY TO THE VESSEL, THAT THEY ARE REQUESTED TO RETURN TO BARTLETT COVE ASAP AND THEY WILL BE DOING AN INVESTIGATION."
- 1309 USCG Transcript – "SCC JUNEAU REPORTS F/V WOODSTOCK WAS COMMS RELAY FOR F/V ALASKAN GYRE, ALASKAN GYRE WAS THE ONLY VESSEL ON SCENE. DIVER WAS NOT TETHERED. ALASKAN GYRE WAS BEING USED FOR A USGS PROGRAM (UC SANTA CRUZ). BODY FOUND WAS LEAD DIVER (27YOM) AND UC SANTA CRUZ WILL CONDUCT NOK. BELIEVED TO HAVE BEEN IN THE WATER APPROXIMATELY 30-35 MINUTES. SCC JUNEAU IO WILL MEET ALASKAN GYRE IN BARTLET COVE 072359Z TO CONDUCT INVESTIGATION."
- 1312 USCG Transcript – SCC BRIEFED. Diver Seven ADVISED THE IT PROBABLY TAKE THE VESSEL APPROXIMATELY 4-5 HOURS TO MAKE THE TRANSIT TO BARTLET COVE ONCE ALL REMAINING DIVERS HAVE BEEN PICKED UP."
- 1325 USCG Transcript – "ASTS BRIEFED."
- 1330 ship time, *Alaskan Gyre* Log – Zodiac dive team aboard – deck and small boats secured, enroute Bartlett Cove."
- 1427 USCG Transcript – "ALASKAN GYRE ADVISED ALL DIVERS ARE ONBOARD AND THEY ARE ENROUTE FROM APPROXIMATELY 4NM NORTH OF CAPE SPENCER, ETS 2000LCL."
- 1431 USCG Transcript – Diver Seven ADVISED NPS AND THE UNIVERSITY OF CALIFORNIA SANTA CRUZ WOULD BE HANDLING NOK NOTIFICATIONS."
- 1558 USCG Transcript – "CGIS S/A NOTIFIED."
- 1900 ship time, *Alaskan Gyre* Log – "Moored NPS dock, Bartlett Cove."

- 2000 ship time, *Alaskan Gyre* Log – Divers "depart vessel for Superintendent's house. NPS officers examining and recording Diver One's dive gear. Diver One transported to NPS building."
- 08/08/2019 USCG Transcript – "CASE CLOSED FOR SAR. VALIDATED BY OS1 One. REVIEWED BY OS1 Two. NO SORTIES RECORDED. MISLE CASE ID: 1185846."
- 08/08/2019 – Diver One's body transported to Medical Examiner's Office Anchorage, Alaska.
- 08/08/2019 – Diver and Crew interviews conducted by NPS Ranger One and USCG representatives Lieutenant One and Coast Guardsman One.
- 8/9/2019, evening, Serious Accident Investigation Team (SAIT) arrives Glacier Bay National Park, Gustavus, AK.
- 8/10/2019 – SAIT investigation begins.
- 8/13/2018, evening – SAIT departs Gustavus, AK.

Diver One's Diver History

At the time of the accident Diver One had completed and logged 269 SCUBA dives. Of these dives, 29 were official training dives working toward several certifications, and 231 were scientific dives under American Academy of Underwater Sciences (AAUS) standards. Diver One logged 62 drysuit dives, including: 27 Antarctic dives based out of McMurdo Station; 19 dives in the Sitka, AK area; and 6 Glacier Bay dives on this trip prior to the accident.

UCSC Diver Training and Equipment Inspections

Diver One was PADI Open Water certified in San Diego, CA in June 2010. He completed NAUI Advanced Diver certification at UCSC on January 13, 2012 and NAUI Rescue Diver certification at UCSC on June 8, 2016. On June 26, 2013, Diver One completed NAUI Enriched Air Nitrox certification, as well as UCSC Scientific Diver Certification (in accordance with UCSC/AAUS standards). Diver One was granted an initial 45 fsw depth authorization to conduct science dives under UCSC auspices. Diver One maintained current CPR, First Aid, Oxygen Administration, and AED certifications, as well as membership with Diver's Alert Network (DAN) from 2012 until the time of his death.

Diver One completed his initial dive gear inspection with UCSC on March 21, 2013. Diver One maintained annual dive gear inspections while doing his PhD studies at the University of California, Santa Barbara. Diver One submitted his dive gear to the UCSC Diving Safety Office for annual inspection on January 4, 2019. Several issues were noted, including: a small leak in the wing style Buoyancy Compensator Device (BCD); a torn 2nd stage mouthpiece; and a sticky inflator valve on his drysuit. The drysuit inflator valve was serviced in house by UCSC Assistant DSO, Diver Nine. The BCD wing and mouthpiece were replaced. Diver One's submitted equipment passed UCSC annual inspection on January 10, 2019.

Diver One's Physical Description

Diver One was 5'8" (1.73 meters) tall and weighed approximately 160 lb. (72.58 kilograms).

Diver Three's Drysuit Sizing

The drysuit loaned to Diver One was a custom cut DUI CF200. At the time it was manufactured, Diver Three was 5'9" (1.75 meters) tall and weighed 170 lb. (77.11 kilograms).

Letter of Reciprocity Details

A Letter of Reciprocity (LOR) is exchanged between organizations with divers diving together on a dive project. For this project LORs were submitted from UCSC to USGS and from USGS to UCSC for divers participating in the "Collaborative Nearshore Marine Research on the Outer Coast of Glacier Bay National Park" (See Document 1).

Diver One's LOR indicated his last diving medical was completed 6/1/2016. Diver One's diving medical examination was scheduled to expire 6/1/2021. The frequency of a scientific diver medical examination is age dependent. UCSC requires a Medical Evaluation of Fitness For SCUBA Diving Report be completed before diving begins and at 5 year intervals before age 40, 3 year intervals between age 40 and 60, and at 2 year intervals above age 60. A medical evaluation also is required to be completed after experiencing any Conditions Which May Disqualify Candidate From Diving or following any major injury or illness or any condition requiring chronic medication (See Document 2). Diver One had logged 20 dives with UCSC in the 12 months prior to the LOR being issued. He held additional specialty training/certifications for Drysuit, Nitrox, and Rescue.

Diver Two's LOR indicated his last diving medical was completed 8/5/2016. Diver Two's diving medical examination was scheduled to expire 8/5/2021. His training in First Aid, CPR, and Oxygen Administration were up to date and current at the time of the incident. He held a 60' (18.29 meter) depth authorization and had logged a total of 311 scientific dives with UCSC and 125 dives in the 12 months prior to the LOR being issued. He held additional specialty training/certifications for Drysuit, Nitrox, and Rescue.

Diver Three's LOR indicated his diving medical examination was valid until 11/2/2019. His training in First Aid, CPR, and Oxygen Administration were up to date and current at the time of the incident. He held a 130' (39.62 meter) depth authorization. He had logged 998 dives with USGS at the time the LOR was issued, 44 dives had been logged in calendar year 2018, and 15 dives had been logged in the previous 6 months. He held drysuit and rebreather authorizations with USGS and had extensive experience in the water associated with the research project.

SAIT NARRATIVE

The morning of August 10, 2019, the SAIT assembled, received team assignments, and Team Lead Marc Blouin presented an overview of the team's charge in the investigative process. Members of the SAIT were briefed by Ranger One and provided access to inspect the portions of Diver One's dive equipment that had been recovered post incident. This included:

- Diver One's dive computer – A Suunto model Zoop, serial number 51771997.
- Diver Two's dive computer – A Suunto model Zoop, serial number 50870492.

- Diver Three's dive computer – A Suunto model Solution, serial number could not be determined.
- Diver One's SCUBA unit.
    - HOG (Highly Optimized Gear) stainless steel back plate with harness.
    - Dris Mirage Wing BCD with power inflator.
    - Faber HP 100 cf steel SCUBA cylinder.
    - Aqualung Legend regulator [Yoke style] first stage Aqualung Legend, serial number 2028040; primary second stage Aqualung Legend, serial number 2028040; octopus second stage Aqualung ABS, serial number B064562; submersible pressure gauge with clip; inflator hose for BCD (approximately 22" in length [55.88 centimeters (cm)]), inflator hose for drysuit (approximately 30" in length [76.2 cm]).
        - Diver One's regulator appeared to function correctly. When the cylinder was turned on, the regulator did not leak or free flow. There was slight damage to the adjustment knob of Diver One's primary 2nd stage regulator (serial number 2028040). No other noticeable damage to the second stages or hoses was detected. The mouthpiece of both second stages were in place and intact.
        - When the system was pressurized, tests performed on the first stage of the SCUBA regulator indicated the first stage regulator was functioning properly. The high pressure port of the first stage regulator indicated a tank pressure of 1600 psi. The low pressure port was able to deliver air to the drysuit inflator valve. The second stage regulator did not free-flow when the system was pressurized. Tests were not performed on the second stage of the regulator, because Ranger One was planning to send the entire SCUBA system to a certified testing facility for evaluation.
- Diver One's personal drysuit (not worn on incident dive) – Hollis, BioDry Drysuit, size medium, fitted with custom boots (BOGS Footwear).
- Diver One's underwater camera (attached to BCD right chest D-ring with a brass clip) – an Olympus Stylus TG-3 in a housing.
- Diver One's slate (attached to BCD harness left chest D-ring with a brass clip) – The slate was constructed of plastic or flat stock PVC. It measured 9.5" x 12" x ¾" (24.13 cm x 30.48 cm x 1.91 cm) and was equipped with a removable frame secured by wing nuts used to hold sheets of Mylar (a waterproof underwater paper that can be written on with a pencil). One side of the slate contained information recorded during Diver One's dive. The slate was designed to use four screws with wingnuts, only three screws and wingnuts were present. The hole for the fourth screw and wingnut contained a 4 inch stainless steel double ended, slide gate, clip. The diameter of the hole in the slate matched the diameter of the slide gate of the clip so closely that the clip was extremely rigid, and the clip did not rotate in any direction as it protruded from the slate at a 90 degree angle. According to Diver Two and Diver Three, Diver One used this clip to hold his calipers (See Photo 1). This stainless steel clip was in addition to the brass clip secured to one corner of the slate that was used to secure the slate to a D-ring on Diver One's BCD harness. When

inspected by the SAIT, the slate was attached to the D-ring on the left chest/shoulder of the BCD harness. The slate also had a length of lightweight elastic tubing affixed to one corner of the slate. A short piece of solid graphite art pencil was affixed to the loose end of the elastic with a plastic wire tie.

- Diver One's DUI weight harness. Only the right side of the detachable weight pockets was present. It contained 14 lb. of soft lead (6.35 kilograms).
- Diver Three's weight harness which had been used as a do not cross line for the crew post incident had initially been collected as evidence. It had been released back to Diver Three when it was discovered not to be directly involved in the incident.
- Diver Three's backup drysuit had been transported to the Medical Examiner's Office in Anchorage and was not available for inspection initially.

Known Missing Items:

  - Diver One's mask.
  - Diver One's left side weight pouch.
  - Diver One's fins.
  - Diver One's ankle weights.
  - Diver Two's quadrat square (white PVC sampling device, used to determine the sampling area for his assigned in water task).

The team then watched the video interviews of the divers conducted by Ranger One. Initially, the SAIT concentrated on the statements of Diver Three and Diver Two, because they were directly involved with the incident dive. Diver Four, Diver Five, and Diver Six statements were reviewed later looking for additional context and information on events outside of the incident dive.

Diver One was known by other UCSC members of the dive team to be an experienced drysuit diver. Diver Three's observation of Diver One in the water gave no indication that Diver One was not an experienced diver with solid diving skills.

The information contained in the video interviews indicated the event happened in a limited window of opportunity. Diver Three's last observation of Diver One was approximately 1118 to 1119 at, or near, the 20 meter mark (65.62 feet) on the transect tape. Diver Two found ankle weights on the bottom near the transect tape at approximately the 25 meter mark (82.02 feet) at approximately 1121. The ankle weights were approximately 1.5 feet apart (0.46 meters).

Reconstruction of the time line indicated Diver Three was exiting the water and entering the vessel at approximately the same time that Diver Two located the ankle weights. Diver Three does not recall seeing or hearing anything at the surface indicating there was an in-water issue with Diver One until Diver Two surfaced and asked if he knows where Diver One is. Diver One's dive computer recorded a surfacing time at 1120. The window of opportunity for this incident when Diver One was unobserved was one to two minutes.

Diver Two finding the ankle weights on the bottom suggests to Diver Three that Diver One had also lost his fins. The positioning of the ankle weights as worn by Diver One made it impossible for the ankle weights to slide over and off Diver One's feet while the fins remained in place.

Diver One was found floating upside down at the surface with his arms near his side and his hands near his waist.

Diver One was found with his regulator not in place in his mouth and his mask missing.

Diver One was known to not have the suspenders of the drysuit in place on his shoulders. The DUI CF200 drysuit he was wearing is a front entry design. The design includes extra material at the waist allowing the torso of the suit to extend/telescope up, making donning and doffing of the suit easier. The suspenders are designed to decrease the likelihood of the extra fabric moving toward the diver's legs/feet. Additionally, the suit is designed with a crotch strap that is sewn into the bottom of the fold of the extra fabric on the diver's back. When donned correctly, the crotch strap passes between the diver's legs and attaches to a quick release/Fastex buckle sewn into the front side of the fold to assist in securing the extra fabric from extending. The crotch strap can be adjusted by the diver to increase or reduce the tension of the strap for fit/comfort. Video taken at the surface by Diver Two just prior to the incident dive shows Diver One from the back and the crotch strap loose from its front attachment point (See Photo 2). A photograph of Diver One's body taken by Ranger One shows the crotch strap not attached in the front. Diver Two and Diver Three stated they did not disconnect the crotch strap after the incident dive. It is unknown if the crotch strap was in the attached position during the incident dive.

The drysuit used by Diver One, on the incident dive, is designed to be worn with Rock Boots. Rock Boots are hard soled shoes that fit over the waterproof socks sewn on to the legs of the drysuit. They are laced in place. In addition to including fin retention ridges as part of their design, Rock Boots restrict the flow of air that can move into the diver's feet and decrease the possibility of the diver's fins being dislodged by air moving into the diver's feet. The SAIT tested the ankle weight arrangement that Diver One devised to keep his fins in place during the dive. The Team discovered that if enough air moved rapidly into the drysuit legs and feet, then very little pressure could dislodge the fins.

Diver One's personal drysuit was a front entry design, though it did not include the extra fabric to allow the suit to telescope when it was donned and doffed. The suit design did include suspenders but did not include a crotch strap.

When gas is placed under pressure, the molecules of the gas move closer together, increasing the density of the gas and reducing the volume. Gas volume in a sealed system/flexible system like a drysuit decreases with increasing pressure (going deeper in the water) and increases with decreasing pressure (going up in the water column). Drysuits must allow for gas to be injected into the suit to adjust for suit squeeze experienced by a diver descending in the water column. They also must include a way for expanding gas to escape or be released from the suit when the diver ascends in the water column. This is accomplished by placing an inflator valve and a dump valve in the drysuit. The inflator valve is attached to a gas source carried by the diver. This can be a hose coming off the diver's breathing gas supply or other cylinder specifically intended to hold gas for inflating the drysuit. The standard inflator valve placement is usually located on the diver's chest, though other "custom placements" are not uncommon. The dump valve is usually attached to the diver's left shoulder, though other "custom placements" are not uncommon. The

dump valve can be adjusted open (turning the valve counterclockwise) or closed (turning the valve clockwise) or set to a position between open or closed to allow gas pressing against the valve to pass through the valve and out of the suit at the rate desired by the diver. The valve can also be depressed by the diver to allow gas to escape. Depressing the valve will cause gas to exit the suit regardless of the valve adjustment position. However, gas can only exit through the valve when the gas inside the suit is in the upper portion of the suit in the proximity of the valve. In an inverted ascent in a drysuit the diver would not be able to dump gas from the suit.

Diver One's personal suit had the inflator on the chest and the dump valve on the left shoulder. The drysuit worn during the incident dive had the inflator valve on the left upper thigh, and the dump valve was on the left shoulder. The borrowed suit also had a relief zipper below the entry zipper. A relief zipper allows a male diver to urinate at the surface without doffing the drysuit.

Dive Team witnesses reported Diver One indicated he had experienced the drysuit inflator valve of his personal suit sticking open after he added gas to his suit during one of the dives conducted the day before the incident dive. Diver One reportedly solved the unexpected injection of gas into his suit by disconnecting the inflator hose.

Diver One's BCD harness was equipped with a quick release buckle on the right shoulder and on the waste strap. The buckles were a swing/cam design; the loose end of the webbing on the harness passes under the retaining area of the buckle near the swing pivot point, the other end of the swing plate on the buckle is used to close the buckle camming the webbing in place, or to open the buckle to release the webbing. In Diver Two's statement he indicated he had released the buckle on Diver One's right shoulder to assist in removing him from his equipment in the water. When examined, the shoulder buckle was in place as if the BCD was ready to be worn. Close examination of the shoulder buckle found an indention pattern below the teeth of the buckle as would be expected if the buckle had been in the closed position for an extended period of time, the buckle opened, the webbing removed, then the webbing restrung through the buckle and the buckle closed in a slightly different location.

When examined by the SAIT, the cylinder attached to Diver One's BCD was found to contain 1600 psi of breathing gas as measured by the diver's submersible pressure gauge (SPG). This equates to approximately 46.5 cf of breathing gas in a 100 cf Faber high pressure steel cylinder. The valve on the cylinder was in the closed position. Diver Three indicated in his interview with Ranger One that he closed the valve post incident to prevent the contents of the cylinder from accidently being discharged. An air test of the breathing gas was conducted using a test kit provided by Trace Analytics of Austin, TX using the step by step instructions provided with the kit. The kit marked with the serial number of the cylinder from which the sample was obtained, the test kit information was recorded on the provided gas test request form. USGS Alaska Region DSO, Diver Seven, and Ranger One were listed on the request form to receive gas test results. The completed test kit and paperwork were given to Ranger One to send in to Trace Analytics for testing. Ranger One gave the kit and paperwork to GLBA Chief Ranger (Ranger Two) who sent the package for testing on August 12, 2019.

Diver One's DUI weight harness was found to be missing the left set of weight pockets. The right set of weight pockets were in place. The right weight pockets contained 14 lb. of lead shot (6.35 kilograms), consisting of two 5 lb. soft weights (red) and one 4 lb. soft weight (blue). The weight harness was reported to be relatively new, with only a few dives having been logged on it. The portions of the system available for examination appeared to be well maintained and in proper working order. The harness is designed to be worn jacket style under the diver's BCD harness. Unlike a traditional weight belt which is worn around the waist with no other means of supporting the belt in place, the DUI weight harness is equipped with adjustable suspenders sewn into the non-ditchable part of the harness. Each set of weight pockets is equipped with a pull handle consisting of a floating handle, attached to a section of flat webbing approximately 14 inches long, the end of which is attached to the weight pocket. The pull handle is also attached to a length of solid plastic cordage that is used to hold the weight pockets in place. The pull handle is attached near the middle of the plastic cordage providing two lengths of cordage approximately 14 inches long. The mounting area for the weight pockets is not ditchable without removing the entire weight harness, which also requires removal of the BCD harness. The ditchable weight pockets have small loops of fabric on the backside arranged along the edges of the weight pockets that are pushed through grommets on the weight pocket mounting plates. The solid plastic cordage is then threaded through the loops of fabric from the weight pockets. The resulting assembly is similar to the ripcord on a parachute. While not impossible to dump accidently, the DUI weight harness system is known to be secure and to be more difficult to release accidently than a traditional weight belt.

According to Diver Two, Diver One was using adjustable ankle weights (See Photo 3) during the dive in which the incident occurred.

Diver One's underwater camera was examined. It was determined that the camera's time stamp was the correct date but on California time. Seven photographs and one video taken during the incident day were present on the camera. Two of these images show a portion of the elastic tubing from Diver One's slate with the graphite writing instrument wire tied to it to the left side of the images. None of the other images appeared to be pertinent to the details of this investigation. The last photograph taken was at 12:11:58 (H:M:S) California time (11:11:58 Alaska time), approximately seven or eight minutes prior to the incident.

Diver One's wrist mounted dive computer was a Suunto Zoop. The dive log function of Diver One's dive computer was accessed manually, and the details of the dives conducted during this dive project were recorded manually (See Document 3). An advantage of most modern dive computers is their ability to record and store real time dive data such as depth, time, and ascent rate throughout a dive, much like a black box on an airplane. Different computers are programmed with different sampling rates. The sampling rate on Diver One's dive computer was set to record data once every thirty seconds. The SAIT downloaded the interface software from the Suunto website (https://www.suunto.com/en-us/Support/software-support/dm5/, Suunto DM5 software Version 1.3.0.19) for downloading the dive computer data to a desk top computer. The dive computer was downloaded into the Suunto software using the directions provided by the manufacturer. The initial download was conducted using the Apple software version of the

program. Some of the dives imported into the Suunto software appeared to display correctly, and some of the imported dives did not appear to display correctly. The import of the incident dive did not appear to be displaying the recorded information correctly. The dive information that was manually recorded from the dice computer showed a maximum depth of 28 fsw (8.53 meters seawater [msw]). The Suunto DM5 software showed a maximum depth of 45.1 meters (approximately 148 feet). The software did display a "Mandatory safety stop violation Ascent warning" at the end of the dive. With the displayed information differing from the information when viewed manually, the SAIT had little confidence in the information displayed by the DM5 software. There was also an "Ascent Warning" indicated in the last 30 seconds of the dive observed by the SAIT using the dive computer's manual dive profile review function.

The dive computer was downloaded to a Personal Computer (PC) version of the DM5 software (See Figure 2). Similar results were encountered. The Suunto Zoop is an older dive computer model. There may be a firmware/software conflict that may be interfering with the file transfer. The PC version of the software did not download all of the dives conducted on the incident day. The Apple version of the software downloaded all of the dives on the incident day, but it displayed the depth information inaccurately on several other dives as well.

The data recorded manually from Diver One's dive computer was used to produce a graph of the dive profile (See Figure 3). The rapid ascent alarm was recorded independently by the dive computer as a violation of its programmed maximum recommended ascent rate. Because the ascent rate was recorded in between the computer's 30 second sampling intervals, the actual ascent rate is unknown.

Inspection of the SCUBA unit found the drysuit inflator hose was of adequate length when using a drysuit with the inflator valve located on the diver's chest. The length of the drysuit inflator hose on Diver One's SCUBA unit was short when using a suit where the inflator valve was on the diver's thigh.

August 12, 2019, the SAIT was transported to the incident location by Ranger One aboard NPS Motor Vessel (M/V) *Talus*. The site was located using the description provided by witnesses and lining up landmarks visible in the GoPro video taken at the surface by Diver Two just prior to the incident dive (See Photo 4).

A weighted line on a buoy was placed in the approximate location the *Solaster* was anchored during the incident dive. A small boat was launched to support divers. Diver Three was brought as a Subject Matter Expert and would partner with Alaska Region DSO, Diver Seven, as the dive team. After careful consideration and discussions among the SAIT and GLBA law enforcement it was determined using Diver Three as a dive team member, on the investigative dives, was acceptable due to his familiarity with the underwater portions of the location, and the fact there was no other diving equipment available on such short notice to fit other members of the SAIT. Divers were briefed and dispatched from the M/V *Talus*.

The search plan entailed placing the weight marking the site in the same relative depth as the *Solaster's* anchor on the incident dive after adjusting for the difference in tide level; looking for the white PVC quadrat and ankle weights first; then laying out a transect tape along the same

depth contour, adjusted for tide level, as that of the incident dive (GPS Reading of SAIT placed anchor float: Drop position N 58º 19.599' / W 136º 48.464'. Afterwards, the position was moved to depth contour N 58º 19.599' / W 136º 48.463'. The divers were directed to send up a pelican float when they found any of the missing items. The team also carried flagging tape to mark the general location of items prior to photographing them, documenting relative position of items relative to each other and the transect tape, and recovering the items.

The divers were deployed at 1041. Observing the divers' bubbles from the surface, we saw the divers searching in the area where they expected to find the quadrat and ankle weights that were dropped from the surface by Diver Two. No pelican buoy was deployed. The divers' bubbles then progressed in the direction the transect tape had been deployed on the incident dive. Approximately nine minutes into the dive (1050) a pelican buoy came to the surface approximately 18 meters (59.06 feet) from the float marking the anchor location of the *Solaster* (GPS reading: N 58º 19.595', W 136º 48.444'). The divers surfaced briefly at 1100 and informed the surface team that they had located a cluster of items: 2 fins, a weight pouch, and a mask. They also informed the surface team that they had not located the ankle weights or quadrat. The divers were given a digital underwater camera system and GoPro and they returned to the bottom to photograph and document the items. During this process, Diver Three discovered Diver One's calipers. When the documentation process was completed, the divers returned to the surface leaving all items in situ. The dive ended at 1143.

The underwater portion of the incident site was characterized as having a sandy bottom with a mix of cobble and boulder-sized rocks (based on the Wentworth scale, See Document 4), understory kelps attached to the rocks, and approximately 20' of visibility.

During the surface interval, photographs and recorded measurements were reviewed and found to be adequate for the needs of the SAIT. Weather conditions were starting to deteriorate. Transit to and from Bartlett Cove to Torch Bay involves navigating an area of water between Cape Spencer and Cape Bingham, known to be hazardous in poor weather conditions. The decision was made to send the divers in for a second dive to recover the found items and make one more, quick search to try and locate the ankle weights and quadrat. The divers began their second dive at 1233. They carried with them a mesh bag into which they placed the found items. They then made a short excursion to the surface to obtain a haul line to attach to the mesh bag containing the recovered items, descended, attached the haul line and signaled for it to be brought to the surface. SAIT member, Diver Nine, in the small boat, then hauled the bag to the surface and transported the bag to the M/V *Talus* where Ranger One took possession of the bag and recovered items. Observing the divers' bubbles from the surface saw them return to the area close to where the *Solaster* would have been anchored during the incident dive and conduct another search. The ankle weights and the quadrat were not located during this search and remain on the bottom near the incident location. The divers surfaced at 1308. Divers and small boat support returned to the M/V *Talus* and the team returned to the NPS dock at Bartlett cove.

Diver One's fins were located in approximately 28' (8.5 meters) of water, 5.6' (1.7 meters) apart. The weight pocket was located in approximately 30' (9.14 meters) of water, 6.5' (2 meters) down slope from the fins. The calipers were located in approximately 33' (10.06 meters) of water, 4.9'

(1.5 meters) down slope from the weight pocket. The mask was located the furthest down slope in approximately 34' (10.36 meters) of water, 8.2' (2.5 meters) from the calipers.

Diver Seven's, who assisted with the SAI, and Diver Three's Dive One profile: Maximum depth exposure 33 fsw (10 msw) for a surface to surface time of 33 minutes. This includes an excursion to the surface to notify surface personnel and obtain camera equipment.

Diver Seven's dive profile for Dive Two was a maximum depth exposure of 49 fsw (15 msw) for a surface to surface time of 33 minutes. Diver Three's dive profile for Dive Two was a maximum depth exposure of 52 fsw (15.8 msw) for 33 minutes.

During the SAIT excursion to the incident site, the drysuit worn by Diver One had been escorted from the Medical Examiner Office by a NPS Ranger and placed into the evidence locker at the Park. Upon returning to Park Headquarters, the SAIT was given access to the drysuit worn by Diver One during the incident as well as the under garments worn.

The SAIT performed a detailed inspection of the drysuit including comparing the sizing of Diver One's personal drysuit with the sizing of the suit worn during the incident and checking the function of the inflator valve and the exhaust valve. The exterior of the suit was slightly damp to the touch. The interior of the suit did not indicate that the suit had been flooded.

Laying the incident suit flat on the ground with the telescoping fabric fold properly adjusted and laying Diver One's personal suit on top of it found the suits to be similar in size (See Photo 5). Unfolding the telescoping fabric fold and repeating the comparison found the incident suit could extend approximately 10 (ten) inches (25.4 cm) beyond the end of Diver One's personal suit (See Photos 6 & 7).

The exhaust valve of the suit manipulated smoothly and appeared to function properly. The position of the exhaust valve was marked, and the valve was manipulated to determine its position relative to open or closed. The exhaust valve was found to be within approximately a quarter turn of being fully open. Members of the SAIT very familiar with drysuit diving considered this close to open position unusual for normal operations during a dive, in that the valve position could easily allow gas in the suit to escape during normal movement causing the diver to add additional gas to maintain warmth and buoyancy. Adjusting the valve to a more standard in-water position where a diver could move without gas escaping the suit too easily and then spinning the valve rapidly toward the open position found the valve came to rest very near the adjustment position found at the start of the inspection.

When working correctly, a drysuit inflator valve must be manually activated to inject gas into a drysuit. The valve is activated by pushing a button that opens the valve and allows gas to pass through. When pressure on the valve is released, a spring inside the valve closes the valve and the gas flow stops. A valve that sticks open can result from several factors: Continued pressure on the activation button by an outside force; O-rings inside the valve assembly not moving as designed due to friction inside the assembly; a weak or broken spring in the valve's return mechanism are examples.

The inflator valve of the suit worn during the incident manipulated smoothly and appeared to function properly. When attached to the drysuit inflator hose of Diver One's regulator, it sealed properly and did not leak gas into the suit. Pushing the inflator button caused gas to pass through the valve. Releasing the button caused gas to stop passing through the valve. There was no appreciable lag between the release of pressure on the button and the valve stopping the flow of gas into the suit.

The inflator valve on the suit worn during the incident has a hard exterior housing that extends near the top of the inflator valve button. This exterior lip around the button would protect the button from accidental activation in most circumstances. While the top most edge of the button is not actually recessed below the edge of the hard exterior housing, simply coming in contact with an object that also contacted the housing lip would not be likely to activate the button. Activation of the valve would require a hard object that could push the button directly.

SAIT Member Diver Nine is approximately one inch shorter and five pounds heavier than Diver One. Diver Nine agreed to don the incident suit so the SAIT could explore the approximate fit and positioning of the suit relative the rest of Diver One's dive equipment.

The suit was donned with the foot coverings worn by Diver One in place, and without suspenders in place. The fit of the suit was inspected with and without the crotch strap connected. (See Photos 9 & 10). The fit was determined to be a little large, but not unreasonably large if properly donned.

The reassembled weight harness and SCUBA unit was then donned, less the underwater camera and slate to facilitate donning. No adjustments to the BCD or weight belt harness were made. The drysuit inflator hose was connected to the drysuit inflator located on the suit's left thigh. Witness statements indicated Diver One did not go to unusual efforts to route the inflator hose to the valve. Video of Diver One taken by Diver Two in water near the start of the incident dive does not show the inflator hose routed over the left hand weight pocket. Instead the hose appears that it may have been routed to lay to the front of the weight pocket (See Photo 11). This routing tends to hold the weight pocket further back on the diver's hip than would normally be expected, which was noted by the SAIT when the GoPro video was first reviewed. Routing the hose in front of the weight pocket also causes the handle of the pocket to rest against the hose (See Photo 13).

The missing weight pocket was found with the pull handle floating up in the water column. Nothing was evident to suggest the handle had snagged on something and been accidently deployed.

The relationship of the weight harness to the drysuit inflator button when viewed during the SAIT dry land test found no portion of the weight harness could be manipulated in a way to activate the button on the inflator valve.

With the weight harness eliminated as a trigger to activate the inflator button. The SAIT re-clipped the camera and slate to the BCD harness to see if the corners of one of these items could activate the button. As soon as the slate was clipped in place, Diver Nine noticed that the double

end clip attached through the hole in the slate designed for a screw and wingnut landed perfectly in the middle of the drysuit inflator button and pushing on the slate activated the button (See Photo 17). It was also noted that the double-end clip was positioned over the inflator button only when the gate of the brass clip securing the slate to the left shoulder D-ring was oriented facing the diver, as it would have been if attached using the diver's thumb to open the gate and moving the clip down onto the D-ring (See Photo 18). Diver Nine then assumed a pushup position to simulate the horizontal position Diver One had been observed employing near the bottom on the incident dive. With the slate beneath the diver and the clip facing up toward the diver, applying downward force associated with a prone diver settling to the bottom caused the clip to activate the button (See Photos 19 & 20). **NOTE**: During this testing process, sufficient force was applied to fracture the edge side portion of the slate material holding the clip in place and two small pieces of material broke off. It is unknown if cracks in the material were present prior to this test.

The short run of the drysuit inflator hose acted somewhat like a one sided suspender restricting the amount of fabric that could telescope down the diver's left leg (See Photo 14). The hose length and position relative to the left side weight pouch served to stabilize the position of the inflator valve. Once the button was depressed, the inflator valve's housing around the button provided a cup helping to stabilize the round end of the clip directly on the button. This cupped position prevented the clip from sliding off the button and kept the button depressed as long as there was pressure on the slate, clip, and button.

On one of the dives the day before the incident, Diver One indicated to his dive buddies that he had experienced a stuck inflator valve on his personal drysuit. He solved the issue by disconnecting the inflator hose.

Physics dictates, adding gas to a drysuit diver's legs will cause them to begin to rise in the water column. The amount of time necessary for a diver's body to reach a tipping point to spill the gas from the torso portion of the suit to his/her legs would be dependent on the diver's body position. Gas from a diver's torso flooding into the diver's legs will move with sufficient force to move any loose fabric in the drysuit toward the diver's feet. Experience has shown that gas flooding into a diver's legs has sufficient force to move attached boots on a drysuit diver's suit off a diver's feet and to cause a diver to lose their fins. Diver One was not wearing attached drysuit boots. In an inverted position, the weight harness or weight belt worn by a diver shifts toward a diver's head due to gravity. Weight shifting toward a diver's head and gas in a diver's legs/feet will place additional strain on the connection of an inflator hose and a drysuit inflator located on a diver's thigh making disconnecting the inflator hose difficult. A weight harness or weight belt will interfere with access to the connection point of a drysuit inflator located on a diver's thigh and a minimal length inflator hose. In an inverted position, weight lost or removed from a diver's weight harness will move toward the bottom. In an inverted position the diver's head, face, mask, and primary second stage regulator are below any weight removed or lost from a diver's weight harness. Fourteen pounds (6.35 kilograms) of soft lead moving from a diver's waist to a diver's face is sufficient mass to dislodge a diver's mask and second stage regulator. Removal of a diver's mask and second stage regulator will expose a diver's airway to seawater. In an

inverted position, an exposed airway will cause water to percolate into a diver's nose and sinuses. A diver ingesting water in sufficient volume can cause the individual's glottis to spasm closed blocking the airway. Compressed gas in a diver's lungs expands as a diver experiences reduced pressure moving toward the surface in the water column. If a diver's airway is blocked, the expanding gas will cause a barotrauma. Over expansion injuries such as Arterial Gas Embolism (AGE) and pneumothorax can result. AGE results when the diver's airway is blocked and expanding gas in the diver's lungs cannot escape to reduce the increasing pressure. The resulting barotrauma allows gas to pass from the lungs into the diver's bloodstream where it can travel throughout the diver's body. A gas bubble that lodges in a diver's brain can cause a blockage, essentially a stroke. Depending on the severity and location of the blockage, incapacitation can be very rapid. A change in pressure of 4 to 5 psi in the diver's lungs can be enough to cause an AGE. The psi change experienced by Diver One during this ascent could have exceeded 13 psi hydrostatic.

A drysuit diver is taught to try and forward roll out of an inverted position to move gas away from their feet and back toward the shoulders of the suit where excess gas can be dumped. The gas filled drysuit socks extending beyond Diver One's feet would make this maneuver nearly impossible, particularly with the rapid rate of gas expansion in the drysuit's legs as he moved closer to the surface, and the limited amount of time he had to deal with this problem.

A normal ascent rate for SCUBA diving is 30 feet (9.14 meters) per minute. A positive buoyant ascent from 25 to 30 fsw (7.62 – 9.14 msw) could approach or exceed 100 feet (30.48 meters) per minute. The point in the ascent where Diver One lost his left side weight pouch will affect the ascent rate. Diver One's dive computer recorded an ascent warning, but the 30 second sampling rate and the relationship of the actual ascent to the sampling cycle did not allow an actual ascent rate to be recorded. It is most probable that the 30-foot (9.14 meter) rate or slower rate taught to all divers over the past 20 years was exceeded. However, the rate itself is not the mechanism of injury in an AGE. It is the expanding gas coupled with a blocked airway.

INVESTIGATION PROCESS

The accident was reported to the USGS Scientific Diving Program Manager on August 7, 2019. In response, a Serious Accident Investigation Team (SAIT) was formed and mobilized. The team consisted of the following:

- one Team Leader
- one Chief Investigator
- two University Diving Safety Specialists

The SAIT convened at the Glacier Bay National Park Headquarters in Gustavus, Alaska on the morning of August 10, 2019. The Team was briefed by the National Park Service Lead Investigator regarding the evidence that was collected up to that time. Interviews were conducted with the two eye witnesses, Diver Three and Diver Two. The process of gathering information that would be considered as evidence, consisted of the following:

- Developing a timeline of events from, before, during and after the accident.

- Visiting the site where the accident occurred and gathering evidence.
- Evaluating human, material, and environmental factors that may have contributed to the accident.
- Reviewing video interviews, statements and documents obtained prior to the Team convening.
- Interviewing eye witnesses to the accident.
- Reviewing operational guidelines and policies.
- Establishing a pattern of actions of the victim that led up to the accident.

Eyewitnesses and data from dive computers, provided detailed accounts of the accident that allowed the Team to develop a timeline of events. Because some evidence was missing, the SAIT developed a plan to search for and retrieve the missing pieces of evidence from the accident site.

FINDINGS

FINDING (Human):	Diver One was well trained and had experience as required by the University of California, Santa Cruz Dive Program.
FINDING (Material):	Diver One's personal drysuit leaked.
FINDING (Material):	Diver One borrowed a drysuit from Diver Three.
FINDING (Human):	Diver One did not use the attached suspenders in the borrowed drysuit.
FINDING (Human):	Diver One did not use footwear designed for use with the borrowed drysuit. Additional footwear for the borrowed drysuit was not available.
FINDING (Material):	Diver One used adjustable ankle weights on the dive in which the accident occurred.
FINDING (Environmental):	Weather was partly sunny with low wind and was not a factor in the accident.
FINDING (Material):	Diver One lost his fins, ankle weights, mask and left weight pouch prior to being discovered on the surface.
FINDING (Environmental):	Current and water visibility were not factors in the accident.
FINDING (Human):	Emergency procedures were followed by the Dive Team.
FINDING (Environmental):	The water temperature was 7^{o} (degrees) Celsius at the time of the accident.
FINDING (Human):	Diver One did not wear gloves on the dive in which the accident occurred.

ACKNOWLEDGEMENTS

The investigative team is grateful to all the personnel who provided assistance to the Serious Accident Investigation Team (SAIT) during their investigation of the diving accident. The SAIT especially acknowledges the cooperation and personal efforts of the following people:

Philip Hooge
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907-697-2230

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907-697-2632

Albert Faria
Chief Ranger
Glacier Bay National Park
Gustavus, AK 99826
907-697-2621

George Esslinger
Alaska Region Dive Safety Officer
USGS, Alaska Science Center
4210 University Drive
Anchorage, AK 99508
907-786-7044

Grant Hilderbrand
Associate Center Director for Marine and Freshwater Ecosystems
USGS, Alaska Science Center
4210 University Drive
Anchorage, AK 99508
907-786-7076

GLOSSARY OF TERMS

AGE - Arterial Gas Embolism, a blockage of blood supply to organs caused by bubbles in an artery.

AK - Alaska.

barotrauma - injuries caused by increased air or water pressure.

BCD - Buoyancy Compensator Device.

cf - cubic foot.

CGIS - Coast Guard Investigative Service.

cm - centimeter.

CPR - cardiopulmonary resuscitation.

DAN - Diver's Alert Network.

DASHO - Designated Agency Safety and Health Official.

DSO - Diving Safety Officer.

DUI - Diving Unlimited International.

EDT - Eastern Daylight Time.

F/V - Fishing Vessel.

fsw - feet sea water, a unit of pressure used in underwater diving.

GLBA - Glacier Bay National Park and Preserve.

GoPro - a brand of underwater video camera.

in-water visibility - a measure of the distance at which an object or light can be discerned.

lb. - pound

LOR - Letter of Reciprocity.

M/V - Motor Vessel.

msw - meters sea water, a unit of pressure used in underwater diving.

NE - Northeast.

NOAA - National Oceanic and Atmospheric Administration.

no-decompression limit - the maximum time that a diver can spend underwater and still ascend directly to the surface without the need for decompression stops.

NPS - National Park Service.

OS1 - Operations Specialist Petty Officer 1st Class

PC - Personal Computer.

pneumothorax - a collapsed lung. A pneumothorax occurs when air leaks into the space between the lung and chest wall. This air pushes on the outside of the lung and makes it collapse.

psi - pounds per square inch.

PVC - polyvinyl chloride.

R/V - Research Vessel.

RMV - Respiratory Minute Volume, a gas consumption rate.

S/A - Special Agent.

SAI - Serious Accident Investigation.

SAIT - Serious Accident Investigation Team.

SCUBA - self-contained underwater breathing apparatus.

sea state - An oceanography term used to describe the general condition of the free surface on a large body of water with respect to wind waves and swell at a certain location and moment. A sea state is characterized by statistics, including the wave height, period, and power spectrum.

SPG - submersible pressure gauge, a device that displays how much air remains in the diver's tank.

UCSC - University of California, Santa Cruz.

USGS - U.S. Geological Survey.

REFERENCES

Barsky, S.M. and T. Neuman. 2003. Investigating Recreational and Commercial Diving Accidents. ISBN 0-9674305-3-4235 pp.

Cheung, Stephen S ; Montie, Diane L ; White, Marrhew D ; Behm, David. Changes in manual dexterity following short-term hand and forearm immersion in 10 degrees C water, Aviation, Space, and Environmental Medicine, September 2003, Vol.74(9), pp.990-3.

MAPS, ILLUSTRATIONS AND PHOTOGRAPHS

Figure 1: Map showing the location of diving accident.

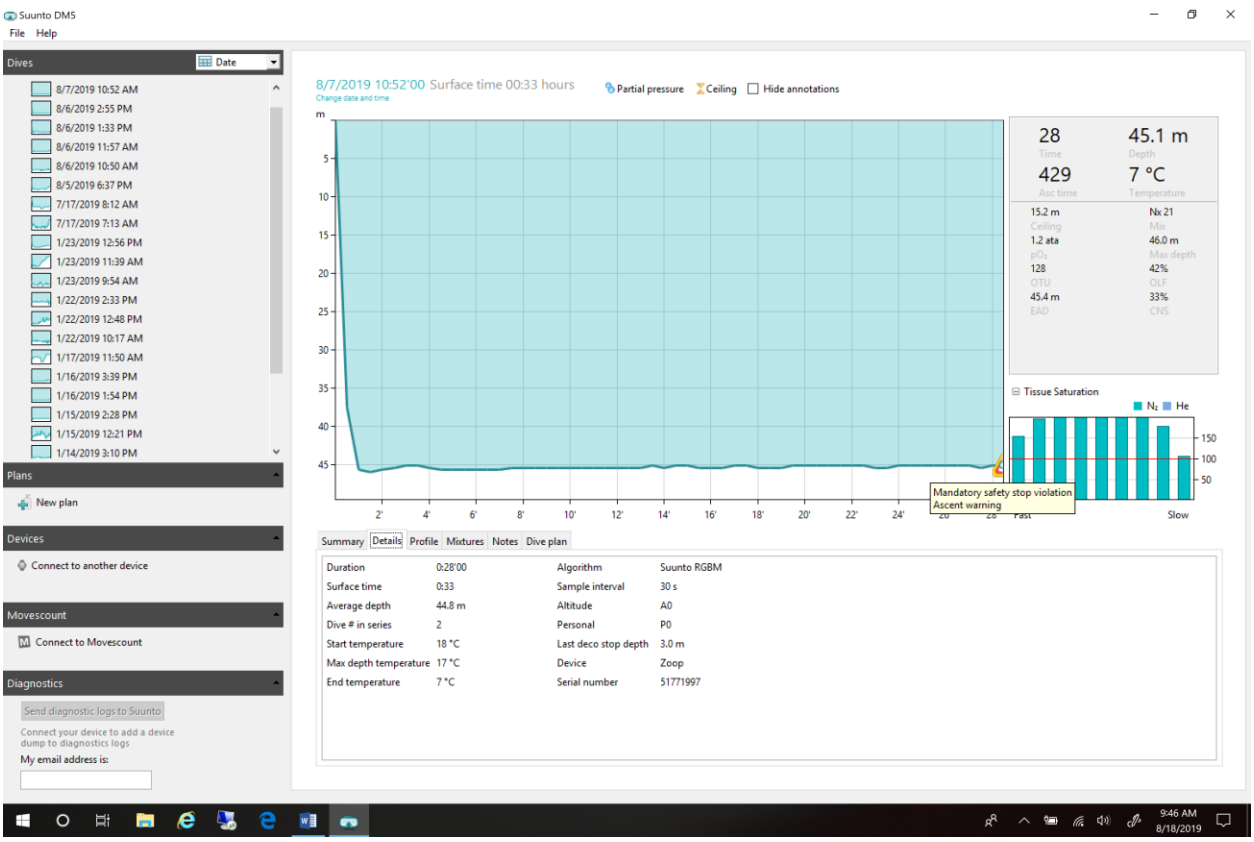


Figure 2: Screen shot of incident dive from PC version of the Suunto DM5 software showing incorrect depth information.

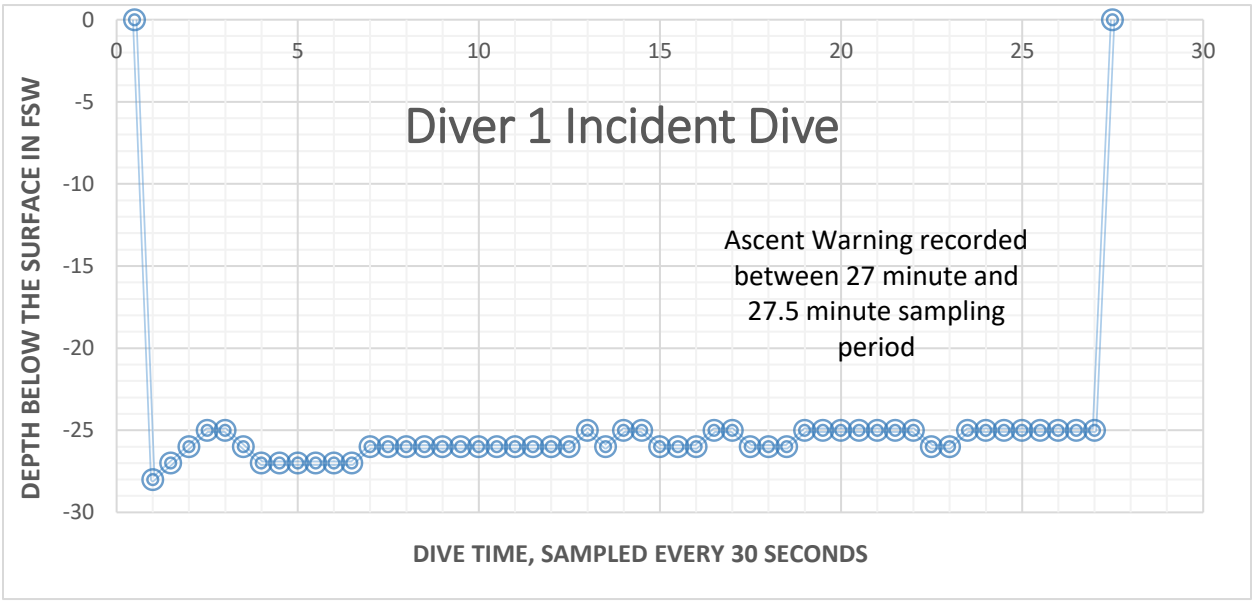


Figure 3: Hand plot of Diver One's dive computer data showing depth in fsw below the surface recorded every 30 seconds.

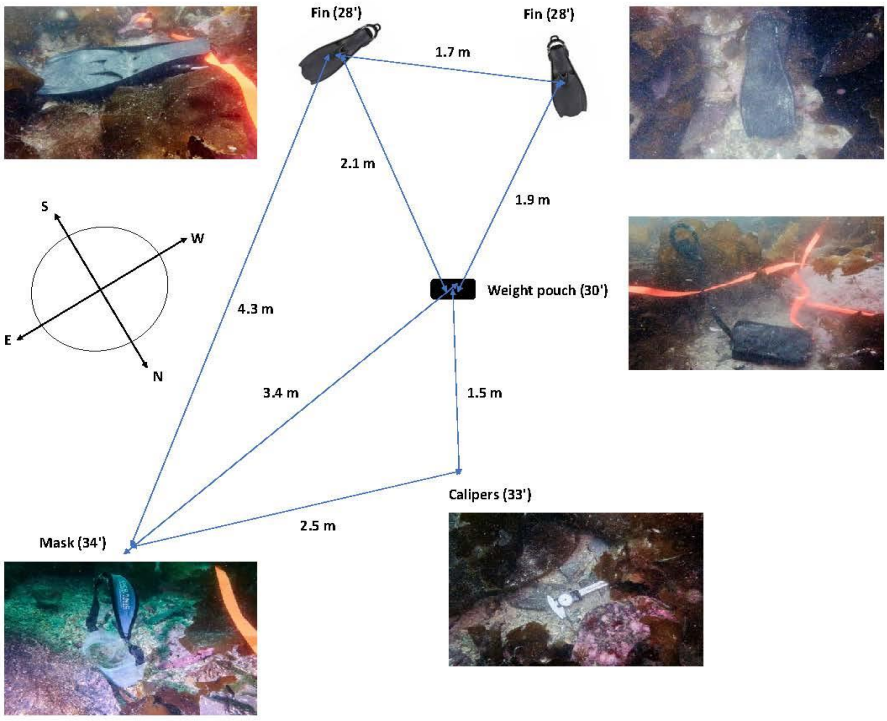


Figure 4: Diagram of the items found on the bottom at the incident dive site.

Photo 1: Example of how Diver One used the stainless steel clip attached to his data slate to hold his calipers.

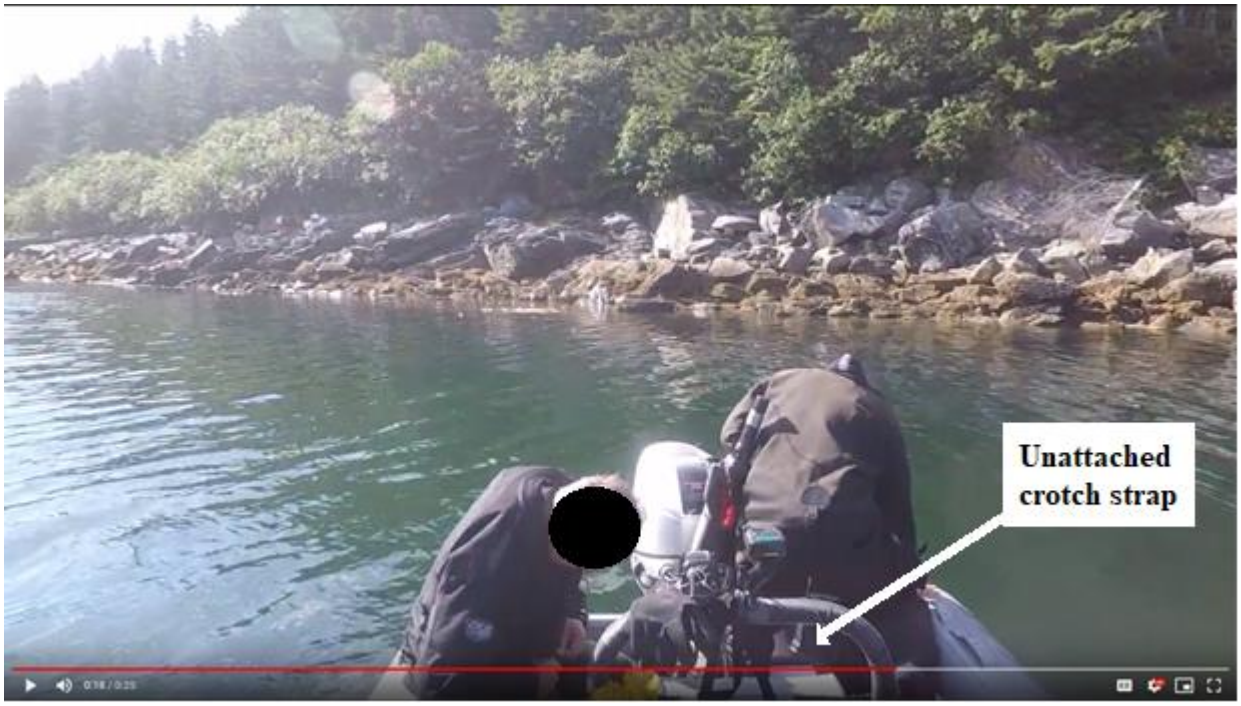


Photo 2: Screen grab image from pre-incident video showing Diver One from the back with the drysuit crotch strap disconnected

Photo 3: Example of an adjustable ankle weight.

Photo 4: Video taken before the incident dive being used by SAIT to identify the dive incident location. Note several distinguishable features including prominent flat rock face and mussel covered rock.

Photo 5: Diver One's personal drysuit laid on top of the drysuit worn during the incident dive
NOTE: The fabric fold of the incident drysuit is in the folded position as it is designed to be worn.

Photo 6: Diver One's personal drysuit laid on top of the drysuit worn during the incident dive
NOTE: The fabric fold of the incident drysuit is fully extended toward the diver's feet.

Photo 7: Comparison of the suit worn during the incident dive (above) and Diver One's personal drysuit (below). With the excess fabric from the fold of the DUI CF200 drysuit extended toward the diver's feet, approximately ten inches of material could have protruded beyond Diver One's feet.

Photo 8: Detail of the inflator of the drysuit worn during the incident.

Photo 9: Demonstration of drysuit with crotch strap clip attached.

Photo 10: Demonstration of drysuit without crotch strap clip attached.

Photo 11: Screen grab image from the start of the incident dive showing Diver One from the left side. The “DUI” in the lower right hand corner is the left side weight pouch.

Photo 12: Side by side comparison of drysuits with crotch strap attached to DUI suit.

Photo 13: Inflation hose pulling up drysuit and tight against left weight pocket.

Photo 14: Diver One's drysuit inflator hose connected to inflator. Illustrating the tension on the hose and position relative to the weight pouch.

Photo 15: Cylinder canting caused by tension on inflation hose.

Photo 16: Screen grab taken from the GoPro video shot at the beginning of the incident dive showing Diver One's cylinder canted to the left due to the length of the drysuit inflator hose attached to the suit inflator on his left thigh.

Photo 17: Data board clipped to the left shoulder D-ring of the Buoyancy Compensator Device (BCD) showing the natural fall of the clip to the drysuit inflator.

Photo 18: SAIT test of data board with stainless steel clip clipped to the left shoulder D-ring of the BCD in suspected pre-incident position.

Photo 19: Data board attached to BCD and showing how the attached stainless steel clip lined up with the button of the inflator valve of the drysuit with the corner of the data board in contact with the “bottom”.

Photo 20: Data board clip contacting inflator valve during inflation test.

APPENDICES

AGREEMENT BETWEEN USGS- ALASKA SCIENCE CENTER AND UC SANTA CRUZ

Collaborative Nearshore Marine Research on the Outer Coast of Glacier Bay National Park

This document describes a collaborative agreement between USGS-Alaska Science Center Nearshore Marine Ecosystem Research Program (ASC) and [redacted] Global Change Ecology lab at UC Santa Cruz (UCSC; [redacted]). We have identified opportunities to facilitate and enhance our mutual interests in nearshore marine ecology in SE Alaska, through logistical synergies and opportunities to share ideas during joint field excursions. In brief, the ASC will provide a research platform (Alaska Gyre) and a research scientist/diver (Weitzman) to facilitate subtidal sampling along the outer coast of Glacier Bay, and UCSC will provide 2 divers for subtidal sampling within Glacier Bay as part of an NPS-funded research project. See below for details:

The Science

The work along the outer coast of Glacier Bay by UCSC has the following objective:

1. Quantify sea urchin abundance and size structure, and kelp forest community structure during August 2019 at sites sampled during 1987, 2003, and 2009.

By doing this, UCSC researchers will have a basis for evaluating variation in kelp forest communities through time, in the face of changing predator communities, including sea otter re-population and recent declines in sea stars as a result of sea star wasting disease. This work will enhance ongoing work by the UCSC group in Sitka Sound, by broadening the geographic scope and facilitating sampling at 2 sites (Surge Bay and Torch Bay) where historical data are available. This work is of high interest and relevance to ASC, as these questions are being addressed as part of our long-term studies in southcentral Alaska as part of Gulf Watch Alaska. The work also provides context that will enhance our understanding of variation in macroalgae communities within Glacier Bay (described below)

The work being conducted within Glacier Bay, led by ASC, is part of research funded by NPS, designed to understand sea otter population status within the bay, as well as effects of their occupation on subtidal communities. Objectives of 2019 field work include:

1. Quantify sea otter diet composition and energy intake rates, and
2. Measure composition and quantity of subtidal invertebrates and algae.

This work is designed to repeat work originating in the 1990's, when sea otters were first occupying Glacier Bay, allowing an unprecedented understanding of ecosystem change in a protected, mixed-sediment system. Given the similarities to questions posed by UCSC about top-down effects of predators on subtidal marine habitats, the synergies and opportunities for intellectual engagement are significant.

Deliverables

We anticipate the following concrete products to emerge from this collaboration, including:

1. A trip report, led by UCSC, with results of the expedition to Torch Bay and Surge Bay incorporated into the Glacier Bay Communities studies report.
2. An annual report, prepared by ASC for NPS, providing a summary of data collection during 2019 for submission to Glacier Bay NP.

Document 1: Collaborative Nearshore Marine Research on the Outer Coast of Glacier Bay National Park

3. We foresee multiple journal manuscripts emerging from each of the research programs described above.
4. Each of the deliverables will include acknowledgement of the logistical support provided by the other party. We also anticipate that there may be opportunities for shared authorship on some reports or manuscripts with additional collaboration.

Below are the specific contributions of each party for facilitating the collaborative field effort:

1. ASC will provide sea time aboard the R/V Alaskan Gyre for 8 days to resample subtidal monitoring sites in Torch Bay and Surge Bay, in August 2019.
    a. Sampling will occur en route of the transit from Homer to Glacier Bay (i.e. dive crew joins Gyre in Yakutat, departs from Bartlett Cove) or following the Glacier Bay subtidal sampling trip.
2. ASC will provide one biologist for the outer coast field effort.
3. UCSC will provide 4-5 qualified divers for resampling the outer coast.
4. UCSC will provide 2 divers for ASC-led sampling inside Glacier Bay (2 weeks in August).

UCSC DIVING MEDICAL EXAM PACKET

This packet consists of the following sections:

Section 1— Medical Exam Overview for divers and instructions for clearance process
Section 2— Diving Medical History Form (Applicant completes)
Section 3— Information for examining clinicians, including List of Possible Contraindications to Diving
Section 4— Physical Examination Form (Clinician completes)
Section 5— Diving Medical Evaluation (2-sided form for results of exam)

Section 1- Medical Exam Overview for Divers and Instructions for Clearance

Diving makes considerable demands on your physical and emotional condition. Diving in the presence of certain medical conditions may pose grave risks not only for yourself, but to anyone coming to your aid if you get into difficulty in the water. Therefore, it is prudent to meet certain medical and physical requirements before beginning a diving or training program. **Verification of physical fitness for diving must be on file in the UCSC Diving Office BEFORE you can dive in UC Santa Cruz programs.**

The UCSC Student Health Center conducts a medical surveillance program for UCSC divers. Medical clearance is required before approval for diving is given. All aspects of evaluation and testing are conducted under the supervision of the Medical Director. Final decisions for medical clearance are made by the UCSC Medical Director or designee. There are fees for the physical and all laboratory tests, even if you are determined to be unfit to dive. The following table summarizes the requirements for clearance for all diving classes.

All Divers Under age 40 Initial & Periodic Re-Exam every 5 years	**All Divers Over age 40 Initial Exam**	**All Divers Over age 40 Periodic Re-Exam every 3 years (every 2 years if over age 60)**
Medical History	Medical History	Medical History
Complete Physical Exam, emphasis on neurological and otological components	Complete Physical Exam, emphasis on neurological and otological components	Complete Physical Exam, emphasis on neurological and otological components
Urine Dip	Urine Dip	Urine Dip
	Resting EKG	Resting EKG
	Chest X-ray	
	Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment	Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment
Any further tests deemed necessary by the clinician	Any further tests deemed necessary by the clinician	Any further tests deemed necessary by the clinician

The process of a diving physical may take several visits to the Student Health Center. You are responsible for knowing which specific medical tests are required for your physical. **Please fill out the "Diving Medical History" form before your appointment for examination and give it to the clinician at the time of the physical exam, along with the other forms in this packet.**

If a diver wishes his or her personal clinician to supply information and test results pertaining to their health status, this information will be considered in this decision. Medical evaluations performed by non-UCSC clinicians must be reviewed by the UCSC Medical Director or designee. You may do this by submitting your COMPLETED medical packet to the Student Health Center. There is a fee for the service. After reviewing your packet, if the UCSC Medical Director determines that further evaluation is needed, you will be asked to schedule an appointment.

If you currently have asthma, have history of asthma, or history of childhood asthma, you must:
1) Undergo a spirometry done at a pulmonologist office
2) Receive medical clearance from that pulmonologist
3) Submit Scuba Medical, Pulmonologist Clearance, and Corresponding Labwork to UCSC Health Center for final approval.

Note: There may be further tests requested if deemed necessary by the UCSC clinician. After receiving medical clearance from both the pulmonologist and UCSC Health Center, you are guaranteed a spot in the Basic Scuba class for the following quarter, as long as the other requirements have been met. Please turn in the medical clearance to the instructor at the first pool session

Once clearance is granted, the diver should take the signed form to her/his SCUBA instructor for the required training using Self-Contained Underwater Breathing Apparatus (SCUBA).

See next page for specific instructions for completing exam requirements

Document 2: Example of UCSC Medical Form

How To Complete Exam Requirements at the UCSC Student Health Center:

Step 1. CONTACT THE APPOINTMENT DESK—Call 831-459-2500 to schedule your appointments.

The Appointment Assistant will:

- Set up appointments for your physical exam and *EKG (if needed)*.
- Order your lab work (and chest x-ray if needed).

Step 2. **Get your Lab work (and chest x-ray if needed) done at least <u>One Week Before</u> your scheduled physical exam appointment. You must have first had the necessary tests ordered by the Appointment Assistant (see Step 1).**

- **Laboratory Testing—M T Th F 9:00a-4:00p W 9:30a-4:00p**
  (Basement level of Student Health Center)
- **Chest X-Ray— M T Th F 9:00a-4:00p W 9:30a-4:00p** (Basement Level of Student Health Center)
  - X-Rays will be read by specialists and become part of your medical record.

Step 3. **Come in for your Physical Exam Appointment.**

- Make sure your lab work (and chest x-ray if needed) were done a *minimum* of 1 week prior.
- Bring **all** of your forms with you. **You must complete** the attached Diving Medical History Form (p. 3 & 4) **before** the physical exam appointment.
- You will see a clinician who will review your test results, do your physical exam and evaluate your fitness for diving.
- If you are cleared, **YOU** must bring the signed Medical Evaluation Form to your SCUBA instructor.
- Please remember that if your medical records need to be reviewed or you need to see a specialist, completing your diving physical may take extra time. **Plan Ahead**.

<u>PHYSICAL BY NON-UCSC CLINICIAN</u>

If you have your Diving Medical Evaluation completed by a non-UCSC clinician, a UCSC clinician MUST review your medical file before diving under UCSC auspices. You may do this by submitting your completed packet to the Student Health Center. There is a fee for the service. After reviewing your packet, if the UCSC Medical Director determines that further evaluation is needed, you will be asked to schedule an appointment.

- **Your clinician** must complete and sign the "Physical Examination—Diving" (p.7) and "Diving Medical Evaluation" (p. 9 & 10) forms. **You must** complete and sign the "Diving Medical History" (p.3 & 4) and the "Diving Medical Evaluation" (p. 9 & 10).
- **You must** submit the above completed and signed forms **and** copies of: your laboratory results, radiologist report (if needed) and EKG results (if needed). You are responsible for assuring that these forms and the results of all the testing gets to the Student Health Center.
- **Please allow 5 working days to receive your clearance.**

Document 2: Example of UCSC Medical Form

(Applicant is to complete/sign both sides of this form, then give to Clinician performing evaluation. Include with packet for clearance)

Section 2—DIVING MEDICAL HISTORY to be completed by diver **before** medical exam and reviewed by examining clinician at time of examination. Your answers to the questions in the diving medical history section are, in many instances, more important in determining your fitness than what the clinician may see, hear or feel when you are examined. Should your answers indicate a condition which might make diving hazardous, you will be asked to review the matter with your clinician. If your clinician concludes that diving would involve undue risk for you, remember that he/she is concerned only with your well-being and safety. Respect the advice and the intent of this medical history form.

Patient name _____ Age _____ Student or Staff ID _____

Phone _____email _____

Have you ever had:	Y	N	Please Explain all YES answers
1. Convulsions, seizures, epilepsy			
2. Fainting or dizzy spells			
3. Migraines or frequent headache			
4. Head injury with loss of consciousness			
5. Back pain or history of back injury			
6a. Asthma			
6b. Have you used an asthma inhaler medication in the past 12 months?			
7. Wheezing with exercise or breathing cold air			
8. Chronic cough or frequent bronchitis			
9. Collapsed lung (pneumothorax)			
10. Lung problem or shortness of breath			
11. Abnormal Chest X-Ray			
12. Do you smoke?			
13. Allergies, hay fever, nasal congestion			
14. Sinus problems			
15. Perforated ear drum, frequent ear infections, mastoid infections			
16. Trouble clearing ears (equalizing pressure in airplanes or when diving)			
17. Hearing problem			
18. Heart disease or heart condition of any kind, including: abnormal heartbeat or ECG, heart murmur, mitral valve			
19. Chest pain or Angina			
20. High blood pressure			
21. Blood disorder or bleeding tendency			

Document 2: Example of UCSC Medical Form

Have you ever had:	Y	N	Please Explain all YES answers
22. Diabetes			
23. Hernia of any kind			
24. Ulcer, stomach problem, or bowel disorder			
25. Nervous disorder, including anxiety, depression, or panic attacks			
26. Claustrophobia			
27. Motion sickness or sea/air sickness			
28. Paralysis			
29. Major surgery			
30. Are you now under doctor's care for any condition?			
31. Are you Pregnant?			
32. Do you take medication regularly?			
33. Do you have a history of alcoholism or drug use?			
34. Wear glasses or contact lenses?			
35. Wear dental plate or prosthesis?			
36. Been rejected or restricted from sports?			
37. Any limiting physical condition or disability?			
38. History of decompression sickness?			
39. History of any problems relating to diving?			
40. Any medical problem not listed -- please describe:			

(This Form to be completed, signed and turned in with packet for clearance)

I certify that the above answers and information represent an accurate and complete description of my medical history.

_____

Patient signature Date

Additional Clinician Comments:

Clinician Signature_____ Date_____

Document 2: Example of UCSC Medical Form

Section 3 - UCSC DIVING MEDICAL EXAM - INFORMATION FOR THE CLINICIAN

TO: Examining Clinician
FROM: UC Santa Cruz Diving Safety Program
RE: Medical Evaluation for Participation in the UCSC Diving Program

This person requires a medical examination to assess their fitness for training as a UCSC diver. He or she should have completed a medical history form and should present it to you for review at the time of the examination. To assist you in making this evaluation, this packet includes information regarding potential disqualifying conditions and appropriate references (see reverse side).

The attached **"Diving Medical History"** form is to be completed by you and used with the **"Physical Examination"** form as the basis for completion of the **"Diving Medical Evaluation"** (2-page) form. The basic physical examination must include the laboratory tests and other evaluations listed below (please note age specific requirements) and all the items on the **"Physical Examination"** form.

A UCSC clinician must then review the diver's medical file including **all** test results, completed "Physical Examination" and "Diving Medical Evaluation" forms. After reviewing the results of your evaluation a UCSC clinician will give the diver final medical clearance to dive under the auspices of UCSC.

All test results (laboratory, x-ray and EKG), "Physical Examination" and "Diving Medical Evaluation" forms should be either given to the diver, Faxed to Medical Records 831.459.3546 or mailed to:

Student Health Center—Attention Medical Records
University of California Santa Cruz
1156 High St.
Santa Cruz, CA 95064

Any questions regarding the exam can be addressed to the Diving Safety Officer [redacted].

All Divers Under age 40 Initial & Periodic Re-Exam every 5 years	**All Divers Over age 40 Initial Exam**	**All Divers Over age 40 Periodic Re-Exam every 3 years (every 2 years if over age 60)**
Medical History	Medical History	Medical History
Complete Physical Exam, emphasis on neurological and otological components	Complete Physical Exam, emphasis on neurological and otological components	Complete Physical Exam, emphasis on neurological and otological components
Urine Dip	Urine Dip	Urine Dip
	Resting EKG	Resting EKG
	Chest X-ray	
	Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment	Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment
Any further tests deemed necessary by the clinician	Any further tests deemed necessary by the clinician	Any further tests deemed necessary by the clinician

Document 2: Example of UCSC Medical Form

Important information for the clinician evaluating candidates for SCUBA Diving:

SCUBA and other modes of diving can be strenuous and hazardous. A special risk is present if the middle ear, sinuses or lung segments do not readily equalize air pressure changes. The most common cause of distress is eustachian insufficiency. Most fatalities involve deficiencies in prudence, judgment, emotional stability or physical fitness. **Please consult the following list of conditions which usually restrict candidates from diving:**

CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING

(Adapted from Bove, 1998: 61 -63, bracketed numbers are pages in Bove)

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears. [5,7,8,9]
2. Vertigo including Meniere's Disease. [13]
3. Stapedectomy or middle ear reconstructive surgery. [11]
4. Recent ocular surgery. [15,18,19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24-25]
7. Episodic loss of consciousness. [1, 26,27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29,30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29,30]
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage. [31]
12. History of neurological decompression illness with residual deficit. [29,30]
13. Head injury with sequelae. [26, 27]
14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease[1]. [33 - 35]
16. Atrial septal defects. [39]
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying. [38]
18. Significant cardiac rhythm or conduction abnormalities. [36 - 37]
19. Implanted cardiac pacemakers and cardiac defibrillators (ICD). [39, 40]
20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History of spontaneous or traumatic pneumothorax. [45]
23. Asthma[2]. [42 - 44]
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.[45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

[1] "Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations." Grundy et. al. 1999. AHA/ACC Scientific Statement. http://www.acc.org/clinical/consensus/risk/risk1999.pdf

[2] "Are Asthmatics Fit to Dive? " Elliott DH, ed. 1996 Undersea and Hyperbaric Medical Society, Kensington, MD.

SELECTED REFERENCES IN DIVING MEDICINE

Most of these are available from Best Publishing Company, P.O. Box 30100, Flagstaff, AZ 86003-0100, the Divers Alert Network (DAN) or the Undersea and Hyperbaric Medical Association (UHMS), Bethesda, MD.

-ACC/AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Gibbons RJ, et al. 1997. Journal of the American College of Cardiology. 30:260-311. http://www.acc.org/clinical/guidelines/exercise/exercise.pdf
-Alert Diver Magazine; Articles on diving medicine http://www.diversalertnetwork.org/medical/articles/index.asp
-"Are Asthmatics Fit to Dive? " Elliott DH, ed. 1996 Undersea and Hyperbaric Medical Society, Kensington, MD.
-"Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations." Grundy et. al. 1999. AHA/ACC Scientific Statement. http://www.acc.org/clinical/consensus/risk/risk1999.pdf
-DIVING MEDICINE, Third Edition, 1997. A. Bove and J. Davis. W.B. Saunders Company, Philadelphia
-DIVING AND SUBAQUATIC MEDICINE, Third Edition, 1994. C. Edmonds, C. Lowery and J. Pennefather. Butterworth-Heinemann Ltd. Oxford
-MEDICAL EXAMINATION OF SPORT SCUBA DIVERS, 1998. Alfred Bove, M.D.,Ph.D. (ed.). Medical Seminars, Inc. San Antonio, TX
-NOAA DIVING MANUAL, NOAA. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.
-U.S. NAVY DIVING MANUAL. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

Document 2: Example of UCSC Medical Form

(This Form to be completed, signed and turned in with packet for clearance)

Section 4 PHYSICAL EXAMINATION FOR DIVING

VITAL SIGNS

Height _____ Weight _____ B/P (seated) _____/_____ Pulse _____

Vision: Without lenses R 20/_____ L 20/_____ Corrected R20/_____ L 20/_____; Contact Lenses YES NO

EXAMINATION

Check each item, giving details for abnormal findings

	Normal	*Abnormal*	*Details*
1. General Appearance			
2. Skin			
3. Eyes			
4. Ears			
Valsalva			
5. Nose nasal septum, sinuses			
6. Mouth teeth gingivae, pharynx			
7. Neck			
8. Chest and lungs			
9. Breasts			
10. Heart			
11. Abdomen			
12. Hernia (unrepaired)			
13. Back and Spine			
14. Joints and extremities			
15. Operative scars deformities			
16. Neuromuscular			
17. Neuropsychiatric			

TESTS *Date Performed*	*Normal*	*Abnormal*	*Details*
Vision			
Urine Dip			
EKG*			
Chest X-ray**			

*Required only for over 40 divers **Required only for initial exam for over 40 divers

Clinician Signature _____ ***Date*** _____

Patient's Name ID#

Document 2: Example of UCSC Medical Form

(This page left blank intentionally so packet maybe 2-side printed and copied)

Document 2: Example of UCSC Medical Form

(This form to be completed and signed by both clinician and applicant)

Section 5 DIVING MEDICAL EVALUATION—*University of California, Santa Cruz*

Name _____

Staff or Student ID # _____ **Date** _____/_____/_____

TO THE CLINICIAN:

This person requires a medical examination to assess their fitness for certification as a diver. She/He has completed a medical history form and should present it to you at the time of the examination. Because diving requires heavy exertion, the diver must be free of cardiovascular and respiratory disease. An absolute requirement is the ability of the lungs, middle ear and sinus to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant. There is a noticeable difference between recreational diving and scientific diving in that the scientific diver may feel obligated to dive due to deadlines and/or sampling regimes despite a possible current health problem whether physical or emotional. Special attention needs to be paid to their health prior to certifying them as scientific divers. The basic physical examination must include the laboratory tests listed below (please note level of training and age qualifications).

Your initials next to the specific lab tests are to confirm that the specified additional testing and lab work have been performed.
Your evaluation and signature is requested on the back of this *DIVING MEDICAL EVALUATION* and will indicate that this person has passed a basic physical exam, the required lab tests, and that no indications of conditions exist that preclude the applicant from diving (see enclosed "*Probable Contraindications to SCUBA Diving*").

A UCSC clinician must review the diver's medical file and give the final clearance to dive. The test results and UCSC Diving Medical Evaluation Form should either be given to the diver or sent to: Student Health Center, University of California, Santa Cruz, CA 95064. Any questions regarding the exam can be addressed to the UCSC Diving Safety Officer, (831) 459-4286 voice, (831) 459-3383 fax.

The following reference is a useful guide to physical examinations of divers:
Medical Examination of Sport SCUBA Divers, edited by A. Bove, M.D. Third edition, Medical Seminars, Inc., Texas.

Laboratory Requirements for UCSC Diving Medical Examination: *Clinician please initial tests completed.*

Initial and Periodic Re-Exam (every 5 years) for divers UNDER 40			
Medical History	___	Urine Dip	___
Any further tests deemed necessary by the clinician to qualify the patient for diving.			
Initial Exam for divers OVER 40			
Medical History	___	Urine Dip	___
Chest X-ray	___	Resting EKG	___
Detailed assessment of coronary artery disease risk factors and any further tests deemed necessary by the clinician to qualify the patient for diving.			
Periodic Re-Exam (every 3 years) for divers OVER 40 (every 2 years if over 60)			
Medical History	___	Urine Dip	___
Resting EKG	___		
Detailed assessment of coronary artery disease risk factors and any further tests deemed necessary by the clinician to qualify the patient for diving.			

On the back of this sheet please check diver's status and sign in the spaces provided.

Document 2: Example of UCSC Medical Form

DIVING MEDICAL EVALUATION—to be signed by Clinician and Applicant

Applicant's Name _____ **Date** _____

[ ] Scuba Diving [ ] Skin Diving

MANDATORY—PLEASE Check ONE ONLY:

[ ] **APPROVAL**: No medical contraindications to diving are present.

[ ] **APPROVAL WITH QUALIFICATIONS**: Evaluation indicates the presence of findings which, while not expected to seriously interfere with the applicant's ability to dive at this time, might under some circumstances present increased risk or possible relative contraindication to diving. This type of approval is also indicated in the presence of conditions that have required clearance by appropriate specialists to evaluate fitness to dive. These findings and instructions regarding them have been explained to the patient and are noted below (see REMARKS).

[ ] **DISAPPROVAL**: The applicant has medical condition(s) which pose unacceptable risk to health and safety in diving. These findings have been explained to the applicant and are noted below (see REMARKS).

REMARKS:_____

_____

_____

Mandatory to be completed by Non-UCSC Clinician:

_____ _____ _____

Signature of non-UCSC clinician (Print or type) Name of non-UCSC examining clinician Date

_____ _____

Address Telephone and fax number

My familiarity with the applicant is:
[ ] With this exam only [ ] Regular clinician for ____ years

[ ] Other (describe) _____

My familiarity with diving medicine:_____

To be completed by reviewing UCSC Clinician:

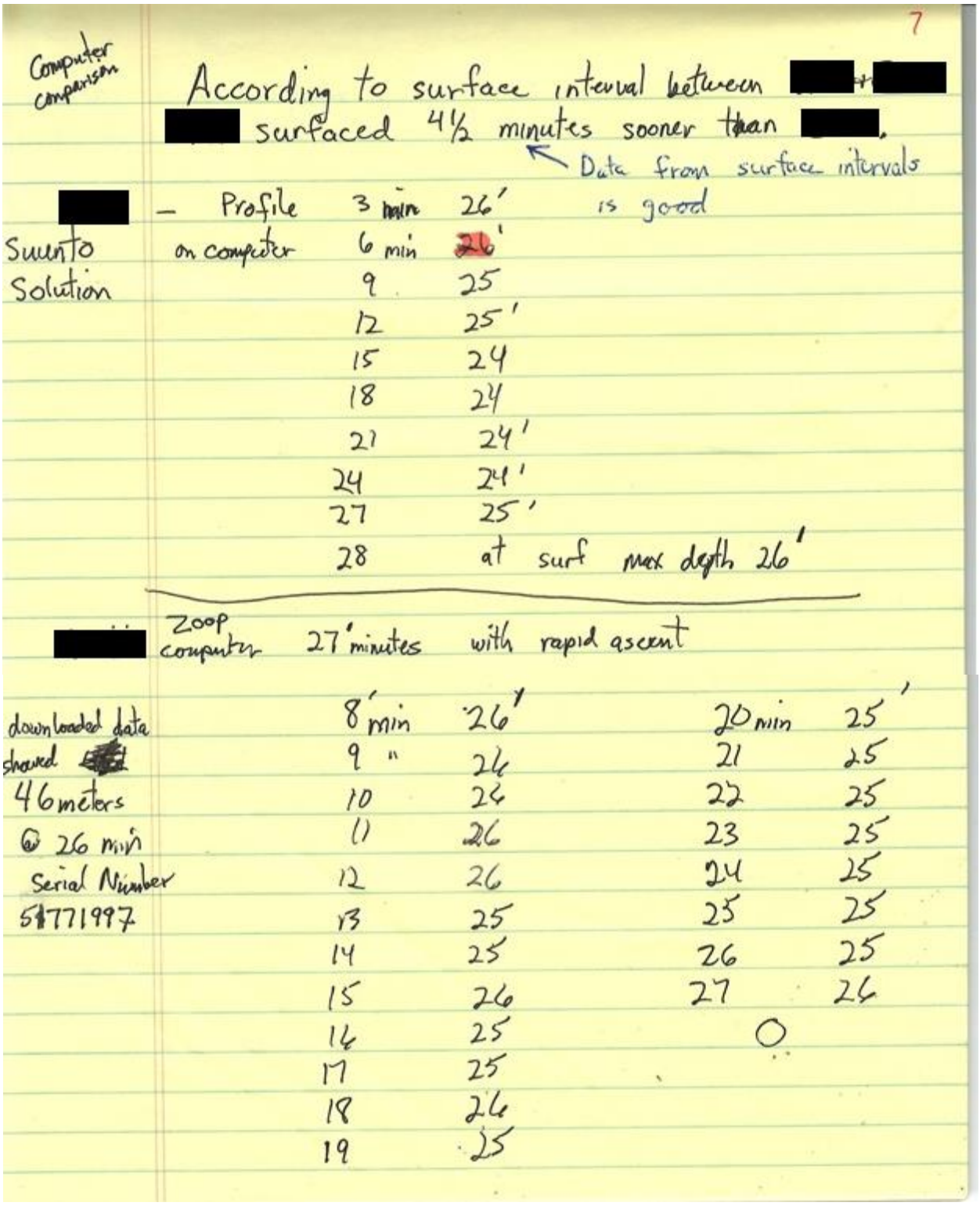
_____ _____ _____

Signature of UCSC clinician **Print name of UCSC clinician** **Date**

Mandatory signature of Applicant: The clinician has reviewed the results of my examination and has fully explained possible risks that may affect my diving. I have been given the opportunity to ask questions to my satisfaction. I authorize the release of this information and all medical information subsequently acquired in association with my diving to the UCSC Diving Officer and Diving Control Board or their designee at UCSC.

Signature of Applicant _____ Date _____.

Document 2: Example of UCSC Medical Form



Computer comparison

7

According to surface interval between [redacted] + [redacted] [redacted] surfaced 4½ minutes sooner than [redacted].

Data from surface intervals is good

[redacted] – Profile on computer

Suunto Solution

3 min	26'
6 min	26'
9	25
12	25'
15	24
18	24
21	24'
24	24'
27	25'
28	at surf max depth 26'

[redacted] Zoop computer 27 minutes with rapid ascent

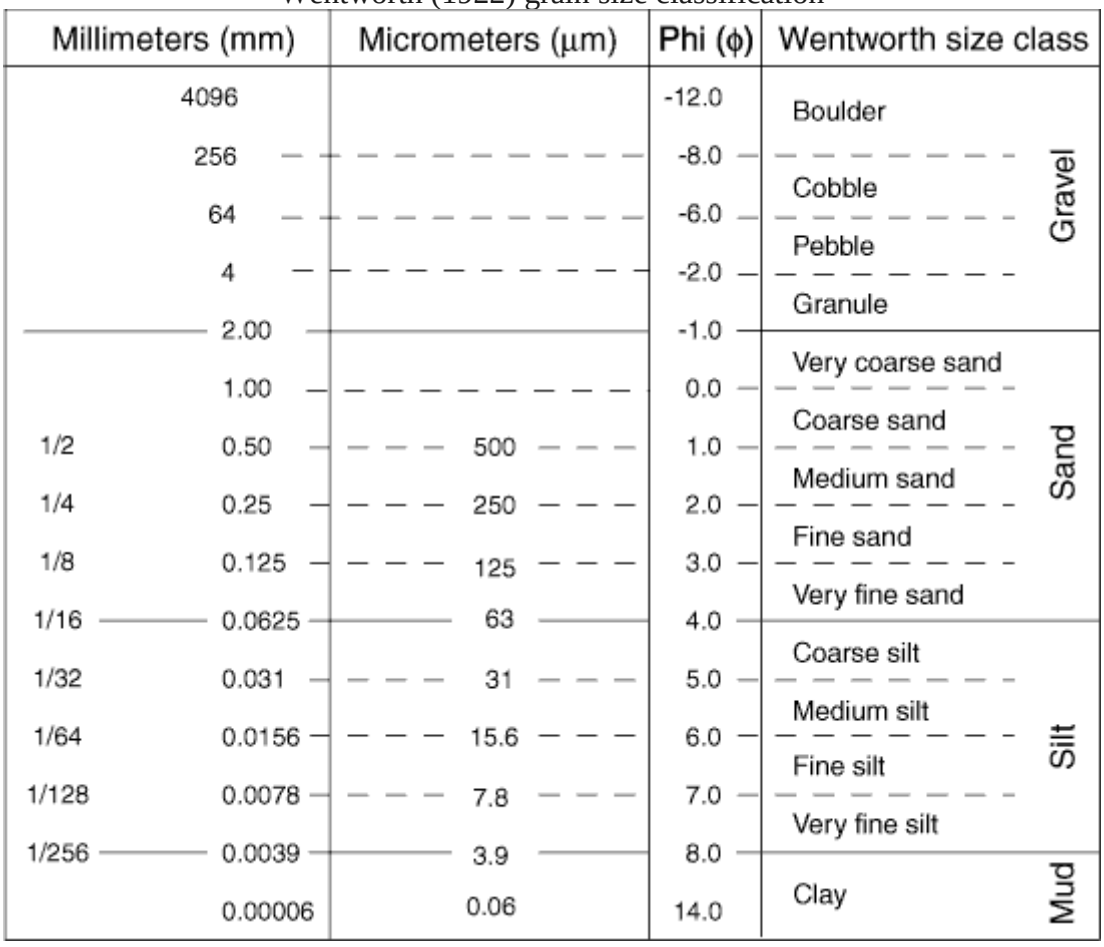
downloaded data showed [redacted] 46 meters @ 26 min

Serial Number 5#771997

8' min	26'	20 min	25'
9 "	26	21	25
10	26	22	25
11	26	23	25
12	26	24	25
13	25	25	25
14	25	26	25
15	26	27	26
16	25		
17	25		
18	26		
19	25		

Document 3: Dive computer data taken from Diver One's and Diver Two's Dive Computers

Wentworth (1922) grain size classification

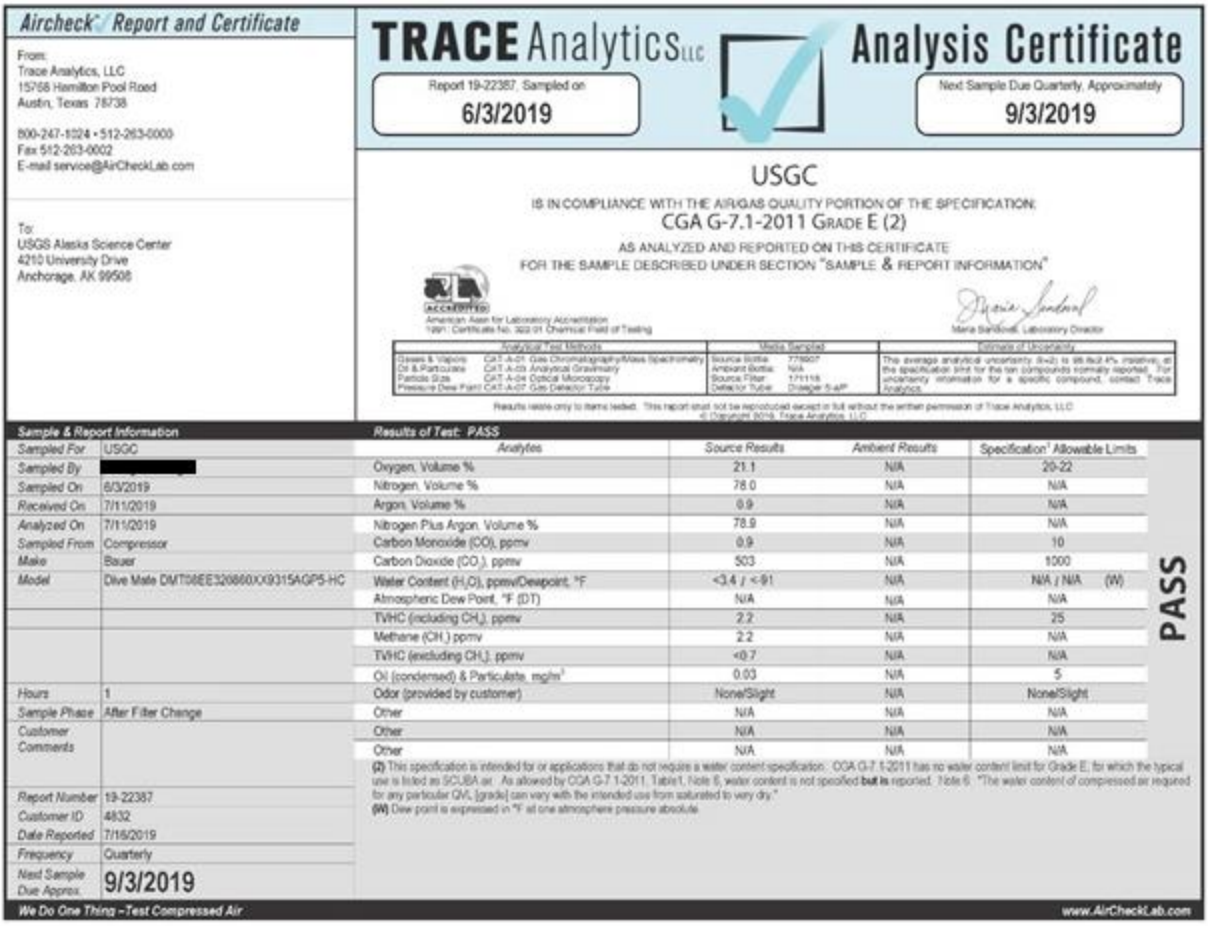


Chester K. Wentworth

WENTWORTH (1922) GRAIN SIZE CLASSIFICATION
The canonical definition of sediment grain sizes as defined by geologist Chester K. Wentworth in a 1922 article in *The Journal of Geology*: "A Scale of Grade and Class Terms for Clastic Sediments."

http://www.planetary.org/multimedia/space-images/charts/wentworth-1922-grain-size.html

Document 4: The Wentworth Scale



Aircheck Report and Certificate

From:
Trace Analytics, LLC
15768 Hamilton Pool Road
Austin, Texas 78738

800-247-1024 • 512-263-0000
Fax 512-263-0002
E-mail service@AirCheckLab.com

To:
USGS Alaska Science Center
4210 University Drive
Anchorage, AK 99508

TRACE Analytics LLC

Analysis Certificate

Report 19-22387, Sampled on: **6/3/2019**

Next Sample Due Quarterly, Approximately: **9/3/2019**

USGC

IS IN COMPLIANCE WITH THE AIR/GAS QUALITY PORTION OF THE SPECIFICATION:
CGA G-7.1-2011 GRADE E (2)
AS ANALYZED AND REPORTED ON THIS CERTIFICATE
FOR THE SAMPLE DESCRIBED UNDER SECTION "SAMPLE & REPORT INFORMATION"

ACCREDITED
American Assn for Laboratory Accreditation
Valid Certificate No. 302.01 Chemical Field of Testing

Maria Sandoval, Laboratory Director

Analytical Test Methods			Media Sampled			Estimate of Uncertainty
Gases & Vapors	CAT-A-01	Gas Chromatography/Mass Spectrometry	Source Bottle	779807		This average analytical uncertainty (k=2) is ±6 but 4% relative, as the specification limit for the ten compounds normally reported. For uncertainty information for a specific compound, contact Trace Analytics.
Oil & Particulate	CAT-A-03	Analytical Gravimetry	Ambient Bottle	N/A		
Particle Size	CAT-A-04	Optical Microscopy	Source Filter	171116		
Pressure Dew Point	CAT-A-07	Gas Detector Tube	Detector Tube	Draeger 5-aP		

Sample & Report Information

Sampled For	USGC
Sampled By	[redacted]
Sampled On	6/3/2019
Received On	7/11/2019
Analyzed On	7/11/2019
Sampled From	Compressor
Make	Bauer
Model	Dive Mate DMT08EE320860XX9315AGPS-HC
Hours	1
Sample Phase	After Filter Change
Customer Comments	
Report Number	19-22387
Customer ID	4832
Date Reported	7/16/2019
Frequency	Quarterly
Next Sample Due Approx.	9/3/2019

Results of Test: PASS

Analytes	Source Results	Ambient Results	Specification[1] Allowable Limits
Oxygen, Volume %	21.1	N/A	20-22
Nitrogen, Volume %	78.0	N/A	N/A
Argon, Volume %	0.9	N/A	N/A
Nitrogen Plus Argon, Volume %	78.9	N/A	N/A
Carbon Monoxide (CO), ppmv	0.9	N/A	10
Carbon Dioxide (CO_2), ppmv	503	N/A	1000
Water Content (H_2O), ppmv/Dewpoint, °F	<3.4 / <-91	N/A	N/A / N/A (W)
Atmospheric Dew Point, °F (DT)	N/A	N/A	N/A
TVHC (including CH_4), ppmv	2.2	N/A	25
Methane (CH_4) ppmv	2.2	N/A	N/A
TVHC (excluding CH_4), ppmv	<0.7	N/A	N/A
Oil (condensed) & Particulate, mg/m³	0.03	N/A	5
Odor (provided by customer)	None/Slight	N/A	None/Slight
Other	N/A	N/A	N/A
Other	N/A	N/A	N/A
Other	N/A	N/A	N/A

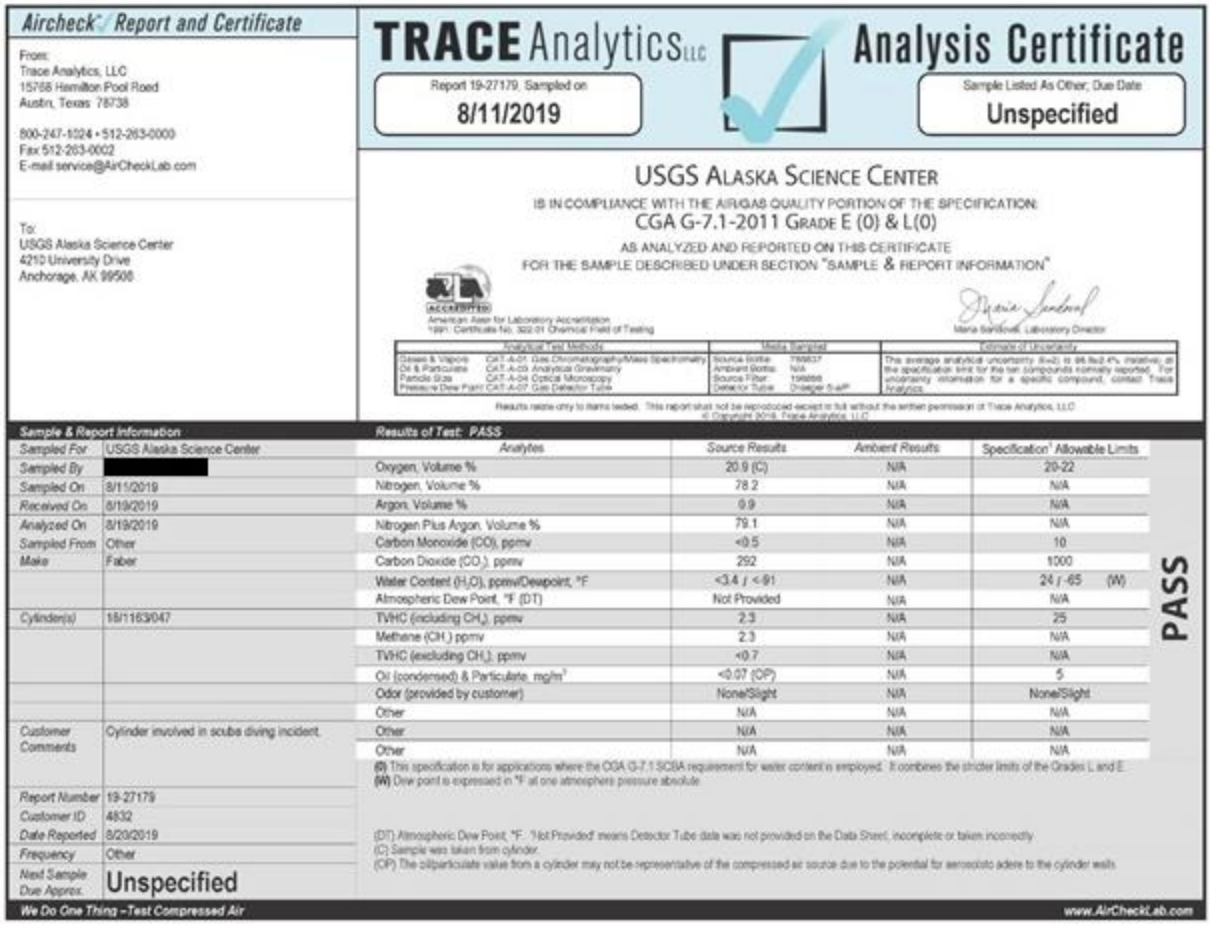
PASS

(2) This specification is intended for oil applications that do not require a water content specification. CGA G-7.1-2011 has no water content limit for Grade E, for which the typical use is listed as SCUBA air. As allowed by CGA G-7.1-2011, Table1, Note 8, water content is not specified **but is** reported. Note 6: "The water content of compressed air required for any particular QVL [grade] can vary with the intended use from saturated to very dry."
(W) Dew point is expressed in °F at one atmosphere pressure absolute.

We Do One Thing – Test Compressed Air

www.AirCheckLab.com

Document 5: Air test results for R/V Gyre Compressor



Aircheck Report and Certificate

From:
Trace Analytics, LLC
15768 Hamilton Pool Road
Austin, Texas 78738

800-247-1024 • 512-263-0000
Fax 512-263-0002
E-mail service@AirCheckLab.com

To:
USGS Alaska Science Center
4210 University Drive
Anchorage, AK 99508

TRACE Analytics LLC

Analysis Certificate

Report 19-27179, Sampled on: 8/11/2019

Sample Listed As Other, Due Date: Unspecified

USGS ALASKA SCIENCE CENTER

IS IN COMPLIANCE WITH THE AIR/GAS QUALITY PORTION OF THE SPECIFICATION:
CGA G-7.1-2011 GRADE E (O) & L(O)

AS ANALYZED AND REPORTED ON THIS CERTIFICATE
FOR THE SAMPLE DESCRIBED UNDER SECTION "SAMPLE & REPORT INFORMATION"

ACCREDITED
American Assn for Laboratory Accreditation
Lab's Certificate No. 3022.01 Chemical Field of Testing

Maria Sandoval, Laboratory Director

Analytical Test Methods		Media Sampled		Estimate of Uncertainty
Gases & Vapors	CAT-A-01 Gas Chromatography/Mass Spectrometry	Source Bottle	795837	The average analytical uncertainty (k=2) is ±4.4% (relative) at the specification limit for the ten compounds normally reported. For uncertainty information for a specific compound, contact Trace Analytics.
Oil & Particulate	CAT-A-03 Analytical Gravimetry	Ambient Bottle	N/A	
Particle Size	CAT-A-04 Optical Microscopy	Source Filter	196866	
Pressure Dew Point	CAT-A-07 Gas Detector Tube	Detector Tube	Draeger 5-a/P	

Results relate only to items tested. This report shall not be reproduced except in full without the written permission of Trace Analytics, LLC
© Copyright 2018, Trace Analytics, LLC

Sample & Report Information

Sampled For	USGS Alaska Science Center
Sampled By	[redacted]
Sampled On	8/11/2019
Received On	8/19/2019
Analyzed On	8/19/2019
Sampled From	Other
Make	Faber
Cylinder(s)	18/1163/047
Customer Comments	Cylinder involved in scuba diving incident.
Report Number	19-27179
Customer ID	4832
Date Reported	8/20/2019
Frequency	Other
Next Sample Due Approx.	Unspecified

Results of Test: PASS

Analytes	Source Results	Ambient Results	Specification[1] Allowable Limits	
Oxygen, Volume %	20.9 (C)	N/A	20-22	
Nitrogen, Volume %	78.2	N/A	N/A	
Argon, Volume %	0.9	N/A	N/A	
Nitrogen Plus Argon, Volume %	79.1	N/A	N/A	
Carbon Monoxide (CO), ppmv	<0.5	N/A	10	
Carbon Dioxide (CO_2), ppmv	292	N/A	1000	
Water Content (H_2O), ppmv/Dewpoint, °F	<3.4 / <-91	N/A	24 / -65	(W)
Atmospheric Dew Point, °F (DT)	Not Provided	N/A	N/A	
TVHC (excluding CH_4), ppmv	2.3	N/A	25	
Methane (CH_4) ppmv	2.3	N/A	N/A	
TVHC (excluding CH_4), ppmv	<0.7	N/A	N/A	
Oil (condensed) & Particulate, mg/m³	<0.07 (OP)	N/A	5	
Odor (provided by customer)	None/Slight	N/A	None/Slight	
Other	N/A	N/A	N/A	
Other	N/A	N/A	N/A	
Other	N/A	N/A	N/A	

PASS

(O) This specification is for applications where the CGA G-7.1 SCBA requirement for water content is employed. It combines the stricter limits of the Grades L and E.
(W) Dew point is expressed in °F at one atmosphere pressure absolute.

(DT) Atmospheric Dew Point, °F. 'Not Provided' means Detector Tube data was not provided on the Data Sheet, incomplete or taken incorrectly.
(C) Sample was taken from cylinder.
(OP) The oil/particulate value from a cylinder may not be representative of the compressed air source due to the potential for aerosols to adhere to the cylinder walls.

We Do One Thing – Test Compressed Air

www.AirCheckLab.com

Document 6: Air Test Results for Diver One's Cylinder, Incident Dive

USGS

Alaska Science Center

Field Emergency Plan

___Original: Project Emergency Plan Book ___Copy: Branch Safety Rep

Field Plan ID: 51964
Date Field Plan Created: 2019-08-05
Project Name: Glacier Bay outer coast dive surveys

Project Leader/Field Office Chief: [redacted]
Primary Office: ASC-Ecosystems Marine and Freshwater Ecology
Date Departing: 2019-08-04
Time Departing: 06:00:00
Date Returning: 2019-08-12
Time Returning: 06:00:00
Region of Work - Land: South East AK
Region of Work - Water: Glacier Bay

Primary Office Contact Information:

Contact	Phone	Email
[redacted]		

Personnel:

Number	Personnel	Date Departing	Date Returning	Personnel Type[1]
1	[redacted]	2019-08-04	2019-08-12	U
2		2019-08-04	2019-08-12	U
3		2019-08-04	2019-08-12	A
4		2019-08-04	2019-08-12	A
5		2019-08-04	2019-08-12	A
6		2019-08-04	2019-08-12	A
7		2019-08-04	2019-08-12	A

[1]*Personnel Type: **U** = USGS employee; **C** = Contractor; **V** = Volunteer; **I** = Invitational Traveler; **A** = Agency Collaborator*

Field Locations/Survey Areas:

Location Letter	Location[2]	Dates at Location	Personnel (using #s from above)	Phone/Radio Contact
a	Yakutat	2019-08-04	1-7	see sat phone info below
b	Torch Bay	2019-08-05 to 08-08	1-7	
c	Surge Bay	2019-08-08 to 08-11	1-7	
d	Bartlett Cove	2019-08-11	1-7	

[2]*Location: Also indicate **(P)** = Primary Camp; **(A)** = Alternate or Mobile Camp; **(S)** = Survey Area*

Method of Travel:

Type	Comments

Document 7: USGS Field Emergency Plan

	Type	Comments
	Aircraft:	
	Float Plane:	
	Helicopter:	
	Do the flights use AFF?	
	ATV:	
	Automobile:	
X	Boat:	USGS R/V Alaskan Gyre
	Snowmachine:	
	Walking/Hiking:	
	Other:	

Communications:

USGS Satellite Phone Number(s) and details: To call the Gyre: First dial 1-480-768-2500 (Iridium network) Then dial 8816-3162-8287 (Gyre sat phone) To email the Gyre: alaskangyre@skyfile.com

Alternate Phone Number:
If checking in with another agency, indicate their name/phone#:
Field Contact (Alternate source if direct communication is not possible):

Communication and Monitoring Schedule:

Field crew is contacting...	Radio Frequencies/Channel or Phone #	Monitoring Schedule (Time/Date)

Safety and Emergency:

Emergency Equipment Carried:

X	First Aid	X	Emergency Shelter	X	GPS
	Firearms	X	Radio	X	Rations
X	Survival Suit/Gear	X	Smoke/Flares	X	Signal Mirrors
X	Telephone/Sat. Phone		Basic Emergency Locator (w/o GPS capability)	X	Emergency Locator w/ GPS capability

Current Safety Training (as needed, by at least one member of the field crew):

X	CPR		Arctic Survival	Pinch Hitters
X	First Aid		General Survival	Fuel Management
	Firearm Safety	X	Water Survival	Rock Climbing
	Basic Aviation Safety B3		Supervisor Aviation Safety M3	Aviation Transportation of HazMat
X	Boat Safety/Operations Maintenance			
	Equipment Operations:			
X	Radio Operations:			
	Other:			

Emergency Response Plan:
In the event of an emergency, the crew will contact the US Coast Guard on VHF channel 16 for assistance. If the crew feels it is necessary abandon the vessel, they will don immersion suits and board either an inflatable boat or a life raft with an EPIRB and survival supplies.

Document 7: USGS Field Emergency Plan

Additional Comments:

Completed By:_____
(Project Leader/Field Office Chief & Date)

Approved By:_____
(Office Chief/Designee & Date)

Document 7: USGS Field Emergency Plan

Doc 1.

P
FM: SECTOR JUNEAU
TO:
INFO:
BT
UNCLAS //N16130//
SUBJ: SEARCH AND RESCUE/PERSON IN WATER (PIW)/ALASKAN GYRE/ALASKAN GYRE/LAT: 58°18.5 N
LONG: 136°48.4 W
PERIOD: 070000Z AUG 19 - 082359Z AUG 19
1. SITUATION.
A. CURRENT STATUS: CLOSED - AGENCY ACTION COMPLETE
B. NOTIFICATION: 07 AUG 2019 [redacted]
C. NARRATIVE: SCC JUNEAU RECEIVED A RELAY NOTIFICATION ON VHF CH. 16 FROM THE CFV WOODSTOCK ON BEHALF ON THE CFV/RESEARCH ALASKAN GYRE (938544) REPORTING AN UNRESPONSIVE DIVER. THE ALASKAN GYRE REPORTED A 27YOM WAS RECOVERED FACE DOWN IN THE WATER AFTER DIVING ON SCUBA TANKS IN APPROXIMATELY 30FT OF WATER. SCC JUNEAU NOTIFIED AS SITKA AND COMMENCED DUTY FLIGHT SURGEON BRIEF. PATIENT WAS UNRESPONSIVE TO CPR WITH NO PULSE, BREATHING, OR READINGS VIA AN AED FOR OVER 30 MINUTES. SCC JUNEAU RELAYED TO ALASKAN GYRE TO SECURE CPR VIA THE FLIGHT SURGEONS RECOMMENDATION. DUE TO THE PATIENT'S CONDITION CG RESPONSE WAS STOOD DOWN. THE INCIDENT OCCURRED WHEN TWO GROUPS OF 3 DIVERS (6 TOTAL) COMMENCED DIVE RESEARCH OFF THE VESSEL ALASKAN GYRE AND THE PATIENTS [redacted] AN UPSIDE DOWN RESURFACE IN WHICH HE ASPIRATED WATER. THE PATIENT WAS THE LEAD DIVER OF THE GROUP AS A POST-DOCTORAL RESEARCHER FOR UC SANTA CRUZ WORKING IN PARTNERSHIP WITH USGS ONBOARD THE VESSEL. THE VESSELS MANAGER IS NOTIFYING THE UNIVERSITY TO COORDINATE NOK NOTIFICATIONS. THE LOCATION OF THE DIVE INCIDENT FALLS WITHIN NPS SMC ZONE AND A RANGER IS MEETING THE VESSEL IN BARTLETT COVE FOR AN INVESTIGATION. USCG DUTY INVESTIGATOR IS ALSO MAKING PREPARATIONS FOR AN ONSITE INVESTIGATION WITH THE VESSEL. VESSEL HAS RECOVERED ALL DIVERS AND WILL ARRIVE IN BARTLETT COVE AT APPROXIMATELY 1800U. INVESTIGATIONS PEND.
D. INVOLVED SUBJECTS:
PERSON NAME: UNKNOWN REPORTING PARTY, DOB: , ROLE:
PERSON NAME: [redacted], DOB: , ROLE:
PERSON NAME: [redacted], DOB: , ROLE:
PERSON NAME: [redacted], DOB: , ROLE: OTHER
PERSON NAME: [redacted], [redacted], ROLE:
VESSEL NAME: ALASKAN GYRE, VIN: 938544, CALL SIGN: WDR6931, FLAG: UNITED STATES, GROSS TONS: 26, LENGTH: 50.0, CLASS/TYPE/SUBTYPE: FISHING VESSEL/FISH CATCHING VESSEL/GENERAL, LPOC: NPOC:
VESSEL NAME: ALASKAN GYRE, VIN: 938544, CALL SIGN: WDR6931, FLAG: UNITED STATES, GROSS TONS: 26, LENGTH: 50.0, CLASS/TYPE/SUBTYPE: FISHING VESSEL/FISH CATCHING VESSEL/GENERAL, LPOC: NPOC:
E. WEATHER:
WEATHER DTTM: 07AUG2019 20:42:00(Z), WEATHER DESC: CAPE CROSS, AK, LOCATION: TORCH BAY, ALASKA, WEATHER SOURCE: NATIONAL WEATHER SERVICE, WIND SPEED: 5 KTS, WIND DIR: 100 T, GUST SPEED: KTS, AIR TEMP: 54 F, VISIBILITY: 10.0 NM, SEA LEVEL PRESSURE: 1012.50, SKY CONDITION: CLEAR, PRECIP AMT (LAST 24 HRS): PRECIPITATION DESC: VISIBILITY PRECIPITATION DESC: WATER CONDITION SOURCE: WATER TEMP: F, WATER DEPTH: FT ABOVE MLLW, TIDE: TIDAL SPEED: KTS, TIDAL DIR: T, RIVER SPEED: KTS, RIVER DIR: T, ICE COVERAGE: %, ICE CHARACTER: WAVE HT: FT, WAVE DIR: T, WAVE PERIOD: SECONDS, SWELL HT: FT, SWELL DIR: T, SWELL PERIOD: SECONDS, WARNINGS IN EFFECT:
2. ACTION TAKEN:
1:40 AM — 071940Z AUG19: [redacted] NOTIFICATION
1:40 — 071940Z AUG19: SCC JUNEAU RECEIVED A RELAY VIA VHF CH16 FROM THE VESSEL WOODSTOCK FOR THE REASEARCH VESSEL ALASKAN GYRE, OF A DIVER FOUND IN THE WATER, FACE DOWN WITHOUT PULSE OR RESPIRATION IN TORCH BAY. SCC ASSUMES SWC/CDR HAYES IN DISTRESS PHASE. GAR L/H, NO CONCERNS.
1:50 AM — 071950Z AUG19: [redacted] CALLED SCC JUNEAU TO RELAY ON BEHALF OF THE WOODSTOCK AND THE ALASKAN GYRE. THE DIVER WAS FOUND FACEDOWN IN THE WATER WITHOUT RESPIRATION OR PULSE AT 1932Z IN TORCH BAY, AK. THE DIVER IS 27 YO MALE.
1:59 AM — 071959Z AUG19: SCC BRIEFED D17 FOR DFS.

Document 8: United States Coast Guard (USCG) Transcript on Mayday Call

0720002Z AUG19: DI7 CONFERENCED DFS/CAPT [redacted] FOR MEDICAL BRIEF.
0720002Z AUG19: A/S [redacted] BRIEFED
0720032Z AUG19: DI7 RECEIVED NOTIFICATION FROM SCC JUNEAU OF A DIVER WHO WAS FOUND FACE DOWN IN ICY STRAIT/CROSS SOUND AREA. UNKNOWN IDENTITY AND WHERE THE BODY CAME FROM. SCC JUNEAU REQUESTS TO SPEAK WITH THE DFS. DIVER THAT WAS RECOVERED BY F/V WOODSTOCK REPORTS THE DIVER HAS BEEN NON RESPONSIVE FOR OVER 30 MINUTES.
0720032Z AUG19: FLIGHT SURGEON BRIEFED AND DETERMINED THAT THAT INVOLVED SUBJECT IS DECEASED. DFS RECOMMENDED ALASKAN GYRE DISCONTINUE CPR. SCC GAV L/L.
0720052Z AUG19: DI7 CONDUCTS CONFERENCE CALL WITH DFS. DFS RECOMMENDED PERSONNEL WHO ARE CONDUCTING CPR CAN STOP AND PRONOUNCED THE DIVER DECEASED.
0720102Z AUG19: SCC ADVISED ALASKAN GYRE VIA VHF CH16 TO DISCONTINUE CPR.
0720182Z AUG19: PDO NOTIFIED.
0720202 AUG19: NATIONAL PARK SERVICE(NPS) DISPATCH CONTACTED SCC IRT DIVING ACCIDENT. KAREN, OF NPS DISPATCH,ADVISED THERE WAS A RANGER OUT IN GLACIER BAY ON STANDBY, THAT COULD POTENTIALLY BE ONSCENE IN APPROXIMATELY 1.5 HRS.
0720342Z AUG19: BRIEFED SMC CAPT [redacted] ABOUT DIVER BEING FOUND, DIVER WAS FOUND BY F/V WOODSTOCK BUT WAS DIVING FOR ALASKAN GYRE. UNKNOWN IF DIVER WAS TETHERED TO ALASKAN GYRE. SMC CDR [redacted] NOTIFIED DI7 SMC IS NATIONAL PARK SERVICE.
0720382Z AUG19: CAPTAIN OF THE ALASKAN GYRE CALLED SCC JUNEAU, REQUESTED SCC CONTACT A PERSON ASHORE, [redacted] (VESSEL MANAGER) AT 907 749 4365. ALASKAN GYRE ADVISED THERE IS NO CELL PHONE SIGNAL UNTIL THEY REACH CAPE SPENCER. THE SHIPS SATELLITE PHONE NUMBER IS [redacted].
0720402Z AUG19: USGS VESSEL MANAGER - [redacted] - BRIEFED. [redacted] ADVISED ALL DIVE OPERATIONS WILL BE CANCELLED PENDING INVESTIGATION. THE DIVERS ARE FROM UNIVERISTY OF SANTA CRUISE WITH ONE USGS DIVER. THE CAPTAIN OF THE VESSEL IS [redacted]. [redacted] BELIEVES THE VESSEL SHOULD BE IN BARTLETT COVE AT APPROXIMATELY 1800LCL THIS EVENING. THE VESSEL WAS ORIGINALLY SCHEDULED TO CONTINUE OPERATIONS UNTIL SUNDAY THIS WEEK AND THEN GO TO GUSTAVUS.
0720552Z AUG19: GLACIER BAY NATIONAL PARK SERVICE IS NOTIFIED THAT THE CG IS STANDING DOWN AND HAS NO FURTHER RESCUE INTENTIONS
0720582Z AUG19: SCC REQUESTED CLARIFICATION WHICH PARTY WOULD CONDUCT NOK NOTIFICATIONS. [redacted] ADVISED THE DECEASED'S NAME IS [redacted] 27YOM. [redacted] WAS THE LEAD DIVER OF THE STUDENTS, AND WAS A MEMBER OF THE UNIVERSITY. THE DIVERS ONSCENE BELIEVE THE INCIDENT WAS [redacted]. THE DIVERS WERE IN RELATIVELY SHALLOW WATER, APPROXIMATELY 10FT OR LESS, AND WERE IN GROUPS OF 3.
0721052Z AUG19: DI7 BRIEFED.
0721062Z AUG19: NPS RANGER [redacted] REQUESTED SCC RELAY TO THE VESSL, THAT THEY ARE REQUESTED TO RETURN TO BARLETT COVE ASAP AND THEY WILL BE DOING AN INVESTIGATION.
0721092Z AUG19: SCC JUNEAU REPORTS F/V WOODSTOCK WAS COMMS RELAY FOR F/V ALASKAN GYRE, ALASKAN GYRE WAS THE ONLY VESSEL ON SCENE. DIVER WAS NOT TETHERED. ALASKAN GYRE WAS BEING USED FOR A USGS PROGRAM (UC SANTA CRUZ). BODY FOUND WAS THE LEAD DIVER (27YOM) AND UC SANTA CRUZ WILL CONDUCT NOK. BELIEVED TO HAVE BEEN IN THE WATER FOR APPROXIMATELY 30-45 MINUTES. SCC JUNEAU IO WILL MEET ALASKAN GYRE IN BARLETT COVE 072359Z TO CONDUCT INVESTIGATION.
0721122Z AUG19: SCC BRIEFED [redacted]. [redacted] ADVISED THEY IT PROBABLY TAKE THE VESSEL APPROXIMEALY 4-5 HOURS TO MAKE THE TRANSIT TO BARLETT COVE ONCE ALL THE REMAINING DIVERS HAVE BEEN PICKED UP.
0721252Z AUG19: ASTS BRIEFED.
0722272Z AUG19: ALASKAN GYRE ADVISED ALL DIVERS ARE ONBOATD AND THEY ARE ENROUTE FROM APPROXIMATELY 4NM NORTH OF CAPE SPENCER, ETA 2000LCL.
0722312Z AUG19: [redacted] ADVISED NPS AND THE UNIVERSITY OF CALIFORNIA SANATA CRUZ WOULD BE HANDLING NOK NOTIFICAIONS.
0723582Z AUG19: CGIS S/A [redacted] NOTIFIED.
0801062Z AUG19: CASE CLOSED FOR SAR.
0801062Z AUG19: VALIDATED BY OS1 [redacted].
0803492Z AUG19: REVIEWED BY OS1 [redacted].
3. PLANS AND RECOMMENDATIONS:
4. AMPLIFYING INFO:
5. SORTIE DATA:
NO SORTIES RECORDED
6. MISLE CASE ID: 1185846

08/08/19 transcripts

Document 8: USCG Transcript on Mayday Call

[redacted]

[EXTERNAL] ALASKAN GYRE - Diving Casualty - Dive Gear Inspection

1 message

[redacted] Fri, Aug 9, 2019 at 9:40 PM

To: [redacted]
Cc: [redacted]

To whom this may concern;

Regarding the Coast Guards inspection of the dive gear recovered from [redacted] on 7 August 2019. Myself and [redacted] while following the US Coast Guards Diving Casualty Investigations Tactic, Techniques, and Procedures manual CGTTP 3-72.4 began our inspection of the dive gear. Upon our arrival on the morning of 8 August we found the victims dive gear had been transferred from the vessel and into the Nation Forest Service communications building in small secured storage space. [redacted] and I looked over the dive gear and noted that all components seemed to be in place and in good working order we did notice the adjusting knob on the primary regulator, the plastic around the valve handle was damaged and had plastic missing from the knob. The first stage valve was found in the closed position so we opened the valve three full turns to the stop and noted the pressure remaining in the tank was 1600 psi while the system was under pressure we did not hear or notice any air leaks. The Buoyancy Compensator was inflated. We noted that the bottom cylinder band buckle was not secured, the top buckle was secured and tight. We bleed the pressure off of the system through the primary regulator and removed the regulator and inspected the o-ring and the inside of the yoke, we noted a small piece of the o-ring approximately the diameter of thread, approximately 1/4 inch extending off of the o-ring and slight surface corrosion on the inlet screen. We did note that first stage regulator was stamped 3000 psi which was lower then the pressure the crew stated they were pressuring the air tanks to 3500 psi. This was as far as we got with our inspection of the gear since we began conducting interviews with the divers and Master of the M/V Alaskan Gyre. Once [redacted] and I received word that US Geological Survey was sending an investigator we stopped further inspection of the dive gear since we were an assisting agency. The following information is true and accurate to the best of my knowledge.

[redacted] CWO4 / Investigations Division
CG SECTOR JUNEAU
PH: [redacted]

Document 9: USCG Dive Gear Inspection Email

DAILY CRUISING LOG

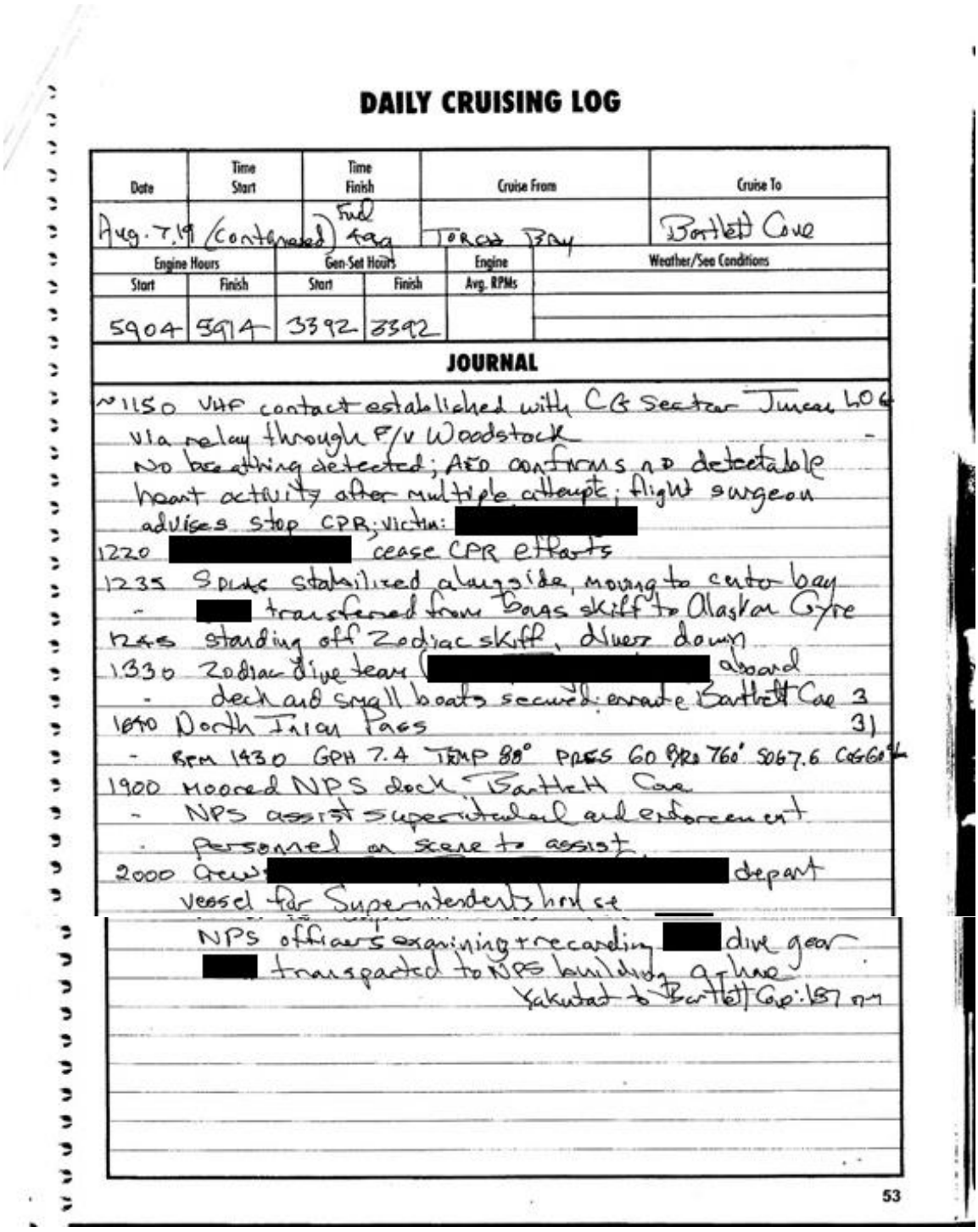
Date	Time Start	Time Finish	Cruise From	Cruise To
AUG. 4 (cont.)	Trip Fuel 360 gal (Homer to Y.A.K.)		Yakutat	

Engine Hours Start	Engine Hours Finish	Gen-Set Hours Start	Gen-Set Hours Finish	Engine Avg. RPMs	Weather/Sea Conditions
5830	5882	3383	3383	3392	Fuel Homer to Yakutat 422 nm

JOURNAL

		LOG
0335	Yakutat Bay Sea buoy to stbd	406
0450	Yakutat	
0525	anchored Yakutat Roads	417
0825	anchor aweigh	
0910	moored Yakutat Harbor received 432g diesel	
1135	moored small boat harbor	422
1230	[redacted] arrive	-
1800	[redacted] arrive	-
1840	Safety address/orientation - all hands	-
1900	underway	0
2007	Ocean Cape to port; W swell 4 ft. wind calm	8
2400	8 nm SSE of Dangerous River	37
Aug. 5	START: 5884 END: 5904 FUEL: 118 g	
0000	underway as before	37
1345	anchored NE arm Torch Bay	134
-	Divers charge tanks and make checkout dive	-
Aug. 6	START: 5904 END: 5904 FUEL: 0	LOG
0000	anchored as before Torch Bay	-
	Dive teams out throughout the day	-
Aug. 7	Start: 5904 END: Fuel:	LOG
0930	Solas and Grey Matter skiffs away with dive teams	-
0955	anchor aweigh	0
1132	Mayday Call from Solas skiff - Diver unconscious	-
1140	along side Solas, E shore, N arm Torch Bay	-
52	[redacted] aboard Solas, unresponsive, [redacted] continuing CPR	

Document 10: USGS R/V Gyre Captain's Log



DAILY CRUISING LOG

Date	Time Start	Time Finish	Cruise From	Cruise To
Aug. 7, 19 (continued)		Fwd 4pg	Tracy Bay	Bartlett Cove

Engine Hours		Gen-Set Hours		Engine	Weather/See Conditions
Start	Finish	Start	Finish	Avg. RPMs	
5904	5914	3392	3392		

JOURNAL

~1150 VHF contact established with CG Sector Juneau LO via relay through F/V Woodstock
No breathing detected; AED confirms no detectable heart activity after multiple attempts; flight surgeon advises stop CPR; victim: [redacted]
1220 [redacted] cease CPR efforts
1235 Spike stabilized alongside, moving to center bay
- [redacted] transferred from Bays skiff to Alaskan Gyre
1245 standing off Zodiac skiff, divers down
1330 Zodiac dive team ([redacted]) aboard
- deck and small boats secured; enroute Bartlett Cove 31
1610 North Inian Pass
- RPM 1430 GPH 7.4 TEMP 88° PASS 60 BRG 760° SOG 7.6 COG 60°
1900 moored NPS dock Bartlett Cove
- NPS assist = superintendent and enforcement personnel on scene to assist
2000 Crew [redacted] depart vessel for Superintendent's house

NPS officers examining + recording [redacted] dive gear
[redacted] transported to NPS building 4 Juneau
Yakutat to Bartlett Cove: 157 nm

53

Document 10: USGS R/V Gyre Captain's Log

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UNIVERSITY OF CALIFORNIA, SANTA CRUZ
DIVING & BOATING SAFETY PROGRAM
831-206-3332 voice
http://www2.ucsc.edu/sci-diving
[redacted]

115 McAllister Way
SANTA CRUZ

UCSC/AAUS REQUEST FOR DIVING RECIPROCITY
VERIFICATION OF DIVER TRAINING AND EXPERIENCE

A scientific diver that is currently certified under the auspices of an organizational member institution of the American Academy of Underwater Sciences (AAUS) shall be recognized by any other organizational member of AAUS and may apply for reciprocity in order to dive with the host organization. Organizational members that are in good standing with AAUS operate, at a minimum, under the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs (2001 edition). The visiting diver will comply with the diving regulations of the host organization's Diving Safety Manual unless previously arranged by both organizations DCIOs.

The host organization has the right to approve or deny this request and may require, at a minimum, a checkout dive with the Diving Safety Officer (DSO) or designee of the host organization. If the request is denied, the host organization should notify the DSO of the visiting diver the reason for the denial. The DSO for the visiting scientific diver has confirmed the following information.

Name of Diver: [redacted]
Email: [redacted]
Dive Dates: **July 2019 (USGS; [redacted])**

	Completed	Renewal
Last diving medical examination	6/1/2016	6/1/2021
Scuba regulator/equipment service/inspected		1/11/2020
CPR training		5/21/2020
Oxygen administration		5/21/2020
First aid for diving		5/21/2020
Depth certification	100	
Date Assigned Current Certification Depth	4/23/2018	
Date of last dive	7/17/2019	
Number of dives completed within previous 12 months?	20	
Maximum dive depth within previous 12 months?	49	
Maximum dive depth within previous 6 months?	37	

Total number of dives logged:	41
UCSC Scientific:	29
UCSC Training:	0
Non-UCSC :	12

Dive Log History:

Depth Range	Dives	Depth Range	Dives
0-40 ft.:	35	130-150 ft.:	0
40-60 ft.:	4	150-190 ft.:	0
60-100 ft.:	1	190+ ft.:	0
100-130 ft.:	0		

Initial Sci. Dive Training Date: 6/15/2013 Organization: UCSC
Additional specialty training/certifications: Dry Suit, Nitrox, Rescue

Comments/Restriction:

Person to Notify in an Emergency: [redacted] Relationship: [redacted]
Contact Number: Home: [redacted]

This is to verify that the above individual is currently a certified scientific diver at UNIVERSITY OF CALIFORNIA, SANTA CRUZ and that UNIVERSITY OF CALIFORNIA, SANTA CRUZ is an organizational member of AAUS. This document does not verify employment status with, or insurability of the divers activity by UCSC. If you have questions about this diver other information provided, please contact the UCSC's Diving & Boating Safety Program.

Diving Safety Officer: [redacted] **Date:** **7/24/2019**

Document 11: Letter of Reciprocity for Diver One

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UNIVERSITY OF CALIFORNIA, SANTA CRUZ
DIVING & BOATING SAFETY PROGRAM
831-206-3332 voice
http://www2.ucsc.edu/sci-diving
[redacted]

115 McAllister Way
SANTA CRUZ

UCSC/AAUS REQUEST FOR DIVING RECIPROCITY
VERIFICATION OF DIVER TRAINING AND EXPERIENCE

A scientific diver that is currently certified under the auspices of an organizational member institution of the American Academy of Underwater Sciences (AAUS) shall be recognized by any other organizational member of AAUS and may apply for reciprocity in order to dive with the host organization. Organizational members that are in good standing with AAUS operate, at a minimum, under the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs (2001 edition). The visiting diver will comply with the diving regulations of the host organization's Diving Safety Manual unless previously arranged by both organizations DCBs.

The host organization has the right to approve or deny this request and may require, at a minimum, a checkout dive with the Diving Safety Officer (DSO) or designee of the host organization. If the request is denied, the host organization should notify the DSO of the visiting diver the reason for the denial. The DSO for the visiting scientific diver has confirmed the following information:

Name of Diver: [redacted]
Email: [redacted]
Dive Dates: **July 2019 (USGS; [redacted])**

	Completed	Renewal
Last diving medical examination	8/5/2016	8/5/2021
Scuba regulator/equipment service/inspected		5/28/2020
CPR training		4/23/2021
Oxygen administration		4/23/2021
First aid for diving		4/23/2021
Depth certification	60	
Date Assigned Current Certification Depth	8/29/2016	
Date of last dive	7/12/2019	
Number of dives completed within previous 12 months?	125	
Maximum dive depth within previous 12 months?	60	
Maximum dive depth within previous 6 months?	55	
Total number of dives logged:	311	
UCSC Scientific:	311	
UCSC Training:	0	
Non-UCSC :	0	

Dive Log History:

Depth Range	Dives	Depth Range	Dives
0-40 ft.:	243	130-150 ft.:	0
40-60 ft.:	66	150-190 ft.:	0
60-100 ft.:	2	190+ ft.:	0
100-130 ft.:	0		

Initial Sci. Dive Training Date: 8/29/2016 Organization: Moss Landing Marine Lab
Additional specialty training/certifications: Dry Suit, Nitrox, Rescue

Comments/Restriction:

Person to Notify in an Emergency: [redacted] Relationship: [redacted]
Contact Number: Home: [redacted]

This is to verify that the above individual is currently a certified scientific diver at UNIVERSITY OF CALIFORNIA, SANTA CRUZ and that UNIVERSITY OF CALIFORNIA, SANTA CRUZ is an organizational member of AAUS. This document does not verify employment status with, or insurability of the divers activity by UCSC. If you have questions about this diver other information provided, please contact the UCSC's Diving & Boating Safety Program.

Diving Safety Officer: [redacted] **Date:** **7/15/2019**

Document 12: Letter of Reciprocity for Diver Two

United States Department of the Interior
U.S. Geological Survey

USGS
science for a changing world

Letter of SCUBA Diving Reciprocity

To: [redacted]
Dive Safety Officer
University of California – Santa Cruz
100 Schaffer Road
Santa Cruz, CA 95816
831-459-4286
www2.ucsc.edu/sci=diving

July 23, 2019

Hi [redacted]

The U.S. Geological Survey conducts scientific research in marine, estuarine, lacustrine, and riverine environments throughout the United States and U.S. Trust Territories. A significant part of some of these investigations involves direct participation by research staff utilizing SCUBA (Self-Contained Underwater Breathing Apparatus). SCUBA diving allows research staff to conduct *in situ* observations, *in situ* sampling, and scientific instrument deployment, monitoring, and recovery.

Recognizing the inherent differences between scientific research diving activities and commercial diving activities, the U.S. Occupational Safety and Health Administration (OSHA) enacted a research diving exemption to their commercial diving regulations (29 CFR Part 1910, Subpart T). This research diving exemption extends protection to those scientists working underwater while lessening the burden associated with commercial diving standards.

To comply with OSHA's research diving exemption, the USGS maintains a Dive Safety Program. This program, fashioned after the program developed by the American Academy of Underwater Scientists (AAUS), meets the requirements of OSHA's research diving exemption.

The USGS Dive Safety Program was designed to promote the safety of the research staff involved with underwater investigations while enhancing the successful completion of their scientific investigations. Dive safety protocols fashioned after AAUS ensures compatibility between cooperative research diving organizations through the adoption of a minimum set of dive safety standards. This minimum set of diving standards forms the foundation of the following Reciprocity Agreement.

[redacted] *is an authorized U.S. Geological Survey research diver for the calendar year beginning 01 January 2019. All SCUBA diving activities must be performed in accordance with the requirements set forth in the U.S. Geological Survey Diving Safety Manual. Please note that* [redacted] *authorization is for non-specialty SCUBA dives and shallow-water, oxygen rebreather dives for the purpose of capturing sea otters.*

[redacted]
U.S. Geological Survey
Scientific Diving Program Manager
600 Fourth Street South
St. Petersburg, FL 33701

[redacted] (cell)

[redacted] (e-mail)

Document 13: Letter of Reciprocity for Diver Three

U.S. DEPARTMENT OF THE INTERIOR
VERIFICATION OF DIVER TRAINING and EXPERIENCE

A Department of the Interior (DOI) diver that is currently certified under the auspices of their Bureau will use this form to request approval to dive with another DOI Bureau (host Bureau) as a visiting diver. The visiting diver will comply with the diving regulations of the host Bureau's Diving Safety Manual, unless previously arranged by both Bureaus' Diving Control Boards.

The host Bureau has the right to approve or deny this request and will require a checkout dive with the Diving Safety Officer (DSO) or designee of the host Bureau. If this request is denied, the host Bureau should notify the DSO of the visiting diver the reason for the denial. The DSO for the visiting diver will confirm the following information:

Diver requesting Reciprocity: [redacted]

Active Status Requirements: (DSO initial to left)

MAB	Diving medical Examination:	Taken:	11/2/2016	Expires:	11/2/2019		
MAB	CPR Training:	Taken:	5/21/2019	Expires:	5/21/2021	Agency:	AHA
MAB	First Aid for Diving:	Taken:	5/21/2019	Expires:	5/21/2021	Agency:	Wild. Med. Soc.
MAB	Oxygen Administration:	Taken:	4/16/2018	Expires:	4/16/2020	Agency:	DAN
MAB	Written diving examination:	Taken:	10/1992				
MAB	SCUBA Regulator service:	Date:	8/24/17*				
MAB	Number of dives:	Total:	998	CY 2018:	44	Last 6 mos.	15
MAB	Date of last dive:	5/30/2019					
MAB	Depth authorization:	130	FSW				
MAB	Diving restrictions?	N	If "Yes", explain:				

* Note: The USGS dive safety manual states: "SCUBA regulators (all first and second stages) must be serviced annually unless specified otherwise by the manufacturer". Scubapro recommends bi-annual service, if less than 100 dives are performed within that time period.

Pertinent Certifications and Training: (please mark all applicable items)

X Open-water I (basic)	___ Navy	X Dry Suit	___ Altitude
___ Open-water II (adv.)	___ NOAA	___ Dive Computers	___ Blue Water
___ Master Diver	___ NPS	___ Decompression	___ Cave / Cavern
___ Dive Master	___ USF&W	___ Nitrox	___ Ice / Polar
___ Assistant Instructor	X USGS	___ Mixed-gas	___ Night
___ Instructor	___ Academia: ____	X Rebreather	___ Rescue
___ Lifesaving	___ Other: ____	___ Saturation	___ Research
___ EMT		___ Other: ____	___ Other: ____
___ Other: ____			

Emergency Contact Information: Due to information restrictions, emergency contact information is available directly from the diver.

[redacted]

This is to verify that the individual above is currently a certified diver with the:
U.S. Geological Survey

Diving Safety Officer: [redacted] 7/23/2019
(Signature) (Date)

FOR OFFICAL USE ONLY

Document 13: Letter of Reciprocity for Diver Three

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UNIVERSITY OF CALIFORNIA, SANTA CRUZ
DIVING & BOATING SAFETY PROGRAM
831-206-3332 voice
http://www2.ucsc.edu/sci-diving
[redacted]

115 McAllister Way
SANTA CRUZ

UCSC Diving Safety Program
Scientific Dive Plan Proposal

Dive Plan Summary

Dive Plan ID: **101413**

Dive Plan Title: **Glacier Bay Resampling 2019**

Dates Proposed: 8/4/19-812/19

Dive Site Location: Glacier Bay, AK

Dive Group: [redacted]

Dive Plan Submitted by: [redacted] #10122

Primary Investigator: [redacted]

Estimated # of dives per diver each day:

Depth Range	< 30 feet	30 - 60 feet	60 - 80 feet	> 80 feet
# Dives per diver each day:	4	0	0	0

Est. Bottom Time/Diver: 60

Dive Mode: Open-Circuit

Breathing Gas: Air

Dive Environment: Coastal

Dive Platform: Other R/V

Scuba Compressor: Is the compressor used to fill SCUBA cylinders owned by the university? No Owner: USGS

Scuba Cylinders: Hydrostatically tested within the past 5 yrs and visually inspected within 1 yr.? Yes

Air Tools: No

Joint Diving Operations: Diving conducted jointly with other agencies/institutions? Yes If yes, list agencies/institutions: USGS

Oxygen at Site: Yes ***First Aid at Site:*** Yes ***Dive Flag at Site:*** Yes

Nearest Medical Treatment Facility to Dive Site:

Location: Sitka, Alaska - Mt Edgecumbe Hospital
Telephone: (907) 966-2411
Transportation Method & Distance: US Coast Guard helicopter

Nearest Recompression Treatment Facility to Dive Site:

Location: Seattle, Virginia Mason Center for Hyperbaric Medicine
Telephone: (206) 583-6543
Transportation Method & Distance: air transport (~2.5hours)

Emergency Contact Numbers:

Local EMS Telephone Number: (907)209-9960 (Sitka), (9
Local Coast Guard RCC Number: 907-209-9960
United States Coast Guard: Channel 16 on Marine VHF Radio
Diver's Alert Network (DAN): 1-919-684-9111 - http://www.diversalertnetwork.org/
Diving Safety Officer Cell Phone: [redacted]

Detailed Dive Plan:

We will be resampling sites surveyed by Jim Estes and colleagues in Torch and Surge Bays, AK.

Dives will occur on a 6-7 m isobath. Divers will randomly place 20, 0.25 m² quadrats along the isobath at each site to count and measure urchins and algal community structure. For urchin surveys, quadrats will be placed using a random number of predetermined fin kicks or random numbers chosen on a 30m transect. After urchins are counted they will be collected and brought to the surface to be measured with calipers. A second diver will count and measure all seastars along a 30m transect using calipers underwater. A third diver will use a quadrat to estimate algal community structure.

The dives will be very short (~30min), and each diver will do ~4/day.

List of sampling equipment in dive plan and considerations for their use:

transect tapes
quadrats

Document 14: UCSC Dive Plan

Diver's Alert Network (DAN): 1-919-684-9111

* 24 hour medical advice - if necessary call collect and state "I have a Medical Emergency" - Use to locate closest recompression chamber or physician consultations. Basic emergency procedures are in the Oxygen Kits.

Out-of State/Country UC Travel Assistance Program

* 1-866-451-7606 (inside US) / 1-202-828-5896 (outside US)

* Apply online prior to travels: http://www.uctrips-insurance.org/

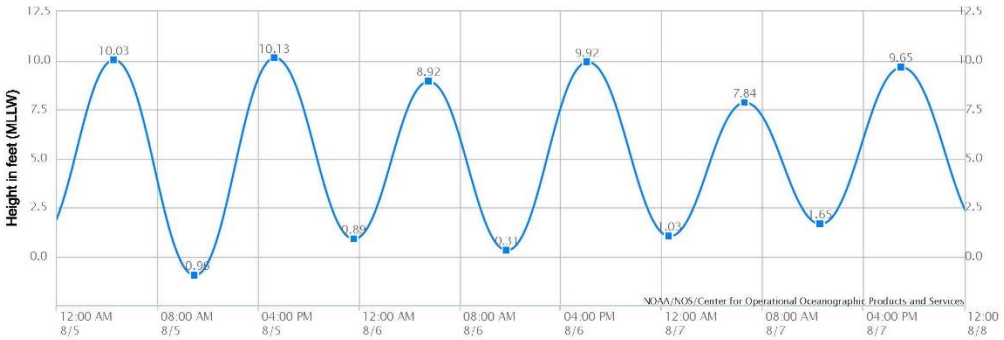
UCSC's Diving Safety Cell Phone [redacted]

Signature: _____ **Title:** _____ **Date:** _____

Document 14: UCSC Dive Plan

Help Print

NOAA/NOS/CO-OPS
Tide Predictions at 9452704, Graves Harbor AK
From 2019/08/05 12:00 AM LST/LDT to 2019/08/07 11:59 PM LST/LDT
Subordinate Station | Ref. Station (Elfin Cove 9452634) | Time offsets (high: 4 min. low: 7 min.) | Height offsets (high: *0.91 ft. low: *1.03 ft.)



Note: The interval is High/Low, the solid blue line depicts a curve fit between the high and low values and approximates the segments between.
Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

High/Low Tide Prediction Data Listing

Station Name: Graves Harbor, AK
Action: Daily
Product: Tide Predictions
Start Date & Time: 2019/8/5 12:00 AM
End Date & Time: 2019/8/7 11:59 PM

Source: NOAA/NOS/CO-OPS
Prediction Type: Subordinate
Datum: MLLW
Height Units: Feet
Time Zone: LST/LDT

Date	Day	Time	Hgt	Time	Hgt	Time	Hgt	Time	Hgt
2019/08/05	Mon	04:32 AM	10.03 H	10:56 AM	-0.96 L	5:17 PM	10.13 H	11:33 PM	0.89 L
2019/08/06	Tue	05:29 AM	8.92 H	11:42 AM	0.31 L	6:06 PM	9.92 H		
2019/08/07	Wed	12:36 AM	1.03 L	06:35 AM	7.84 H	12:34 PM	1.65 L	7:00 PM	9.65 H

Document 15: NOAA Tide Chart for August 7, 2019 at nearby Graves Harbor

Gustavus Weather History for August 7, 2019

Show weather for: August 7, 2019

Scroll right to see more

	Conditions			Comfort			
Time		Temp	Weather	Wind	Humidity	Barometer	Visibility
12:53 am Wed, Aug 7		58 °F	Clear.	No wind	78%	29.96 "Hg	10 mi
1:53 am		57 °F	Clear.	No wind	83%	29.96 "Hg	10 mi
2:53 am		55 °F	Clear.	5 mph	83%	29.96 "Hg	10 mi
3:53 am		54 °F	Passing clouds.	No wind	83%	29.96 "Hg	10 mi
4:53 am		53 °F	Passing clouds.	No wind	83%	29.96 "Hg	10 mi
5:53 am		54 °F	Passing clouds.	5 mph	83%	29.96 "Hg	10 mi
6:53 am		58 °F	Passing clouds.	No wind	78%	29.95 "Hg	10 mi
7:53 am		59 °F	Passing clouds.	5 mph	81%	29.94 "Hg	10 mi
8:53 am		63 °F	Scattered clouds.	8 mph	81%	29.93 "Hg	10 mi
9:53 am		65 °F	Partly sunny.	8 mph	76%	29.92 "Hg	10 mi
10:53 am		69 °F	Partly sunny.	8 mph	68%	29.91 "Hg	10 mi
11:53 am		71 °F	Partly sunny.	12 mph	63%	29.91 "Hg	10 mi
12:53 pm		75 °F	Partly sunny.	10 mph	52%	29.90 "Hg	10 mi

Document 16: Weather history for August 7, 2019 at Gustavus, AK

	Conditions			Comfort			
Time		Temp	Weather	Wind	Humidity	Barometer	Visibility
1:53 pm		80 °F	Partly sunny.	9 mph	41%	29.88 "Hg	10 mi
2:53 pm		79 °F	Scattered clouds.	10 mph	39%	29.87 "Hg	10 mi
3:53 pm		82 °F	Scattered clouds.	10 mph	34%	29.85 "Hg	10 mi
4:53 pm		80 °F	Scattered clouds.	10 mph	35%	29.84 "Hg	10 mi
5:53 pm		78 °F	Scattered clouds.	5 mph	39%	29.83 "Hg	10 mi
6:53 pm		77 °F	Scattered clouds.	7 mph	37%	29.83 "Hg	10 mi
7:53 pm		74 °F	Scattered clouds.	3 mph	43%	29.84 "Hg	10 mi
8:53 pm		67 °F	Broken clouds.	8 mph	55%	29.84 "Hg	10 mi
9:53 pm		63 °F	Partly cloudy.	12 mph	70%	29.86 "Hg	10 mi
10:53 pm		63 °F	Partly cloudy.	5 mph	65%	29.87 "Hg	10 mi
11:53 pm		61 °F	Partly cloudy.	3 mph	72%	29.88 "Hg	10 mi

Document 16: Weather history for August 7, 2019 at Gustavus, AK

Monterey Bay Diving
625 California Ave Unit C
Sand City CA 93955
831-642-9966
info@montereybaydiving.com
www.montereybaydiving.com

Invoice

Date	Invoice No.
01/09/19	13187

Bill To

[redacted]

Terms	Due Date	Boat Name	Harbor Slip
	01/09/19		

Item	Description	Quantity	Rate	Amount
Wrist Seal Repair	Dry Suit Wrist Seal Installation/Repair	2	90.00	180.00T
Miscellaneous	Dive Boot Replacement	1	129.00	129.00T

PAID 1/9/2019

Subtotal	$309.00
Sales Tax (8.75%)	$27.04
Total	$336.04

Document 17: Invoice for Diver One's drysuit repair, 1/9/2019

Fwd: Suit Repair

[redacted] Mon, Sep 2, 2019 at 1:23 PM
To: [redacted]

---------- Forwarded message ---------
From: **Monterey Bay Diving** <montereybaydiving@gmail.com>
Date: Mon, Sep 2, 2019 at 12:50 PM
Subject: Re: Suit Repair
To: [redacted]

Yes it was, all suits are tested before leaving.

I know, what a tragedy!!!

[redacted]
Monterey Bay Diving
[redacted]
www.montereybaydiving.com

On Mon, Sep 2, 2019 at 10:44 AM [redacted] wrote:

[redacted]

Do you know if the suit was tested for leaks after the boots and seals were replaced? I'm guessing yes. Thanks.
Unbelievable news about the Conception...

[redacted]

--
[redacted]
Diving & Boating Safety Program
UCSC/LML
[redacted]

[redacted]
www2.ucsc.edu/sci-diving
http://scientificboating.org/

--
[redacted]
Diving & Boating Safety Program
UCSC/LML
[redacted]

[redacted] voice
fax
www2.ucsc.edu/sci-diving
http://scientificboating.org/

Document 18: Email exchange between UCSC and Monterey Bay Diving