COLORADO
Division of Oil and Public Safety
Department of Labor and Employment

Amusement Rides and Devices Program
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ACCIDENT INVESTIGATION REPORT

Accident Information

Accident Date:	September 5, 2021
Accident Report Date:	Verbal report on September 5, 2021 Written report on September 11, 2021
Permit Holder or Operator:	Glenwood Tramway LLC, dba Glenwood Caverns Adventure Park
Facility Address:	51000 Two Rivers Plaza Rd, Glenwood Springs, Colorado 81601
Accident Description:	Patron fatality on the Haunted Mine Drop amusement ride
Device Name and number:	Haunted Mine Drop, serial number #J0100
Investigators:	Scott Narreau, Amusement Rides and Devices Program Supervisor David Knight, Amusement Rides and Devices Audit Inspector Leslie Sohl, Amusement Rides and Devices Technical Specialist

Background

On September 5, 2021, at 8:41 pm, Mr. Scott Narreau with the Colorado Department of Labor and Employment, Division of Oil and Public Safety - Amusement Rides and Devices Program (OPS) received a phone call from Ms. Nancy Heard, manager of the Glenwood Caverns Adventure Park (GCAP) in Glenwood Springs, Colorado, stating that there had been an accident on the Haunted Mine Drop (HMD) ride on September 5, 2021, at approximately 7:15 pm. Ms. Heard reported that a patron (Ms. Wongel Estifanos) suffered injuries that led to a fatality and that no additional details were known at that time.

The HMD was immediately shut down and, following recovery of Ms. Estifanos from the HMD shaft by first responders, the scene was preserved. First responders, the Garfield County Sheriff's office (GCSO), Case # 21-14438, and the Garfield County Coroner's Office (GCCO), Case # 21-09-05, also responded to the accident. GCAP additionally closed its entire facility from September 6-10, 2021, in light of the fatality.

The HMD is a drop tower style ride that uses gravity to create freefall. The HMD carries 6 passengers and drops 110 feet into a shaft in the ground. Operators are responsible for fastening and checking two separate seatbelts for each passenger prior to dispatching the ride. When Ms. Estifanos, a six-year old girl, sat down on the ride, operators did not notice she was sitting on top of both seatbelts. The control system of the ride prevented the operators from dispatching the ride and alerted them to a seatbelt safety issue on Ms. Estifanos' seat. Operators took several incorrect actions and reset the ride seatbelt

monitors which allowed them to dispatch the ride. Because Ms. Estifanos was not restrained in the seat she became separated from her seat and fell to the bottom of the HMD shaft, resulting in her death. This fatal accident was the result of multiple operator errors, exacerbated by several factors detailed in this report.

Investigation Authority and Scope

The Colorado Revised Statutes (CRS) 8-20-1002 require OPS to promulgate the Amusement Rides and Devices Regulations found at 7 Colorado Code of Regulations (CCR) 1101-12. Statutes and regulations can be viewed at *www.colorado.gov/ops/RegulationsStatutes*. Operations and devices at GCAP must comply with the standards adopted by these regulations, the manufacturer's recommendations (if applicable) and all applicable federal, state and local safety, fire, health, building codes, and standards. These rules and regulations apply to the construction, inspection, operation, repair and maintenance of the ride involved in this accident. Regulations require that every owner/operator of regulated amusement rides or devices first register the rides with OPS and receive a permit from OPS in order to operate in Colorado. The permit application approval process includes verifying that the owner/operator has current and appropriate liability insurance and that every ride has received an annual ride inspection that was conducted by an OPS-certified third-party inspector.

The intent of this investigation is to determine:

- The cause of the accident;
- If violations of the Amusement Rides and Devices Regulations occurred; and
- If additional safeguards are warranted to prevent the possibility of future accidents.

Investigation Timeline

The timeline for the OPS investigation of the accident is described below. Further details of the investigation may be listed within other sections of this report.

- On September 7, 2021, Mr. David Knight and Mr. Narreau met with Ms. Heard, Mr. Jordan Lipp (GCAP counsel), Mr. Matt Jenness (GCSO), and Mr. Rob Glassmire (GCCO) at GCAP to initiate the investigation by first viewing HMD surveillance video. The parties then evaluated the condition and operation of the HMD ride. Mr. Narreau, Mr. Jenness and Ms. Heard interviewed the ride operator (Operator 1) responsible for initially loading the patrons (passengers) on the ride when the accident occurred. The operator who dispatched the ride (Operator 2) was not interviewed at this time but had previously been interviewed by GCSO, according to Mr. Jenness. Mr. Narreau had further discussions with Ms. Heard regarding training of the operators.
- On September 8 and 9, 2021, Mr. Narreau visited GCAP to further review the HMD surveillance video and conduct interviews with additional staff, including the Attractions Trainer and the Director of Maintenance.
- On September 10, 2021, Mr. Narreau visited GCAP to again review the HMD surveillance video and to visit the HMD to understand the operation of the restraint system (seatbelts). OPS emailed GCAP a shutdown notice for the HMD and requirements to reopen the other rides not involved in the accident at GCAP. GCAP submitted documents to OPS as requested.
- On September 11, 2021, GCAP submitted the official GCAP incident report to OPS. OPS authorized GCAP to reopen all rides except the HMD.
- On September 13, 2021, Mr. Narreau visited GCAP to review the HMD surveillance video of operations prior to the accident.

- September 14, 2021, OPS requested that GCAP submit all documentation received from the manufacturer regarding the commissioning of the HMD and all correspondence from the manufacturer since January 1, 2020. OPS also requested and received the HMD - Operator training checklists for Operator 1 and Operator 2 from GCAP.
- On September 15, 2021, OPS staff met virtually with ownership and management from Altitude Rides and Attractions, LLC (Altitude Attractions) to understand their involvement post-accident. Altitude Attractions' legal counsel was present for this meeting, as were staff from the State of Colorado's Attorney General's office. At the time of this meeting, Altitude Attractions had not investigated the accident, and OPS was not able to get a clear answer about the letter[1] sent to Soaring Eagle clients regarding Altitude Attractions' status as the manufacturer or not. OPS was given access to interview recordings from GCSO, as well as the additional documents that OPS requested from GCAP on September 14, 2021. OPS reviewed recorded interviews completed by GCSO of Operators 1 and 2 and other GCAP staff that responded to the accident.

During the investigation GCCO received and forwarded an email to OPS from a person that was a passenger on the HMD in 2019. Mr. Narreau spoke by phone with the person on September 13, 2021. In visits to GCAP, Mr. Narreau communicated with GCAP staff to determine whether they were aware of the email. On September 20, 2021, Ms. Heard sent an email response to Mr. Narreau regarding the 2019 patron email.

Device Description and Operation

The HMD is a drop tower style ride where guests experience a freefall while seated in amphitheater style chairs. Once passengers are loaded into the passenger cart the operator dispatches the ride, the floor below the cart retracts, and passengers experience a freefall drop down a shaft into the ground for 110 feet, after which they are hoisted back up to the top to unload. Duration of the ride is approximately 120 seconds. The HMD consists of: a tower; a hoist system; a passenger cart; a lift cart; a sliding floor; a brake system; and controls. The control panel includes a Human Machine Interface (HMI) screen, dispatch button, and manual controls. The HMI is a specialized touch-screen that tells the operator what is happening on the ride, including any issues (errors) with the monitored seatbelt. The passenger cart includes six seats, each of which have two separate seatbelts. The HMI Screen monitors one seatbelt; this seatbelt has a rod (also known as a pin in the manual) which pushes into and is held by a buckle (known as a restraint block in the manual) next to the passenger's seat. The other seatbelt mimics an automotive lap seatbelt and is not monitored by the HMI screen.

When the passenger cart arrives back at the top to unload, the restraint block automatically unlocks so that rods can be removed. The control system is set up so that after a brief amount of time (less than a minute), the restraint block is automatically relocked. If the seatbelt rods are not removed from the restraint block within that unlock window, the rods are locked back into place and the HMI screen will denote that with a *restraint cycled* error (red indicator light). Rods that are removed from the restraint block in that unlock window, once a new passenger is seated, must be placed into the restraint block to be locked. Any rods not inserted will cause the HMI screen to denote that with a *restraints* error (a different red indicator light). Each seat has its own set of indicator lights for each of these scenarios on the HMI screen.

[1]Per a letter dated January 20, 2020, from Soaring Eagle Zipline Inc and Altitude Attractions: the Soaring Eagle product line with all the rights to the Soaring Eagle name was sold to Altitude Rides and Attractions LLC.

According to *Section 2: Cave Drop Overview* of the Soaring Eagle Operation & Maintenance Manual[2], Rev D July 2017 (hereafter referred to as the manufacturer's operating manual), "The Cave Drop Ride contains unprotected heights, high voltage electronics, automated machinery, and other hazards…..It is critical that the Owner/Operator have a complete understanding of this manual before operating any of the rides that are part of the Cave Drop."

Equipment Evaluation

GCAP has been operating for more than 15 years. The HMD was added to the annual GCAP permit effective July 21, 2017. The application for the permit to operate the HMD included a certificate of inspection dated July 21, 2017, which was conducted by the manufacturer of the ride, Soaring Eagle Zipline Inc. In commissioning the ride, Soaring Eagle issued a document, dated August 7, 2017[3], to GCAP, stating that the HMD was designed and manufactured to meet ASTM F2291 Standard Practice for Design of Amusement Rides and Devices, which is one of several ASTM standards adopted in the Colorado Amusement Rides and Devices Regulations.

Each year thereafter, OPS issued an annual permit to the GCAP which allowed it to continue operating the HMD. Annual inspections for the HMD occurred on June 15, 2018, June 8, 2019, June 16, 2020, and June 8, 2021. The Certificates of Inspection indicate that the ride was inspected in accordance with the Colorado Amusement Rides and Devices Regulations (7 CCR 1101-12) and that any deficiencies identified or noted at the time of the inspections were corrected.

Additional documents received and reviewed by OPS during this investigation include:

- All third-party inspection reports for the history of the ride.
- Commissioning inspection report for the ride.
- Maintenance records and daily inspections for a period of 30 days prior to the accident and including the day of the accident.
- Accident reports for the last three years prior to the accident.
- Manufacturer drawings.
- Familiarization training documentation issued by the manufacturer to GCAP in 2017.

Mr. Knight and Mr. Narreau observed an unloaded ride cycle on site, post-accident, on September 7, 2021. The HMD functioned according to specifications.

Operation Evaluation

Operating Procedures & Training

Upon request by OPS, GCAP provided OPS a copy of the manufacturer's operating manual, as well as a site-specific Haunted Mine Drop - Operations Manual, revised April 12, 2021 (hereafter referred to as the operations manual).

GCAP uses a training checklist for each ride which must be initialed and signed by the trainer, signed by the operator, and signed by the manager.

[2] The paper copy provided was scanned by OPS staff, and in the scanned copy, the images are not visible, but the text can be read. Altitude Attractions provided digital copies of the manufacturer's operating manual Rev C & Rev D to OPS on September 15, 2021. Rev C shows pictures clearly.
[3] This document was signed by the same person who also issued the January 20, 2020, letter.

According to correspondence with GCAP, Operator 1 was hired on July 9, 2021 and received training on August 5, 2021. Operator 2 was hired on August 21, 2021 and received training on August 22, 2021.

During the investigation and review of both manuals and training checklists, the following was noted:

- "Operations manual (refer to written procedure)" is the first item on the HMD - Operator checklist. This item was initialed for Operator 2 and not for Operator 1.
- Operating procedures in both manuals instruct the operator to:
    - Pull the seatbelt over the passenger and insert rod into the restraint block.
    - Gently tighten the seatbelt against the passenger.
    - Repeat this step for each of the passengers.
- Operating procedures in both manuals instruct the operator to visually check to confirm that each passenger has a seatbelt over their lap.
- Neither manual details a procedure that operators must follow between ride cycles in regards preparing the seatbelts for the next group of passengers.
    - The manufacturer's operating manual notes that the restraint block automatically unlocks when the ride is being unloaded; it does not include the fact that after a brief period the restraint block is automatically relocked.
- Operating procedures in both documents instruct the operator to verify that the HMI screen shows no errors.
    - The manufacturer's operating manual details what the various lights (indicators) on the HMI screen represent, and it does not detail what the procedure is when errors occur (when indicators are red).
    - The operations manual does not include an explanation of the various lights (indicators) on the HMI screen, and it does not detail what the procedure is when errors occur (when indicators are red).
- Except for telling operators to check the HMI screen for errors, there is no procedure in the operations manual to follow if an error is found. The operations manual has a *fault procedure* and an *unplanned downtime procedure.* Neither procedure denotes when to specifically apply each. Step 1 of the unplanned downtime procedure is to unload passengers.
- Restraint Release Selector Switch's purpose is described in the manufacturer's operating manual; however, neither manual describes under what circumstances and by whom this action can be done.

GCAP Incident Reports, Interviews and Other Correspondence

GCAP submitted internal incident reports to OPS. Reports were completed by Operator 1, Operator 2, Ms. Heard, and the staff acting as the queue line attendant. After reading the reports and conducting interviews, Mr. Narreau noted the following:

- GCAP's September 11, 2021, incident report stated that during loading of passengers, Operator 1 did not notice Ms. Estifanos was sitting on both seatbelts. The incident report also stated that when Operator 2 arrived they removed and reinserted the rods for each monitored seatbelt and still did not notice that Ms. Estifanos was sitting on the seatbelts. The ride was dispatched, and following the retraction of the cart, Ms. Estifanos was not in the seat.
- GCAP staff are provided copies of the GCAP operations manual during training, and portions of the document are posted in the control room. Ride operators are not provided with copies of the manufacturer's operating manual.
- The Attractions Trainer does not reference the manufacturer's operating manual during training.
- An explanation of the HMI Screen and its various indicator lights is not a part of the GCAP operations manual.

- Terminology for key components of the HMD operating procedures, including the rod (on the end of the seatbelt), the HMI screen indicator lights, and errors, were either not known by Altitude Attractions and GCAP management, or they were referred to by other terms that were inconsistent with the terms used in the operating procedures in both manuals. Not using consistent terminology or referencing ride parts by their names hinders operators' ability to learn and consistently execute a procedure. It also prevents staff from clearly distinguishing between different types of scenarios for which they may be responsible.
- When asked what the procedure for the seatbelts is between ride cycles, the Attractions Trainer said there were no specific requirements. Mr. Narreau watched surveillance video with the Attractions Trainer that showed an operator who was not involved in the accident unbuckling and moving seatbelts from seats that were unoccupied. All seatbelts for the ride were pulled away from the seats and laid alongside to leave the seats cleared before new passengers were allowed in the space. In video surveillance reviewed by OPS staff, this process was performed consistently by other operators who operated the HMD, including Operator 2 when they operated the ride earlier on September 5, 2021.
- The email complaint from a former patron that was sent to GCCO on September 8, 2021, was originally sent to GCAP on August 15, 2019. In the email, the patron described an incident on August 14, 2019, when they were a passenger on the HMD. The patron stated that when they were loaded onto the ride, they sat on the seatbelts and told the operator that they were not buckled in. The operator pulled on the tightening strap of the seatbelt and disputed that the patron was not buckled in. After persistence from the patron, the operator did verify that the patron was not buckled in and mitigated the issue prior to dispatching the ride.
- Inadequate training was a factor in the accident occurring. For that reason, OPS required GCAP to provide refresher training to the staff operating the other rides in the park prior to GCAP reopening the rides that were not involved in the accident (see State email from September 10, 2021).

Operator Surveillance Video Review

- Mr. Narreau watched the following videos of HMD operations:
  - September 3, 2021, from 10 am through the closing of ride for the day
  - September 4, 2021, from the opening of the ride through 5:45 pm
  - September 5, 2021, from 6 pm through the time of the accident.
- In video surveillance leading up to and including the accident, the following was observed:
  - In ride cycles immediately prior to the accident, Operator 1 inconsistently used the process of unbuckling and moving all seatbelts to clear the seats.
  - On the HMD, passengers often attempted to help fasten their own seatbelts. Operators did not appear to try and stop this from occurring.
  - In the ride cycle immediately prior to the accident, seat #3 was unoccupied and the operator fastened both seatbelts, inserting the rod into the restraint block to allow the ride to dispatch.
  - After passengers exited the ride cycle immediately prior to the accident, Operator 1 moved directly from the control room to the entry door to load more passengers; the process of managing the seatbelts was not completed at all - leaving seat #3's seatbelts locked on the seat.
  - Ms. Estifanos sat in seat #3 on top of the seatbelts and put the tail of a seatbelt across her lap.
  - Operator 1 assisted passengers in locking rods into restraint blocks and clipping unlocked secondary seatbelts and then proceeded to check that all rods were in the restraint block.
  - When Operator 1 got to seat #3, Operator 1 looked at the restraint block and pulled the tails of the seatbelts and did not notice that Ms. Estifanos was only holding the tail of one seatbelt across her lap. As Operator 1 tightened the seatbelts, the tail was pulled out of

Ms. Estifanos' hands, and Operator 1 did not notice that the seatbelts were not positioned across her lap.
- When Operator 1 went to the control room, the HMI screen showed an error on seat #3 due to not being cycled. Per the manufacturer's manual, this meant the rod was not removed from the restraint block after the previous cycle.
- Operator 1 returned multiple times to check the rods on all seats and pushed the rods into the restraint blocks. Per the interview with Operator 1, they did not believe the error because they were convinced the restraint had been cycled and that the issue was improperly inserted rods.
- When Operator 2 arrived, Operator 1 noted that there was an error preventing the ride from dispatching.
- Operator 2 chose to unlock the restraint block using the manual Restraint Release Selector Switch, and then went and removed all rods from the restraint block next to the seats and immediately reinserted them, without understanding and resolving the actual issue - that Ms. Estifanos did not have the seatbelts across her lap.
- In checking seatbelts, Operator 2 checked Ms. Estifanos' seatbelts by repeating the same actions as Operator 1 did in the first check. Ms. Estifanos had placed the tail of a seatbelt back across her lap; Operator 2 also did not notice that neither of the seatbelts were positioned across her lap.
- Operators 1 and 2 returned to the control room, and the HMI screen showed no errors; Operator 2 then dispatched the ride.

Findings

There were several factors that contributed to this fatality. A summary of these factors are in the findings listed below:

1. **Operator 1 did not prepare the seatbelts before allowing Ms. Estifanos and the other passengers to be seated. Because of this inaction Ms. Estifanos sat on a previously unoccupied seat, on top of the still locked seatbelts.**
    - While not formally a part of the documented procedures or training, other GCAP operators appear to have adopted a process of unbuckling and moving all seatbelts to clear the seats, including removing rods from the restraint block on unoccupied seats prior to allowing passengers to enter the ride. Operator 1 had done this inconsistently on earlier ride cycles and did not do this on the accident ride cycle.
    - OPS sees this process as critical for several reasons including:
        - Seatbelts are ready and able to be positioned for the next passengers properly.
        - Ensuring rods have been cycled
        - Prevents the automatic relocking of rods on previously unoccupied seats
        - Allows the ride to operate in automatic mode without operators using the Restraint Release Selector Switch.

2. **Both Operator 1 and 2 did not follow the operating procedures noted in the manufacturer's operating manual, which is a violation of Amusement Ride and Devices Regulations. Because of this the HMD seatbelts were not positioned over Ms. Estifanos.**

    - Section 2-5-1(B) of the regulations states, "Amusement Ride and Device Operators are required to operate each ride or device in accordance with these regulations, adopted codes and any applicable manufacturers' recommendations."
    - Specific procedures not followed were:
        - Pull the seatbelt over the passenger and insert the rod into the restraint block.
        - Visually check to confirm that each passenger has a seatbelt over their lap.

- These procedures indicate that the operators of the HMD are required to perform this task as they are the trained professionals. Passengers cannot be expected to know or correctly execute the safety procedures for this ride.

3. **Training for both Operators 1 and 2 did not appear to emphasize the inherent risks of the ride, nor did it include reviewing the manufacturer's operating manual, which is a violation of Amusement Ride and Devices Regulations. Because of this Operators 1 and 2 did not fully understand their responsibility regarding passenger safety. Not having a complete understanding of the HMI screen and reasons for the various errors, the operators were not equipped to operate and dispatch the ride.**

    - Section 2-5-1(A) of the regulations states, “Ride Operators shall be trained in accordance with these regulations, adopted codes and standards, and any applicable recommendations provided by the Amusement Ride or Device manufacturer.”
    - Specific manufacturer recommendations not adequately trained on were:
        - The procedures described in Finding #2.
        - Information about the HMI screen and indicator lights.
    - The *restraint cycled* error on the HMI screen for seat #3 indicated that the seatbelt’s rod had not been removed from the restraint block before Ms. Estifanos sat down. The fact that the seatbelt had not been removed from the restraint block means it cannot have been positioned properly on the next passenger. The HMI screen error appears to be designed to warn operators of this fact.
    - In the accident ride cycle video, OPS observed Operator 1 incorrectly attempting to resolve the *restraints cycled* error. The HMI screen tells operators exactly what seat had the error (seat #3). Operator 1 did not need to focus on any other seat, and yet they attempted to push rods further into the restraint blocks for random seats, including seat #3. The action of pushing rods is used to resolve an unrelated error (a *restraints* error) and does not address the fact that the seatbelts on seat #3 were not cycled.

4. **Having multiple operators making decisions and participating at different steps within the ride cycle was unusual and took the focus away from passenger safety.**

    - The decision to focus on the rods and the restraint block, rather than on whether the seatbelts were positioned properly, indicates that Operator 2 did not have a complete understanding of the various HMI screen indicator lights.
    - When Operator 2 joined Operator 1 during the accident ride cycle, they chose to restart mid-procedure and appear to have switched the Restraint Release Selector Switch from locked to unlocked, without unloading passengers to determine what the issue was.
    - Due to the fact that Operator 1 did not know how to deal with the *restraint cycled* error indicated on the HMI screen, it might have been considered ‘unplanned downtime’. If Operator 1 had followed the unplanned downtime procedure, they would have unloaded passengers before proceeding.

5. **The restraint system (seatbelts) and the accompanying documentation (manufacturer's operating manual) contributed to the accident in the following ways:**

    - The manufacturer’s operating manual does not instruct operators on how to properly address errors. The failure of the manual to instruct operators on how to address errors hinders operators' ability to effectively utilize the safety in place within the system.
    - Based on the location of pieces of the seatbelts, it is possible to lock both the seatbelts when they are incorrectly positioned.
    - Neither the manufacturer’s manual nor the operating manual instructed that it was the operator’s responsibility to buckle the unmonitored seatbelt across the passenger.

Conclusions

These conclusions were formulated based on the assessment of the evidence available at the time of the investigation.

This investigation was able to conclusively identify the factors that caused the accident and resulted in a fatality. The fatal accident was the result of multiple operator errors, specifically failure to ensure proper utilization of the passenger restraint system (seatbelts), and a lack of understanding and resolution of the Human Machine Interface (HMI) screen error conditions on the control panel.

Factors that led to the operator error were:

- Lack of procedures
- Inadequate training
- More than one operator taking responsibility of a ride during a ride cycle
- The restraint system involved

The Haunted Mine Drop (HMD) will remain closed until OPS repermits the ride, which will require the factors that caused the operator error to be addressed and a Certificate of Inspection to be submitted.

This investigation did identify violations of the Colorado Amusement Rides and Devices Regulations. Enforcement will be pursued via the statutory process.

OPS will share learnings from this accident with industry stakeholders in the interest of public safety. According to OPS records, there are no other HMDs (or similarly designed drop rides) manufactured by Soaring Eagle in Colorado. For the purpose of disseminating the findings to other owners/operators with this type of ride, Altitude Attractions will also be provided a copy of this report; they are the only company that has access to Soaring Eagle records which may include a client list and ride locations.