



A Fire Fighter Drowns After Attempting to Rescue a Civilian Stranded in Flood Water - Colorado

SUMMARY

On August 17, 2000, a 37-year-old male career fire fighter drowned while attempting to rescue a civilian stranded in flood waters. The career fire department was notified of several cars that were stranded due to heavy amounts of rain and subsequent flooding. A crew was dispatched to the scene at approximately 1700 hours to assist motorists stranded by the flood waters. After the crew determined that there were no civilians in the cars, they waited until the police arrived to take over scene control. While two fire fighters (Fire Fighter #1 and the victim) were waiting for the police to arrive, they were verbally summoned by a civilian bystander to help a female civilian stranded in the water. The civilian was observed holding onto a pole in a pool of water that appeared to be about 3 feet deep. Due to the flooding conditions it was not obvious to the fire fighters that she was standing at the top edge of a culvert approximately 10 feet deep. Both of the fire fighters responded to the location of the female civilian and attempted a rescue. Fire Fighter #1 was the first to enter the water, and he was quickly pulled under by the undertow. The victim entered the water to aid Fire

Fighter #1 to safety, then reentered the water to retrieve the civilian. While doing so, the victim was pulled under the water, into the culvert, and through a large-diameter pipe. For several hours, Fire Fighter #1 and other crews made numerous attempts to rescue and recover the victim. At approximately 2245 hours, the victim was found several blocks from the original location of the attempted rescue. He was pronounced dead at the scene.

The NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should

- *ensure that a proper scene size-up is conducted before performing any rescue operations, and applicable information is relayed to the officer in charge*
- *ensure that all rescue personnel are provided and wear appropriate personal protective equipment when operating at a water incident*



View of drainage pipe where victim was found

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at

www.cdc.gov/niosh/firehome.html
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- ***ensure that fire fighters who could potentially perform a water rescue are trained and utilize the “Reach, Throw, Row and Go” technique***
- ***develop site surveys for existing water hazards***
- ***ensure standard operating procedures (SOPs) are developed and utilized when water rescues are performed***
- ***ensure that when using self-contained breathing apparatus (SCBAs), manufacturer’s guidelines are followed***

Additionally,

- ***municipalities should identify flood-related hazards and take steps to correct them as soon as possible in order to minimize potential for injury.***

INTRODUCTION

On August 17, 2000, a 37-year-old male career fire fighter died while attempting to rescue a civilian stranded in flood waters. On August 18, 2000, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On January 10-12, 2001, two NIOSH safety and occupational health specialists investigated this incident. A meeting was conducted with the fire department safety officers, a representative from the International Association of Fire Fighters (IAFF), and a representative from the city’s Wastewater Management Division. Interviews were conducted with the Incident Commander, the Captain of the apparatus to which the victim was assigned, and other fire fighters involved in this incident. Copies of the police report, the department’s standard operating procedures (SOPs), the victim’s training records, the dispatch

log, the department’s investigative report, photos and maps of the incident site, and the death certificate were reviewed.

The career fire department involved in this incident serves a population of approximately 500,000 in a geographical area of 154.9 square miles and is comprised of 921 uniformed personnel who staff 31 fire stations.

On the day of the incident, weather conditions were cloudy with severe rain and thunderstorms. The site of the incident consisted of a 4-lane divided boulevard, a 5-foot diameter culvert which feeds into a drainage system, and an underground cement vault measuring 10 feet by 8 feet. A drainage pipe, laid under the boulevard, measures approximately 5 feet in diameter. The exposed, open south end of the pipe lies within a large drainage ditch into which it empties. The bottom of the pipe at the inlet was approximately 8 feet below the road surface. The inlet was not covered and was totally accessible. On the day of the incident, the flood waters were approximately 10 feet deep at the inlet and were flowing in a northerly direction. With this amount of water, the pipe had a capacity of approximately 200 cubic feet per second and a velocity of approximately 15 feet per second. This drainage pipe was on a 6-year plan to be replaced with a larger capacity pipe and covered to prevent injury due to high flood water in that area. Work was expected to begin in year 2003. Since this incident, a junction box has been installed which covers the drain to the surface level.

Both the victim and fire fighter #1 were wearing fire fighter turnouts consisting of bunker pants, coat, boots, gloves, and a helmet. Neither the victim nor the assisting fire fighter had received water rescue training. The victim was certified through the State as fire fighter level II and had 3 years and 4 months’ experience.



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INVESTIGATION

On August 17, 2000, at approximately 1700 hours, Unit 10 was dispatched to assist stranded motorists in flood water. Responding on Unit 10 was a Captain, the Engine Operator, and Fire Fighters #1, #2, #3, and #4 (the victim). The engine operator positioned the apparatus approximately two blocks to the south of the flooded area and noticed that the street was filled with standing water (approximately 3 feet deep). Several stranded cars were stopped in the area.

The Captain sent the victim and fire fighter #1 to the north to check for any motorists in need of assistance. The two waded through approximately knee- to waist-high water for two blocks, checking in several cars that were floating in the water. After approximately 15 minutes on the scene, the victim called the Captain on his radio and reported that all of the civilian motorists had exited their cars. The Captain told the victim and Fire Fighter #1 to remain at the north end of the street to provide traffic control and inform drivers to use an alternative route until the police arrived on the scene. The victim positioned himself near the curb of the northbound lane and Fire Fighter #1 was standing near the median in the southbound lane, directing traffic.

A few minutes later, a civilian security guard at a bank across the street began yelling to the victim and Fire Fighter #1 that a female was stranded in the water and needed help. Neither the victim nor Fire Fighter #1 could see the stranded female, but they immediately began wading toward the security guard to investigate. On the way to the other side of the street, the victim called the Captain on the radio to inform him that they had received notice that a civilian was stranded and that they were going to check further into the situation.

Fire Fighter #1, approximately 40 feet in front of the victim, approached the west side of the street and

could see a female standing and holding onto a small metal pole (typically used for street signs) rising out of a pool of water. Fire Fighter #1 then entered the large pool of water to retrieve the civilian. Fire Fighter #1 stated that he believed the water was only 3 feet deep and that the civilian was standing on the ground. Therefore, he thought it was safe to enter the water. He was not aware that the civilian was standing on the edge of a large slope into the pool of water, which was approximately 10 feet deep. Fire Fighter #1 also stated that he did not see any visible current when he entered the water. As Fire Fighter #1 approached the civilian, he began to go under the surface of the water. The victim approached the pool of water and saw Fire Fighter #1 going under the water due to the undertow. The victim reportedly handed his radio to a civilian bystander then entered the water to help Fire Fighter #1. The victim grabbed Fire Fighter #1, and they both struggled to the edge of the water. Fire Fighter #1, with his back to the water, climbed onto the bank, coughing from water he had swallowed. Before the victim reentered the water to assist the civilian, he told Fire Fighter #1 to radio for help. As Fire Fighter #1 turned around, the victim was gone and his helmet was circling on the surface of the water. Fire Fighter #1 removed his bunker coat and told the civilian witnesses to use the radio and call for help. Fire Fighter #1 stated that at this point he still did not realize there was a large-diameter pipe below the surface of the water. He thought he was being pulled under the water because his bunker coat and pants were weighing him down.

Fire Fighter #1 reentered the water and assisted the civilian to safety. Witnesses found a welding cable and tied it around Fire Fighter #1's waist. He reentered the water and began to frantically search for the victim under the surface of the water. At 1744 hours, a female civilian witness used the radio to call for help. The Captain, several hundred feet to the south of the scene, was confused about who



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was on the radio. Since his crew did not have any females on duty, he first thought it was a fire fighter on another scene.

During his search efforts, Fire Fighter #1 went under the water hoping to see the victim below the surface. After not locating the victim, Fire Fighter #1 exited the water and called on the radio for help, stating that a fire fighter was down. The Captain and Fire Fighter #3 then ran to the location. As they approached the pool of water from the south (see Diagram), they saw several bystanders forming a human chain and assisting Fire Fighter #1 in the water searching for the victim. Fire Fighter #1 stated that at this point he realized that there was a large culvert under the surface of the water and he was reaching into the culvert searching for the victim.

The Captain instructed Fire Fighter #2 to radio Central Dispatch for additional units and the underwater team. He then instructed all civilian bystanders to exit the water. At approximately 1755 hours, the following units were dispatched to the scene: District Chief #2; Rescue 11 (an underwater unit) with a Lieutenant, an Engine Operator, a safety diver, and a technician; Truck 9 with a fire fighter (acting Lieutenant), an Engine Operator, and three fire fighters; Pumper 9 with a Captain, Engine Operator and two fire fighters, and Pumper 1 (dive team) with a Lieutenant and two technicians. A representative from the city Waste Water Management Department was also called to the scene to provide maps of the underground drains.

When District Chief #2 arrived on the scene, he assumed Incident Command (IC). Fire Fighter #1 was continuing his search in the area where the victim went under the water. The IC was briefed by the Captain that the victim had been lost for approximately 10 minutes. The IC noted

that the pool of water now had a large whirlpool effect. The IC requested Engine 9 to report to the scene.

At approximately 1805 hours, Engine 9 arrived with a Captain, Engine Operator, and two fire fighters. The Captain from Engine 9 informed the IC that he knew where the culvert exited and that he had old maps of the drain system. The maps were last updated in 1994; however, the drainage system had been modified since then. The IC directed him and his crew to search the location where the culvert ended.

During additional rescue attempts, the Engine Operator from Engine 9 used a self-contained breathing apparatus (SCBA) under water in the open culvert on the opposite side of the driveway to the bank to assist in finding the victim.

The IC instructed the Engine Operator from Truck 9 to don an SCBA, and he entered the area where the victim was last seen. He was tied off with a rope line, and he noted that the water was calm at the surface; however, approximately 5 feet below the surface, the force of the water started to pull him into the pipe. He signaled to the surface crew to pull him up.

At approximately this time, the dive team arrived. The IC briefed a safety diver from Rescue 11 about the conditions. The diver was equipped with a wet suit and self-contained underwater breathing apparatus (SCUBA), and was tied off around the waist with a rescue rope. The diver entered the pool of water by standing on the top edge of the culvert and noticed a small whirlpool at the surface of the water. He entered the culvert by grasping the interior ridges of the pipe; however, he retreated due to the strong current pulling him further into the culvert and pulling his mask from his face. The diver then exited the water.



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The IC directed pumps to be used to pump out as much water as possible where the victim was pulled in. He then had crews cover the culvert with plywood to try to reduce the water flow. Once the water level was down approximately 6 inches from the top of the culvert, the safety diver from Rescue 11 directed light from his flashlight into the culvert. He could see into the culvert approximately 50 feet but did not see the victim. Crews continued searching the area for approximately 3 hours (see Photo). A crew at the north end of the scene found a strobe light flashing under the water. The crew then noticed the reflective tape from the victim's bunker coat approximately 1 foot below the surface of the water. At approximately 2245 hours, the crews called out that they had located the victim. The victim was removed by the police department and fire fighters. He was pronounced dead by the coroner and transported to the city morgue.

CAUSE OF DEATH

The death certificate listed the cause of death as apparent drowning.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fire fighters should ensure that a proper scene size-up is conducted before performing any rescue operations, and applicable information is relayed to the officer in charge.^{1,2}

Discussion: Fire fighters should conduct a complete scene size-up and relay the information to the officer in charge. Similar to a fireground incident, size-up information is imperative to ensure all information is considered, a risk-benefit analysis is conducted, protocols are followed, and hazards are identified and minimized. Typically scene size-up is the responsibility of the first arriving officer; however, fire fighters should also examine their surroundings to identify hazards as they approach the scene.

Recommendation #2: Fire departments should ensure that all rescue personnel are provided and wear appropriate personal protective equipment (PPE) when operating at a water incident.²

Discussion: All fire departments who are subject to water rescue should ensure that all rescuers are trained in water rescue and that they don proper PPE. This includes a water rescue helmet and an appropriate personal flotation device (PFD). Fire fighters should not be placed in a water rescue situation wearing standard fire fighter turnout clothing. Turnout clothing, when saturated with water can add a considerable amount of weight (approximately 60 pounds) to a fire fighters overall weight, making it very difficult to swim. Since this incident, the department has issued PFDs on every apparatus as well as alternative reflective gear to wear during inclement weather operations.

Recommendation #3: Fire departments should ensure that fire fighters who could potentially perform a water rescue are trained and utilize the "Reach, Throw, Row and Go" technique.

Discussion: In the event that trained designated dive rescue personnel are not available, fire fighters should be trained in the "Reach, Throw, Row and Go" rescue technique. Rescuers should attempt a rescue by extending a long-handled tool (e.g., pike pole), throwing a rope or flotation device with an attached rope to the victim, or by using a boat to gain access to the victim. Additionally, a pike pole could be used to determine the water depth before the fire fighter walks into unknown waters. As a last resort, rescuers who are outfitted in proper PPE (i.e., clothing and a PFD) should attempt to swim to victims to bring them to safety. Fire fighters who respond to any potential water rescue situations should be properly trained to perform water rescues.

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Recommendation #4: Fire departments should develop site surveys for existing water hazards.¹

Discussion: Site surveys for water hazards should include existing water hazards based on historical data. The survey should also include flood maps, and identify other site-specific hazards and specific PPE needed for each site. After a site survey is developed, all fire fighters should be trained on potentially dangerous areas which could result in a water rescue. Although the body of water where the victim drowned is not typically thought of as a hazardous site, the surrounding residents and the department had known the potential for flooding with very little rainfall. Since this incident, the department has identified all open culverts, sewers, or similar types of drains and has developed recommendations that are provided to various city fire stations and to the city public works division (i.e., grates, signs, etc.) to minimize the possibility of future incidents.

Recommendation #5: Fire departments should ensure standard operating procedures (SOPs) are developed and utilized when water rescues are performed.³

Discussion: In addition to other fireground operations, standard operating procedures (SOPs) pertaining to water rescues should be developed to standardize practices and techniques. SOPs should outline, at a minimum, the following: mandatory appropriate PPE; equipment or apparel likely to endanger personnel if they fall into the water or attempt a rescue; upstream safety spotters; personnel staged at downstream points; staging only properly trained personnel in the danger area; standard communications; waterway rescue preplans; and safety consideration for rescuers.

Recommendation #6: Fire departments should ensure that when using self-contained breathing apparatus (SCBAs), manufacturer's guidelines are followed.⁴

Discussion: Although there is no evidence that it contributed to this fatal event, Recommendation #6 is being provided as a reminder of good safety policy. SCBA manufacturer's precautions should be followed to ensure fire fighters' safety. In the manufacturer's operating and maintenance instructions it states that "the respirator is not to be used for purposes other than authorized by your respiratory protection program. For example, this respirator must not be used under water." There are a number of reasons for this statement. When an SCBA is used under water, the curved polycarbonate lens of the facepiece with water on one side and air on the other can cause significant distortion of the user's vision due to the refraction of the light as it passes from water to air. Additionally, because the pressure reducer of an SCBA is referenced to the ambient environment, there are passages connecting the interior portions of the pressure reducer to the surrounding atmosphere. This pressure reducer is generally optimized for the passage of gas and is intended to restrict the passage of dirt and/or liquid. With repeated immersion, water can collect in these passages and, without tear down of the pressure reducer for cleaning, can promote corrosion of the pressure reducer. In interviews conducted by NIOSH, two fire fighters stated that they had used their SCBAs under water before the underwater dive team's arrival to aid in the rescue attempts to find the victim. The crew that attempted rescue with their SCBAs had reportedly been told by the SCBA sales representative that the face piece would maintain a seal when submerged under water. The crew members then tested the face piece seal integrity in a swimming pool. As a result of their experience with the face piece maintaining a seal under water, they believed that they could successfully use an SCBA during an underwater rescue attempt. NIOSH strongly advocates following manufacturer's recommendations that SCBAs not be used under water.



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Additionally, municipalities should consider the following:

Recommendation #7: Municipalities should identify flood-related hazards and take steps to correct them as soon as possible in order to minimize potential for injury.

Discussion: Before this incident, the city had received several complaints about the large amount of standing water and flooding in this area. The drainage pipe involved in this incident was originally installed in 1960 and measures 60 inches in diameter. It was on a 6-year plan to be replaced with a larger velocity pipe (approximately 72 - 84 inches in diameter) and covered to prevent accidental injury during times of flooding. Work to replace this pipe was expected to begin in year 2003. Since this incident, a junction box and a trash grate have been installed to help prevent future injuries.

REFERENCES

1. NFPA [2000]. NFPA 1006 Standard for rescue technician professional qualifications. Quincy, MA: National Fire Protection Association.
2. International Fire Service Training Association [1998]. Essentials of fire fighting. 4th ed. Stillwater, OK: Oklahoma State University.
3. Collins, L [2000]. Rapids learners. *Fire Chief* 44(8):54-65.
4. Scott Aviation [1997]. Scott operating and maintenance instructions, Air-Pak@2.2/3.0/4/5.

INVESTIGATOR INFORMATION

This investigation was conducted by Kimberly L. Cortez and Mark McFall, Safety and Occupational Health Specialists, NIOSH, Surveillance and Field Investigations Branch, Division of Safety Research.



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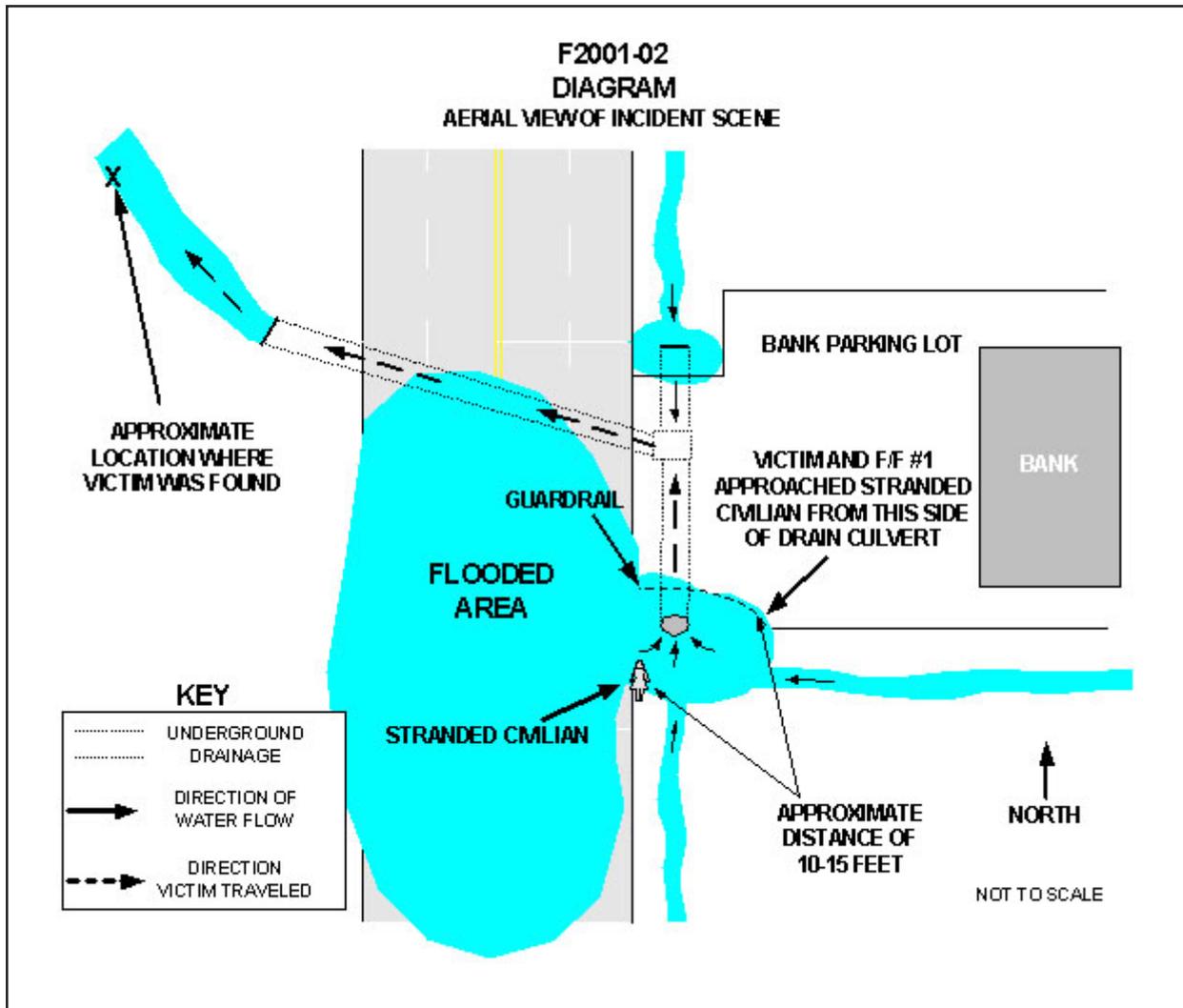


Diagram of incident site

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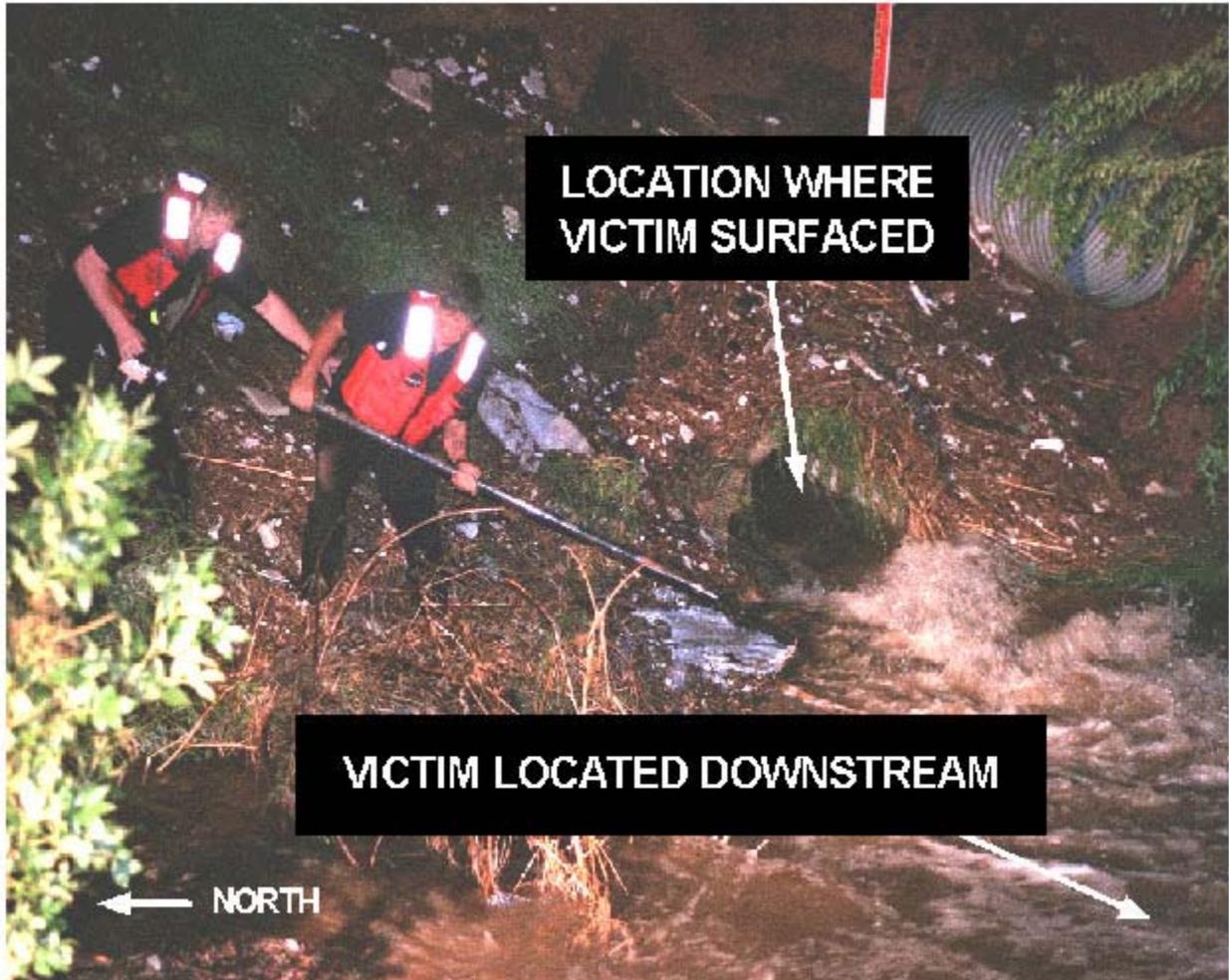


Photo courtesy of the Denver Post: View of drainage pipe where victim was found

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