



City Worker Killed When Struck by a Dump Truck in Washington State

FATALITY INVESTIGATION REPORT



Investigation: # 00WA041
SHARP Report: # 52-11-2004

Release Date: August 5, 2004



WA FACE Program/SHARP
PO Box 44330
Olympia, WA 98504-4330
(888) 667-4277
<http://www.lni.wa.gov/Safety/Research/FACE>

City Worker Killed When Struck by a Dump Truck in Washington State.

Investigation: # 00WA04101

Release Date:

SHARP Report: # 52-11-2004

SUMMARY

On August 8, 2000, a 43-year-old male public works employee died when he was struck and run over by a dump truck that was backing up along a city street that was under construction. A construction superintendent was also struck and seriously injured in the incident. The city worker was working alongside the construction superintendent at the time of the incident. Both were standing in the street running a chalk line, when a dump truck backed down the street and struck them. Within moments 911 was called and both victims were transported to a local medical center. The city worker died while in transit to the medical center.

To prevent similar occurrences in the future, the Washington State Fatality Assessment and Control Evaluation (FACE) investigative team concluded that employers engaged in roadway construction or maintenance should follow these guidelines:

- **Develop and utilize an “Internal Traffic Control Plan” for each road construction project.**
- **Employers should use visual safety devices (i.e., retroreflective barrels, delineators, portable barricades, cones) to channel construction vehicles to separate them from workers in the work zone.**
- **All employees working in road construction work zones should wear high visibility safety apparel such as high visibility vests and hard hats.**
- **Construction work zones and construction vehicle/equipment traffic flow should be designed to avoid backing up vehicles/equipment as much as possible.**
- **Use a spotter to provide direction for trucks and heavy equipment backing up in work zones.**
- **Dump trucks should be equipped with additional visual or sensing devices to cover “blind spots.”**
- **Construction vehicle drivers and key work zone personnel should be equipped with two-way portable radio communication devices to help coordinate construction vehicle activity within the work zone.**
- **Careful consideration should be given to the use of cell phones when working in construction work zones around moving equipment.**

INTRODUCTION

On August 9, 2000, the Washington State FACE Program was notified by the WISHA* (Washington Industrial Safety & Health Act) Services Division of the death of a 43-year-old city public works employee.

The Washington FACE Principle Investigator and the Field Investigator met with the regional WISHA representative who was investigating the case. After reviewing the case with WISHA, the WA FACE team traveled with the WISHA representative to the incident site. The WISHA representative helped locate the site of the incident, define the details of the construction site, and the position of the people and equipment involved in this incident.

The Washington FACE Field Investigator also conducted preliminary phone interviews and then later met with a representative of the city public works department whose employee was involved in this incident. Phone interviews were also conducted with the city human resources/health and safety representative who was not available during the time of the site visit.

The incident site was a road construction work zone where a private company had been contracted by the city to install storm drains and upgrade the sewer line.

The north-south running street was a narrow two-lane asphalt roadway that had moderate to very low traffic flow with very little housing and was mostly bordered by open land. There were no intersecting streets along this road to impact the construction zone.

Because the street was lightly populated it was set up as restricted access for construction and local vehicles only, and was blocked to through traffic with barricades and signage at both ends of the street. On the date of the incident, the project was in its initial phase of setting up and preparing for excavation and laying pipe. There was a combination construction vehicle turn around area and pipe staging area located near the south end of the street (see Figure 1). Pipe was also laid out parallel to the street along the sides of the area to be excavated. A construction worker operating a back-hoe was in the process of excavating a section of the road on the north end of the street. The posted speed limit for this street was 25 mph. The weather that morning was clear, dry and warm and was not considered a factor in the incident.

The two victims, the city worker and the project superintendent, were to meet that morning to review the project's progress and its next phase.

The city employs about 200 people who work in various departments and functions of city government. About 20 of those work in the public works department, including the fatal victim. This department designs, maintains, and administers the construction of city streets and utilities such as water, storm sewers and sanitary sewers.

The public works department supervisor who was interviewed, was not very familiar with the safety processes that the city had in place. The city does not have a full time safety and health

* The OSHA State Plan program in Washington State.

person. The duties for health and safety have been assigned to the Human Resources Manager. The city had a joint management and labor safety committee that met on a quarterly basis. The city also routinely held monthly tail-gate safety meetings within its various departments.

The fatal victim had attended a number of documented safety and health training sessions including training that was specific to highway, road and street construction work zone hazards (e.g., certified flagger training and traffic control safety plan training).

Because the incident resulted in a fatality and a commercial vehicle was involved, the local city police department called in the Washington State Patrol Traffic Investigation Division and the Washington State Patrol Commercial Enforcement unit to help in the incident investigation and review of the truck and driver involved in the incident.

The truck involved was a 1977 Mack 3-axle dump truck. The Washington State Patrol Commercial Vehicle Enforcement officers inspected the dump truck and found it to be in good working condition, including the back up alarm.

The injured construction superintendent stated that he did not remember hearing the back up alarm prior to being struck. The dump truck driver estimated that at the time of the incident he was backing up at between 5 and 10 mph. The dump truck driver was voluntarily taken for a routine drug screening where all findings were negative.

INVESTIGATION

On August 8, 2000, a Tuesday morning, a city public works engineering technician left his office to travel to a work zone construction project. He was to meet with a construction superintendent at the construction site to review activities related to a storm water and sewer upgrade project.

The construction crew at the site consisted of the construction project superintendent (injured victim), a back-hoe operator and two laborers. The city worker arrived at the work zone shortly after 7:00 AM and parked his city truck off to the left side of the road facing north, near the mid-point of the work zone. The city worker got out of his truck and greeted the construction superintendent.

At about the same time, one of the construction company's dump trucks had turned onto the street from the south. The driver was to pick up material being excavated by the back-hoe on the north end of the work zone (See Figure 1).

As the dump truck driver entered the construction work zone he saw the construction superintendent heading in his direction. The driver thought the construction superintendent wanted to talk to him so he pulled into the pipe staging area. The staging area was used to store materials, pipe and equipment for the project.

The truck driver got out of his truck in anticipation of a meeting and getting some instruction from the construction superintendent. The driver then saw the superintendent stop at the city worker's pickup truck. At that point the dump truck driver saw no indication that the superintendent wanted to speak with him.*

As soon as it became apparent that the superintendent did not need to speak with him, the driver got back into his truck and prepared to back down the street, approximately 600 feet, toward the back-hoe located at the north end of the street. As he was backing up the dump truck, the last thing he saw of the victims was that they were standing near the city worker's truck along the side of the road (Photo 1).

After greeting, the superintendent and the city worker stepped into the middle of the street and stopped directly over a storm drain cover (manhole). The superintendent was trying to determine the alignment for a long section of 36" storm drain pipe that would be installed there.

The superintendent enlisted the aid of one of his laborers to help take measurements and define the alignment for the next section of pipe. Both the superintendent and the city worker were facing north with their backs to the dump truck. The superintendent held one end of a string, which was run about 300 to 400 feet toward the north end of the street by the laborer. The superintendent held the string in one hand and a can of marking paint in the other. The city worker was overseeing the process at the request of the superintendent.

The city worker was standing next to the superintendent in the center of the road approximately 150 ft. north of the staging area watching the string alignment process. He was reportedly also talking on the cell phone at that time. Neither the superintendent nor the city worker were wearing high-visibility clothing, vests or hard hats.

At approximately 7:25 AM, the superintendent stated that he was suddenly struck very hard around his mid-back and was knocked to the ground. At the time of impact, the superintendent indicated that he had heard no unusual sound and had no idea what had struck him. He then remembers "being balled-up" and seeing the rear-axles of the dump truck rolling over him. The superintendent was dragged by the dump truck for approximately 25 feet before coming to rest near the front bumper after the truck stopped (Photo 2). As he tried to get up to see what had happened, he saw a laborer coming to assist him. He directed the laborer to check on the city worker. The superintendent noted that the truck driver was extremely distraught and was not able to effectively provide assistance to either victim.

The truck driver picked up the city worker's cell phone from the ground and tried to call for help. He had difficulty in using the cell phone and handed it over to the laborer. The laborer called 911 for assistance. Both the local fire department's EMS and the local police department arrived at the scene within 5 minutes of the call.

The EMS team attended to the two injured workers. The superintendent suffered severe injuries to his back, hands, and left leg. The city worker was more seriously injured. EMS

* No one on the site had two-way radios for communication.

personnel found that the city worker had a weak pulse, was bleeding from the head and mouth and was not responsive.

The city worker died while in transport to a nearby medical facility.

CAUSE OF DEATH

The medical examiner listed the cause of death as cranial and cerebral trauma due to, or as a consequence of a pedestrian/vehicle accident.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Develop and utilize an “Internal Traffic Control Plan” for each road construction project.

Discussion:

The hazards related to construction and public vehicle exposures were greatly reduced in this project, primarily because the following factors: 1) the type of construction activity, 2) the road closure restricting traffic, and 3) the low number of both construction workers and construction vehicles working or traveling through the work site. Even with restricted and low volume of traffic on this quiet city street, one person died and another was seriously injured.

This incident demonstrates the importance of having an “Internal Traffic Control Plan” (ITCP). An internal traffic control plan should be developed prior to any on-site construction activities and revised as needed during the project. The ITCP defines processes and procedures for worker safety within the work zone. The elements of the ITCP should indicate where and how construction equipment, vehicles, and workers on foot interact within the work zone. The ITCP doesn’t have to be a complex document but one that briefly describes work zone activities in relation to safe practices to be used for workers and construction vehicle movement within the work zone. The ITCP should contain a coordinated procedure that defines the communication process for equipment and truck drivers as they travel through the work site including the process for backing up equipment and vehicles. This is especially true in situations when vehicles are traveling through areas of the work zone where workers are on foot.

Other items that should be included in the ITCP are:

- The use of temporary internal traffic control safety devices,
- The use of construction vehicle spotters,
- The use of high visibility clothing, vests, hard hats, and
- A communication plan and safety review with non-construction personnel working within the work zone (i.e., the city worker, local residents etc.).

It is important that the ITCP be clearly understood by all workers. The plan should define the work areas, hazards, and potential emergency situations and hazard prevention methods related to the construction work zone.

Recommendation #2: Employers should use visual safety devices (i.e., retroreflective barrels, delineators, portable barricades, cones) to channel construction vehicles to separate them from workers in the work zone.

Discussion:

Both workers on foot and construction vehicles and equipment are necessary parts of any highway, road or street construction project. The National Institute for Occupational Safety and Health (NIOSH) in their studies¹ indicate that almost half of all work zone fatalities occur inside the work area and involve construction machinery, with the majority of those worker fatalities as the result of dump trucks backing over the workers on foot. Elements of the ITCP should define how to separate workers on foot from construction vehicle traffic while in the work zone. This can be done by using temporary traffic control devices such as retroreflective portable barrels, cones, and portable lightweight fold up barricades.

Although these temporary devices are not as effective as positive protective barriers (i.e., concrete barriers/jersey barriers) they are more practical for short duration worker exposures and can be quickly set up and taken down when the short duration job is completed.

Please note, the use of any traffic control safety devices should meet Washington State Dept. of Transportation, WISHA, County and Municipality and Manual on Uniform Traffic Control Devices (MUTCD) guidelines. The employer should also review the use of these devices with the manufacturer for appropriate application in and around highway and roadwork zones.

Recommendation #3: All employees working in road construction work zones should wear high visibility safety apparel such as high visibility vests and hard hats.

Discussion:

Neither the superintendent nor the city worker in this incident was wearing high visibility clothing, vests or hard hats. It is extremely important for workers to wear highly visible clothing and other highly visible safety equipment such as vests and hard hats when they are working in a construction work zone. Making workers more visible to construction vehicles operating in the work zone is an important part of helping reduce injuries and fatalities within the work zone. At a minimum, it is suggested that all workers wear at least ANSI /ISEA¹ 107-1999 class 2 retroreflective vests and a highly visible hard hats.

¹ American National Standards Institute/International Safety Equipment Association

Recommendation #4: Construction work zones and construction vehicle/equipment traffic flow should be designed to avoid backing up vehicles/equipment as much as possible.

Discussion:

A high number of fatalities and serious injuries (as reported by NIOSH¹) occur when construction vehicles (especially dump trucks) are backing up within the work zone and strike workers.

Truck drivers and construction vehicle drivers should avoid backing up in a construction zone. This is especially true when there is no spotter available or the construction site isn't designed to provide a controlled or channelized area for backing up. The work zone and its related tasks and procedures should be designed to avoid vehicles driving in reverse while entering, exiting, and driving through the work zone.

The typical construction equipment and vehicle mirrors do not give the driver the whole picture behind them. Blind spots still exist. Conditions and the location of personnel can change very quickly within the work zone and not anticipating those changes can result in serious consequences, as it did in this incident. A lot can happen in just a few seconds. The driver last saw the victims standing near the city worker's truck along the side of the road and then just moments later they were struck by the backing dump truck.

The FACE investigation showed that the truck did not have to back up from the staging area but could have driven closer to the back-hoe, made a turn and positioned the dump truck near the back-hoe without backing up through the entire work zone.

Recommendation #5: Use a spotter to provide direction for trucks and heavy equipment backing up in work zones.

Discussion:

A good option to better manage trucks and other construction equipment that need to back up within the work zone, is to use a spotter. A spotter can help the truck driver and/or equipment operator safely maneuver in, out of, and through the work zone. The spotter provides the "vision" that the driver does not have when backing up and helps reduce their "blind spots."

A spotter, with proper precautions for their own personal safety, can help the construction vehicle driver maneuver through the obstacles and changing conditions of a work zone, as well as help the driver to be alert for non-construction pedestrian and vehicle traffic traveling through the work zone.

When using a spotter, it is of the utmost importance that the safety of this worker be taken into account. The spotter needs to be trained and educated in the duties of a spotter, including identifying the hazards and hazard control methods while performing those duties. The spotter needs to wear a distinctive and highly visible safety vest (ANSI/107-1999 Class 2 minimum). The spotter needs to be out of vehicle traffic lanes and out of the direct path of the moving/backing construction vehicle's movement. If the spotter is not visible to the truck driver, then the driver should stop until positive visual contact with the spotter has been made. The driver should not move the vehicle unless they get an all clear sign from the spotter.

The superintendent or one of the laborers could have acted as a spotter for the dump truck driver in this incident. A flagger should not act as a spotter, as this would take them away from their primary traffic control duties.

Recommendation #6: Dump trucks should be equipped with additional visual or sensing devices to cover "blind spots."

Discussion:

There are a variety of vision enhancement and/or object and people detection systems that can be used to help drivers when they are backing up their vehicles in work zones. Some of this equipment uses radar, sonar and ultrasonic devices. Rear vision video cameras are also available that can provide the driver with a clear view of what is behind him or her. Many of these camera systems are currently in use in both construction and non-construction applications.² NIOSH is also currently evaluating a number of these systems.³

Currently many commercial and personal vehicles are equipped with object proximity sensors that sound an alarm, and in some cases have visual indicators for the driver, when an object or person is near the rear of a backing vehicle. The Forewarn Back-up Aid⁴ is a radar-based obstacle detection-system that couples ultrasonic sensors with a single-beam radar sensor in the rear bumper. This combination offers the longest rear-sensing detection range currently available - up to 16.4 feet (5 meters). The large detection area extends Back-up Aid's useful speed range-from parking speeds (generally less than 2 mph) to normal reverse speeds (about 7 mph).

It is recommended that when new trucks and equipment are purchased, visual and/or object sensing devices should be purchased as well. These sensing devices can also be installed on older trucks and equipment.

Recommendation #7: Construction vehicle drivers and key work zone personnel should be equipped with two-way portable radio communication devices to help coordinate construction vehicle activity within the work zone.

Discussion:

In an active and changing road construction work zone, effective communication is an important element for the safe completion of the project. It is recommended that the project

supervisors/superintendents and the construction vehicle drivers and other key personnel be equipped with two-way radios. The radios can be used to not only provide for the exchange of important project information, but they can also be used to send and receive warnings of hazards.

In this instance the truck driver could have contacted the superintendent and asked if he wanted to talk with him. If not, the driver could have told the superintendent to stand clear as he was backing down the road or he could have asked for someone to act as a spotter as he backed down the road. The superintendent also could have called the dump truck driver to let him know that he and others would be working in the middle of the road marking a section of the storm sewer and to not back down the road until they were done.

The ability to communicate effectively should be a standard part of a work zone operating safety plan. Both construction vehicle and equipment drivers need to be able to communicate with workers on foot so that both parties can safely interact with each other in a busy work zone. Two-way radios can help provide greater control of this activity and can help provide quick and clear instruction to both the workers and drivers during routine production activities and in hazard or emergency situations.

Recommendation #8: Careful consideration should be given to the use of cell phones when working in construction work zones around moving equipment.

Discussion:

Serious safety issues have been identified with the use of cell phones while driving. According to the National Highway Traffic Administration (NHTSA)⁵ “driver distraction” is a contributing factor in at least 20-30 % of all motor vehicle collisions.

A recent study by the University of Utah⁶ claims that cell phone use while driving, significantly interferes with drivers’ attention to their surroundings. They have labeled this phenomenon “inattention blindness,” where the focus of the driver’s attention is on making a phone call or having a phone conversation and not on driving tasks. They indicate that the phone conversations turn attention away from the “external environment.”

It was noted in the investigation of this incident that, the city worker was talking on his cell phone at the time of the incident. Both victims were also standing in the middle of the road facing away from the on-coming dump truck.

It is possible that the victim was distracted by talking on, or dialing his cell phone and may have been subject to “inattention blindness” similar to motorists while on the cell phone and thus not aware of the “external environment” of the work zone hazards. The superintendent, who the victim was standing next to, may have also been distracted by his task. It is recommended that cell phone use guidelines be established for use by those who may be at risk from hazards (i.e., construction vehicle and equipment traffic) while within the work zones. The guidelines should not only define where the cell phone should not be used, but also define appropriate areas where their use would be safe within the work zone.

ACKNOWLEDGEMENTS

In conducting this work zone fatality investigation, the Washington State FACE investigation team requested that the contents of this report be reviewed by key representatives from the labor and business communities involved and Washington State and Federal worker safety agencies, prior to its publication.

Though we are not able to acknowledge specific individuals for their invaluable input into this document, we would like to recognize the following for their help and support to the FACE process:

- The Employer involved in the incident
- WISHA enforcement
- WISHA Policy & Technical Services staff
- Federal Face Program Management (NIOSH)
- Safety & Health Assessment & Research for Prevention (SHARP)
- WA and Northern Idaho District Council of Laborers
- Seattle Public Utilities
- Washington State Attorney Generals Office

APPENDIX

Backup Alarms

One issue not discussed in this report was backup alarms. These are generally standard equipment on most construction vehicles. However, the ITCP should include procedures for verifying that all trucks and equipment within the work zone have audible backup alarms and that they are functioning correctly. The alarms must also be loud enough to be heard above the construction and environmental noise at least 15 feet from the back of the vehicle. A guideline is that an alarm should be 10 decibels louder than the background noise. This is an important consideration, as intermittent noise such as the operation of machinery could significantly raise the background noise level and negate the utility of a backup alarm.

A potential problem with backup alarms is “habituation,” or becoming too accustomed to the alarm, resulting in less attention to the signal. A method of counteracting this could be to investigate options for altering the backup alarm sound frequency or presentation to reduce the effect of habituation. Care should be taken, however, to make sure that the alarm is still quickly recognized as a backup alarm if changes to the standard “beeping” signal are made.

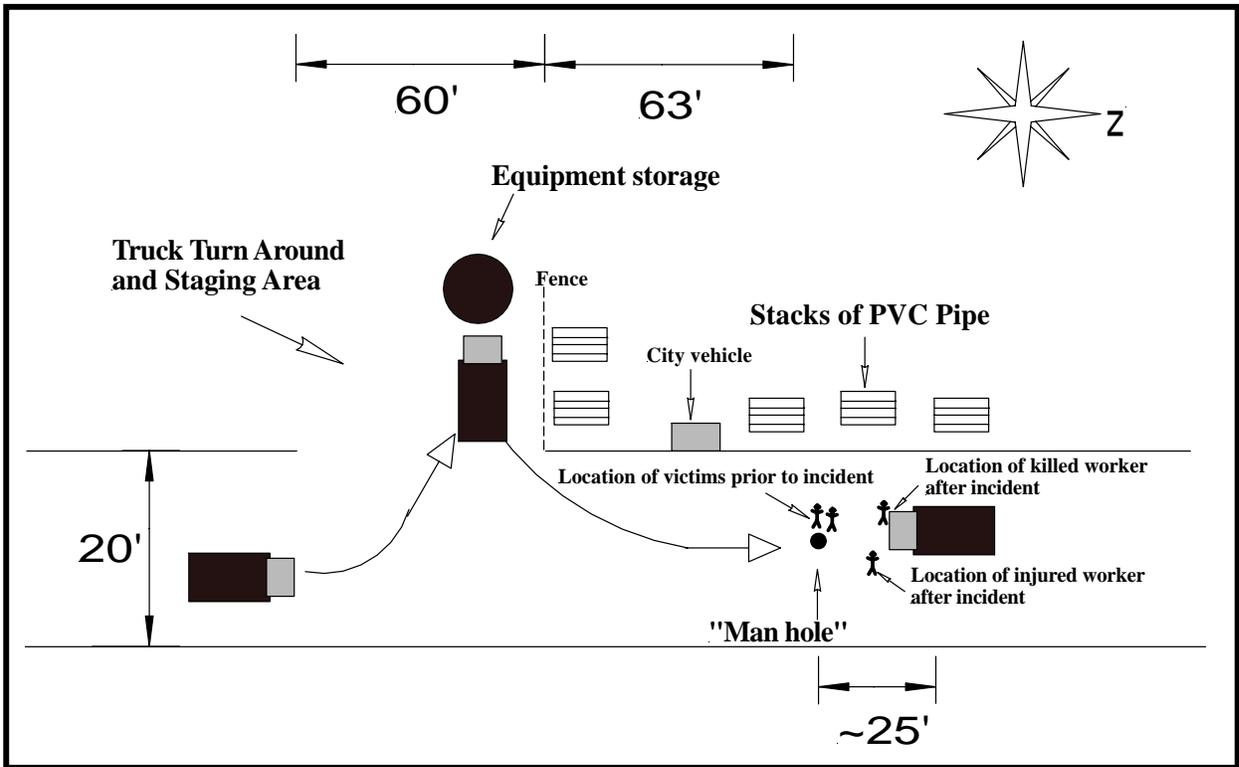


Figure 1 Layout of work zone.

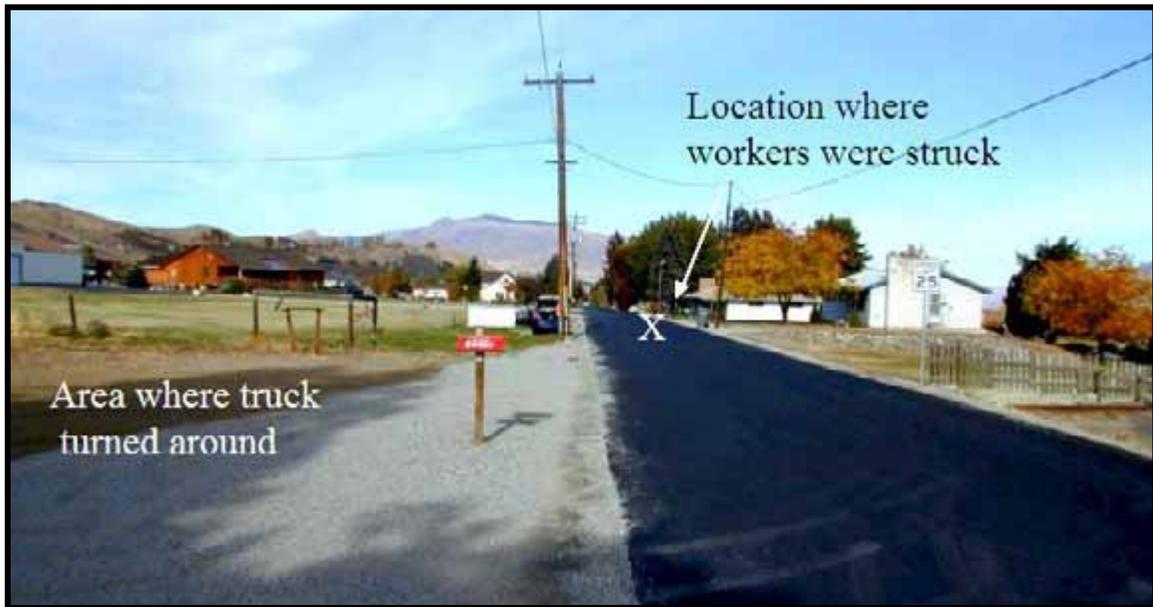


Photo 1 Incident site after completion of the job.



Photo 2 Incident site and dump truck.

REFERENCES

- ¹ Pratt, Stephanie G., Fosbroke, David E., Marsh, Suzanne M. Building Safer Highway Work Zones: Measures to Prevent Worker Injuries From Vehicles and Equipment. Cincinnati, OH. National Institute for Occupational Safety and Health, April 2001.
- ² Trout, Nada D., Ullman, Gerald L., *Devices and Technology to Improve Flagger/Worker Safety/Research Report 2963-1F*. College Station Texas: The Texas Transportation Institute, The Texas A&M University, Texas Department of Transportation. 1997.
- ³ “Selection of Systems to Monitor Blind Areas Behind Sanding Trucks”, National Institute for Occupational Safety and Health, Spokane Research Laboratory, Prepared for the Washington State Department of Transportation by Todd M. Ruff, October 30, 2000.
- ⁴ Delphi Corporation’s Safety Warning System. www.delphi.com/products/auto/safety/warning/
- ⁵ Royal, D. *National Survey of Distracted and Drowsy Driving Attitudes and Behaviors: 2002 / Volume 1 – Findings Report*. The Gallup Organization. Submitted to National Highway Traffic Safety Administration. March 2003.
- ⁶ Strayer, David L., Drews, Frank A., and Johnston, William A. “Cell Phone-Induced Failures of Visual Attention During Simulated Driving.” *Journal of Experimental Psychology: Applied*, Volume 9, Number 1, March 2003.

BIBLIOGRAPHY

- 1) Safety Standards for General Safety and Health, Chapter 296-24 WAC, State of Washington, Department of Labor and Industries.
- 2) Safety Standards for Safety Standards for Construction Work, Chapter 296-155 WAC, State of Washington, Department of Labor and Industries.
- 3) Employee Protection in Public Work Areas, Chapter 296- 45-52530 WAC, State of Washington, Department of Labor and Industries.
- 4) *Part VI Manual on Uniform Traffic Control Devices (MUTCD), Part VI Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations*. 1988 Edition of MUTCD, Revision 3, September 1993 U.S Department of Transportation, Federal Highway Administration.
- 5) *Work Zone Traffic Control Guidelines*. M54-44, Washington State Department of Transportation, Field Operations Support Center, May 2000.
- 6) Trout, Nada D., Ullman, Gerald L., *Devices and Technology to Improve Flagger/Worker Safety/Research Report 2963-1F*. College Station Texas: The Texas Transportation Institute, The Texas A&M University, Texas Department of Transportation. 1997.
- 7) Graham, Jerry L., Hinch, John, Stout, Dale, Lerner, Neil, *Maintenance Work Zone Safety*. Washington, DC: National Research Council, Strategic Highway Research Program, 1990.
- 8) *Highway Work Zone Safety*. Washington State Department of Transportation, January 1994.
- 9) Recarte, Miguel. Nunes, Luis M. “Mental Workload While Driving: Effects on Visual Search, Discrimination, and Decision Making,” *Journal of Experimental Psychology: Applied*, Volume 9, Number 2, June 2003.