

UNITED STATES  
DEPARTMENT OF LABOR  
MINE SAFETY AND HEALTH ADMINISTRATION  
Metal and Nonmetal Mine Safety and Health

REPORT OF INVESTIGATION

Surface Nonmetal Mine  
(Sand and Gravel)

Fatal Falling, Rolling or Sliding Rock/Material Accident  
June 30, 2015

P. A. Landers Inc.  
CEC #4  
Plymouth, Plymouth County, Massachusetts  
Mine I.D. No. 19-01128

Investigators

Thomas J. Shilling  
Mine Safety and Health Inspector

Arthur D. Wall  
Mine Safety and Health Inspector

Eric J. Gottheld  
Senior Civil Engineer

Denis G. Rickey  
Mine Safety and Health Specialist (Training)

Originating Office  
Mine Safety and Health Administration  
Northeast District  
178 Thorn Hill Rd., Suite 100  
Warrendale, PA 15086-7573  
Kevin H. Abel, Acting Northeast District Manager



## OVERVIEW

On June 30, 2015, Charles E. Pace, equipment operator, age 65, was killed while operating a front-end loader at the base of a sand bank. Pace was trapped in the operator's cab when a portion of the bank collapsed and engulfed the front-end loader.

The accident occurred due to mine management's failure to utilize previously established mining methods to maintain wall, bank, and slope stability in the area. The victim was extracting material from the base of a 128 feet high bank that was not sloped to a safe angle. In addition, management failed to adequately examine the mining area prior to commencing work and periodically throughout the shift as changing ground conditions warranted.

## GENERAL INFORMATION

CEC #4 (also referred to as Pit 46), a surface sand and gravel operation owned and operated by P. A. Landers Incorporated, is located in Plymouth, Plymouth County, Massachusetts. The principal operating official was Preston A. Landers, Owner. The mine operates one eight hour shift per day, five days a week. Three miners are employed at CEC #4.

Sand and gravel is mined using a front-end loader to extract material from the base of a sand bank and feed a portable screening plant. The material is screened, sized, and sold for use in the construction industry.

The Mine Safety and Health Administration (MSHA) completed the last regular inspection of this operation on June 18, 2015.

## DESCRIPTION OF ACCIDENT

On the day of the accident, Charles E. Pace (victim) reported for work at his normal start time of 6:00 a.m. He waited at the mine access gate for Peter C. Johnson, Equipment Operator, who arrived at about 6:15 a.m. and unlocked the gate. Afterward, Pace proceeded to the pit and prepared the screening plant for production. Johnson unlocked the scale house and then traveled the roadways, examining the site and looking for evidence of trespassers. Johnson then went to the mobile equipment parking area and began check-out and start-up of equipment to be used during the shift. When Johnson traveled to the screening plant, Pace was completing his daily maintenance activities. At that time, Johnson began loading customer trucks and Pace began feeding the screening plant with material extracted from the sand bank.

About 10:15 a.m., Pace and Johnson took a break since there were no customer trucks in the pit. At 10:35 a.m., Johnson returned to loading customer trucks and Pace returned to feeding the plant. At approximately 10:45 a.m., Johnson drove around the plant to move material from the oversize stacker conveyor and observed Pace's front-end loader partially buried at the bottom of the sand bank. Pace's front-end loader was still running with its lights on and the backup alarm sounding. Johnson immediately radioed Anna Pesonen, Scale House Clerk, and asked her to call 9-1-1 for emergency assistance. Johnson then used his front-end loader to dig along the left side of Pace's machine in an attempt to free it from the fallen material. Pesonen called 9-1-1 and remained on the line with the dispatcher until she heard the sirens from the rescue vehicles arriving onsite.

Christopher D. O'Neil, truck driver, was leaving the pit after being loaded and heard Johnson's radio request to call 9-1-1. O'Neil turned his truck around and returned to the pit. At that time, Johnson was still removing sand from the left side of Pace's front-end loader. After exiting his truck, O'Neill ran to the right side of Pace's front-end loader and began digging by hand until he was able to force the right side window open. Then, he began to dig sand from inside of the cab.

Joseph M. Southwell, truck driver, had driven to the site to be loaded when he observed the activity around Pace's front-end loader. Southwell exited his truck and ran to a nearby mini-excavator and trammed it into position along the right rear side of Pace's machine to assist O'Neil. Johnson asked Southwell to leave the excavator and go get a bulldozer.

Arnold J. Werra, truck driver, had his truck on the scale when Pesonen informed him of the accident and asked him to take her van to the pit to assist. Werra obliged and brought shovels with him to Pace's front-end loader. He helped to dig sand until the local fire department arrived and then he left the mine.

Stephen Nava, truck driver, was traveling to the scale house with a loaded truck when he heard the radio calls for help. He waited for the emergency service vehicles to arrive and then escorted them to the scene. After helping them to unload their equipment, Nava drove Southwell to the bulldozer.

At approximately 11:00 a.m., the rescue squad took charge of the scene. At that time, Pace was unresponsive and had no vital signs. An attempt was made to pull Pace's front-end loader out of the sand bank using a tow chain and Johnson's front-end loader; however, it failed when the tow chain broke. Then, Johnson's front-end loader and Southwell's bulldozer were moved into place along the left side of Pace's front-end loader to shore up the embankment and provide protection for the recovery personnel. At approximately 3:00 p.m., after cutting away the rear window and using a vacuum truck to extract material from inside of the cab, Pace was removed from the machine. The cause of death was attributed to compressional asphyxiation.

## **INVESTIGATION OF THE ACCIDENT**

MSHA was notified of the accident at 11:14 a.m. on June 30, 2015, by a telephone call from Robert Haggerty, Safety Director, to the Department of Labor's National Contact Center (DOLNCC). The DOLNCC notified Kevin H. Abel, Assistant District Manager, and an investigation was started the same day. An order was issued under provisions of Section 103(j) of the Mine Act. This order was later modified to Section 103(k) of the Mine Act after the arrival of an Authorized Representative at the mine site.

MSHA's accident investigation team traveled to the mine and conducted a physical inspection of the accident scene, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, employees, and State and Local law enforcement.

## **DISCUSSION**

### **Location of the Accident**

The accident occurred in the northwestern section of the mine property, which was phase 4 of the mining cycle. Phases 1 through 3 had been mined, reclaimed, and revegetated. There were two entrances to Pit 46 located near the southwest corner of

the property. An access road crossed a dike between two cranberry bogs and entered the working area from the east. The top of the pit slope was situated about 500 feet north of the access road (also referred to as a bog road) and near the northern boundary of phase 4. The bottom of the slope was less than 400 feet from the access road. The pit bottom dipped, less than 3 percent, toward the face of the slope.

The work area included an excavation into the sand bank, the portable screening plant and stacker conveyor area, and the stockpile and loadout areas. The excavation into the sand bank was v-shaped with an entrance about 120 feet wide near the toe of the reclaimed slope and narrowing to the north. At about 120 feet into the v-shaped excavation, the pit was about 35 feet wide. The v-shaped excavation was approximately 170 feet deep from the entrance. About a month prior to the accident, the excavation was about 130 feet deep from the entrance.

At the time of the accident, the victim was operating a front-end loader on the pit bottom, excavating material from the base of the sand bank. The front-end loader was facing north and was reportedly backing up when the failure occurred. The failure occurred near the top of the slope in the northwest corner of the excavation (see Figure 1). The failed material slid in a southeasterly direction and covered the loader. Sand and gravel broke through the windshield and engulfed the victim.

At the north end of the excavation, the slope was about 120 feet high and had an overall inclination of about 41 degrees from horizontal. However, the upper 80 feet was steeper than 44 degrees and the top 15 feet of the slope had an inclination of about 58 degrees from horizontal (see Figure 2).

Post-failure measurements determined that the slope in the northwest corner was about 128 feet high and had an overall inclination of about 40 degrees from horizontal. The top 45 feet of the failed slope had an average inclination of about 48 degrees and the top 21 feet had an inclination of about 55 degrees from horizontal.

### **Material Description**

The material being mined was sand and gravel. The gravel was rounded and the sand appeared to be predominantly fine grained. The in situ material was dense, moist, and light brown in color. Dense, moist sand can exhibit an apparent cohesion due to surface tension and negative capillary pore water pressure. This strength is moisture sensitive and transitory. Dry sand and saturated sand will lose all apparent cohesion. The sand and gravel at Pit 46 appeared to exhibit these qualities. At its natural moisture, this material had an apparent cohesion, which was moisture sensitive. As this material was exposed to the air and sun, it lost some of its natural moisture, lost its cohesive strength, and sloughed off. As the sand dried, its color changed to light tan. The dry, loose sand and gravel had an angle of repose of about 33 degrees. The sloughed material piled at the bottom of the bank and was mined.

## **Equipment and Mining Practice**

The mining practice employed in this pit used two rubber-tired front-end loaders (Caterpillar 980G and Caterpillar 972M), a track-mounted bulldozer (Caterpillar D8R), and an off-road haul truck. A portable screening plant (Roadrunner CEC) and stacker conveyor (80-foot Anaconda) were used to segregate and stow the sand and gravel. At the time of the accident, the victim was operating the Caterpillar 972M front-end loader.

The company did not have a specific mining plan; however, mining had most recently started in the phase 4 area and had been advancing in a northerly direction. In general, the mining method employed during phase 4 consisted of excavating material from the base of the slope using a front-end loader. Joseph Southwell indicated that failures did occur and that the failures (sloughing) usually occurred when the natural material dried, which could be during the day or overnight. Reportedly, a front-end loader would excavate the loose material that had fallen from the sand bank. When all the loose material was removed, the operator would excavate into the undisturbed sand bank and move along the base until more material fell to the bottom. The front-end loader excavating the sand bank loaded the raw material into the screen. The sand was stockpiled using a stacker conveyor directly from the screen plant. The gravel was piled near the plant. A second equipment operator used a front-end loader to move the gravel portion to separate stockpiles and loaded customer trucks from the sand and gravel stockpiles.

## **Engineering Evaluation**

At its natural moisture, this material has an apparent cohesion, which is moisture sensitive. As the material is exposed to the air and sun it loses some of its natural moisture, loses its cohesive strength and sloughs off. The material being mined was mostly sand with an angle of repose of about 33 degrees. However, the slope in natural material above the loose material was steeper than 33 degrees. The average inclination of the slope in natural material was 48 degrees or more and the slopes near the top of the bank were measured to be up to 58 degrees from horizontal.

Mining from the bottom of the slope relies upon material sliding to the pit bottom as the front-end loader removes material from the toe. In this practice a relatively controlled shallow failure is induced by oversteepening the slope through removal of material from the toe. A hazardous condition can develop when the material does not fail and slide shortly after excavation at the toe and the slope becomes oversteepened by the mining process. Due to the apparent cohesion of the sandy material, slopes steeper than the angle of repose can stand for a period of time, but may fail suddenly. With increasing height and oversteepening of the slope there is a decrease in stability and an increase in the volume of material that can potentially fail, both of which increase the hazard. It is a good practice to move to flatter sloping areas when a significant portion of the slope becomes oversteepened.

In some cases, removal of loose drier material from the bottom would induce failures that expose moist material that is oversteepened near the top of the slope. In this case, the hazard also increases with the total height above the pit bottom, due to an increase

in the potential energy of the falling material, and the height of the oversteepened portion above the loose material, which increases the potential volume. Removal of the flatter sloping material from the toe exposes more of the oversteepened slope above, subjecting the bank to larger failures, and also moves the front-end loader closer to the oversteepened slope. At Pit 46, it was primarily the natural material that was moist and would stand oversteepened.

### **Weather**

On the day of the accident, weather conditions were clear with temperatures in the low 80's. Average wind speed was 3 mph with gusts up to 20 mph. On Sunday, June 28, 2015, two days before the accident, the recorded total rainfall for the area was 0.84 inches. On the previous Sunday, the area had 0.81 inches of rainfall. The investigators determined that the resultant wet conditions present at Pit 46, due to previous rainfall in the area, likely contributed to triggering the failure.

### **Seismicity**

The United State Geological Survey website had no record of an earthquake greater than a magnitude M1.5 within 50 miles of the site during the month of June 2015. The investigators concluded that the failure was not triggered by an earthquake.

### **Summary**

The operator was relying upon the process of natural and excavation induced failures to feed material to the pit bottom. However, prolonged excavation at the toe of the sand bank created an oversteepened slope above the front-end loader. The height of the oversteepened slope above the pit bottom was also excessive and unsafe to work below. The great height of the sand bank contributed to the instability, and worsened the hazard by increasing the potential volume of material that could fail and the energy it had in falling. Rainfall likely contributed to the instability and triggered the failure event by increasing the weight of the material. The additional moisture infiltrating the natural material may have also contributed by reducing the apparent cohesion. The excavation into the toe of the slope was also a triggering event for the failure.

The active pit area was about 170 feet long and about 120 feet wide at its open end, which narrowed to about 35 feet wide near the back end of the front-end loader. This pit configuration created a relatively narrow work space with pit slopes on three sides of the front-end loader. The narrow pit dimensions exacerbated the consequences of the failure by reducing the area that falling material had to fill and exposing the front-end loader operator to additional oversteepened sand bank slopes.

Although the mine operator had used bulldozers in the past to push the bank material down to a flatter slope, this mining practice had not been employed during this phase of mining.

## TRAINING AND EXPERIENCE

Charles E. Pace had 19 years and 8 weeks of mining experience as an equipment operator, including 11 years and 8 weeks at this mine. A representative of MSHA's Educational Field and Small Mines Services reviewed the mine operator's Part 46 training records for Pace. The reviewer concluded that Pace had received all required training; however, the task training provided was not documented as required. A noncontributory citation was issued during an E16 Spot Inspection for this violation.

## ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following root causes were identified.

**Root Cause:** Management failed to utilize previously established mining methods to maintain wall, bank, and slope stability in the area. The mine operator had used bulldozers in the past to push the bank material down to a flatter slope; however, this mining practice had not been employed during this phase of mining. The victim was extracting material from the base of a 128 feet high bank that was not sloped to a safe angle.

**Corrective Action:** Management established and implemented new policies and procedures to reclaim the existing phase 4 excavation (accident area). In addition, new policies and procedures were made to address future excavations at the mine. These new policies and procedures utilize bulldozers to push material down the slope toward the face of the excavation while maintaining a uniform slope gradient of 2.5:1 to 3:1. Future excavations will have a minimum working width of 300 feet, sloped on all three sides. The slope gradients will be monitored on a daily basis. Material pushed down the slope will be windrowed or stockpiled and will be loaded and transported to the screening plant. All mobile equipment operators were trained in these new policies and procedures.

**Root Cause:** Management failed to adequately examine the mining area prior to commencing work and periodically throughout the shift as changing ground conditions warranted.

**Corrective Action:** Management established and implemented an examination plan for the mining area and designated an exam coordinator, responsible for ensuring adequate examinations and monitoring slope gradients. Examinations of the face of the slope and side slopes will be conducted each day prior to the start of excavation and as weather conditions dictate, particularly during and after precipitation events. The slope surfaces will be evaluated for bulging, cuts, seepage, and cracking. Any adverse conditions found will be corrected prior to the commencement of mining in the area. Mining will also cease at any time during the shift when adverse conditions are encountered until they can be evaluated and addressed. All mobile equipment operators were trained by the exam coordinator in the new examination plan relative to identifying adverse ground conditions, changing slope conditions, and remedial actions.

## CONCLUSION

The accident occurred due to mine management's failure to establish mining methods to maintain wall, bank, and slope stability in the area. The victim was extracting material from the base of a 128 feet high bank that was not sloped to a safe angle. In addition, management failed to adequately examine the mining area prior to commencing work and periodically throughout the shift as changing ground conditions warranted.

## ENFORCEMENT ACTIONS

**Order No. 8917725** - Issued on June 30, 2015, under the provisions of Section 103(j) of the Mine Act. An Authorized Representative modified this order to Section 103(k) of the Mine Act upon arrival at the mine site:

*An accident occurred at this operation on June 30, 2015 at approximately 1100 hours. This order is being issued under section 103(j) of the Federal Mine Safety and Health Act of 1977, to prevent destruction of any evidence which would assist in investigating the cause or causes of the accident. It prohibits all activity the pit where the accident occurred until MSHA deems that it is safe to resume normal mining operations in this area. This order was initially issued orally to the mine operator at 1146 hours and has now been reduced to writing.*

*The initial order is modified to reflect that MSHA is now proceeding under the authority of section 103(k) of the Federal Mine Safety and Health Act of 1977. This section 103(k) order is intended to protect the safety of all persons including those involved in rescue and recovery operations or investigation of the accident. The mine operator shall obtain prior approval from an Authorized Representative of the Secretary for all actions to recover and or restore operations in the affected area. Additionally, the mine operator is reminded of its existing obligation to prevent the destruction of evidence that would help in investigating the cause or causes of the accident.*

The order was inadvertently terminated on July 7, 2015.

**Order No. 8807990** – Issued on July 7, 2015, under the provisions of Section 103(k) of the Mine Act:

*A fatal accident occurred at this operation on June 30, 2015, at approximately 1100 hours. This Order is issued to assure the safety of all persons. The Mine Operator shall obtain prior approval from an Authorized Representative of the Secretary for all actions to recover and or restore operations in the affected area. Note: This order replaces order No. 8917725 which was terminated in error.*

The order was terminated on August 14, 2015, when conditions that contributed to the accident no longer existed.

**Citation No. 8917382** - Issued under the provisions of 104(d)(1) of the Mine Act for violation of 30 CFR § 56.3130 – Wall, bank, and slope stability:

*On June 30, 2015, a fatal accident occurred at this mine when a miner was removing material from the bottom of an approximately 128-foot high sand bank with a front-end loader. The bank failed engulfing the front-end loader, resulting in fatal injuries to the victim inside of the operator's cab. The mine operator had used bulldozers in the past to push the material down to a flatter slope, but this mining practice was not employed during this phase of mining. Management engaged in aggravated conduct constituting more than ordinary negligence by changing a previously established mining method that maintained wall, bank, and slope stability in this excavation where miners worked or traveled to perform their assigned tasks. The new mining method adopted by the mine operator did not maintain wall, bank, and slope stability in the excavation where the victim was working. This violation is an unwarrantable failure to comply with a mandatory standard.*

**Order No. 8917383** - Issued under the provisions of 104(d)(1) of the Mine Act for violation of 30 CFR § 56.3401 – Examination of ground conditions:

*On June 30, 2015, a fatal accident occurred at this mine when a miner was removing material from the bottom of an approximately 128-foot high sand bank with a front-end loader. The bank failed engulfing the front-end loader, resulting in fatal injuries to the victim inside of the operator's cab. Management engaged in aggravated conduct constituting more than ordinary negligence by not ensuring that examinations were conducted of ground conditions areas where work is to be performed as changing ground conditions warranted. The sand bank walls in the Phase 4 excavation had become steepened as material was being loaded out reducing their stability. The person conducting the examination stated he did so from a distance of over 900 feet away as he drives along the quarry roadways. This violation is an unwarrantable failure to comply with a mandatory standard.*

Approved: K. H. Abel  
Kevin H. Abel  
Acting District Manager

Date: Oct. 13 2015

## **LIST OF APPENDICES**

Appendix A: Persons Participating in the Investigation

Appendix B: Victim Information

Appendix C: Accident Scene Schematics and Photos (Figure 1 and Figure 2)

## APPENDIX A

### PERSONS PARTICIPATING IN THE INVESTIGATION

#### P. A. Landers Inc.

Preston A. Landers	Owner
Robert A. Haggerty Jr.	Safety Director
Charles D. Merritt III	Plant Supervisor
Peter C. Johnson	Equipment Operator
Anna Pesonen	Scale House Clerk
Christopher D. O'Neil	Truck Driver
Joseph M. Southwell	Truck Driver
Arnold J. Werra	Truck Driver

#### Jackson Kelly

Patrick W. Dennison	Attorney, Council for P. A. Landers Inc.
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#### Fred E. Nava & Son, Inc.

Stephen F. Nava	Truck Driver
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#### Massachusetts Department of Public Safety

Brian E. Logan	Supervisor, District Engineering Inspector
Patrick T. J. Kane	District Engineering Inspector

#### Mine Safety and Health Administration

Thomas J. Shilling	Mine Safety & Health Inspector
Arthur D. Wall	Mine Safety & Health Inspector
Eric J. Gottheld	Sr. Civil Engineer
Denis G. Rickey	Mine Safety & Health Specialist (Training)

# APPENDIX B

## VICTIM INFORMATION

Accident Investigation Data - Victim Information

**U.S. Department of Labor**  
Mine Safety and Health Administration



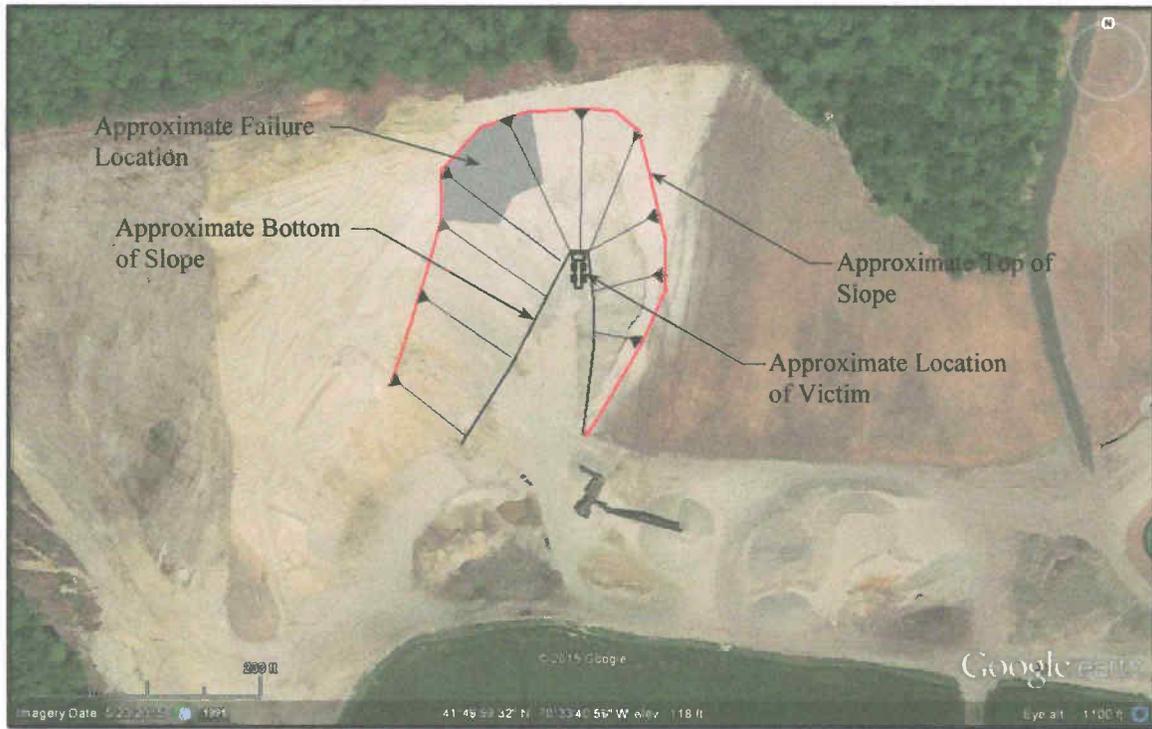
Event Number:

Victim Information:

1. Name of Injured/III Employee: <i>Charles E Pace</i>			2. Sex: <i>M</i>		3. Victim's Age: <i>65</i>		4. Degree of Injury: <i>01 Fatal</i>										
5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: <i>a Date: 06/30/2015 b Time: 11:00</i>					6. Date and Time Started: <i>a Date: 06/30/2015 b Time: 10:56</i>												
7. Regular Job Title: <i>082 Front end loader operator</i>				8. Work Activity when injured: <i>053 Operating a front end loader</i>				9. Was this work activity part of regular job? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>									
10. Experience			b. Regular			c. This			d. Total								
a. This			Job Title:			Mine:			Mining:								
Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days						
<i>11</i>	<i>18</i>	<i>1</i>	<i>11</i>	<i>18</i>	<i>1</i>	<i>11</i>	<i>18</i>	<i>1</i>	<i>19</i>	<i>8</i>	<i>0</i>						
11. What Directly Inflicted Injury or Illness? <i>093 falling sand</i>						12. Nature of Injury or Illness: <i>110 asphyxia</i>											
13. Training Deficiencies:																	
Hazard:			New/Newly-Employed			Experienced Miner:			Annual:			Task:					
14. Company of Employment: (If different from production operator) <i>Operator</i>						Independent Contractor ID: (if applicable)											
15. On-site Emergency Medical Treatment:																	
Not Applicable: <input checked="" type="checkbox"/>			First-Aid: <input type="checkbox"/>			CPR: <input type="checkbox"/>			EMT: <input type="checkbox"/>			Medical Professional: <input type="checkbox"/>			None: <input type="checkbox"/>		
16. Part 50 Document Control Number: (form 7000-1)						17. Union Affiliation of Victim: <i>9999</i>						None (No Union Affiliation)					

## APPENDIX C

### ACCIDENT SCENE SCHEMATICS AND PHOTOS



**Figure 1 - Plan view sketch of Pit 46 mining area (a portion of Phase 4)**

# APPENDIX C

## ACCIDENT SCENE SCHEMATICS AND PHOTOS

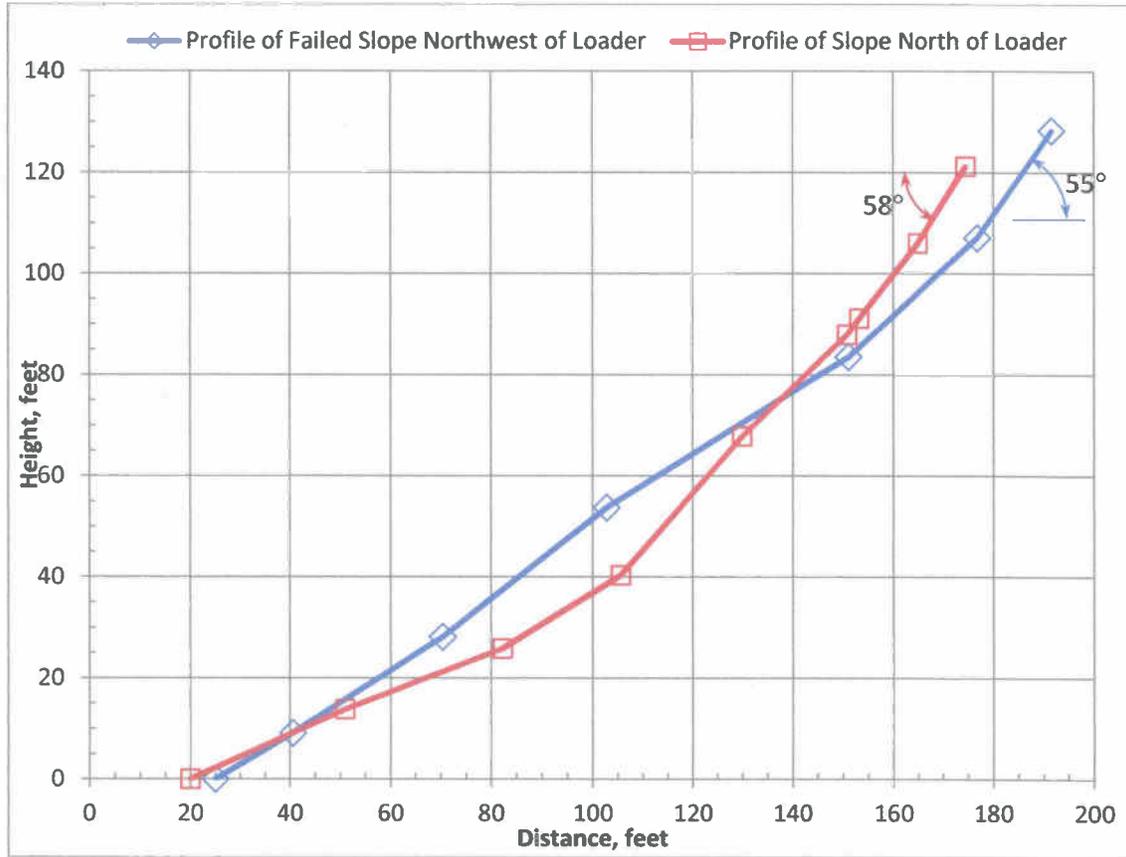


Figure 2 - Approximate profiles of sand bank slopes adjacent to the front-end loader