

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

REPORT OF INVESTIGATION

Underground Metal Mine  
(Silver Ore)

Fatal Explosives and Blasting Agents Accident  
November 17, 2013

Star Mine Operations LLC  
Revenue Mine  
Ouray, Ouray County, Colorado  
Mine ID No. 05-03528

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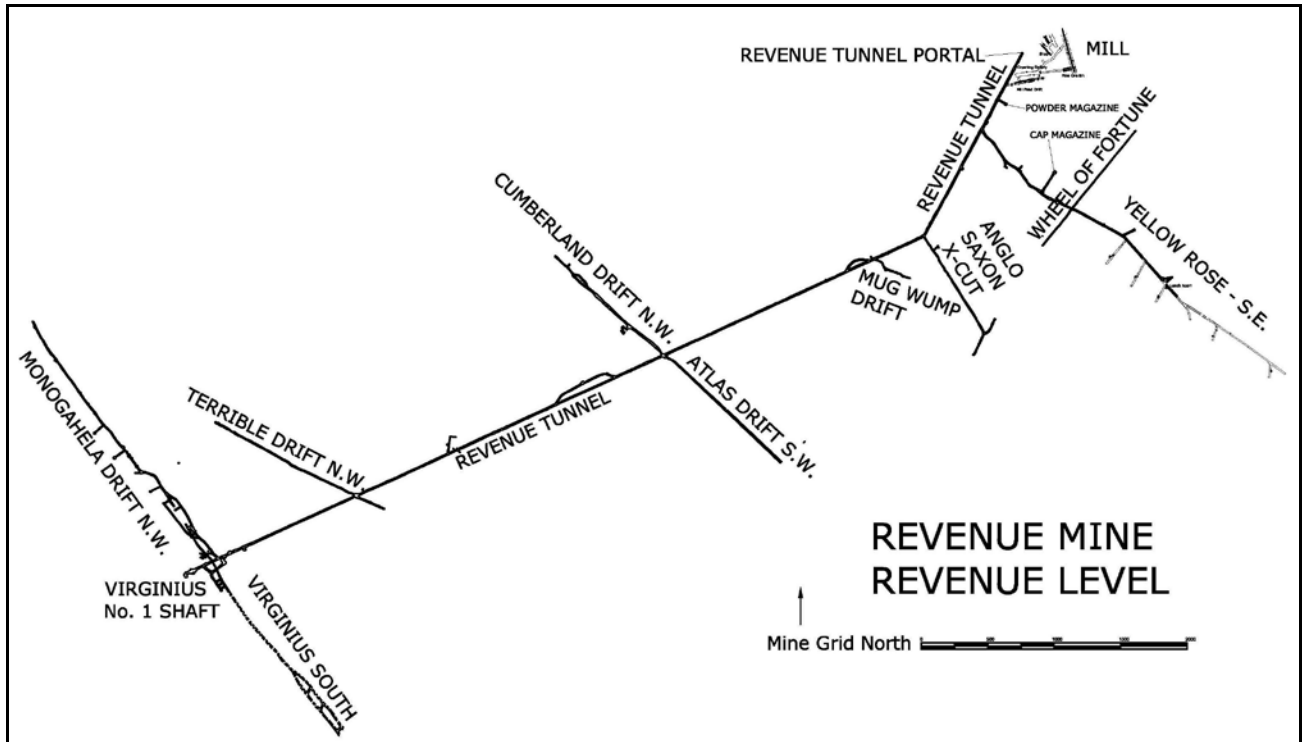
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## OVERVIEW

On November 17, 2013 (day shift), Nicholas K. Cappanno, Nipper<sup>1</sup>, age 33, and Rick L. Williams, White Crew Shift Boss, age 59, died as a result of carbon monoxide poisoning in the unventilated Monogahela drift.<sup>2</sup>

On November 16, 2013 (day shift), the day before the accident, Rick Williams, Cappanno, and other miners transferred approximately 1,600 pounds of deteriorated explosives to the end of the Monogahela drift for detonation. At approximately 2:00 p.m., the explosives were detonated under Rick Williams's supervision. At 3:30 p.m., the crew departed the mine without informing the oncoming shift of the blast and without barricading the Monogahela drift.

Approximately 10:30 p.m. on the next shift (night shift - November 16, 2013), Larry D. Kibel, Blue Crew Shift Boss, instructed Chadrik W. Kibel (Larry Kibel's nephew), Welder/Mechanic, and Steven B. Puderbaugh, Miner II, to enter the Monogahela drift to repair a water pump. When the miners traveled within 580 feet of where the blast occurred, they experienced headaches, nausea, and dizziness. They were able to exit the drift. C. Kibel told John M. Gillon, Track Crew Lead Man, "there is something bad back there." J. Gillon traveled approximately 800 feet into the Monogahela drift to the "S" curves and retreated due to poor air quality in the drift. At that time, C. Kibel and Puderbaugh were feeling worse and were transported to the surface by Mitchell P. Gillon, Trammer (John M. Gillon's brother). The miners informed L. Kibel of their condition and experience in the Monogahela drift. When J. Gillon came out at the end of the shift, he also reported to L. Kibel that something was wrong in the Monogahela drift.

L. Kibel did not enter the mine to conduct an examination to determine what caused the miners to become ill. The Operator did not take any actions to prevent other miners from entering the drift and did not investigate or take any action with respect to C. Kibel, Puderbaugh, or Gillon's complaint and/or report. L. Kibel did not alert upper management of the incident or the imminent danger which existed in the Monogahela drift until he was informed of the fatal accident which occurred on the following shift.

On November 17, 2013 (dayshift), the crew met on the surface and Rick Williams assigned tasks to the miners. The miners then went underground while Rick Williams remained on the surface. When the crew met in the Revenue lunchroom, Cappanno, a new miner with one month of mining experience, said he was going to travel into the drift to observe the results of the blast. Cory A. Geist, Miner's Helper, with 14 months of mining experience, accompanied Cappanno into the drift. When they approached the face of the drift, Cappanno was overcome by carbon monoxide gas, fell to the ground, and was nonresponsive. Geist also felt ill, but was able to retreat from the area and alert other miners that Cappanno needed assistance.

After receiving notification of the incident from his crew, Rick Williams began to call persons listed on the mine's emergency contact list. When Rick Williams called Daniel M. Woodruff,

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<sup>1</sup> A nipper is a mining term referring to a person, typically the most junior person on a crew, who handles supplies, including explosives, and delivers them to working areas.

<sup>2</sup> A drift is a horizontal passage underground. A drift follows the ore vein, as distinguished from a crosscut, which intersects it.

Safety Manager, Woodruff told him to evacuate the mine and call 9-1-1. Ryan D. Glover, Mechanic, called 9-1-1 and reported that one miner was down in the underground mine and requested mine rescue support, life flight (air medical evacuation), and breathing apparatus. At approximately 7:45 a.m., Rick Williams loaded 30-minute air packs on a locomotive and traveled into the mine.

Rick Williams was overcome in an attempt to rescue Cappanno. Twenty other miners were also exposed to carbon monoxide while attempting to rescue Cappanno and Rick Williams. Seven of these miners were subsequently hospitalized for follow-up treatment for various levels of carbon monoxide poisoning. Mine rescue teams recovered Cappanno and Rick Williams later that day – November 17, 2013.

The accident occurred due to management's failure to dispose of deteriorated explosives in a safe manner. Management did not follow the guidance of the explosives manufacturer concerning the proper disposal of the deteriorated explosives. The explosives were detonated in an area of the mine that was not ventilated.

No post-blast examinations were conducted. Three miners went into the unventilated area and two of them reported feeling ill, however, management failed to take any action. Management also failed to withdraw persons as a result of the imminent danger created by detonating the deteriorated explosives in an unventilated area of the mine. Management failed to establish an accurate and effective ventilation plan for the Monogahela drift and failed to barricade or seal unventilated areas. Additionally, management failed to indoctrinate new employees in safe work procedures and properly train miners.

Further, management failed to notify the Mine Safety and Health Administration (MSHA) of an immediately reportable accident - an inundation of carbon monoxide gas, which occurred after the blast was detonated in the Monogahela drift on November 16, 2013.

## **GENERAL INFORMATION**

The Revenue Mine, an underground silver operation owned and operated by Star Mine Operations, LLC, is located in Ouray, Ouray County, Colorado. The principal operating official is Rory Williams (no relation to Rick Williams), Manager / Owner. The mine operates two, nine-hour shifts per day, seven days per week. Normal shifts are 6:00 a.m. to 3:30 p.m. (day shift) and 5:00 p.m. to 2:00 a.m. (night shift). On each shift, a production crew and an Alimak Raise<sup>3</sup> crew work in the mine. There are three production crews (White, Blue, and Red) and three Alimak Raise crews (Black, Green, and Orange). The production crews rotate on a 6-days work, 3-days off schedule, while the Alimak Raise crews rotate on a 14-days work, 7-days off schedule. Total employment is 120 persons. The crew schedule for the month of November, 2013 is listed in Appendix C.

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<sup>3</sup> Raises are driven in a vertical or steeply inclined direction off a drift. During the development of raises, gravity assists in drilling and mucking, thereby making the process more economical. In 1957, the Alimak Company introduced a technique of developing raises with a mechanical climbing machine. The Alimak raise climber is designed to drive raises up to 328 feet (100 meters) long, or more. Alimak raise climbing machines were used at the Revenue Mine.

An overview of the mine's history is provided in Appendix D. Ore is extracted through draw holes to reclaim material previously mined by others. New ore is mined using the shrinkage stoping method. The ore is drilled using jacklegs and stopers and blasted using packaged emulsion explosives and ammonium nitrate fuel oil blasting agent with non-electric detonators. The explosives are initiated with a detonating cord and safety fuse for face rounds and with an electric detonator for raise rounds. Rail cars are loaded using Eimco shovels, slushers, or chutes. The rock is hauled to the coarse ore drift or surface stockpile by rail. Prior to the accident, ore was being mined to be processed in an underground mill when construction is completed. The finished concentrates will be sent for refining and ultimately sold as precious metals.

MSHA completed the last regular inspection at this mine on October 24, 2013.

### **SIGNIFICANT EVENTS PRIOR TO THE ACCIDENT**

On November 11, 2013, Jack E. Clark, Underground Operations Manager, ordered work to be suspended in the Monogahela drift due to a lack of ventilation. Contrary to Clark's directive, on the following day shift, Rick Williams, White Crew Shift Boss, instructed his crew to drill and blast 35 holes in the crosscuts at the Chinaman Chute, located in the Monogahela drift. The night shift crew, at the direction of Ryan L. Reese, Red Crew Shift Boss, slushed and hauled 12 carloads of ore from the drift and set up to drill the left side of the chute.

On November 13, 2013 (day shift), management conducted an annual refresher training session. The White Crew, including Rick Williams and Cappanno, were in attendance. During the training session, management and the attendees discussed the subject of deteriorated explosives. As a result of wet conditions present in the underground explosives storage facilities,<sup>4</sup> the existing stock of Dyno Split D, a nitro-glycerin based explosive manufactured by Dyno Nobel, had started to deteriorate. Ross Tabberer of Western Explosive Systems Company (WESCO<sup>5</sup>), the mine's explosives distributor, was present at the refresher training session and explained that the deteriorated explosives should be taken out of the mine and burned or be detonated over time with the normal production blasts until the entire supply was exhausted. Tabberer also gave a third option - WESCO could remove the deteriorated explosives from the mine property. Tabberer did not recommend detonating the deteriorated explosives as was done in the Monogahela drift on November 16, 2013.

According to Dyno Nobel Inc., the company provides an "Always/Never" sheet in every box of explosives that it ships. This sheet explains under the heading "Destruction of Commercial Explosive Materials" that, if the user plans to destroy explosives, then the manufacturer should be consulted. Management did not consult Dyno Nobel Inc. for guidance to properly dispose of the deteriorated explosives. The operator's actions to destroy the deteriorated explosives underground in an open air blast did not comply with the manufacturer's recommendations or with MSHA mandatory standard for safe disposal of damaged or deteriorated explosive material.

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<sup>4</sup> Storage facility (per 30 CFR §57.2 Definitions) refers to the entire class of structures specially constructed and located for the storage of explosives in an underground mine.

<sup>5</sup> WESCO is operated as a "joint venture" with Dyno Nobel, Inc.

On November 14, 2013, the dayshift White Crew slushed and hauled ore from the Chinaman Chute off the Monogahela drift. A miner on the crew documented on his “5 Point Card”<sup>6</sup> that ventilation was needed in the Monogahela drift. On that same day, the night shift Red Crew installed pipe in the drift. Management did not take any action in response to the miner’s 5 Point Card notation about ventilation.

On November 15, 2013, work was again suspended in the Monogahela drift due to a lack of ventilation. Rick Williams and Reese both documented on their daily shift report or “shifter notes” that no work was to be performed in the drift until ventilation was provided (the entries are listed below).

11-15-2013 Day Shift - “No work until ventilation”

11-15-2013 Night Shift - “No work Need vent fan”

On the same day, Rick Williams, Donald J. Gurule, Mine Foreman, and Martin W. Chenoweth, Technical Services Manager, discussed the handling of deteriorated explosives. They disagreed on the composition of the powder and whether or not it needed to be destroyed. As a result, Chenoweth researched the explosives in question (Dyno Split D) and found that it was nitroglycerine based dynamite.<sup>7</sup> He shared this information with Gurule.

On Saturday, November 16, 2013, Rick Williams, Cappanno, and Michael B. Perry, Mucker, transferred approximately 1,600 pounds of the deteriorated Dyno Split D explosives from the powder storage facility to the end of the Monogahela drift for disposal. Although there is evidence that management had discussions regarding the handling and disposal of deteriorated explosives, the accident investigation team was unable to determine if anyone from management directed Rick Williams to destroy the deteriorated explosives inside the mine.

The explosives were transported to the drift on steel flatcars towed by a locomotive. Before entering the Monogahela drift, Rick Williams instructed Christopher R. Yurgartis, General Laborer, to accompany them to help unload the explosives. The miners hand-carried the explosives approximately 150 feet to within 50 feet of the face of the Monogahela drift. They stacked the explosives against the left rib interlayered with detonating cord. As they worked, the miners complained of bad air. Rick Williams told them to slow down due to low oxygen in the area. Management did not provide or use gas detectors to determine what contaminants or atmospheric conditions were present.

Rick Williams forgot the pull-cord igniter needed for the detonation and returned to one of the explosive storage facilities to retrieve it. He returned at 2:00 p.m. Mangus C. Lee, Miner, and Cory A. Geist, Miner’s Helper, approached the face of the Monogahela drift to talk with Rick

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<sup>6</sup> See Discussion section Examinations and Recordkeeping.

<sup>7</sup> According to Dyno Nobel Inc., the nitroglycerine based dynamite stick powder does not become more unstable due to getting wet, absorbing moisture and/or having nitrate salts leach out of the package. The white crystals that may form on the outside of the charges with subsequent partial drying are these nitrate salts - they are not typically hazardous and this dynamite can be safely used. Some reduction in detonation performance may occur in such instances. The extent of detonation performance will depend on the amount of moisture absorbed in the dynamite, the amount of nitrate salt migration out of the product, and the product charge diameter, with the performance of smaller diameter product being adversely affected more easily than larger diameter product.

Williams about a problem with their roof drill. All six of the miners retreated approximately 1,500 feet to the Chinaman Chute. Rick Williams instructed Yurgartis to light the safety fuse with the pull-cord igniter. The air blast knocked the miners down and some flying debris struck them, but no one was injured. The miners then returned to the Revenue lunchroom, located near the entrance to the Monogahela drift, where Cappanno told Lee he wanted to travel back to the blast area to see the effects of the blast. Lee advised Cappanno against reentry into the blast area due to the lack of ventilation.

At the end of the shift, the entire day shift crew assembled, boarded mantrips<sup>8</sup>, and traveled to the surface. At 3:30 p.m., the day shift crew boarded company-owned vans and traveled approximately 7 miles to the Star Mine Operations LLC's main office in Ouray, Colorado, and then left for the day.

Day and night shifts at the Revenue Mine do not overlap. There is approximately a 30-minute gap between shifts and as a result, when the night shift crew arrived at the main office on November 16, 2013, no one from the day shift crew was there. The shift boss and miners from each shift did not have an opportunity to communicate in person. Shift bosses and miners were to leave important messages and production notes for the oncoming shift on a white board located in the surface lunchroom at the mine. Neither Rick Williams nor any other miners made any notations on the white board concerning the blast, the Monogahela drift or any ventilation issues for the oncoming shift.

The night shift crew boarded the same company-owned vans and traveled to the mine site, arriving at 5:00 p.m. At that time, L. Kibel assembled his crew and provided their work assignments. Some miners were assigned to dig track tie pockets and set track ties in the Virginius South and others were to conduct typical mining operations in the Yellow Rose drift.

At 10:30 p.m., L. Kibel was in the shifters' office when he received a telephone call from Clark (Underground Operations Manager) directing him to send someone to the "Blue Lagoon," a water containment area located approximately 900 feet into the Monogahela drift, to check the pump and water levels. Clark is the person who issued the order to suspend all work in the Monogahela drift on November 11, 2013. There is no evidence that he rescinded this order or that management took any action to correct the ventilation issue that caused Clark to suspend work in the drift.

As a result of Clark's call, L. Kibel sent C. Kibel and Puderbaugh to the Blue Lagoon. When the miners reached the area, they decided to walk further into the Monogahela drift. C. Kibel and Puderbaugh began to feel ill just before reaching the last chute located 1,670 feet into the Monogahela drift. They retreated to the Blue Lagoon and attempted to complete their assigned task but were too ill. C. Kibel and Puderbaugh managed to walk out of the Monogahela drift to the Revenue lunchroom, arriving there at 11:30 p.m., and complained of feeling dizzy and disoriented. Puderbaugh complained that his hands had no feeling. C. Kibel told John M. Gillon, Track Crew Lead Man, "there is something bad back there."

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<sup>8</sup> At this mine, mantrips were rail-mounted personnel carriers used to transport miners into and out of the mine to and from the working areas.

J. Gillon traveled approximately 800 feet into the Monogahela drift to the “S” curves and retreated due to poor air quality in the drift. At that time, C. Kibel and Puderbaugh were feeling worse and were transported to the surface by Mitchell P. Gillon, Trammer (John M. Gillon’s brother). The miners informed L. Kibel of their condition and experience in the Monogahela drift. When J. Gillon came out at the end of the shift, he also reported to L. Kibel that something was wrong in the Monogahela drift. Although no gas detectors were used on this shift to determine the air quality, the symptoms the miners experienced were consistent with exposure to high concentrations of carbon monoxide.

The night shift ended at 2:00 a.m. on November 17, 2013. L. Kibel did not report the miners’ illnesses or the poor air quality in the Monogahela drift to upper management. He did not leave any notations regarding the Blue Lagoon, the miners’ illness/symptoms or ventilation issues in the Monogahela drift on the white board in the surface lunchroom at the mine.

### **DESCRIPTION OF THE ACCIDENT**

On Sunday, November 17, 2013, at 6:00 a.m. (dayshift), the White Crew met in the surface lunchroom and received assignments from Rick Williams. After the meeting, Vernon J. Paulsen, Senior Lead Mechanic, and Philip M. Maier, Mechanic, traveled to the Virginius South to inspect equipment. Kenneth L. Jenkins, Miner, and Craig L. Miller, Mucker, also traveled to the Virginius South drift to work on the rail. The remainder of the White Crew traveled to the Revenue lunchroom and the Alimak Black Crew went to work in the Yellow Rose drift (a detailed post-accident map of the Monogahela drift is provided in Appendix E).

In the Revenue lunchroom, Cappanno stated he was going into the Monogahela drift to look at the blast area. Geist accompanied him into the drift because Rick Williams taught them to never travel alone. Management did not instruct either miner to enter the Monogahela drift and it was not a part of their assigned tasks. The two miners rode a locomotive to the last chute located 1,670 feet into the drift and walked toward the face of the dead end<sup>9</sup> drift. As they walked, Geist suspected bad air. He lit his cigarette lighter to check for oxygen deficiency because they did not have a gas detector with them. (Using a cigarette lighter is not an acceptable method to check for oxygen deficiency). When Geist observed the flame, he told Cappanno they needed to retreat from the drift. They took a few steps toward the locomotive when Cappanno felt ill and passed out. He was approximately 150 feet from the face. Geist was able to stir Cappanno and they walked another 50 feet when Cappanno again passed out. Geist also felt the effects of the carbon monoxide and fell to one knee. Geist told Cappanno he was going to leave and get help. When Geist reached the locomotive, he fell again but managed to climb into the locomotive and exit the drift.

Jenkins and Miller saw Geist exit the Monogahela drift and head toward the Revenue lunchroom. As Geist entered the lunchroom, he stated Cappanno collapsed about 150 feet from the face in the Monogahela drift and needed help. Geist warned the others to be careful because there is

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<sup>9</sup> Dead end is an entry or mine passage extending beyond the mine workings into solid ore. An underground passageway either blocked or not mined through.



“bad air in the drift.” Geist also told them to “turn on some air valves,” referring to the air valves on the compressed air line in the drift.

At 7:02 a.m., Jenkins, Mangus C. Lee, Miner, Kyle E. Schoenebaum, Miner, and Leonardo Torres, Nipper, left the Revenue lunchroom to find Cappanno. The locomotive they were using derailed at the Blue Lagoon. Torres remained at the locomotive and tried to get it back on track while the others ran toward the face. As the miners advanced, they stopped to open compressed air valves along the way; however, they did not realize the main airline was shut off near the entrance to the Monogahela drift. While trying to re-rail the locomotive, Torres felt dizzy and walked out of the drift.

At 7:08 a.m., Miller called the surface from the Revenue lunchroom and spoke to Ryan D. Glover, Mechanic, to inform him of the accident. Glover told Miller to bring Geist out of the mine. After Miller’s call, Geist also called the surface from the lunchroom and spoke to Mark C. Coleman, Shift Surface Foreman, and told him that “people are down with cuts and bleeding in bad air and they need help.”

Miners in the Yellow Rose drift overheard the calls for help and Michael A. McFarland, Miner, Christopher C. Scott, Miner I, Arthur M. Ficco, Miner, and Zachary D. Ficco, Mucker, headed toward the Monogahela drift to help. About the same time, Miller and Geist left the Revenue lunchroom and headed toward the portal on a locomotive.

In the Monogahela drift, Lee, Jenkins, and Schoenebaum found Cappanno. He was unconscious, gasping for air, and had facial injuries. The miners tried to carry him out, could not, so began dragging him instead. Lee began feeling light headed and retreated. Jenkins and Schoenebaum continued to drag Cappanno. After dragging Cappanno approximately 200 feet, Jenkins and Schoenebaum felt dizzy and stumbled. They left Cappanno near a compressed air discharge valve and retreated. Jenkins and Schoenebaum caught up with Lee and assisted him in retreating.

At 7:11 a.m., Glover, who was on the surface and originally notified of the accident, notified Rick Williams. At that time, Rick Williams began to call persons listed on the mine’s emergency contact list. He left a voicemail message for Gurule (Mine Foreman) stating that Cappanno went into the Monogahela drift, there is no air, he passed out, and there are other miners trying to get him out of the drift.

At 7:15 a.m., Coleman told Rick Williams that help was needed underground. Rick Williams stated he had already been notified. Rick Williams called Daniel M. Woodruff, Safety Manager, and Woodruff told him to evacuate the mine and call 9-1-1.

At 7:19 a.m., Glover called 9-1-1 and reported that one miner was down in the underground mine and requested mine rescue support, life flight (air medical evacuation), and breathing apparatus. Glover reported that a miner had passed out underground and they could not get to him because there was no ventilation. Glover handed the phone to Coleman and went to the surface lunchroom to monitor the mine pager phone.

About 7:21 a.m., A. Ficco, Z. Ficco, McFarland, and Scott were traveling on a locomotive in the Revenue tunnel toward the Monogahela drift when they met Miller and Geist at the Terrible drift, traveling out. The miners traded locomotives and A. Ficco transported Geist to the surface while Z. Ficco, McFarland, Scott, and Miller continued to the Monogahela drift.

At 7:30 a.m., Michael L. Luther, Miner, entered the Monogahela drift to try to help Cappanno and passed Jenkins, Schoenebaum and Lee who were retreating from the drift. Luther reached Cappanno and attempted to revive him by providing breaths. When Cappanno did not respond, Luther dragged Cappanno as he retreated.

When Jenkins, Schoenebaum, and Lee exited the Monogahela drift, Torres asked Jenkins how to use his MSA Model W-65 self-rescuer. Jenkins told Torres not to go back into the Monogahela drift, but Torres donned his W-65 self-rescuer and went to look for Cappanno. Torres arrived to find Luther with Cappanno. Luther helped to place Cappanno on Torres's shoulder and they retreated toward the Revenue tunnel. As Torres carried Cappanno, he felt nauseated, stopped, and removed his W-65 self-rescuer because he thought it was not working properly. After retreating about 100 feet, Torres felt lightheaded and could not continue. He left Luther with Cappanno and retreated. Luther dragged Cappanno about 50 feet and then collapsed. After breathing from a compressed air valve, Luther felt better but was unable to drag Cappanno any farther. After retreating another 50 feet, Luther passed out.

At 7:35 a.m., Rick Williams called John R. Trujillo, Project Director, to inform him of the accident. Rick Williams then loaded two 30-minute air packs on a locomotive and traveled into the mine. About this time, Jenkins, Schoenebaum, and Lee left the Revenue lunchroom on a locomotive and headed to the surface. On the way out, they met Rick Williams in the Revenue tunnel. Rick Williams returned to the surface with Lee and Jenkins, while Schoenebaum returned to the Revenue lunchroom with the 30-minute air packs. After retrieving two additional 30-minute air packs, Rick Williams, Glover, and Yurgartis reentered the mine on a locomotive and traveled toward the Monogahela drift.

Miller and McFarland entered the Monogahela drift on foot, carrying a stretcher and an oxygen bottle, while Scott gathered air hoses and Z. Ficco searched for an available locomotive. Miller and McFarland found Torres disoriented and sitting against a rib. As Miller helped Torres to a compressed air valve in an attempt to revive him, McFarland continued advancing. When Torres felt well enough to exit the drift, Miller left him and went to catch up with McFarland. They found Luther laying unresponsive in the track. McFarland attempted to provide oxygen to Luther, but had no hose for the regulator. They placed Luther on the stretcher and retreated dragging the stretcher.

Scott met Miller and McFarland dragging Luther on the stretcher. Scott helped carry the stretcher to the derailed locomotive. McFarland was unable to continue and retreated. Miller remained with Luther. Scott went back to look for Cappanno, opening compressed air valves along the way, and found that the main airline was off. Before reaching the water pump, he found the main airline valve and opened it. Scott continued advancing and connected a 50-foot long air hose to an air valve beyond the Chinaman Chute and secured the hose just past a

collapsed chute. Scott advanced until he became disoriented and retreated approximately 900 feet to the refuge chamber.

Z. Ficco found a locomotive and entered the Monogahela drift where he met McFarland and Torres coming out. Z. Ficco continued advancing and stopped at the derailed locomotive where he found Miller with Luther. Miller and Z. Ficco carried Luther around the derailed locomotive, hooked the stretcher to the back of Z. Ficco's locomotive and pulled Luther to the Revenue lunchroom.

Paulsen and Maier arrived at the Revenue lunchroom from the Virginius South and Rick Williams, Glover, and Yurgartis arrived with the additional air packs from the surface. Rick Williams discussed what to do next with Schoenebaum, Z. Ficco, and McFarland. Schoenebaum and McFarland did not have enough strength to don air packs, so they retreated to the surface with Luther. Rick Williams instructed Z. Ficco, Paulsen, and Maier to remain at the lunchroom and all other miners were instructed to evacuate the mine.

At 8:00 a.m., Rick Williams and Z. Ficco donned air packs and entered the Monogahela drift. They parked at the derailed locomotive and advanced on foot. When they reached Cappanno, approximately 700 feet beyond the derailed locomotive, they checked his vital signs and found none. Z. Ficco attempted to revive Cappanno by placing the face-piece of his air pack on Cappanno, however, Cappanno did not respond. Z. Ficco re-donned his face-piece and told Rick Williams they needed to retreat. Rick Williams and Z. Ficco retreated while dragging Cappanno.

Rick Williams told Z. Ficco that he could not continue and retreated. Z. Ficco continued to drag Cappanno approximately 400 feet when his air pack's low-air alarm sounded and he retreated as well. On the way out of the drift, Z. Ficco found Rick Williams lying against a rib approximately 50 feet from the derailed locomotive. Z. Ficco motioned to Rick Williams that he was out of oxygen and they needed to get out. Rick Williams nodded and pointed out. As Z. Ficco retreated, his air pack ran out of air and he realized Rick Williams was not with him, but had returned to Cappanno.

When Z. Ficco arrived at the Revenue lunchroom, Ronald F. "Bumper" Williams (no relation to Rick Williams or Rory Williams), a member of the San Juan Cooperative Mine Rescue Team (SJCMRT) and Ouray County Emergency Medical Service (EMS), called in from the surface to request a ride into the mine. Z. Ficco left the lunchroom on a locomotive and traveled approximately 1,000 feet toward the portal. Z. Ficco met Daniel L. Ficco, Electrician, A. Ficco, and Jason M. Rockwell, Miner's Helper, riding in a locomotive driven by Michael T. McCracken, Core Driller, advancing with four air packs provided by the Ouray County Fire Department and three stretchers. They traded locomotives at the Terrible drift and Z. Ficco continued to the surface.

At 8:15 a.m., D. Ficco and A. Ficco donned air packs and entered the Monogahela drift. About 300 feet beyond the derailed locomotive, they found Rick Williams administering cardiopulmonary resuscitation (CPR) to Cappanno. They attempted to place an air pack on Rick Williams, but he resisted. They urged Rick Williams to his feet and he walked approximately 50 feet before collapsing. D. Ficco and A. Ficco placed Cappanno on a stretcher. They placed Rick

Williams on a second stretcher and carried him out approximately 20 feet when the low-air alarm for A. Ficco's air pack sounded and he retreated. D. Ficco continued to drag Rick Williams another 20 feet.

Ronald Williams (SJCMRT) was delayed on the surface because a gas detector that he needed was locked in the Safety Manager's office and he had to wait until the door was unlocked. At 8:30 a.m., he entered the mine on a locomotive with two additional air packs, blankets, and the gas detector. Approximately 500 feet into the drift, Ronald Williams's gas detector alarmed and he donned an air pack. The gas detector's readings were reported as: 860 ppm CO, 10% NO<sub>2</sub> [*sic.*], and 19.5% O<sub>2</sub>. Ronald Williams advanced on foot to the derailed locomotive where he met A. Ficco, who was retreating from the drift. Ronald Williams told A. Ficco there was an additional air pack on the locomotive. When Ronald Williams reached D. Ficco and Rick Williams, he helped drag Rick Williams another 30 feet toward the locomotive. At that time, D. Ficco's low-air alarm sounded and he retreated.

A. Ficco donned the spare air pack and returned to Ronald Williams to assist with Rick Williams. When D. Ficco reached the locomotive, there were no remaining air packs, so he retreated to the refuge chamber on foot.

Ronald Williams dragged Cappanno to the derailed locomotive and checked his vital signs but found no pulse. Ronald Williams left Cappanno and went to help with Rick Williams. When A. Ficco returned, the low-air alarm for Ronald Williams's air pack sounded. At that time, Ronald Williams ran to an air hose attached to the main air line. A. Ficco dragged Rick Williams to the air hose and went to the locomotive to get blankets.

Ronald Williams used a whip check to attach an air hose to Rick Williams's wrist. Rick Williams was still breathing at that time. Ronald Williams retreated, complaining he felt ill and passed A. Ficco on his way out. A. Ficco returned to Cappanno and Rick Williams and covered them with blankets. Rick Williams was experiencing difficulty breathing. A. Ficco remained with him for approximately five minutes before retreating.

D. Ficco, A. Ficco, and Ronald Williams all retreated to the refuge chamber where Paulsen instructed them to evacuate the mine.

The SJCMRT arrived at the mine and entered the portal at 1:05 p.m. By 2:01 p.m., they alerted the Command Center they were retreating with Rick Williams and Cappanno. At 2:13 p.m., they arrived at the surface where the Ouray County Coroner pronounced the victims dead. The cause of death for both victims was attributed to acute carbon monoxide poisoning.

## **MINE RESCUE OPERATIONS**

As set forth above in the "Description of the Accident," Glover called 9-1-1 at approximately 7:19 a.m. on November 17, 2013. He asked the 9-1-1- dispatcher for Ronald F. "Bumper" Williams. The Montrose Regional Dispatch Center (MRDC) alerted the local Ouray County EMS, Mountain Rescue, and the Ouray County Sheriff's department.

At 7:30 a.m., Ronald Williams received a page from the Ouray County EMS concerning the emergency at the mine.

At 7:48 a.m., Mountain Rescue notified the MRDC that a mine rescue team was needed at the mine because Mountain Rescue was not equipped or qualified to go underground.

At 7:51 a.m., MRDC notified Ronald Williams of the accident.

At 7:52 a.m., Woodruff (Safety Manager) notified MSHA of the mine emergency.

At 7:57 a.m., Ronald Williams arrived at the mine, called underground and spoke to Z. Ficco, who was in the Revenue lunchroom, to request a ride into the mine.

Joe C. Smart, Lezah J. Saunders, Richard L. Peterson and John M. Gillon (who also worked at the Revenue Mine, but was off on the day of the accident) of the SJCMRT were alerted and gathered at the mine rescue station in Ridgeway, Colorado, approximately 17 miles from the mine. A fifth mine rescue team member, Thomas A. Bird, was dispatched directly to the mine to assess the situation.

At 8:40 a.m., the SJCMRT was notified that six miners were out of the mine and on stretchers and ten miners were still in the mine. The team was mobilized and prepared to depart for the mine. At 9:22 a.m., the GCC Energy LLC, King Coal Mine Rescue Team was also called and placed on standby. At approximately 10:00 a.m., both teams departed for the mine.

The SJCMRT arrived at the mine at 10:29 a.m. and prepared to go underground. During their briefing, they were instructed to enter the portal, travel along the Revenue tunnel toward the Monogahela drift and call out to the surface at every mine phone location. At 1:05 p.m., they donned their apparatuses and entered the mine. The GCC Energy LLC team remained on the surface as a backup team during the entire time that the SJCMRT was underground.

By 1:40 p.m., the SJCMRT had traveled along the Revenue Tunnel and arrived at the Revenue lunchroom. At that time, the team requested that they be allowed to break communication and travel into the Monogahela drift. Permission was granted, but at 1:42 p.m., the team called out to inform the surface that they were in the Monogahela drift, they had measured 36 ppm carbon monoxide, and that they were continuing on to locate the missing miners.<sup>10</sup> At that time, the GCC Energy team was staged and ready to go into the mine if the SJCMRT did not call out again within 20 minutes.

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<sup>10</sup> From interviews with the SJCMRT members and as verified by the surface incident command rescue log, the team had not encountered concentrations of carbon monoxide or any other airborne contaminant until they reached this area of the mine. Although they did not report additional concentrations of gases from the drift, peak readings provided by the SJCMRT from their gas detector showed that the environment contained much more (i.e., a low of 18.8 percent oxygen; a high of 1,371 ppm carbon monoxide; and a high of 10 ppm nitrogen dioxide).

When the SJCMRT reached the derailed locomotive, they found Nicholas Cappanno and Rick Williams on stretchers. Neither of them had a pulse, but Rick Williams was still warm. The team placed a spare breathing apparatus on him and loaded both miners on a locomotive for transport.

At 2:01 p.m., the SJCMRT alerted the Command Center that they were at the Revenue lunchroom and were retreating with one “deceased” miner (Cappanno) and one “warm miner with no pulse” (Rick Williams). Life flight had been called and was en route to the mine. As the team traveled out of the mine, they administered CPR and rescue breaths, via the apparatus bypass button, to Rick Williams until they reached the surface.

At 2:13 p.m., the SJCMRT exited the mine portal with the victims. EMT’s continued to perform CPR on Rick Williams. Life flight arrived and Rick Williams was pronounced dead at 2:42 p.m.

All miners and mine rescue team members were out of the mine and the portal entrance was locked at approximately 3:20 p.m.

## **INVESTIGATION OF THE ACCIDENT**

On November 17, 2013, at 7:52 a.m., Woodruff, the Safety Manager, notified MSHA of the accident via telephone call to MSHA’s National Call Center. The National Call Center notified Kenneth Valentine, Supervisory Special Investigator, Rocky Mountain District Office, Denver, Colorado. At 8:40 a.m., Valentine issued an order under provisions of Section 103(j) of the Mine Act, and an investigation started the same day. Richard Laufenberg, District Manager, Michael Dennehy, Assistant District Manager, Michael Okuniewicz, Family Liaison, and other district personnel were dispatched to the mine. At 6:40 p.m., Melvin M. Lapin, Supervisory Mine Safety and Health Inspector, and Lee A. Hughes, Mine Safety and Health Inspector, arrived at the mine. At that time, Hughes modified the 103(j) order to a 103(k) order.

MSHA’s accident investigation team traveled to the mine, conducted a physical inspection of the accident site, interviewed employees, and reviewed documents, conditions, and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, employees, and Federal, State, and local law enforcement and rescue agencies.

## **DISCUSSION**

### **Location of the Accident**

The accident occurred in the Monogahela drift of the Revenue Mine. The Monogahela drift extends 2,300 feet from the Revenue tunnel to the dead end face. The average dimension of the drift is 10 feet high by 9 feet wide. Figure 1 depicts the location of the Monogahela drift as it relates to the entire mine workings. The location of the two victims at the time of recovery is shown on the map. The highlighted accident area also includes the entire area inundated by

blasting gasses. In addition to the victims, 20 other miners were exposed to toxic and noxious gasses at various locations throughout the drift.

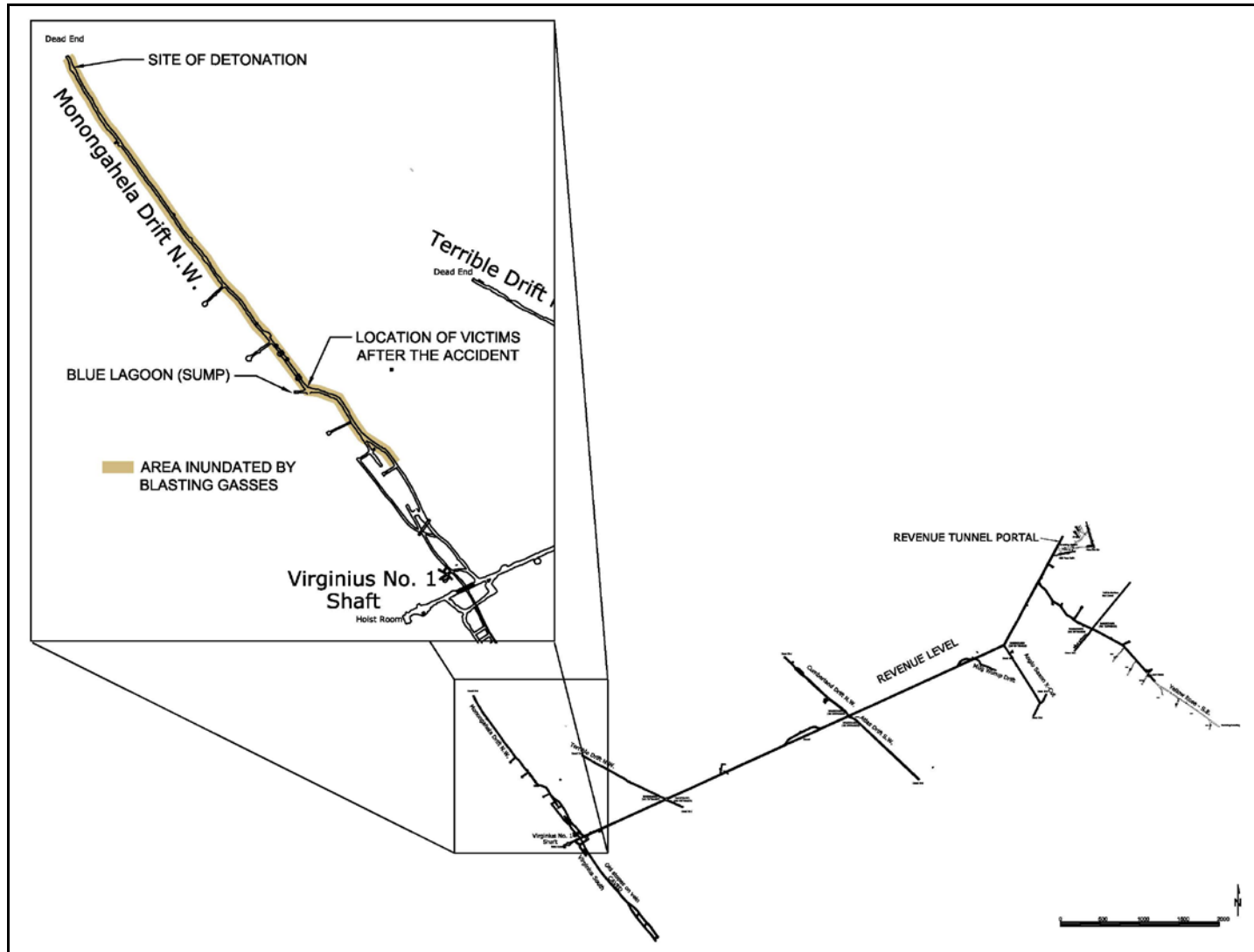


Figure 1 – Location of the Accident



## **Weather, Environmental, and Access**

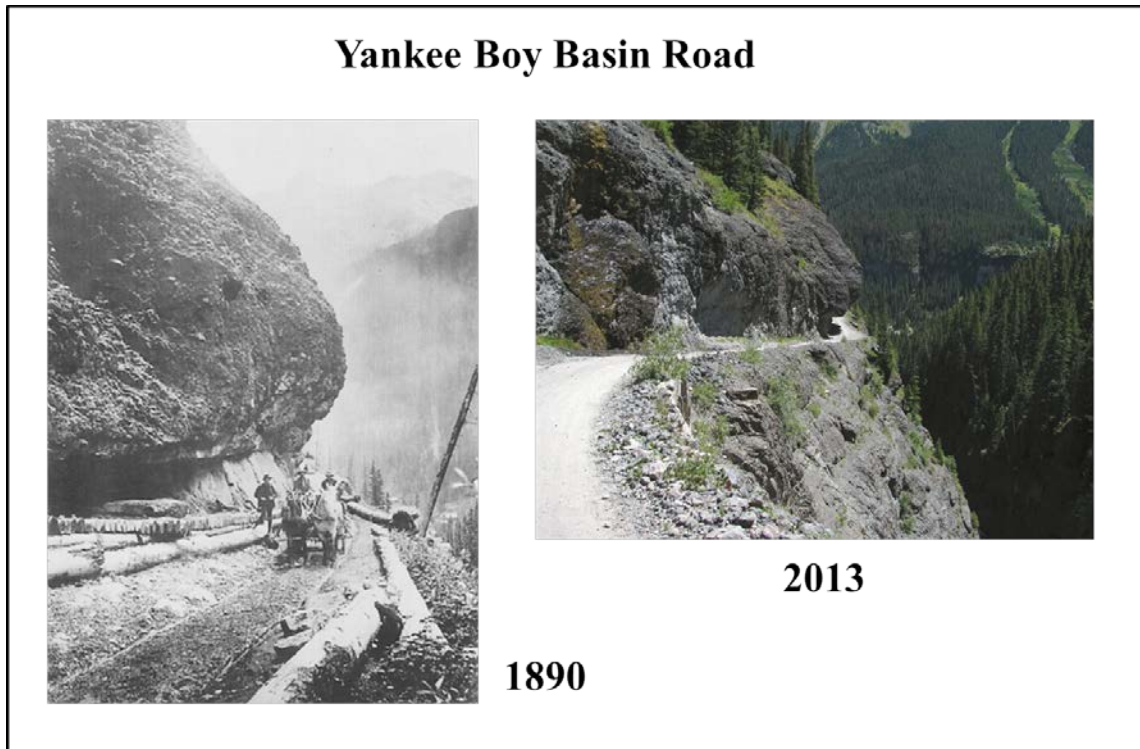
On the day of the accident, the weather at the mine was snowing and the average temperature was 34° Fahrenheit. The road to the mine was snow covered and initially did not allow ambulance access to the mine (see Figure 2). A county plow truck operator saw emergency crews traveling toward the mine, came to their aid, and plowed the road to the mine. Weather was not considered to be a contributing factor to the accident.



**Figure 2 - Ambulance Staging Area at Angel Creek on November 17, 2013**

The directions to the mine from Ouray, Colorado are to travel south on U.S. Highway 550 (Million Dollar Highway) to County Road 361. Turn right on County Road 361 (Canyon Creek Road/Camp Bird Road). At the Camp Bird Mine, bear right onto County Road 26 to the mine site on the left. The distance from downtown Ouray to the mine is 6.9 miles and travel time during the accident investigation varied from 40 minutes on a clear day with no new snow on the road to over one hour when it was snowing or the road was ice covered.

Previous roads to the mine were replaced by the current road which was completed in 1890 (see Figure 3). The completion of the road reduced the steepest grade on the road to 15 percent, at the sharp turns or “switchbacks.” The road climbs from 7,900 feet in Ouray to 11,000 feet at the mine portal. The U.S. Forest Service closes the road to the public during the winter months at a location just before the switchbacks.



**Figure 3 – The Road to the Mine, Past and Present**

The Yankee Boy Basin Road that leads to the mine is owned by Ouray County. The mine gate is located where the road crosses Sneffels Creek. The mine is accessed through a key pad-locked gate across a wooden bridge over Sneffels Creek. The mine operator has the combination and it must be obtained prior to entering the mine site.

Since 1886, the mine operator has maintained the road during the winter months from the first switchback to the mine site, even though the county owns the road. From the switchbacks to the mine site, the road is single lane and very narrow with occasional pullouts for passing. There are no guardrails or berms along the road and the drop off to the creek below varies from approximately 500 feet to 1,500 feet. Tire chains are required to access the mine when the road is snow or ice covered. A section of the road, known as the “Overhanging Rock” (see Figure 3), prevents high clearance vehicles from accessing the mine and numerous sharp turns limit the length of vehicles that can use the road. The road is normally snow covered from November to June. However, snow accumulations have forced the road to be closed as early as September and remain closed until the following August.

**Mine Recovery Operations**

MSHA appointed an accident investigation team comprised of personnel from Metal and Nonmetal Mine Safety and Health, Technical Support, Educational Field Services, and the Office of the Solicitor. On December 3, 2013, the accident investigation team traveled to the mine, along with members of the MSHA Mine Emergency Unit (MEU) and management officials from the Rocky Mountain District, to implement Star Mine Operation, LLC’s approved

Mine Recovery Ventilation Plan to reventilate the mine so the accident could be safely investigated. MSHA modified the 103(k) order to allow the plan to proceed. Specifically, the modification provided that the MSHA command center would monitor and direct the recovery operation and have the latitude to make adjustments to the recovery plan as needed.

Mine rescue teams from San Juan Cooperative Mine Rescue and Front Range Mine Rescue also arrived at the mine to assist in the plan. They were assembled and briefed on the procedures and plans for exploration. Teams included an advancing team, a team at the fresh air base (FAB), and a backup team on the surface. A MEU member accompanied each team as well. Exploration was to be conducted bare-faced unless adverse concentrations of gases were encountered (i.e., less than 19.5 percent oxygen and more than 50 ppm carbon monoxide).

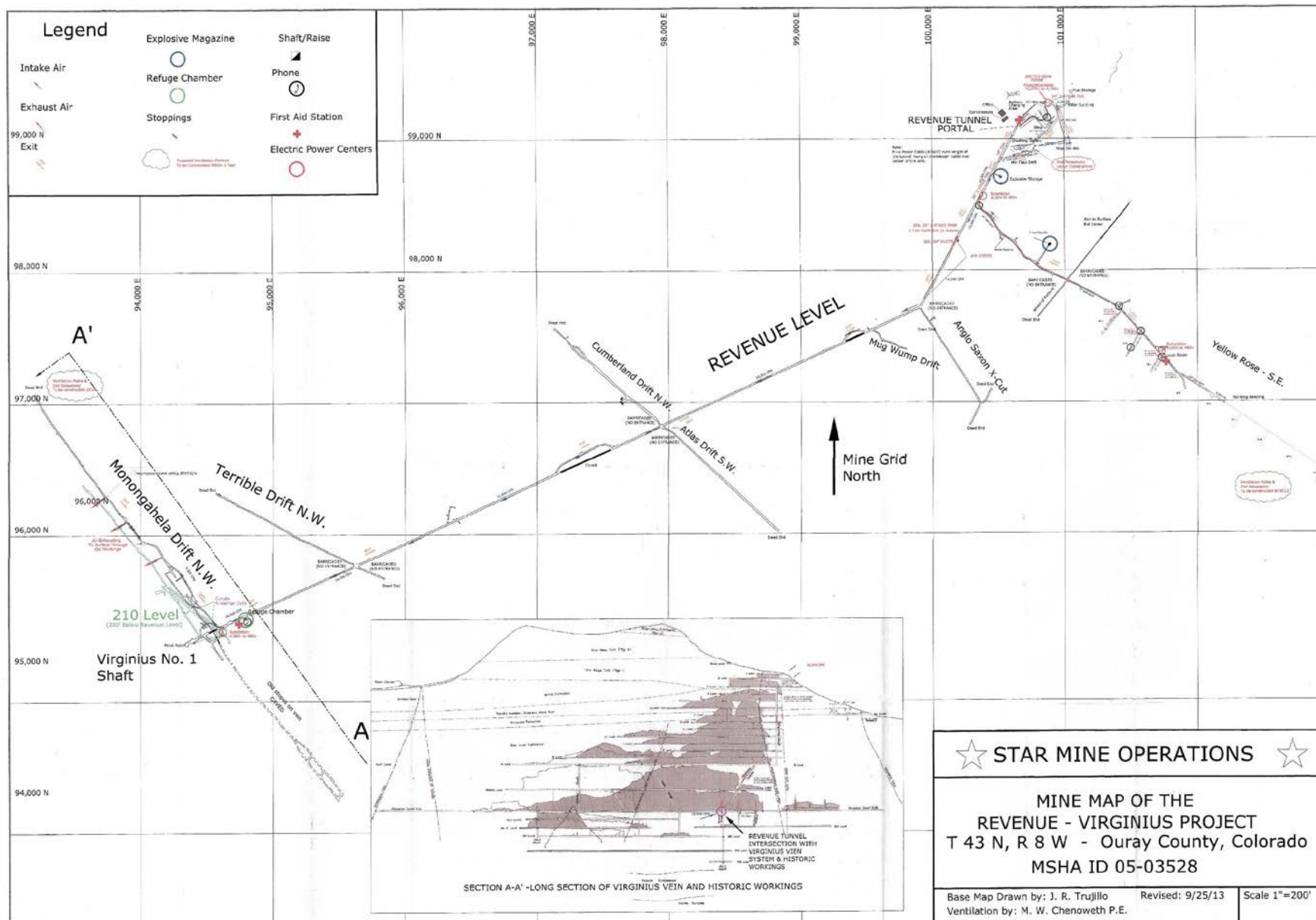
Following the briefing, the teams went into the mine. As the advancing team explored the mine, they found clear air and no damage from the main access portal to the Revenue lunchroom located near the Monogahela drift. The second team followed. A fresh air base (FAB) was established at the lunchroom. One team remained at the FAB to back up the advancing team. The advancing team moved in by the FAB to approximately 800 feet from the face until debris from the blast slowed their progress. The advancing team conducted the exploration of the mine bare-faced within 200 feet of the face of the Monogahela drift (the immediate accident scene). Four of the team members explored this area under apparatus. The maximum concentration of carbon monoxide found was 75 ppm. At that point, the team discovered the 4-inch diameter compressed air line, used to ventilate the face, was not blowing air. They requested and received permission to adjust the system valves to restore flow toward the face. The team followed the adjustment procedures outlined by company personnel familiar with the system. The teams reestablished airflow and then retreated from the mine. The entire recovery operation lasted about six hours.

## **Ventilation**

The Revenue Mine consists of the Revenue tunnel and associated drifts. The tunnel extends to the southwest approximately 7,600 feet from the Revenue Portal to the Virginus No.1 shaft. The tunnel connects to the historical Virginus mine workings near the Virginus No.1 shaft.

Three distinct work areas branch off of the Revenue tunnel: the Yellow Rose drift, the Monogahela drift, and the Virginus South. The Yellow Rose drift is located 650 feet from the portal. The Monogahela drift and the Virginus South are in close proximity to the Virginus No.1 shaft.

Ventilation in the mine is supplied by two 28-inch diameter, double 30 horsepower Spendrup fans in the Revenue tunnel. These main fans are located approximately 950 feet in by the portal and are connected in a blowing arrangement to two, 24-inch ducts. The two ducts extend through a pair of airlock doors allowing the fans to operate as if installed in a bulkhead. This creates positive ventilating pressure in by the doors. The doors are approximately 500 feet apart. A copy of the ventilation plan in effect at the time of the accident is shown in Figure 4.



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Figure 4 –Ventilation Plan Map for the Revenue Mine, September 25, 2013

## **Air Pressure/Quantity Survey**

From December 9 through December 11, 2013, the accident investigation team conducted an air pressure/quantity survey to assess the mine ventilation system. Pitot tube measurements indicated that the fans produce a total of 23,400 cubic feet per minute (cfm). The airflow measured in the Revenue tunnel averaged 15,600 cfm. There was 7,800 cfm leaking back through the airlock doors. The accident team measured the air pressure created by the fans across the doors at 1.22 inches of water gauge (in. water). The fans operate at a pressure of 4.3 in. water gauge and push air through the 24-inch ducting.

The accident investigation team also conducted a test to determine the effect on ventilation and air pressure when one of the airlock doors is opened. Measurements were taken with both doors closed and then again with the inby door open. The airflow in the Revenue tunnel was decreased by 1,200 cfm when the inby door was opened. The pressure across the doors decreased from 1.22 in. water gauge to 1.11 in. water gauge. This change in pressure did not significantly affect the ventilation inby the airlock doors.

Between the Revenue portal and the main fans, the Mill Feed drift was driven to the west from the Revenue tunnel about 190 feet inby the portal. An auxiliary fan produced 5,300 cfm of air from the Revenue tunnel to supply the Mill Feed drift. The effect of this fan on the mine ventilation system was insignificant due to its moderate volume and close proximity to the portal.

The Yellow Rose drift also was mined off the Revenue tunnel between the portal and the main fans. Most of the active workings are located in this drift. A 28-inch diameter Spendrup fan is installed blowing into a 24-inch diameter duct. This main duct extends the length of the Yellow Rose drift with auxiliary ducts branching off to ventilate active areas. The air exhausts through the drift into the Revenue tunnel. The exhausted air is drawn into the main fans and blown further into the mine. As a result, miners working inby the main fans were exposed to airborne contaminants generated by mining in the Yellow Rose drift.

During the ventilation survey, the accident investigation team measured 12,100 cfm of air in the Yellow Rose duct. This was less than the 15,600 cfm in the Revenue tunnel; therefore, no recirculation occurred in the Yellow Rose drift. The ventilation was confirmed with chemical smoke.

Chemical smoke tests were conducted at all of the old drifts intersecting the Yellow Rose drift. No airflow was found entering or exiting these openings, including the Wheel of Fortune drift which extends to the surface. Management also reported that at one time, the return air in the Yellow Rose drift recirculated through the Yellow Rose fan. In September, 2013, the mine operator added tubing to the fan inlet to extend it closer to the portal to prevent recirculation.

Each raise mined off the Yellow Rose drift was ventilated by approximately 2,500 cfm. Flexible tubing extended to the hideaway landings at each raise. Ventilation in the raise was provided using compressed air.

Airflow in the Yellow Rose drift, inby the lunch room, was 6,200 cfm. This airflow ventilated three crosscuts and the face of the Yellow Rose drift. There was 5,000 cfm of air reaching the

face. The accident investigation team also tested the air in the Yellow Rose drift using a hand-held gas detector. It did not find any airborne contaminants or oxygen deficiency.

Several drifts intersected the Revenue tunnel between the Yellow Rose drift and the Virginius No.1 shaft area - the Anglo Saxon drift, the Mug Wump drift, the Cumberland drift N.W., the Atlas drift S.W., and the Terrible drift. All of the drifts were tested with chemical smoke. No airflow entered or exited these drifts. During interviews, management indicated some of the drifts may have connected to old mine workings. Possible connecting mines were identified as the Monarch, Terrible, Atlas, Sidney, Cumberland, Camp Bird, Wheel of Fortune, Montana, and the Ophir tunnel. A review of historical maps confirmed the Virginius workings connect to the Ophir Tunnel and Camp Bird mine workings by way of the Montana Vein. The accident investigation team could not determine if any air exiting the Revenue mine through the Virginius workings traveled into these other mines. Management indicated an un-named raise near the airlock doors connects to the surface. No airflow was detected in the raise when tested with chemical smoke.

The southwest end of the Revenue tunnel intersects the Monogahela drift N.W. and the Virginius South at nearly right angles. The majority of the historical Virginius mine workings lie above the Monogahela drift and the Virginius South along the Virginius vein. The old workings extend to the surface. The Virginius No.1 shaft begins at this point and extends downward approximately 700 feet. The Revenue level is also the bottom end of the Virginius incline which extends upward through old workings towards the Virginius shaft. The Virginius shaft is offset from the Virginius No.1 shaft and extends upwards through the old workings to the surface.

The old workings above the Revenue tunnel level form the exhaust air course for the active workings. The air that ventilates the Revenue tunnel travels to the Virginius No.1 shaft area and the Virginius South. The end of the Revenue tunnel near the shaft had caved and a drift was mined around the caved area. This drift had 14,100 cfm of airflow while 1,500 cfm of air went over the cave for the total of 15,600 cfm exiting the Revenue tunnel (see Figure 5).

Of the 14,100 cfm going around the cave, 6,400 cfm went to the Virginius South and 7,700 cfm toward the No.1 Shaft. The air entering the Virginius South went into three raises driven up into old stopes. Management indicated this airflow travels through old workings to the surface. However, the accident investigation team could not determine the quantity of air flowing to the Virginius incline or down the No.1 shaft because the area around the shaft had not been rehabilitated and was unsafe for travel.

Minimal air flowed from the mouth of the Monogahela drift to the first crosscut; i.e., airflow was observed moving slightly inby near the back and slightly outby near the floor. Approximately 5,800 cfm was measured coming from the F9 raise and traveling outby in the Monogahela drift to the first crosscut. One crosscut, inby the F9 raise, was referred to as the "last open crosscut" because management and the miners believed airflow entered this crosscut. Chemical smoke tests showed no airflow entered or exited this opening.

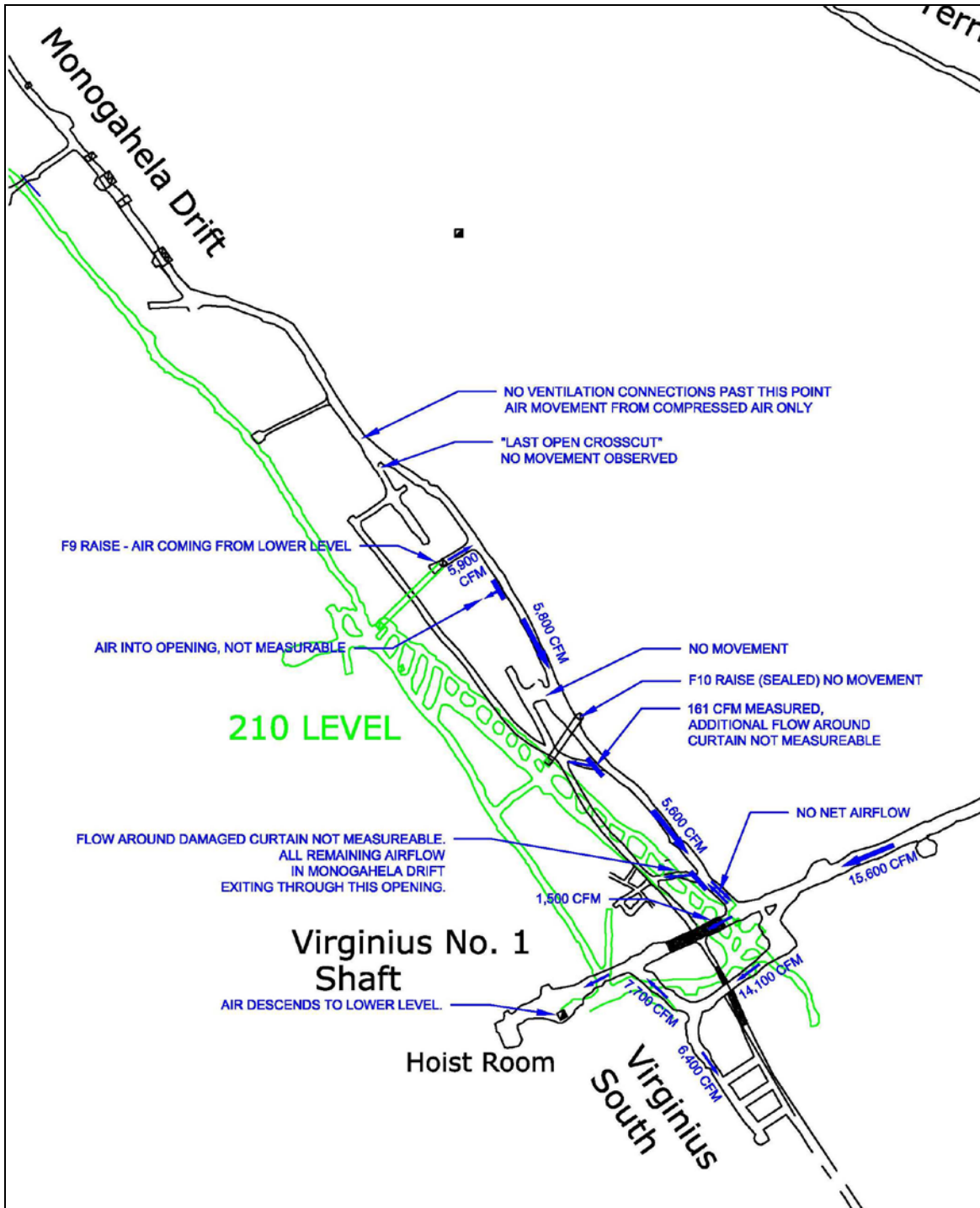


Figure 5 – Post-Accident Ventilation

The accident investigation team used chemical smoke to check every opening off the Monogahela drift, in by the last open crosscut, and no airflow was detected entering or exiting the drift. In by the F9 raise, compressed air lines, opened during the recovery, provided the only airflow toward the face of the drift. Measurements showed this quantity ranged from 1,300 cfm to 3,100 cfm. With the compressed airline closed, there would be no ventilation beyond the F9 raise. The F9 raise was located approximately 450 feet into the Monogahela drift. The drift was 2,300 feet long. The site of the explosive detonation was 50 feet from the face of the drift (2,250 feet into the drift), 1,650 feet beyond the last open crosscut and approximately 1,800 feet in by the F9 raise. A flexible ventilation duct had been installed in a portion of the drift; however, no fan was installed to provide forced airflow.

The accident investigation team conducted a tracer gas study to determine the source of the air exiting the F9 raise. The F9 raise connects to the 210 foot level (old workings) located below the Monogahela drift. One and one-half cubic feet of sulfur hexafluoride (SF<sub>6</sub>) gas was released at the bottom, over a 10-minute period, as close to the Virginus No. 1 shaft as possible. SF<sub>6</sub> was used since it is a man-made, non-toxic gas, detectable at concentrations in parts per billion ranges. Periodic atmospheric bottle samples were taken over a five-hour period in the airflow coming from the F9 raise.

The bottle samples were later analyzed using a gas chromatograph. The results of the tracer gas study showed that the air going toward the No.1 shaft exited the F9 raise 25 minutes after the release of the tracer gas. Of the 1.5 cubic feet of gas released, 1.4 cubic feet was accounted for. The results confirmed that 5,800 cfm of air was descending the No.1 shaft, traveling along the 210 level, and coming out at the F9 raise. Temperature measurements taken at the No. 1 Shaft and at the F9 raise indicated the air coming from the F9 raise was warmer and less dense than the air at the No. 1 Shaft. The air current was driven by natural ventilating pressure; however, the source of the warmer air on the 210 level could not be determined.

At the time of the accident, natural ventilating pressure also aided the mine's overall ventilation. Air warmed by the mine ascending the old workings to the surface at the top of the mountain is less dense than the air entering the Revenue portal. This creates a chimney effect and aids mine ventilation. The reverse would be evident in summer months, working against the mine fans.

## **Ventilation Plans**

### May 9, 2012 Plan<sup>11</sup>

The rehabilitation of the Revenue underground mine began in October 2011. Star Mine Operations, LLC submitted the mine's ventilation plan to MSHA in April, 2012. On April 25, 2012, the District Manager sent the operator a letter listing deficiencies with the plan. As a result, the operator submitted a revised ventilation plan, signed by John R. Trujillo, Project Director, on May 9, 2012. MSHA received the revised plan the same day. MSHA reviewed the plan and no deficiencies were found. The Assistant District Manager, on behalf of the District Manager, sent a letter to that effect to Star Mine Operation, LLC on the same day - May 9, 2012.

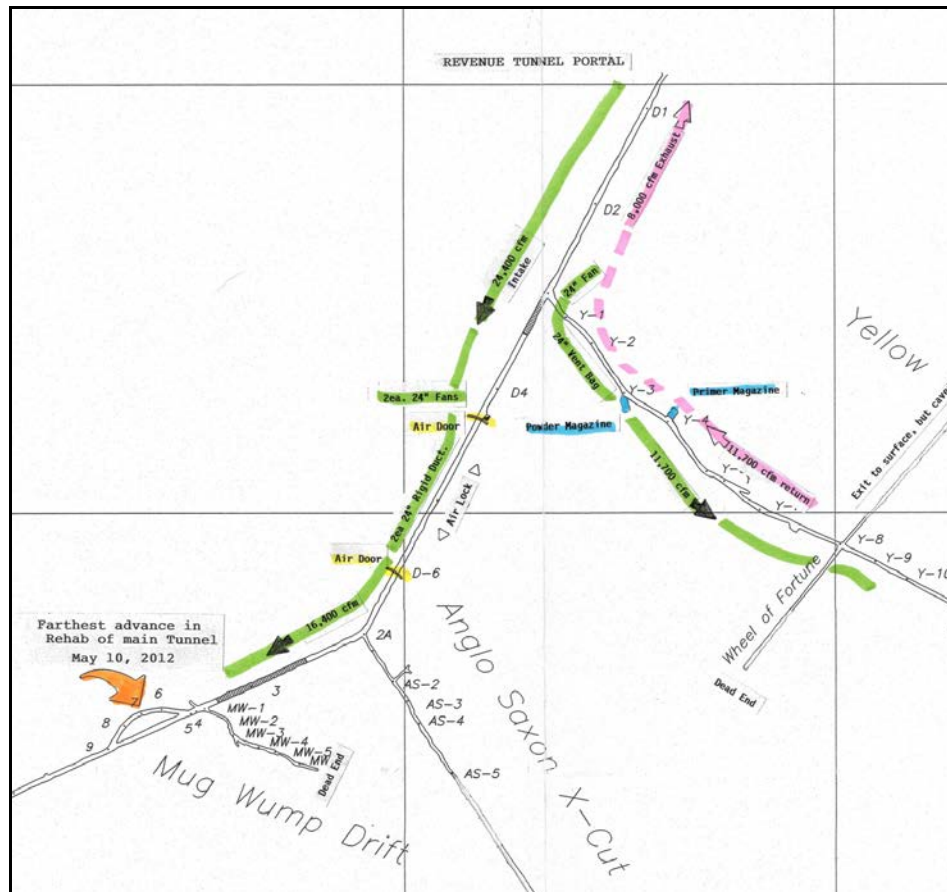
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<sup>11</sup> Per 30 CFR §57.8520, ventilation plans for underground metal and nonmetal mines are submitted to the MSHA District Manager upon written request for review and comment. All ventilation plans referenced in this section are listed by the date on which MSHA notified the operator that there were no deficiencies with the plan.



The revised plan map depicted that the single-entry Revenue tunnel had been rehabilitated a short distance beyond the Mug Wump drift, approximately 2,000 feet from the portal (see Figure 6). No ventilation arrows or controls were shown on the map in by the furthest point of rehabilitation. The plan indicated that two 24-inch diameter fans had been installed in the Revenue tunnel and indicated that the fans delivered 16,400 cfm to the tunnel. The map also indicated that the operator installed a separate 24-inch fan and approximately 1,000 feet of flexible ventilation tubing (vent bag) in the Yellow Rose drift. The map indicated that the fan in the Yellow Rose drift produced 11,700 cfm of airflow in the drift.

The air quantities shown on the map in the Revenue tunnel and in the Yellow Rose drift were consistent with those measured during the accident investigation; however, the revised plan map also depicted that 24,400 cfm was flowing from the portal to the fans in the Revenue tunnel and 8,000 cfm was exhausting from the Yellow Rose drift toward the portal in the same single-entry drift. Although the resultant airflow (16,400 cfm) was shown traveling past the fans, airflow could not travel in two directions as depicted without a physical separation between the two air currents.



**Figure 6 – Portion of the May 9, 2012 Ventilation Plan Map**

Star Mine Operations LLC attached a report entitled “Ventilation Analysis of the Revenue Level drift at the Virginius Mine” dated December 5, 2011, to the May 9, 2012 revised ventilation plan. The report was prepared by Agapito Associates, Inc., a mining engineering consultant firm. It

documented a mine ventilation study conducted by Agapito Associates, Inc. on November 16, 2011. At that time, Star Mine Operations LLC did not have any mechanical ventilation in place at the mine. The report indicated that all of the airflow measured in the mine was caused by natural ventilation. According to the report, the airflow was generated by the atmospheric density differences between the outside and the internal mine environments. The report stated “No air movement in or out of the main Revenue Level drift was detected, except at the Revenue Portal and the Monogahela drift area.” The report also stated “The Monogahela drift has been mined out to the surface and air flows in or out of the area depending on atmospheric conditions.” The report did not document where air flowed in or out of the drift and did not indicate air measurements beyond a few hundred feet into the Monogahela drift. It also indicated that four Spendrup fans were available for use at the mine. The report recommended that Star Mine Operations install two of these fans, with tubing, at the Revenue tunnel airlock doors and install a third fan, with tubing, to ventilate the Yellow Rose drift. According to the revised ventilation plan submitted on May 9, 2012, Star Mine Operations LLC implemented these recommendations.

#### January 23, 2013 Plan

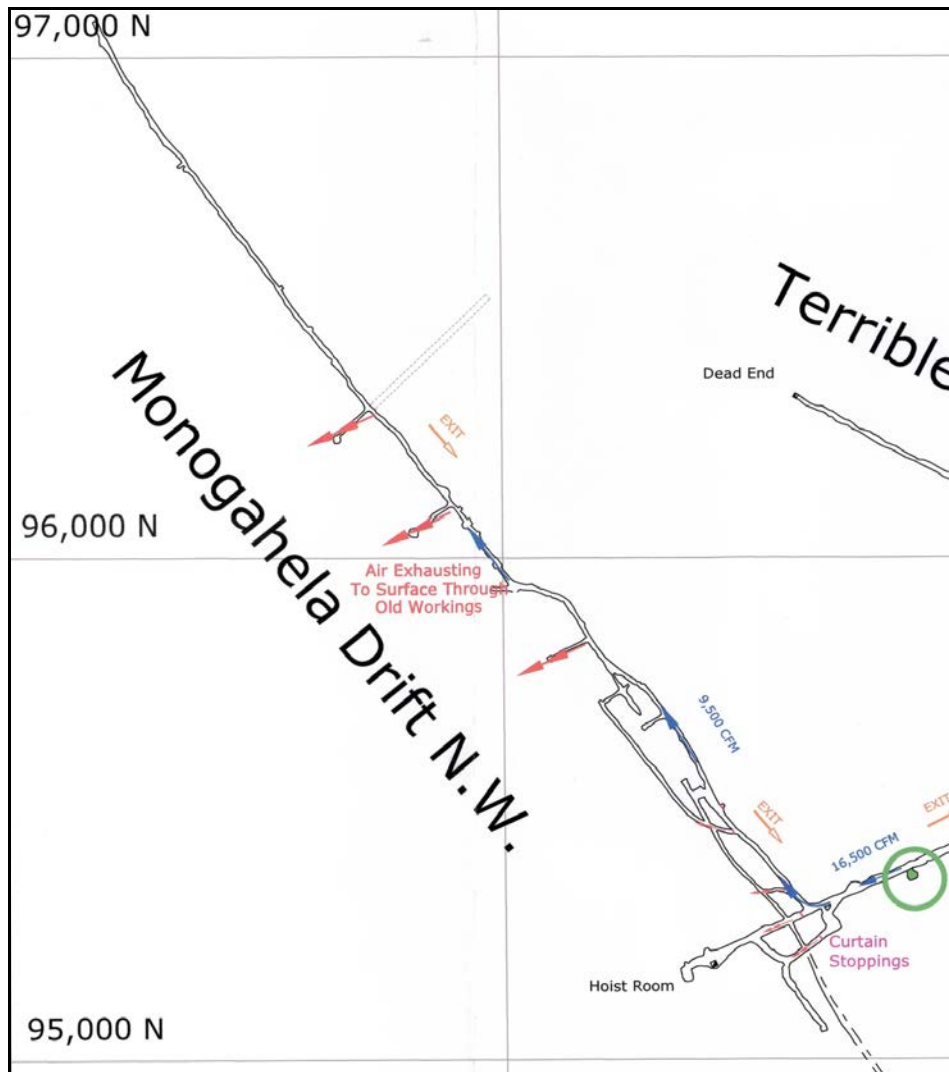
On January 10, 2013, the mine operator submitted an updated ventilation plan, signed by Trujillo, to MSHA. The plan stated that Trujillo prepared the base plan map and Martin W. Chenoweth, P.E prepared the ventilation data. (At the time, Chenoweth was a contractor working for TetraTech, Inc). MSHA received the plan on January 18, 2013, for review. On January 23, 2013, the Assistant District Manager, on behalf of District Manager, sent a letter to the operator stating MSHA did not find any deficiencies with the plan.

The plan map indicated that there was 16,500 cfm of air flowing in the Revenue tunnel with one fan running. The map depicted that the Yellow Rose drift was ventilated with one fan and associated tubing and produced an airflow of 11,700 cfm. This quantity was comparable with the measurements taken by the accident investigation team in connection with the accident (12,100 cfm). The 11,700 cfm was shown as exhausting from the drift toward the Revenue tunnel.

According to the plan map, airflow in the Revenue tunnel exited the mine through the Monogahela drift (see Figure 7). It also showed that the Revenue tunnel, in by the Monogahela drift (the track entry to the shaft), and the first two crosscuts off the Monogahela drift were to be closed off with curtain stoppings. This would have caused the main airflow to enter the Monogahela drift before exiting through old workings. During his interview, Chenoweth confirmed that he personally measured 9,500 cfm in the Monogahela drift at the location as designated on the plan map.

The plan map depicts air exiting the Monogahela drift through three drifts (drill stations) to the southwest off of the Monogahela drift; however, the accident investigation team found that the drill stations were dead end drifts and no air could exit. When asked about this map inaccuracy, Chenoweth stated he physically had not been to the drill stations at the time the map was prepared. Chenoweth thought the air exited through the “last open crosscut.” (The last open crosscut is located 600 feet in by the intersection of the Revenue tunnel and the Monogahela drift and just out by the three drill stations.) Chenoweth said that beyond the “last open crosscut,”

there was no ventilation other than compressed air. The compressed air line normally would have been capped on the end and the air drop valves closed. Therefore, unless compressed air was being used by a miner, the remaining 1,700 feet of the Monogahela drift remained unventilated. Chenoweth stated he would have been concerned if someone had been working there; however, in January 2013, the closest active working area was located about 7,000 feet outby in the Yellow Rose drift.



**Figure 7 – Portion of the January 23, 2013 Ventilation Plan Map**

The January 23, 2013, ventilation plan required the mine operator to indicate the “location of seals used to isolate abandoned workings” and the “location of areas withdrawn from the ventilation system” on the map (items 2 and 3 of ventilation plan). No seals were depicted on the map and no areas were shown as withdrawn from the ventilation system. This implies that all areas of the mine were ventilated.

In addition, Item 10d of the mine operator’s ventilation plan stated:

Diagrams, descriptions or sketches showing how ventilation is provided to typical work places. We currently have two main working areas in the mine, the Yellow Rose drift S.E. and the main Revenue Tunnel extending into the Monogahela drift N.W. Both of these working areas are being supplied abundant quantities of fresh air by the main fans as shown on the mine map. As we work in additional areas that are out of the main air flow we will use booster (auxiliary) fans and flexible vent bag to provide adequate air to those areas.

As the accident investigation team discovered, this was incorrect. The plan stated that the operator would use auxiliary fans to ventilate areas out of the main airflow: however, there were no auxiliary fans installed in the Monogahela drift.

#### September 27, 2013 Plan

On August 23, 2013, the mine operator submitted another updated ventilation plan to MSHA. The plan was signed by Danny M. Woodruff, Safety Manager. The corresponding map indicated that it was prepared by Trujillo with the ventilation by Chenoweth, now Technical Services Manager. (As of this submittal, Chenoweth had left TetraTech Inc. and was an employee of Star Mine Operations LLC.) MSHA received the plan on August 27, 2013 for review.

On September 10, 2013, the District Manager sent a letter to the mine operator identifying a number of deficiencies that MSHA found with the plan and asked for additional information/clarification:

1. §57.8520(b)(1) Please provide CFM air quantities readings at all exhaust locations on the mine map.
2. §57.8520(b)(1) Please describe how the Anglo Saxon Crosscut and Terrible drift are ventilated. Are these areas barricaded and posted as an unventilated area, per 30 CFR § 57.8528?
3. §57.8520(c) Mine fan data for all active main and booster fans including manufacturer's name, type, size, fan speed, blade setting, approximate pressure at present operating point, and motor brake horsepower rating. Please provide the above required information in the ventilation plan.
4. Please refer to the enclosed map #1. Can you describe what the thin lines are referencing?
5. Please refer to the enclosed map #2. Can you describe what the dashed line is referencing?

On September 26, 2013, Star Mine Operations LLC submitted a revised plan, which MSHA received the same day. In reviewing the revised plan, MSHA concluded that the operator addressed the deficiencies identified in MSHA's September 10 letter. Specifically:

1. The operator indicated that the air quantities provided on the September 26, 2013 plan map were the same as those indicated on the August 26, 2013, plan map.
2. The operator labeled the Anglo-Saxon crosscut and the Terrible drift as barricaded in the revised September 26, 2013 plan. Additionally, the operator labeled the Cumberland, Atlas, and the two Wheel of Fortune drifts as barricaded as well.
3. The operator provided the requested data for all active main and booster fans as requested.
4. The operator provided the requested explanation.
5. The operator provided the requested explanation.

On September 27, 2013, the Assistant District Manager, on behalf of the District Manager, sent the operator a letter stating that no deficiencies were found in the revised plan. This is the ventilation plan that was in effect at the time of the accident.

Items 1 and 2 identified in MSHA's September 10, 2013, letter were directly related to the accident. With respect to Item 1, if the operator took air quantity measurements, as requested, it would have found that the drift stations off the Monogahela drift were dead end drifts. Either the operator did not take measurements or it intentionally submitted the map using false information.

In item 2, MSHA recognized that there may be unventilated dead end drifts in the mine. The mine operator responded in the revised plan by addressing not only the two drifts in question, but four others. However, the accident team identified at least five other openings during the investigation which were not addressed in the revised plan – (1) the raise 900 feet into the Revenue tunnel at the first door; (2) the Mug Wump drift; (3) the drifts 5,500 feet into the Revenue tunnel; (4) the Virginus South drift; and (5) the Monogahela drift. All of these drifts were unventilated and management should have directed that they be ventilated, sealed or barricaded.

The September 27, 2013, plan indicated that there was 16,500 cfm flowing in the Revenue tunnel with one fan running. This air quantity was identical to the one shown on the January, 2013 plan map. The accident investigation team measured 15,600 cfm in the Revenue tunnel, but both of the main fans were running when air measurement was taken.

The Yellow Rose drift was depicted as ventilated with a fan and tubing producing 13,200 cfm near the mouth of the drift. This air quantity was consistent with measurements taken during the accident investigation (12,100 cfm). The same air quantity was shown as exhausting from the drift toward the Revenue tunnel. Further into the Yellow Rose drift, the map indicated 6,400 cfm of air near the face that was just in by Crosscut 6 (shown as XC-6 on the map). This air quantity was consistent with measurements taken during the accident investigation.

According to the September 27, 2013, plan map, the air quantity in the Monogahela drift was 9,500 cfm, the same air quantity and location as the January 2013 map (see Figure 8). However, the curtain stoppings depicted on the January 2013 map in the entry to the Virginus South and in the Revenue tunnel in by the Monogahela drift were not on the August 23, 2013, submittal.

These curtain stoppings also were not present during the accident investigation and the accident investigation team found that the airflow was traveling outby in the Monogahela drift as previously described. Consequently, the accident investigation team determined that the 9,500 cfm shown on the map was inaccurate.

The map also depicted the mine air exiting the Monogahela drift through the drill stations to the southwest and exhausting to the surface through old workings. As previously discussed, this was not possible because they were dead end drifts.

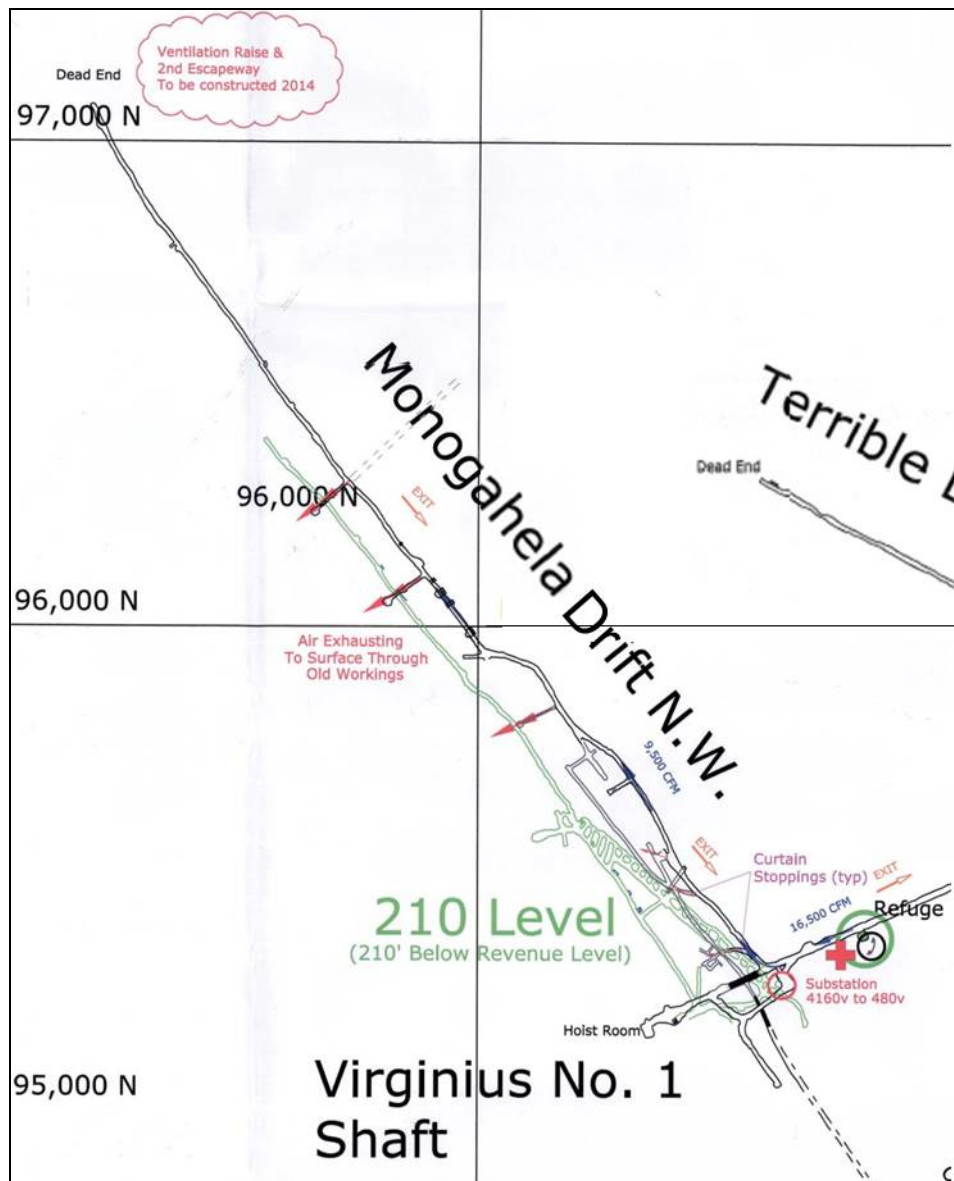


Figure 8 – Portion of the September 27, 2013 Ventilation Plan Map

## **Gas Detection Equipment**

The accident investigation team found Star Mine Operations, LLC had three hand-held multi-gas detectors at the Revenue Mine. Two of the instruments were Industrial Scientific Corporation (ISC) Model MX6 multi-gas detectors and the third instrument was a Mine Safety Appliance Company (MSA) Model Altair 5 multi-gas detector. When interviewed, Woodruff, Safety Manager, stated the gas detectors were stored in his office, but were available to the shift bosses and miners for use as needed. When Woodruff was onsite, the office was open and anyone could walk in and ask for a detector. When he was not at the mine, Woodruff stated that his office was locked, but the shift bosses had access to the office key and could take a gas detector at any time. R. Reese, Red Crew Shift Boss, stated that he could get a gas detector at any time, but did not typically need one. L. Kibel, Blue Crew Shift Boss, stated that when he suspected bad air, someone from the safety department would come underground and test the area for his crew. L. Kibel stated that unless Woodruff was present, the safety office was always locked, he had no key, and consequently, he could not get a gas detector to check for contaminants in the mine.

As part of the accident investigation, MSHA Technical Support personnel examined the gas detectors to determine their operational status and whether they contained any data from measurements taken before and during the accident, rescue, and recovery. The results of the examination revealed:

MX6 No. 1 was within calibration for O<sub>2</sub>, CO, NO<sub>2</sub>, and combustibles. The instrument was last calibrated on December 12, 2013, after the accident. Data was retrieved from this instrument with assistance from ISC.

MX6 No. 2 was within calibration for O<sub>2</sub>, CO, NO<sub>2</sub>, NO, H<sub>2</sub>S, and combustibles. The high range CH<sub>4</sub> sensor did not respond properly. The instrument was last calibrated on December 3, 2013, after the accident. Data was retrieved from this instrument with assistance from ISC.

The Altair gas detector was within calibration for O<sub>2</sub>, CO, and H<sub>2</sub>S. The combustible sensor was set to alarm at 20 LEL (Lower Explosive Limit) and responded properly. The instrument's internal clock was observed to be malfunctioning. Therefore, the data times retrieved from the instrument were unreliable.

The clocks in the MX6 detectors did not coincide with actual time when examined. The data from the MX6 instruments was corrected for time based on the times and measurements recorded by the mine rescue team during the recovery of the victims. MX6 No.1 contained data starting at 11:05 a.m. on the day of the accident. MX6 No. 2 contained starting at 8:41 a.m. on November 17, 2013 (the day of the accident).

The data from the day of the accident for CO concentrations is shown on Figures 9 and 10. The data indicates MX6 No. 2 was used during the rescue attempt by Ronald Williams, who entered the gas inundated area at 9:06 a.m. The recorded CO concentrations reached the sensor maximum value of 1,500 ppm within three minutes. It is not possible to determine the actual concentration beyond the sensor maximum. The indicated concentrations began to decline at

9:25 a.m. to a level of approximately 690 ppm CO where it remained for six minutes. After 9:31 a.m., the data indicates the instrument was no longer in the area contaminated by the blast. This coincides with the approximate time that Ronald Williams left the Monogahela drift and traveled to the refuge chamber.

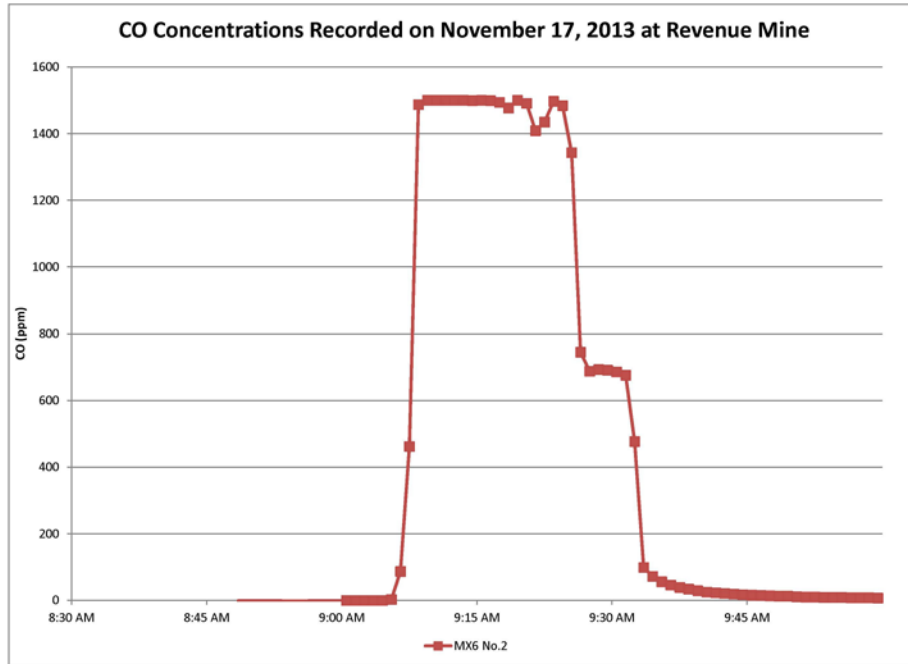
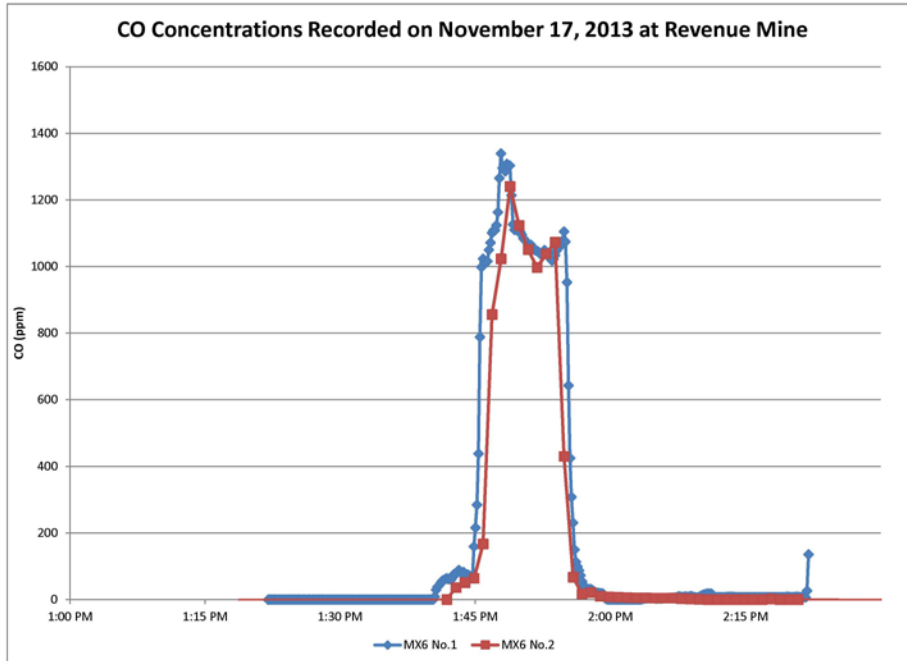


Figure 9 – MX6 No. 2

Data was retrieved from both MX6's indicating they were used during the recovery of the victims. During that time, CO concentrations still exceeded 1,000 ppm in the Monogahela drift (see Figure 10).





**Figure 10 – MX6 No. 1 and MX6 No. 2**

The peaks shown on the instruments during the initial rescue attempts show that the victims and injured miners were exposed to CO concentrations exceeding 1,500 ppm. The momentary plateau (at approximately 9:30 a.m.) shown in Figure 9 coincides with the time during which Ronald Williams had retreated to the compressed air line in the Monogahela drift after his low-air alarm sounded. The response of the gas detectors during the rescue attempts shows that, if the instruments had been used to conduct a post-blast examination, they would have alerted persons to the deadly atmosphere in the Monogahela drift..

### **Self-Rescue Devices**

Star Mine Operations, LLC provided all miners with Mine Safety Appliance (MSA) Model W-65<sup>12</sup> self-rescuers to wear while underground. Training records at the mine showed that the miners had been trained in the use of their self-rescue devices during new miner and annual refresher training. A training rescuer was used to demonstrate how to don the rescuer.

The accident investigation team found during interviews that only one miner used his W-65 self-rescuer after the accident during the initial rescue effort. Although the miner stated he was unsure how to properly don the device, he put it on as he entered the Monogahela drift, but removed it when he became ill and thought it was not working. Other miners interviewed stated that they did not use their self-rescue devices because there was no smoke. The miners

<sup>12</sup> The MSA W-65 self-rescuer functions by converting carbon monoxide to carbon dioxide through an exothermic reaction with the chemical hopcalite. The W-65 is donned by first opening the storage canister and removing the top cover. Second, the wearer grips the head straps and pulls the rescuer from the bottom cover (the rescuer will function with the bottom cover in place). Third, the wearer inserts the mouth piece with the flange inside the lips and bites down on the lugs. Finally, the wearer puts the nose clips on and pulls the strap over the head.

associated the presence of carbon monoxide with smoke. Although there were high concentrations of carbon monoxide in the Monogahela drift at the time of the accident, there was no visible smoke.

## **Explosives and Blasting**

### **Blasting Procedures**

Star Mine Operations, LLC did not have any written standard operating procedures (SOP) for blasting operations at the mine. Drilling, blasting, and mucking occurred on all shifts. Drilling crews established and marked a drill pattern in their respective raise or drift. A typical production shot consisted of approximately 35 holes and 200 pounds of explosives. The drillers would drill 1 $\frac{5}{8}$  inch diameter holes from 4 to 6 feet deep. Nippers were responsible for removing the explosives used for each shot from the storage facilities and delivering them to the work areas as needed. Management assigned the nippers the task of updating the explosive inventories. Nippers returned the unused explosives to the storage facilities and adjusted the inventories.

Once the holes were loaded with explosives, the shots were typically detonated after the miners exited the work area to eat lunch or left the mine at the end of the shift. Production blasting was typically conducted about two times per day. The broken rock from the previous blasts was mucked and transported to the surface stockpile.

When non-electric detonators were used, the safety fuse was lit and the explosives were detonated. When electric detonating caps were used, the shot was initiated from a remote blasting box using lead-in wire. Management did not specify a minimum safe distance from the blast site where miners should be safely located.

Management did not provide miners with an instrument to test the continuity of the electrical blasting circuit. According to persons interviewed, the shift bosses for the Alimak Raise Crews had requested blasting galvanometers on several occasions. To ensure a complete blasting circuit, each shot was dual primed with two caps in parallel to ensure positive detonation.

Management did not have any method to warn miners before firing a blast. There were no blasting sirens, horns, or other audible device available to warn miners of the impending blast. While constructing the crushing gallery and mill area, management used a megaphone to warn miners of an impending blast.

### **Post-Blast Procedures**

Star Mine Operations, LLC did not have any written SOP for post-blasting examinations at the mine. Neither management nor miners used multi-gas detectors upon re-entry to the blast area and they did not conduct a proper post-blast examination of each area. Shift bosses stated during interviews that they would watch for visible smoke in the blast areas. The shift bosses indicated that it normally took about an hour of “smoke time” before areas were reentered. When the miners went back into the blast area, they would carry scaling bars and bar down the loose

material as they traveled. There was no method for using blasting sirens, horns, or other audible device to advise miners that the blast area was clear. In addition, multi-gas detectors were not used to determine the levels of oxygen or concentration of airborne contaminants in work areas.

## **Explosives Storage, Handling, and Training**

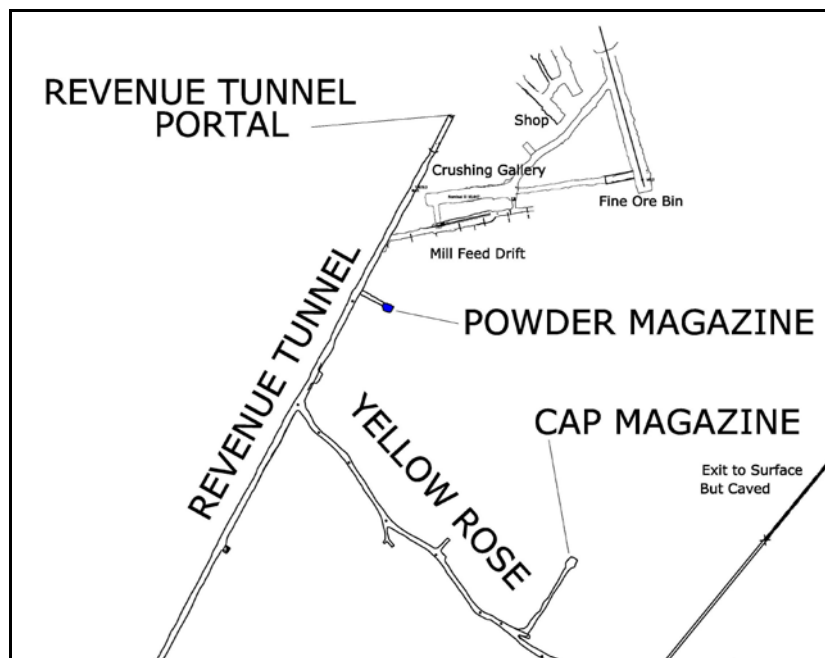
### **Explosives Storage Facilities**

The bulk explosives (powder) and detonator (cap) storage facilities were located underground (see Figure 11). Star Mine Operations, LLC did not use prefabricated facilities for explosives storage. Instead, the two storage facilities were rooms driven off existing drifts specifically mined for this purpose. Each facility was approximately 15 feet wide by 20 feet deep. The explosives storage facility was located approximately 53 feet from the mainline haulage in the Revenue tunnel and approximately 400 feet from the portal entrance. The storage facility's location did not meet the requirements of 30 CFR § 57.6160(a)(2) which states:

§ 57.6160 Main facilities.

(a) Main facilities used to store explosive material underground shall be located—

(2) So that a fire or explosion in the storage facilities will not prevent escape from the mine, or cause detonation of the contents of another storage facility.



**Figure 11 – Location of Explosives Storage Facilities in the Revenue Mine (each designated as “Magazine” on the map)**

The front of each storage facility had an expanded metal security gate in place and the roofs were bolted with chain link wire to secure the top (see Figure 12). Although an insulating material had been applied to the interior of the facilities, there were several areas found in each facility with exposed bare metal.



**Figure 12 – Entrance to Powder Storage Facility**

The back was not grouted or coated with shotcrete inside the powder storage facility; therefore, water constantly dripped onto the explosives (see Figure 13). The wet conditions damaged and deteriorated the explosives inside the facility. Water infiltration was not evident in the cap storage facility.



**Figure 13 – Inside of Powder Storage Facility**

The explosives were stored inside the powder storage facility on wooden shelving built along each rib. The shelves were located approximately 30 inches and 60 inches above the floor level. Explosives were stored in the original cardboard containers, but were not stacked to facilitate the use of the oldest product first. Some stacks had three or four different manufacturer's date coded boxes stored together. Approximately 3,750 pounds of blasting agent in the form of bagged ammonium nitrate / fuel oil mixture (ANFO) was stored on wooden pallets on the floor. Exposed metal nails protruding from the pallets presented an additional hazard to the bagged

ANFO and miners. The ANFO had been partially covered with a plastic tarp, but that did not prevent water damage. The packaged or stick type explosives were also exposed to the wet conditions causing some to become deteriorated. Some of the stick explosives had been cut down the entire length of the protective wrapper exposing the inside material to moisture (see Figure 14).

## Inventory

The operator kept the explosives inventory on company-generated forms separated by explosive type. Management assigned the nipper from each crew to use these forms to document the amount and type of explosives taken from or returned to each storage facility during their respective shift. The respective shift boss, ultimately, was responsible for daily monitoring of the storage facilities' inventories and for ensuring the inventories were accurate.

The accident investigation team conducted a physical inventory in each storage facility. The results showed that the operator, and specifically the responsible shift bosses, did not keep either facility's inventory current; i.e., the inventories did not reflect the actual amount of explosives in the storage facilities. Approximately 2,400 separate units of explosives were missing based on the total amount of each explosive type.



Figure 14 – Explosives in the Powder Storage Facility

## Explosives Training

Management did not provide adequate task training for the safe storage, handling, and use of explosives for anyone employed at the mine. Despite the fact that Cappanno (victim) did not have any explosives training, Star Mining Operations assigned him the job of nipper. In this position, for approximately one month, he removed explosives and caps from the storage facilities, transported them to the blasting area, and maintained the explosives inventory. In addition to his regular duties, Cappanno helped prime, load, and detonate the shot on November 16, 2013. Prior to his employment at the mine, Cappanno had no previous experience as a miner and no previous experience in the use of explosives.

## **The Bureau of Alcohol, Tobacco, Firearms and Explosives**

Due to inconsistencies regarding the explosives inventory and the condition of the explosives at the mine, the accident investigation team requested that agents and investigators of the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) assist in the inspection and investigation of the onsite explosives storage and use. ATF personnel and the Grand Junction, Colorado Bomb Squad assisted in the removal and safe disposal of approximately 400 pounds of deteriorated explosives and detonators. The ATF also conducted a physical inventory of the explosives onsite and reviewed the mine operator's records. At the conclusion of their investigation, the ATF recorded nine violations under Title 27, Code of Federal Regulations.

As a result of the ATF actions at the mine, the mine operator obtained two Type II storage magazines and placed them at a secure surface location on mine property. All of the explosives were removed from the underground mine and stored in these new magazines. In addition, Jack E. Clark, Underground Operations Manager, voluntarily forfeited his blasting license because all of the infractions cited by the ATF had occurred while he was the responsible licensee at the mine.

### **Examinations and Recordkeeping**

Star Mine Operations, LLC used a modified version of the "Five Point Safety System"<sup>13</sup> to comply with examination and recordkeeping requirements at the Revenue Mine (specifically, 30 CFR §57.18002 Examination of Working Places and 30 CFR §57.14100 Safety Defects; Examination, Correction and Records). As part of the mine operator's system, management developed a pocket-sized card which the miners referred to as the "5 Point Card" (see Appendix F).

Each day, the mine operator provided every miner a "5 Point Card" and expected them to complete it by the end of their work shift. The shift bosses were expected to review the cards, take appropriate action necessary to correct any noted hazards, and sign the card with the time it was signed. The shift bosses forwarded the cards to the mine foreman or the underground mine manager, whoever was on duty at the time. They were expected to review the information on the card, take appropriate actions to correct hazards that were noted by the miners and the shift bosses, and sign the card, including the time it was signed. The mine foreman or the underground mine manager submitted the cards to the safety manager for review and signature and then the operator was to file the cards.

The operator assigned inexperienced and untrained miners the responsibility of identifying hazards and conducting working place examinations. The operator failed to use its Five Point Safety System and associated 5 Point Cards as intended, and as a result, hazardous conditions

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<sup>13</sup> The 5-Point Safety System was crafted by Neil George, General Safety Engineer at Inco in Sudbury, (Ontario) and later Director of Safety with the Western Quebec Mines Accident Prevention Association. Since he introduced his "Five Point Safety System" in 1942, it has been adopted in mines across Canada and around the world. These are the five steps in the system: 1. Check the entrance to the place of work. 2. Are working place and equipment in good order? 3. Are people working properly? 4. Do an act of safety. 5. Can and will people continue to work properly?

were not properly identified, documented, and corrected. The operator failed to take the necessary follow-up and corrective actions to ensure the safety and health of the miners who worked at the Revenue Mine.

Under 30 CFR § 57.18002(a):

- (a) A competent person designated by the operator shall examine each working place at least once each shift for conditions which may adversely affect safety or health. The operator shall promptly initiate appropriate action to correct such conditions.

Volume IV of the MSHA Program Policy Manual for 30 CFR § 57.18002(a) states:

MSHA intends that the terms “competent person” and “working place,” used in §§ 56/57.18002(a), be interpreted as defined in §§ 56/57.2, Definitions.

A “competent person” according to §§ 56/57.2, is “a person having abilities and experience that fully qualify him to perform the duty to which he is assigned.” This definition includes any person who, in the judgment of the operator, is fully qualified to perform the assigned task. MSHA does not require that a competent person be a mine foreman, mine superintendent, or other person associated with mine management.

The phrase “working place” is defined in 30 CFR §§ 56/57.2 as: “any place in or about a mine where work is being performed.” As used in the standard, the phrase applies to those locations at a mine site where persons work during a shift in the mining or milling processes.

Evidence that a previous shift examination was not conducted or that prompt corrective action was not taken will result in a citation for violation of §§ 56/57.18002(a) or (c). This evidence may include information which demonstrates that safety or health hazards existed prior to the working shift in which they were found. Although the presence of hazards covered by other standards may indicate a failure to comply with this standard, MSHA does not intend to cite §§ 56/57.18002 automatically when the Agency finds an imminent danger or a violation of another standard.

By providing a 5 Point Card to all miners, the mine operator designated them as “competent persons.” The miners were expected to conduct a workplace examination in their respective work area regardless of their level of experience or training in mining. This included several new miners who were hired and assigned work duties prior to completing their required 40 hours of initial training or task training. In addition, experienced miners were hired and assigned work before they received their required experienced miner training or task training, which would have included an introduction to the work environment and hazard recognition.

On the day shift of November 16, 2013, Rick Williams received only one 5 Point Card from his crew. The miner documented under the heading “Today’s Line-Up – Work to be Performed / Special Instructions” section of his card “clean powder mag – help blast old powder – dispose of B.O. powder.” Neither Rick Williams nor any other management official signed the card. If the

intended procedure had been followed, various levels of management would have been aware explosives were detonated in the Monogahela drift. Immediate action should have been taken to ensure the safety of the oncoming shifts by informing them of potential hazards in the area, including the presence of toxic and poisonous gasses in the area.

The mine operator failed to ensure that miners were “competent” to conduct the work place examinations based on their respective training, ability, and level of experience. The mine operator also failed to ensure that the 5 Point Cards were being reviewed by all levels of management and appropriate follow-up action was taken to ensure the safety of miners.

Under 30 CFR § 57.18002(b):

- (b) A record that such examinations were conducted shall be kept by the operator for a period of one year, and shall be made available for review by the Secretary or his authorized representative.

Volume IV of the MSHA Program Policy Manual for 30 CFR § 57.18002(b) states:

Standards §§ 56/57.18002(b) require operators to keep records of working place examinations. These records must include: (1) the date the examination was made; (2) the examiner's name; and (3) the working places examined. MSHA intends to allow operators considerable flexibility in complying with this provision in order to minimize the paperwork burden. Records of examinations may be entered on computer data bases or documents already in use, such as production sheets, logs, charts, time cards, or other format that is more convenient for mine operators.

In order to comply with the record retention portion of §§ 56/57.18002(b), operators must retain workplace examination records for the preceding 12 months. As an alternative to the 12-month retention period, an operator may discard these records after MSHA has completed its next regular inspection of the mine, if the operator also certifies that the examinations have been made for the preceding 12 months.

Management failed to ensure that miners turned in the 5 Point Cards at the end of each shift, and failed to ensure that the 5 Point Cards were reviewed, and/or corrective actions were taken when necessary. Ultimately, by allowing their own system to fail, management did not have any methods to ensure the areas where miners worked or traveled were being examined on every shift and documented as required by 30 CFR §57.18002(b).

Under 30 CFR § 57.18002(c):

- (c) In addition, conditions that may present an imminent danger which are noted by the person conducting the examination shall be brought to the immediate attention of the operator who shall withdraw all persons from the area affected.

Volume IV of the MSHA Program Policy Manual for 30 CFR § 57.18002(c) states:



Evidence that a previous shift examination was not conducted or that prompt corrective action was not taken will result in a citation for violation of §§ 56/57.18002(a) or (c). This evidence may include information which demonstrates that safety or health hazards existed prior to the working shift in which they were found. Although the presence of hazards covered by other standards may indicate a failure to comply with this standard, MSHA does not intend to cite §§ 56/57.18002 automatically when the Agency finds an imminent danger or a violation of another standard.

On the day shift of November 16, 2013, miners complained to Rick Williams that the air in the drift was “bad.” (See “Significant Events Prior to the Accident” above). Rick Williams did not take any corrective action. He did not obtain or use a gas detector to test the atmosphere where the miners were working and he did not withdraw the miners from the area. He also did not report the apparent lack of ventilation to upper management.

After the shot was initiated, Rick Williams did not ensure that entrance to the drift was barricaded to warn others of the need to conduct a post-blast examination prior to entry. Further, neither Rick Williams nor any of the miners involved in the November 16 blasting noted the hazardous conditions in the Monogahela drift on their respective 5 Point Cards.

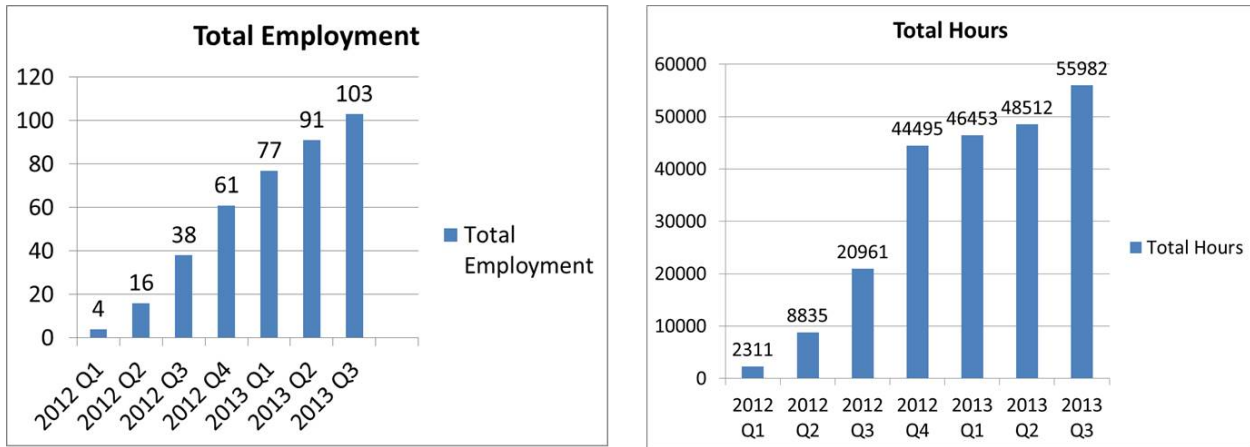
On the night shift of November 16, 2013, three miners told L. Kibel there was something wrong with the air in the Monogahela drift. (See “Significant Events Prior to the Accident” above). L. Kibel took no action to assist these miners or to ensure the safety of the miners who remained in the mine. He did not go into the mine to investigate the conditions in the drift that had caused their illnesses nor did he take any action to prevent others from going into the drift. Neither L. Kibel nor the three miners involved recorded any information concerning the incident on their respective 5 Point Cards or shifters’ reports. Finally, L. Kibel did not alert upper management to the incident or the imminent danger which existed in the Monogahela drift until he was informed of the fatal accident which occurred on the following shift. The operator ignored the imminent danger conditions identified, and brought to management’s attention, in the Monogahela drift on November 16, 2013, and this resulted in the death of two miners on November 17, 2013.

## **TRAINING AND EXPERIENCE**

Star Mine Operations, LLC began operations on October 19, 2011. The initial Part 48 training plan submitted by the mine operator on October 24, 2011 and was approved by the District Manager on the same day. The operator submitted an updated plan on May 30, 2013. MSHA returned it to the operator noting deficiencies with the plan. The operator revised the plan to address the deficiencies and resubmitted it to MSHA on July 22, 2013. The District Manager approved the plan on August 28, 2013. This is the Part 48 plan that was in effect at the time of the accident.

In the fourth Quarter of 2011, the mine operator reported that two surface miners were employed at the mine. In the first Quarter of 2012, the mine operator reported it employed four surface miners. After that, employment rose as the mine was rehabilitated and mining began. Figure 15 shows the dramatic growth of employment and the hours worked over a 1.75 year period. At the

time of the accident investigation (fourth Quarter of 2013), 120 employees were working at the mine.



**Figure 15 –Total Employment and Hours Worked at the Revenue Mine**

The accident investigation team reviewed all of the miners’ training records and noted discrepancies in the records. Many of the miners were assigned work duties prior to receiving required training. MSHA issued noncontributory citations during an E16 Spot Inspection for these violations. MSHA also issued citations for violations of all pertinent sections of 30 CFR Part 48, including New Miner under 30 CFR § 48.5 and § 48.25; Experienced Miner under 30 CFR § 48.6 and § 48.26; and Annual Refresher Training under 30 CFR § 48.8. These violations involved 50 miners which was nearly one half of the workforce. In addition, the operator was cited for a violation of 30 CFR § 48.7(b) for insufficient task training for all miners with respect to blasting operations at the mine. At the time of the accident investigation, this violation included 118 miners. A contributory violation was issued under the same standard for the accident victims.

From October, 2011 until April 2013, the mine operator used two onsite certified instructors and a variety of cooperative trainers to train the miners. In April 2013, Woodruff was hired as a full-time Safety Manager / Trainer.

Nicholas K. Cappanno (victim) was hired on October 14, 2013. He had no previous mining experience. Cappanno was assigned to work in the underground portions of the mine until November 1, 2013, when Woodruff (Safety Manager) realized that Cappanno had been assigned work duties without having the required training. At that time, Cappanno was removed from the mine and provided with 32 hours of classroom training. An MSHA Form 5000-23 was issued and signed by both Woodruff and Cappanno on November 4, 2013. Cappanno was sent back into the mine without having the required final 8 hours of training. Cappanno attended Annual Refresher Training on November 13, 2013. An MSHA Form 5000-23 was signed and placed in Cappanno’s training file.

Cappanno was assigned as a nipper to handle explosives for the mining crew, transporting the explosives to the mining areas. Cappanno worked alone at this task. His training file did not contain documentation that he had received task training for handling or transporting explosives.

Rick L. Williams (victim) was hired on June 12, 2012. He had 35 years of previous underground mining experience and was first assigned to the mining crew. In May, 2013, he was promoted to the Shift Boss position.

There was no documentation to show that Rick Williams had received the required Experienced Miner training at the time of his hiring. A 5000-23 certificate designated as Annual Refresher training, dated June 22, 2012, was issued and signed by Jack E. Clark, Underground Operations Manager. A second MSHA Form 5000-23 designated as Other, Site Specific, was issued and signed by Trujillo (Project Manager) on September 11, 2012. A third MSHA Form 5000-23 was issued to Rick Williams, designated as Annual Refresher, on November 29, 2012. The certificate was not signed by the instructor. Rick Williams attended Annual Refresher Training on November 13, 2013. An MSHA Form 5000-23 was signed and placed in his training file.

## ROOT CAUSE ANALYSIS

The accident investigation team conducted a root cause analysis to identify the underlying causes of the accident that were correctable through reasonable management controls. Listed below are root causes identified during the analysis and the corresponding corrective actions implemented to prevent a recurrence of the accident:

**Root Cause:** Management failed to establish safe blasting procedures. Specifically, management failed to establish procedures to ensure that damaged and deteriorated explosives were disposed of in a safe manner in accordance with the instructions of the manufacturer. Management failed to ensure that miners did not engage in blasting operations without direction and immediate supervision until the miners demonstrated safe blasting procedures. In addition, management failed to establish procedures to ensure that a person, with the ability and experience to perform an examination, conducted a post-blast examination to address potential blast-related hazards before work resumed in the blast area.

**Corrective Action:** After the accident, about 400 pounds of damaged and deteriorated explosives were removed from the mine and safely detonated by the ATF and Grand Junction Bomb Squad. The remaining explosives were removed from the underground storage facilities, inventoried, separated by product type and date code, and stored in surface magazines. Management established and trained all miners in safe blasting procedures. In the future, inexperienced miners will be supervised and directed until management determines the miners are fully trained and knowledgeable in safe blasting procedures. Management established procedures and trained all miners in the identification and proper disposal of deteriorated or damaged explosives. In addition, management developed written standard operating procedures (SOP's) regarding proper post-blast examinations and trained all miners in these SOP's.

**Root Cause:** Management failed to ensure that the Monogahela drift was ventilated or sealed or barricaded and posted against entry. Ventilation was not provided as stated in the submitted mine ventilation plan. The lack of ventilation in the Monogahela drift allowed carbon-monoxide gas to accumulate after the blast.

**Corrective Action:** Management developed a mine ventilation plan to ventilate the Monogahela drift. All other unventilated areas of the mine were ventilated, sealed, or barricaded and posted against entry.

**Root Cause:** Management failed to establish procedures to ensure miners did not enter areas where an imminent danger could be present. The shift bosses were not trained in addressing potential hazards which could cause immediate harm to the miners in the affected area.

**Corrective Action:** Management implemented procedures to train persons to recognize conditions that create an imminent danger. When an imminent danger is found, the condition will be immediately corrected or miners withdrawn from the area and the area barricaded and posted against entry.

**Root Cause:** Management failed to ensure MSHA was immediately contacted at once without delay within 15-minutes once the mine operator knew an accident (inundation of carbon monoxide) had occurred on November 16, 2013.

**Corrective Action:** Management implemented a notification tree to ensure MSHA is immediately contacted after an immediately reportable accident occurs.

## CONCLUSION

The accident occurred due to management's failure to dispose of deteriorated explosives in a safe manner in direct conflict with instructions that it received from the explosives distributor. The explosives were detonated in the Monogahela drift that was not ventilated and in which, according to mine records, miners were not to be working. Management failed to conduct a post-blast examination and did not provide any notice to the oncoming shift regarding blasting activities in the Monogahela drift. The Monogahela drift was not barricaded and on the next shift after the blast, two miners went into the unventilated area and reported feeling very ill; however, management still failed to take any action.

Additionally, management did not establish an accurate and effective ventilation plan, barricade or seal unventilated areas, indoctrinate new employees in safe work procedures, or properly train miners.

Finally, management failed to withdraw persons as a result of the imminent danger created by detonating the deteriorated explosives in an unventilated area of the mine. The Mine Safety and Health Administration (MSHA) was not notified of the immediately reportable accident that occurred on November 16, 2013.

---

Neal H. Merrifield  
Administrator for Metal and Nonmetal  
Mine Safety and Health

---

Date

## ENFORCEMENT ACTIONS

### Issued to Star Mine Operations, LLC

Order No. 8754902 - Issued on November 17, 2013, under the provisions of Section 103(j) of the Mine Act:

*A 103J order was verbally issued by Kenneth Valentine at 08:40 hrs. on this date when MSHA received an escalation report stating that two miners were down at this operation on November 17, 2013. Two miners were overcome by unknown gasses from a recent blast which may have displaced the oxygen. This order is being issued to withdraw all personnel from the affected area and to assure the safety of all persons at this operation. It prohibits all activity and entry at the underground portion of this mine until MSHA has determined that it is safe to resume normal mining operations to recover and/or restore operations.*

The order was subsequently modified to Section 103(k) after an Authorized Representative arrived at the mine. This order was terminated on March 5, 2014, after conditions that contributed to the accident no longer existed.

Order No. 8769606 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 57.6900:

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. Approximately 25 to 30 cases of deteriorated explosives (Dyno-Nobel Dynosplit D) were hauled into the face area of the Monogahela Drift and detonated in an open air blast. The drift was not sufficiently ventilated to clear the gasses produced by the blast.*

*Mine Management engaged in aggravated conduct constituting more than ordinary negligence in that: management was aware of the deteriorated explosives and failed to properly dispose of them; management was aware of the unsafe handling of explosives and took no action to correct the practice; and management was aware of safe practices for disposal but did not follow that procedure when disposing of the explosives. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769607 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 57.6306(g):

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. A post-blast examination of the Monogahela Drift was not conducted prior to work resuming in the blast area.*

*Mine Management engaged in aggravated conduct constituting more than ordinary negligence in that they: locked the necessary gas-detectors in their offices preventing miners from using them during post-blast examinations; did not ensure that a post-blast*

*examination was conducted after the blast in the Monogahela Drift; ordered miners into the blast area without conducting a post-blast examination; were aware there were inadequate post-blast procedures in use; did not include or ensure that post-blast examinations were included in the mines training plan. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769608 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 57.8528:

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. The unventilated Monogahela Drift was not barricaded or posted against entry. Mine management engaged in aggravated conduct constituting more than ordinary negligence in that they: failed to ventilate the area and still insisted on production from the area; knew the area was unventilated, failed to barricade or post the area, and continued to assign miners to work in the area. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769609 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 57.18006:

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. Nick Cappanno (victim) had not been indoctrinated in safe work practices as evidenced by his improper handling of explosives, entry into an unventilated area to dispose of explosives, and re-entry into an area after a blast without the knowledge or tools needed to prevent injury. Cappanno had been indoctrinated in unsafe work procedures such as entering drifts before toxic gasses had cleared, using his body as a gas meter, not accounting for explosives used or returned to explosive storage facilities, and moving explosives on a steel flat car. Cappanno's actions on the date of the accident show that he was unaware of the hazards related to blasting in unventilated areas therefore proving that he had not been indoctrinated in safe work procedures.*

*Mine management engaged in aggravated conduct constituting more than ordinary negligence in that they: were aware of the unsafe handling of explosives by Mr. Cappanno and took no action to correct the practice; were aware that Mr. Cappanno did not know of the hazards related to blasting in unventilated areas and failed to ensure that Mr. Cappanno wouldn't enter the affected area; demonstrated unsafe work procedures to the miners through the normal day-to-day operating procedures at the mine. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769610 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 57.18002(c):

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. The high levels of toxic gas in the Monogahela Drift that existed post blast on 11/16/2013 presented an imminent danger to miners*

*working in the area on evening shift. Miners discovered the condition while examining the area and the condition was brought to the attention of Management.*

*Mine Management engaged in aggravated conduct constituting more than ordinary negligence in that they were aware of an imminent danger condition at the mine and took no action to correct the condition or to withdraw people from the area affected. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769611 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 48.7(b):

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. Nick Cappanno (victim) and Rick Williams (victim) engaged in blasting operations and explosives disposal without having completed the required task training under 48.7a and without supervision by a miner with the required knowledge under 48.7b.*

*Mine Management engaged in aggravated conduct constituting more than ordinary negligence in that they did not train or ensure training was completed for Nick Cappanno or Rick Williams prior to them engaging in blasting operations. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769613 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 50.10(d):

*A fatal accident occurred at this operation on November 17, 2013 when two miners entered an unventilated area after a blast. Two other miners entered the Monogahela Drift during the evening shift prior to the accident and fell ill from exposure to toxic gasses. This condition was reported to Larry Kibel - Shifter and was investigated by Johnny Gillon - Track Crew Lead Man. Larry Kibel - Shifter and Johnny Gillon - Track Crew Lead Man engaged in aggravated conduct constituting more than ordinary negligence. This violation is an unwarrantable failure to comply with a mandatory standard.*

Order No. 8769614 - Issued under the provisions of 104(d)(1) of the Mine Act for a violation of 30 CFR 57.8520:

*On 9/25/2013 the mine operator submitted a written plan of the mine ventilation system including a map, which was received in the MSHA District Office on 9/26/2013. The base map was drawn by JR Trujillo and the ventilation was added by Martin Chenoweth PE. False information was submitted on the map, and required information was not included.*

*(1)The map showed that entries in the Monogahela Drift at the 7+00, 11+00, and 14+00 locations connected to the old works, with drift air exhausting out those entries. In fact, these entries dead ended into solid faces that did not connect to the old works and through which no exhaust air could possibly go.*

- (2) *There were no ventilation connections to the Monogahela Drift in by the 6+00 crosscut for a distance of 1700 feet despite them being shown on the map.*
- (3) *There was a connection to the old works at the F9 Raise that was not shown on the submitted map. Air from The Virginius Shaft traveled into the Monogahela Drift from the F9 Raise.*
- (4) *The approximately 6,000 CFM of air flow entering the Monogahela Drift from the F9 Raise was not shown on the map. This was the principal ventilating air flow for the Monogahela Drift.*
- (5) *The three crosscuts in the Virginius South Drift that were acting as an exhaust location into the old works were not shown on the map as active workings or as projected additions to the ventilation system.*
- (6) *There were known underground mine openings adjacent to the mine that were not shown on the map.*

*In addition, inspection revealed numerous conditions in the mine which were contrary to the ventilation plan submitted by the operator:*

- (1) *The air movement indicated on the submitted map at the 3+00 crosscut did not exist.*
- (2) *The intake air current of 9,500 CFM into the Monogahela Drift shown on the submitted map was not correct. The airflow was exhausting and measured at 6,154 CFM.*
- (3) *Curtains were not installed per the plan. The ventilation plan showed air curtains in the first three intersections of the Monogahela Drift. But the curtain in the first intersection was only half installed and the curtain in the third intersection was not in place.*
- (4) *Page 3 of the ventilation plan states that there were no internal combustion engine units underground however, the mine was using the following diesel equipment underground: Genie S-60 Man Lift Model #:S6006-14513, Skytrak 6042 Forklift Model #:0160023309, Caterpillar 268B Skid Loader Model #:CAT0268BCLBA01375.*
- (5) *Ventilation was not provided as stated in the submitted plan. The plan states: "As we work in additional areas out of the main air flow we will use booster (auxiliary) fans and flexible vent bag to provide adequate air to those areas." The work areas in the Monogahela drift which included the Chinaman Chute and the blast site near the face of the drift were not in the main air flow. But the operator did not ventilate them with fans and vent bags. This lack of ventilation allowed carbon-monoxide gas to inundate the Monogahela Drift after the blast detonated on November 16, 2013 and prevented removal of the gas from the drift, contributing to the deaths of two miners on November 17, 2013.*

*Mine Management engaged in aggravated conduct constituting more than ordinary negligence in that they: provided the map for the ventilation plan that showed the direction of air flows in the Monogahela and Virginius areas knowing that the ventilation shown on the map was not physically possible; constructed the ventilation plan and map with other false information and without the inclusion of required information such as the*



*location of connecting and adjacent mine openings; submitted the false information to MSHA; distributed the incorrect information to miners through the maps; set out the ventilation plan and failed to ventilate the working areas of the Monogahela drift as per the plan, despite miners' requests; failed to provide ventilation to the working areas prior to production and blasting work being conducted. Further, the mine's professional engineer signed the maps. This violation is an unwarrantable failure to comply with a mandatory standard.*

## **LIST OF APPENDICES**

Appendix A – List of Persons Participating in the Investigation

Appendix B – Victims’ Information

Appendix C – Underground Crew Schedule for November 2013

Appendix D – Historical Overview of the Revenue Mine

Appendix E – Monogahela Drift – Accident Scene Mapping

Appendix F – Star Mine Operation, LLC - “5 Point Card”

## APPENDIX A

### PERSONS PARTICIPATING IN THE INVESTIGATION

#### **Star Mine Operations LLC**

John R. Trujillo	Project Manager
John E. Trujillo	Surface Project Manager
Jack E. Clark	Underground Mine Manager
Daniel M. Woodruff	Safety Manager
Martin W. Chenoweth, P.E.	Mine Engineer
Donald J. Gurule	Mine Foreman
Larry D. Kibel	Shift Boss (Blue Crew)
Ryan L. Reese	Shift Boss (Red Crew)
Scott A. Kearns	Shift Boss (Green Crew)
George E. Munzing	Shift Boss (Orange Crew)
David G. Turcotte	Consultant (David Turcotte & Co., Inc.)
Cole A. Wist	Legal Counsel (Holland and Hart)
Jason A. Crow	Legal Counsel (Holland and Hart)
Gregory E. Goldberg	Legal Counsel (Holland and Hart)

#### **Bureau of Alcohol, Tobacco, Firearms and Explosives**

Steven L. Beggs	Supervisory Special Agent
Matthew Traver	Special Agent
Rebecca Sauerhaft	Special Agent
Rennie Mora	Special Agent
Gary Smith	Explosive Enforcement
Stephen Shelly	Explosive Enforcement
James D. Scholan	Investigator
Shanika Sanders	Investigator
Officers (five)	Grand Junction Bomb Squad

#### **Mine Rescue Teams**

San Juan Cooperative Mine Rescue	Ridgeway, Colorado
Front Range Mine Rescue	Broomfield, Colorado
GCC/King Coal Mine Rescue	Hesperus, Colorado

#### **State of Colorado**

Scott B. Waybright	Mine Inspector/Safety Trainer
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## **Mine Safety and Health Administration**

Donald J. Foster  
Kevin H. Abel  
Richard Laufenberg  
Michael T. Dennehy  
Melvin M. Lapin  
Joseph M. Denk  
Thomas A. Morley  
Keith S. Markeson  
Lee A. Hughes  
Mike H. Tromble  
L. Dave Smith  
Dan L. Vetter  
Michael Okuniewicz  
Donald A. Sulkowski  
Paul Huemrich  
Jason Reichart

Northeast District Manager (Team Leader)  
Northeast District Assistant Manager  
Rocky Mountain District Manager  
Rocky Mountain Assistant District Manager  
Denver Field Office Supervisor  
Northeast District Staff Assistant  
Supervisory Mining Engineer  
Mine Safety and Health Inspector  
Mine Safety and Health Inspector  
Mine Safety and Health Inspector  
Special Investigator  
Mine Safety and Health Specialist- Training  
Salt Lake City Field Office Supervisor  
Mining Engineer  
Environmental Engineer  
General Engineer

## APPENDIX B

### VICTIM INFORMATION

Accident Investigation Data - Victim Information

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



Event Number: 

6	6	1	6	2	1	4
---	---	---	---	---	---	---

<b>Victim Information: 1</b>																											
1. Name of Injured/ill Employee: <i>Nicholas K. Cappanno</i>				2. Sex <i>M</i>		3. Victim's Age <i>34</i>		4. Degree of Injury: <i>01 Fatal</i>																			
5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: <i>a. Date: 11/17/2013 b. Time: 8:35</i>								6. Date and Time Started: <i>a. Date: 11/12/2013 b. Time: 6:00</i>																			
7. Regular Job Title: <i>007 Nipper/ Powder Monkey</i>				8. Work Activity when Injured: <i>090 Post blast Inspection</i>				9. Was this work activity part of regular job? <table style="width: 100%;"><tr><td>Yes</td><td><input checked="" type="checkbox"/></td><td>No</td><td><input type="checkbox"/></td></tr></table>						Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>										
Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>																								
10. Experience		Years	Weeks	Days	b. Regular		Years	Weeks	Days	c. This		Years	Weeks	Days	d. Total		Years	Weeks	Days								
a. This										Mine:					Mining:												
Work Activity:		<i>0</i>	<i>4</i>	<i>6</i>	Job Title:		<i>0</i>	<i>4</i>	<i>6</i>			<i>0</i>	<i>4</i>	<i>6</i>			<i>0</i>	<i>4</i>	<i>6</i>								
11. What Directly Inflicted Injury or Illness? <i>023 Carbon Monoxide Gas</i>								12. Nature of Injury or Illness: <i>110 Asphyxiation/ Suffocation</i>																			
13. Training Deficiencies: Hazard: <table style="width: 100%;"><tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr></table> New/Newly-Employed Experienced Miner: <input checked="" type="checkbox"/> Annual: <input type="checkbox"/> Task: <input checked="" type="checkbox"/>														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
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 type="checkbox"/> First-Aid: <input checked="" type="checkbox"/> CPR: <input checked="" type="checkbox"/> EMT: <input checked="" type="checkbox"/> Medical Professional: <input type="checkbox"/> None: <input type="checkbox"/>																											
16. Part 50 Document Control Number: (form 7000-1) <i>220133260028</i>								17. Union Affiliation of Victim: <i>9999 None (No Union Affiliation)</i>																			

<b>Victim Information: 2</b>																											
1. Name of Injured/ill Employee: <i>Rick L. Williams</i>				2. Sex <i>M</i>		3. Victim's Age <i>58</i>		4. Degree of Injury: <i>01 Fatal</i>																			
5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: <i>a. Date: 11/17/2013 b. Time: 14:30</i>								6. Date and Time Started: <i>a. Date: 11/12/2013 b. Time: 6:00</i>																			
7. Regular Job Title: <i>049 Shift Boss</i>				8. Work Activity when Injured: <i>001 Accident recovery</i>				9. Was this work activity part of regular job? <table style="width: 100%;"><tr><td>Yes</td><td><input type="checkbox"/></td><td>No</td><td><input checked="" type="checkbox"/></td></tr></table>						Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>										
Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>																								
10. Experience		Years	Weeks	Days	b. Regular		Years	Weeks	Days	c. This		Years	Week	Days	d. Total		Years	Weeks	Days								
a. This										Mine:					Mining:												
Work Activity:		<i>0</i>	<i>0</i>	<i>1</i>	Job Title:		<i>0</i>	<i>21</i>	<i>5</i>			<i>1</i>	<i>22</i>	<i>5</i>			<i>36</i>	<i>22</i>	<i>5</i>								
11. What Directly Inflicted Injury or Illness? <i>023 Carbon Monoxide Gas</i>								12. Nature of Injury or Illness: <i>110 Asphyxiation/ Suffocation</i>																			
13. Training Deficiencies: Hazard: <table style="width: 100%;"><tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr></table> New/Newly-Employed Experienced Miner: <input type="checkbox"/> Annual: <input type="checkbox"/> Task: <input checked="" type="checkbox"/>														<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														
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 type="checkbox"/> First-Aid: <input checked="" type="checkbox"/> CPR: <input checked="" type="checkbox"/> EMT: <input checked="" type="checkbox"/> Medical Professional: <input checked="" type="checkbox"/> None: <input type="checkbox"/>																											
16. Part 50 Document Control Number: (form 7000-1) <i>220133260031</i>								17. Union Affiliation of Victim: <i>9999 None (No Union Affiliation)</i>																			

APPENDIX C

UNDERGROUND CREW SCHEDULE FOR NOVEMBER 2013

November 2013						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1 Red (D) Blue (N)  Orange (D) Green (N)	2 Red (D) White (N)  Orange (D) Green (N)
3 Red (D) White (N)  Orange (D) Green (N)	4 Red (D) White (N)  Orange (D) Green (N)	5 Blue (D) White (N)  Orange (D) Green (N)	6 Blue (D) White (N)  Orange (D) Green (N)	7 Blue (D) White (N)  Orange (D) Green (N)	8 Blue (D) Red (N)  Orange (D) Green (N)	9 Blue (D) Red (N)  Orange (D) Green (N)
10 Blue (D) Red (N)  Black (D) Green (N)	11 Blue (D) Red (N)  Black (D) Green (N)	12 White (D) Red (N)  Black (D) Green (N)	13 White (D) Red (N)  Black (D) Orange (N)	14 White (D) Red (N)  Black (D) Orange (N)	15 White (D) Blue (N)  Black (D) Orange (N)	16 White (D) Blue (N)  Black (D) Orange (N)
17 White (D) Blue (N)  Black (D) Orange (N)	18 Red (D) Blue (N)  Black (D) Orange (N)	19 Red (D) Blue (N)  Black (D) Orange (N)	20 Red (D) Blue (N)  Green (D) Orange (N)	21 Red (D) White (N)  Green (D) Orange (N)	22 Red (D) White (N)  Green (D) Orange (N)	23 Red (D) White (N)  Green (D) Orange (N)
24 Blue (D) White (N)  Green (D) Orange (N)	25 Blue (D) White (N)  Green (D) Orange (N)	26 Blue (D) White (N)  Green (D) Black (N)	27 Blue (D) Red (N)  Green (D) Black (N)	28 Blue (D) Red (N)  Green (D) Black (N)	29 Blue (D) Red (N)  Green (D) Black (N)	30 White (D) Red (N)  Green (D) Black (N)

## APPENDIX D

### HISTORICAL OVERVIEW OF THE REVENUE MINE<sup>14</sup>

The Revenue Mine was originally planned as a haulage level mine, with side benefits of water drainage and improved ventilation for the overlying mines of the Virginius, Terrible, Monogahela, Monarch, and Sydney Mines. The plan was only realized for the Virginius.

The history of the Revenue Mine starts with the discovery of silver in the area at the Virginius vein in 1876. Virginius Mine was first developed in 1880 with the first ore being extracted from the mine during the winter of 1878-1879 while the mine was in development.

The portal of the Virginius Mine is located at the head of the Yankee Boy Basin in the San Juan Mountains at an altitude of approximately 12,500 feet. Ore was initially hauled out through the portal entrance and later hoisted to the portal level from the lower levels of the mine.

The Revenue tunnel was started in the fall of 1888 to intersect the Virginius Vein at a depth of 2,000 feet at a grade of 0.33% to allow for natural drainage. The tunnel was conceived as a way to reduce the costs of transporting the ore by eliminating hoisting and extracting the ore from the mountain at a lower elevation closer to the rail head in Ouray, Colorado. The first vein cut by the tunnel was the Monarch vein which was intersected on August 1, 1892. The tunnel was considered completed on February 1, 1893 when the Virginius Vein was cut.

In 1902, the Revenue tunnel was connected to the Montana Mine which was originally serviced by the Ophir tunnel from the Telluride, Colorado side of the mountain, allowing ore from the Montana to be processed at the Revenue Mill. In 1917 a large strike was made on the Cumberland Vein off the Revenue tunnel.

The Ophir tunnel from the Telluride side of the mountain was connected to the Camp Bird Mine. Until about 1920 a miner could enter the Ophir tunnel near Telluride, Colorado, climb up a raise, and walk out the Camp Bird on the Ouray side.

In 1936 two 400-foot raises from the Revenue tunnel to the Terrible Vein were completed. In 1938 a three compartment 600-foot raise to the Cumberland Vein was planned and contracted. It is unknown if this raise was completed.

William B. Freland filed a claim for the Virginius Vein on June 28, 1876 and sold that claim on December 26, 1876 to C.C. Alvard, James M. Case, John Curran, and William L. Bradburn. Freland had never developed the claim into a mine.

On July 21, 1877, C.C. Alvard gained full ownership of the claim. The Caroline Mining Company, owned by Albert E. Reynolds and John M. Maugham, purchased the mine in 1880. The Revenue Tunnel Mines Company was formed by the consolidation of the Caroline Mining Company, the Hector Mining Company, and the Glacier Mining Company on July 30, 1900. From the spring of 1915 to December 1916 the mines were owned by the St. John Mining

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<sup>14</sup> The Great Revenue and Surrounding Mines, Doris H. Gregory ©1996.

Company of London. During World War I, when St. John Mining Company defaulted on its payments, the properties were repossessed by A.E. Reynolds. Currently, the Revenue Mines are owned by the Revenue-Virginus Corporation of Boulder, Colorado, and all of the shareholders are descendants of A.E. Reynolds.

Operator history of the mine includes several companies, starting with the transfer of holdings of the Revenue Mines Company to the Revenue Leasing Company of Kansas City in 1912. From that time to the present, the mines have been operated under leases.

In addition to the historical information provided above by Doris Gregory, the following information was obtained from water rights and permit filings with the State of Colorado.

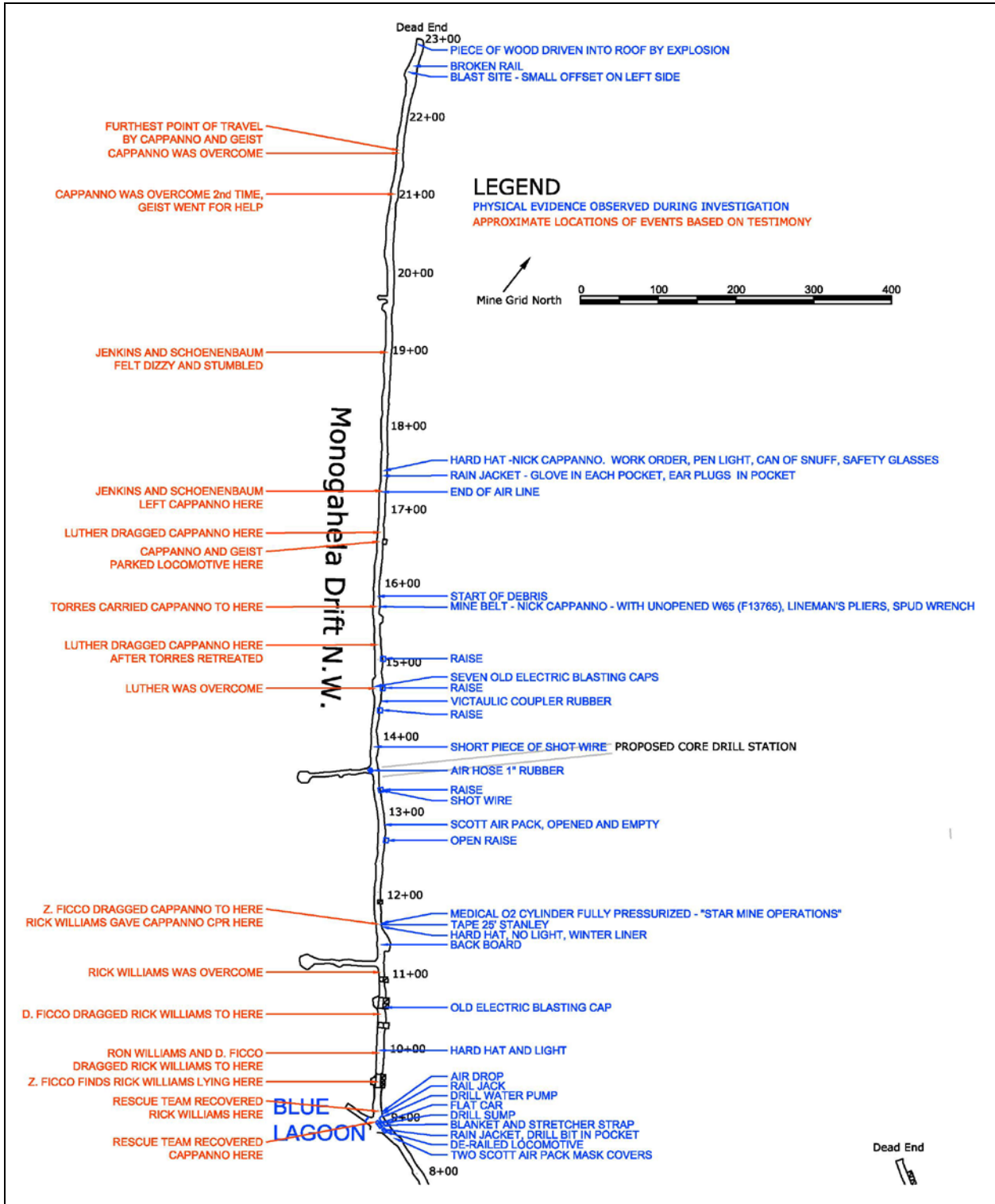
In 1945, the mine was leased and rehabilitation work was conducted by King Lease of the Camp Bird. In 1963, the mines were leased to Federal Resources Corporation. In 1964, Federal Resources conducted further rehabilitation work and extended a drift northwest from the Virginus #1 Shaft into the Monogahela workings. The company operated the mine until the fall of 1978 when they gave up the lease. At that time, the mines were leased to Ranchers Exploration and Development Corporation (REDC) with John R. Trujillo as Chief Geologist. Trujillo (Operations Manager for the Revenue Mine at the time of the accident) has been active in the operation of the mine since that time.

Over the next three to four years REDC opened up the Revenue tunnel and worked their way down the #1 Shaft, approximately 700 feet. In the 1980's Hecla Mining Company assumed the lease. In August 1984, Hecla closed the mine and then dropped the lease in 1986. Sunshine Precious Metals, Inc. leased the mine from 1995 to 2003; however, there is no evidence that any mining was performed. In 2011, Star Mine Operations, LLC obtained the rights to the property.

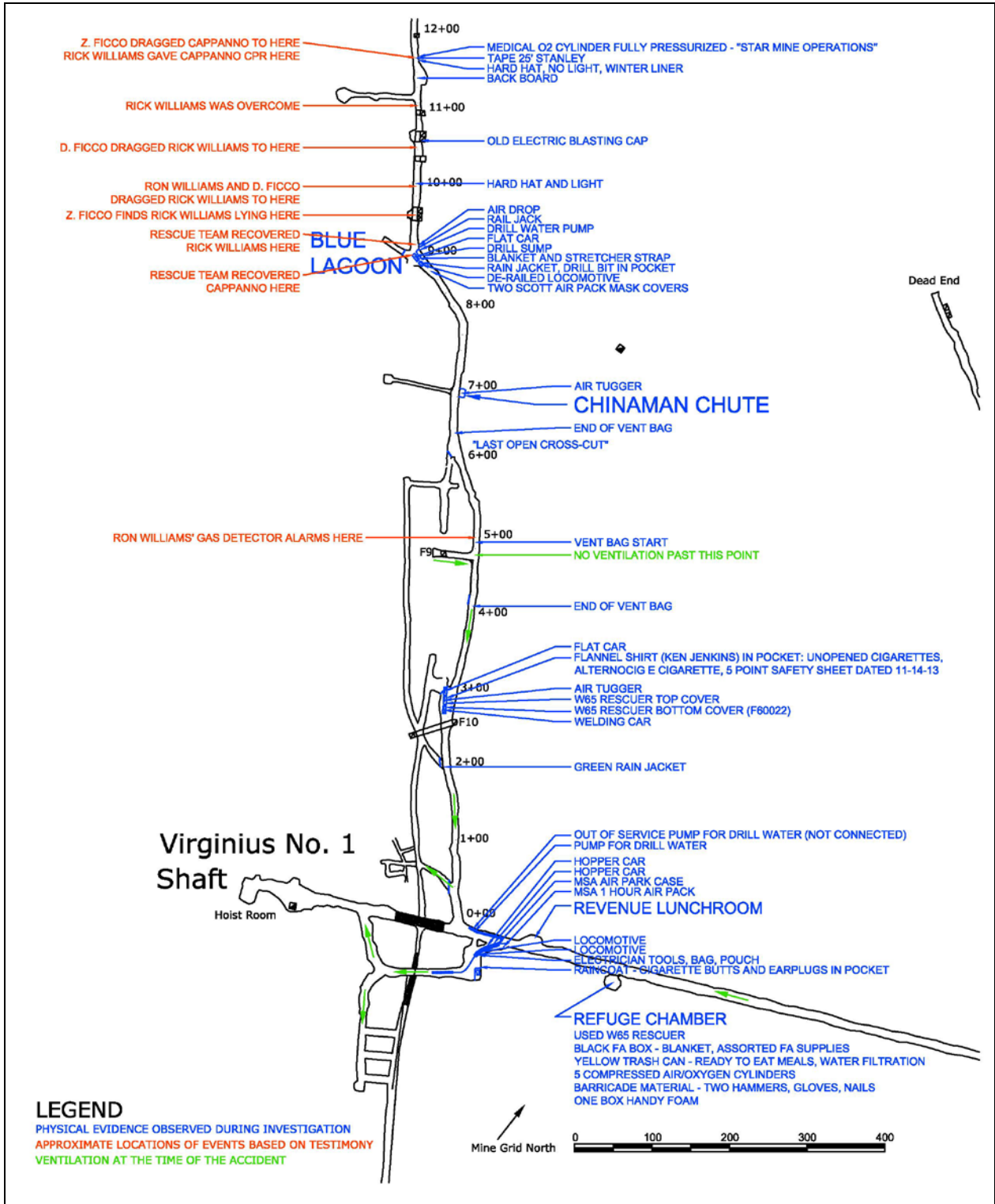


# APPENDIX E

## MONOGAHELA DRIFT – ACCIDENT SCENE MAPPING (PART 1)



# MONOGAHELA DRIFT - ACCIDENT SCENE MAPPING (PART 2)



# APPENDIX F

## STAR MINE OPERATIONS, LLC - "5 POINT CARD"

### Front Side

#### 5 PSS CHECKLIST

**TRAVELWAYS AND ENTRANCE**

- DRIFTS
- LADDES
- HOUSING
- VENTILATION
- LIGHTING
- CHASSIS SIGNS
- FUELING SYSTEMS

**WORKING PLACE**

- SCALING
- BOLTING
- BOOTLESS WASHED
- BOOTLESS MARKED
- HOUSING
- VENTILATION
- DANGER SIGNS
- GRAZE OIL
- LIFTERS PLUGGED

**ENVIRONMENTAL**

- FIRE CONTROUSION
- NOISE
- FIRE HAZARDOUS
- AIR WATER LEAKS
- DUST
- STORM WATER
- SPILLS
- FUEL/OIL STORAGE
- HOUSING

**EQUIPMENT/MATERIALS**

- CAP STORAGE
- SAFETY BARS
- GUARDS IN PLACE
- STAMPS
- FENCIBLES
- GARAGE
- BARFRAMES
- TOOLS, CARLES
- HOSE, SAFETY ROPES
- GLASSES, GLOVES
- ELECTRICAL INSTALLATIONS
- PPE
- HAZARDOUS MATERIALS

**MEN WORKING SAFELY AND PROPERLY?**

(A) HAVE UNSAFE CONDITIONS BEEN CORRECTED OR REPORTED?  
 (B) ARE EMPLOYEES WEARING APPROPRIATE PROTECTIVE EQUIPMENT?  
 (C) ARE EMPLOYEES USING THE PROPER TOOLS AND EQUIPMENT?  
 (D) ARE EMPLOYEES FOLLOWING WORKING PROCEDURES?  
 (E) HAS THE HOUSEKEEPING BEEN DONE?

**DO AN ACT OF SAFETY?**

(A) CAN AND WILL THE MEN CONTINUE TO WORK SAFELY?  
 (B) ARE THE EMPLOYEES WORKING SAFELY?  
 (C) DO THEY UNDERSTAND THE INSTRUCTIONS ON-SITE?  
 (D) HAVE THE EMPLOYEES BEEN TRAINED PROPERLY FOR THE WORK DONE?  
 (E) ARE THERE ANY DANGERS THE EMPLOYEES MIGHT FACE AFTER THE SUPERVISOR HAS LEFT THE WORKSITE?

**HAZARD IDENTIFICATION DEFINITIONS**

**Class A** - an event that could have resulted in loss of life or injury  
**Class B** - a safety hazard - A possible source of damage

#### TODAY'S LINE-UP

WORK TO BE PERFORMED/SPECIAL INSTRUCTIONS

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ALTERNATE TASKS

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WORK COMPLETED & COMMENTS FOR NEXT SHIFT


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STAR MINE OPERATIONS, LLC  
**5 POINT SAFETY SYSTEM**  
 SAFETY STARTS WITH YOU - REMAIN INJURY FREE

DATE: \_\_\_\_\_ DVS N/S Workplace \_\_\_\_\_

SUPERVISOR(S): \_\_\_\_\_

WORKER(S): \_\_\_\_\_

Safety Theme: \_\_\_\_\_

Yes  No

1. CHECKED TRAVELWAYS AND ENTRANCE TO PLACE OF WORK?

2. ARE WORKING PLACE AND EQUIPMENT IN GOOD ORDER?

3. AM I/ARE WE WORKING SAFELY AND PROPERLY?

4. DO AN ACT OF SAFETY (STOP AND CORRECT)?

5. CAN WE AND WILL WE CONTINUE TO WORK SAFELY AND PROPERLY? COMMENTS

WORKER: \_\_\_\_\_ TIME: \_\_\_\_\_

SUPERVISOR: \_\_\_\_\_ TIME: \_\_\_\_\_

SENIOR MNGT: \_\_\_\_\_ TIME: \_\_\_\_\_

SAFETY/OTHER: \_\_\_\_\_ TIME: \_\_\_\_\_

Date: \_\_\_\_\_

Shift: \_\_\_\_\_

Machine Number: \_\_\_\_\_

Hour Start: \_\_\_\_\_

Meter End: \_\_\_\_\_

Location: \_\_\_\_\_

State of unit: \_\_\_\_\_

	UNIT 1	UNIT 2	UNIT 3	UNIT 4

Repairs needed:

Unit 1: \_\_\_\_\_

Unit 2: \_\_\_\_\_

Unit 3: \_\_\_\_\_

Unit 4: \_\_\_\_\_

Other: \_\_\_\_\_

Print: \_\_\_\_\_

Operator: \_\_\_\_\_

Supervisor: \_\_\_\_\_

Mechanical Dept:

Supervisor: \_\_\_\_\_

Work order: \_\_\_\_\_

Vehicle pre-ops must be completed as per 30 CFR Part 57.14100

### Reverse Side

OPERATION UNIT PRE-OPERATION LIST

	UNIT 1	UNIT 2	UNIT 3	UNIT 4
<b>FLUIDS</b>				
Engine oil				
Hydraulic oil				
Transmission oil				
Coolant/Water/Freeze				
Diesel				
<b>GREASE</b>				
Suction pins				
Centre pins				
Boom pins				
Nozzle block				
Oscillating axis				
Steering cylinders				
Hoist cylinders				
Dump cylinders				
<b>VISUAL CHECKS</b>				
Fan, drive belts, guards				
Hoses				
Tires, pins & wheel nuts				
Wheel chocks				
Fire extinguisher				
Fire suppression system				
Operator's compartment				
Damage				
<b>AFTER STARTING</b>				
Lights				
Instrument readings				
Leak & warning systems				
Controls				
Exhaust systems				
Tire leaks				
<b>SAFETY TESTS</b>				
Brake tests completed				
is per procedure				

**DO NOT OPERATE UNSAFE EQUIPMENT**

Vehicle pre-ops must be completed as per 30 CFR Part 57.14100

#### WORKPLACE INSPECTION

Check List:   
 ✓ = OK   
 N/A = Not Applicable   
 X = Action Required

Code:   
 W = Worker   
 S = Supervisor   
 SL = 2nd Line Supervisor

Location	1			2			3		
	W	S	SL	W	S	SL	W	S	SL
Coste									
Ventilation									
Housekeeping									
Ground Condition									
Ground Support									
Signs / Barricades									
Proper PPE used									
Machine Guards									
Lock & Tag									
Face Prep.									

FURTHER ACTION REQUIRED: \_\_\_\_\_

RESPONSE TO WORKER'S SAFETY CONCERNS \_\_\_\_\_

**STOP AND CORRECT 5X5**

#### IDENTIFY HAZARDS

**ASSESS THE RISKS**

**CONSEQUENCES**

- Could kill, permanently disable, or cause very serious damage
- Could cause serious injury or damage
- Could cause moderate injury or moderate damage
- Could cause first aid injury or minor damage
- Could not cause injury or damage

**PROBABILITY**

A ALMOST certain to happen  
 B LIKELY to happen  
 C MODERATE, possible, it might happen  
 D UNLIKELY, not likely to happen  
 E RARE, practically impossible

CONSEQUENCE	PROBABILITY					RISK LEVEL
	A	B	C	D	E	
1						INTOLERABLE  HIGH  MODERATE  LOW
2						
3						
4						
5						

#### HAZARD IDENTIFICATION

Environmental hazard or Spill

Close Call  Safety Hazard

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Location Equipment # \_\_\_\_\_

Describe what did or could occur \_\_\_\_\_

What action has been taken to reduce or eliminate the hazard? \_\_\_\_\_

Suggestions for improvement \_\_\_\_\_

Status EOG? Not Started  In Progress  Complete

Is further investigation required? YES  NO

Supervisor Classify Hazard: Class A  Class B  Class C

**Class A** - Any condition or practice with potential for permanent disability, loss of life or body part and/or extensive loss of structure, equipment, material.

**Class B** - Any condition or practice with potential of serious injury/ illness or property damage that is disruptive but less severe than Class A.

**Class C** - Any condition or practice with probable potential for non-disabling injury or illness, or non-disruptive property damage.