Collision Avoidance Systems and Collision Warning Systems

Reducing Surface Mobile Equipment Accidents Through Technology

MSHA POWERED HAULAGE INITIATIVE

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MSHA Powered Haulage Safety Initiative

Request For Information (RFI)

- MSHA Published RFI on June 26, 2018
- RFI Seeks Information on Technological Improvements for Powered Haulage Equipment that may have Lifesaving Implications for the Mining Industry
- RFI Closes on December 24, 2018

U.S. Department of Labor
MSHA
Mine Safety & Health Administration

MSHA Powered Haulage Safety Initiative

7 Stakeholder Meetings Held During August and September

- Birmingham, AL
- Dallas, TX
- Reno, NV
- Beckley, WV
- Albany, NY
- Arlington, VA
- Webinar

U.S. Department of Labor
MSHA
Mine Safety & Health Administration

MSHA Powered Haulage Safety Initiative

Areas of Focus

- Mobile Equipment at Surface Mines
  - Seat Belts
  - Large Equipment Striking Smaller Equipment
  - Highwalls and Dump Points
- Conveyor Belt Safety

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Mobile Equipment at Surface Mines

- Equipment Collisions with Other Equipment
- Equipment Collisions with Pedestrians

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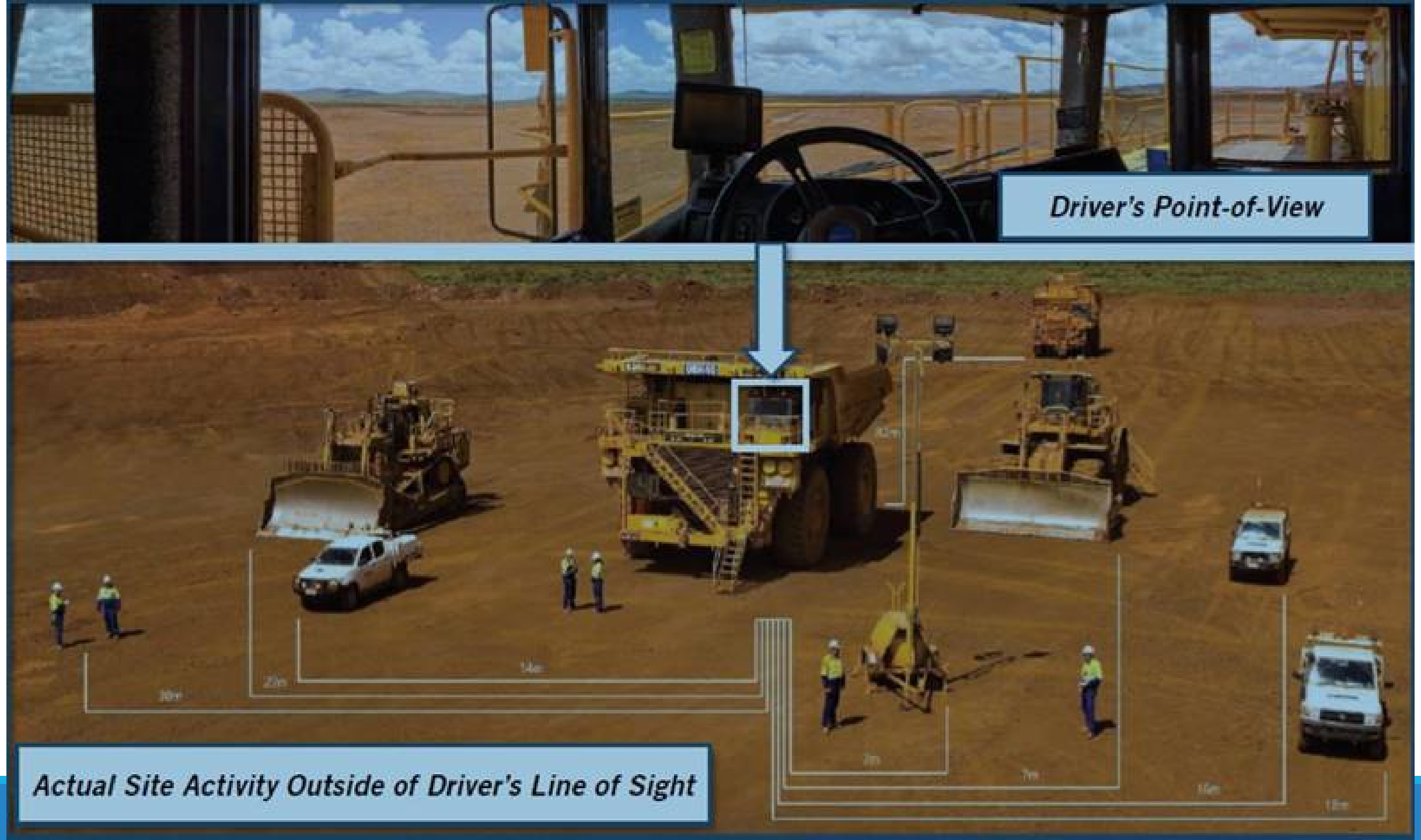
Mobile Equipment at Surface Mines

- 2017 Accidents
  - Nearly 40 % of Fatalities Involved Mobile Equipment
  - Over 30% of Injuries Involved Mobile Equipment
- Since 2007 - 61 Mining Fatalities Involving Mobile Equipment

Mobile Equipment at Surface Mines

Blind Areas

- Mobile Equipment Size and Shape and the Operator's Cab Location can each Create Unique Blind Areas
- Blind Areas have Contributed to Mobile Equipment Operators Driving over Highwalls or Dump Points, Colliding with Other Equipment, and Striking Miners


Driver's Point-of-View
Actual Site Activity Outside of Driver's Line of Sight

Blind Areas

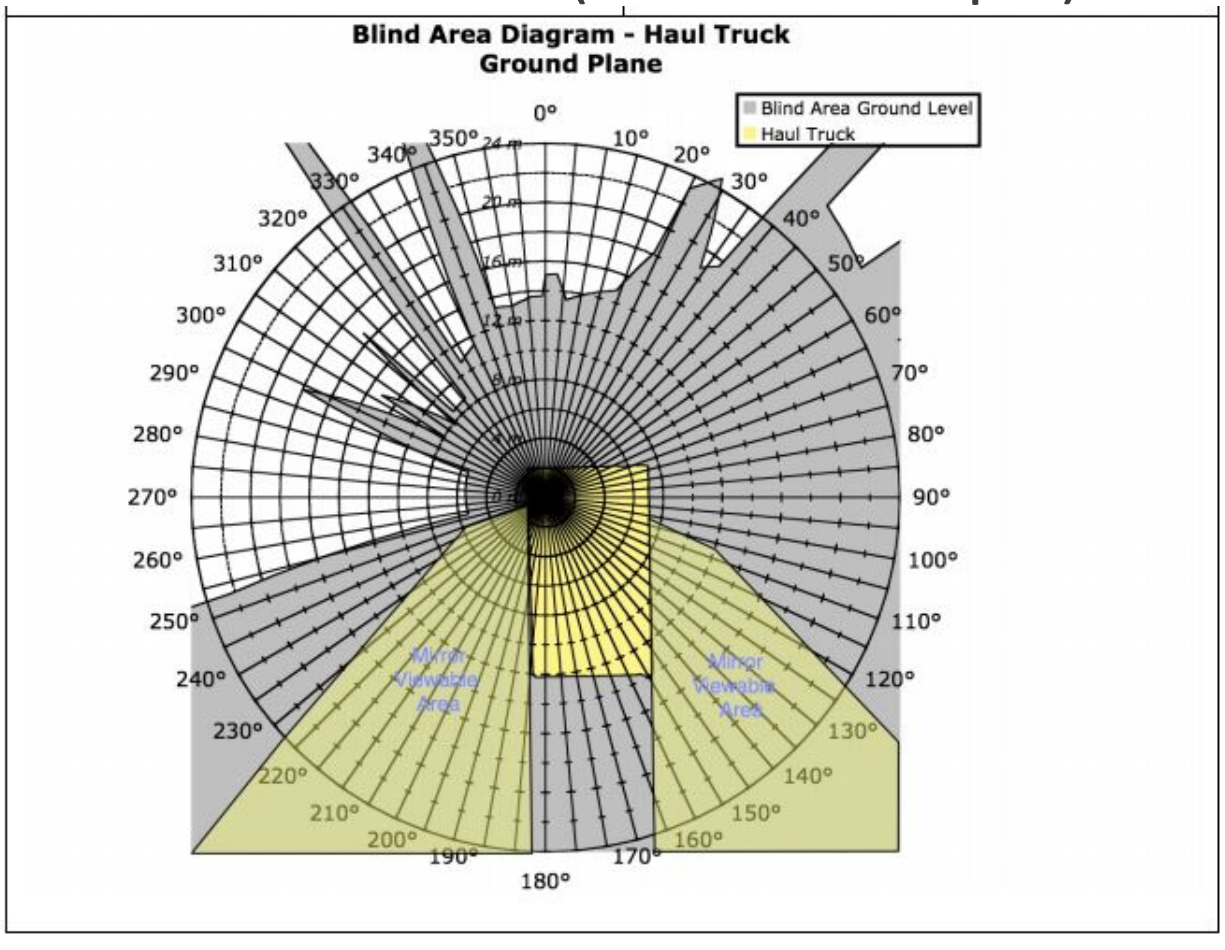
- NIOSH has Developed a Manual Method of Evaluating Mobile Equipment Blind Areas

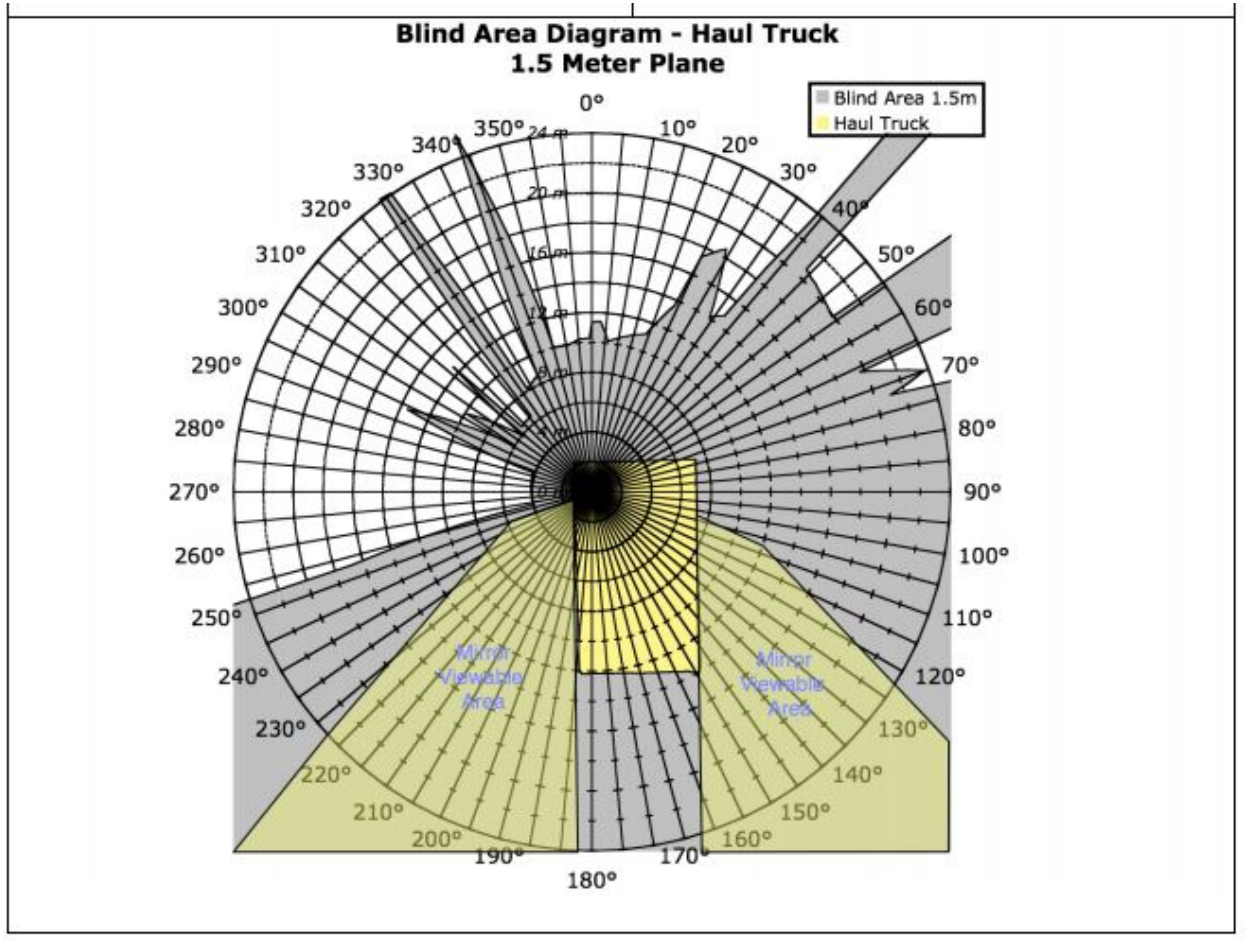
- Simplified Version of ISO Method Used by OEMs to Enable End Users to Perform Evaluations

  - https://www.cdc.gov/niosh/topics/highwayworkzones/bad/manualmethod.html

Blind Areas

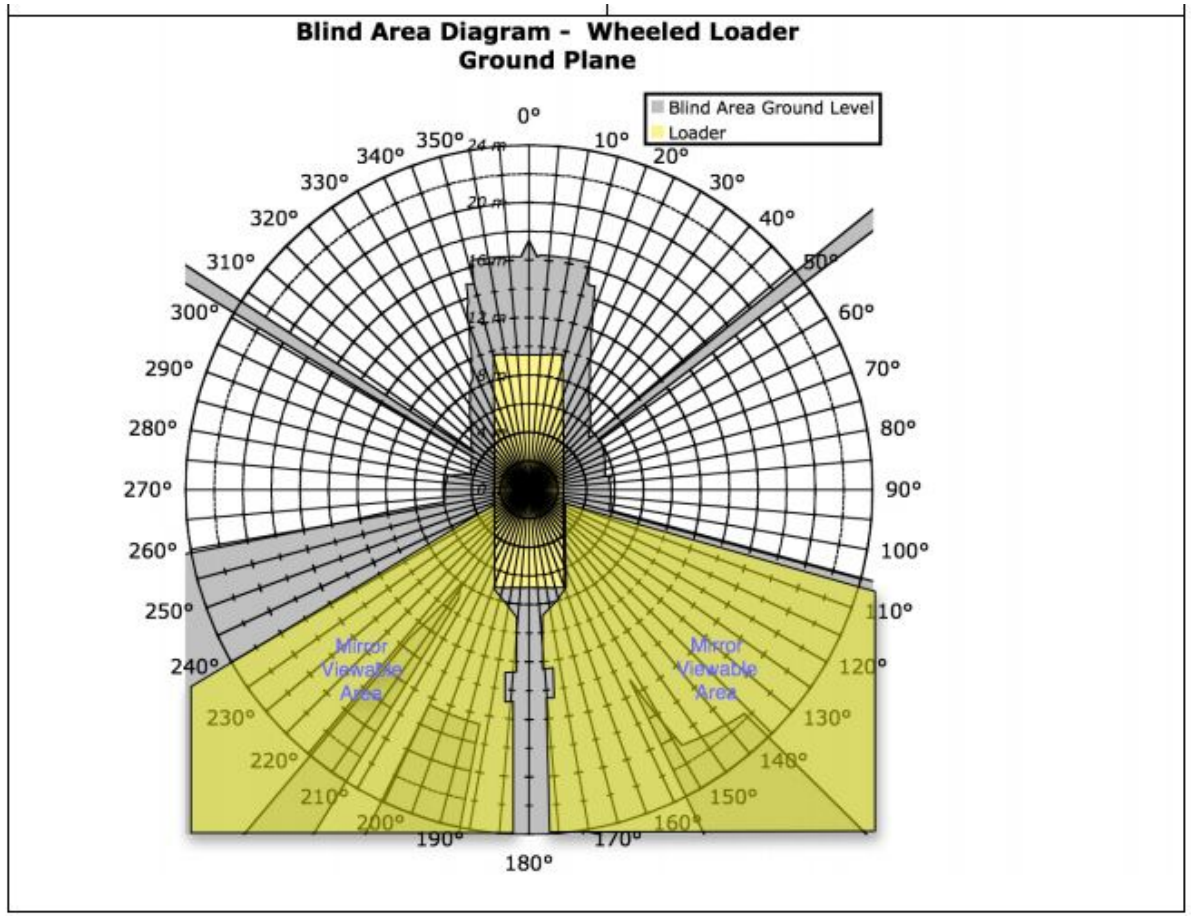
- Haul Truck (NIOSH Example)

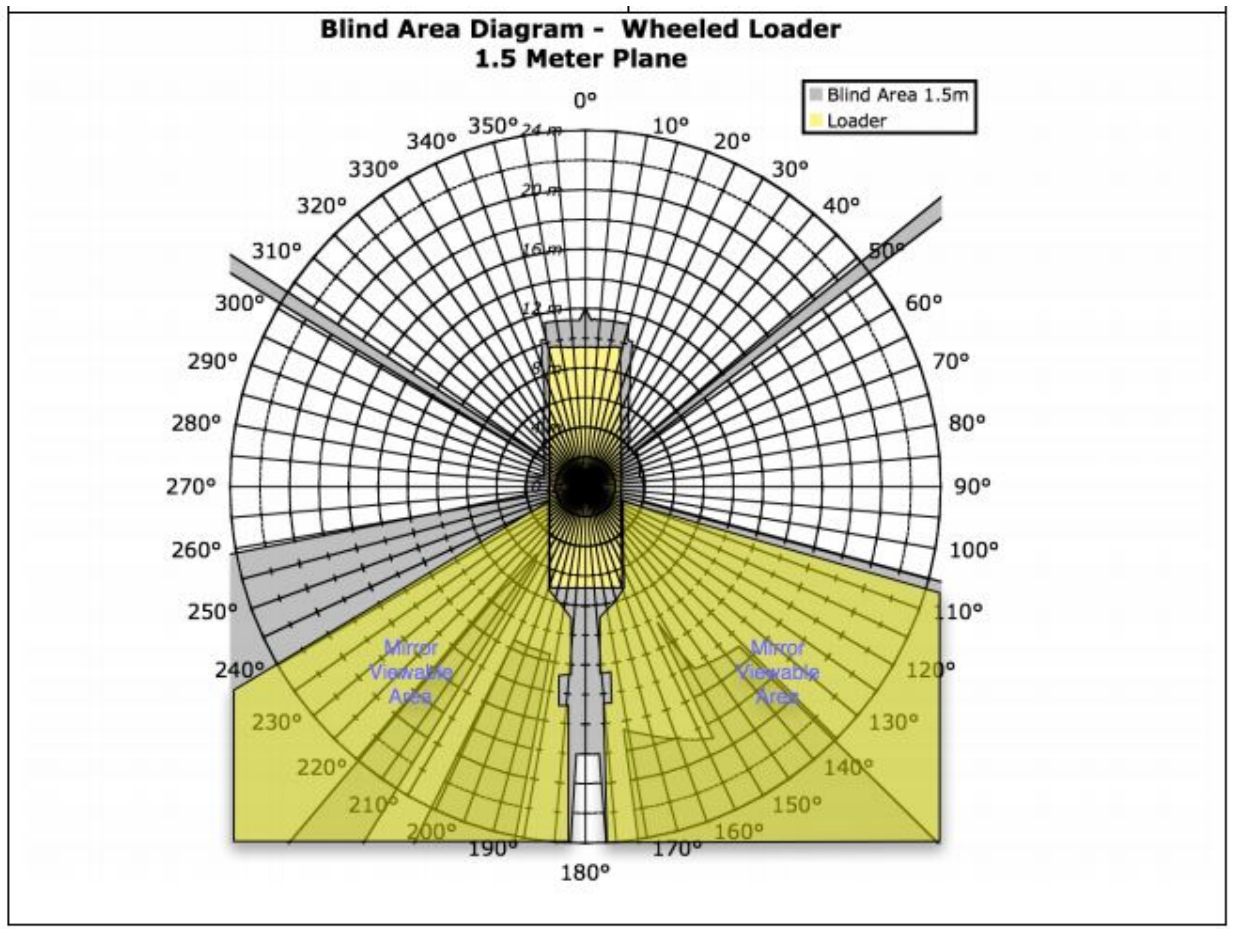




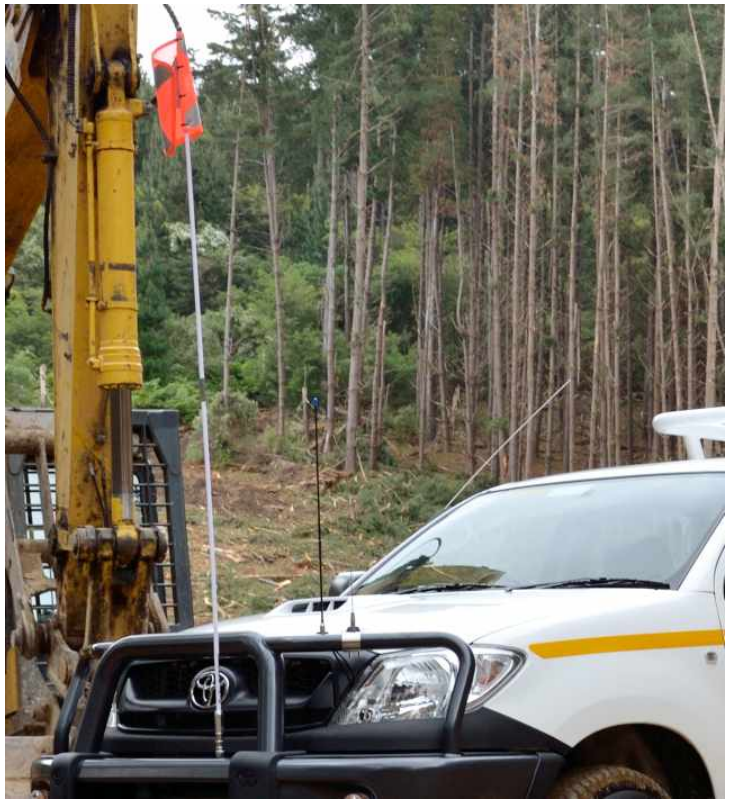
Blind Areas

- Front End Loader (NIOSH Example)





Low Tech Technology Solutions



Collision Warning / Collision Avoidance

Collision Warning System (CWS)

- Provide Equipment Operators with an Awareness of the Location of Nearby Personnel, Light Vehicles, Stationary Structures, and Other Pieces of Equipment through Display Screen in the Operator's Compartment and through Audible and Visible Alarms

Collision Avoidance System (CAS)

- Operates the Same as CWS Except that CAS can take Control of the Mobile Equipment to Slow Down or Stop it Before an Accident can Occur

Collision Warning / Avoidance Technology

Global Navigational Satellite System (GNSS)

- GPS in United States
- Systems Track Equipment in Relation to One Another
- Ability to “Geo-Fence” Areas to Restrict Equipment to Set Boundaries

Collision Warning / Avoidance Technology

RADAR

LIDAR

Ultrasound

- Units Installed on Mobile Equipment to Detect Other Equipment and Objects, including Pedestrians Using Time of Flight Measurements

Collision Warning / Avoidance Technology

Electromagnetic

Radio Frequency Identification (RFID)

- Units Installed on Mobile Equipment to Detect Sensors Mounted on Other Equipment and Objects, Including Pedestrians

Collision Warning / Avoidance Technology

Cameras

- Video Screens Display Camera Feeds from Blind Spots Around the Equipment

CWS Preventable Fatal Accident Analyses

United States Surface Mining Operations Since 2003

- Using CWS could have Prevented 21 Accidents that Resulted in 23 Fatalities

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CWS Preventable Fatal Accident Analyses

EXAMPLE #1

- Front End Loader Backs into Pickup Truck that had Parked Behind it

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

EXAMPLE #2

- Van Pulled Up with 9 Miners along side Haul Truck
- 2 miners were killed

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

EXAMPLE #3

- Pickup Truck Parked in the Haul Truck Traffic Path

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

EXAMPLE #4

- Truck Driver Ran over Portable Toilet

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Possibly	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

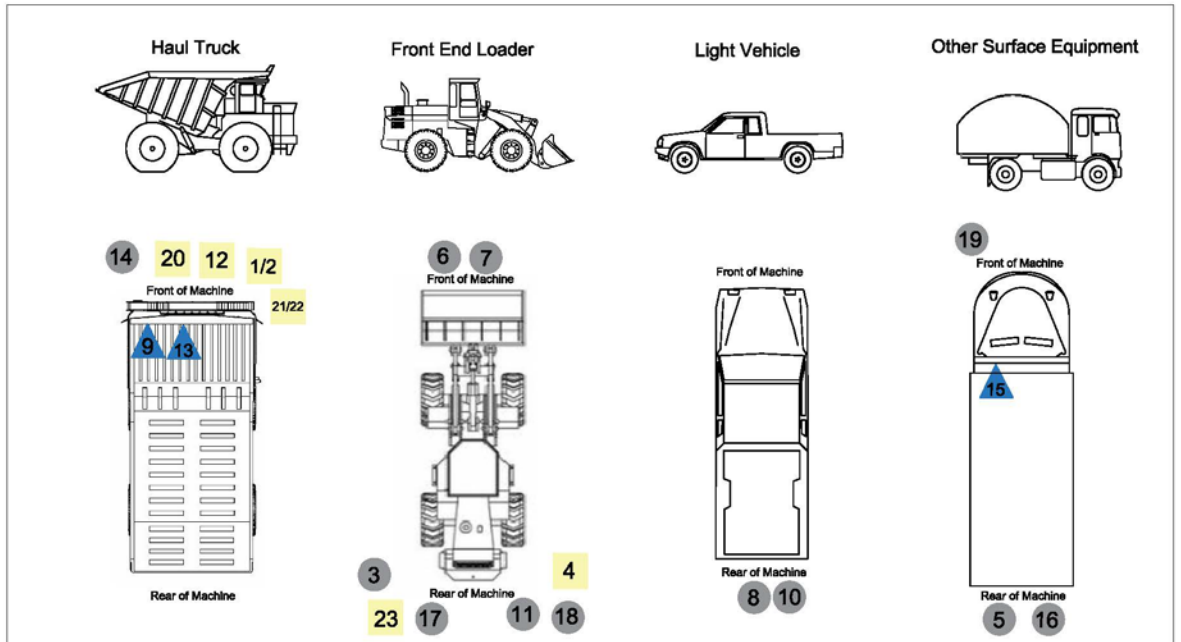
EXAMPLE #5

- Scraper and Fuel/Grease Truck Collided on Haul Road

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses



CWS Preventable Fatals 2003 - 2017	
Pedestrians	12
Light Vehicle Occupant	8
Equipment Operator (Machine-Machine Contact)	3

CWS Preventable Fatal Accidents 2003 - 2017

Fatals by Equipment Type	COAL	MNM
Haul Truck	4	5
Front End Loader	0	8
Light Vehicle	1	1
Other Equipment	1	3

FIGURE 1

Victim's Physical Location
In Relation to Surface Equipment

- Pedestrians
- Light Vehicle Occupant
- Surface Equipment Operator

CWS Preventable Fatal Accident Analyses

- Victims Located in Front of Haul Trucks on 5 of 7 Haul Truck Accidents
- Victims Located Behind Front End Loaders in 6 of 8 Front End Loader Accidents
- 14 of 21 Surface Equipment Accidents Occurred while Equipment was at Low Speed and Initiating a Forward or Reverse Movement

CWS Preventable Fatal Accident Analyses

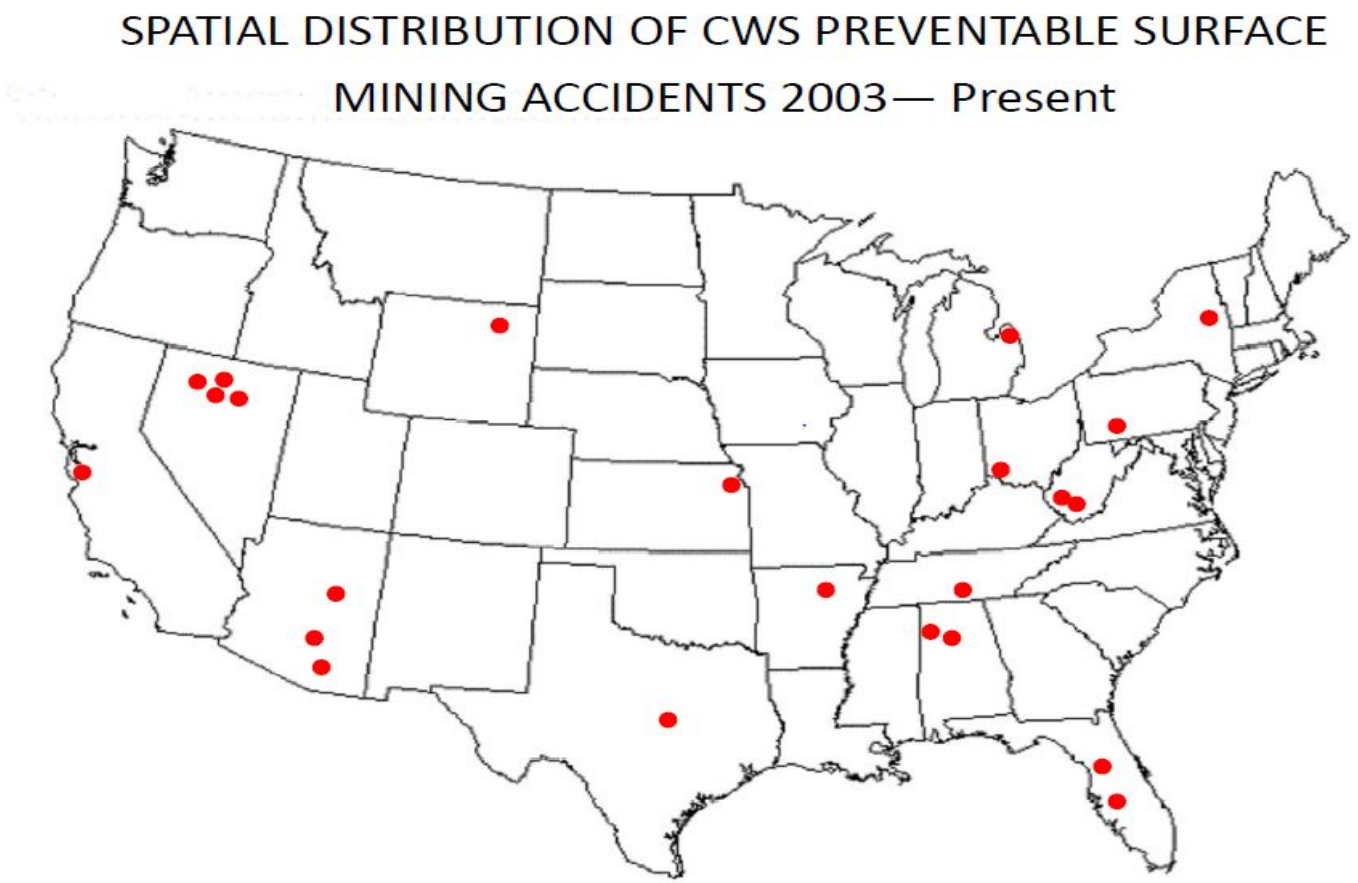
CWS Preventable Fatals By Mine Size (2003-Present)

Mine Size	Fatals
<20	4
20-200	11
>200	8

CWS Preventable Fatals by Mine Type (2003-Present)

Mine Type	Fatals
Coal	6
Gold	4
Cement	3
Stone	3
Sand & Gravel	2
Copper	2
Limestone	2
Phosphate	1

CWS Preventable Fatal Accident Analyses



Summary

- MSHA Powered Haulage Safety Initiative
- RFI Open thru December 24, 2018
- Improving Surface Mobile Equipment Awareness
  - Evaluating Equipment Blind Areas
  - Low Tech Solutions
  - Collision Warning Systems / Collision Avoidance Systems

Questions?

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