Final Report (vol.1)

Mining Health, Safety and Prevention Review

Ministry of Labour
Dear Minister Flynn:

In December 2013, the Minister of Labour asked me, as Chief Prevention Officer, to undertake a comprehensive review of the health, safety and prevention issues related to underground mining in the Province of Ontario. The Mining Health, Safety and Prevention Review (Review) was launched in January 2014, a progress report and some early deliverables were presented to you in September 2014. I am pleased to provide you with the final report.

The information and recommendations in the report are a result of intensive study into a wide range of issues that impact health and safety in underground mines. The depth and scope of the Review could not have been possible without the support of the Advisory Group, and the cooperation of employer and worker representatives who participated on the working groups.

The Advisory Group demonstrated continued commitment to the Review Process, by providing their guidance and expert opinion. The strength of the final recommendations is due in large part to their work.

Another important part of the Review was the support of six working groups that were established to investigate certain areas. Each of the working groups had worker and employer representation and drew freely from the expertise and knowledge of others within the mining sector. Their work not only provided important insights, but demonstrated the ability of both groups to work collaboratively. I wish to thank the members of the working groups and other participants in this process for their diligent work.

The final report contains my recommendations for improving health and safety in the underground mining sector. It addresses the key issues that were identified as the priorities for
the Review. In addition, it highlights areas for improvement that the Advisory Group agreed need to be addressed immediately. These early deliverables are identified in the report.

This report is part of a journey of continuous improvement. Health and safety is not a static issue, it is constantly changing as workplaces and technologies evolve. Beyond the implementation of these recommendations is the need to maintain open communication about emerging health and safety issues and potential solutions.

The publication of this report marks an important milestone along our ongoing journey of change and improvement.

Yours truly,

George Gritziotis
Chief Prevention Officer
Associate Deputy Minister
Acknowledgement

The work of the Review was supported by the very considerable contributions of the members of the Advisory Group, the working groups, subject matter experts and staff in the Ministry of Labour and Workplace Safety North. Most importantly, the work could not have been done without the passionate and informed participation of men and women who work in Ontario’s underground mining sector and their families.

Dedication:

In memory of Joseph Dwayne Plamondon (1961-2015)

As the facilitator of the Internal Responsibility System working group, Dwayne was an important part of the Mining Health Safety and Prevention Review. Extremely generous with his time, he also provided expert advice to all the other working groups, including guiding the development of a new unique risk assessment process that will inform mining health and safety work in Ontario for the future. His hard work, perseverance and knowledge significantly influenced mining review recommendations to prevent mine related injuries, illnesses and fatalities.

Dwayne’s role in the Review was another important milestone in a career dedicated to improving health and safety since his first days as a miner. His many outstanding contributions to mine safety will have a lasting impact for years to come. To recognize his critical role in the Review, we dedicate this report to Dwayne.
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Executive Summary

Ontario’s mining sector is a vital part of our economy; a large employer and an economic driver of other industries. Underground mining is an increasingly high-tech operation which, by its nature, presents a range of health and safety hazards. While Ontario’s mining sector is one of the safest in the world, there are always opportunities for improvement.

In December 2013, the Minister of Labour asked the Chief Prevention Officer (CPO) to undertake a Mining Health, Safety and Prevention Review (the Review) focusing specifically on the occupational health and safety needs of the underground mining sector. The goals are to ensure that those who work in Ontario’s mines come home healthy and safe at the end of every shift, and to maintain a productive and innovative mining industry.

Through a highly consultative and transparent process that involved labour, employers, government, health and safety partners, the public and content experts – and included extensive review of the data and experience in other jurisdictions – the Review identified six key health and safety issues in underground mining:

1. Health and safety hazards
2. The impact of new technology and management of change
3. Emergency preparedness and mine rescue
4. Training, skills and labour supply issues
5. The capacity of the occupational health and safety system
6. The Internal Responsibility System¹

The first three issues highlight hazards and risks in the underground mining environment, while the last three reinforce the critical importance of people, training, organizations, systems and structures in improving health and safety in Ontario mines. Addressing these issues could significantly improve health and safety outcomes.

¹ The Internal Responsibility System first appeared in Ontario in the 1976 Report of the Royal Commission on the Health and Safety of Workers in Mines led by Dr. James Ham, in Table 51 (see Volume 2) which detailed occupational health and safety responsibilities for various workplace parties including CEOs, unions, employers, workers and supervisors proportional to the degree of control they exercise in the workplace. (see Volume 2 of this report).
Key Findings

1. **Health and Safety Hazards**: To improve health and safety, the underground mining sector needs a clear understanding of the risks associated with working underground. This understanding is best achieved through a consistent, ongoing risk assessment process. Regular risk assessments help focus attention on the hazards that pose the greatest risk to health and safety. They also ensure that the sector is able to identify new or evolving hazards and take steps to mitigate them.

   Through a comprehensive **Mining Sector Risk Assessment** process conducted collaboratively with labour and employers, the Review ranked the different hazards associated with mining underground and identified five key hazards that pose the greatest risk to health and safety:
   - Ground control including the risks associated with seismicity and rockbursts
   - Occupational disease focusing particularly on exposure to airborne hazards
   - Water management, particularly problematic water in ore and waste passages
   - Mobile equipment and the risk of collisions
   - Worker fatigue

2. **New Technology and Management of Change**: Underground mining is a complex high-tech industry and new technologies are continually being introduced into the underground environment. These innovations have produced great advantages: they have reduced a lot of the labour intensive work and helped improve safety, particularly in their ability to improve ground control, prevent falls and control environmental exposure to dust. However, each new technology can mean new risks. To reduce those risks, the mining industry should use a consistent change management process when introducing a new technology and/or a change in process. Based on information provided by risk and change management experts and its review of best practices worldwide, the Review identified the key elements of an effective change management process for underground mining:
   - Leadership support
   - Worker involvement
   - Organizational support (including a system to review the change management process)
   - Training for all participants (including change managers)
   - A clear risk assessment process evaluating the use of both existing and new technologies, and a policy setting out the circumstances that require change management.
3. **Emergency Response and Mine Rescue**: Ontario Mine Rescue is a strong system that is well respected for its effectiveness. However, new mining technologies and processes, combined with the trend towards deeper, expanded and more remote mines, are creating challenges for emergency response and mine rescue systems, including:

- Harder to reach, hotter and more humid environments that put great stress on rescue workers and limit the time they can work safely
- Incidents that occur at new exploratory mine sites, which are often remote and don’t have emergency or rescue infrastructure
- Incidents that occur at surface mines and in mining plants, which lack emergency response requirements

To meet these challenges, the mining sector needs highly fit, competent rescue workers who are acclimatized to work in hotter, more humid conditions, skilled in the use of new technologies and have access to support to help them manage the stress of a critical incident. The sector also needs to ensure it has appropriate emergency response plans in place for a wider range of work sites.

4. **Training, Skills and Labour Supply Issues**: Ontario’s mining sector is facing potential skill and labour shortages due to retirements, demand from new mines, and mine expansions. By 2021, the sector will need to recruit over 6,000 new workers – or more than a third of its current workforce. As a result, the sector will soon be relying on a significant number of relatively inexperienced workers who will be working in increasingly complex environments (i.e. deeper mines, more remote mines) with a growing number of new mining technologies and approaches. Training has always been one of the cornerstones of health and safety in underground mining and it is becoming increasingly critical.

Within the sector, there is strong support for the mandatory training standards for underground mining established by the Ministry of Training, Colleges and Universities and the Common Core training modules overseen by the Mining Tripartite Committee. However, the Review identified a number of improvements, particularly related to training delivery, supervisor training and access to refresher training.

5. **Capacity of Ontario’s Occupational Health and Safety System**: All partners in Ontario’s mining occupational health and safety system – the Ministry of Labour, the Workplace Safety and Insurance Board, the relevant Health and Safety Associations, the joint occupational health and safety committees or representatives and workers and employers – play a critical role in creating a health and safety culture. Faced with
expected labour shortages, new technologies and processes, and more challenging mining environments, the system must ensure it has the technical expertise to support the sector. This includes establishing processes, procedures and best practices to identify and respond to hazards and risks, such as enforcement and the protection of workers who raise safety issues from reprisals.

6. **The Internal Responsibility System**

   The concept of the Internal Responsibility System (IRS) – where all parties in the workplace contribute to detecting and correcting workplace anomalies that can lead to injury and illness – was introduced in 1976 and is the underpinning of the Occupational Health and Safety Act. However, the IRS has been applied inconsistently within the mining sector. The Review found that the IRS would be more effective if there was:
   
   - Increased enforcement, particularly related to reprisals
   - Improved reporting mechanisms, so workers are more involved and aware of reports on health and safety issues, and
   - More communication within the mining sector about critical incidents, to help identify emerging risks or trends

**Recommendations**

The Review’s recommendations involve a range of strategies to respond to the six key issues including: research, legislative changes, training and capacity building, new technologies, and more effective communication.

1. **Health and Safety Hazards:** To mitigate key health and safety hazards in Ontario’s underground mines, the Review developed a series of recommendations that will:

   - Strengthen existing legislation; help to focus the efforts of the Mining Legislative Review Committee (see Volume 2: Report Addendum) on the highest risk health and safety hazards in the mining sector; and encourage the development/ adoption of best practices and new technology to improve health and safety.

   1.1 The Ministry of Labour supported by all relevant health and safety system partners and subject matter experts, to undertake a Mining Sector Risk Assessment with employers and labour every 3 years.

   1.2 The Ministry of Labour to require employers in the mining sector to conduct risk assessments, which would include measures and procedures to control the risks identified in the assessment as likely to expose a worker to injury and illness. The joint
health and safety committee, health and safety representative or workers, be consulted on the risk assessment. Employer risk reassessments are to be done as often as necessary to ensure programs that result from the assessment continues to protect workers.

1.3 The Ministry of Labour to work with its Research Advisory Council to focus its grants and research on topics that address the priority hazards identified in the Mining Sector Risk Assessment, and disseminate and act upon the findings where appropriate.

In particular, the Review identified several research opportunities:

- Defining the scientific basis for de-stressing practices and developing guidance materials that define best practices for de-stressing
- Exploring options for collaborating with technology developers to mitigate risks associated with seismicity and rockbursting (i.e. similar to the Australian Centre for Geomechanics model)
- Defining and quantifying the harmful health and safety effects of worker fatigue in the Ontario Mining Sector, and researching other sectors (e.g. transportation, health care and the military) to see how the mining sector compares, and how the problem has been managed.

1.4 The Mining Legislative Review Committee to align the majority of its work with the major hazards identified in the sector level risk assessment exercise.

1.5 The Ministry of Labour to require that mining employers to address the priority hazards identified in the risk ranking exercise:

- Enhance ground control protection by identifying key elements in the control of these hazards and requiring employers to maintain a record of significant seismic events in addition to incidents of ground instability
- Require employers to prepare a formal plan to manage hazards that cause occupational illness, including requirements for worker and supervisor training and communication
- Require all underground mines employers to have in place a formal water management program
- Specify that precautions be taken by employers to guard against the accumulation of water in bins, ore and waste passes and chutes
- Require all underground mines to have in place a formal traffic management plan.
1.6 The Ministry of Labour to review existing occupational exposure limits for a number of key airborne and chemical hazardous substances in underground mines with a view for giving further consideration to the limits for those substances and, if appropriate and advisable, amend Regulation 833. Priority to be given to a review of the occupational exposure limits for silica, nitrogen dioxide and diesel particulate matter (DPM). Other hazards to be considered include sulfur dioxide, and radon.

2. **New Technologies and Management of Change Process:** To mitigate the risks associated with introducing new technologies into an underground mining environment, the Review made the following recommendation:

2.1 The Ministry of Labour to require mine operators to establish and implement a written management of change procedure, to include workers and the joint health and safety committee or health and safety representative.

3. **Emergency Preparedness and Mine Rescue:** To ensure Ontario’s mine rescue system is able to respond in increasingly challenging mining environments, the Review recommends the following:

3.1 The Ministry of Labour to require mining companies to conduct risk assessments to establish Emergency Response Plans for exploration sites, new mines, surface mines and mining plants.

3.2 Workplace Safety North to revise the Mine Rescue Handbook to include guidelines for fitness of crew members, critical incident stress management and acclimatization of emergency responders.

3.3 The Ministry of Labour to work with stakeholders to develop proposed recommendations regarding the responsibilities of mine rescue crew members and mine owners/employers, with respect to mine rescue operations.

4. **Training, Skills and Labour Supply Issues:** To ensure that Ontario’s underground mining workforce has the skills to work in more complex, high-tech environments, the Review made the following recommendations:

4.1 Enhance supervisor and management training by:

- Requiring the Mining Tripartite Committee, which supports the development of Common Core training, to present to the Ministries of Labour and Training, Colleges and Universities options and recommendations to enhance supervisor and management health and safety training
• Requesting the Mining Tripartite Committee to review the pre-requisites for Supervisor Common Core training and determine the best format for this training (e.g. classroom learning, hands-on experience).

4.2 The Ministry of Labour to engage in discussions with the Ministry of Training, Colleges and Universities about the quality and consistency of Common Core training in the underground mining sector, evaluate the current state of that training delivery and identify circumstances where refresher training may be appropriate.

5. **Capacity of the Occupational Health and Safety System**: To ensure the occupational health and safety system has the skills and capacity to support the underground mining sector, the Review made the following recommendations:

5.1 The Ministry of Labour and the relevant Health and Safety Associations to increase their capacity to ensure the health and safety system has the resources to address mining hazards effectively – particularly the priority hazards identified in the risk-ranking exercise. In particular:

- Increase ministry capacity in geotechnical, mining, mechanical, electrical, structural, and civil engineering
- Increase system partners’ technical capacity/resources related to industrial hygiene and mechanical issues.

5.2 The Ministry of Labour to review its policies and procedures that apply to mining inspectors related to unannounced field visits, reprisals, repeat orders, the training of inspectors and the provision of information to workplace parties and how those policies and procedures are implemented. Take appropriate actions based on the findings of that review. In particular, address the following operational policies and procedures:

- Clarify the use of unannounced proactive field visits
- Clarify the appropriate use of orders versus other methods to achieve compliance for priority hazards especially with regard to repeated non-compliance with the same issue in a specific workplace
- Clarify inspector action to be taken in situations of suspected reprisal
- Align proactive activities, whenever possible, to the priority hazards identified in the sector level risk assessment
- Clarify the training provided to inspectors to address priority hazards and the inspector’s role in the inquest process
• Identify any further training required to support changes in policies and procedures brought about by the Review and/or changes in the regulations.

5.3 The Ministry of Labour and its partners to review the health and safety system’s ability to meet the needs of the mining sector especially related to providing services to remote communities, training small numbers of trainees, and aligning their training activities to the priority hazards. Take appropriate actions based upon the findings of that review.

5.4 The Ministry of Labour to work with the Ministry of Community Safety and Correctional Services to enhance the information supplied to the Chief Coroner’s Office and build better linkages between both ministries. This collaboration includes:

• Conducting and regularly updating an aggregate analysis of all past inquests into mining fatalities
• Holding information sessions with the Chief Coroner to identify opportunities for coroners to use the analysis to improve future inquests into fatalities in the mining sector

6. **Internal Responsibility System.** The concept of the Internal Responsibility System is the underpinning of the health and safety system. To help it achieve its potential, the Review recommends the following:

6.1 The Ontario Mining Association to work with labour representatives to develop an Internal Responsibility System best practice guideline as an industry benchmark and to be endorsed by the Ontario Mining Association for implementation by its members.

6.2 The health and safety system to share information both on emerging injury and illness trends, and information on incidents causing serious injury across the industry to trigger preventative actions by workplace parties.

**Next Steps**

Members of the Review recognize that health and safety is an ongoing process of continuous quality improvement. As the underground mining sector evolves, there is always the potential for new or different risks and hazards. In addition to the formal recommendations listed above, the Review suggests a number of other actions the health and safety system could take to improve health and safety for everyone working in the underground mining sector, including:

• Studying whether the positions, roles and responsibilities stipulated under the Occupational Health and Safety Act meet the current needs of Ontario workplaces
• Studying the health and safety system in surface plants and surface mining
• Continuing to work with subject matter experts to explore priority hazards
• Preserving the database on occupational illness beyond the life of the current project led by the Ontario Cancer Research Centre
• Improving the way research relevant to occupational health and safety in the mining sector is compiled, shared and made available
• Evaluating the impact of alcohol and drugs use in workplace incidents
• Studying the way in which an accreditation program may benefit the mining sector
About the Mining Health, Safety and Prevention Review

The mining sector is an integral part of Ontario’s economy. With revenues of about $11 billion a year, the sector (underground and surface mining) employs over 26,000 Ontarians directly and creates over 50,000 indirect jobs. It also fuels a vast number of other industries and sectors.

Ontario’s miners work in environments that are subject to various types of occupational health and safety hazards. They are also part of an evolving sector that is making greater use of new technologies and changing processes. Given the risks associated with increasingly complex mining environments, occupational health and safety is paramount.

As the following charts show, the number of lost-time injury claims made to the Workplace Safety and Insurance Board in the mining sector has decreased over the past decade; however the number of worker fatalities has not.

In December 2013, the Minister of Labour asked the Chief Prevention Officer to undertake a Mining Health, Safety and Prevention Review (the Review). The objective of the Review was to examine the occupational health and safety needs of the mining sector. The Review, which focused on underground mining, sought to:

- assess current and emerging occupational health and safety issues in the mining sector
- describe the state of health and safety in Ontario mines
- review past recommendations from public enquiries into mining health and safety and from Coroner’s inquests into mining fatalities
- make recommendations to enhance and improve mining health and safety.

Its findings and recommendations, if implemented, will help those who work underground go home healthy and safe at the end of every shift. They will also help maintain a productive and innovative mining sector across our province.
Chart 1: Lost-time Injury Rates Ontario Mining Sector 2004-2013

Table 1: Lost-time Injury Rates Ontario Mining Sector 2004-2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Allowed Lost-time injuries per 100 Full-Time Equivalent (FTE) workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>1.9</td>
</tr>
<tr>
<td>2005</td>
<td>1.6</td>
</tr>
<tr>
<td>2006</td>
<td>1.5</td>
</tr>
<tr>
<td>2007</td>
<td>1.4</td>
</tr>
<tr>
<td>2008</td>
<td>1.3</td>
</tr>
<tr>
<td>2009</td>
<td>1.1</td>
</tr>
<tr>
<td>2010</td>
<td>1.3</td>
</tr>
<tr>
<td>2011</td>
<td>0.9</td>
</tr>
<tr>
<td>2012</td>
<td>0.8</td>
</tr>
<tr>
<td>2013</td>
<td>0.8</td>
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Chart 2: Traumatic Fatalities Ontario Mining Sector 2004-2014

Table 2: Traumatic Fatalities Ontario Mining Sector 2004-2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Claims</th>
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<tr>
<td>2004</td>
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</tr>
<tr>
<td>2005</td>
<td>1</td>
</tr>
<tr>
<td>2006</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>4</td>
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<td>2008</td>
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<tr>
<td>2011</td>
<td>6</td>
</tr>
<tr>
<td>2012</td>
<td>2</td>
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<tr>
<td>2013</td>
<td>2</td>
</tr>
<tr>
<td>2014</td>
<td>6</td>
</tr>
</tbody>
</table>

3 Ibid
Chart 3 - Allowed Fatal Occupational Disease Claims Ontario Mining Sector 2004-2013

Table 3 - Allowed Fatal Occupational Disease Claims Ontario Mining Sector 2004-2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Allowed Occupational Disease Fatality Claims</th>
</tr>
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<tbody>
<tr>
<td>2004</td>
<td>20</td>
</tr>
<tr>
<td>2005</td>
<td>32</td>
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<td>2006</td>
<td>16</td>
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<td>2011</td>
<td>14</td>
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<td>2012</td>
<td>8</td>
</tr>
<tr>
<td>2013</td>
<td>10</td>
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Ibid
Chart 4 – Top 7 Incident Categories associated with Critical and Fatal Injuries – 2000-2014

Table 4 - Top 7 Incident Categories associated with Critical and Fatal Injuries – 2000-2014

<table>
<thead>
<tr>
<th>Incident Classification</th>
<th>Number of Reported Fatal Injuries</th>
<th>Number of Reported Critical Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power haulage and transportation off site</td>
<td>12</td>
<td>56</td>
</tr>
<tr>
<td>Falls of ground</td>
<td>8</td>
<td>46</td>
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<tr>
<td>Slips, fall of person</td>
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<td>102</td>
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<tr>
<td>Run of material</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Falling, rolling or sliding rock or material</td>
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<td>41</td>
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<tr>
<td>of any kind</td>
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<td>Machinery</td>
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<tr>
<td>Vessels under pressure</td>
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<td>9</td>
</tr>
</tbody>
</table>

The Review Process

To ensure the Review was informed by public and stakeholder views as well as empirical data, the Chief Prevention Officer created a highly consultative and transparent process that included:

1. An **Advisory Group** comprised of key mining stakeholders from employer and labour organizations and relevant health and safety organizations (see Volume 2 Report Addendum Appendix A for a listing of advisory group members and their affiliations). Members were chosen for their demonstrated commitment to occupational health and safety in the mining sector, and their roles as recognized leaders within their professional / organizational communities.

2. Twelve **public consultations** with individuals and organizations who are most affected by and knowledgeable about the mining sector, including mining community stakeholders and partners (both labour and employers), academic experts, educators / trainers, community organizations, government workers and other relevant groups and individuals. In total, 150 people participated in the public consultations, and the Review received 35 formal presentations and 64 written submissions.

3. Four **site visits** to mines that represented different hard and soft rock mining environments, where the Chief Prevention Officer and members of the Advisory Group could observe first-hand a variety of mining techniques including bulk mining, cut-and-fill mining and room-and-pillar mining. The Review appreciated the invitation to visit and, most importantly, the chance to talk with the men and women who work underground at these mines: Nickel Rim South Mine, Glencore; Coleman Mine, Vale; Lockerby Mine, First Nickel in Sudbury; and Ojibway Mine, Windsor Salt in Windsor.

4. Extensive **research** into best practices in mining safety, prevention and enforcement in Ontario and around the world, which provided information on initiatives that have been successful in improving mining health and safety.

5. A **risk assessment** to help the Review fully understand the risks workers face in underground mining. The results of the risk assessment will also help employers and workers as well as their representatives, the Ministry of Labour and Health and Safety Associations (HSAs) work together to mitigate risks and reduce the incidence of injury, illness and death in Ontario mining workplaces (see Volume 2: Report Addendum for an in depth description of the sector level risk assessment process).

6. Six **working groups**, with representatives from labour and employers, to address key issues identified by the Advisory Group. The working groups (see Volume 2: Report
Addendum) used a variety of sources of information including consulting subject matter experts, reviewing recommendations from previous inquiries and inquests, and feedback from the public consultations.

7. A **resource group** of subject matter experts who provided information to the working groups on an as-needed basis (see Volume 2 Report Addendum Appendix A for a list of subject matter experts).

The Review was coordinated by a secretariat in the Ministry of Labour and supported by the Ministry’s Prevention Office, Health and Safety Policy Branch, Operations Division and Legal Services Branch in consultation with mining stakeholders. Additional support was provided by the Ministry of Northern Development and Mines and Workplace Safety North.
The Key Issues

The Advisory Group identified six key health and safety issues in underground mining that, if addressed, could have the greatest impact on improving health and safety outcomes:

1. Health and safety hazards
2. The impact of new technology and the use of a management of change process to evaluate implications for health and safety
3. Emergency preparedness and mine rescue
4. Training, skills and labour supply issues
5. The capacity of the occupational health and safety system
6. The Internal Responsibility System

This report describes each of these issues, summarizes current knowledge and makes recommendations on how to reduce risks and enhance health and safety.

Note: Although the issues are presented as though they are distinct, recommendations that address one issue often affect the others.

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6 The Internal Responsibility System first appeared in Ontario in the 1976 Report of the Royal Commission on the Health and Safety of Workers in Mines led by Dr. James Ham, in Table 51 which detailed occupational health and safety responsibilities for various workplace parties including CEOs, unions, employers, workers and supervisors proportional to the degree of control they exercise in the workplace. (see Volume 2: Report Addendum of this report).
1. Health and Safety Hazards

Issue

Underground mining, by its nature, presents a range of health and safety hazards that are different from those in other sectors. Some hazards, such as ground instability, are inherent in the underground environment. Others are introduced through complex mining activities and processes, which bring potential hazards into the underground environment including hazards from mobile equipment such as large vehicles that may limit visibility for the driver. Risks can increase as mines in Ontario get deeper and more expansive. If these hazards are not managed properly using appropriate controls, they can result in serious traumatic injuries, death or occupational illness.

To significantly improve health and safety in underground mining, the Ontario Occupational Health and Safety System (see Volume 2: Report Addendum) partners and mining sector stakeholders need to identify and rank the hazards that pose the greatest risk and warrant the highest level of attention.

What We Heard

The risk assessment process organized by the Ministry of Labour in early 2014 engaged both labour and employers in evaluating and ranking the predominant health and safety hazards in underground mining in Ontario. This process was developed and led by Richard Prial and Dr. Sujoy Dey of the Ministry of Labour specifically to leverage the expertise within workplaces. Using the risk assessment outcomes along with information from the public consultations, written submissions, statistical analyses and Coroner’s inquests, the Review identified five priority hazards, each of which can create a range of health and safety issues:

- Ground control hazards
- Occupational disease hazards
- Hazards associated with water management
- Hazards associated with mobile equipment
- Worker fatigue.

For each hazard, the Review analyzed one specific aspect in detail. The analysis involved exploring different ways to control it, using what is known as the hierarchy of controls, which includes: eliminating the hazard, substituting a less hazardous process, engineering controls that could reduce risk, and administrative and procedural controls. For example, within the
ground control hazard, many different aspects could be explored, such as various types of ground failure mechanisms, development heading face instability, ground support issues (i.e. ground support selection, installation and quality control), the monitoring of ground movement, and the rehabilitation of damaged excavation. For the timing being, however, the Review focused exclusively on one particular type of ground failure mechanism - seismicity and rockbursting – because it is becoming a more prominent issue as Ontario mines become deeper.

Malcolm Sparrow in his book *The Regulatory Craft*\(^7\) highlights the effectiveness of focusing resources on a limited set of issues. As he says, “pick important problems and fix them.” The systemic risk assessment process provides the sector and the workplace parties with a list of important problems that need to be addressed. The use of a risk ranking exercise to generate the priority hazards for the system gives the workplace parties the ability to determine priorities. In turn, the priorities allow the health and safety system to focus its efforts on the most important issues for the workplace, which may change over time. Workplace parties can also use the results to determine firm-specific responses to high priority hazards and even compare their internal risk ranking to that of the overall mining sector.

**Analysis**

**Ground Control Hazards**

Over the last 80 years, unmitigated ground control hazards have resulted in the greatest number of traumatic injuries in underground mining workplaces (see Volume 2: Report Addendum).

In terms of ground control hazards, the Review focused on seismicity and rockbursting and identified opportunities to improve:

- the ability to identify any predisposition for seismicity and rockbursting at the mine design stage, including better reliance on risk assessment methods and better quality geotechnical data
- the way microseismic monitoring results are managed, analyzed and interpreted
- operational controls, including de-stress blasting practices and the use of re-entry protocols following rockbursts
- research into ways to minimize the occurrence of seismicity and rockbursting in underground mines.

To reduce hazards associated with seismicity and rockbursting, an assessment of the risk of seismicity and rockbursting over the expected life of an underground mine must be a critical part of the mine design process. To be able to assess risk, mine design engineers need proper geotechnical data, including accurate information about mine geology and mine-specific stress levels. One effective way to reduce rockbursting hazards would be for the sector to share best practices.

Most seismically active underground mines in Ontario operate microseismic monitoring systems that measure seismic activity and identify potential risks. However, in general, the results from these monitoring systems are in databases that are not always well maintained, which limits the ability of ground control engineers to analyze and interpret this information – or use it to reduce hazards. The mining sector needs dedicated resources to properly manage microseismic monitoring databases so the information can be organized, analyzed and interpreted accurately.

In addition to the information currently required, mine sites should maintain a record of strong seismic events and incidents of ground instability that have occurred, as well as an explanation of the response to each occurrence. This information would enhance efforts to control ground control hazards.

During the Review, subject matter experts indicated that de-stress blasting techniques can be effective in controlling certain types of rockbursting risks in underground mines. However, the theory behind these techniques is unclear. The re-entry protocols currently in place in burst-prone underground mines vary considerably across the province. If the mining sector is going to make optimal use of these techniques, it needs more research into their scientific basis.

Currently, no organization exists in Ontario to oversee and coordinate research into methods for minimizing seismicity and rockbursting or to work with mining companies to adopt new technology to mitigate the risks associated with rockbursting. The Review heard that Ontario needs to leverage the expertise of organizations like the Australian Centre for Geomechanics, which effectively provides that kind of oversight for its mining sector.

**Occupational Disease Hazards**

While traumatic fatality incidents in the mining sector have declined substantially over the past several decades, deaths related to occupational illness have not (see Volume 2: Report Addendum).
In terms of occupational disease hazards, the Review focused on airborne hazards such as diesel particulate matter and silica in underground mines and identified opportunities to:

- raise awareness – among workers and employers - of the importance of controlling risks to health in underground mines
- increase understanding of the health effects of exposure to diesel emissions in underground mines and improve controls
- review and update occupational exposure limits (OELs) for airborne hazards in underground mines
- identify and publicize available options for monitoring ventilation in underground mines in order to reduce concentrations of airborne hazards.

The subject matter experts consulted by the Review share a strongly held belief that the underground mining sector generally puts more emphasis on preventing traumatic injuries than occupational illness. The tendency to focus on traumatic injuries may be due to the fact that workers may not develop symptoms of occupational illness for many years. However, occupational diseases, such as silicosis or various forms of cancer, have serious implications for health and well-being. It is important to limit exposure to hazards that can cause occupational illness including but not limited to airborne hazards, which require effective ventilation systems.

Working in a closed underground environment, miners can be exposed to airborne hazards, such as diesel emissions and silica, putting them at higher risk of developing occupational illness. The Review heard that both supervisors and workers need better education and training so they are more aware of the seriousness of airborne health hazards in underground mines.

Subject matter experts indicated that the sector needs more research to be able to reduce occupational disease hazards. For example, recent research revealed that some components of emissions from diesel powered equipment are carcinogenic. Over the past 20 years, a significant amount of research has been and continues to be done to develop filters to eliminate the harmful effects of diesel exhaust and to identify the optimum diesel fuel type that would result in the least harmful emissions.

In 2004, the Ministry of Labour introduced a review process for establishing occupational exposure levels (OELs) to ensure that these limits are regularly reviewed and updated. Under this process, the Ministry of Labour releases proposals for new or revised OELs (based on the annual recommendations of the American Conference of Governmental Industrial Hygienists).
for public consultation. During consultations, stakeholders are invited to submit comments on any or all of the proposed changes. Recent proposals to reduce the OELs for some airborne hazards (e.g. nitrogen dioxide) have prompted serious debate among some stakeholders over the feasibility of implementing the proposed levels. The Review heard that a systematic, scientific health-based review of OELs for a number of key airborne hazards in underground mines would help address the limits and improve health outcomes.

A wide variety of methods are available for monitoring most aspects of ventilation in underground mines. However, the sector currently lacks guidance materials that would identify suitable options for monitoring situations expected to occur in an underground mine. The Review heard that these kinds of guidance materials would be extremely useful for mine ventilation specialists.

**Water Management Hazards**

Over the last 25 years, fatal injuries related to water management hazards in underground mining workplaces have not declined (see Volume 2 Report Addendum).

In terms of water management hazards, the Review focused on undesired and problematic water in ore and waste passes and chutes in underground mines and identified opportunities to improve methods currently used to:

- prevent and minimize the amount of water - both naturally occurring and introduced as part of the mining process - entering underground mines
- remove water that has entered underground mines
- safely manage water once it has inadvertently entered ore and waste passes and chutes.

A water management plan is key to reducing water-related hazards. Strategies to minimize the amount of water entering an underground mine include: sealing exploration diamond drill holes that emanate from the surface; and grouting fragmented rock masses that could become a conduit for water transmission. Strategies to enhance capacity to remove water once it has entered an underground mine include: ensuring proper sump and drain hole designs; and having sufficient pumping systems and pump maintenance programs in place.

At the design stage, steps must be taken to ensure that mine water drains away from ore and waste passes and chutes, and that programs are in place to seal holes that intersect these passes. Mining operations must also: institute inspection programs, including camera systems where possible, to detect water that inadvertently enters ore and waste passes and chutes; and put the controls for pass control gates in positions that are safely accessible.
Other elements that would be part of an effective water management plan would include: effectively managing water that has entered ore and waste passes and chutes through operational procedures, and if necessary, procedures for non-routine hazardous tasks; training programs to ensure workers and supervisors are able to recognize dangerous conditions in ore and waste passes and chutes that could result in uncontrolled runs of material; ensuring that inputs into ore and waste passes do not result in uncontrolled runs of material; ensuring that workers operating ore and waste pass chutes or control gates are not endangered by potential runs of material; measuring and recording ore and waste pass content levels; effective communications between mine departments whose activities could influence ore and waste pass and chute contents, performance and conditions; and safe blasting practices for resolving hang-ups in ore and waste passes and chutes involving wet material.

**Mobile Equipment Hazards**

Over the past 14 years, mobile equipment has displaced ground control issues as the major source of fatal injuries in underground mining (see Volume 2: Report Addendum).

In terms of mobile equipment hazards, the Review focused on the risks of collision and identified opportunities to:

- coordinate research into developing line-of-sight (LOS) proximity detection devices and collision avoidance systems

- enhance understanding of the cognitive impact of LOS proximity detection devices and collision avoidance systems on mobile equipment operators.

Ontario’s underground mines make extensive use of large mobile equipment that can pose a hazard, particularly when the operator’s ability to see other vehicles or pedestrians is obscured. Much work has been done in recent years to develop LOS proximity detection devices and collision avoidance systems. If used properly, these technologies can play an important role in preventing mobile equipment collisions in underground mines. However, the Review heard that, to date, the inventors and developers of these systems have not collaborated effectively to make the kinds of improvements to these technologies that would make them more relevant to mine operators. The Ministry of Labour has begun to address this issue by working with researchers and providing research grants to projects that promote collaboration.

The Review also heard that, regardless of the technology in place to minimize the risk of mobile equipment collisions in underground mines, mobile equipment operators need to have a keen sense of situational awareness. In general, as the level of technology to prevent vehicle collisions increases, the level of operator situational awareness must also increase. Operators
must be able to effectively process all of the information provided by the technology and need appropriate training.

Several other practices would also reduce hazards associated with mobile equipment including: using high visibility clothing – a recommendation that has already been implemented (see Early Progress, page 54); establishing right-of-way protocols; optimizing the use of reflective striping on mobile equipment; optimizing the use and style of strobe lights; establishing communication protocols for accessing production or haulage areas; and developing signage and cap lamp signalling protocols.

**Worker Fatigue**

Worker fatigue was identified as one of the top concerns in the mining sector risk ranking exercise (see Volume 2: Report Addendum). Worker fatigue has not previously been a focus of the health and safety system. However, given the current level of concern about this hazard, the Review believes further investigation is warranted.

In terms of worker fatigue, the Review looked specifically at the effect of irregular shift schedules and identified opportunities to:

- improve understanding of the extent to which worker fatigue has played a part in serious injuries and fatalities in underground mining in Ontario
- learn from progress other sectors have made in addressing worker fatigue issues.

The Review heard that other sectors, like transportation, have made significant progress in addressing worker fatigue. Studies of how other sectors have developed and implemented successful methods to address fatigue might identify strategies that could be explored and considered in the mining sector.

**Recommendations**

To mitigate key health and safety hazards in Ontario’s underground mines, the Review developed a series of recommendations that will: strengthen existing legislation; help to focus the efforts of the Mining Legislative Review Committee (see Volume 2: Report Addendum) on the highest risk health and safety hazards in the mining sector; and encourage the development/adopter of best practices and new technology to improve health and safety.

1.1 The Ministry of Labour, supported by all relevant health and safety system partners and subject matter experts, to undertake a Mining Sector Risk Assessment with employers and labour every 3 years.
1.2 The Ministry of Labour to require employers in the mining sector to conduct risk assessments, which would include measures and procedures to control the risks identified in the assessment as likely to expose a worker to injury and illness. The joint health and safety committee, health and safety representative, union or workers be consulted on the risk assessment. Employer risk reassessments are to be done as often as necessary to ensure programs that result from the assessment continue to protect workers.

1.3 The Ministry of Labour to work with its Research Advisory Council to focus its grants and research on topics that address the priority hazards identified in the Mining Sector Risk Assessment, and disseminate and act upon the findings where appropriate.

In particular, the Review identified several research opportunities:

- Defining the scientific basis for de-stressing practices, and developing guidance materials that define best practices for de-stressing
- Exploring options for collaborating with technology developers to mitigate risks associated with seismicity and rockbursting (i.e. similar to the Australian Centre for Geomechanics model)
- Defining and quantifying the harmful health and safety effects of worker fatigue in the Ontario Mining Sector, and researching other sectors (e.g. transportation, health care and the military) to see how the mining sector compares, and how the problem has been managed.

1.4 The Mining Legislative Review Committee to align the majority of its work with the major hazards identified in the sector level risk assessment exercise.

1.5 The Ministry of Labour to require that mining employers to address the priority hazards identified in the risk ranking exercise:

- Enhance ground control protection by identifying key elements in the control of these hazards, and requiring employers to maintain a record of significant seismic events in addition to incidents of ground instability
- Require employers to prepare a formal plan to manage hazards that cause occupational illness, including requirements for worker and supervisor training and communication
- Require all underground mines employers to have in place a formal water management program
• Specify that precautions be taken by employers to guard against the accumulation of water in bins, ore and waste passes and chutes

• Require all underground mines to have in place a formal traffic management plan.

1.6 The Ministry of Labour to review existing occupational exposure limits for a number of key airborne and chemical hazardous substances in underground mines with a view for giving further consideration to the limits for those substances and, if appropriate and advisable, amend Regulation 833. Priority to be given to a review of the occupational exposure limits for silica, nitrogen dioxide and diesel particulate matter (DPM). Other hazards to be considered include: sulfur dioxide, and radon.
2. The Impact of New Technology and Management of Change

Issue

Underground mining is a complex high-tech industry. New technologies have removed a lot of the labour intensive work that was part of mining operations in the past and, in some cases, they have also improved safety. In 2003, at the International Association of Labour Inspectors annual meeting in Toronto, a tripartite panel identified three key factors in improved mining safety in Ontario and lower rates of lost-time injuries: improved technology, mandatory training and the development of tripartite mechanisms, such as the Mining Legislative Review Committee and the tripartite development of the Ministry of Training, Colleges and Universities training standards.

New technologies can play a significant role in improving performance and processes. In these times of continuous technological advances, mining operators see the potential for higher productivity and lower operating costs. However, each new technology represents a change in a mining operation and requires proper management of change strategies. Effective management of change can help identify and eliminate hazards, enhance equipment performance and improve the bottom line – while improper management of change can introduce new hazards into the work place. The Ham Commission Report (1976) noted that “trade-offs between productivity and occupational risks are inherent and rarely consciously made.” It is, therefore, imperative that the mining sector establish a means to evaluate and understand the implications of changes on health and safety, and implement adequate mitigation strategies.

What We Heard

During the Review, stakeholders discussed their concerns about the impact of new technology and improper management of change on worker health and safety. They stressed the critical importance of proper management of change processes including risk assessments when implementing new technology or processes. They talked about the need for greater worker participation in evaluating risk and in change processes, and clearer guidance on how to involve workers and joint health and safety committees in meaningful ways as opposed to just informing them. They also emphasized the importance of sharing information on new technologies introduced in the workplace and developing a method to communicate any operational issues related to a new technology.
**Analysis**

Over the past several decades, Ontario’s mining sector has seen significant technological advances in areas such as underground communications, ergonomics, fire suppression, hoist automation, ground control, blasting materials, fall arrest, dust control and the delivery of training. When properly introduced, technological improvements have the potential to reduce all injuries, lost-time injury rates and fatalities.

On the issue of the impact of introducing new technology into underground mining workplaces, the Review heard from experts in risk management and management of change processes from organizations around the world. Resource people from labour, employers, academia and the health and safety system partners also provided their insights. Mining companies in Ontario were asked to submit their policies related to the management of change. The Review also had the opportunity to look at best practices in Ontario and other global leaders in mining, chemical industries and the nuclear industry. Diffusion rates of new technology were not readily available when the Review was exploring this issue.

**Technological Advances**

A variety of new technologies intended to make the mining environment safer are currently being developed, including but not limited to:

- tier 4 engines that reduce emissions
- ventilation on demand systems that will improve air quality
- fire suppression systems to reduce risks associated with fires in ultra-deep mining situations or fires that occur as a result of new technology
- mobile equipment position and location monitoring devices to facilitate traffic control and prevent vehicular collisions
- proximity detection devices and cameras on equipment to reduce risks associated with mobile and other equipment.

While the introduction of safety-related technologies generally holds great promise, not enough research has yet been done on some of the safety technologies for the mining sector. It is imperative that appropriate, thorough study and risk assessments are conducted to ensure no new uncontrolled hazards are introduced as a result of new technologies entering the work environment.
**Management of Change**

Change can play a significant role in improving performance and processes. Change, which can be initiated either internally or by external industry trends, can also introduce new hazards unless reviewed by highly knowledgeable people, such as equipment specialists, management system specialists, engineers, and assigned operations and maintenance personnel. In an effective management of change process, experts work collectively to justify the need to make the change in the first place. They then verify that the change reduces or eliminates the current risk and does not introduce other risks.

Change can also be more hazardous when it is not communicated clearly to those who need to know, such as operators and maintenance people. Communication is critical to preventing hazards which arise out of “not-knowing”. Effective communication includes notifying and involving personnel and updating written documents, such as operating procedures, training modules and maintenance plans.

During the Review, the question of what would trigger a management of change policy was raised, and it was agreed that it would depend on the circumstance and would be determined collaboratively by the workplace parties, including the workers at risk and the relevant supervisors and managers. This management of change concepts appear to be reasonably straightforward; however, based on the Review’s analysis, the understanding and application of these concepts varies across the mining sector. These differences may be due to the fact that the requirements or key elements of a management of change process are not laid out in the current mining regulations. For example, Regulation 854 requires the employer to notify the joint health and safety committee or health and safety representative when there is a change in procedure or a change in the composition, design, size or arrangement of a material, object, device or thing. However, there is no requirement for the employer to engage knowledgeable persons and workers affected by the proposed change in a management of change process - just a requirement to inform them of the change.

The Regulation also currently requires that a written statement of proposed development, construction, introduction, alteration or use be given to the joint health and safety committee or health and safety representative. However, there is no requirement to engage affected workers and their representatives in reviewing the proposed change in order to identify hazards, and assure those hazards will be mitigated.

Based on the findings of the Review, the key elements of an effective management of change process include:
1. **Leadership Support**: Leadership is key to effective management of change. To provide leadership support, new leaders need to understand the mine’s current initiatives and programs, and the rationale for them. Any organizational change would also be scrutinized using the same process as for a technology or process change.

2. **Worker Involvement**: Workers and their representatives need to be involved in a meaningful way when any change is being contemplated or introduced. Without buy-in from labour and the joint health and safety committee, management of change processes will not be effective.

3. **Organizational Support**: A management of change procedure cannot operate without organizational support and structure. That support includes providing adequate guidance in defining the various levels of change. For example, information should be provided on whether the proposed change is a “change in kind” versus a substantial change or an emergency change / short term measure. The organization must also ensure that any short-term or emergency change is not left in place beyond the appropriate timeline. Organizational support also includes a system to review the implementation and success of the management of change process as part of continuous quality improvement.

4. **Training for Participants**: An effective management of change process requires training specific to each role in implementing the change. For example, the review team facilitator of the management of change process needs training on how to ensure the procedure is followed and the analysis is sufficiently detailed. Training is also required for key individuals who will manage the change process as well as for all participants, and it may be required for workers who are potentially affected by the change.

5. **Clear Procedure**: The optimal way to introduce new technology and processes into the mining sector is through a clear management of change procedure. A well-defined procedure will adequately address any proposed change in technology, processes, mining plan or leadership or organizational change at the mine site. The procedure must be risk based and include both the current technology and the new technology. The management of change review team must adequately represent the depth and breadth of knowledge and experience required for a detailed review. The workplace parties must also develop a clear policy outlining the circumstances that would trigger the management of change process.

(See Volume 2: Report Addendum: Audit Elements of Effective Management of Change Procedure.)
Recommendation

2.1 The Ministry of Labour to require mine operators to establish and implement a written management of change procedure, to include workers and the joint health and safety committee or health and safety representative.
3. Emergency Response and Mine Rescue

Issue
New mining technologies and processes combined with the trend to deeper, expanded and more remote mines create challenges for emergency response and mine rescue systems. A key question is whether the current emergency preparedness and response system is adequate in light of increasing risks.

What We Heard
The mining sector takes great pride in Ontario’s mine rescue system, and is generally satisfied with the current way it is set up and operates. However, the Review heard from a number of people that it is important to evaluate the ability of the current mine rescue system to respond to hazards created by new technologies and mining methods and to launch effective rescue operations as mines in Ontario get deeper and distances from the shaft increase.

Analysis
The Review gathered information from a variety of sources including Coroner’s jury inquest recommendations, the Ham, Burkett and Stevenson Commissions/Inquiries, scans of regulatory requirements in other jurisdictions, public consultations and consultations with other jurisdictions. The Review held consultations with organized labour, management, the Ontario Mine Rescue Technical Advisory Committee and the Ontario Mine Rescue organizational staff. The Review compared Ontario’s requirements, standards and regulations for emergency preparedness and response with those of other jurisdictions. The Review also heard that, in recognition of the unique nature of emergency management and mine rescue, the need for separate and specific risk assessment requirements should be considered. A separate risk assessment requirement for emergencies and mine rescue would be in line with the practices of many other provinces.

Current Challenges to Emergency Preparedness and Mine Rescue
Rescue work is some of the most labour-intensive and dangerous in the mining sector and is often done in conditions that are “immediately dangerous to life or health”. As mines get deeper and move further from the shaft or when companies explore new sites and mines, they create greater safety risks for emergency responders, which must be taken into account in emergency planning.
As mines expand and get deeper, it becomes more challenging to get mine rescue responders to the location of the emergency quickly. Emergency plans must consider this. Specially designed and constructed team transport vehicles can be provided to mine rescue teams so they are able to get to the site of the emergency faster.

As depth increases, the environment becomes hotter and more humid due to increasing rock temperature. High temperatures and humidity can affect mine rescue team performance. Responders may need to work for shorter periods of time so planning has to take into account the potential need for shorter shifts.

Rescue teams rely on breathing apparatus and researchers/manufacturers recommend that four hours is the longest a responder should be allowed to remain under oxygen. Best practice by mine rescue organizations is to limit responders to two hours.

The establishment of underground mine rescue substations would create complexities associated with the storage, care and maintenance of breathing apparatus. This work must be conducted in a clean, air-conditioned and dust-free environment, which may be difficult to create underground. Underground mine rescue stations would also mean that companies would have to purchase additional mine rescue equipment. Emergency plans should consider the use of self-rescuers (i.e. individual breathing devices carried by miners) in addition to the strategic use and location of permanent and portable refuge stations.

When companies are involved in advanced exploration) There can be serious health and safety issues yet the companies are not currently required to have an emergency response plan for those sites – despite the fact that workers could encounter typical underground mining risks, including oxygen deficiency, mine gasses, falls of ground and inrush of water. The complexity of an emergency response plan for an exploration site will depend on a number of factors including geographic location of the mine/project, number of workers at the site, proximity to municipal emergency response organizations, proximity to neighbouring operations that have response capability and site-specific hazards. It is important that companies have emergency response plans that:

- address typical underground risks
- are based on a risk assessment, evaluated by the joint health and safety committee where applicable, tested regularly and adjusted to address new and emerging hazards
- are reviewed and updated at least annually by the owner/employer and made available for review by Ministry of Labour inspectors.
Unlike other jurisdictions, Ontario does not currently require **surface mines and mining plants** to conduct regular formal risk assessments or establish, maintain and evaluate an emergency plan. Surface mines and mining plants often rely on municipalities to assist with response to an emergency situation. However, municipal fire services and emergency medical services (EMS) have limitations and need to be consulted before being imbedded as standard procedures within a site’s emergency response plan. To support mine and mining plant operators, it is essential for the mining sector to develop a guideline of critical elements (components) of a written emergency plan with clearly defined roles and responsibilities during an emergency. These plans need to be reviewed, audited and tested regularly to ensure compliance. Adjustments need to be made when changes within the workplace may affect response capability.

**Fitness and Competence of Volunteer Emergency Responders**

Mine rescues in Ontario are conducted by volunteer emergency responders who require a high level of fitness, support and knowledge.

**General Fitness:** Rescuers must be capable of performing arduous work under extreme conditions. Ontario Mine Rescue requires responders to have annual physical examinations and clinical testing to assess their fitness. However, the comprehensiveness of the exam may vary depending on the examining physician, who may not be aware of the intensity of work performed by these individuals.

To ensure responders are physically fit enough, some jurisdictions employ/use certain medical professionals who are responsible for overseeing medical examinations and clinical tests and who examine and release volunteers after a mission under oxygen. Many jurisdictions have stringent mine rescue fitness standards. For example, mine rescue organizations in the United Kingdom, German, Poland and the Czech Republic conduct monthly fitness testing. To ensure responders are fit, Ontario could consider specifying fitness requirements.

**Acclimation:** Heat and humidity are significant hazards to rescue responders. Arduous work significantly increases risk of heat-related illnesses, even at moderate ambient temperatures. Rescuers responding to emergencies under hot conditions must be acclimatized to be able to function effectively. Failure to do so can be a matter of life and death. For example, in 1998, six Polish rescuers lost their lives while responding to a routine situation and two American rescuers died of heat exhaustion at the Goldstrike decline in 2002. Since that time, all mine rescue organisations have adopted heat stress guidelines that limit underground mine rescue missions under heated conditions. Although Ontario Mine Rescue has adopted criteria for limiting the time (mission duration), volunteers are still exposed to high temperatures and
humidity. This strategy alone may not be enough to ensure responders are acclimatized to their particular operation.

**Critical Incident Stress:** Responders may be involved in rescue and/or recovery operations. For responders involved in recovery operations, finding bodies is distressing. Volunteers should have immediate access to Critical Incident Stress management teams following an incident. Stress-related anxiety is normal but, if the emotions are not dealt with in a healthy effective fashion, they can lead to emotional turmoil and even harmful behaviour. Part of the risk assessment process should include identifying individuals who may be involved in recovery operations and establishing a plan to provide education, support and counselling.

**Impact of New Technology:** Technology affects how rescue teams respond to emergencies. Just as there are new technologies for mining, there are new technologies for mine rescue. The Technical Advisory Committee of Ontario Mine Rescue is responsible for investigating any new technology and making recommendations about which technologies should be adopted to improve the safety of members of rescue teams. Processes are in place to ensure that responders are trained in the use of any new technology.

**Medical Skills:** All Ontario mine rescue team members are required to have a minimum of standard first aid to assist with injured workers. Many have advanced first aid training.

**Training Program/Skills Competency:** Ontario Mine Rescue has several standardized competency-based mine rescue training programs including:

a) Introductory Program
b) Refresher (Regular) Training
c) Advanced Mine Rescue Certification
d) Management Program
e) Technician Program
f) Technician Refresher Training
g) Supervisory Program

All Ontario Mine Rescue training programs come with leader guides and participant manuals and, where appropriate, competency checklists that are used to evaluate performance. The organization also maintains a comprehensive training database which tracks training received, competencies, oxygen time, experience in other jurisdictions and first aid certifications.
Training is normally delivered between September and May of each year. The current training schedule, which appears to be based on district and provincial mine rescue competitions (see below) rather than the needs of mine operators or responders, could result in long periods of time between regular and refresher training. The mine rescue training program would benefit from being evaluated to assess how best to deliver the knowledge components of the program as well as responders’ ability to maintain competency over time. Findings could be used to determine how often responders need refresher training.

**Role of Mine Rescue Competitions:** Ontario’s mine rescue competition is designed to simulate a complete incident response with numerous integrated tasks. A competition includes team preparation and team briefing, followed by solving a complex incident that will typically include triage, use of special equipment and firefighting. Although this exercise results in a very complete and thorough evaluation of a team’s ability to work through these tasks, it is not necessarily representative of what happens in an actual emergency situation.

In their competitions, most other jurisdictions establish separate tasks that are classified into knowledge, skill and endurance categories. Teams are required to complete several tasks and are evaluated against standards. A competition broken down into separate tasks would more accurately assess the competency of Ontario's mine rescue workers in real life situations.

**Recommendations**

3.1 The Ministry of Labour to require mining companies to conduct risk assessments to establish Emergency Response Plans for exploration sites, new mines, surface mines and mining plants.

3.2 Workplace Safety North to revise the Mine Rescue Handbook to include guidelines for fitness of crew members, critical incident stress management and acclimatization of emergency responders.

3.3 The Ministry of Labour to work with stakeholders to develop proposed recommendations regarding the responsibilities of mine rescue crew members and mine owners/employers, with respect to mine rescue operations.
4. Training, Skills and Labour Supply Issues

Issue
In the near future, Ontario’s mining sector may face skill and labour shortages. Worker losses, including those from retirements, combined with new demand from the expansion and development of existing and new mines will increase recruitment and training requirements within the sector. The Ministry of Training, Colleges and Universities has developed mandatory training program standards for underground mining, which form the basis for the mining Common Core training modules. It is important to determine whether the content of these training programs and the way they are delivered will meet growing and changing workplace needs.

What We Heard
The Review heard that health and safety in the workplace is an integral part of life-long learning. It begins when students are introduced to the workplace - through co-op or ‘Take Your Child To Work’ programs or their first job - and continues throughout their working life. All those in the mining sector share a desired outcome: everyone wants to make sure miners come home safe at the end of every shift. With respect to training and skills development, all agree that all workers on a job-site need to be:

- trained and competent in the skills they need to perform their tasks, including the use of any equipment they are provided or required to use
- aware of the hazards and associated risks they may encounter in their work.

Within the mining sector, there is support for the current modular training program concept and approach to training. While there is some support for making mining a registered trade and developing appropriate apprentice programs to transfer knowledge from the more experienced miner to the apprentice, most feel the current Common Core modular training model serves the sector well. Most believe that the diverse nature of mines across Ontario does not lend itself to the traditional apprenticeship model.

The concerns that do exist with the Common Core program focus mainly on how the modules are delivered and how content is kept relevant and up-to-date. For example, the Review heard that the training program would be more effective if there were: standards for trainers; better tools to evaluate the effectiveness of the training for new workers and assess trainees’ competencies once they have completed the training; and opportunities for ongoing and refresher training. At the current time, once someone has completed the modules, no further training is required. The Review questioned whether a one-time course is enough to support
workers throughout their careers. In terms of keeping the training current and relevant, the Review heard that the content of the Common Core modules -- particularly the modules for supervisors -- should be reviewed by the Ministry of Training, Colleges and Universities.

Analysis

Labour Supply and Workforce Challenges

Ontario's mining sector currently employs about 26,377 workers - 12,408 of whom are working in underground mines (including mines that operate both at the underground and open pit level).

Table 5 - Ontario Mining Employment 2014 Total

<table>
<thead>
<tr>
<th>Type of Worker</th>
<th>Number of Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground (Full Time)</td>
<td>10,549</td>
</tr>
<tr>
<td>Underground (Contractors)</td>
<td>1,859</td>
</tr>
<tr>
<td>Open Pit (Full Time)</td>
<td>4,076</td>
</tr>
<tr>
<td>Open Pit (Contractors)</td>
<td>719</td>
</tr>
<tr>
<td>Stone, Sand and Gravel</td>
<td>7,600</td>
</tr>
<tr>
<td>Other (R&amp;D, Head Office, Engineering)</td>
<td>1,574</td>
</tr>
<tr>
<td>Total</td>
<td>26,377</td>
</tr>
</tbody>
</table>

Ontario’s mining sector is aware of the challenges associated with attracting and keeping a skilled workforce. According to a Mining Industry Human Resources Council (MiHR) analysis, by 2018, approximately 50% of the current Ontario mining workforce will have left the sector – more than half of these through retirement\(^8\). Worker losses of this scale will create large hiring requirements and training needs.\(^9\) In 2016, the sector will need to recruit 6,700 people just to maintain existing capacity (i.e. baseline). By 2021, the sector will need to recruit 15,810 people – or over 35% of the current mining workforce in Ontario – for the baseline scenario.\(^10\)

Table 6 - Hiring requirements as determined by MiHR under three scenarios: baseline, contractionary, and expansionary human resource needs scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2016</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractionary</td>
<td>5,410</td>
<td>14,080</td>
</tr>
<tr>
<td>Baseline</td>
<td>6,700</td>
<td>15,810</td>
</tr>
<tr>
<td>Expansionary</td>
<td>7,640</td>
<td>16,910</td>
</tr>
</tbody>
</table>

\(^10\) Mining Industry Human Resources Council, “Canadian Mining Industry Employment and Hiring Forecasts 2011,” 19
The Advisory Group assessed the potential for future growth in Ontario’s mining sector based on information provided by the Ontario Mining Association (OMA) and the Ministry of Northern Development and Mines (MNDDM). The Review’s analysis of labour supply made an important distinction between longer-term and regionally significant economic development projects like the Ring of Fire and mine-specific labour needs for new mines and expansions.

Based on analysis of the predictions from MNDDM as well as the MiHR analysis cited above, the Review is of the opinion that there will be continued growth in the industry with new mine development and the sector will face challenges as it competes with other sectors for a limited pool of skilled workers. The long-term labour supply challenges are different for the mining sector as a whole than they are for regional development projects like the Ring of Fire or for specific new mines and expansions. Remote mines will likely find it even more challenging to recruit.

The Provincial Government has been working closely with labour and employer organizations, community stakeholders, the education sector, and relevant Health and Safety Associations to implement strategies to ensure the mining sector has the skilled workers it needs. For example, there are now more educational opportunities for students, concerted efforts to improve the industry’s image and targeted efforts to attract new talent to the north and retain them. Industry organizations are taking a proactive approach by educating students and teachers about the industry. Given that health and safety in the workplace is an important part of life-long learning, exposing secondary students to more health and safety training and awareness provides a sound beginning and a base for young people entering the workforce. Elements of health and safety are already included in a variety of places in the secondary school curriculum.

**Training in the Mining Sector**

In the future, the mining sector will be relying on a significant number of relatively inexperienced miners who will be working in more complex environments (i.e. deeper mines, more remote mines) with a growing number of new mining technologies and approaches. Both new and existing workers, including outside contractors, tradespeople and others, will need to be able to rapidly attain the necessary skills and training -- which is a critical part of a world-class health and safety system.

To examine current health and safety training practices, the Review examined Ontario mining companies’ policies related to health and safety training including the information covered, format of delivery (classroom, online, onsite) and duration. The Review also looked at best practices in Ontario and other global mining jurisdictions. From this assessment, the Review learned that the mining workforce across Canada, North America and internationally varies...
extensively, depending on the type of material mined and the methods used. Requirements for training also vary based on factors such as the type of mining and whether it is a combination of surface mines or underground mines.

Ontario’s Occupational Health and Safety Act (OHSA) requires employers to provide workers with information, instruction and training to protect their health and safety, including providing supervisors with the information and instruction they need to fulfill their responsibilities under the Act. Employers engaged in mining operations must train their workers in the Common Core and Specialty Modules required by OHSA Regulation 854, Mines and Mining Plants. Employers are also required to train workers on the specific equipment/processes they will be using and to provide other training programs as needed.

Worker Training: The Ministry of Training, Colleges and Universities (MTCU), in consultation with the mining sector under the Mining Tripartite Committee¹¹ (MTC), develop and maintain the modular mining training programs: the Common Core Modules and the Specialty Modules. Common Core training provides mandatory entry-level training for new workers entering specific mine work environments. For example the Underground Hard Rock Miner Program #770010 consists of four mandatory Common Core and 75 Specialty Modules (which are taken as required). The four Common Core modules cover the following competencies:

- Follow Surface and Underground Induction Procedures (U0000)
- Perform General Inspections (U0001)
- Scale Loose Rock (U0002)
- Perform General Lock Out and Tag on Prime Movers and Other Related Equipment (U0012)

The Specialty Modules are mandatory hands-on competency-based workplace training (section 11, Regulation 854, Mines and Mining Plants, OHSA). Mine and mining plant employers are required to establish and maintain the appropriate modular training program(s) to train their workers. Each employer must apply to the Ministry of Training, Colleges and Universities to grant a designated person signing authority, which means that person is accountable for ensuring the quality of training, maintaining training records and determining the competency of workers for accreditation after completing the modular training program. Each program has specific guidelines outlining program prerequisites, ministry accreditation requirements, signing authority responsibilities, trainer qualifications and audit guidelines.

¹¹ The Mining Tripartite Committee consists of an equal number of industry labour and management representatives as well as representatives from the Ministries of Labour and Training, Colleges and Universities.
Maintaining worker skills and knowledge as well as awareness of hazards on the job site are critical to health and safety. While there are requirements for the initial training of mine workers in Ontario, there is currently no formal requirement for refresher training or any mechanism to ensure workers keep up-to-date with new skills or changing technology. In terms of refresher training, the Stevenson Inquiry (1986) recommended periodic refresher courses in ground control which, then as now, was a priority hazard. The inquiry also recommended that miners should be regularly evaluated on their knowledge of current practices and given additional training if needed. In terms of training in new skills and processes, whenever new underground technologies and mining techniques are introduced, it is essential that miners receive proper and timely training.

**Manager/Supervisor Training:** During an assessment workshop (July 2014) facilitated by the Ministry of Labour and in other consultations, the Review heard experience and training of supervisors and managers are an important factors in workplace health and safety.

To be a supervisor in a mine, individuals must meet four key requirements:

- hold a current WSIB approved First Aid Certificate
- complete the full Basic Common Core training for underground hard rock miner
- be registered in the Supervisor Common Core module
- meet the OHSA definition of a competent person.

At the current time in Ontario, individuals can start supervisory duties in a mine before completing their Supervisory Common Core. In 2012, the number of pre-requisites modules in the Supervisor Common Core was reduced and, in the opinion of subject matter experts, these changes reduced the robustness of the training. When the Review compared Ontario’s manager/supervisor training requirements with those in other jurisdictions in Canada, the United States and internationally, it found that other jurisdictions have unique or distinct training requirements for both underground mine managers and supervisors that do not currently exist in Ontario. For example, some jurisdictions have specific requirements that apply to a “mine manager”, including:

- a specific post-secondary degree in a mine engineering discipline or valid documentation from an equivalent certifying authority
- relevant experience in underground mining for a specified period of time (up to five years) and specific mine work experience such as one year working at a working face
firsthand experience as a supervisor

knowledge of applicable legislation and underground mine rescue operations of the mine.

In addition, some jurisdictions have specific requirements for supervisors, including:

- completing specific courses of study, including the role of a supervisor in health and safety management systems and ground control
- completing any required training as soon as reasonably practicable after being designated a manager (in some jurisdictions, supervisors who could demonstrate various combinations of experience, education or training would be considered to already have equivalent training)
- being mentored by another supervisor for a minimum number of hours.

**Executive/Company-wide Training**: Dr. James Ham in reflecting on the Occupational Health and Safety Act said if he “were to make one change to the legislation, it would be to make CEOs more responsible for the health and safety performance of their company.”\(^{12}\) To truly protect worker health and safety, mining companies must develop a culture of health and safety throughout the organization. It is critical that all people within the company be familiar with health and safety rules, processes and obligations while operating in Ontario.

The commitment of the senior Mine Manager sets the whole tone for a safety culture. Other jurisdictions have recognized the need for senior management to be actively engaged in health and safety by establishing minimum requirements. In some cases, as indicated above, they have established expectations related to experience and training; in others, they require professional accreditation to be a Mine Manager. In Ontario there are no such pre-requisites.

**Challenges in Ensuring Consistent High Quality Training**

The mining sector faces two key issues in ensuring high quality training: keeping training program content up to date and ensuring the training is delivered consistently in all sites.

The Mining Tripartite Committee is responsible for developing and updating training programs and advising the Ministry of Training, Colleges and Universities (MTCU) on training modules. This collaborative group can be an effective mechanism for continually improving mine safety training in Ontario. The Committee would benefit from consistent capacity and permanent representation from the Ministry of Training, Colleges and Universities. The Review heard that, while the Committee is doing excellent work, it must have access to resources to operate at a consistent high level.

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The Review also heard that the quality of training delivery can vary from worksite to worksite. In 2008, Signing Authority Audit guidelines were established by the Ministry of Training, Colleges and Universities to address the issue of consistency by standardizing key aspects of training development, delivery and reporting. However, this audit is self-conducted by the signing authority, kept within the firm and not reviewed by a third party. There is currently no means to determine the quality and consistency of training in the sector. Some ongoing work at the Ministry of Labour with regard to creating training program and provider standards could provide a model for enhancing the delivery of training in the sector.

**Mining as a Trade**

During the public consultations, some people expressed the opinion that mining should be a trade but there was much more support for the current Common Core training modules. The Review examined best practices in other jurisdictions, as well as other Canadian approaches to certification (e.g. MiHR Canadian Mining Certification program). If underground mining were a trade or a certified program (as proposed by MiHR), the skills could be more portable – for both workers and employers. However, higher training requirements could create a barrier to workers entering the field or currently working in the sector, which could be problematic for an industry facing potential labour recruitment challenges over the next decade. At this stage in the sector’s development, the Review is not recommending making mining a trade.

**Recommendations**

4.1 Enhance supervisor and management training by:

- Requiring the Mining Tripartite Committee, which supports the development of Common Core training, to present to the Ministries of Labour and Training, Colleges and Universities options and recommendations to enhance supervisor and management health and safety training

- Requesting the Mining Tripartite Committee to review the pre-requisites for Supervisor Common Core training and determining the best format for this training (e.g. classroom learning, hands-on experience).

4.2 The Ministry of Labour to engage in discussions with the Ministry of Training, Colleges and Universities about the quality and consistency of Common Core training delivery in the underground mining sector, evaluate the current state of that training, and identify circumstances where refresher training may be appropriate.
5. Capacity of the Occupational Health and Safety System

Issue
A number of partners work together to create the Ontario occupational health and safety system (see Volume 2: Report Addendum), including the Ministry of Labour, the Workplace Safety and Insurance Board, and relevant Health and Safety Associations. In addition, the joint health and safety committees or health and safety representatives at each company are a critical part of the health and safety system and play a key role in creating a health and safety culture.

The system partners must have extensive knowledge of current health and safety hazards associated with underground mining as well as the technical capacity to identify emerging hazards in an increasingly complex and high-tech industry. Given the anticipated growth in Ontario’s mining sector, the impact of new technologies and processes, and the expected labour shortages and changing training needs, the current occupational health and safety system must enhance its capacity to respond to the health and safety issues affecting underground mining in Ontario.

What We Heard

Ontario’s Mining Sector to Grow Slightly and Open New Mines in Remote Areas
To better understand and predict expected growth in Ontario’s mining sector and, in particular, underground mining, the Review consulted a number of organizations who monitor sector growth including the Ontario Mining Association, the Mineral Sector Analysis and Promotion Branch of the Ontario Ministry of Northern Development and Mines, and the field component of the Mining Health and Safety Program of the Ontario Ministry of Labour. These organizations identified a number of factors that will influence growth in the underground mining sector in the foreseeable future, including:

- Global drivers of change such as demand for commodities and related pricing; investment in mining innovation; and continued growth in the supply and services sector.

- Local drivers such as access to capital for exploration and development; input, production and transportation costs; energy costs; identification of new ore reserves and improving discovery rates; and future labour supply needs with new skills and a culture of safety.
• While value of exploration is down from recent historic levels, Ontario continues to lead Canada in mineral exploration investment as it has for the past decade and has opened more new mines than anywhere else in Canada.

Based on these factors, Ontario’s mining sector expects to see continued but not significant growth and related job opportunities. The organizations consulted predict that, over the next five years, slightly more new mines will start up than the number of existing mines that will close. There are 35 advanced exploration projects currently underway and several new mines are slated to open over the next three to five years. Based on the size of the sector alone, the relevant Occupational Health and Safety System partners will need to at least maintain their current capacity levels.

**Analysis**

*More Engineering Expertise Required*

The health and safety pressures in the mining sector will come less from growth and more from the fact that the industry is becoming more technically complex. Deeper mines and more mines in remote areas will require more intense health and safety support.

In recent years, the Mining Health and Safety Program of the Ministry of Labour launched a campaign to recruit inspectors and have bolstered its inspection capacity. During the consultations some stakeholders expressed the opinion that over the past two decades, the ministry’s technical capability has declined. A review of Regulation 854 of the OHSA concluded that over 50 of its 293 sections require engineering support for the inspectorate to ensure effective enforcement, and that most of those 50 sections pertain to high or extreme risk hazards such as ground control. In order of priority, the Capacity working identified the following engineering disciplines required to support and enforce the regulation:

- mechanical engineering
- mining engineering
- ground control (i.e. geotechnical) engineering
- electrical engineering
- structural engineering
- civil engineering.

The ministry’s Mining Health and Safety Program currently has some expertise in mining engineering but does not have the full range of specialities required. To begin addressing
technical capacity, the Ministry of Labour has provided supplementary training in mining-specific issues to their mechanical engineers in the Industrial program. In addition, the Northern Region recently hired a structural engineer.

When the Review compared Ontario’s occupational health and safety system with those of the 11 other Canadian provinces and territories with active mining sectors, it found considerable variability in terms of the size of mining sector, the ministry responsible for mining health and safety inspection services, the model for providing technical support to mining operations, and processes for evaluating the health and safety implications of new technology. However, despite the variability, all jurisdictions agreed that it is important to have strong in-house engineering expertise to support mining health and safety inspectors. In fact, some jurisdictions require inspectors to have an engineering background.


**More Training Needed in New Technologies**

To assess whether mining inspectors have the knowledge and skills to ensure compliance with regulatory requirements related to emerging health and safety challenges, the Review examined in detail the training program for Ministry of Labour mining inspectors. Training consists of a comprehensive formal nine-month program for new inspectors, as well as refresher training for incumbent inspectors. The nine-month program for a new inspector includes both corporate, ministry and program-specific components and is delivered in both classroom and field settings.

The program-specific component consists of a blend of in-class and e-learning training on Regulation 854, combined with on-the-job field assignments with designated mentors. Upon completion of a mandatory training curriculum and successful demonstration of competencies through reviews and examinations, new recruits are appointed as Occupational Health and Safety Inspectors, and are designated Provincial Offenses Officers.

While the training program for mining inspectors is robust, the Review identified opportunities for improvement. Given the use of new technologies in the mining sector and the emphasis on risk assessment tools to estimate the level of risk associated with health and safety hazards, it would be prudent to incorporate a “new technology” component into the training program. With
this training, inspectors would be able to evaluate management of change and risk assessment processes being applied in the sector for the purpose of ensuring compliance with the proposed amendments to the regulation.

**A Systematic Analysis of Findings from Coroner’s Inquests**

Deaths that occur as a result of an accident in the course of employment at construction sites, mining plants and mines are subject to mandatory inquests. Between 1996 and 2009, 36 inquests were held related to deaths in Ontario’s mining sector.\(^{13}\) Although the findings and recommendations from these inquests have helped stakeholders address health and safety weaknesses, they have never been analyzed in a thorough, systematic and holistic way. The Review believes this kind of systematic review will provide information that could:

- help coroners prepare for and carry out inquests into mining fatalities, by giving them a broader perspective on the health and safety hazards that have historically resulted in fatalities in Ontario’s mining sector. Most active coroners in Ontario are unfamiliar with the mining sector and its health and safety hazards so they would benefit from this analysis.
- form a basis for recommending changes to mining health and safety statutes
- be used to inform risk assessments (i.e. by both quantifying and qualifying the consequence and likelihood of harms)
- assist in the design of health and safety programs
- help establish priorities for auditing health and safety programs
- be useful for education and research purposes.

In 2012, the co-chairs of the Mining Legislative Review Committee, in collaboration with the Supervising Coroner for the Northern Region of Ontario, prepared a formal scope of work for the type of analysis described above.

**Protecting Workers from Reprisals**

Ontario’s Occupational Health and Safety Act (OHSA) provide workers with rights and responsibilities. Section 50 of the OHSA prohibits employers from penalizing workers for obeying the law or exercising their rights. During the Review, it was clear that workplace reprisals are a concern in some underground mines. In response, the Review examined the existing process for responding to reprisals to identify opportunities for improvement.

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\(^{13}\) Coroner Jury Reports Analysis for Mining Sector, Data Management and Performance Metrics Unit, Prevention Office, August 2014.
A significant amount of work has recently been done to address the issue of reprisals. In December 2010, the Tony Dean Expert Advisory Panel on Occupational Health and Safety released its final report after a comprehensive review of Ontario's workplace health and safety system. The Expert Panel identified concerns about the way in which Section 50 of the Ontario Occupational Health and Safety Act (i.e. prohibiting reprisals) is being administered. Specifically, the Panel found that the way in which Section 50 was enforced:

- discouraged many workers from exercising their rights under the Occupational Health and Safety Act
- did not adequately protect workers from reprisals

The Expert Panel also heard that:

- when workers appealed to the Ontario Labour Relations Board because they had experienced reprisals, the procedures were complex and took a long time
- the Ministry of Labour rarely prosecuted employers for violating Section 50.

As a result of the recommendations of the Expert Panel report, legislative amendments to the OHSA under Bill 160 specify new roles for the Ontario Labour Relations Board, the Office of the Worker Advisor, the Office of the Employer Advisor and the Ministry of Labour in addressing reprisals. However, the Review heard that, within the mining sector, the “new” roles defined by Bill 160 are not clearly understood. More effective communication about how the process to investigate reported reprisals has changed will benefit all sectors.

**Roles and Responsibilities of Joint Health and Safety Committees**

The Review heard that joint health and safety committees must have the capacity to ensure compliance to the relevant sections of the OHSA that set out their rights and responsibilities – and that inspectors can help the committees function effectively by providing information on how other firms implement the regulations. In fact, many stakeholders noted that they would like the Ministry of Labour to play more of a consultative role.

Because joint health and safety committees are critical to supporting a positive health and safety culture, the Review conducted a comprehensive literature search to identify the optimum model for joint health and safety committees. In the Review’s opinion, the model proposed by K. Burkett in Volume I of *Towards Safe Production* (i.e. the report of The Joint Federal-Provincial Inquiry Commission into Safety in Mines and Mining Plants in Ontario) exemplify best practices. According to this model, the optimum role of a joint health and safety committee should consist of the following responsibilities:
• Provide advice and insight from a health and safety perspective in the planning of work rules and practices

• Provide advice and insight from a health and safety perspective in the planning of new or altered facilities, production processes and work methods

• Provide advice and insight from a health and safety perspective in the purchase of production equipment

• Provide guidance on the setting of safety goals and objectives for the organization as a whole and for the appropriate sub-units

• Assess the effectiveness of existing safety programs, including the use of supervisory contacts, workplace meetings, communications and safety incentives, and make appropriate recommendations

• Assess the effectiveness of the health and safety content of worker training and make appropriate recommendations

• Analyse all injury and accident statistics for both the organization as a whole and its sub-units to identify trends and make appropriate recommendations

• Monitor the response of first-line supervision to health and safety issues at their level and make appropriate recommendations.\(^{14}\)

**Recommendations**

5.1 The Ministry of Labour and the relevant Health and Safety Associations to increase their capacity to ensure the health and safety system has the resources to address mining hazards effectively – particularly the priority hazards identified in the risk-ranking exercise. In particular:

- Increase ministry capacity in geotechnical, mining, mechanical, electrical, structural, and civil engineering

- Increase system partners’ technical capacity/ resources related to industrial hygiene and mechanical issues.

5.2 The Ministry of Labour to review its policies and procedures that apply to mining inspectors related to unannounced field visits, reprisals, repeat orders, the training of inspectors and the provision of information to workplace parties and how those policies and procedures

are implemented. Take appropriate actions based on the findings of that review. In particular, address the following operational policies and procedures:

- Clarify the use of unannounced proactive field visits
- Clarify the appropriate use of orders versus other methods to achieve compliance for priority hazards, especially with regard to repeated non-compliance with the same issue in a specific workplace
- Clarify inspector action to be taken in situations of suspected reprisal
- Align proactive activities, whenever possible, to the priority hazards identified in the sector level risk assessment
- Clarify the training provided to inspectors to address priority hazards, and the inspector’s role in the inquest process

Identify any further training required to support changes in policies and procedures brought about by the Review and/or changes in the regulations

5.3 The Ministry of Labour and its partners to review the health and safety system’s ability to meet the needs of the mining sector especially related to providing services to remote communities, training small numbers of trainees, and aligning their training activities to the priority hazards. Take appropriate actions based upon the findings of that review.

5.4 The Ministry of Labour to work with the Ministry of Community Safety and Correctional Services to enhance the information supplied to the Chief Coroner’s Office and build better linkages between both ministries. This collaboration includes:

- Conducting and regularly updating an aggregate analysis of all past inquests into mining fatalities
- Holding information sessions with the Chief Coroner to identify opportunities for coroners to use the analysis to improve future inquests into fatalities in the mining sector.
6. Internal Responsibility System

Underground Mining and the Internal Responsibility System

In 1976, Dr. James Ham introduced the concept of the Internal Responsibility System (IRS) to Ontario in the Report of the Royal Commission on the Health and Safety of Workers in Mines. The Ham Commission led to the coming into force of the OHSA in 1979. The OHSA provides for the establishment and maintenance of the IRS, for example by setting out specific duties and functions for workplace parties. As the “birthplace” of the IRS, mining has continually studied IRS concepts and, although underground mining workplaces have unique characteristics that affect how the IRS is manifested, the experience in the mining sector may be useful to other sectors.

With this Review, the mining sector had another opportunity to examine the concept created nearly 40 years ago.

Issue

Although the language in the OHSA was shaped by the concept of the IRS in the Ham Commission Report, the Act does not reference nor define the Internal Responsibility System nor does it specifically state that a section of the OHSA relates to the IRS. However, those sections of the OHSA that relate to the responsibilities and rights of the workplace parties are commonly thought to be the “IRS” sections of the Act.

Ham outlined the role of the workplace parties that contribute directly to the Internal Responsibility System in identifying and controlling workplace hazards that can lead to injury and illness. However, he did not describe the roles of other groups who also contribute, such as the Ministry of Labour. The Review also heard that, in practice, the IRS has been applied inconsistently within the mining sector – perhaps because of the lack of a common understanding of how the IRS should function. The Review explored whether there is an opportunity to strengthen the understanding of how the Internal Responsibility System should work and help it realize its potential.

What We Heard

During the consultations, the Review heard a variety of views of the kinds of workplace practices that support an effective IRS, including:

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Leadership: The role of the mine manager in creating and maintaining a culture that fosters worker participation and identifying and mitigating hazards is key to an effective IRS. The Review heard repeatedly that a single individual in a position of power and influence who is committed to resolving health and safety concerns and who believes in genuinely empowering a worker to participate and engage, can have a dramatic impact on the strength of the IRS.

Effective Enforcement: Subject matter experts emphasized the importance of multiple layers of checks and balances to ensure safety management systems are working correctly. For example, in New South Wales, when a high-risk hazard is known in the mining industry, the mine is required by legislation to have a plan in place to control the hazard. To ensure the control plan does not erode, it is continuously monitored internally by worker representatives and is subject to third-party external audits every 24 to 36 months. The multiple layers of checks and balances help prevent latent failures. As Ham noted, “Any internal system of direct responsibility will be imperfect and requires audit, not because of any inherent defect in form but because it is a human organization in which conditions of work and concern for the well-being of persons create grounds for tension.”

No Reprisals: For the IRS to work effectively, workers play a key role in identifying safety concerns. For a worker to fulfil that role, the process must be free from any direct or subtle acts of reprisal against the worker by any of the levels of management. Unfortunately, the Review heard examples of where this process did not function properly or successfully in Ontario mines. The theme of reprisals was a common theme in many presentations on the IRS.

Knowledge Transfer and Organizational Memory: Given that a large percentage of the workforce will retire over the next few years, a great deal of collective health and safety knowledge may be lost to the sector. While individual mine sites will have to develop their own processes to retain “organizational memory” over the next five years, the Ministry of Labour and the relevant health and safety partners can also play a role by distributing pertinent safety information. Newer workers will not have the same level of knowledge and workplace experience as older workers, so the health and safety system should build the capacity needed to support the transfer of occupational health and safety information.

A Common Understanding of the Internal Responsibility System: Over its year-long effort to develop recommendations to strengthen the IRS in Ontario’s mines, the Review heard two opinions about the value of a common description of the IRS. Some people strongly support

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defining the IRS while others strongly oppose it, and both sides firmly and genuinely believe their point of view will strengthen the IRS in the long run. The management side believes that, to improve the system, there must be a clear understanding of the IRS, the goals to be achieved and the methods to reach these goals. The labour side believes that defining the IRS risks confusing the roles, rights and responsibilities specified under the Occupational Health and Safety Act.

**Best Practice Guideline for Underground Mining IRS.** The workplace parties are currently developing a best practice IRS guideline for the underground mining sector. Once completed, this guideline will reflect the consensus statement of the employers and workers on optimal workplace practices. It will be a significant and tangible expression of the collaborative work done by labour and employer organizations to find a common understanding of how the IRS can best be expressed in the underground mining sector. The Review believes this guideline would be a good starting point for further discussion on the Internal Responsibility System.

**Analysis**

The Review's findings are grouped into three categories, each of which is essential to a well-functioning Internal Responsibility System.

1. **Increase Safety Knowledge throughout the Mining Sector**

   Given the expected turnover in the mining workforce, the mining sector has already turned its attention to retaining site-specific operational knowledge. To help this process, the Ministry of Labour and the relevant system partners should increase the amount and type of information it provides to the industry for posting in the workplace and sharing with joint health and safety committees.

   The ministry’s current policy on issuing Hazard Alerts is to only alert the sector about new or unique hazards. The Review heard from both employer and labour representatives that they want more information from the Ministry of Labour on significant incidents, critical injuries and fatal injuries. Even if the information is repetitive, it will serve a useful purpose by highlighting potential trends. This practice will be particularly helpful for new workers who lack experience and an historical perspective on risks: they will benefit from repeated reminders of the outcomes of uncontrolled hazards.

   In addition to specific incident notifications, the workplace parties would like more aggregate trend information made available. This type of information would help identify emerging trends and provide a warning signal of issues that needed attention. It would also help the parties put the incidents in their workplace in the context of the sector as a whole.
“Failure to heed warning signals” is identified as one of the 10 pathways in Quinlan’s report *Ten Pathways to Death and Disaster*. Quinlan found health and safety management systems often didn’t give “sufficient attention to warning signals of low-frequency high-impact events” and “high-potential incidents are known precursors to many catastrophic workplace events and... need to be investigated and assessed individually as well as in aggregate or as subgroups over time to identify trends.”17

2. Effective Reporting Mechanisms

While some stakeholders felt that workers should raise their health and safety concerns first with their supervisor, others were concerned that such a requirement would limit workers’ participation in the IRS, especially if the relationship between the supervisor and worker is damaged, and/or the worker fears reprisals. In their view, the ability of the worker to take concerns to the Ministry of Labour and the joint health and safety committee must be understood and respected.

One way to support worker participation in the IRS is to ensure that effective reporting mechanisms are in place to allow workers to raise issues, and learn the outcome of their report. For example, processes that require internal reporting and increase worker representation and participation can empower workers in a meaningful way, which benefits the IRS and improves health and safety in the workplace. Better communication from the Ministry of Labour and other system partners – through hazard alerts and other tools -- can also encourage worker participation as can a well-designed management of change process.

3. Increase Enforcement

Most workers who addressed the subject of the IRS felt their ability to influence and strengthen their organization’s IRS could be better supported by Ministry of Labour enforcement practices. In the view of labour, the current roles of worker representatives and joint health and safety committees have become marginalized compared to the roles envisioned by the Ham and Burkett Commissions. As a result, many of the checks and balances put in place for the IRS have been eroded. Workers expressed concerns that the IRS has become dependent on the personality and moral engagement of a single individual in the form of the person “in charge”.

In their view, external enforcement practices are a necessary component to ensuring a healthy IRS in an underground mining environment. This concept is not new: the Ham, Burkett, Laughren, and Richard 18 Commissions all reinforced the crucial role of enforcement in helping the self-regulatory system established under the OHSA function effectively.

**Strengthen the Internal Responsibility System**

The Internal Responsibility System is the underpinning of the Occupational Health and Safety Act; therefore, it is essential that the workplace parties and the health and safety system clearly understand what it is and how it should function.

Both labour and employer organizations agree that the elements of the IRS are embedded in the Occupational Health and Safety Act. Therefore, an effective IRS requires, as a minimum, full compliance with the OHSA. Both groups also recognize the importance of outside support for the IRS. Without the contributory elements of the IRS, both employer and labour organizations believe the IRS would eventually weaken and fail.

However, they had a different perspective about the IRS. A clear understanding of these different points of view and their potential impact on health and safety will help the health and safety system in its future communication and work with the workplace parties. The information and opinions gathered in the course of the Review will aid in developing a common understanding of a well-functioning Internal Responsibility System.

**Recommendations**

6.1 The Ontario Mining Association to work with labour representatives to develop an Internal Responsibility System best practice guideline as an industry benchmark, to be endorsed by the Ontario Mining Association for implementation by its members

6.2 The health and safety system to share data both on emerging injury and illness trends, and information on incidents causing serious injury across the industry to trigger preventative actions by workplace parties.

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18 Richard, Peter K., The Westray Story: A Predictable Path to Disaster, 1997
Early Progress in Improving Health and Safety

The Ministry did not wait until the end of the Review to start acting on its advice. As promised by the government at the outset of the review, quick steps were taken to address some issues identified early in the process (see Progress Report).

High Visibility Safety Apparel

In September 2014, the Ministry of Labour developed a best practice guideline to help stakeholders comply with the current requirements regarding high visibility safety apparel. The Ministry also consulted on proposed regulatory amendments that apply to the mining sector, which align with the Canadian Standards Association (CSA) ongoing review of its standard for high visibility apparel. The Review has already discussed these proposed amendments with the Mining Legislative Review Committee.

Joint Health and Safety Committee Certification Part II

To support the upcoming implementation of the 2014 Joint Health and Safety Committee (JHSC) Certification Training Program and Provider Standards, the Ministry of Labour sought advice on potential hazard modules from the Review’s Hazards Working Group and others in the mining sector. The risk assessment conducted as part of the Review was used to inform the program’s list of hazards and the ministry used focus group discussions, teleconferences and email surveys to obtain stakeholder feedback on the implementation framework to formalize Part Two of the 2014 JHSC program standard. A report back on the feedback and recommendations on the 2014 JHSC implementation framework will be shared with the Chief Prevention Officer by the end of March 2015.

New Mining Research Projects

Work has already started on two research initiatives.

1. The Ontario Cancer Research Centre’s creation of the Ontario Mining Exposure Database. Started in the summer of 2014, the database will help identify groups of workers who may have been exposed to a carcinogen in the workplace in the past and may now be at higher risk of developing occupational disease. The project has completed its early milestones of collecting data and developing the database and is now in the process of entering the paper records into the electronic database. As valuable as this database will be, it won’t provide information on current levels of exposure in the Ontario mining sector or the occupational disease risks facing workers in the industry today.
2. **The Centre for Research in Occupational Health and Safety project to evaluate personal protective equipment as a control strategy to reduce foot-transmitted vibration.** In the mining industry, operators of locomotives, jumbo drills, bolters and raise platforms as well as workers who drill and bolt off of scissor platforms are regularly exposed to foot-transmitted vibration. This exposure can cause blanching of the toes, and tingling and numbness in the feet and toes. It can disrupt blood circulation and cause innervation to the toes and feet, leading to permanent damage and vibration induced white-feet. Research has shown that "anti-vibration" gloves can reduce the impact of hand-arm vibration but, to date, there have been no controlled studies examining the effectiveness of personal protective equipment, such as mats, boots and/or insoles, in reducing the impact of foot-transmitted vibration. With this study, researchers have been conducting tests to determine the best combinations of mats, boots and insoles. Preliminary results are promising. At 3Hz and 40Hz the best combination of personal protective equipment reduced the transmission of vibration from the platform through the foot by over 50%. Researchers also learned that the best mat, boot and insole combination was different for exposures at 3Hz and 40Hz.

**Other Recommendations**

Some of the final recommendations in this report are also underway. For example:

1. **A Strong Focus on Key Hazards.** The Mining Legislative Review Committee’s working groups are being realigned to reflect the priority hazards identified through the Review’s risk assessment. The Committee has created a Ground Control Sub-committee and, at its next meeting, will discuss expanding the Diesel Sub-committee into a Ventilation and Industrial Hygiene Sub-committee. Both changes demonstrate the mining industry’s commitment to focus on these key hazards. Both Sub-committees will continue to work on these issues, recommending regulatory changes to reduce risks.

2. **Strengthening the Mining Workforce.** In response to concerns that mine inspectors may not be adequately trained, the Ministry of Labour’s Divisional Learning Group reviewed the training course for newly hired inspectors and made many modifications based on the Review’s findings. The group has also revised the refresher training program for inspectors to include more intensive training on key issues.

3. **More Technical Capacity.** The Review highlighted the need for more technical expertise in the Ministry of Labour. In response, in the last 12 months the Northern Region has been able to hire two engineers to work in the mining program, and plans are underway to recruit more professional staff.
Next Steps

During the Review, a number of issues were identified that did not “fit” the scope of this report but still require attention. The Chief Prevention Officer will seek direction from the Minister with respect to addressing the following:

1. **Study whether the positions, roles and responsibilities stipulated under the Occupational Health and Safety Act meet the current needs of Ontario workplaces**

   In their work, the Advisory Group and Working Groups identified a number of issues that could affect all workers in Ontario, and require input from a broader range of workplaces. In particular, the Review noted that the basic elements of worker and employer rights and responsibilities in the Occupational Health and Safety Act have remained unchanged since the Act was created – even though work environments have changed dramatically over the past few decades.

   One of the key issues is whether the positions, roles and responsibilities under the Act meet the current needs of Ontario workplaces. For example, when Ham (1976) first set out the concept of the Internal Responsibility System, he envisioned one worker representative for every 25 workers working one shift a month in that role. Both Burkett (1981) and Laughren (1988) felt the worker representative role should be a full-time position, although they differed on the ratio of worker representatives to workers (1:500 vs 1:250). The IRS Working Group acknowledged the critical role of the worker representative and agreed that full-time representatives would be able to contribute more effectively to the IRS than part-time ones.

   The nature of work and the structure of workplaces have changed significantly in the time since the OHSA was created. Jurisdictions around the world have created models of worker and employer rights and responsibilities that are different from the Occupational Health and Safety Act.

2. **Study the health and safety system in surface plants and surface mining**

   The Advisory Group recommended that the Ministry of Labour, in collaboration with the relevant system partners and the workplace parties, review health and safety – including emergency preparedness – in surface plants and surface mining. While many of the hazards in underground mines also occur in surface operations, surface mining has its own unique hazards that should be carefully assessed.
3. **Continue to work with subject matter experts to explore priority hazards**

During the course of the Review, subject matter experts helped focus attention on specific elements of the priority hazards. By using subject matter experts, the Ministry of Labour was able to take advantage of the extensive expertise that exists in the system partners, academia, other ministries and the workplaces themselves. Given the duration of the Review, only segments of the priority hazards could be studied. The work should continue, looking at the other issues related to the priority hazards.

The short (half day) focused sessions with subject matter experts was valuable for the ministry as well as for the experts themselves, who were able to share knowledge with one another. Ongoing meetings with experts should not duplicate the work done by the working groups of the Mining Legislative Review Committee or the Technical Advisory Committees of Workplace Safety North; instead, they should focus on identifying strategies to mitigate specific elements of the high hazards.

4. **Preserve the database on occupational illness beyond the life of the current project led by the Ontario Cancer Research Centre**

In the past, there were several programs that required mandatory collection of health records related to exposures to various agents. However, when these programs ended, their records -- which are all in paper form -- were stored in various locations across the province and are difficult to use and easily lost. To ensure the mining sector continues to have access to valuable data, the Ministry of Labour should identify the location of these records and develop a plan to ensure they are preserved and, more importantly, digitized so they can be accessed by researchers.

5. **Improve the way research relevant to occupational health and safety in the mining sector is compiled, shared and made available**

The Review heard from various sources, including the research community, that research is being done and/or new techniques to reduce injury and illness are being tested but the information is not being shared. When findings that show better ways to improve health and safety are not shared, they can't make a difference. When the workplace parties and subject matter experts share ideas, then positive changes can be made.

6. **Evaluate the impact of alcohol and drugs use in workplace incidents**

Burkett studied the relationship between alcohol and drug use and workplace accidents in 1981. His report concluded that, while there was likely no evidence that alcohol and drug
use was more or less prevalent in underground mining than in any other industry, both posed a significant safety issue.

Since 1981, mining workplaces have become more technologically advanced and more miners are working alone. The attitude to the use of alcohol and some drugs has also changed markedly. All the priority hazards identified by the Review would be exacerbated by even slight impairment due to alcohol or drugs.

As a starting point, past serious occurrences could be examined to determine what, if any, part alcohol and/or drug use played in the incident.

7. **Study the way in which an accreditation program may benefit the mining sector**

The Review heard from a variety of stakeholders that good performance should be recognized by the health and safety system. A formal recognition would potentially provide others to meet the same level of achievement. The underground mining sector was interested in how an accreditation program could be beneficial to organizations within the sector.
Conclusion

The recommendations in this report are intended to improve health and safety in mines and ensure that all workers arrive home to their friends and family each day. The aim is to integrate occupational health and safety improvements while supporting innovation and fostering productivity in the sector.

The Review received support, input and advice from workers and employers, industry experts, and the academic community. Without this support, the report would not have been possible. Beyond the implementation of these recommendations is the need to maintain these relationships and open communication about emerging health and safety issues and potential solutions.

These efforts are important because the only way we will eliminate workplace injuries, illnesses and fatalities is if we stay on this path of continuous improvement. The publication of this report marks an important milestone along our journey of change and improvement. This is not the endpoint of the process put in place to improve mining health and safety; in fact there is a lot to do. Health and safety is not a static issue, it’s constantly changing as workplaces and technologies evolve and only in partnership can we continue to improve health and safety outcomes.