

# Social and Psychological Dimensions of Mining Activities and Impacts on Quality of Life

STATE OF KNOWLEDGE



# **Social and Psychological Dimensions of Mining Activities and Impacts on Quality of Life**

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Direction de la santé environnementale et de la toxicologie

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## Key messages

Industry and government interest in Quebec mineral development, particularly in the region targeted by the *Plan Nord*, is leading public health actors to study development activities and their repercussions on health. To help the public health network better understand the health repercussions of mining activities, a review of the literature has been carried out. This review documents nuisance impacts on quality of life, as well as the psychological and social effects on individuals and communities living near mineral exploration and development sites. It also summarizes the impacts of fly-in/fly-out (FIFO) on the psychological health of mine workers, as well as identifying the social and psychological effects of the mine closure/rehabilitation phase.

### Main findings of the literature review

#### *Nuisance impacts on quality of life*

- Mineral exploration and development produce nuisance impacts, chief among them dust, noise, vibrations and increased traffic.
- Road and infrastructure construction, ore hauling, blasting and drilling are the activities most likely to have irritating and disruptive effects on neighbouring communities.
- Direct effects on well-being and lifestyle, and indirect effects on physical health, such as sleep disruption, stress and loss of tranquility, have been observed in a number of the case studies.

#### *Social and psychological effects: generally negative despite some positive aspect*

- Communities are generally hopeful and enthusiastic about the potential for prosperity, stable jobs and the return of young people when mining projects are announced.
- The arrival of the mining industry can spur employment and business activities. It can also lead to price hikes for goods and services.
- The demographic growth produced by a mining project (the boomtown effect) is likely to ramp up demand for services and infrastructure, particularly in the area of housing. It can create conflicts between newcomers and long-time residents.
- The presence of worker camps seems to also create a lot of pressure on certain services and infrastructure, even if this type of accommodations is a response to a housing shortage.
- Using the FIFO workforce management model leads to long working hours, difficulties balancing work and home life and other factors that can impact workers' psychological health. However, workers toiling in close quarters with one another for hours on end sometimes gives rise to a special sort of social support system that is beneficial to psychological health in the workplace.
- A poor attitude on the part of the industry (when it is uncommunicative, rarely consults the population or seems indifferent to the changes in people's lives), lifestyle changes, expropriation or relocation of buildings and increased nuisance can lead to negative psychological effects such as anxiety, distress and a sense of powerlessness.
- Proper preparation on the part of the various stakeholders, particularly in response to demographic growth, can mitigate certain social and psychological effects. In addition, the specific characteristics of each host community, industry activities and site configuration systematically require an initial assessment of the community in order to document the actual effects.



## Summary

### Context

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Beyond their effects on physical health, mineral exploration and development activities are likely to have psychological and social effects, some good and some bad, on individuals (including the mine workers) and the neighbouring communities.

Furthermore, certain mining activities modify the living space considerably (more than in the case of other types of industrial activities), and thus reshape the social and psychological dimensions associated with the physical space, in addition to affecting people's well-being. Public health actors must therefore be equipped with the latest knowledge to be able to understand and prevent the potential impacts of the mining industry on the health and quality of life of the communities.

### Objectives of the literature review

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This report documents the relationship between mining industry activities and aspects associated with the quality of life and social and psychological health of the neighbouring communities. It seeks to equip public health professionals in their activities relating to the development and management of current and future mining projects. To that end, the authors have surveyed the literature in order to identify effects associated with this industry.

To meet the expectations of the ministère de la Santé et des Services sociaux (MSSS), the Institut national de santé publique du Québec (INSPQ) has also documented the links between the fly-in/fly-out (FIFO) workforce management model and the psychological health of mine workers.

### Methodology

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The body of literature considered in this review includes scientific publications as well as studies found in grey literature. The latter proved indispensable in this type of review (e.g. impact studies, public hearing reports).

The documentary research methodology comprised two main stages: 1) six databases were consulted using the multidisciplinary platform EBSCOhost and two search engines (Google and Google Scholar); and 2) complementary data sources were consulted (e.g. BAPE reports on mining projects).

The documentary research was carried out from October 5 to 18, 2016 and includes documents published between 2005 and 2016. It was based on three concepts: mining activity; the types of impacts considered (social impacts, psychological impacts and nuisance affecting quality of life); and the notion of community.

Several criteria of inclusion and exclusion were applied during the documentary research phase and during document selection in order to determine relevance based on the title and summary. A final stage involved assessing the quality of the documents through an in-depth reading. Another series of criteria were used for that purpose, including the independence of the funding and authors. The authors of the present review adopted a robust methodological approach that helped reduce bias and ensure the validity of the observations. In all, 46 studies were selected.

## Key observations

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### Nuisance impacts on quality of life

Mineral exploration and development produce nuisance impacts, chief among them dust, noise, vibrations and increased traffic. The extent of the effects varies by activity phase and site characteristics, because, in some cases, these activities can be repetitive and can stretch over several months.

According to the studies included in the present review of the literature, dust-related effects seem especially significant by virtue of the broad spectrum of sources and effects. It seems that people living near a mining site or haul road, as well as industry workers, are more affected than others.

The main dust-related effects in the context of exploration and development are as follows:

- Annoyances such as dust buildup and respiratory problems;
- Changes in lifestyle habits, such as curtailing food gathering and gardening activities, avoiding hanging laundry out to dry on a clothesline and opening windows;
- A perception of poor air quality, which can leave some people feeling stressed or worried.

Blast-related explosions, drilling near people's homes and hauling ore in heavy-duty trucks are reported to be the activities most likely to cause noise and vibrations. According to the studies consulted, noise causes nuisance and disruption, which in turn produces impacts on residents' health and quality of life, including:

- Disturbed sleep;
- Jumpiness, stress, anxiety, fear and anger;
- Changes in lifestyle habits;
- Loss of tranquility.

Increased traffic associated with mining activities is likely to generate various effects, including a concern for pedestrian safety and for having to share the road with heavy trucks, as well as changes in animal migration habits, which in turn can affect the hunting activities of certain indigenous communities.

### Social dimensions

The documents consulted outline the social dimensions associated with mining activities, be they related to exploration, development or closure.

Sociopolitical consequences, including conflict, disengagement and alienation, are observed right from the exploration stage. The literature identifies a number of causes of this conflict within the community, neighbourhood and family:

- Location of the project;
- Potential impacts on community members;
- Perception of inequality and injustice;
- Difficulty understanding the other stakeholders' positions;

- Exploration activities, such as construction of worker camps, relocation or destruction of buildings, or drilling, especially when the project has yet to receive official approval.

When development activities are taking place, the social dimensions identified centre mainly around rapid increases in the population and the arrival of workers from out of town (the “boomtown” effect). Case studies identify a number of favourable and unfavourable impacts, such as:

- Increased employment opportunities and business activities;
- A hike in the prices for goods and services;
- Changes at the cultural and sociopolitical levels;
- Increased demand for services and infrastructure.

But owing to contradictory data, it is difficult to conclude whether mining activities have a generally positive or negative impact. From a socioeconomic standpoint, the impacts can vary by geographic location of the mining community, by the company’s economic weight in the community and by the type of employee mobility management.

From a cultural and sociopolitical standpoint, the effects vary by the mining host community. These effects have to do with social cohesion, conflicts, changes in lifestyle and public order. Some of the studies present mixed results, which highlights the importance of examining the specific cultural and social context of each community instead of relying on generalizations.

In terms of services and infrastructure, demographic growth produced by the boomtown effect is likely to drive up the demand for housing, health care and municipal, social, educational, emergency and recreational services. Studies on small isolated communities seem to place a greater emphasis on the effects of this rapid population increase, particularly on housing, access to health services and road maintenance.

According to a number of the articles consulted, the choice of setting up worker camps and of adopting a FIFO approach have greater negative impacts on social cohesion, regional socioeconomic development, services and infrastructures than on integration of workers and their families into the community.

Lastly, a few documents examine the social dimensions associated with closing a mine. When the mine has been the main employer for decades, its decommissioning seems to have a drastic impact on the community’s lifestyle. According to the literature, closing a mine makes it necessary to develop a new economic foundation in order to ensure the community’s well-being.

### **Psychological dimensions**

The literature consulted sheds light on the psychological dimensions associated with mining activities. As for the social dimensions, the psychological effects may occur when the project is announced, during mine operations, or during mine closure.

Some of the studies consulted indicate that residents exhibit stress, worry, sadness and anger during the project announcement and mining phases, as well as feelings of powerlessness and insecurity. These are attributed in particular to the absence of choice, anticipated lifestyle changes and a lack of information.

When it comes to mining activities, several scientific articles found instances of stress, distress and depression, as well as feelings of powerlessness and insecurity in the communities situated near mining infrastructure in the face of lifestyle changes or loss of land caused by the operations of one or more mines. The following factors contribute to this:

- A poor attitude on the part of the industry (when it is uncommunicative, rarely consults the population or seems indifferent to the changes in people's lives);
- Changes in lifestyle;
- Expropriation or relocation of buildings;
- Increase in nuisance impacts.

Feelings of worry and fear have also been documented in a number of the studies, attributable primarily to financial and environmental considerations.

Some of the documents consulted identify psychological repercussions associated with mine closures, pointing out a significant link between decommissioning a mine and a rise in psychological distress experienced by some of the individuals affected, especially in communities where the mine was the primary employer or in instances when the mine closed suddenly.

### **Avenues for action or research**

With a view to improving current practices and avoiding certain negative repercussions on communities' socioeconomic development and social fabric, some of the authors whose works were consulted suggest the following actions:

- Increase information sharing and cooperation between the host community and the mining industry;
- Help outside workers and their families get settled into the host community by organizing a number of social and community activities;
- Document the exposure of FIFO mine workers to some of the factors identified, such as high workload and difficulties striking a balance between work and home life.

## **Conclusion**

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The literature consulted highlights more negative than positive effects on health and well-being, although positive effects have indeed been observed. Planning for the arrival of the mining industry by the various stakeholders and an open, participatory management approach are recommended by several of the authors in order to avoid or mitigate the negative impacts and increase positive ones.

## 1 Introduction

Quebec's public health authorities adhere to the definition proposed by the World Health Organization (WHO) whereby health is not simply the absence of disease, but also a state allowing the full development of individuals and communities. Thus, public health efforts must seek to create environments favourable not only to physical health, but also to the well-being of the community.

Industry and government interest in Quebec mineral development, particularly in the region targeted by the *Plan Nord*, is leading public health actors to study development activities and their repercussions on health. Beyond their effects on physical health, mineral exploration and development activities are likely to have psychological and social effects, some good and some bad, on individuals (including the mine workers) and the neighbouring communities (Chadderton et al., 2011; Mactaggart et al. 2016; Rodon et al., 2014). In addition, certain mining activities modify the living space considerably (more than in the case of other types of industrial activities), and thus reshape the social and psychological dimensions associated with the physical space.

This report documents the relationship between mining industry activities and aspects associated with the quality of life and social and psychological health of the neighbouring communities. It seeks to equip public health professionals in their activities relating to the development and management of current and future mining projects. To that end, the authors have surveyed the literature in order to identify effects associated with this industry. The studies reviewed examine a few Quebec cases, as well as cases in other countries and regions with similar socioeconomic and sociopolitical conditions to those of Quebec. These cases are of particular interest to the authors, as they are transposable to the Quebec context.

In response to a request from the ministère de la Santé et des Services sociaux (MSSS), the Institut national de santé publique du Québec (INSPQ) also documented the impacts of the fly-in/fly-out (FIFO) model on the psychological health of mine workers. The highlights of this review, with its own specific methodology, are presented in section 3.2.2<sup>1</sup>.

The report is divided into three chapters. The first describes the documentary research methodology employed and sets out the document selection criteria. The second chapter summarizes the results that were identified and describes the social and psychological dimensions associated with the mining industry, as well as the data dealing with potential nuisance impacts and their effects on quality of life. Box 1 summarizes the key findings on links between the FIFO workforce management model and mine workers' psychological health. The third and final chapter summarizes the literature review, identifies the main factors influencing the impacts and proposes avenues for research or action to minimize the negative impacts and maximize the positive ones.

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<sup>1</sup> A summary of the review of literature, conducted on this specific question, will be published in 2018.





## 2 Methodology

### 2.1 Review approach

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This review of the literature seeks to answer the following research question: “What are the social and psychological effects associated with mining activities on neighbouring communities in Quebec or a similar region?” The mining activities considered in this review include all activities relating to mineral exploration, mining operations (including refining, primary processing, structuring of the workforce) and mine closing processes (e.g. site rehabilitation). The impacts of mineral processing activities that do not take place near the mine itself are not considered. These mining activities can take place in either underground mines or open pit mines. Appendix 1 explains the mining cycle, with references to the various mining activities documented in this report.

The authors adopted a rigorous methodological approach in order to reduce methodological bias and ensure the validity of the findings. This method is described in sections 2.2.3 through 2.2.5. The body of literature considered in this review includes scientific publications as well as studies found in grey literature. The latter proved indispensable in this type of review (e.g. impact studies, public hearing reports), since they provide data on the mineral exploration phase and, in the case of the reports compiled by the Bureau d'audiences publiques sur l'environnement (BAPE), on Quebec mining projects.

### 2.2 Documentary research

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A review of the literature focusing on the effects on the health of the mine workers and neighbouring community was consulted to develop the documentary research methodology (Stephens and Ahern, 2001). The latter proved useful in defining the keywords and considering the criteria for including or excluding studies. The documentary research methodology comprised two main stages: 1) six databases and two search engines were consulted; and 2) complementary data sources were consulted (these will be described later in this report).

#### 2.2.1 CONSULTATION OF DATABASES AND SEARCH ENGINES

The following databases, queried via the EBSCOhost multidisciplinary platform, were checked to identify scientific publications:

- Environment Complete;
- MEDLINE Complete;
- Psychology and Behavioral Sciences Collection;
- PsycINFO;
- Public Affairs Index;
- SocINDEX with Full Text.

The Google and Google Scholar search engines were used to identify studies found in the grey literature.

The documentary research was carried out from October 5 to 18, 2016. It is based on three concepts, namely types of impacts considered (social, psychological and nuisance), as well as the notion of community. The use of various synonyms and MeSH descriptors was helpful in refining the research. Table 1 offers certain clarifications in this regard. Considering the time allotted for document analysis, the research using both search engines focused solely on the mines' social impacts, and not on the psychological aspects or on the nuisance impacts, although one of the complementary strategies (2b, see section 2.2.2) partially makes up for this shortcoming.

Note: the Google.ca and Google Scholar.ca research strategy differs from the EBSCOhost strategy on account of the occasionally limited search functionalities of these two search engines.

**Table 1** Research strategies via the EBSCOhost platform and search engines

	Keywords used <sup>a</sup>	Date consulted	Limits	Notes
<b>EBSCOhost</b>	See Appendix 2 for detailed research strategy	October 5, 2016	<ul style="list-style-type: none"> <li>▪ English and French</li> <li>▪ 2005 – 2016</li> </ul>	<ul style="list-style-type: none"> <li>▪ All results = 1152 results</li> </ul>
<b>Google.ca</b>	In title: mining "social impact" community	October 11, 2016	<ul style="list-style-type: none"> <li>▪ 2005 – 2016</li> </ul>	<ul style="list-style-type: none"> <li>▪ Only the first 10 pages</li> <li>▪ (142 first results out of 2080 obtained)</li> <li>▪ Sorted by relevance</li> </ul>
<b>Google Scholar.ca</b>	mines OR mineral AND "social impacts" AND community	October 18, 2016	<ul style="list-style-type: none"> <li>▪ "Search pages in French" filter</li> <li>▪ 2005 – 2016</li> <li>▪ Anywhere in article</li> </ul>	<ul style="list-style-type: none"> <li>▪ All results obtained = 540</li> <li>▪ Sorted by relevance</li> </ul>

<sup>a</sup> The present review of literature did not seek to document the impacts felt specifically in indigenous communities, and so keywords referring to these communities were not included in the research strategy. Studies catalogued on these communities were considered.

### 2.2.2 OTHER DOCUMENTARY SOURCES CONSULTED

The following additional data sources were consulted:

1. The BAPE website to examine the reports of public hearings on specific mining projects (thus, strategic environmental assessments (SEA) were not considered). These reports had to have been released between 2005 and 2016 (the details on these reports are found in Appendix 3).
2. Two researchs supervised by a researcher at the Université du Québec à Rimouski (UQAR) were used to select relevant studies from among the results obtained:
  - a. List of titles obtained as part of the project: "Risques et gestion des nouvelles formes de délocalisation communautaire de causes anthropiques ou naturelles." This study, which was underway during the data collection process, looked at the home communities of the FIFO mine workers. A Zotero database comprising 223 documents was provided by the research assistants. The article selection steps (sections 2.2.3 to 2.2.5) were applied.
  - b. List of articles selected as part of an INSPQ internship, supervised by the lead author of this review. Entitled "Les effets psychologiques des nuisances à la qualité de vie dans un contexte d'exploitation minière," this five-week internship (May to June 2016) was in response to a need expressed by the Direction de santé publique de l'Abitibi-Témiscamingue. The research methodology employed was the same as the one used for the present review, with the exception of certain keywords.

### 2.2.3 DOCUMENTARY RESEARCH CRITERIA

An initial series of inclusion and exclusion criteria were applied (see Table 2) to the databases and search engines, as well as to the documents identified from among the additional data sources consulted.

**Table 2 Additional documentary research criteria**

Criteria	Inclusion	Exclusion
<b>Type of study</b>	<ul style="list-style-type: none"> <li>▪ Primary literature studies (scientific publications)</li> <li>▪ Theses and reports from expert panels, impact studies, health impact assessments.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reviews of the literature, systematic reviews and meta-analyses.</li> <li>▪ Letters, editorials.</li> <li>▪ Essays, conference proceedings and PowerPoint presentations.</li> </ul>
<b>Document form</b>	<ul style="list-style-type: none"> <li>▪ With summary</li> </ul>	<ul style="list-style-type: none"> <li>▪ Without summary</li> </ul>
<b>Publication date</b>	<ul style="list-style-type: none"> <li>▪ 2005 – 2016</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pre 2005</li> </ul>

The methodology adopted by the authors of the works considered in connection with this research is based on qualitative, quantitative or mixed approaches. It was agreed to use only the primary literature to compile the findings from this review of the literature, and thus to eschew reviews of literature, systematic reviews and meta-analyses (see [Données probantes: pyramide des 6 S](#)). Lastly, letters and editorials (opinion pieces, really) along with essays, conference proceedings and PowerPoint presentations were excluded.

The documentary research phase was followed by three other phases that served to establish the body of works selected for the analysis: 1) assessment of relevance based on title; 2) assessment of relevance based on summary; and 3) in-depth quality analysis based on a complete read of the document.

### 2.2.4 ANALYSIS OF RELEVANCE

The titles generated by the document search and the corresponding summaries were sorted using various relevance criteria, in light of the research question (see Table 3).

**Table 3 Criteria for assessing relevance of summaries**

Criteria	Description	Variables considered	Document excluded
<b>Population</b>	The study must examine a population exposed at the time of the research <sup>a</sup> .	<ul style="list-style-type: none"> <li>▪ Family</li> <li>▪ Neighbourhood</li> <li>▪ City</li> <li>▪ Village</li> <li>▪ Community</li> <li>▪ Region</li> <li>▪ Defined subgroup within a defined territorial unit (e.g. women, children)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Undefined population</li> </ul>

Criteria	Description	Variables considered	Document excluded
<b>Exposure</b>	The exposure is associated with mining activities.	<ul style="list-style-type: none"> <li>▪ Mining activities, i.e. all of the activities relating to mineral exploration, mining operations (including refining, primary processing, structuring of the workforce) and mine closing processes (e.g. site rehabilitation).</li> <li>▪ The impacts of mineral processing activities that do not take place near the mine itself are not considered, however.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Other activities aimed at extracting non-renewable resources (e.g. quarries and sandpits, hydrocarbons).</li> </ul>
	Exposure conditions must be similar to the Quebec context.	<ul style="list-style-type: none"> <li>▪ Study carried out in Quebec or elsewhere, but in a similar context (member countries of the Organisation for Economic Co-operation and Development [OECD]).</li> </ul>	<ul style="list-style-type: none"> <li>▪ Exposure conditions not similar to Quebec context.</li> </ul>
<b>Measuring or anticipating the effects</b>	The study must deal with or anticipate the effects on well-being, psychological health and social health of the population exposed, be they negative or positive.	<ul style="list-style-type: none"> <li>▪ Measurement or anticipation of effects that act directly or indirectly on the well-being, psychological health and social health of the participants. Socioeconomic effects can also be considered.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Effects measured on physical health, except for psychosocial effects.</li> </ul>

<sup>a</sup> Even the mere announcement of a mining project can give rise to certain impacts.

### 2.2.5 ASSESSMENT OF DOCUMENT QUALITY

By applying formal and relevance-based documentary research criteria (see Tables 2 and 3), the authors were able to target works in the desired format and respond to the research question. A subsequent in-depth read of these writings made it possible to evaluate their scientific quality according to specific criteria, to wit:

- Author independence;
- Funding independence<sup>2</sup>;
- Presence of clearly defined objectives;
- Research methodology explicit enough to be reproduced<sup>3</sup>;
- Results presented are consistent with the objectives set out;
- Compliance with relevance assessment criteria<sup>4</sup>.

Over the course of this research, the two report authors shared the task of assessing the quality of the works. If one author doubted the quality of a work, she had to get the other to validate her assessment with an eye to reaching a consensus. For each of these criteria, a grade (excellent (++)),

<sup>2</sup> If the independence of the funding could not be determined (the case with 14 studies), the document was kept, albeit with a quality grade of only acceptable (+).

<sup>3</sup> Minimum description of data collection methods used.

<sup>4</sup> Although an initial analysis of the relevance of the documents identified was based on the title and summary (section 2.2.4), a more in-depth analysis of a document could still cause it to be rejected at the quality assessment stage.

acceptable (+) or unacceptable (-) was assigned. A single unacceptable grade meant that the document was rejected<sup>5</sup>.

Documents deemed relevant and of good enough quality (excellent [++] or acceptable [+]) are summarized in an assessment chart (see Appendix 3). The difference between a grade of excellent and acceptable was based on an overall assessment by the authors of the present review of the literature as to the degree of compliance with the various quality assessment criteria. Works that were rejected are presented in another table, along with the reasons for their exclusion (see Appendix 4).

## 2.3 Research assessment

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To begin with, consultation of scientific databases via the EBSCOhost search platform and both search engines (Google and Google Scholar) identified 1834 works (see Table 4), of which 108 duplicates were excluded. Of these documents, 127 were selected based on the title and summary, and of this number, 60 were selected for the quality assessment, which in turn yielded a final selection of 28 documents. The documents that failed to make this final cut did not comply with the quality criteria set out in section 2.2.5. The main reason for their exclusion is that the results did not provide food for thought concerning the research question. This was seen in 18 of the 45 rejected documents (see Appendix 4 for a table outlining the rejected studies and their bibliographical references). Non-independent funding (7/45), an appearance of conflict of interest (7/45) or the fact that the methodology is absent, that there are significant methodological problems or that the document is not the right type of publication (e.g. a review of the literature) were also reasons for rejecting the publications (11/45).

Next, the complementary research identified 31 additional documents, which were assessed as to their quality. Of these documents, 18 were selected. Thus, the present review of the literature focuses on 28 publications identified by the databases and search engines, and 18 from other documentary sources.

The 46 documents that made it into this review of the literature are distributed among the various research strategies in the following manner (see sections 1.2.1 and 1.2.2):

- EBSCOhost: 23;
- Google.ca: 1;
- Google Scholar.ca: 4;
- BAPE reports: 7;
- List of titles obtained from the UQAR research project: 8;
- List of documents from the INSPQ internship: 3.

Note: several documents selected in connection with the EBSCOhost strategy also appeared in the Google.ca, List of titles obtained from the UQAR research project and List of documents from the INSPQ internship strategies, which explains the lower counts reported. There were also publication

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<sup>5</sup> Note: an identification of the study's limits and potential biases originally figured among the quality and scientific relevance criteria. Since too few authors made mention of this, it was decided to eliminate this criterion after the fact, lest too many documents be excluded.

similarities between the list of titles obtained from the UQAR research project and the Google Scholar.ca strategy.

**Table 4      Documentary research assessment**

<b>Research</b>	<b>Number of documents</b>
<b>Database via EBSCOhost platform and search engines (scientific and grey literature)</b>	
Documents identified	1834
Documents identified, without duplicates	1726
Documents selected on the basis of title and summary	127
Documents subjected to quality assessment	60
Documents selected for the review	28
<b>Other documentary sources (scientific and grey literature)</b>	
Documents obtained	235
Documents subjected to quality assessment	31
Documents selected for the review	18
<b>Total</b>	<b>46</b>

## 3 Results

This review of the scientific and grey literature yielded 46 recent and high-quality original studies (2005 – 2016). The studies selected for the review focused on communities where mineral exploration, mining or mine closing activities take place, affording insight into the direct impacts these activities have on quality of life, as well as the social and psychological effects. Most of the communities examined in these studies are located in Australia (n = 23) and Canada (n = 17), with the United States (n = 4) and Europe (n = 2) accounting for some as well<sup>6</sup>. The mining activities described in these studies are associated with open pit or underground mines, and the resources mined include coal, bauxite, uranium, gold, iron, copper, apatite, diamonds and niobium. The analysis did not take account of these distinctions unless they were relevant in interpreting the results.

The first section on results (3.1) deals with the nuisances<sup>7</sup> affecting quality of life identified in the literature, while sections 3.2 and 3.3 present the social and psychological effects identified in the various phases of a mining project.

### 3.1 Mining-related nuisance impacts on quality of life

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The documents looking at communities located in the vicinity of ore exploration and mining activities highlight certain changes in quality of life. The activities associated with these two phases are similar (infrastructure construction, drilling and blasting) and generate similar nuisance that can have effects on quality of life (see Appendix 1 on the mining cycle). The intensity and duration of the effects vary according to the project phase and the type of mine (underground or open pit). In addition, the nuisance impacts seem to become particularly evident when there are several mining operations in proximity to a city, as was the case around the Australian cities of Moranbah and Muswellbrook, where there were five coal mines operating within a 30 km<sup>2</sup> perimeter (Franks et al., 2010; Moran and Brereton, 2013).

The communities involved and the context peculiar to each community are also factors that can modulate the nuisance impacts, as have shown certain studies on the community of Malartic in Abitibi-Témiscamingue, home to an open pit mine. Certain groups in Malartic seem unaffected by dust or vibrations, while others seem inconvenienced or irritated (Brisson et al., 2015; LeBlanc, 2012). This concrete case shows once again<sup>8</sup> that compliance with environmental standards does not mean that there is no disruption for the neighbouring community (BAPE, 2016).

The main nuisance impacts identified in the literature on mining activities are described below, and consist of dust, noise, vibrations and road traffic.

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<sup>6</sup> See Appendix 3 for details on the studies selected.

<sup>7</sup> According to the Programme national de santé publique 2015-2025, a nuisance is defined as: [translation] “a possible undesirable effect on well-being or an indirect effect on physical health following exposure to a factor such as odor, noise, lice, bedbugs, etc.” (MSSS, 2015, p. 44).

<sup>8</sup> This fact was previously recognized in a 2008 Supreme Court of Canada decision in a case involving Ciment du Saint-Laurent (Supreme Court of Canada, 2008).

### **3.1.1 DUST**

According to the studies included in the present review of the literature, dust-related effects seem especially significant by virtue of the broad spectrum of sources and effects (BAPE, 2013, 2015, 2016; Brisson et al., 2015; Franks et al., 2010; Hendryx and Innes-Wimsatt, 2013; HHIC, 2012; Higginbotham et al., 2007; Ivanova et al., 2007; Moran and Brereton, 2013).

#### **Sources**

The sources of dust specifically attributable to mining activities have been extensively documented (BAPE, 2007, 2009, 2013, 2015, 2016; Blangy and Deffner, 2014; HHIC, 2012; Ivanova et al., 2007). Road construction, ore hauling and blasting during the exploration and mining phases would seem to be the activities generating the most dust (BAPE, 2007, 2013, 2015, 2016; Blangy and Deffner, 2014; HHIC, 2012). Particulate matter from open exposed areas and waste rock piles from underground and open pit mines also seem to be sources of dust (HHIC, 2012; Ivanova et al., 2007).

#### **Effects**

According to the documents consulted, the presence of dust cause annoyances such as dirt and problems breathing, and causes some residents to change their lifestyle habits. More specifically, indigenous and non-indigenous residents curtail their food gathering and gardening activities, or avoid hanging laundry out to dry on a clothesline or opening windows (BAPE, 2013, 2016; Blangy and Deffner, 2014; Brisson et al., 2015; HHIC, 2012). Accumulations of dust on garden furniture, automobiles and house exteriors have also been observed, for example, in the Malartic case study, forcing some residents to remove dust more often (BAPE, 2016; Brisson et al., 2015).

The literature also documents the perception of poor air quality among certain residents exposed to mining-generated dust (Brisson et al., 2015; Browne et al., 2013; Hendryx and Innes-Wimsatt, 2013; HHIC, 2012; Higginbotham et al., 2007; Moran and Brereton, 2013; Suopajärvi et al., 2016). Prospective studies point in the same direction (ACEE, 2015; BAPE, 2009, 2013, 2015, 2016). The scope of the dust-related nuisance impacts can leave some individuals worried and even distressed due to fears for their health and that of their loved ones, and can lead them to sell their homes and leave the community (Brisson et al., 2015; Hendryx and Innes-Wimsatt, 2013; LeBlanc, 2012).

#### **Population affected**

According to the literature, the populations that seem most vulnerable to the effects of dust are the elderly and children (BAPE, 2009, 2016; HHIC, 2012), as well as residents living or working near the mine (BAPE, 2013, 2015; LeBlanc, 2012).

### **3.1.2 NOISE AND VIBRATIONS<sup>9</sup>**

A number of the studies deal with nuisance impacts associated with noise and vibrations generated by mining activities (BAPE, 2015; BAPE, 2016; Brisson et al., 2015; Franks et al., 2010; HHIC, 2012; Higginbotham et al., 2007; Ivanova et al., 2007; Moran and Brereton, 2013; Suopajärvi et al., 2016).

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<sup>9</sup> Noise and vibrations are dealt with together in this review, since they often come from the same sources and cause the same types of impacts on health.



## Sources

According to the literature on the subject, blast-related explosions, drilling near people's homes and hauling ore in heavy-duty trucks are the activities most likely to cause noise and vibrations during the exploration and mining phases (BAPE, 2009, 2013, 2015, 2016; Brisson et al., 2015; HHIC, 2012; Higginbotham et al., 2007; Moran and Brereton, 2013; Suopajärvi et al., 2016). Lesser sources of noise, low frequencies<sup>10</sup> and vibrations are also cited in the documents, namely digging and crushing activities, infrastructure construction, ore hauling by train, use of engine braking, increased traffic and helicopters flying at low altitudes (BAPE, 2009, 2013, 2015; Blangy and Deffner, 2014; Brisson et al., 2015; HHIC, 2012).

## Effects

According to the studies consulted, noise causes annoyances and disruption, which in turn produce impacts on residents' health and quality of life, such as sleep interruptions, stress and changes in lifestyle habits, including having to close all windows during the summer (ACEE, 2015; BAPE, 2015, 2016; Brisson et al., 2015). Loss of tranquility brought on by the change in living environment is another effect cited in some of the documents (ACEE, 2015; BAPE, 2016; Brisson et al., 2015; HHIC, 2012).

Blasting can leave people startled, stressed, anxious, fearful and angry (BAPE, 2013, 2016; Brisson et al., 2015). The effects can vary from one resident to another, however, as documented in the Malartic case study. There, vibrations from blasting, scheduled at set times to avoid becoming a nuisance impacts for certain citizens, leave others stressed from the anticipation (BAPE, 2016; Brisson et al., 2015).

## Population affected

According to the documents reviewed, the most vulnerable populations are residents living or working near the mining activities, including road infrastructure used by the workers and for ore hauling (LeBlanc, 2012; Moran and Brereton, 2013; Suopajärvi et al., 2016). Rural populations living in areas with low ambient noise are also particularly affected by the increased decibel levels in their environment (BAPE, 2015; HHIC, 2012).

### 3.1.3 ROAD TRAFFIC

Some of the documents consulted report an increase in road traffic or in automobile speed associated with the resumption of mining activities and with the construction of new roads (BAPE, 2007, 2009, 2015, 2016; Brisson et al., 2015).

According to the literature, this increased traffic is likely to generate various effects, including:

- a concern for pedestrian safety and for having to share the road with heavy trucks (BAPE, 2015, 2016; Brisson et al., 2015);
- changes in animal migration habits, which in turn can affect the hunting activities of certain indigenous communities (BAPE, 2007; Blangy and Deffner, 2014).

The documents indicate that individuals living near mining activities, and in particular children, the elderly and cottagers enjoying the quiet life, are especially vulnerable (BAPE, 2015; Brisson et al., 2015).

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<sup>10</sup> Low frequencies are acoustic waves that spread over longer distances than in the case with noises whose high frequencies dominate, for example (Martin et al., 2015).

In short, the present review indicates that certain mining activities during the exploration and mine operation phases can cause nuisance impacts and disruptions affecting quality of life. The sources are well documented, and measures can be taken to mitigate the effects on affected populations.

## 3.2 Social dimensions of mining activities

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The documents consulted outline the social dimensions associated with mining activities, be they associated with exploration, development or closure. The dimensions identified encompass a variety of effects on the populations affected by mining projects, which can generate changes in people's day-to-day lives or lifestyle, be they of a cultural (values, cultural confrontation, marginalization) or community nature (cohesion, resources, social tension, violence). Most of the effects identified stem from the boomtown effect<sup>11</sup> and potentially target social fabric, socioeconomic conditions and services/infrastructure. Some of the changes identified can give rise to positive or negative impacts, depending on various factors like characteristics of the host community (Petrova and Marinova, 2013). These factors are mentioned in the results when they are listed in the literature. Factors of social acceptance, in connection with the effects noted, are also observed.

### 3.2.1 ANNOUNCEMENT OF MINE PROJECT AND EXPLORATION

Two scientific articles document social effects appearing as soon as the project has been announced, particularly with respect to sociopolitical dynamics (Brisson et al., 2015; Moffatt and Baker, 2013). In addition, five BAPE reports confirm these effects and examine social acceptance factors (community consent) peculiar to exploration activities (BAPE, 2007, 2009, 2013, 2014, 2015).

#### Potential effects on sociopolitical dynamics

The present literature review includes a Quebec study and an Australian study describing effects involving sociopolitical dynamics, namely conflicts, disengagement and alienation of certain individuals or groups (Brisson et al., 2015; Moffatt and Baker, 2013). Prospective surveys have also documented these effects in the case of Quebec mining projects (BAPE, 2007, 2009, 2013, 2015). The studies show that as soon as it is announced, a mining project can cause conflicts within the community, neighbourhood and family (BAPE, 2013; Brisson et al., 2015; Moffatt and Baker, 2013).

The literature identifies a number of causes for these conflicts:

- Project location (Moffatt and Baker, 2013);
- Potential impacts on community members (BAPE, 2015);
- Perception of inequality and injustice (BAPE, 2009; Brisson et al., 2015);
- Difficulty understanding the other stakeholders' positions (Brisson et al., 2015).
- Exploration activities, such as construction of worker camps, relocation or destruction of buildings, or drilling, especially when the project has not yet received official approval (BAPE, 2007, 2009; Brisson et al., 2015).

The groups most often at the heart of these social conflicts seem to be individuals living near the mine and the socioeconomic actors (BAPE, 2013; Moffatt and Baker, 2013). Certain groups can also

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<sup>11</sup> The boomtown effect consists of a temporary but rapid increase in the size of the community that is host to the industrial activity in question, causing various social and socioeconomic impacts that can be positive or negative.

find themselves marginalized by the project announcement, such as residents who have taken a public stance on the mining project, or mining company employees (Brisson et al., 2015).

What is more, a feeling of dispossession (residents no longer feeling at home in their own community) arising as soon as the exploration work begins can result in sociopolitical disengagement among various segments of the population, which can translate into a feeling of powerlessness and a loss of trust toward government authorities (Brisson et al., 2015).

### **Social acceptance of project**

The level of social acceptance (consent on the part of the population) can vary within the community as soon as the mining industry looks to move in (BAPE, 2009, 2013, 2014, 2015; Brisson et al., 2015). According to the literature, the factors responsible for this varying degree of acceptance are:

- Direct financial benefits (job creation) – and indirect ones as well (economic prosperity of the region) (BAPE, 2009, 2013, 2014, 2015);
- Citizen involvement during the project design phase (BAPE, 2007, 2009, 2013; Brisson et al., 2015);
- The community's identity and its mining history (BAPE, 2009, 2013).

### **3.2.2 MINING OPERATIONS**

Most of the documents reviewed identify both positive and negative effects during the mining operations phase, particularly when it comes to the arrival of workers from out of town and socioeconomic development, two phenomena associated with the boomtown effect (Blais, 2015; Blangy and Deffner, 2014; Brisson et al., 2015; Browne et al., 2011; Carrington et al., 2010; Chapman et al., 2015a; Chapman et al., 2015b; Dwyer et al., 2016; Eklund, 2015; Garnett, 2012; Higginbotham et al., 2007; Hossain et al., 2013; Ivanova et al., 2007; Kelty and Kelty, 2011; Lawrie et al., 2011; Lovell and Critchley, 2010; Miller et al., 2012; Moran and Brereton, 2013; Petrova and Marinova, 2013; Rolfe and Kinnear, 2013; Schmidt, 2015; Scott et al., 2011; Shandro et al., 2011; Suopajärvi et al., 2016; Tonts et al., 2012). More specifically, potential effects on the social fabric, socioeconomics, services and infrastructure have been identified.

#### **Boomtown effect**

The literature shows that the temporary nature of the mining project gives rise to the boomtown effect within the host community (Lawrie et al., 2011; Miller et al., 2012; Scott et al., 2011; Shandro et al., 2011; Tonts et al., 2012). It should be pointed out that the population increase attributable to mining activities is a factor that leads to numerous economic, social and environmental impacts, both favourable and unfavourable, to wit: more job openings and business activities (Browne et al., 2011; Ivanova et al., 2007; Kelty and Kelty, 2011; Lovell and Critchley, 2010), increased prices for goods and services (Carrington et al., 2010; Chapman et al., 2015a; Hossain et al., 2013; Lawrie et al., 2011; Petrova and Marinova, 2013), cultural and sociopolitical changes (BAPE, 2016; Brisson et al., 2015; Higginbotham et al., 2007; Hossain et al., 2013; Moran and Brereton, 2013) and rising demand for services and infrastructure (Dwyer et al., 2016; Eklund, 2015; Garnett, 2012; Rolfe and Kinnear, 2013). These impacts are considered in detail in the following sections.

A number of the articles indicate that the decision to establish worker camps and to adopt the FIFO-DIDO approach<sup>12</sup> (*fly-in/fly-out* and *drive-in/drive-out*) has more negative impacts on social cohesion, regional socioeconomic development, services and infrastructure than does an approach that sees workers and their families integrated into the community (Chapman et al., 2015b; Garnett, 2012; Hossain et al., 2013; Lovell and Critchley, 2010; Miller et al., 2012; Rolfe and Kinnear, 2013; Suopajärvi et al., 2016).

Lastly, according to the scientific studies reviewed, the boomtown effect seems to have more of an impact in rural communities with a low population density, including certain indigenous communities, because the population increase experienced by these communities has a more pronounced effect on services, infrastructures and the social fabric (Blais, 2015; Blangy and Deffner, 2014; Lovell and Critchley, 2010; Miller et al., 2012; Schmidt, 2015; Suopajärvi et al., 2016).

A review of the literature, with a specific methodology and focusing on the links between the FIFO approach and the psychological health of the mine workers, also identified certain issues. These findings are presented in the following box.

**Highlights: review of the literature on fly-in/fly-out and psychological health in the mining workplace**

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A synthesis of current knowledge designed to document the links between the fly-in/fly-out (FIFO) work model and the psychological health of mine workers has been produced by the Institut national de santé publique du Québec (INSPQ, Pelletier et al., due out in 2017). The highlights of this report are described below.

- Fatigue associated with long work hours, short recovery periods between shifts and the quality of living quarters is seen as one of the main occupational health and safety issues faced by FIFO mine workers (Devine et al., 2008; Henry et al., 2013; Langdon et al., 2016; McTernan et al., 2016; Muller et al., 2008). According to one study, 70% of FIFO mine workers surveyed report sleep disorders (Everingham et al., 2013). According to Clifford (2009), 45% of these workers say they often feel very tired, and this fatigue leaves them irritable and fearful of making mistakes (McTernan et al., 2016).
- Difficulties balancing work and home life also pose a major concern for FIFO mine workers, according to several studies (Clifford, 2009; Everingham et al., 2013; Henry et al., 2013; Jones, 2013; Joyce et al., 2012; Langdon et al., 2016; McTernan et al., 2016; Torkington et al., 2011; Vojnovic et al., 2014). Lengthy and frequent periods spent away from home contribute to a

<sup>12</sup> FIFO-DIDO is a workforce management model present in Australia since the early 1970s, and even more in vogue since the 1990s (Eklund, 2015; Rolfe and Kinnear, 2013). This practice is also found in Canada (Blais, 2015). Mining companies favour FIFO-DIDO for practical reasons, such as the location of the mining site in a remote area, the temporary nature of the mining operations and the potential pressure in terms of housing and infrastructure (Garnett, 2012; Hossain, 2013; Rolfe and Kinnear, 2013). FIFO-DIDO can require the employer to build worker camps to house out-of-town workers, most of them young men (Carrington et al., 2010). The camps can be located within or alongside the community, a few kilometers away or completely isolated from the nearest community (Carrington et al., 2010; Scott et al., 2011). They can be self-sufficient in terms of food, health, transportation and sports and recreation (Scott et al., 2011). On days off, these workers usually return to their principal residence, which can be located several hundred kilometers from the mine (Carrington et al., 2010; Ivanova et al., 2007).

feeling of social isolation and a decrease in psychological well-being (Langdon et al., 2016). Isolation is occasionally a source of domestic conflicts and worries stemming from an inability to be present when needed or in the case of an emergency (McTernan et al., 2016). The inability to keep to a stable routine and to engage in recreational activities are other factors that can have an effect on the psychological health of FIFO mine workers (McTernan et al., 2016).

- Some FIFO mine workers resort to drug and alcohol use to help them get to sleep and deal with stress (Henry et al., 2013). These workers consume more alcoholic drinks on a daily and weekly basis than other types of workers (Joyce et al., 2012). These studies do not indicate whether alcohol is prohibited in FIFO camps.
- Some of the studies find that the prevalence of psychological disorders is higher among FIFO mine workers than among other worker populations (Henry et al., 2013; Jacobs, 2015), while others find that these workers are in better psychological health (Everingham et al., 2013; Joyce et al., 2012). One study tried to draw a link between FIFO mine work and suicide, but the results are not conclusive due to a lack of available data (Jacobs, 2015).
- FIFO worker exposure to psychosocial risks in the workplace, such as heavy workload, a lack of decision-making autonomy and a low degree of social support from the immediate supervisor, was associated with higher risks of developing psychological problems (Albrecht and Anglim, 2017; McTernan et al., 2016). However, management practices promoting a climate of psychosocial security (policies and practices aimed at protecting psychological health in the workplace) are seen as a major protective factor for psychological health (Albrecht and Anglim, 2017; McTernan et al., 2016; Vojnovic et al., 2014). Also, FIFO mine workers seem to be exposed to a unique and protective form of social support among coworkers (Henry et al., 2013; McTernan et al., 2016; Torkington et al., 2011). Living in close quarters for lengthy periods, workers often keep an eye out for one another, confide their personal problems to one another and help one another in times of trouble (McTernan et al., 2016).
- Several courses of action are proposed to protect and promote the psychological health of FIFO mine workers (Albrecht and Anglim, 2017; Everingham et al., 2013; Jacobs, 2015; Langdon et al., 2016; McTernan et al., 2016), including: taking a holistic approach to managing the FIFO system by considering all of the issues associated with this work model; informing workers and their families, prior to or at the time of hire, about the working conditions and any issues involving psychological health and work/home life balance; putting in place measures to detect any signs and symptoms of deteriorating psychological health; promoting various forms of psychological assistance and support.
- Since most of the studies reviewed are Australian, further research is necessary in order to document the links between the FIFO management model and the psychological health of Quebec mine workers. There is a voluminous body of literature on the links between workplace psychosocial factors and the effects on psychological health (e.g. Bonde et al., 2008; Stansfeld and Candy, 2006; Vézina et al., 2011). It would be useful to expand this review to include the workplace psychosocial risks to which mine workers in general (and not just FIFO workers) are exposed in order to create a better documented portrait of factors detrimental or favourable to the psychological health of this population of workers. Also, quantitative studies comparing FIFO mine workers to other mine workers and other employment categories would seem necessary, given the contradictory findings of the studies aimed at measuring the prevalence of psychological disorders among these workers.

**References:**

*The references for this box are found at the end of section 5.*

### **Potential effects on social fabric**

The studies reviewed describe various effects on social fabric (interaction among individuals and groups). These effects vary by the mining host community. The increase in the population and the arrival of newcomers in the community, both directly linked to the boomtown effect, generate the most and clearest impacts on social cohesion, conflicts, changes in lifestyle and public order (Higginbotham et al., 2007; Hossain et al., 2013; Moran and Brereton, 2013; Petrova and Marinova, 2013).

#### *Social ties*

The effects of out-of-town workers on the sociopolitical dynamics of certain communities are brought up in the studies, but owing to contradictory data it is difficult to reach conclusions on all these aspects.

These workers seem to have difficulty fitting into the host community, either because they view it as simply a production site or because their work schedule does not allow for proper integration (Carrington et al., 2010; Higginbotham et al., 2007; Hossain et al., 2013; Ivanova et al., 2007; Lovell and Critchley, 2010; Petrova and Marinova, 2013). This situation can have an adverse effect on social and community life (Carrington et al., 2010; Ivanova et al., 2007; Petrova and Marinova, 2013).

Concrete cases described in the literature show the difficulty some communities have finding volunteers to maintain community services and activities, which can translate into a loss of these services and activities at a time when the population is rising (Higginbotham et al., 2007; LeBlanc, 2012; Lovell and Critchley, 2010; Petrova and Marinova, 2013). In one case, this situation left elderly volunteers feeling pressured (Miller et al., 2012).

A trend cannot be identified when it comes to ties between local residents and newcomers. The few documented cases involving remote mining communities in Australia and Canada show that certain local residents no longer make an effort to create ties with the out-of-town workers and their families because they find it exhausting to have to always nourish new friendships (Blangy and Deffner, 2014; Lovell and Critchley, 2010). And yet, other studies tell a different story, i.e. informal mutual support systems have sprung up to offset the loss of community services (Petrova and Marinova, 2013).

Several case studies in Australia, Canada and the US describe increased conflicts, social cleavages and marginalization in the communities studied (Bell, 2009; Brisson et al., 2015; Higginbotham et al., 2007; Ivanova et al., 2007; LeBlanc, 2012). More specifically, these situations seem to stem from the creation of social inequities and the perception of injustices, caused by rising incomes for some residents, by an increase in the cost of living and by direct negotiations with the company to obtain territorial financial compensation (Brisson et al., 2015; Higginbotham et al., 2007; Ivanova et al., 2007). Debates surrounding opposition to the project can also give rise to conflicts about such things as loss of quality of life, decreasing home values and the attitude of the mining company (BAPE, 2015, 2016).

According to the literature, conflicts undermine social cohesion, which in turn can severely weaken a community's social capital<sup>13</sup> (Petrova and Marinova, 2013). This weakened social capital observed in certain mining communities can affect the community's ability to come together and fight (citizen

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<sup>13</sup> Social capital (or social cement) denotes the relationship uniting various persons within a network. This dynamic is manifested by ties of knowledge and recognition. Social capital ensures attachment to a group and stability in the form of various types of support (Bouchard-Bastien et al., 2013).

mobilization) against the environmental changes or the injustices that some industries could impose (BAPE, 2016; Bell, 2009; Brisson et al., 2015; Higginbotham et al., 2007; Moffatt and Baker, 2013).

Certain indigenous and non-indigenous communities have also seen their social capital decline during mining operations. The factors behind this include:

- Loss of community activities in relation to the land (BAPE, 2016; Dylan and Smallboy, 2016; Higginbotham et al., 2007; Schmidt, 2015);
- Exodus of families with deep roots in the community due to their opposition to the project (Brisson et al., 2015; BAPE, 2015; Hossain et al., 2013; Moffatt and Baker, 2013);
- Change in lifestyle (Blais, 2015; Blangy and Deffner, 2014);
- Homes and institutions expropriated or relocated (Brisson et al., 2015; Frantàl, 2016).

### *Culture*

Several of the scientific studies involve areas that were not originally mining communities and where the arrival of this industry presented potential changes in lifestyle and in the perception by the region of the communities operating a mine (Eklund, 2015; Frantàl, 2016; Hossain et al., 2013; Kelty and Kelty, 2011; Petrova and Marinova, 2013).

The effects described are as follows:

- Local residents confronted with cultural differences among the out-of-town workers<sup>14</sup> (Carrington et al., 2010; Frantàl, 2016; Hossain et al. 2013; Ivanova et al., 2007; Scott et al., 2011);
- The town's rural, agricultural or coastal nature giving way to a more industrial vocation (Kelty and Kelty, 2011; Miller et al., 2012; Petrova and Marinova, 2013).

Certain farmers and First Nations residents seem more affected by these effects, since these groups' identity is tied in with the land in question (Dylan and Smallboy, 2016; Suopajärvi et al., 2016; Schmidt, 2015; BAPE, 2015; Miller et al., 2012).

Mining activities can also conflict with the tradition-based activities of the indigenous peoples who use the land, as documented in one of the studies reviewed (Blais, 2015) and in some of the prospective studies (ACCE, 2015; BAPE, 2007, 2013). The analysis based on the present review of the literature identifies above all the lost access to the land and its resources, and the fear that contaminated land will adversely impact hunting and fishing activities as well as the consumption of traditional foods (Blais, 2015; Dylan and Smallboy, 2016).

### *Public order*

The studies consulted offer mixed findings as to crimes and misdemeanours. On the one hand, some authors have observed in certain Australian (Western Australia and Queensland) and Quebec (Abitibi-Témiscamingue and Nunavik) communities, some of them indigenous, that the arrival of outside workers has had effects on the public order (e.g. increases in driving under the influence, drug consumption, violence and prostitution) (Blais, 2015; Carrington et al., 2010; Hossain et al., 2013; Ivanova et al., 2007; Lawrie et al., 2011; Lockie, 2011; Lovell and Critchley, 2010; Schmidt, 2015; Scott et al., 2011; Shandro et al., 2011).

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<sup>14</sup> The communities that seem especially vulnerable to cultural confrontations are those without a tradition of mining (Carrington et al., 2010; Lockie, 2011; Scott et al., 2011).

Various factors are presented to explain the increase in these effects:

- Being far removed from the positive influence of family and friends (Carrington et al., 2010; Hossain et al., 2013; Lovell and Critchley, 2010; Schmidt, 2015; Scott et al., 2011);
- The intense work pace of mine workers (Carrington et al., 2010; Ivanova et al., 2007);
- High disposable income (Blais, 2015; Blangy and Deffner, 2014; Brisson et al., 2015; Chapman et al., 2015a; Schmidt, 2015);
- The rapid increase in population (Lawrie et al., 2011; Lockie, 2011; Lovell and Critchley, 2010; Scott et al., 2011).

One scientific study based on 140 interviews examined the climate of violence among the men living in a mining community in the region of Armstrong, located in Western Australia (Carrington et al., 2010). To explain the high rate of violence, the authors cited the social hierarchy<sup>15</sup> among the men residing in the community (Carrington et al., 2010). According to the studies consulted, excessive drinking is another factor leading to violence among male residents, since bars are the main places where social disorder manifests itself (Carrington et al., 2010; Lockie, 2011; Lovell and Critchley, 2010).

On the other hand, three of the studies reviewed seem to show no correlation between the boomtown effect and an increase in crime (Lawrie et al., 2011; Lovell and Critchley, 2010; Scott et al., 2011). Rather, the study by Lovell and Critchley (2010) establishes a correlation between the rural character of a community and an increase in crimes committed against women. In the same vein, the studies by Lawrie et al. (2011) and Scott et al. (2011) emphasize the importance of considering the specific cultural and social context of each community, instead of generalizing.

### **Potential socioeconomic effects**

The studies' findings on socioeconomic impacts can vary according to the geographic location of the mining community, the company's economic weight in the community and the type of workforce mobility management employed (Tonts et al., 2012). This precludes conclusive findings as to the overall positive or negative effect of mining activities on socioeconomic indicators.

First, an increase in job openings and business activity is indicated in a number of the documents (BAPE, 2013, 2016; Blais, 2015; Brisson et al., 2015; Chapman et al., 2015a; Chapman et al., 2015b; Garnett, 2012; Higginbotham et al., 2007; Ivanova et al., 2007; Lawrie et al., 2011; Lovell and Critchley, 2010; Miller et al., 2012; Moran and Brereton, 2013; Petrova and Marinova, 2013; Rolfe and Kinnear, 2013; Suopajärvi et al., 2016; Tonts et al., 2012). This economic stimulus seems to be of particular benefit to local merchants (thanks to the increase in the community's population) and to landlords (since they can charge more for rent) (Garnett, 2012; Ivanova et al., 2007; Petrova and Marinova, 2013; Rolfe and Kinnear, 2013). Mining can also stimulate the regional economy (Higginbotham et al., 2007; Moran and Brereton, 2013; Rolfe and Kinnear, 2013; Tonts et al., 2012). However, a number of studies show that the FIFO-DIDO workforce model is not conducive to local socioeconomic development and can even stifle economic opportunities in the region, since the employees do not spend a lot in the host community, despite their high wages (BAPE, 2007, 2013; Blais, 2015; Blangy and Deffner, 2014; Chapman et al., 2015b; Garnett, 2012; Miller et al., 2012; Rolfe and Kinnear, 2013; Suopajärvi et al., 2016).

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<sup>15</sup> Divisions in the group seem to stem from the worker's type of employment (subcontractor, contractor with the company, permanent professional, and executive) and from type of housing (temporary camp, base camp, community housing) (Carrington et al., 2010).



Second, the studies consulted confirm that the mining industry pays its employees high wages, and that this higher income produces both positive and negative impacts within the host community (BAPE, 2016; Chapman et al., 2015a; Ivanova et al., 2007; Lawrie et al., 2011; Lovell and Critchley, 2010; Rolfe and Kinnear, 2013).

On the one hand, increased earnings among certain indigenous and non-indigenous workers translate into higher consumption of goods and an improved standard of living (Blais, 2015; Blangy and Deffner, 2014; Brisson et al., 2015; Lovell and Critchley, 2010; Moran and Brereton, 2013). The high pay offered by the mining industry also helps stem the exodus of young people, especially in small remote communities with few job opportunities (BAPE, 2007, 2009, 2013; Brisson et al., 2015; Miller et al., 2012; Moran and Brereton, 2013). That said, the study by Dylan and Smallboy (2016) focusing on a Cree community in Ontario shows that not all young people aspire to work in the mining sector, especially those who have a spiritual and identity-based connection to the land (Dylan and Smallboy, 2016).

On the other hand, some of the scientific studies demonstrate that the increase in individual earnings can negatively impact the community (Brisson et al., 2015; Chapman et al., 2015a; Tonts et al., 2012). For example, three studies carried out in isolated Canadian indigenous communities illustrate that the transition from a subsistence-based lifestyle to a wage-based economy can generate a number of social impacts, including less time spent hunting (a pursuit that feeds other community members) and village services and economic activities coming to a standstill (daycare centres, municipal services) because the residents head south to make purchases (Blais, 2015; Blangy and Deffner, 2014; Schmidt, 2015). Increased income is also associated with a rise in drug and alcohol consumption in indigenous and non-indigenous communities (Blais, 2015; Blangy and Deffner, 2014; Brisson et al., 2015; Chapman et al., 2015a; Schmidt, 2015).

Third, agriculture and tourism are sectors that, from an economic standpoint, seem particularly affected by the arrival of the mining industry (Dwyer et al., 2016; Franks et al., 2010; Frantàl, 2016; Hossain et al., 2013; Ivanova et al., 2007; Miller et al., 2012; Petrova and Marinova, 2013). Prospective studies also underscore this effect (BAPE, 2005, 2013, 2015). The well-paying jobs offered by the mining industry are in competition with those offered by agricultural and tourism companies, which struggle to find people to fill these jobs (Dwyer et al., 2016; Franks et al., 2010; Hossain et al., 2013; Ivanova et al., 2007; Miller et al., 2012; Petrova and Marinova, 2013). Mining operation activities can also conflict with agricultural and tourist activities (BAPE, 2013, 2015; Franks et al., 2010; Frantàl, 2016). Furthermore, the risks of environmental contamination and landscape industrialization are cited in some of the studies as factors undermining the sustainability of both of these economic sectors<sup>16</sup> (Dwyer et al., 2016; Hossain et al., 2013; Miller et al., 2012). Two studies, however, point out that mining-based tourism (mineralogical museum, mine tours) is likely to prosper during the mining phase (BAPE, 2016; Miller et al., 2012).

Lastly, the price of goods and services, particularly housing, tends to rise for both local residents and out-of-town workers in the host community (Carrington et al., 2010; Chapman et al., 2015a; Hossain et al., 2013; Lawrie et al., 2011; Petrova and Marinova, 2013). According to the studies reviewed, this dynamic can help widen the gap between rich and poor and leave certain groups more vulnerable (BAPE, 2016; Brisson et al., 2015; Chapman et al., 2015a; Shandro et al., 2011; Tonts et al., 2012).

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<sup>16</sup> According to a study in Australia with municipal representatives of four mining communities, this situation is problematic since agriculture and tourism are seen as the key to successfully ensuring a mining community's long-term socioeconomic development once the mine has closed (Miller et al., 2012).

### **Potential effects on services and infrastructure**

The boomtown effect can have both positive and negative effects on services and infrastructure. A number of the documents and prospective studies discuss the impacts of the rise in population on the demand for housing, health care, municipal services, social services, education, emergency services and recreation (BAPE, 2007, 2016; Brisson et al., 2015; Carrington et al., 2010; Chapman et al., 2015b; Eklund, 2015; Franks et al., 2010; Garnett, 2012; Hossain et al., 2013; Ivanova et al., 2007; Kelty and Kelty, 2011; Lovell and Critchley, 2010; Miller et al., 2012; Petrova and Marinova, 2013; Rolfe and Kinnear, 2013; Scott et al., 2011; Shandro et al., 2011; Tonts et al., 2012). The studies on small, remote communities seem to place greater emphasis on this population spike, particularly from the standpoint of housing, access to health services and maintenance of road infrastructure (Carrington et al., 2010; Eklund, 2015; Franks et al., 2010; Garnett, 2012; Hossain et al., 2013; Kelty and Kelty, 2011; Lovell and Critchley, 2010; Miller et al., 2012; Rolfe and Kinnear, 2013; Shandro et al., 2011). As illustrated in some of the case studies, the housing scarcity can drive families out of the community, which risks leading (if only indirectly) to a loss of services in health, education and the public sector, since some employers and professionals may opt to exercise their profession in their new community (Garnett, 2012; Hossain et al., 2013; Ivanova et al., 2007).

However, the economic shot in the arm from the boomtown effect can help diversify the supply of cultural, sports and recreational services (Blais, 2015; Brisson et al., 2015).

The presence of worker camps also seems to drive up the pressure on certain services and infrastructure in the host community, even though this housing setup is itself a response to the housing shortage (Garnett, 2012; Hossain et al., 2013). According to the scientific studies consulted, out-of-town workers are not seen as local residents despite accounting for anywhere from 24 to 50 per cent of the total population (Carrington et al., 2010; Garnett, 2012; Scott et al., 2011). As per the case studies, these workers exert considerable pressure on municipal services (drinking water, wastewater treatment, residual waste, roads) and local agencies (Chapman et al., 2015b; Garnett, 2012; Miller et al., 2012; Rolfe and Kinnear, 2013).

One Australian case study reports that this pressure on infrastructure can also be felt in larger communities near the mining region, where FIFO workers have their primary residence, such as Perth in Western Australia (Garnett, 2012).

#### *Local authorities: response and preparations*

The present literature review has documented the importance of planning to adequately respond to residents' service and infrastructure needs (Chapman et al., 2015; Franks et al., 2010; Lovell and Critchley, 2010; Rolfe and Kinnear, 2013). The studies consulted point out the necessity on the part of municipal and government authorities to plan holistically for the arrival of this industry while equipping themselves with the necessary financial, human and legislative resources (BAPE, 2016; Blais, 2015; Chapman et al., 2015; Franks et al., 2010; Lawrie, et al., 2011; Moran and Brereton, 2013; Rolfe and Kinnear, 2013; Shandro et al., 2011). Shortcomings in information sharing among the authorities, the mining industry and the community are also presented in some of the case studies (Brisson et al. 2015; Franks et al., 2010; Shandro et al., 2011).

### Social acceptance of activities

The literature indicates that once mining activities have begun, the degree of social acceptance varies within the host community. That is the case in the studies carried out in Victoria (Australia), Alaska and Quebec (Brisson et al., 2015; Kelty and Kelty, 2011; Van der Plank et al., 2016). These factors are:

- Direct financial benefits – jobs – and indirect ones as well – economic prosperity in the region (Brisson et al., 2015; Chapman et al., 2015b; Frantàl, 2016; Kelty and Kelty, 2011; Petrova and Marinova, 2013; Van der Plank et al., 2016);
- Consulting and involving residents in mine development decisions (BAPE, 2016; Chapman et al., 2015b; Ivanova et al., 2007; Suopajärvi et al., 2016; Van der Plank et al., 2016);
- Attachment to the land as a function of identity<sup>17</sup> (Cater and Keeling, 2013; Frantàl, 2016; Kelty and Kelty, 2011; Suopajärvi et al., 2016; Van der Plank et al., 2016);
- Community’s characteristics and development history (Cater and Keeling, 2013; Chapman et al., 2015b; Van der Plank et al., 2016);
- Land claims by certain First Nations (BAPE, 2016).

### 3.2.3 CLOSING

The present literature review includes a few scientific articles and impact studies dealing with the social effects of mine closing activities. Some of the documents also identify socioeconomic effects directly associated with a mine closing.

#### Social effects

Three studies describe effects on social fabric, especially in terms of cultural changes and social capital (Bell, 2009; Browne et al., 2011; Cater and Keeling, 2013).

An ethnographic study<sup>18</sup> conducted in a West Virginian mining community that has mined coal for decades points out an association between economic decline and a deterioration of the social fabric and community confidence (Bell, 2009). These effects are mainly caused by:

- A decline in the population due to a decline in job openings;
- Residents feel powerless in the face of the company’s decision to close its doors;
- Conflict with the mining company during an ownership change.

In the cases studied, the closing of a mine that has been the main employer for decades has a drastic effect on the community’s way of life, and some authors associate this change with a loss of identity (Bell, 2009; Cater and Keeling, 2013). However, a mine’s important “physical presence” is not erased when it closes, which can help maintain the perception of a mining region (Browne et al., 2011). In fact, this situation has been observed in a community created by mining activities, namely Rankin Inlet in Nunavut (Cater and Keeling, 2013).

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<sup>17</sup> This factor seems particularly important for populations that depend culturally and economically on their natural environment.

<sup>18</sup> Survey method in the social sciences that involves a lengthy stay in the community being studied and that focuses on day-to-day activities and the meaning that people assign to their actions (Smith, 1982).

### **Potential socioeconomic effects**

According to a few of the articles consulted, closing a mine requires that a new economic foundation be developed to ensure the well-being of the community (BAPE, 2013, 2016; Browne et al., 2011; Moran and Brereton, 2013). One-industry towns (be they indigenous or not) that are economically dependent on the mining industry seem particularly vulnerable to a mine closing (Browne et al., 2011; BAPE, 2007).

All in all, the present review indicates that from the time a project is announced right through until the exploration, development and closing phases have been completed, mining activities can cause various social effects in terms of social ties, culture, public order and socioeconomic conditions. These effects are mainly attributable to an increase in the population and an economic stimulus, both of which are associated with the boomtown effect.

## **3.3 Psychological dimensions associated with mining activities**

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The literature consulted sheds light on the psychological dimensions associated with mining activities. These dimensions relate specifically to individuals and their behaviour, autonomy, judgment, thought processes, etc. The effects most frequently identified in this review are stress, anxiety, anger, uncertainty and hope. As for the social dimensions, psychological effects can be felt when a mine project is announced, during the mining phase itself and right through until the mine's closing.

### **3.3.1 ANNOUNCEMENT OF MINE EXPLORATION PROJECT**

Some of the studies consulted indicate that residents exhibit stress, worry, sadness and anger during the project announcement and mining phases, as well as feelings of powerlessness and insecurity. These are attributed in particular to the absence of choice, anticipated lifestyle changes and a lack of information (BAPE, 2005, 2013, 2014, 2015; Brisson et al., 2015; Moffatt and Baker, 2013).

The documents indicate that the following factors can contribute to these effects:

- Exploratory drilling and relocation of certain buildings are two activities that seem particularly likely to generate insecurity and uncertainty owing to a lack of information, as well as feelings of powerlessness, turmoil, sadness, frustration, anger and stress in connection with the change in environment and lifestyle (BAPE, 2005, 2013, 2014, 2015; Brisson et al., 2015; Moffatt and Baker, 2013);
- The lack of information about the environmental effects (water tables) and potential nuisance impacts, such as dust and noise, can also lead to feelings of insecurity and powerlessness (BAPE, 2013, 2014, 2015).

The literature also indicates that communities are hopeful and excited about the potential for prosperity, stable jobs and the return of young people when mining projects are announced (BAPE, 2013, 2014, 2015; Brisson et al., 2015; Chapman et al., 2015; LeBlanc, 2012). These feelings seem especially prevalent in small communities suffering from economic decline (BAPE, 2013; Brisson et al., 2015; Chapman et al., 2015).

### 3.3.2 MINING OPERATIONS

The documents consulted as part of this review highlight a number of psychological dimensions that manifest themselves during mining activities. Several scientific articles found instances of stress, distress and depression, as well as feelings of powerlessness and insecurity in communities situated near mining infrastructure in the face of lifestyle changes or loss of land caused by the operations of one or more<sup>19</sup> (Albrecht et al., 2007; Brisson et al., 2015; Browne et al., 2011; Frantàl, 2016; Hendryx and Innes-Wimsatt, 2013; Higginbotham et al., 2007; Kelty and Kelty, 2011; McSpirit et al., 2007; Moffatt and Baker, 2013; Suopajärvi et al., 2016). BAPE reports also document these manifestations and feelings within Quebec communities (BAPE, 2009, 2013, 2015, 2016).

The factors cited by the literature are:

- A poor attitude on the part of the industry (when it is uncommunicative, rarely consults the population or seems indifferent to the changes in people's lives) gives rise to a feeling of insecurity, frustration and anger (Brisson et al., 2015; Browne et al., 2011; Chapman et al., 2015; Frantàl, 2016; Higginbotham et al., 2007; Hossain et al., 2013; LeBlanc, 2012; Moffatt and Baker, 2013; Suopajärvi et al., 2016).
- Lifestyle changes, especially when directly related to the land affected, can generate distress and a feeling of powerlessness (Albrecht et al., 2007; Browne et al., 2011; Frantàl, 2016; Hendryx and Innes-Wimsatt, 2013; Higginbotham et al., 2007; Kelty and Kelty, 2011; Moffatt and Baker, 2013). These changes have been experienced by farmers in Australia (Hossain et al., 2013; Miller et al., 2012; Moffatt and Baker, 2013) and by certain First Nations in Canada (BAPE, 2015; Dylan and Smallboy, 2016).
- Building expropriation or relocation, which results in a loss of landmarks and changes in living habits, has also caused stress, anxiousness and bitterness (Albrecht et al., 2007; BAPE, 2016; Brisson et al., 2015; Frantàl, 2016; HHIC, 2012; Hossain et al., 2013; LeBlanc, 2012; Moffatt and Baker, 2013).
- Increased nuisance impacts (dust, noise, vibrations) and increased traffic seem to bring on feelings of anxiety, distress and powerlessness (BAPE, 2016; Higginbotham et al., 2007; LeBlanc, 2012).

#### Worries and fears

Feelings of worry and fear have also been documented in a number of the studies, attributable primarily to financial and environmental considerations. To a lesser extent, these fears are triggered by considerations of health and loss of lifestyle.

Farmers have been the subject of numerous case studies in this regard. According to studies on Queensland-area farmers in Australia, these individuals are anxious and fearful due to uncertainty about their future and about the sustainability of agriculture in the region (Hossain et al., 2013; Miller et al., 2012; Moffatt and Baker, 2013). Moreover, the lack of information concerning the mining company's development intentions and the risks of water and land contamination is discouraging

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<sup>19</sup> Several of the documents consulted associate these effects with the concept of solastalgia. Solastalgia is a concept developed by Glenn Albrecht that helps conceptualize the distress brought on by environmental changes. Unlike nostalgia, which corresponds to the melancholy or homesickness felt by individuals separated from their homes, solastalgia is a feeling of distress generated by environmental changes affecting the individuals' living environment (Albrecht et al., 2007). This concept helps shed light on and clarify the stress experienced by people who feel dispossessed from their land without having been displaced or having suffered a catastrophe.

some young people from taking over the family farm and convincing some farmers to sell their farm (Hossain et al., 2013; Moffatt and Baker, 2013).

The mine's proximity, as well as the dust and noise emanating from the mine, also causes stress, anxiety and insecurity among certain residents who fear that their homes will lose value (Albrecht et al., 2007; BAPE, 2015, 2016; Brisson et al., 2015; Hendryx et Innes- Wimsatt, 2013; Moffatt and Baker, 2013).

Studies on other communities, be they indigenous or not, have identified fears associated with risks of underground and surface water contamination, as well as the incompatibility of mining activities with other nature-related activities such as tourism, fishing, hunting and gardening (Suopajärvi et al., 2016; Dylan and Smallboy, 2016; Blais, 2015; Miller et al., 2012; Kelty and Kelty, 2011). Prospective studies also cite these fears, which are likely to change residents' lifestyle (ACEE, 2015; BAPE, 2005, 2007, 2009, 2013, 2016; HHIC, 2012).

Lastly, the environmental fall-out from previous mines, the perception of a lack of planning and mismanagement of nuisance impacts can leave residents mistrustful of the authorities (BAPE, 2009, 2013, 2015, 2016; Brisson et al., 2015; McSpirit et al., 2007; Suopajärvi et al., 2016). The feeling of mistrust can cause certain worries from a physical health standpoint, as well as displays of anger and anxiety as identified in Martin County, Kentucky, following a major mine residue spill (McSpirit et al., 2007).

### **3.3.3 MINE CLOSING**

Some of the documents discuss the psychological effects associated with mine closings in three different communities, located in Australia, Canada and the United States (Bell, 2009; Browne et al., 2011; Shandro et al., 2011). They reveal a significant association between the mine closing and an increase in psychological ailments among some of the affected population, particularly in communities where the mining industry is the primary employer (Bell, 2009) or when the closing was sudden (Browne et al., 2011).

Feelings of anxiety, distress and depression were observed in the affected communities (Bell, 2009; Shandro et al., 2011), as well as a loss of hope and disillusionment about the region's development – this on top of the significant environmental and social losses (Bell, 2009; Browne et al., 2011). According to the study by Browne et al. (2011), these psychological ailments are exacerbated by the fact that the mining companies operate in an uncertain environment despite touting the certainty of social and economic benefits in their messages to the community in order to gain its acceptance and trust (Browne et al., 2011).

Physical remnants can also remain on the mine site after its closing, such as waste rock and flooded pits, which can leave some people sad and bitter about the economic and social sacrifices made by the community (Browne et al., 2011). One prospective study also discussed fears among certain residents concerning the commitments made by the company. These residents doubt that the site will be rehabilitated or the premises secured once the mine has closed (ACEE, 2015).

In short, the studies consulted indicate that mining activities can cause psychological effects in the neighbouring community, associated with the project announcement, the exploration and mining phases and the mine's closing, and depend on various factors, including the company's attitude, the nuisance impacts caused by the mine and the community's way of life predating these activities.

## 4 Discussion and conclusion

The 46 documents selected for the present literature review outline effects on quality of life and social and psychological health directly or indirectly related to one or another of the activities associated with the mining cycle. These situations could recur in the presence of similar conditions regarding the physical, economic and social characteristics of the host community, the nature of the industry's activities and the degree of preparedness on the part of local, regional and government authorities.

### 4.1 Summary of results

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Depending on the scope and intensity of the work, the exploration and mining phases are likely to generate nuisance impacts like dust, noise and vibrations, along with increased traffic. Road and infrastructure construction, ore extraction and hauling, blasting and drilling are among the activities most likely to cause annoyances and disruptions affecting the quality of life in the neighbouring community. Direct effects on well-being and living habits, along with indirect effects on physical health, were observed in a number of the case studies.

As for the social and psychological aspects, effects relating to the project announcement, the exploration and mining phases and the mine's closing have been examined in recent studies.

Right from the time the project is announced and exploration activities commence, effects on sociopolitical dynamics have been observed, including conflicts, disengagement and marginalization. Communities are hopeful and excited about the potential for prosperity, stable jobs and the return of young people when mining projects are announced.

The case studies consulted indicate that once mining activities begin, the social impacts stemming from the boomtown effect are generally negative. This demographic growth is likely to ramp up demand for services and infrastructure. The presence of worker camps seems to also create a lot of pressure on certain services and infrastructure, even if this type of accommodations is a response to a housing shortage. The studies also document various effects on the community's cultural and social fabric (interaction among individuals and groups) associated with mining activities and the arrival of outside workers. These effects vary from one community to the next and involve social cohesion, conflicts, lifestyle changes and the public order. As for the psychological dimensions, a poor attitude on the part of the industry (when it is uncommunicative, rarely consults the population or seems indifferent to the changes in people's lives), lifestyle changes, expropriation or relocation of buildings and increased nuisance impacts can lead to negative psychological effects such as anxiety, distress and a sense of powerlessness.

From a socioeconomic standpoint, the arrival of the mining industry can boost job availability and spur business activity. It can also drive up the cost of goods and services. In the final analysis, it is hard to say one way or another whether mining activities have an overall positive or negative effect on socioeconomic conditions.

Finally, a few documents broach the social and psychological dimensions of mine closings. When the mine company has been the main employer for decades, its decommissioning seems to have a drastic impact on the community's lifestyle. According to the literature, closing a mine makes it necessary to develop a new economic foundation in order to ensure the community's well-being. Some of the studies also point out a significant link between decommissioning a mine and a rise in psychological distress experienced by some of the individuals affected, especially in communities where the mine was the primary employer or in instances when the mine closed suddenly.

All in all, the literature consulted highlights more negative than positive effects on health and well-being, although positive effects have indeed been observed. Planning for the arrival of the mining industry by the various stakeholders, particularly in response to demographic growth, can mitigate some of the negative social and psychological effects. In addition, the specific characteristics of each host community, industry activities and site configuration systematically require an initial assessment of the community in order to document the actual effects.

## 4.2 Factors modulating the impacts

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As in the case with the other types of impacts, social and psychological impacts can vary in intensity depending on the community or the group that is home to the mining activities. These differences are attributable to certain impact-modulating factors. The cases identified in the present review highlight some examples. At the time of the initial assessment of the community, identifying these factors can help anticipate certain favourable and unfavourable impacts.

The studies on small, remote communities indicate that residents seem more likely to feel the negative effects of rapid population growth, particularly from the standpoint of housing, access to health services and maintenance of road infrastructure. The high pay offered by the mining industry also helps stem the exodus of young people, especially in small remote communities with few employment opportunities.

Studies also show that the mining company's economic weight in the community and the type of employee mobility management employed are factors that modulate these impacts. For example, according to the scientific literature consulted, setting up worker camps and adopting a FIFO approach have greater negative impacts on social fabric, regional socioeconomic development, services and infrastructures than on integration of workers and their families into the community.

According to some of the studies consulted, factors involving social acceptance (consent on the part of the population) can modulate the social and psychological impacts. For example, shortcomings in the citizen participation mechanisms deployed, which can stand in the way of the host community's consent, have in some instances left community members feeling insecure, frustrated and angry.

Lastly, the need for municipal and government authorities to plan holistically for the arrival of this industry while equipping themselves with the necessary financial, human and legislative resources is also raised in a number of the studies consulted. Planning for the arrival of the mining industry by the various stakeholders would help avoid or mitigate the negative effects and enhance the positive effects.

## 4.3 Avenues for action or research

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With a view to improving current practices and avoiding certain negative repercussions on communities' socioeconomic development and social fabric, some of the authors whose works were consulted suggest, for example, helping outside workers and their families get settled into the host community by organizing a number of social and community activities.



Additional courses of action proposed to protect and enhance the psychological health of FIFO mine workers include considering the management of the FIFO system from a holistic perspective by incorporating all of the issues associated with this labour model; informing workers and their families, prior to or at the time of hire, about the working conditions and any issues involving psychological health and work/home life balance; putting in place measures to detect any signs and symptoms of deteriorating psychological health; and promoting various forms of psychological assistance and support.

Increased information sharing among the various stakeholders is also recommended by certain authors, although some maintain that these initiatives sometimes require a very mature and collaborative relationship among the parties. Cooperation between the host community and the industry seems especially important during the site closing and rehabilitation phase in order to ensure a successful socioeconomic transition for the community.

In closing, the portrait that has emerged from this review of the literature will help equip public health professionals to carry out their mandates, but a number of issues in connection with quality of life and the social and psychological effects of mining activities still need to be documented. It is important not to generalize these effects to include all mining activities, but rather to follow proper procedure when assessing the social impacts, which involves evaluating the initial status of each community. There is also a need to better document the authorities' response to the pressure brought to bear by the increase in population so as to better plan for the arrival of the mining industry. Finally, studies aimed at documenting indigenous perceptions of mining operations and taking stock of the State's obligations to consult and accommodate these communities would also be useful in ensuring a greater understanding of the context in which mining projects are implemented in certain regions of Quebec.



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## **Appendix 1**

### **Mining cycle**



## The Mining Cycle

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Developing a mine site, be it an open-pit or underground mine, usually constitutes a large-scale project that is rolled out over several decades, in some cases. During the various administrative and technical phases, numerous important actors will participate through a complex decision-making process, while substantial sums of money will need to be invested by the mine operator in order to build the infrastructure necessary for mineral extraction and refinement (Comité sectoriel de main-d'œuvre de l'industrie des mines, 2016; ministère de l'Énergie et des Ressources naturelles [MERN], 2010).

The various steps leading to the development of a mine, or “mining cycle,” can be divided into successive segments of various frequency and length, depending on the underlying issues. Thus, geologists, architects, engineers, legal staff, economists, managers and community representatives all possess a distinct but complementary vision of the mining cycle. For the purposes of the present report, the authors have seen fit to support their review of the literature with respect to three main series of activities (or phases), the boundaries of which mark milestones in the mining cycle:

1. Exploration, feasibility and development of site;
2. Development of site;
3. Closing and rehabilitation of site.

Each of these phases requires separate experts, technicians and investors, presents specific challenges and entails different risks. Independent of these steps, it should be pointed out that all types of mining projects are subject to economic constraints that can alter the viability of the project mid-stream and result in the suspension of the work or a premature end to the project. Like any business, mining companies must also comply with a series of strict laws and regulations aimed at protecting the environment as well as the health and safety of the workers and public. Mechanisms for consulting the local populations (including indigenous groups) are also required, and are deployed according to the progress of the project, its scope and its anticipated impacts. All in all, the complexity of the mining cycle is such that a project that completes each of the steps leading to the mine's opening is in fact the exception and not the rule (Indigenous and Northern Affairs Canada [INAC], 2010; MERN, 2010).

### **1. Exploration, feasibility and development of site**

Mine exploration consists in identifying sites where mineral resources are present in minable quantities. Such sites are commonly referred to as “mineral deposits”. While prospecting campaigns map geologic structures of interest and offer clues as to their mining potential, drilling programs to extract and analyze samples from the subsurface assess the volume and content of the mineral deposits identified (INAC, 2010; Comité sectoriel de main-d'œuvre de l'industrie des mines; 2016). This work is generally performed without first obtaining official acquisition rights on the targeted mineral resources. Mineral exploration is carried out in well-defined sectors where preliminary data indicate the presence of certain geologic anomalies (mineral occurrences) (INAC, 2010).

Technical, financial and environmental feasibility analyses remain an additional and essential step in completing this initial phase of the mining cycle (Comité sectoriel de main-d'œuvre de l'industrie des mines; 2016).

Once the company has acquired rights to the land and the desired resource (i.e. a mining concession or lease), exploratory work and deeper analyses can proceed in order to define the features of the deposit. While the aforementioned prospecting work requires only temporary infrastructure, advanced exploration work generally requires that a mining camp be set up to house a group of workers and the necessary machinery (e.g. generators, refuelling facilities, heavy machinery, etc.) for carrying out the projected work. This work includes subsurface sampling activities (coring), digging small-scale trenches and vertical wells, and even the installation of small processing centres. This phase generally wraps up with a feasibility study before the project is subjected to an environmental assessment (INAC, 2010).

Once these preliminary steps have been carried out, mine development and construction of the necessary infrastructure commence only if 1) the deposit is sufficient enough to become a mine, 2) the economic profitability of the enterprise justifies its operation, 3) the development meets the regulatory requirements in effect and 4) the mine can be developed while respecting the environment and the affected population. Developing a mine involves carrying out a number of concurrent activities aimed at obtaining the necessary guarantees, permits, plans and assessments. In the best-case scenario, and subject to shareholder approval, mine development can proceed (INAC, 2010; Comité sectoriel de main-d'œuvre de l'industrie des mines, 2016; MERN, 2010).

## **2. Site development**

The development process, which is step two of the mining cycle, cannot commence unless the operator has received all of the permits and authorizations from the appropriate concerned authorities. This is the step where the mineral resource is extracted from the deposit and processed in order to fashion a mineral product that can be sold by the mining company.

Coinciding with the actual extraction (i.e. removing the mineral resource from the depths of the subsurface) are multiple processing steps based on the mineral resource being mined. Generally speaking, ore from the mine is crushed and milled into a fine powder, and then, using various physical and chemical separation processes, the valuable minerals are segregated from the surrounding (or “waste”) rock. The mineral concentrate obtained from this is then refined to increase its purity and processed to facilitate its transport and/or use. These latter steps can be carried out in processing plants situated on the mine site itself or elsewhere. It should be pointed out that the nature of these activities barely differs, regardless of whether the mine is open-pit or underground.

It should be kept in mind that only a fraction of the extracted ore contains valuable minerals. While the waste rock can be used as fill/construction material on the mine site itself, the sludge and water from the various treatments and from meteoric water runoff are generally treated in specially designed watertight retention ponds (Comité sectoriel de main-d'œuvre de l'industrie des mines, 2016). While the scale and design of this work depends on the type of mining and the physiographic features of the site, the dimension of the work is generally proportional to the size of the deposit.

A mine can be operated for just a few years or for decades, if the mineral reserves and economic environment warrant its continued operation. Most mining companies generally expect it to take about 10 years to recoup their initial investments. During that period, the company's managers are constantly evaluating mine activities in light of any developments that could affect its economic viability, as well as proceeding with regular updates on operational practices that reflect the changing opportunities for bringing the mineral resource to market and introducing new technologies. How long the mine will be operated depends directly on these follow-ups (AANC, 2010).

### 3. Site closing and rehabilitation

While the closing of the mining site constitutes the final step of the mining cycle, it should be pointed out that rehabilitation activities have been planned for even before the mining permits were issued, which is to say during the preliminary project development phase. Indeed, the environmental risks associated with the mine closing and rehabilitation or with the site decommissioning are paid special attention in this day and age. In addition to helping rebuild a viable ecosystem, the closing process must ensure that the decommissioned site is integrated into its neighbouring environment to guarantee the stability and sustainability of the containment, grading and reforestation work undertaken. In general, this process can take anywhere from a few years to a decade (Comité sectoriel de main-d'œuvre de l'industrie des mines, 2016). Despite these measures, the public and governments still harbour concerns about abandoned mines because of the environmental risks they pose and the sizeable investments that will be necessary to fully rehabilitate these sites (INAC, 2010).

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## **Appendix 2**

### **EBSCOhost platform search history**





**Table 1 EBSCOhost platform search history**

Databases queried:

- Environment Complete;
- MEDLINE Complete;
- Psychology and Behavioral Sciences Collection;
- PsycINFO;
- Public Affairs Index;
- SocINDEX with Full Text.

Search done on October 5, 2016.

#	Question	Hits
S16	S11 OR S15	1152
S15	S9 AND S10 AND S14	17
S14	S12 AND S13	47
S13	MH ("environmental psychology" OR "stress, psychological")	99 562
S12	MH (mining OR coal mining)	32 810
S11	S9 AND S10 AND S11	1141
S10	LA (eng OR English OR fre OR French)	34 795 236
S9	(DT 2005-2016)	16 082 806
S8	S1 N10 S6 N10 S7	1 651
S7	TI (communit* OR population* OR city OR cities OR town* OR village* OR family OR families OR neighborhood* OR neighbourhood* OR region OR regions OR regional OR "rural setting*" OR municipalit*) OR AB (communit* OR population* OR city OR cities OR town* OR village* OR family OR families OR neighborhood* OR neighbourhood* OR region OR regions OR regional OR "rural setting*" OR municipalit*)	5 853 844
S6	S2 OR S3 OR S4 OR S5	14 798 998
S5	TI (well-being OR wellbeing OR wellness OR stress* OR health OR "mental disorder*" OR (quality N0 life) OR annoyance* OR nuisance*) OR (well-being OR wellbeing OR wellness OR stress* OR health OR "mental disorder*" OR (quality N0 life) OR annoyance* OR nuisance*)	6 570 182
S4	TI (social* OR psychosocial* OR psycho-social* OR sociopsycholog* OR socio-psycholog* OR psychological* OR socioeconomic* OR socio-economic*) OR AB (social* OR psychosocial* OR psycho-social* OR sociopsycholog* OR socio-psycholog* OR psychological* OR socioeconomic* OR socio-economic*)	2 431 681
S3	TI (effect* OR impact* OR consequence*) OR AB (effect* OR impact* OR consequence*)	9 288 591
S2	TI (boomtown* OR boom-town* OR fly-in OR fly-out OR drive-in OR drive-out) OR AB (boomtown* OR boom-town* OR fly-in OR fly-out OR drive-in OR drive-out)	88 355
S1	TI (mine OR mines OR mining*) OR AB (mine OR mines OR mining*)	82 291
S = Set, MH = MeSH, LA = Language, DT = Publication date, TI = title, AB = abstract. The search strategy comprises all of the queries.		



## **Appendix 3**

**Description of the documents selected  
during quality assessment stage**



**Table 1** Description of the documents selected during quality assessment stage

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticip- ated	Assessed quality <sup>a</sup>	
				Well- being	Psycho- logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Albrecht et al. (2007)	<ul style="list-style-type: none"> <li>▪ Individual interviews</li> <li>▪ Focus groups</li> <li>▪ Population survey analyses</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Upper Hunter Valley, New South Wales (NSW)</li> <li>▪ 2003 – 2006</li> </ul>	<ul style="list-style-type: none"> <li>▪ 60 people met with (interviews &amp; focus groups)</li> </ul>	X	X		X		X	
Bell, S. E. (2009)	<ul style="list-style-type: none"> <li>▪ Semi-directed individual interviews</li> </ul>	<ul style="list-style-type: none"> <li>▪ US</li> <li>▪ 2 rural cities in West Virginia</li> <li>▪ Summer 2006</li> </ul>	<ul style="list-style-type: none"> <li>▪ 40 participants</li> </ul>			X	X		X	
Blais, J. (2015)	<ul style="list-style-type: none"> <li>▪ Semi-directed and informal interviews</li> <li>▪ Participatory observations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Nunavik; Inuit communities of Kuujuaq, Salluit and Kangiqsujuaq</li> <li>▪ Oct. 14 – Nov. 12,</li> <li>▪ 2012</li> </ul>	<ul style="list-style-type: none"> <li>▪ 46 participants (including 32 of Inuit origin)</li> </ul>			X	X		X	

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Blangy, S. and Deffner, A. (2014)	<ul style="list-style-type: none"> <li>▪ Participatory action research (accounts, <i>cartes au sol</i>, graphic forms, role-playing, building future scenarios)</li> <li>▪ Individual interviews</li> <li>▪ Participatory observations</li> <li>▪ Log</li> <li>▪ Participatory workshops</li> <li>▪ Analysis of the literature</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Qamani'tuaq (or Baker Lake), Nunavut</li> <li>▪ 2007 – 2014</li> </ul>	<ul style="list-style-type: none"> <li>▪ Over 50 participants</li> </ul>	X		X	X		X	
Brisson, G., Morin- Boulais, C. and Bouchard-Bastien, E. (2015)	<ul style="list-style-type: none"> <li>▪ Semi-directed interviews</li> <li>▪ Participatory observations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Malartic, Québec</li> <li>▪ Summer 2012 and summer 2013</li> </ul>	<ul style="list-style-type: none"> <li>▪ 93 participants</li> </ul>	X	X	X	X		X	
Browne, A. L., Stehlik, D. and Buckley, A. (2011)	<ul style="list-style-type: none"> <li>▪ Semi-directed interviews (community members) and discussion forum (farmers)</li> <li>▪ Complementary interviews with key informants</li> <li>▪ National media articles from June 2008 - December 2009 as well as regional and local media and research reports</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Country of Ravensthorpe, Western Australian (WA)</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ 41 interview participants</li> <li>▪ 24 farmers participated in the discussion forum</li> </ul>	X	X	X	X			X

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Bureau d'audiences publiques sur l'environnement (2005)	<ul style="list-style-type: none"> <li>Public consultations</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Oka, Québec</li> <li>January 2005</li> </ul>	<ul style="list-style-type: none"> <li>21 briefs</li> <li>554 participants</li> </ul>		X	X		X	X	
Bureau d'audiences publiques sur l'environnement (2007)	<ul style="list-style-type: none"> <li>Public consultations (indigenous and non-indigenous)</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Fermont, Québec</li> <li>August - September 2007</li> </ul>	<ul style="list-style-type: none"> <li>24 briefs</li> <li>45 participants</li> </ul>	X	X	X		X	X	
Bureau d'audiences publiques sur l'environnement (2009)	<ul style="list-style-type: none"> <li>Public consultations</li> <li>Documentary research</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Malartic, Québec</li> <li>March - April 2009</li> </ul>	<ul style="list-style-type: none"> <li>83 briefs</li> <li>115 participants</li> </ul>	X	X	X		X	X	
Bureau d'audiences publiques sur l'environnement (2013)	<ul style="list-style-type: none"> <li>Public consultations</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Sept-Îles, Québec</li> <li>August - September 2013</li> </ul>	<ul style="list-style-type: none"> <li>150 briefs</li> <li>202 participants</li> </ul>	X	X	X		X	X	
Bureau d'audiences publiques sur l'environnement (2014)	<ul style="list-style-type: none"> <li>Public consultations</li> <li>Documentary research</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Launay, Québec</li> <li>May - June 2014</li> </ul>	<ul style="list-style-type: none"> <li>54 briefs</li> <li>51 participants</li> </ul>	X	X	X		X	X	
Bureau d'audiences publiques sur l'environnement (2015)	<ul style="list-style-type: none"> <li>Public consultations</li> <li>Documentary research</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Saguenay, Québec</li> <li>April - May 2015</li> </ul>	<ul style="list-style-type: none"> <li>89 briefs</li> <li>128 participants</li> </ul>	X	X	X		X	X	

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Bureau d'audiences publiques sur l'environnement (2016)	<ul style="list-style-type: none"> <li>▪ Public consultations</li> <li>▪ Documentary research</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Malartic, Québec</li> <li>▪ June - July 2016</li> </ul>	<ul style="list-style-type: none"> <li>▪ 119 briefs</li> <li>▪ 99 participants</li> </ul>	X	X	X	X	X	X	
Canadian Environmental Assessment Agency (2015)	<ul style="list-style-type: none"> <li>▪ Public consultations</li> <li>▪ Expert consultations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Nemaska, Québec</li> <li>▪ December 2012 to November 2013</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>	X	X			X	X	
Carrington, K., McIntosh, A. and Scott, J. (2010)	<ul style="list-style-type: none"> <li>▪ Case study</li> <li>▪ Interviews</li> <li>▪ Triangulation with data from Australian Bureau of Statistics (ABS), crime data and community profiles</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Armstrong region and city of Pembleton, WA</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ 140 participants (elected officials and other community stakeholders, peace officers and police officers, educators, youth workers, health workers, etc.).</li> </ul>		X	X	X		X	



**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Cater, T. and Keeling, A. (2013)	<ul style="list-style-type: none"> <li>▪ Semi-directed interviews</li> <li>▪ Participatory observations</li> <li>▪ Qualitative analysis of countryside</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Ranklin Inlet, Nunavut</li> <li>▪ 2011 and 2012</li> </ul>	<ul style="list-style-type: none"> <li>▪ 21 interviews</li> </ul>			X	X		X	
Chapman, R., Plummer, P. and Tonts, M. (2015)	<ul style="list-style-type: none"> <li>▪ Analysis of databases</li> <li>▪ Modelling and ordinary least squares (OLS) regression</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ 33 mining communities, WA</li> <li>▪ 2001 - 2011</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>			X	X		X	
Chapman, R., Tonts, M. and Plummer, P. (2015)	<ul style="list-style-type: none"> <li>▪ In-person survey</li> <li>▪ (Q-sort), including informal interviews</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Mining communities of Onslow and Karratha, Pilbara region, WA</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ 28 participants from Onslow</li> <li>▪ 20 participants from Karratha</li> </ul>			X	X		X	
Dwyer et al. (2014)	<ul style="list-style-type: none"> <li>▪ Computable general equilibrium (CGE) modelling</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Territories economically dependent on mining activities and tourism, particularly the Northern Territory, Tasmania and Queensland</li> <li>▪ 2004 – 2012</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>			X	X		X	

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Dylan, A. and Smallboy, B. (2016)	<ul style="list-style-type: none"> <li>▪ Interviews with key adult informants in the communities (phase 1)</li> <li>▪ Interviews with key youth informants and focus groups (phase 2)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Cree community, Mushkegowuk territory, Western James Bay in Northern Ontario, and city of Moosonee</li> <li>▪ Over a four-year period</li> </ul>	<ul style="list-style-type: none"> <li>▪ 50 participants</li> </ul>	X	X		X		X	
Eklund, E. (2014)	<ul style="list-style-type: none"> <li>▪ Historical survey (statistical databases)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Coal mining communities</li> <li>▪ 1901 - 2001</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>			X	X		X	
Franks, D. M., Brereton, D. and Moran, C. J. (2010)	<ul style="list-style-type: none"> <li>▪ Qualitative analysis with help of conceptual model</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Hunter Valley and Gunnedah Basin (NSW) et Bowen Basin (Queensland)</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>	X		X	X		X	
Frantál, B. (2016)	<ul style="list-style-type: none"> <li>▪ Questionnaire administered face to face</li> </ul>	<ul style="list-style-type: none"> <li>▪ Czech Republic</li> <li>▪ 2 cities that would be affected by mines if there were land changes (Horní Jiřetín and Litvínov)</li> <li>▪ 2012</li> </ul>	<ul style="list-style-type: none"> <li>▪ 200 people per city</li> </ul>	X		X	X	X		

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Garnett, A. M. (2012)	<ul style="list-style-type: none"> <li>Quantitative analysis of regional statistics</li> </ul>	<ul style="list-style-type: none"> <li>Australia</li> <li>WA</li> <li>Analysis based on several periods, mainly in the 2000s</li> </ul>	<ul style="list-style-type: none"> <li>Not mentioned</li> </ul>			X	X			X
Habitat Health Impact Consulting (2012)	<ul style="list-style-type: none"> <li>Public consultations (telephone and face to face)</li> <li>Group meeting</li> <li>Documentary analysis</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>Keno, Yukon</li> <li>June 2012</li> </ul>	<ul style="list-style-type: none"> <li>21 people met with</li> </ul>	X	X			X	X	
Hendryx, M. (2013)	<ul style="list-style-type: none"> <li>Telephone survey</li> </ul>	<ul style="list-style-type: none"> <li>US</li> <li>Central Appalachia (Kentucky, Tennessee, Virginia and West Virginia)</li> <li>2006</li> </ul>	<ul style="list-style-type: none"> <li>8591 respondents</li> </ul>		X		X		X	
Higginbotham et al. (2007)	<ul style="list-style-type: none"> <li>Mail-in questionnaire</li> <li>Semi-directed interviews</li> <li>Analysis with the Environmental Distress Scale (EDS) model</li> </ul>	<ul style="list-style-type: none"> <li>Australia</li> <li>Upper Hunter Valley, NSW</li> <li>Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>203 questionnaire respondents</li> <li>45 interview participants</li> </ul>	X	X		X			X
Hossain et al. (2013)	<ul style="list-style-type: none"> <li>12 workshops</li> <li>Quantitative classification of issues raised</li> </ul>	<ul style="list-style-type: none"> <li>Australia</li> <li>12 communities in Southern Queensland</li> <li>November 2010 - April 2011</li> </ul>	<ul style="list-style-type: none"> <li>239 participants, mainly farmers, civil servants and health workers</li> </ul>		X	X	X		X	

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Ivanova et al. (2007)	<ul style="list-style-type: none"> <li>▪ Modelling and linear regression</li> <li>▪ Case study</li> <li>▪ Semi-directed interviews</li> <li>▪ Telephone and mail-in surveys</li> <li>▪ Focus groups</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Blackwater, Bowen Basin</li> <li>▪ October-November 2005</li> </ul>	<ul style="list-style-type: none"> <li>▪ 15 interview participants</li> <li>▪ 304 survey participants</li> </ul>	X		X	X			X
Kelty R. and Kelty R. (2011)	<ul style="list-style-type: none"> <li>▪ Self-administered questionnaires</li> <li>▪ Interviews with key stakeholders</li> <li>▪ Participatory observations</li> </ul>	<ul style="list-style-type: none"> <li>▪ US</li> <li>▪ Community of salmon fishers; Bristol Bay, Alaska</li> <li>▪ During commercial fishing season in 2007</li> </ul>	<ul style="list-style-type: none"> <li>▪ 50 participants</li> </ul>	X		X	X			X
Lawrie, M., Tonts, M. and Plummer, P. (2011)	<ul style="list-style-type: none"> <li>▪ Qualitative statistical analysis</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Kalgoorlie-Boulder, Port-Headland and Karratha-Dampier, WA</li> <li>▪ 1999 - 2009</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>			X	X			X
LeBlanc et al. (2012)	<ul style="list-style-type: none"> <li>▪ Questionnaires (closed questions) administered face to face</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Malartic, Québec</li> <li>▪ Oct. - Dec. 2011</li> </ul>	<ul style="list-style-type: none"> <li>▪ 306 questionnaire s completed</li> </ul>	X	X	X	X		X	

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Lockie, S. (2011)	<ul style="list-style-type: none"> <li>▪ Case study</li> <li>▪ Telephone survey</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Bowen Basin and Mackay region, Queensland</li> <li>▪ June and July 2007</li> </ul>	<ul style="list-style-type: none"> <li>▪ 532 respondents</li> </ul>	X	X		X		X	
Lovell J. and Critchley, J. (2010)	<ul style="list-style-type: none"> <li>▪ Focus groups</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Remote mining community (name not provided)</li> <li>▪ Collection period not mentioned but lasted six weeks</li> </ul>	<ul style="list-style-type: none"> <li>▪ 16 participants</li> </ul>		X		X		X	
McSpirit et al. (2007)	<ul style="list-style-type: none"> <li>▪ Observations on the ground</li> <li>▪ Semi-directed interviews</li> <li>▪ Self-administered questionnaires distributed door to door</li> </ul>	<ul style="list-style-type: none"> <li>▪ US</li> <li>▪ Martin County and Perry County, Kentucky; Mingo and Wyoming County, West Virginia</li> <li>▪ In March 2001, September 2001 (Kentucky) and in April 2005 (West Virginia)</li> </ul>	<ul style="list-style-type: none"> <li>▪ 290 participants from Martin County</li> <li>▪ 249 participants from Perry County</li> <li>▪ 157 participants from Mingo County</li> <li>▪ 96 participants from Wyoming County</li> </ul>	X	X		X			X

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Miller, E., Van Meegen, K. and Buys, L. (2012)	<ul style="list-style-type: none"> <li>▪ Case study</li> <li>▪ Focus groups</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ City of Stanthorpe and Warwick (Southern Downs) and Dalby and Chinchilla (Western Downs) in Darling Downs, Queensland</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ 28 municipal representatives</li> </ul>			X	X		X	
Moffat, J. and Baker, P. (2013)	<ul style="list-style-type: none"> <li>▪ Case study</li> <li>▪ Semi-directed interviews</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Farming community of Clarence Moreton Basin, Queensland</li> <li>▪ August – October 2009</li> </ul>	<ul style="list-style-type: none"> <li>▪ 17 interviews for 19 participants</li> </ul>	X	X	X	X			X
Moran, C. J. and Brereton, D. (2013)	<ul style="list-style-type: none"> <li>▪ Interviews</li> <li>▪ Focus groups</li> <li>▪ Analysis of complaints</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Muswellbrook, Upper Hunter Valley, NSW</li> <li>▪ 2006</li> </ul>	<ul style="list-style-type: none"> <li>▪ 59 participants</li> </ul>	X	X		X			X
Petrova, S. and Marinova, D. (2013)	<ul style="list-style-type: none"> <li>▪ Self-administered questionnaires</li> <li>▪ Individual interviews</li> <li>▪ Analysis of databases</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Boddington, WA</li> <li>▪ 2010 – 2011</li> </ul>	<ul style="list-style-type: none"> <li>▪ 56 questionnaire respondents</li> <li>▪ 14 interview participants</li> </ul>			X	X			X

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Rolfe, J. and Kinneer, S. (2013)	<ul style="list-style-type: none"> <li>▪ Analysis of quantitative databases</li> <li>▪ Modelling</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Central Queensland</li> <li>▪ 2010</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>			X	X		X	
Schmidt, G. (2015)	<ul style="list-style-type: none"> <li>▪ Case study based on review of literature, press review, database analyses and personal communications</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Wekweètì, Northwest Territories; community of</li> <li>▪ 141 inhabitants</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not mentioned</li> </ul>			X	X		X	
Scott, J., Carrington, K. and McIntosh, A. (2012)	<ul style="list-style-type: none"> <li>▪ Individual or group interviews</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Mining communities, WA</li> <li>▪ Collection period not mentioned</li> </ul>	<ul style="list-style-type: none"> <li>▪ 38 participants</li> </ul>		X	X	X		X	
Shandro et al. (2011)	<ul style="list-style-type: none"> <li>▪ Interviews</li> <li>▪ Participatory observations</li> <li>▪ Documentary research (newspapers and historical records)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Canada</li> <li>▪ Community of Tumbler Ridge, British Columbia</li> <li>▪ May - November</li> <li>▪ 2009</li> </ul>	<ul style="list-style-type: none"> <li>▪ 10 participants</li> </ul>		X	X	X		X	
Suopajarvi et al. (2016)	<ul style="list-style-type: none"> <li>▪ Semi-structured thematic interviews with individuals and groups</li> </ul>	<ul style="list-style-type: none"> <li>▪ Northern Europe and Northeastern Russia</li> <li>▪ Municipalities in Finland, Norway and Sweden</li> <li>▪ Fall 2013 and spring 2014</li> </ul>	<ul style="list-style-type: none"> <li>▪ 85 interviews (half with residents living near an existing or pending mine, the other half with local stakeholders)</li> </ul>	X	X	X	X		X	

**Table 1 Description of the documents selected during quality assessment stage (cont'd)**

Studies	Data collection methods	Country Concerned population Collection period	Sample size	Impacts			Impacts measured	Impacts anticipated	Assessed quality <sup>a</sup>	
				Well-being	Psycho-logical health	Social health			++ <sup>b</sup>	+ <sup>c</sup>
Tonts, M., Plummer, P. and Lawrie, M. (2012)	<ul style="list-style-type: none"> <li>▪ Analysis of databases</li> <li>▪ Modelling and regressions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Mining communities, WA</li> <li>▪ 2006</li> </ul>	<ul style="list-style-type: none"> <li>▪ 33 mining cities</li> </ul>			X	X		X	
Van der Plank, S., Walsh, B. and Behrens, P. (2016)	<ul style="list-style-type: none"> <li>▪ Mixed method (distributed questionnaires combined with interviews)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Australia</li> <li>▪ Stakeholders likely to be affected by the mine located in Horsham, Victoria</li> <li>▪ 2013 - 2015</li> </ul>	<ul style="list-style-type: none"> <li>▪ 97 questionnaire respondents</li> <li>▪ 25 interview participants</li> </ul>			X	X		X	

<sup>a</sup> The quality was assessed on the basis of the following criteria: independence of the authors and funding; presence of clearly defined objectives; a research methodology explicit enough to be replicated; consistency between the objectives and the results; and usefulness for the research.

<sup>b</sup> ++ = quality is excellent.

<sup>c</sup> + = quality is acceptable.



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## **Appendix 4**

**List of the documents rejected  
during quality assessment stage**



Authors	Reasons article was excluded					
	Funding was not independent	Appearance of conflict of interest on part of one or more authors	Imprecise objectives	Methodology absent/methodological problems or publication type not selected (e.g. review of literature)	Results inconsistent with objectives or conclusions (internal validity)	Inadequate based on relevance assessment criteria
Akbar, D., Rolfe, J. and Kabir, S. M. Z. (2013)						X
Austin, K. and Buchan, D. (2016)		X				
Banfield, L. and Jardine, C. G. (2013)						X
Beaudoin-Jobin, C. (2012)		X				
Bice, S. (2013)						X
Brereton et al. (2013)	X					
Brueckner et al. (2013)				X		
Bud et al. (2015)						X
Carney, J. (2015)				X		
Cheshire, L., Everingham, J.-A. and Lawrence, G. (2014)	X					
Cordial, P., Riding-Malon, R. and Lips, H. (2012)				X		
Cottle, D. and Keys, A. (2014)				X		
Czyewski, K. and Tester, F. (2014)						X
Dawson, S. E and Madsen, G. E. (2011)					X	
Degnen, C. (2005)						X
Franklin et al. (2015)						X
Gardner, J.H. and Bell, D. T. (2007)		X				

Authors	Reasons article was excluded					
	Funding was not independent	Appearance of conflict of interest on part of one or more authors	Imprecise objectives	Methodology absent/methodological problems or publication type not selected (e.g. review of literature)	Results inconsistent with objectives or conclusions (internal validity)	Inadequate based on relevance assessment criteria
Grontmij (2013)		X				
Hajkowicz, S. A., Heyenga, S. and Moffat, K. (2011)		X				
Keeling, A. and Sandlos, J. (2009)						X
Kemp et al. (2011)				X		
Kotey, B. and Rolfe, J. (2014)				X		
Langton, M. and Mazel, O. (2008)						X
Lockie et al. (2009)	X					
Loechel, B., Hodgkinson, J. and Moffat, K. (2013)	X					
Martinàt, S. et al. (2014)				X		
Mason, C.M. et al. (2014)		X				
Mayan, O. N. et al. (2006)						X
Michell, G. and McManus, P. (2013)						X
Moffat, K. and Zhang, A. (2014)	X					
Nelsen, J. L., Scoble, M. and Ostry, A. (2010)			X			
Owen, J. R. and Kemp, D. (2015)				X		
Petkova et al. (2009)	X					
Que, S. and Awuah-Offei, K. (2014)	X					



Authors	Reasons article was excluded					
	Funding was not independent	Appearance of conflict of interest on part of one or more authors	Imprecise objectives	Methodology absent/methodological problems or publication type not selected (e.g. review of literature)	Results inconsistent with objectives or conclusions (internal validity)	Inadequate based on relevance assessment criteria
Roberts, J. H. (2009)						X
Rodon, T., Lévesque, F. et Blais, J. (2013)				X		
Rolfe et al. (2007)				X		
Ruddell, R. and Ortiz, N. R. (2015)						X
Smith, A. M., Adams, R. and Bushell, F. (2010)						X
Storey, K. (2010)				X		
Suutarinen, T. (2013)						X
Tarras-Wahlberg, N. H. (2014)						X
Törmä, H., Kujala, S. and Kinnunen, J. (2015)						X
Zhang, A. and Moffat, K. (2015)		X				
Zobrist et al. (2009)						X
<b>TOTAL</b>	<b>7</b>	<b>7</b>	<b>1</b>	<b>11</b>	<b>1</b>	<b>18</b>

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