

Bureau
d'audiences
publiques sur
l'environnement

The Inquiry
Commission's
Guidelines and
Conclusions
from Report 307

Issues relating to shale gas exploration and exploitation in the St. Lawrence Lowlands

Inquiry and Public Hearing Report

TRANSLATION

November 2014

In case of divergence, the French version shall prevail.

The Inquiry Commission's Guidelines and Conclusions

13.1 Issues relating to shale gas exploration and exploitation in the St. Lawrence Lowlands

On January 30, 2014, following on from the work of the Strategic Environmental Assessment (SEA) Committee on Shale Gas, the Bureau d'audiences publiques sur l'environnement (BAPE) was asked by the Minister of Sustainable Development, Environment, Wildlife and Parks to hold an inquiry and public hearings. Specifically, the BAPE was asked to hold public consultations on issues relating to shale gas exploration and exploitation in the St. Lawrence Lowlands Utica shale field, and to report its observations and analysis to the Minister. The BAPE's findings would then be used to fuel Government reflections on the sustainable development of the shale gas energy sector.

The mandate came as part of the debate that has taken place in Québec in the last few years on shale gas exploration and exploitation. The debate is reflected among other things in the 2011 report by the BAPE inquiry commission on sustainable development of the shale gas industry, and in the 2013 SEA studies that were a direct result of the commission's work.

In 2011, the Sustainable Development Commissioner also made a contribution to the debate during his audit of the Government's management of shale gas exploration and exploitation. He recommended the introduction of structural mechanisms and means to ensure that the industry would be developed in compliance with the Sustainable Development Act, and in line with Government guidelines, regional development priorities and the public interest.

One of the goals of the 2006-2015 Energy Strategy was to strengthen and diversify petroleum and natural gas supply security and develop Québec's resource potential. The Québec Commission on Energy Issues, tasked with drawing up a profile of supplies, production, development and consumption for different forms of energy, held consultations and filed its report, entitled *Maîtriser notre avenir énergétique* (Mastering our Energy Future) in January 2014.

The Québec Government's Action Plan on Hydrocarbons was published in May 2014. Among other things, it announced a strategic environmental assessment of the entire hydrocarbon industry, to be followed by a general review and modernization of the legislative and regulatory framework, culminating with the tabling of a draft bill on

hydrocarbons in 2015. The Minister of Energy and Natural Resources also asked the Régie de l'énergie for an opinion on Québec's natural gas supplies.

This inquiry commission's work falls within this general process, which is designed to provide the Government with information as it reflects on the relevance of developing the shale gas industry within the context of sustainable development. Although it has refrained from making assumptions regarding the development of the shale gas industry in Québec, the inquiry commission has nevertheless considered the issues, potential mitigation measures and legislative framework proposals that were considered in SEA studies and addressed in briefs tabled at the public hearings.

Potential impacts on the water resource

Although drilling initially took place in the Utica Shale in the period 2006 to 2010, there is still some uncertainty regarding the resource's gas potential and the volumes that are technically extractable. The density breakdown is not known, meaning that it is not possible to forecast how a shale gas industry might eventually be deployed (it is also subject to other technical and economic requirements). The distribution and density of drilling rigs on constraint-free and as yet non-delimited portions of the territory would, of course, depend on the pace of deployment.

Issues connected with water management and use were one of the main concerns raised at the hearings. The SEA Committee had no information on how the industry would be deployed, and instead prepared a number of development scenarios. According to these scenarios, a future shale gas industry would place significant pressure on watercourses in the St. Lawrence Lowlands, in terms of both water withdrawal and wastewater disposal. During low flow periods, especially in the summer, many watercourses would simply not be able to provide the volumes of water required for hydraulic fracturing and still meet the needs of ecosystems and other users. To obtain an accurate assessment of the watercourses' ability to meet these needs, it would be necessary to calculate spatial distribution, as well as the industry's water withdrawal volumes, duration and periods. If a shale gas industry is eventually developed, this aspect would have to be regulated as part of the authorization process, in line with the principles of prevention and respect for ecosystem load capacity. For regulation to be possible, more information would have to be obtained on the watercourse system to be used by the industry.

According to the SEAs, the risk of groundwater contamination from migration of fracturing fluids through natural faults appears to be low. However, there is still some uncertainty as to the structure of the intermediate layer between the Utica Shale and the shallow aquifers used as drinking water sources, and the existence of channels through which contaminants may potentially migrate. Because of this uncertainty, combined with a lack of knowledge about the composition of fracturing and reflux water, it is not currently possible to assess the level to which the aquifers are vulnerable to this type of contamination. More information on natural fracturing is required.

In 2014, the Geological Survey of Canada began a characterization study of the intermediate layers between the Utica Shale and the shallow aquifers that supply drinking water to many residents of the Lowlands area. However, the study covers only a small portion of the territory. A map of natural faults needs to be prepared for the entire St. Lawrence Lowlands area.

The *Water Withdrawal and Protection Regulation*, adopted in August 2014, prohibits hydraulic fracturing at depths of less than 400 metres under the base of an aquifer. The probability that this activity would generate vertical faults in excess of this length is minimal. However, given the large amount of fracturing that would take place in the event that shale gas is exploited, it is possible that several vertical fractures might exceed the 400 metres distance and breach the aquifers. Accordingly, the Government should increase the vertical distance required between hydraulic fracturing operations and the base of an aquifer, to ensure that they are separated by a sufficiently thick tract of undisturbed rock.

With regard to the industry's wastewater, the inquiry commission notes that there is currently not enough information available to rule with any degree of certainty on its characteristics and the real risk it presents for health and the environment. However, the MDDELCC has targeted a list of contaminants that are potentially harmful to aquatic environments and has set disposal requirements for them. It has also excluded, by regulation, those fracturing inputs that are persistent and bioaccumulable.

Municipal water purification facilities are not designed to treat this type of waste, and other management methods must therefore be used, such as on-rig treatment or dedicated treatment plants. The inquiry commission does not regard injection of the industry's wastewater into deep geological formations as a viable option, given the limited information available on the subsurface and the lack of appropriate regulation.

Reuse of fracturing water, in line with the principle of environmental protection, should be given priority. If the shale gas industry is developed, gas companies, when requesting their certificates of authorization, should be required to present a detailed wastewater management plan, covering the period from raw water withdrawal to treatment and discharge into watercourses, showing that it will reuse as much of the water as possible.

Potential impacts on host communities

The shale gas industry would be deployed in the St. Lawrence Lowlands, an area situated mainly on the south shore of the St. Lawrence River between Québec City and Montreal. Based on the development scenarios used for the SEA, drilling rig density within this area may be quite high, at roughly one rig per 4 km². The rigs would occupy the whole of the territory that is free from legal and regulatory constraints, accounting for roughly 50% of the total area or less, taking into account the requirements of the new *Water Withdrawal and Protection Regulation*.

Shale gas exploration and exploitation activities generate a range of nuisances and impacts, especially during drilling and hydraulic fracturing. Based on the model produced, they would be felt by the occupants of homes and public buildings located several hundred metres from the rigs, even if the most stringent mitigation measures are applied. The intensity of the impacts would depend on the pace at which the activities are deployed.

For example, air quality could be altered even with the application of mitigation measures. Nitrogen dioxide norms could be exceeded up to 300 metres from a rig during hydraulic fracturing. In addition, odours may be noticeable at levels sufficient to trigger complaints at distances of up to 600 metres from the rigs during hydraulic fracturing. As for the noise generated by hydraulic fracturing, it may be in excess of 40 dBA, i.e. the sleep disturbance ceiling, more than four kilometres from the rig, even if mitigation measures are applied.

The SEA did not assess the potential risks to health in the event that the shale gas industry is developed. Research in the United States suggests that the risks may be higher for populations living close to drilling rigs or in those regions where drilling activities are concentrated. Potentially harmful contaminants include nitrogen oxides and sulphur oxides, which are associated with an increase in respiratory problems, and volatile organic compounds, which have mutagenic or carcinogenic effects. More information is needed on the impact these elements may have on human health.

The inquiry commission believes the current minimum distances between drilling rigs and inhabited areas, i.e. 100 metres between a residential or public building and a well, are not sufficient to guarantee the quality of life, health and safety of residents. If the shale gas industry is developed, the authorities concerned should review these regulatory distances to ensure that standards and criteria for residential and public buildings are maintained in real-life operating conditions. The same distances should also apply to farm buildings housing animals.

The inquiry commission believes that drilling, hydraulic fracturing and trucking activities should be prohibited at night. Similarly, flares should not be authorized because they generate light pollution; they should be replaced by incinerators.

Numerous studies have also shown that citizens perceive increased truck traffic as one of the most significant problems associated with the shale gas industry. Each horizontal well may require up to 4,000 return trips, mainly during the drilling and fracturing stages. Increased traffic could also cause road surfaces to deteriorate more quickly, force users to change their travel habits and increase the risk of accidents. Dust and vibration may also become a nuisance. The inquiry commission feels that, if the shale gas industry is developed, all gas companies should be required to submit an assessment of anticipated traffic impacts with their applications for authorization. The assessment should include a map showing the anticipated routes to be used by the trucks, and a description of the current state

of the roads concerned. It should also take into account the potential cumulative impacts in cases where several gas companies are present in a given region.

Lastly, the companies should also be required to sign an agreement covering damage caused to municipal infrastructures. In the case of water transportation, supplies should be piped in rather than brought in by truck, to reduce the volume of traffic on rural roads.

Potential impacts on farming and tourism

Based on the development scenarios used for the SEA, there would be one drilling rig per 4 km², or one rig every three or four farms in rural areas. The potential impacts of shale gas industry activities on water availability, surface water and groundwater quality, air quality, sound levels and vehicular traffic, not to mention accidental wastewater or contaminant spillages, may therefore affect farms.

Farms that sell their products on the mass market, where product evaluation criteria are objective, are less likely to be affected by shale gas industry activities than those that sell their products directly to end users. This latter group may be penalized if consumer perceptions of product quality change as a result of shale gas activities. The reputation effect is primordial, and it is by no means certain that customers would return even if the industry ceased its activities and the situation reverted to its pre-exploration status.

The visual impacts associated with drilling and fracturing facilities, including rigs, are difficult to mitigate in open areas. The presence of shale gas activities may adversely affect the experience of tourists and visitors to the St. Lawrence Lowlands regions, among other things due to the potential impact of the activities on village and countryside landscapes, peace and quiet, air quality, and driving enjoyment and safety on rural roads.

If the shale gas industry is developed, the inquiry commission believes the gas companies, when applying for authorization, should be required to submit an assessment of potential impacts for farms and for tourism and agri-tourism companies. A framework agreement between the Union des producteurs agricoles and the gas companies would help standardize contractual conditions and ensure that appropriate compensation is paid to the farmers concerned.

Protection of natural environments

A further challenge of industry development would be the protection of natural environments and biodiversity. There could be a significant impact on fragmentation of plant and wildlife habitats, compromising the implementation of government policies aimed at controlling loss of forest cover and ensuring ecosystem sustainability in the St. Lawrence Lowlands region. The inquiry commission is of the opinion that, if the shale gas industry is developed, gas companies, when applying for authorization, should be required to submit an assessment of these impacts and

propose mitigation and other measures that would ensure compliance with ecosystem support capacities.

Proposed protected areas, exceptional forest ecosystems, wildlife sanctuaries, biological sanctuaries and wildlife habitats should all be given protected status to prohibit hydrocarbon exploration and exploitation within their boundaries, in line with the principles of protection for biodiversity and respect for ecosystem support capacities.

Greenhouse gas emissions

The inquiry commission notes that greenhouse gas (GHG) emissions associated with shale gas industry activities could potentially increase Québec's emissions budget by an average of 3% (small-scale scenario) to 23.2% (large-scale scenario). It is difficult to assess the net impact that these activities would have for climate change, since it would depend not only on the level of GHG emissions, but also on the substitution effect with different energy sources in Québec and elsewhere in North America.

Fugitive emissions of methane would be responsible for a significant percentage of the industry's budget. Fugitive emissions occurring after well closure were not considered in this estimate. However, they could contribute significantly to GHG emissions, in that only 15% to 20% of the gas would have been extracted when the well is closed.

The inquiry commission notes that, if the shale gas industry is developed, Québec should be able to fulfill its international GHG reduction commitments, given the existence of the GHG emissions trading system that would force the gas companies to purchase allowances equivalent to their total emissions. However, current prices on Québec's carbon market would only cover about 24% of the overall externalities and costs associated with the generation of one tonne of carbon, as estimated by the U.S. Environmental Protection Agency.

Natural and technological risks

The *Regulation respecting petroleum, natural gas and underground reservoirs* states that a well drilling licensee cannot drill within 100 metres of the high water mark. However, past experience with landslides in Québec has shown that this distance is not sufficient to prevent a rig and the workers on it from being swept away.

According to the SEA, the shale gas industry's target area lies within sectors that may be exposed to retrogressive (i.e. large-scale) landslides. The 100 metre distance mentioned in the *Regulation respecting petroleum, natural gas and underground reservoirs* would therefore seem to be insufficient. In the inquiry commission's opinion, there should be no gas wells in any potential landslide zone already identified on a government map. If the area in question is not mapped,

protective strips at the summit and base of the talus, as proposed in the SEA, should be mandatory when facilities are built on sensitive clay.

Large-scale deployment of the shale gas industry in the St. Lawrence Lowlands would present risks for the environment and for human health and safety. Some of these risks are similar to those associated with the conventional natural gas industry, while others are specific to shale gas exploration. The inquiry commission notes that, based on the various simulations performed for the SEA, technological accidents such as blow-outs or explosions of propane reservoirs can injure or kill rig workers and anyone else in the vicinity, up to a distance of more than 300 metres. Accidents such as these can also cause spillage or emission of contaminants, polluting the environment. The inquiry commission believes the minimum distances stipulated in the *Regulation respecting petroleum, natural gas and underground reservoirs* should be reviewed so as to take technological risks into account and protect the health and safety of residents living in the vicinity of the rigs.

Companies engaging in shale gas exploration and exploitation activities are not currently required to produce a risk analysis or emergency plan. In the inquiry commission's view, the technological risk associated with these activities should be subject to the mandatory reporting requirements set out in the *Civil Protection Act*. If the shale gas industry is deployed, the gas companies should be required to submit an emergency plan to the authorities when they apply for authorization. Citizens living in the vicinity of the drilling rigs should be notified of the associated risks and the steps to take in the event of a disaster.

The inquiry commission also believes the \$1 million civil liability insurance coverage currently required by the *Regulation respecting petroleum, natural gas and underground reservoirs* should be increased to a level that covers the actual costs that would be generated by a catastrophic accident on a drilling rig.

Post-closure issues

Cementing quality has been identified as a key element in ensuring the integrity of wells, and a critical factor in determining the extent of gas and liquid leaks. Preserving good quality cementing is a challenge from the standpoint of execution, maintenance and surveillance. Based on the information given to the inquiry commission, the gas industry's ability to guarantee the integrity of its wells in the very long term, and hence to prevent gas and liquid from leaking into aquifers or the atmosphere, has not been proved.

The inquiry commission is of the opinion that the requirements of the *Regulation respecting petroleum, natural gas and underground reservoirs* concerning well construction should be reviewed. In addition, if the shale gas industry is deployed, the companies should be required to submit a long-term well integrity management plan with their applications for authorization, to avoid potential leakage and ensure public safety.

The Government should also ensure that the performance guarantee to be provided by the gas companies is sufficiently high to allow for maintenance and restoration of integrity of wells. Lastly, given that most of the wells will probably outlast the gas companies that drill them, a fund should be created and financed by the industry to cover the costs of any remedial work that may be needed to address leaks from orphan wells.

Benefits and costs for Québec

The inquiry commission notes the absence of evidence to show that shale gas exploration and exploitation in the St. Lawrence Lowlands, using the hydraulic fracturing technique, would be beneficial for Québec. According to the cost-benefit analysis in the SEA, based on current natural gas prices and forecasts for the next 25 years, shale gas operations in the St. Lawrence Lowlands would not be profitable for the industry, and in addition would generate costs and externalities for Québec in excess of the benefits they would bring. In other words, their net social value would be negative.

Even if gas prices rose in the coming years to levels that would allow the industry to make a profit, there is no evidence to show that shale gas exploitation would be beneficial to Québec, given the high level of potential costs and externalities compared to the royalties payable.

The number of jobs associated with the development of 3,600 wells over a 15-year period has been estimated at roughly 8,000 per year. However, it is not possible, based on the information currently available, to establish either the number of jobs created and not simply “maintained” by the shale gas industry, or the number of jobs that would go to Québec workers.

The inquiry commission notes, based on current legislation, that the regions in which shale gas exploration and exploitation would take place would not receive a share of the royalties collected by the Government. The inquiry commission feels that, if the shale gas industry is eventually deployed, a portion of these royalties should be paid back into these regions, to compensate for some of the costs and externalities they would have to bear. Moreover, the Government should pay future royalties from shale gas operations into the Generations Fund, as it does for mining royalties.

The gas resource and the industry

The inquiry commission notes that the estimated volumes of gas that may potentially be recovered from the Utica Shale in the St. Lawrence Lowlands are fairly modest compared to the estimates for gas deposits in many other gas-producing regions of North America. Moreover, some of these reserves (i.e. the major portion of Corridor 1) would probably be exempt from exploitation due to the shallowness of the Utica Shale and new regulatory provisions governing water protection and withdrawal.

In 2013, Gaz Métro, Gazifère and TransCanada Pipelines Limited signed an agreement designed to secure access to gas transportation infrastructures for natural gas imports to Québec. The agreement is subject to approval by the National Energy Board. It provides that Gaz Métro must agree to pay an amount equivalent to the cost of transportation for the gas it distributes, whether or not it uses the Ontario-Québec pipelines. As a result, firms producing gas in Québec would probably not obtain any market proximity benefit and would not, in their gas sale price in Québec, be able to recover part of the amount currently invoiced to consumers for the transportation of gas to Québec.

Lastly, based on the SEA Committee's development scenarios, the volume of natural gas produced in the St. Lawrence Lowlands would exceed Québec's consumption levels for a number of years. A significant portion of the gas produced would therefore have to be exported. Securing access to the transportation infrastructures needed to export the gas would be a challenge.

Social issues

In places where extraction activities have been part of the regional economy for some time, case studies describe local cultures that have accepted and learned to coexist with the industry. This is a reflection not only of the time element and the fact that the activities have become rooted in the community's everyday life, but also of their role in the regional economy. Social acceptability appears to have become anchored in the collective awareness. Social issues are more evident in regions with little or no experience of petroleum or gas activities, as is the case in the St. Lawrence Lowlands.

Many of the comments made to the inquiry commission reflect the participants' worries and frustrations. The participants felt a real sense of powerlessness and dispossession, due mainly to the uncertainty surrounding the industry's future presence on their property and the fact that shale gas prospecting licences have been issued for the entire St. Lawrence Lowlands area. Some people referred to this situation as "the invasive approach by the gas companies". This sense of loss of control over their own space or territory was shared by a number of municipal and regional officers; in their case, the sense of powerlessness stemmed from the fact that the Mining Act takes precedence over the Act respecting land use planning and development.

Many studies report a public loss of trust in the gas companies, due among other things to their lack of transparency, and a loss of trust in Government authorities as a result. At the public hearing, similar concerns were expressed by private citizens, environmental organizations and associations.

Most of the briefs presented at the hearings reflected strong concern about or complete rejection of shale gas operations. Many citizens and municipal officers said they thought shale gas operations should not be permitted unless there was clear proof of social acceptability. They also questioned the best way of defining this aspect.

There is no clear definition of the notion of social acceptability, and people tend to interpret and understand it from their own perspectives. In some cases acceptance will depend on the person's vision of society, while for other people it becomes a means of expressing their concerns about the project's potential impacts on their health and quality of life. Social acceptability is used both to confirm the project's validity and to refuse it.

The Government Action Plan on Hydrocarbons, tabled in May 2014, stipulates that, in the Government's view, exploration and exploitation work must be supported by the communities concerned. However, the concept of social acceptability, the method used to measure it and the level of support required have not yet been clearly established in a way that is agreed upon by all the stakeholders concerned.

The inquiry commission is of the opinion that the Government should stipulate how it defines social acceptability and how it will decide whether or not shale gas industry development is indeed supported by the communities concerned. The commission also believes that a relationship of trust must be re-established between citizens, the industry and the Government authorities as an absolute prerequisite for social acceptance of the industry's activities.

The companies' social responsibility

A transparent approach by a project promoter may be helpful in achieving social consensus, in line with the principle of access to information. One of the main manifestations of transparency is easy access by citizens to appropriate information so that they are able to form an opinion on a project's risks and acceptability. On the other hand, it is not always easy for investors, consumers and citizens to judge the relevance and validity of the information they are given.

It is for this reason that, in recent years, many sector-based associations, international standards organizations and NGOs have proposed different environmental management programs designed to structure the companies' practices. More recently, some organizations have begun to propose corporate social responsibility (CSR) programs that generally include environmental commitments and practices, as well as provisions concerning ethics, stewardship and community relations. In Canada, in the petroleum and gas sectors, the programs or program elements proposed by sector-based associations tend to be limited mainly to environmental management and information disclosure principles and practices.

The inquiry commission is of the opinion that, if the shale gas industry is deployed in Québec, it would be desirable for the gas companies to agree on a shared reference framework for environmental management and social responsibility, so that it is easier for citizens to obtain information. The companies should also ensure that their subcontractors and suppliers adopt similar good practices.

Integrated land planning at regional level

Deployment of the industry, which would occupy a significant portion of the farmland in the St. Lawrence Lowlands region, would place a significant constraint on land use and planning for current activities such as farming, tourism, agri-tourism and vacation development. The inquiry commission notes that land use planning policies and tools, under the responsibility of local authorities, would be inoperable because they are superseded by the *Mining Act* and the *Act respecting land use planning and development*. This could compromise the ability of the regional county municipalities (RCMs) to achieve the goals set by the Government, and may also hinder the introduction of municipal by-laws designed to minimize nuisances caused by the industry's activities. The new legislative framework for land use planning and hydrocarbon operations should grant certain powers to the municipalities, so they are able to structure the industry's development within their territories, in accordance with the principle of subsidiarity.

Another important aspect would be to clearly identify the sectors of the region in which petroleum and gas activities would be prohibited. The inquiry commission believes that, pursuant to the principle of subsidiarity, future hydrocarbon legislation should grant RCMs the power to delimit areas incompatible with gas activities in their land use plan (similar powers are planned for mining projects). Government guidelines specific to gas activities should also be adopted, so that the municipal authorities are better supported on issues relating to territorial planning and development.

The inquiry commission notes that a regional coordination organization, such as a regional land and natural resource commission, may be able to help with regional planning of shale gas industry development. It could, for example, facilitate the production of a comprehensive, integrated plan of gas industry development, particularly with regard to water management, emergency plans and corporate development plans.

Legislative framework

The shale gas industry should not be developed in Québec until an appropriate legislative framework, which also includes local and regional authorities, has been adopted. Specifically, the Québec Government should not allow pilot projects to go ahead until the legislative framework has been updated.

The current review of some major pieces of legislation, including the *Act respecting land use planning and development*, the *Civil Protection Act* and the future *Act respecting hydrocarbons*, provides an opportunity to adjust the framework applicable to shale gas industry activities in a way that would ensure consistency of land planning tools, reduce impacts on citizens' health and quality of life, ensure the safety of people and property, and protect ecosystems and biodiversity.

To clarify the framework applicable to the industry, the inquiry commission is of the opinion that a regulation governing environmental analysis of gas exploration and extraction would be needed. The regulation could include some of the obligations already stipulated in environmental legislation, including the obligation to obtain a certificate of authorization pursuant to section 22 of the Environmental Quality Act, and would formalize the requirements of the provisional guidelines currently used by the MDDELCC. The regulation should set out, in a single text, the nature, scope and extent of the impact assessment to be carried out by every gas company.

In addition, the MDDELCC should require every gas company to group together, within a single application for authorization, an assessment of the anticipated impacts of all its exploration and extraction activities within a given territory, from initial fieldwork to final well closure. The application for authorization should preferably cover several rigs, or all the anticipated development within a given area, so that the cumulative impacts of gas activities can be assessed more accurately.

The inquiry commission is of the opinion that the authorization procedure stipulated in the new regulation should introduce a partnership and cooperation-based approach between the various government departments and agencies concerned, so that their expertise can be used to improve the environmental analysis of gas projects.

Lastly, the inquiry commission reiterates that, before the shale gas industry is deployed in the St. Lawrence Lowlands, a number of social, environmental and economic conditions must be met to ensure that the principles set out in the Sustainable Development Act can truly apply to the industry's development in Québec.

13.2 In Conclusion

Shale gas exploration and exploitation in the St. Lawrence Lowlands area is likely to have some significant impacts for the host communities: degradation of air quality, increased noise, traffic and light pollution, decreased property values in zones located close to the drilling rigs, impacts on landscapes, risk of technological accidents, social impacts and impacts for health. The industry's activities could also have consequences for environmental quality, particularly surface and groundwater quality. In addition, they may affect protected areas and wetlands, and may lead to fragmentation of the forests. The greenhouse gas emissions associated with the industry's activities could exacerbate climate change. Lastly, the presence of exploration activities could have a negative effect on certain economic sectors in the host regions, specifically farming, tourism and agri-tourism.

It is important to remember that, unlike the majority of shale gas producing areas in North America, which are located in sparsely populated regions, the St. Lawrence Lowlands are situated in the heart of Québec's most densely populated and

developed region. The extent of the potential impacts for host communities is due in part to the density of existing developments and uses.

Mitigation measures have been identified for many potential impacts. In some cases, these measures involve practices with which the industry is familiar, or require equipment that is easily obtained. In other cases, however, it would be difficult, if not impossible, even with the most stringent mitigation measures, to ensure compliance with standards; an example would be the noise from drilling and hydraulic fracturing. Some other impacts for residents, local enterprise or the environment cannot be mitigated at all. This would be the case for potential impacts on property values, or impacts for tourism and agri-tourism companies.

Although knowledge levels have progressed in recent years, little is still known about the rock layer situated between the gas shale and the surface aquifers. Further information on this layer is vital in order to assess the potential for contaminant migration into the aquifers. Similarly, the techniques and practices that may be used to ensure proper cementing of gas wells in the short and very long terms are not yet mastered and widely applied. Yet, cementing quality is the main factor in preventing gas or liquid leakages into aquifers or the atmosphere, especially given that at least 80% of the total gas deposit would remain in the Utica Shale after final well closure. More information is required on these issues, and better practices must be introduced to ensure the integrity of wells before fracturing activities are authorized.

It is highly likely that most of the wells will outlast the gas companies that drill them. Even with the creation of a fund, financed by the industry, that will pay for maintenance of and repairs to orphan wells, the risk that disused wells will one day become an environmental liability for Québec is real. Experience elsewhere in Canada has shown that Government authorities are likely to have problems when it comes to rigorous monitoring of leaks from disused wells.

Given current and forecast natural gas prices, the royalties and other financial benefits payable to Québec would be insufficient to compensate for the social and environmental costs and externalities, or even to ensure financial viability for the industry. Even if prices were to increase sufficiently to permit viability in the coming years, there is no evidence to show that the financial benefits for Québec would be great enough to compensate for all the short- and long-term social and environmental costs and externalities.

The inquiry commission notes that the main natural gas supply security issue faced by Québec in the short and medium term is not North American production capability, but access to transportation infrastructures for gas being brought into the province.

Moreover, the inquiry commission has found that social acceptance of shale gas exploration – which the Government, most of the hearing participants and the gas

companies themselves regard as an essential condition to go ahead – is far from being acquired.

In short, given the scope of the potential impacts associated with shale gas industry activities in a sensitive and densely-populated area such as the St. Lawrence Lowlands, and also given the uncertainty surrounding the potential impacts on aquifer water quality and the industry's ability to maintain well integrity over the very long term, the inquiry commission believes it has not been demonstrated that shale gas exploration and extraction in the St. Lawrence Lowlands, using the hydraulic fracturing technique, would be beneficial to Québec.