



NEW BRUNSWICK COMMISSION ON HYDRAULIC FRACTURING – VOLUME III

Compendium of Mitigation Options for Potential Human and Environmental Impacts of Shale Gas Development

FEBRUARY 2016



About Volume III

This volume provides an extensive review of health and environmental impacts associated with various stages of unconventional oil and gas development in New Brunswick. It draws heavily on scientific literature up to December 2015. The Commission recognizes that while this is an extensive review, it is far from exhaustive because of the ongoing emergence of new information regarding the health and environmental impacts of unconventional oil and gas development. It is the Commission's hope that New Brunswick policymakers and regulators will regard this volume as a working document to help guide their deliberations, if the Government decides to proceed with hydraulic fracturing. This volume can and should be refined as new research and knowledge becomes available.

The Commission also recognizes this volume's limits in helping to craft strong public policy and regulations to serve New Brunswick. As we stated in Volume I, the issue of hydraulic fracturing is about more than just science. As Dr. David Wheeler, chair of the Nova Scotia Independent Review Panel on Hydraulic Fracturing told the Commission, "This is about the social construct of risk."

During the course of the Commission's work, this document served as a framework to help the Commission organize its evidence and complete its mandate.

However, it is only one of several information sources contributing to the Commission's findings. This review considers the role of mitigation in reducing the significance of potential health and environmental issues. While mitigation is in many cases both available and legally enforceable, an implicit assumption is that the Government will continue to maintain the political will and the capacity to impose, enforce and monitor compliance with its regulatory regime for unconventional oil and gas development. Another key assumption is that industry will continue its efforts to innovate and evolve to further reduce the environmental footprint of its activities.

A "high" ranking for the significance of an environmental issue following mitigation is not intended to represent a "no-go" decision for unconventional oil and gas development; neither does a "low" ranking indicate that development should proceed. It is the proper role of government to weigh the potential risks and benefits associated with any decisions surrounding unconventional oil and gas development.

Stages and Potential Impacts Associated with Unconventional Oil and Natural Gas Development in New Brunswick

Notes:

- 1) These stages include/encompass all the activities that must be completed in order to bring a new shale gas area into production, and to abandon the facilities after production is over. Individual wells do not necessarily follow all of these stages. For example, once the presence of a resource has been established, the exploration, stratigraphic test well and exploration well stages may not be required.
- 2) This list is intended to identify the most prominent potential impacts associated with each stage, rather than present an exhaustive inventory of all potential impacts.
- 3) This list focuses primarily on biophysical impacts and does not directly address all potential socioeconomic or human health impacts.
- 4) In determining the Potential for Significant Impact in Absence of Mitigation, the highest weighting was given to Probability of Occurrence and Potential Negative Consequences.
- 5) The following abbreviations are used in this document: EIA - environmental impact assessment; DEM - Department of Energy and Mines; DTI - Department of Transportation and Infrastructure; GHG - greenhouse gas; ONGA - New Brunswick's Oil and Natural Gas Act; RFI - New Brunswick's Rules for Industry for oil and natural gas (released in 2013).

LEGEND - For assessment of "Significance Following Mitigation"

Low There is little potential for a significant impact provided that mitigation is in place and all rules and requirements are enforced.

Medium There is moderate potential for significant impact if mitigation and enforcement are in place.

High There is high potential for significant impact. There is insufficient information and further study is required.

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
1) Exploration (Pre-drilling)														
	Issues associated with all activities taking place as part of this stage	Weeks to Months	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Medium	Minor to Moderate	Short to Medium	Small	Medium	Medium	Security and emergency planning	Section 8.1		Low	Security and emergency planning is addressed in RFI and these requirements are implemented under the Authority of the EIA Regulation.
1 a)	Aerial survey (remote sensing)	Weeks	None identified	Low	Minor	Short	Large	Low	Low	None identified	Not Addressed		Low	Activity is addressed under Geophysical Exploration Regulation, ONGA.
1 b)	Soil sampling (geochemical survey)	Weeks to Months	None identified	Low	Minor	Short	Large	Low	Low	None identified	Not Addressed		Low	Activity is addressed under Geophysical Exploration Regulation, ONGA.
1 c)	Deploying geophones and vehicle-mounted vibroseis seismic survey (road allowances)	Weeks	Potential impact of vibration on sensitive structures and land uses	Low	Minor	Short	Small	Low	Low	Set-backs Require a financial security, payable if damage occurs	Section 1.1 Section 10.1		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA.
			Potential impact of vibration on water wells and groundwater quality	Low	Minor	Short	Small	Low	Low	Low	Set-backs Baseline water well testing before seismic survey Resampling of well water after seismic testing Establish a water supply restoration protocol to be implemented if the water supply is impaired	Section 1.1 Section 5.1 Section 5.1, Appendix 9 Section 10.2		Low

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			Road and traffic impacts	Low	Minor	Short	Large	Low	Low	Provide signage, flag persons, etc. Haul route planning Requirements for oversize/overmass loads and weight restrictions	Addressed according to DTI requirements Section 9.2 Section 9.1		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA, DTI requirements and the EIA Regulation.
1 d)	Line cutting	Weeks	Impacts on vegetation and wildlife	Low	Moderate	Medium	Large	Medium	Low	None identified	Not Addressed		Low	
1 e)	Deploying geophones and drilling shot holes for seismic survey (where site is not accessible for vehicle-mounted vibroseis survey)	Days	Potential release of groundwater from shot hole (impact on groundwater quantity)	Low	Minor	Short	Small	Low	Low	Cease drilling and plug the hole if there is a release of groundwater	Section 1.3		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA.
			Potential release of methane from shot hole	Low	Minor	Short	Small	Low	Low	Take steps to confine the gas	Section 1.4		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA.
1 f)	Inserting charge and detonation	Days	Potential impact of vibration on sensitive structures and land uses	Low	Minor	Short	Small	Low	Low	Set-backs Require a financial security, payable if damage occurs	Section 1.1 Section 10.1		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA.
			Potential impact of vibration on water wells and groundwater quality	Low	Minor	Short	Small	Low	Low	Set-backs Baseline water well testing before seismic survey Resampling of well water after seismic testing Establish a water supply restoration protocol to be implemented if the water supply is impaired	Section 1.1 Section 5.1, Appendix 9 Section 5.1, Appendix 9 Section 10.2		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA and the EIA Regulation.
			Potential impact on public safety (unexploded charges)	Low	Moderate to Severe	Medium	Small	Low	Medium	Make an appropriate response in the event of a misfire of the explosive charge	Section 1.6		Low	The required mitigation is appropriate and can be implemented under the existing regulatory framework. Charges require special equipment to detonate.

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
1 g)	Plugging and abandoning shot holes	Days	Potential impact on shallow groundwater	Low	Minor	Short	Small	Medium	Low	Ensure proper plugging and abandonment	Section 1.5		Low	The required mitigation can be implemented under the Geophysical Exploration Regulation, ONGA.
2) Road and Well Pad Construction														
	Issues associated with all activities taking place as part of this stage	Weeks to Months	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Minor to Moderate	Short to Medium	Medium to Large	Medium	Low	Security and emergency planning	Section 8.1		Low	Security and emergency planning is addressed in RFI and these requirements are implemented under the Authority of the EIA Regulation.
			Generic spills and leaks	Medium	Minor to Moderate	Short to Medium	Small	Low	Medium	Spill prevention, reporting and response plans	Section 4.11, Appendix 6		Low	Appropriate mitigation has been incorporated in the RFI and can be implemented under the authority of the EIA Regulation.
			Potential damage to surface property owners due to incidents and accidents	Low	Minor	Short	Small	Low	Low	Collect surface water samples before well pad construction commences Collect surface water samples during and after well construction	Section 5.2, Appendix 10 Section 5.2, Appendix 10		Low	The required mitigation can be addressed under DEM's well licencing requirements.
			Generic impacts on adjacent sensitive land uses (dwellings, schools, etc.), including consideration of the future facilities and activities taking place on roads and well pads (i.e. Stages 3, 4, 5, and 6)	Medium	Moderate to Severe	Long	Small	High	High	Require a financial security, payable if damage occurs	Section 10.1		High	This issue falls within the area of "Social Licence". The required conversation with landowners has not yet occurred.
										Facility siting restrictions	Section 9.7			
										Require strategic planning of infrastructure to avoid sensitive land uses and reduce disturbance	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
2 a)	Land clearing, fill and gravel placement (roads and pads)	Weeks to Months	Potential for erosion and sedimentation during construction and operation	Medium	Moderate	Medium to Long	Medium to Large	High	Medium	Prepare and implement run-off management plan (erosion and sediment controls)	Appendix 7		Medium	Appropriate mitigation has been incorporated in the RFI, however the potential scale of activity means that it is likely that impacts cannot be entirely avoided.
										Run-off management plans for well pads	Section 4.12			
										Collect surface water samples before well pad construction commences	Section 5.2, Appendix 10			
										Collect surface water samples during and after well construction	Section 5.2, Appendix 10			
										Locate well pads on level ground	Section 9.7			

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
Potential for land fragmentation	High	Moderate to Severe	Long	Medium to Large	High	High	Facility siting restrictions Require strategic planning of linear infrastructure to avoid sensitive land uses and reduce land fragmentation and disturbance	Section 9.7 Not Addressed	Yes	Medium	This issue can be mitigated somewhat, but given the nature of the facilities that would be constructed, land fragmentation cannot be avoided. The EIA Regulation grants the authority to implement this requirement.
Potential for wildlife habitat fragmentation	High	Not Fully Known	Long	Medium to Large	High	High	Require strategic planning of linear infrastructure to avoid sensitive land uses and reduce land fragmentation and disturbance Avoid forest fragmentation when siting facilities	Not Addressed Section 9.7	Yes	Medium	This issue can be mitigated somewhat, but given the nature of the facilities that would be constructed, land fragmentation cannot be avoided. The EIA Regulation grants the authority to implement this requirement.
Potential impacts due to flooding (water quality, increased flood elevations) during construction and operation	Low	Moderate	Medium to Long	Small	Medium	Low	Facility siting restrictions Ban on well pads in flood prone areas	Section 9.8 Section 9.8, well pads are currently allowed subject to conditions	Yes	Low	The required mitigation can be implemented under the authority of the EIA Regulation. Under the RFI, specified facilities are not permitted in floodplains. Well pads may be permitted subject to conditions. There is currently no ban on well pads in flood prone areas, however the EIA Regulation gives the authority to impose such a ban.
Potential impacts on surface water quality and wetlands during construction	Medium	Moderate	Medium to Long	Medium to Large	Medium to High	Medium	Facility siting restrictions Collect surface water samples before well pad construction commences Collect surface water samples during and after well construction	Section 9.8 Section 5.2, Appendix 10 Section 5.2, Appendix 10		Low	Appropriate mitigation has been incorporated in the RFI. The required mitigation can be implemented under the authority of the EIA Regulation.
Potential long-term impacts on vegetation, soil, land capability	High	Moderate	Long	Medium to Large	High	High	Record existing site conditions before commencement of construction to guide future site restoration (See also Stage 9 - "Abandonment and Site Restoration")	Appendix 17		Medium	The required mitigation can reduce but not completely eliminate impacts on land capability. (See also Stage 9 - "Abandonment and Site Restoration").

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			Potential for leaks and spills to affect public, communal and individual water supplies	Low	Minor	Long	Small	Medium	Low				Low	The required mitigation can be implemented under the authority of the EIA Regulation.
										Facility siting restrictions and setbacks	Section 9.9, 9.10 (It may be an appropriate time to re-visit the required setbacks based on the latest research and a scan of requirements in other jurisdictions)	Yes		The EIA Regulation grants the authority to implement this requirement.
										Collect baseline samples from adjacent water wells/monitoring wells before well pad construction commences Require mandatory (as opposed to discretionary) installation of monitoring wells adjacent to well pads Establish a water supply restoration protocol to be implemented if the water supply is impaired	Not Addressed Section 10.2	Yes		The EIA Regulation grants the authority to implement this requirement.

3) Stratigraphic Test Well
 Definition: A stratigraphic test well is a well that is drilled in order to identify and evaluate the subsurface geology of an area. It is not used for oil and gas production and does not involve hydraulic fracturing.

Issues associated with all activities taking place as part of this stage	Days	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Minor	Medium	Medium to Large	Medium	Low		Security and emergency planning	Section 8.1		Low	Security and emergency planning is addressed in RFI and these requirements are implemented under the Authority of the EIA Regulation.
		Generic spills and leaks	Low	Minor	Short to Medium	Small	Low	Low		Spill prevention, reporting and response plans	Not addressed for stratigraphic test wells	Yes	Low	The EIA Regulation grants the authority to include this requirement.
		Noise	Medium	Moderate	Short	Small	Low	Medium		Establish appropriate noise level limits	Section 9.4		Medium	EIA conditions and Approval to Operate can require appropriate setbacks and other noise limiting mitigation. While noise can be reduced and kept within accepted threshold limits, it cannot be eliminated.
										Provide resources to allow affected people to relocate temporarily	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
		Potential damage to surface property owners due to incidents and accidents	Low	Minor	Short	Small	Low	Low	Low		Require a financial security, payable if damage occurs	Section 10.1		Low
3 a) Transporting drill rig and drilling equipment to the site	Days	Potential impacts on roads and traffic	Low	Minor	Short	Medium to Large	Low	Low		Requirements for oversize/overmass loads and weight restrictions	Section 9.1		Low	The required mitigation can be implemented in accordance with DTI requirements and under the authority of the EIA Regulation.
										Haul route planning	Section 9.2			

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3 b)	Exterior lighting of work site	Days	Visual impact (dwellings, recreational areas, etc.)	Medium	Moderate	Short	Small	Medium	Medium	Visual impact analysis	Section 9.6		Medium	Potential impacts include those caused by exterior lighting. While the current requirements for mitigation can reduce visual impacts, they cannot eliminate them.

4) Exploration Well Definition: An exploration well is a well that is drilled in or near an area with known or suspected oil or gas potential, in order to further evaluate this potential. It may become a production well, and may be subject to hydraulic fracturing.

Issues associated with all activities taking place as part of this stage	Days to Weeks	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Moderate	Short to Medium	Medium to Large	Medium	Low	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
		Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Moderate	Short to Medium	Medium to Large	Medium	Low	Security and emergency planning	Section 8.1		Low	Security and emergency planning is addressed in RFI and these requirements are implemented under the Authority of the EIA Regulation.
		Generic spills and leaks	Medium	Minor to Moderate	Short to Medium	Small	Medium	Medium	Spill prevention, reporting and response plans Aquifer vulnerability mapping as a management tool to direct spill prevention requirements	Section 4.11, 4.13, 4.17, Appendix 6, Approvals Not Addressed	Yes	Medium	While appropriate mitigation has been included in the RFI, the intensity and duration of activities in this stage increase the potential for leaks and spills.
		Potential impacts on public, communal and individual water supplies	Low	Moderate to Severe	Medium to Long	Small	Medium	Medium	Facility siting restrictions and setbacks Establish a water supply restoration protocol to be implemented if the water supply is impaired	Section 9.9, 9.10 (It may be time to revisit the required setbacks based on the latest research and a scan of requirements in other jurisdictions) Section 10.2	Yes	Medium	The EIA Regulation grants the authority to implement this requirement. Addressed in RFI, EIA Conditions and Wellfield and Watershed Protected Area Designation Orders. While appropriate mitigation has been implemented, the intensity and duration of activities in this stage increase the potential for leaks and spills. The EIA Regulation grants the authority to implement this requirement.
		Noise	High	Moderate to Severe	Short	Small	High	High	Establish appropriate noise level limits Monitor noise and mitigate where necessary Provide resources to allow affected people to relocate temporarily	Section 9.4 Section 9.5 Not Addressed	Yes	Medium	While noise can be reduced using the required mitigation, it cannot be eliminated. The EIA Regulation grants the authority to implement this requirement.
		Potential damage to surface property owners due to incidents and accidents	Low	Minor to Moderate	Short	Small	Low	Low	Require a financial security, payable if damage occurs Require facility operators to have liability insurance	Section 10.1 Section 10.4		Low	The required mitigation as specified in the RFI can be addressed under DEM's well licencing requirements.

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Potential impacts on air quality	Medium	Moderate	Short	Small to Medium	High	Medium	Set emission limits Prepare emission inventory Conduct emission dispersion modelling Conduct air quality monitoring at source Conduct ambient air quality monitoring Require the design and implementation of new monitoring protocols that focus on the information needed to fully capture the data needed to assess impacts of air emission on public health (e.g. implementing real time continuous air quality monitoring; linking monitoring results to atmospheric (weather) conditions; monitoring for a wider range of pollutants; monitoring indoor air quality, etc.) Prepare fugitive emission management plan	Section 7.1 Section 7.2 Section 7.3 Section 7.4 Section 7.5 Not Addressed Section 7.6, Appendix 11	Yes	Medium	Mitigation can reduce emissions but cannot eliminate entirely. Exploratory drilling is of relatively short duration.
Release of greenhouse gases	Medium	Moderate	Short	Large	High	Medium	Prepare greenhouse gas reduction plan Report greenhouse gas emissions Prescribed use of low emission equipment Require a periodic, comprehensive inspection of equipment to locate and address methane leaks Impose greenhouse gas reduction regulations	Section 7.6, Appendix 11 Section 7.6 Not Addressed Not Addressed Not Addressed	Yes Yes Yes	Medium	Mitigation can reduce emissions but cannot eliminate them entirely. Exploratory drilling is of relatively short duration, but there is a potential for cumulative effects.
Potential impacts on roads and traffic	Medium	Moderate	Short	Medium to Large	High	Medium	Requirements for oversize/overmass loads and weight restrictions Haul route planning	Section 9.1 Section 9.2		Medium	The mitigation measures are appropriate but impacts on roads and traffic cannot be avoided. Traffic volumes would likely be much less than during hydraulic fracturing (See Stage 6).
Visual impact (dwellings, recreational areas, etc.)	High	Moderate to Severe	Short	Small	High	High	Visual impact analysis, incineration, use of flare shields Setbacks for flaring	Section 9.6 Section 9.11		Medium	The required mitigation is appropriate however it will not be possible to eliminate visual impacts at work locations visible from public roads or settled areas.

4 a)	Transporting drill rig and drilling equipment to the site	Days
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4 b)	Exterior lighting of work site; gas flaring	Days to Weeks
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4 c)	Well drilling, casing and cementing	Days to Weeks	Potential soil, groundwater and surface water contamination due to leaks and spills at the surface	Low	Moderate	Medium to Long	Small	Medium	Low				Low	The required mitigation can be implemented under the authority of the EIA Regulation.
			Incorporate measures in the well pad to prevent the escape of spills Use closed loop, pitless systems for managing drilling mud Run-off management plans for well pads Secondary containment for storage tanks Avoid use of underground storage tanks at well pads Collect surface water samples during and after well construction	Section 4.1 Section 4.2 Section 4.12 Section 4.17, Appendix 8 Appendix 8		Yes	Revised monitoring protocols can be established under the authority contained in the EIA regulation.							
			Collect water well samples before and after drilling	Section 5.1, Appendix 9										
4 d)	Drilling, casing and cementing	See Stage 5	Potential environmental contamination due to improper disposal of drill cuttings, drilling fluid, etc.	Medium	Moderate	Medium to Long	Small to Medium	Medium	Medium				Low	Appropriate mitigation has been incorporated in the RFI and can be implemented under the authority of the EIA Regulation. This stage does not involve hydraulic fracturing.
			Prepare detailed waste management plan before commencing operations Characterize (analyze) the waste in order to determine disposal options Verify that drill cuttings are uncontaminated prior to on-site disposal or land spreading	Section 4.4, 4.5, Appendix 5 Section 4.5, 4.6 Section 4.7										
4 e)	Hydraulic fracturing and related activities	See Stage 6	See Stage 6					See Stage 6				See Stage 6		
5) Production well Definition: A production well is a well that is drilled within a known, producing oil or gas field in order to produce oil or gas. This well may be subject to hydraulic fracturing.														
Issues associated with all activities taking place as part of this stage	Days to Weeks	→	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Moderate to Severe	Medium to Long	Medium to Large	Medium	Medium				Medium	Security and emergency planning is addressed in RFI and these requirements are implemented under the authority of the EIA Regulation.
			Security and emergency planning	Section 8.1										
			Generic spills and leaks	Medium	Minor to Moderate	Short to Medium	Small	Medium	Medium				Yes	Medium
			Spill prevention, reporting and response plans	Section 4.11, Appendix 6										
			Aquifer vulnerability mapping as a management tool to direct spill prevention requirements	Not Addressed										

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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
Potential impacts on public, communal and individual water supplies	Low	Moderate to Severe	Medium to Long	Small	Medium	Medium				Low	The required mitigation can be implemented under the EIA Regulation and using a Wellfield and Watershed Protected Area Designation Order under the Clean Water Act (for public water supplies).
							Facility siting restrictions and setbacks	Section 9.9, 9.10 (it may be time to revisit the required setbacks based on the latest research and a scan of requirements in other jurisdictions)	Yes		The EIA Regulation grants the authority to implement this requirement.
							Establish a water supply restoration protocol to be implemented if the water supply is impaired	Section 10.2			
Noise	High	Moderate to Severe	Short	Small	High	High				Medium	The required mitigation can be implemented under the authority of the EIA Regulation. While noise can be reduced, it cannot be eliminated.
							Establish appropriate noise level limits	Section 9.4			
							Monitor noise and mitigate where necessary	Section 9.5			
							Provide resources to allow affected people to relocate temporarily	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
Potential damage to surface property owners due to incidents and accidents	Low	Minor to Moderate	Short	Small	Low	Low				Low	The required mitigation can be implemented under the authority of the EIA Regulation.
							Require a financial security, payable if damage occurs	Section 10.1			
							Require facility operators to have liability insurance	Section 10.4			
Potential impacts on air quality	High	Moderate	Long	Small to Medium	High	High				Medium	Mitigation can reduce emissions but cannot eliminate them entirely. There is a potential for cumulative air quality impacts.
							Set emission limits	Section 7.1			
							Prepare emission inventory	Section 7.2			
							Conduct emission dispersion modelling	Section 7.3			
							Conduct air quality monitoring at source	Section 7.4			
							Conduct ambient air quality monitoring	Section 7.5			
							Require the design and implementation of new monitoring protocols that focus on the information needed to fully capture the data needed to assess impacts of air emission on public health (e.g. implementing real time continuous air quality monitoring; linking monitoring results to atmospheric (weather) conditions; monitoring for a wider range of pollutants; monitoring indoor air quality, etc.)	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Prepare fugitive emission management plan	Section 7.6, Appendix 11			

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			Release of greenhouse gases	High	Moderate	Long	Large	High	High	Prepare greenhouse gas reduction plan Report greenhouse gas emissions Prescribed use of low emission equipment Require a periodic, comprehensive inspection of equipment to locate and address methane leaks Impose greenhouse gas reduction regulations	Section 7.6, Appendix 11 Section 7.6 Not Addressed Not Addressed Not Addressed (may be required by federal government in future)	Yes Yes Yes	Medium	Mitigation can reduce emissions but cannot eliminate them entirely. There are no emission limits that specifically target greenhouse gases. The EIA Regulation grants the authority to implement this requirement. The EIA Regulation grants the authority to implement this requirement. The EIA Regulation grants the authority to implement this requirement.
5 a)	Transporting drill rig and drilling equipment to the site	Days	Potential impacts on roads and traffic	Medium	Moderate	Short	Large	High	Medium	Requirements for oversize/overmass loads and weight restrictions Haul route planning	Section 9.1 Section 9.2		Medium	The mitigation measures are appropriate but impacts on roads and traffic cannot be avoided. Traffic volumes would likely be less than during hydraulic fracturing (see Stage 6).
5 b)	Exterior lighting of work site; gas flaring	Days to Weeks	Visual impact (dwellings, recreational areas, etc.)	High	Moderate to Severe	Short	Small	High	High	Visual impact analysis Setbacks for flaring	Section 9.6 Section 9.11		Medium	The required mitigation is appropriate, however it will not be possible to eliminate visual impacts at work locations visible from public roads or settled areas.
5 c)	Drilling surface hole	Days	Potential groundwater impacts before protective casing is installed	Low	Moderate	Short	Small	Medium	Low	Use of prescribed drilling fluid to protect water quality Use of conductor pipe to prevent groundwater infiltration as necessary Don't use recycled "dirty" water for drilling operations until groundwater is protected by the surface casing	Section 2.1 Section 2.6 Section 4.8		Low	Mitigation can be implemented under DEM's well licencing requirements.
5 d)	Installing and cementing surface casing	Days	Potential for future groundwater contamination due to barrier leaks or loss of surface casing integrity	Medium	Moderate	Medium to Long	Small	Medium	Medium	Install a surface casing that extends to a specified depth (i.e. to below the groundwater layer) Isolate the surface casing from the production casing (multi casing) Do not extend the surface casing into zones known to contain shallow gas	Section 2.7 Section 2.7 Section 2.7		Low	Required mitigation is appropriate and can be implemented under DEM's well licencing requirements.

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (<u>Without Mitigation</u>)	Potential Negative Consequences of Occurrence (<u>Without Mitigation</u>)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
										Make sure the surface casing cement is installed as soon as possible Require that the conductor casing be cemented to its full length Require that surface casing be cemented along its entire length Specify a minimum cement volume Verify location of top of cement; remedial cementing if necessary Mandatory wait period before disturbing cement Cement evaluation and testing Require qualified professional to witness cementing	Section 2.7, 2.13 Section 2.12 Section 2.13 Section 2.13 Section 2.16 Section 2.17 Section 2.18 Section 2.19			
5 e)	Drilling vertical and horizontal component of well bore and installing intermediate and production casing and cement	Days to Weeks	Potential for blow-out (uncontrolled release of gas or fluids)	Low	Moderate to Severe	Medium to Long	Small	Low	Medium	Use of conductor casing to facilitate well control Use of certified well control personnel Install remotely activated blowout preventer and other blowout prevention requirements	Section 2.6 Section 2.26 Section 2.27, 2.28	Yes	Low	The required mitigation is appropriate and can be implemented under DEM's current well licencing requirements.
			Potential soil, groundwater and surface water contamination due to leaks and spills at the surface	Medium	Moderate	Medium to Long	Small	Medium	Medium	Incorporate measures in the well pad to prevent the escape of spills Use closed loop, pitless systems for managing drilling fluid Run-off management plans for well pads Secondary containment for storage tanks Avoid use of underground storage tanks at well pad Collect surface water samples during and after well construction Collect water well samples before and after drilling	Section 4.1 Section 4.2 Section 4.12 Section 4.17, Appendix 8 Appendix 8 Section 5.2, Appendix 10 (Monitoring protocols should be clarified as to the monitoring location, frequency, duration and target parameters.) Section 5.1, Appendix 9	Yes	Medium	While appropriate mitigation has been implemented, the intensity and duration of activities in this stage increase the potential for leaks and spills. This stage does not involve the use of hydraulic fracture fluids.
			Potential for future groundwater contamination due to barrier leaks or loss of well bore integrity						See Stages 6 and 8					See Stages 6 and 8

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
			Potential environmental contamination due to improper disposal of drill cuttings, drilling fluid, etc.	Medium	Moderate	Medium to Long	Small to Medium	Medium	Medium	Prepare detailed waste management plan before commencing operations Characterize (analyze) the waste in order to determine disposal options Verify that drill cuttings are uncontaminated prior to onsite disposal or land spreading	Section 4.4, 4.5, Appendix 5 Section 4.5, 4.6 Section 4.7		Low	The required mitigation measures are appropriate and can be implemented under the authority of the EIA Regulation. (See also Stage 6 - Hydraulic Fracturing).
5 f)	Hydraulic fracturing and related activities	See Stage 6	See Stage 6						See Stage 6				See Stage 6	
5 g)	Install permanent wellhead equipment and battery	Days (Facility in place for years)	Visual impact (dwellings, recreational areas, etc.)	Low	Minor	Long	Small	Medium	Low	Visual impact analysis	Section 9.6		Low	Well head equipment is minimal in size and extent.
			Potential impacts due to flooding, potential impacts on surface water quality and wetlands	Medium	Moderate	Long	Small to Medium	Low	Medium	Facility siting restrictions and setbacks Ban on well pads in flood prone areas	Section 9.8 Section 9.8. Well pads are currently allowed, subject to conditions	Yes	Low	Under the RFI, specified facilities are not permitted in floodplains. Well pads may be permitted subject to conditions. There is currently no ban on well pads in flood prone areas, however the EIA Regulation gives the authority to impose such a ban.
6) Hydraulic fracturing														
	Issues associated with all activities taking place as part of this stage	Days	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Moderate to Severe	Medium to Long	Medium to Large	Medium	Medium	Security and emergency planning	Section 8.1		Medium	Addressed under the RFI. The EIA Regulation grants the authority to implement these requirements.
			Generic spills and leaks	Medium	Minor to Moderate	Short to Medium	Small	Medium	Medium	Spill prevention, reporting and response plans Aquifer vulnerability mapping as a management tool to direct spill prevention requirements	Section 4.11, Appendix 6 Not Addressed	Yes	Low	Required mitigation is appropriate. Addressed under the RFI. The EIA Regulation grants the authority to implement these requirements.
			Potential impacts on public, communal and individual water supplies	Low	Moderate to Severe	Medium to Long	Small	Medium	Medium	Facility siting restrictions and setbacks Establish a water supply restoration protocol to be implemented if the water supply is impaired	Section 9.9, 9.10. It may be time to revisit the required setbacks based on the latest research and a scan of requirements in other jurisdictions Section 10.2	Yes	Medium	The required mitigation can be implemented under the authority of the EIA Regulation and Wellfield and Watershed Protected Area Designation Orders. While appropriate mitigation has been implemented, the intensity and duration of activities in this stage increase the potential for leaks and spills. The EIA Regulation grants the authority to implement these requirements.

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
Noise (including transportation component)	High	Moderate to Severe	Short	Medium to Large	High	High				High	The required mitigation can be implemented under the authority of the EIA Regulation. While noise can be reduced and kept within accepted threshold limits, it cannot be eliminated. Transportation-related noise may impact extensive areas.
							Establish appropriate noise level limits	Section 9.4			
							Monitor noise and mitigate where necessary	Section 9.5			
							Provide resources to allow affected people to relocate temporarily	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
Potential impacts on air quality	High	Moderate to Severe	Short	Small to Medium	High	High				High	The required mitigation can reduce emissions but cannot eliminate them entirely. There is a potential for cumulative air quality impacts especially emissions from vehicles. The intensity of emissions would likely be increased due to the need to power hydraulic fracturing equipment (pumps, trucks to haul water and wastewater) using diesel fuel.
							Set emission limits	Section 7.1			
							Prepare emission inventory	Section 7.2			
							Conduct emission dispersion modelling	Section 7.3			
							Conduct air quality monitoring at source	Section 7.4			
							Conduct ambient air quality monitoring	Section 7.5			
							Require the design and implementation of new monitoring protocols that focus on the information needed to fully capture the data needed to assess impacts of air emission on public health (e.g. implementing real time continuous air quality monitoring; linking monitoring results to atmospheric (weather) conditions; monitoring for a wider range of pollutants; monitoring indoor air quality, etc.)	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Prepare fugitive emission management plan	Section 7.6, Appendix 11			
							Require that flowback be stored in covered tanks (no pits)	Section 4.8			
Release of greenhouse gases	High	Moderate	Short	Large	High	High				Medium	Mitigation can reduce emissions but cannot eliminate them entirely. There is an absence of emission limits that specifically target greenhouse gases.
							Prepare greenhouse gas reduction plan	Section 7.6, Appendix 11			
							Report greenhouse gas emissions	Section 7.6		Yes	The EIA Regulation grants the authority to implement this requirement.
							Prescribed use of low emission equipment	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Require a periodic, comprehensive inspection of equipment to locate and address methane leaks	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Impose greenhouse gas reduction regulations	Not Addressed (may be required by federal government in future)	Yes		The EIA Regulation grants the authority to implement this requirement.

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			Potential damage to surface property owners due to incidents and accidents	Low	Minor to Moderate	Short	Small	Low	Low	Require a financial security, payable if damage occurs Require facility operators to have liability insurance	Section 10.1 Section 10.4		Low	The required mitigation can be addressed under the authority of the EIA Regulation and DEM legislation.
6 a)	Exterior lighting of work site	Days	Visual impact (dwellings, recreational areas, etc.)	High	Moderate to Severe	Short	Small	High	High	Visual impact analysis, flare shields, incineration	Section 9.6		Medium	The required mitigation is appropriate however it will not be possible to eliminate visual impacts at work locations visible from public roads or settled areas.
6 b)	Water sourcing and extraction	Days to Weeks	Potential impact of large scale water withdrawals on other water users and the environment	Medium	Moderate	Short	Medium to Large	High	Medium	Require justification for not using a waterless hydraulic fracturing fluid Use recycled flowback or produced water where possible Develop a water management plan Use non-potable water where possible Use ocean water or deep, saline groundwater where possible Assess the sustainability of the proposed water supply If surface water is used, leave enough water for other users, and enough to maintain aquatic habitat Monitor, record and report water use	Section 6.1 Section 4.8, 6.2 Section 6.1 Section 6.3 Section 6.3 Section 6.4 Section 6.4 Section 6.5		Low	The required mitigation is appropriate and can be implemented under the authority of the EIA Regulation.
6 c)	Transportation of road-mounted hydraulic fracturing equipment and related materials to and from the site (including water and wastewater)	Days	Potential soil, groundwater and surface water contamination due to leaks and spills during transportation	Low	Moderate	Short to Medium	Medium to Large	Medium	Low	Provisions for transportation of dangerous goods Security and emergency planning Spill prevention, reporting and response plans	Section 4.14 Section 8.1 Section 4.11, Appendix 6		Low	The required mitigation can be implemented under the authority of the EIA Regulation.

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
Potential impacts on roads and traffic	High	Moderate to Severe	Short	Medium to Large	High	High				High	The required mitigation can reduce impacts but they cannot be avoided. There is a potential for cumulative effects.
							Requirements for oversize/overmass loads and weight restrictions	Section 9.1			
							Haul route planning (to avoid sensitive areas such as school zones, etc.)	Section 9.2			
							Road use agreements and road system integrity studies	Section 9.2			
							Increased vehicle inspections	Not Addressed (may be implemented at the discretion of DTI through EIA)	Yes		The EIA Regulation grants the authority to implement this requirement.
							Limit truck travel to the closest destination (i.e. the closest available water source and waste treatment facility)	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Require on-site recycling of wastewater to reduce the number of truck trips	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Encourage the use of temporary pipelines to transport water	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
6 d) Mixing of water and hydraulic fracturing fluid components on site; fracture fluid storage	Hours to Days	Potential soil, groundwater and surface water contamination due to leaks and spills at the surface	Medium	Moderate	Short to Medium	Small	Low	High		High	There is uncertainty regarding the ability to assess chemicals based on potential human physiological impact resulting from exposure.
							Incorporate measures in the well pad to prevent the escape of spills	Section 4.1			
							Secondary containment for storage tanks	Section 4.17, Appendix 8			
							Run-off management plans for well pads	Section 4.12			
							Special provisions for chemical management	Section 4.13, 4.15			
							Special provisions to control site access and ensure secure storage	Section 4.16			
							Collect baseline samples from adjacent water wells/monitoring wells before well pad construction commences	Section 5.1, Appendix 9			
							Require mandatory (as opposed to discretionary) installation of monitoring wells adjacent to well pads	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Collect surface water samples during and after well construction	Section 5.2, Appendix 10 (Monitoring protocols should be clarified as to the monitoring location, frequency, duration and target parameters)	Yes		The EIA Regulation grants the authority to implement this requirement.
							Ban the use of specified toxic compounds in hydraulic fracture fluids (e.g. BTEX)	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Disclosure and risk assessment for fracture fluid	Section 11.3			

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6 e)	Casing perforation	Hours to Days	Potential for perforation to take place outside the intended extraction zone (e.g. within a groundwater layer) due to operator error	Low	Moderate to Severe	Medium to Long	Small to Medium	Low	Low	Proper training and supervision of well completion staff	Section 2.26		Low	
6 f)	Pumping of fracture fluid under pressure, to the perforation site in well bore	Hours to Days	Potential for unintended induced seismicity (earthquakes)	Low	Minor to Moderate	Short	Small to Medium	Medium	Low	Assess potential for induced seismic activity prior to hydraulic fracturing Consider potential for induced seismicity in evaluating potential well locations Take appropriate action if induced seismicity exceeds pre-determined limits Follow new guidance being developed by the BC Oil and Gas Commission and the Geological Survey of Canada Other potential mitigative options include: a) pumping of successive stages at reduced volumes; b) skipping a next stage; c) delay of further pumping until seismicity subsides; and d) potentially redesigning the perforation clusters to allow pumping at lower rates and volumes Establish a baseline record of seismic activity, in advance of the introduction of hydraulic fracturing to help detect future changes in the seismic regime	Section 9.14 Section 9.14 Section 9.14 Not Addressed Not Addressed Not Addressed	Yes Yes Yes	Low	The implemented mitigation further reduces the probability of this occurrence. Additional mitigation is also available as noted below. The EIA Regulation grants the authority to implement this requirement. The EIA Regulation grants the authority to implement this requirement. The EIA Regulation grants the authority to implement this requirement.
			Potential for cementing or casing failure leading to barrier leaks or loss of well bore integrity. (See also Stage 8)	Medium	Moderate to Severe	Medium to Long	Small	High	High	Implementation of "minimum barrier protection" concept (overlapping layers of casing) Establish casing specifications (material, joints, pressure rating etc.) Surface casing and cement not to be exposed to any hydraulic fracturing pressure Install intermediate or production casing Pressure testing of well casing and surface equipment prior to hydraulic fracturing Operator to complete pre-fracture checklist and certification prior to hydraulic fracturing	Section 2.8 Section 2.5 Section 2.8 Section 2.9 Section 2.21 Section 2.23		High	While the required mitigation is appropriate and NB's two barrier requirement reduces leak potential, there is uncertainty regarding how best to reduce long-term risk of leaks (see also Stage 8).

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										<p>Keep hydraulic fracturing pressure below the test pressure of any given component</p> <p>Terminate hydraulic fracturing under prescribed conditions (e.g. if there is a loss of pressure or the test pressure is exceeded)</p> <p>Cease activities and plug well if operator cannot effect a repair</p> <p>Collect baseline samples from adjacent water wells/monitoring wells before well pad construction commences</p> <p>Require mandatory (as opposed to discretionary) installation of monitoring wells adjacent to well pads</p> <p>Resampling of water wells and monitoring wells after completion of hydraulic fracturing</p> <p>Ban the use of specified toxic compounds in hydraulic fracture fluids (e.g. BTEX)</p> <p>Conduct long-term groundwater monitoring program to detect long-term groundwater impacts</p> <p>Require the use of specific, advanced monitoring techniques such as spectral noise logging, high precision temperature logging, and fiber-optic distributed acoustic sensing to detect and locate leaks during the lifetime of the well</p> <p>See also Stage 8</p>	<p>Section 2.24</p> <p>Section 2.24</p> <p>Section 2.25</p> <p>Section 5.1, Appendix 9</p> <p>Not Addressed</p> <p>Section 5.1, Appendix 9</p> <p>Not Addressed</p> <p>Not Addressed</p> <p>Not Addressed</p>	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p>	<p>The EIA Regulation grants the authority to implement this requirement.</p> <p>EIA Regulation provides the authority to implement this requirement.</p> <p>EIA Regulation provides the authority to implement this requirement.</p> <p>The EIA Regulation grants the authority to implement this requirement.</p>	
			Potential soil, groundwater or surface water contamination due to failure of hydraulic fracturing equipment at the surface	Medium	Moderate to Severe	Short to Medium	Small	Medium	High				High	There is uncertainty regarding the ability to assess chemicals based on potential human physiological impact resulting from exposure.
										<p>Pressure testing of surface equipment prior to hydraulic fracturing</p> <p>Operator to complete pre-fracture checklist and certification prior to hydraulic fracturing</p> <p>Keep hydraulic fracturing pressure below the test pressure of any given component</p> <p>Terminate hydraulic fracturing under prescribed conditions (e.g. if there is a loss of pressure or the test pressure is exceeded)</p> <p>Have measures in place for emergency containment of hydraulic fracture fluid (diversion valves, tanks, vacuum trucks, etc.)</p>	<p>Section 2.21</p> <p>Section 2.23</p> <p>Section 2.24</p> <p>Section 2.24</p> <p>Section 4.3</p>			

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
							Ban the use of specified toxic compounds in hydraulic fracture fluids (e.g. BTEX)	Not Addressed	Yes		EIA Regulation provides the authority to implement this requirement.
							Disclosure and risk assessment for fracture fluid	Section 11.3			
							Collect surface water samples during and after well construction	Section 5.2, Appendix 10 (Monitoring protocols should be clarified as to the monitoring location, frequency, duration and target parameters)	Yes		The EIA Regulation grants the authority to implement this requirement.
Potential soil, groundwater or surface water contamination due to connection of the well bore to an adjacent well	Low	Moderate to Severe	Medium to Long	Small to Medium	Low	Low				Low	The required mitigation can be implemented under the authority of the EIA Regulation and DEM's well licencing requirements.
							Make contact with adjacent operators and notify them of hydraulic fracturing	Section 2.22			
							Assess potential for inter-well bore communication between the stimulated well and adjacent (active or abandoned) wells	Section 3.1			
							Take appropriate action if potential for inter-wellbore communication is found to exist	Section 3.1			
Potential groundwater contamination due to inadequate geological containment	Low	Moderate to Severe	Medium to Long	Small to Medium	High	Medium				Low	The required mitigation is appropriate and can be implemented under the authority of the EIA Regulation and DEM's well licencing requirements.
							Assess geologic containment prior to hydraulic fracturing	Section 3.2			
							Conduct an analysis of the results of the hydraulic fracturing	Section 3.3			
							Prohibit "shallow" hydraulic fracturing	Section 3.4			
							Prohibit hydraulic fracturing within potable (non-saline) groundwater zones	Section 3.4			
							Collect baseline samples from adjacent water wells/monitoring wells before well pad construction commences	Section 5.1, Appendix 9			
							Require mandatory (as opposed to discretionary) installation of monitoring wells adjacent to well pads	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Conduct long-term water well monitoring program to detect long-term groundwater impacts	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.

6 g) Monitoring of fracturing progress (via pressure variations, geophones)	Hours
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None identified	None identified	Not Addressed
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Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
6 h)	Flowback recovery and storage	Days to Weeks	Potential soil, groundwater and surface water contamination due to leaks and spills at the surface	Medium	Moderate	Short to Medium	Small	Low	Medium	<p>Incorporate measures in the well pad to prevent the escape of spills</p> <p>Require that flowback be stored in covered tanks (no pits)</p> <p>Require secondary containment for flowback storage tanks</p> <p>Avoid use of underground storage tanks at well pad</p> <p>Limit the duration of onsite storage of flowback</p> <p>Collect baseline samples from adjacent water wells/monitoring wells before well pad construction commences</p> <p>Require mandatory (as opposed to discretionary) installation of monitoring wells adjacent to well pads</p> <p>Collect surface water samples during and after well construction</p>	<p>Section 4.1</p> <p>Section 4.8</p> <p>Section 4.8, 4.17, Appendix 8</p> <p>Appendix 8</p> <p>Section 4.8</p> <p>Section 5.1, Appendix 9</p> <p>Not Addressed</p> <p>Section 5.2, Appendix 10 (Monitoring protocols should be clarified as to the monitoring location, frequency, duration and target parameters)</p>	<p>Yes</p> <p>Yes</p>	Low	<p>The required mitigation is appropriate. These requirements can be imposed under the authority of the EIA Regulation.</p> <p>The EIA Regulation grants the authority to implement this requirement.</p> <p>The EIA Regulation grants the authority to implement this requirement.</p>
6 i)	Flowback treatment and disposal	Days to Weeks	Potential environmental contamination due to improper treatment or disposal	High	Moderate to Severe	Long	Medium to Large	High	High	<p>Prepare detailed waste management plan before commencing operations</p> <p>Characterize (analyze) the waste in order to determine disposal options</p> <p>Place restrictions on on-site disposal</p> <p>Require that flowback be treated or disposed of in accordance with an approved waste management plan</p> <p>Test flowback for naturally occurring radioactive materials and ensure appropriate disposal</p> <p>Do not allow disposal of flowback at waste treatment facilities that are not designed to fully treat this material</p>	<p>Section 4.4, 4.5, Appendix 5</p> <p>Section 4.5, 4.6</p> <p>Section 4.7</p> <p>Section 4.8</p> <p>Section 4.9</p> <p>Section 4.10</p>		Medium	Addressed under the RFI. These requirements can be imposed under the authority of the EIA Regulation. The potential large volumes of wastewater (in future) and the current lack of disposal options within the province mean that although wastewater has been treated appropriately to date, there remains a moderate potential for significant impact in the long term.

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
							Require downstream water quality monitoring for any waste treatment facility that discharges to surface water Recycle flowback and produced water where possible Develop a comprehensive provincial policy paper on wastewater disposal options for New Brunswick supported by estimates of volumes and characteristics of wastewater based on a number of potential oil and gas development scenarios (well numbers, well locations etc.)	Section 4.10 Section 4.8, 6.2 Not Addressed	Yes		Government initiative or policy is required.
Potential induced seismicity associated with subsurface disposal	Low	Moderate to Severe	Short	Small to Medium	Medium	Medium				Low	As a matter of policy this activity currently not allowed in NB.
							Ban subsurface disposal	Not Addressed	Yes		It has not yet been determined if New Brunswick geology would allow sub-surface disposal. This potential has not been thoroughly assessed and subsurface disposal may not be physically possible. Additional scientific information is required. The issue of potential wastewater disposal by deep well injection in New Brunswick could be addressed within the context of a policy paper on wastewater treatment and disposal options for New Brunswick. A ban on subsurface wastewater injection could be implemented under the authority of the EIA Regulation.
							Seismic monitoring with action plan to be implemented in the event that a predefined level of seismic activity is exceeded	Not Addressed (see above)	Yes		See above comment.

7) Shutting in the well until production infrastructure is established

Issues associated with all activities taking place as part of this stage

Months to Years



Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Moderate	Long	Small	Medium	Low					
							Security and emergency planning	Section 8.1			
Generic spills and leaks	Medium	Minor to Moderate	Short to Medium	Small	Medium	Medium					
							Spill prevention, reporting and response plans	Section 4.11, Appendix 6			
Potential damage to surface property owners due to incidents and accidents	Low	Minor	Short	Small	Low	Low					
							Require a financial security, payable if damage occurs Require facility operators to have liability insurance	Section 10.1 Section 10.4			

Low Security and emergency planning is addressed in RFI and these requirements are implemented under the authority of the EIA Regulation.

Low The required mitigation is appropriate. These requirements can be imposed under the authority of the EIA Regulation.

Low The required mitigation can be implemented under the authority of the EIA Regulation and DEM's well licencing requirements.

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
7 a)	Close off and secure wellhead	Days	Potential groundwater contamination, threats to public safety and air quality impacts due to leaks in the well bore	Medium	Moderate	Long	Small to Medium	High	Medium	Well integrity monitoring Establish requirements for surface casing vent flow and gas migration testing, reporting and repair Require the use of specific, advanced monitoring techniques such as spectral noise logging, high precision temperature logging, and fiber-optic distributed acoustic sensing to detect and locate leaks during the lifetime of the well Establish requirements for investigation and notification for casing vent flow, gas migration and stray gas	Section 5.3 Appendix 2, Appendix 4 Not Addressed Section 2.29	Yes	Low	The required mitigation is appropriate. These requirements can be imposed under the authority of the EIA Regulation and DEM legislation. The EIA Regulation grants the authority to implement this requirement.
8) Gas / Oil production														
	Issues associated with all activities taking place as part of this stage	Years	Potential emergencies and threats (natural hazards, accidents, deliberate threats, etc.)	Low	Moderate to Severe	Medium to Long	Small to Medium	Medium	Medium	Security and emergency planning	Section 8.1		Low	The required mitigation is appropriate. Security and emergency planning is addressed in RFI and these requirements are implemented under the Authority of the EIA Regulation.
			Generic spills and leaks	Medium	Minor to Moderate	Short to Medium	Small	Medium	Medium	Spill prevention, reporting and response plans	Section 4.11, Appendix 6		Low	The required mitigation is appropriate and can be implemented under the authority of EIA Regulation.
			Potential damage to surface property owners due to incidents and accidents	Low	Minor to Moderate	Medium to Long	Small to Medium	Low	Low	Require a financial security, payable if damage occurs Require facility operators to have liability insurance	Section 10.1 Section 10.4		Low	The required mitigation can be implemented under the authority of the EIA Regulation and DEM's well licencing requirements.
			Generic impact of facilities (compressor stations, etc.) on adjacent sensitive land uses	High	Moderate to Severe	Long	Small	High	High	Facility siting restrictions and setbacks Reduce potential land use conflicts by strategic infrastructure planning	Section 9.7, 9.11 Not Addressed	Yes	High	This issue falls within the area of social licence. The required conversation with landowners has not yet occurred. EIA Regulation grants the authority to implement this requirement.
8 a)	Construction and operation of gathering lines	Months (Construction) Years (Operation)	Land fragmentation, habitat fragmentation	High	Moderate to Severe	Long	Medium to Large	High	High	Require linear infrastructure to follow existing road allowances and right-of-ways Require strategic planning of linear infrastructure to avoid sensitive land uses and minimize disturbance	Not Addressed Not Addressed	Yes Yes	Medium	This issue can be mitigated somewhat, but given the nature of the facilities that would be constructed, land fragmentation cannot be avoided. The EIA Regulation grants the authority to implement this requirement. The EIA Regulation grants the authority to implement this requirement.

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
			Potential impacts due to flooding, potential impacts on surface water quality and wetlands	Medium	Moderate	Long	Small to Medium	High	Medium				Low	The required mitigation is appropriate and can be implemented under the Clean Water Act.
										Permits required within 30 meters of a watercourse or regulated wetland	Section 9.8	Yes		The EIA Regulation grants the authority to implement this requirement.
										Require strategic planning of linear infrastructure to avoid sensitive land uses and minimize disturbance	Not Addressed			
			Potential impacts on public, communal and individual water supplies	Low	Moderate to Severe	Medium to Long	Small to Medium	Medium	Medium				Low	The required mitigation is appropriate and can be implemented under the authority of the EIA Regulation.
										Facility siting restrictions and setbacks	Section 9.9			
										Establish a water supply restoration protocol to be implemented if the water supply is impaired	Section 10.2			
										Require strategic planning of linear infrastructure to avoid sensitive land uses and minimize disturbance	Not Addressed	YES		The EIA Regulation grants the authority to implement this requirement.
8 b)	Construction and operation of gas treatment facilities	Months (Construction) Years (Operation)	Potential impacts on air quality	Medium	Moderate	Long	Small to Medium	High	Medium				Medium	Mitigation can reduce emissions but cannot eliminate them entirely. There is a potential for cumulative air quality impacts.
										Set emission limits	Section 7.1			
										Prepare emission inventory	Section 7.2			
										Conduct emission dispersion modelling	Section 7.3			
										Conduct air quality monitoring at source	Section 7.4			
										Conduct ambient air quality monitoring	Section 7.5			
										Require the design and implementation of new monitoring protocols that focus on the information needed to fully capture the data needed to assess impacts of air emission on public health (e.g. implementing real time continuous air quality monitoring; linking monitoring results to atmospheric (weather) conditions; monitoring for a wider range of pollutants; monitoring indoor air quality, etc.)	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
										Prepare fugitive emission management plan	Section 7.6, Appendix 11			
			Release of greenhouse gases	Medium	Moderate	Long	Large	High	Medium				Medium	Mitigation can reduce emissions but cannot eliminate them entirely. There are no emission limits that specifically target greenhouse gases.
										Prepare greenhouse gas reduction plan	Section 7.6, Appendix 11			
										Report greenhouse gas emissions	Section 7.6	Yes		EIA Regulation grants the authority to implement this requirement.
										Prescribed use of low emission equipment	Not Addressed	Yes		EIA Regulation grants the authority to implement this requirement.
										Require a periodic, comprehensive inspection of equipment to locate and address methane leaks	Not Addressed	Yes		EIA Regulation grants the authority to implement this requirement.

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
							Impose greenhouse gas reduction regulations	Not Addressed (may be required by federal government in future)	Yes		EIA Regulation grants the authority to implement this requirement.
Noise	Medium	Moderate	Long	Small	Low	Medium				Medium	EIA Regulation can be used to require appropriate setbacks and other noise limiting mitigation. While noise can be reduced, it cannot be eliminated.
							Establish appropriate noise level limits	Section 9.4			
							Monitor noise and mitigate where necessary	Section 9.5			
							Special provisions to address low frequency noise	Section 9.5			
Visual impact (dwellings, recreational areas, etc.)	Medium	Moderate	Long	Medium to Large	Medium	Medium				Low	The required mitigation is appropriate and can be implemented under the authority of the EIA Regulation.
							Visual impact analysis	Section 9.6			
Potential impacts due to flooding, potential impacts on surface water quality and wetlands	Low	Moderate	Long	Small	Low	Low				Low	The required mitigation can be implemented under the authority of the EIA Regulation.
							Facility siting restrictions - no gas treatment plants allowed in flood prone areas	Section 9.8			
Potential impacts on public, communal and individual water supplies	Low	Moderate	Medium to Long	Small	Low	Low				Low	The required mitigation can be implemented under the authority of the EIA Regulation.
							Facility siting restrictions and setbacks	Section 9.9, 9.11			
Potential impacts on air quality	High	Moderate to Severe	Long	Small	High	High				High	Mitigation can reduce emissions but cannot eliminate them entirely. There is a potential for long-term cumulative air quality impacts.
							Set emission limits	Section 7.1			
							Prepare emission inventory	Section 7.2			
							Conduct emission dispersion modelling+M509	Section 7.3			
							Conduct air quality monitoring at source	Section 7.4			
							Conduct ambient air quality monitoring	Section 7.5			
							Require the design and implementation of new monitoring protocols that focus on the information needed to fully capture the data needed to assess impacts of air emission on public health (e.g. implementing real time continuous air quality monitoring; linking monitoring results to atmospheric (weather) conditions; monitoring for a wider range of pollutants; monitoring indoor air quality, etc.)	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
							Prepare fugitive emission management plan	Section 7.6, Appendix 11			
							Setbacks specifically designed to mitigate potential localized air quality impacts	Not Addressed	Yes		EIA Regulation grants the authority to implement this requirement.

8 c)	Construction and operation of compressor stations	Months (Construction) Years (Operation)
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			Release of greenhouse gases	High	Moderate to Severe	Long	Large	High	High				Medium	Mitigation can reduce emissions but cannot eliminate them entirely. There are no emission limits that specifically target greenhouse gases.
										Prepare greenhouse gas reduction plan	Section 7.6, Appendix 11			
										Report greenhouse gas emissions	Section 7.6	Yes		The EIA Regulation grants the authority to implement this requirement.
										Prescribed use of low emission equipment	Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
											Not Addressed	Yes		The EIA Regulation grants the authority to implement this requirement.
										Impose greenhouse gas reduction regulations	Not Addressed (may be required by federal government in future)	Yes		The EIA Regulation grants the authority to implement this requirement.
			Noise	High	Moderate to Severe	Long	Small	High	High				High	While noise can be reduced, it cannot be eliminated. Compressor stations have the potential to produce low frequency noise, requiring special noise abatement measures.
										Establish appropriate noise level limits	Section 9.4			
										Monitor noise and mitigate where necessary	Section 9.5			
			Visual impact (dwellings, recreational areas, etc.)	Medium	Moderate	Long	Small	Medium	Medium				Low	Required mitigation is appropriate and can be implemented under the authority of EIA Regulation.
										Visual impact analysis	Section 9.6			
			Potential impacts due to flooding, potential impacts on surface water quality	Low	Moderate	Long	Small	Low	Low				Low	Required mitigation can be implemented under the authority of EIA Regulation.
										Facility siting restrictions - No Compressor stations allowed in flood prone areas	Section 9.8			
			Potential impacts on public, communal or individual water supplies	Low	Moderate	Medium to Long	Small	Low	Low				Low	Required mitigation can be implemented under the authority of EIA Regulation.
										Facility siting restrictions and setbacks	Section 9.9			
8 d)	Producing gas	Years	Potential groundwater contamination, threats to public safety and air quality impacts due to leaks in the well bore (See also Stage 6)	Medium	Moderate to Severe	Long	Small to Medium	High	High				High	While the required mitigation is appropriate and NB's two barrier requirement reduces leak potential, there is uncertainty regarding how best to reduce long-term risk of leaks. (See also Stage 6)
										Establish casing specifications (material, joints, pressure rating, etc.)	Section 2.2, 2.3, 2.4			
										Require the use of surface casing venting to direct any gas leakage away from groundwater	Section 2.5			
										Require monitoring, reporting, assessment and repair of casing vent flow as appropriate	Section 2.5, 2.29			
										Implementation of "minimum barrier protection" concept (overlapping layers of casing)	Section 2.8			
										Establish standards and specifications for cementing	Section 2.10			

Stage	Activity	Duration of Activity (Per Well or Program)
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Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (<u>Without Mitigation</u>)	Potential Negative Consequences of Occurrence (<u>Without Mitigation</u>)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
							<p>Monitor cement mixing and pumping</p> <p>Require the use of centralizers to assure that a cement sheath surrounds the outside of the casing</p> <p>Establish requirements for extent of cementing and cement volume for intermediate casing</p> <p>Establish requirements for extent of cementing and cement volume for production casing</p> <p>Verify location of top of cement; remedial cementing if necessary</p> <p>Mandatory wait period before disturbing cement</p> <p>Cement evaluation and testing</p> <p>Require qualified professional to witness cementing</p> <p>Pressure testing of well casing and surface equipment</p> <p>Cease activities and plug well if operator cannot effect a repair</p> <p>Well integrity monitoring</p> <p>Establish requirements for surface casing vent flow and gas migration testing, reporting and repair</p> <p>Require the use of specific, advanced monitoring techniques such as spectral noise logging, high precision temperature logging, and fiber-optic distributed acoustic sensing to detect and locate leaks during the lifetime of the well</p> <p>Establish requirements for investigation and notification for casing vent flow, gas migration and stray gas</p> <p>Collect gas (methane) samples from drilling muds at regular intervals during drilling</p> <p>Isotopically characterize these samples so that any future methane leaks can be linked to specific locations within the well bore - need not be for every well drilled, but at least for each well drilled in a new area/formation or an appropriate distribution of wells logged to be representative of the formation</p> <p>See also Stage 6</p>	<p>Section 2.10</p> <p>Section 2.11</p> <p>Section 2.14</p> <p>Section 2.15</p> <p>Section 2.16</p> <p>Section 2.17</p> <p>Section 2.18</p> <p>Section 2.19</p> <p>Section 2.21</p> <p>Section 2.25</p> <p>Section 5.3</p> <p>Appendix 2, Appendix 4</p> <p>Not Addressed</p> <p>Section 2.29</p> <p>Not Addressed</p> <p>Not Addressed</p>	<p>Yes</p> <p>Yes</p>	<p>Can be addressed under DEM's well licencing requirements.</p> <p>The EIA Regulation grants the authority to implement this requirement.</p>	
Potential impacts on public, communal and individual water supplies		See Stages 5 and 6				See Stages 5 and 6				See Stages 5 and 6	
Potential impacts on air quality		See Stages 5 and 6				See Stages 5 and 6				See Stages 5 and 6	
Release of Greenhouse gases		See Stages 5 and 6				See Stages 5 and 6				See Stages 5 and 6	

Stage	Activity	Duration of Activity (Per Well or Program)	Key Environmental Issues (Environmental "Hot Spots")	Probability of Occurrence (Without Mitigation)	Potential Negative Consequences of Occurrence (Without Mitigation)	Potential Duration of Negative Effects	Potential Spatial Extent of Negative Effects	Potential for Cumulative Effects (For Multiple Activities or Facilities)	Potential for Significant Impact in Absence of Mitigation	Examples of Available Mitigation or Prevention	Relevant Section of New Brunswick's 2013 "Rules for Industry" (RFI)	Is there Potential for Improvements to Current Requirements?	Significance Following Mitigation	Comments
8 e)	Ongoing well maintenance	Years	Potential impacts on roads and traffic	Medium	Minor to Moderate	Long	Medium to Large	High	Medium	Requirements for oversize/overmass loads and weight restrictions	Section 9.1, 9.2		Low	Required mitigation is appropriate and can be implemented under the authority of EIA Regulation.
8 f)	Produced water storage and treatment/disposal	Years	Potential soil, groundwater and surface water contamination due to leaks and spills at the surface	Low	Moderate	Long	Small	High	Low	Incorporate measures in the well pad to prevent the escape of spills Require spill prevention, reporting and response plans Secondary containment for storage tanks Avoid use of underground storage tanks at well pad	Section 4.1 Section 4.11, Appendix 6 Section 4.17, Appendix 8 Appendix 8		Low	The required mitigation can be implemented under the authority of EIA Regulation.
			Potential environmental contamination due to improper waste storage, transportation and disposal	High	Moderate	Long	Medium to Large	High	High	Prepare detailed waste management plan before commencing operations Characterize (analyze) the waste in order to determine disposal options Require that produced water be stored in covered tanks (no pits) Require that produced water be treated or disposed of in accordance with an approved waste management plan Do not allow disposal of produced water at waste treatment facilities that are not designed to fully treat this material Require downstream water quality monitoring for any waste treatment facility that discharges to surface water Develop a comprehensive provincial policy paper on wastewater disposal options for New Brunswick supported by estimates of volumes and characteristics of wastewater based on a number of potential oil and gas development scenarios (well numbers, well locations etc.)	Section 4.4, 4.5, Appendix 5 Section 4.5, 4.6 Section 4.8 Section 4.8 Section 4.10 Section 4.10 Not Addressed		Medium	The required mitigation can be implemented under the authority of EIA Regulation. Waste management (produced water) remains a concern, but volumes of wastewater will be less than during the hydraulic fracturing stage.
8 g)	Reduction of size of well pad	See Stage 9	See Stage 9									Yes		This must be addressed by future policy direction from government.
													See Stage 9	

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9) Abandonment and Site Restoration														
9 a)	Removal of surface equipment, well pad and access road	Weeks. Abandoned facilities are permanent	Potential for ongoing erosion, loss of land capability	High	Moderate	Medium to Long	Small to Medium	High	High	Establish site restoration and remediation requirements	Section 9.12, 9.13, Appendix 17	Yes	Medium	The required mitigation can reduce but not completely eliminate impacts on land capability.
									Ensure timely restoration	Appendix 17	Require an assessment of the effectiveness of the site restoration			
			Potential for ongoing site contamination	Medium	Moderate	Medium to Long	Small to Medium	Medium	Medium	Require the completion of an environmental site assessment including environmental sampling	Appendix 17		Low	The required mitigation is appropriate and can be implemented under the authority of the EIA Regulation.
									Require remediation as required in accordance with New Brunswick's guideline for the management of contaminated sites	Section 9.13, Appendix 17				
9 b)	Well plugging and abandonment	Days to implement. Abandoned well is permanent	Potential for GHG (methane) leaks to atmosphere or groundwater if well not properly plugged	Medium	Moderate	Long	Large	High	Medium	Specify appropriate well plugging and abandonment procedures	Section 2.30		Medium	Mitigation can be implemented under the authority of EIA Regulation. Long-term monitoring and availability of funds for remediation of any leaks will be key.
								Require operators to post a financial security to cover costs if a well is not properly plugged or abandoned	Section 10.3					
9 c)	Decommissioning of other oil and gas facilities including gathering lines	Weeks to Months	Potential for ongoing erosion, loss of land capability	High	Moderate	Medium to Long	Medium to Large	High	High	Establish site restoration and remediation requirements	Section 9.12, 9.13, Appendix 17	Yes	Medium	Mitigation can be implemented under the authority of EIA Regulation. The required mitigation can reduce but not completely eliminate impacts on land capability.
									Ensure timely restoration	Not Addressed	Require an assessment of the effectiveness of the site restoration			
			Potential for ongoing site contamination	Medium	Moderate	Medium to Long	Medium to Large	Medium	Medium	Require the completion of an environmental site assessment including environmental sampling	Appendix 17		Low	The required mitigation is appropriate and can be implemented under the authority of the EIA Regulation.
									Require remediation as required in accordance with New Brunswick's guideline for the management of contaminated sites	Section 9.13, Appendix 17				

