Responsible Environmental Management of Oil and Gas Activities in New Brunswick

Recommendations for Public Discussion

New Brunswick Natural Gas Group

May 2012

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FORWARD

In January of 2011, the Government of New Brunswick established a Natural Gas Steering Committee and directed it to prepare an Action Plan to ensure that any expansion of the natural gas industry in the Province will take place in a careful and responsible manner. With this goal in mind, the Steering Committee assembled the Natural Gas Group comprised of experts drawn from within the provincial government and assigned it the task of developing the Action Plan.

This discussion document has been prepared by the Natural Gas Group as part of the above mentioned Action Plan. It presents 12 key principles for achieving responsible environmental management of both oil and natural gas activities in New Brunswick and describes a set of recommendations for putting the principles into operation. These recommendations are now being released for public comment.

The recommendations contained in this discussion document are not the product of a single author. They were prepared using advice from a broad cross-section of New Brunswickers via the Provincial Forum on Natural Gas held on June 23, 2011, as well as input from departments and agencies of the Provincial government. Valuable information was also obtained from a review of scientific studies, critiques, model standards, best management practices and evolving regulatory regimes in other North American jurisdictions.

The assistance of all who take the time to review and comment on the proposals contained in this discussion document will be greatly appreciated.

The New Brunswick Natural Gas Group
May, 2012

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INTRODUCTION

Some New Brunswickers might be surprised to learn that their province has hosted its own oil and natural gas industry for well over a century. It dates back to 1859, when one of the first oil wells drilled in Canada was constructed near the community of Dover. Since that time about 320 oil and natural gas wells have been drilled in New Brunswick; of these 82 were drilled in the last 2 decades. Today, there are 16 wells producing oil in the Hillsborough area, while 30 natural gas wells are in production near Sussex.

There are already environmental protection measures in place that address in New Brunswick's oil and gas industry. However in recent years, exploration and production of unconventional oil and natural gas have began to take place in the province. New Brunswick therefore stands on the threshold of what might eventually become an expanded oil and gas industry, based on technologies such as horizontal drilling and hydraulic fracturing. It is now appropriate to review and where appropriate, strengthen existing environmental and technical standards to ensure continued responsible environmental management of this industry, both now and in the future.

Purpose and Scope

Responsible Environmental Management of Oil and Gas Activities in New Brunswick contains a set of recommendations that the Natural Gas Group believes are necessary to support the province's on-going environmental management of oil and gas activities. The recommendations address all stages of land-based oil and natural gas production from exploration to well abandonment; however particular emphasis has been placed on the drilling and completion of oil and gas production wells, including hydraulic fracturing.

This document contains recommendations aimed at strengthening the existing regulatory regime governing oil and gas activities. It does not provide a list of the requirements that have already been imposed on operators of oil and gas activities in New Brunswick over the past several decades. Information about the existing regulatory regime is available at:
http://www2.gnb.ca/content/gnb/en/departments/natural_resources/Promo/NaturalGas.html

The recommendations in this document are intended to apply to oil and gas activities and facilities located on either privately owned or provincially owned land. Unless otherwise indicated, the recommendations are not intended to apply retroactively to oil and gas facilities that have already been approved and constructed.

An executive summary is available under separate cover.

How this Document was Prepared

In preparing this discussion document the Natural Gas Group reviewed information from a variety of sources including scientific studies, critiques, model standards, best management practices and proposed or existing regulations in other North American jurisdictions. A list of references is available under separate cover.

Preliminary information from the above sources was used to identify an initial list of environmental concerns pertaining to oil and gas activities and a preliminary list of potential responses. These were circulated to other subject matter experts within the provincial government. In June of 2011, approximately 60 subject matter experts representing 12 government departments and agencies participated in a technical workshop to discuss issues and share ideas. Further valuable

input was obtained during the Provincial Forum on Natural Gas, held in Fredericton on June 23, 2011, attended by a cross-section of representatives from environmental groups, First Nations, government, industry and academia.

Using the above feed-back and a continued review of the sources noted above the Natural Gas Group subsequently identified a set of 12 principles to guide responsible environmental management of oil and gas activities in New Brunswick. These were announced by Government in December of 2011 and were used to guide the preparation of this discussion document. They are:

1. Addressing Potential Concerns Associated With Geophysical (Seismic) Testing;
2. Preventing Potential Contaminants from Escaping the Well bore;
3. Assessing Geological Containment Outside the Well bore;
4. Managing Wastes and Preventing Potential Contaminants from Escaping the Well Pad;
5. Monitoring to Protect Water Quality;
6. Providing for the Sustainable Use of Water;
7. Addressing Air Emissions including Greenhouse Gases;
8. Addressing Public Safety and Emergency Planning;
9. Protecting Communities and the Environment;
10. Reducing Financial Risks to Landowners and the Province and Protecting Landowner Rights;
11. Sharing Information; and
12. Maintaining an Effective Regulatory Framework

Recommendations were then formulated to address these principles. The recommendations are contained in this discussion document which has now been released for public comment.

Throughout the process, of assembling and refining its recommendations, the Natural Gas Group continued to review relevant literature, scientific studies and North American legislative initiatives as they became available.

The Recommendations

A total of 116 recommendations are included in this discussion document. They are listed in the Table of Contents and are numbered and organized according to the principle they are intended to address. They are further divided into:

a) 104 short-term recommendations that are relevant to the current and anticipated short-term future level of oil and natural gas activity in the province and could be phased in over approximately the next 1 to 2 years, commencing in 2012; and

b) 12 potential longer term responses that could be considered over approximately the next 3 or more years, if it becomes apparent that the scale and extent of oil and gas activities will expand significantly in New Brunswick in the future. At the time of preparation of this discussion document, this is far from certain because the oil and gas potential for much of New Brunswick (particularly with respect to unconventional oil and gas) remains unproven. In addition, for at least the short term:

- natural gas prices are low; and
- the cost of oil and gas production in New Brunswick is high relative to many other jurisdictions because a well servicing and support industry has not been fully established here.

Potential triggers for implementing the longer term recommendations include the identification of new reserves of oil or natural gas in New Brunswick that are outside of, and larger than those offered by the province's established exploration or production areas which include the McCully gas field near Sussex, the Elgin shale gas exploration area and the Stoney Creek oil and gas field near Hillsborough.

An Opportunity to Provide Your Comments

Responsible Environmental Management of Oil and Gas Activities in New Brunswick: Recommendations for Public Discussion has been prepared by the Natural Gas Group to assist the public in becoming familiar with the measures and recommendations being proposed and also to obtain public comment.

Comments can be submitted until July 18, 2012, by mail, fax or email using the following contact information:

Natural Gas Group
1350 Regent Street,
Room 150
Fredericton, NB
E3C 1G6
Fax: (506) 453-3671
Email: naturalgas@gnb.ca

An on-line form is also available and can be used to submit comments. The form and an electronic version of this document are available at: www.gnb.ca/naturalgas

There will also be a series of public events held beginning in early June. A schedule will be available on the website noted above.

Following the conclusion of the review period a summary of comments received will be prepared and posted on the above website.

Next Steps

All comments received about these proposals will be reviewed and considered by Government. Once the review period has concluded, it is anticipated that the contents of this document will be finalized and subsequently implemented according to a schedule to be determined by Government.

The Need for Continuous Improvement

Developing a plan for the responsible environmental management of oil and gas activities in New Brunswick is not a one-time activity. Technology relating to unconventional oil and gas development is evolving rapidly. In addition, future experience with oil and gas activities in New Brunswick and elsewhere may suggest additional responses. It is anticipated that the measures adopted by the province will be revisited in the future, as new information, technology and best management practices become available.

DEFINITIONS

When used in this document:

"annulus" *(annular space) means the ring-shaped space (gap) between the outside of a well casing and the wall of the well bore or between two layers of overlapping casing.*

"battery" *means a system or arrangement of tanks or other surface equipment receiving the production of one or more oil or gas wells prior to its transportation, and includes the separators, dehydrators, storage tanks, pumps, compressors and other surface equipment by which fluids (e.g. oil, natural gas, produced water) coming from a well are separated, measured or stored.*

"blow-out" *means an uncontrolled flow of reservoir fluids (e.g. water, oil or gas) into a well bore, whether or not the flow reaches the surface.*

"casing bowl" *means the part of the well head (the top of a well) that incorporates features to secure and seal the upper end of the casing string and provides the foundation for the wellhead.*

"casing seat" *means the location of the bottom of a segment (string) of casing that is cemented in a well.*

"casing shoe" *means a metal collar attached to the bottom of a segment (string) of well casing.*

"casing string" *means a complete segment of well casing (surface casing, intermediate casing, or production casing) assembled from a number of pipe sections that are typically joined together using threaded couplings.*

"casing vent" *means a connection between the atmosphere and an annulus.*

"cement evaluation log" *means a method of verifying the integrity of cement that has been installed in an oil or gas well. One example is a "cement bond log, in which information obtained from acoustic signals passing along the well casing, is used to evaluate cement-to-pipe and cement-to-formation bonding.*

"cement top" *(top of cement) means the highest elevation of cement in an annulus.*

"cement top log" *means a way of determining the highest elevation of cement in an annulus.*

"centralizer" *means an object placed in the well bore to position (centre) the casing strings within the well bore to help ensure that cement surrounds the well casing. Centralizers are made with two bands that fit the pipe tightly with spring steel ribs that arch out to press against the wall of the well bore.*

"christmas tree" *means an assembly of valves and fittings at the top of an oil or gas well, used to control well flow.*

"circulation method" *means pumping a volume of fresh water into the well casing (after a sufficient volume of cement to fill the annulus is pumped into the casing) until the casing cement reaches a specified elevation in the annular space.*

"closed-loop drilling fluid system" *(sometimes referred to as a "closed mud" or a "pitless" system) means a system for managing drilling fluid (drill mud) that eliminates the need for excavated pits. Pits are replaced by a series of storage tanks that separate liquids and solids and facilitate recycling of the drilling fluid.*

"completion" *means preparing a well for production, which involves removing the drilling equipment, stimulating the well (i.e. hydraulic fracturing) and installing valving, and other flow-control devices.*

"conditioning" *means cleaning and preparing a well bore prior to cementing.*

"conductor casing" *means a casing installed and cemented in a well to perform the same function as a conductor pipe and also to facilitate well control during drilling of the hole that will contain the surface casing.*

"conductor pipe" *means a vertical pipe installed in a well to prevent the ground near the surface of the well bore from caving in and to conduct drilling mud (fluid) from the bottom of the well bore to the surface when drilling starts. It includes a seal to prevent infiltration of groundwater into the well bore.*

"diminished in quality" *means a reduction in water quality based on the chemical parameters that could potentially be affected by seismic testing or by the drilling and hydraulic fracturing of an oil or gas well, (as evidenced by a comparison between pre- and post activity water well sampling), that is outside the normal range of variation in water quality for the aquifer under consideration, with reference to information sources such as the Department of Environment's background water quality program and the New Brunswick Groundwater Geochemistry Atlas.*

"drill cuttings" *means chips and small fragments of rock that are brought to the surface during the drilling of an oil or gas well. They are carried to the surface by the drilling fluid.*

"diverter" *means a system used to direct fluid (e.g. oil, gas, formation water) away from the drilling rig (e.g. when a "kick" is encountered).*

"drilling fluid" *(drilling mud) means a fluid that is pumped down the well bore to cool and lubricate the drill bit. After reaching the bit, the drill fluid typically circulates back up the well bore to the surface.*

"drilling out" *means drilling through concrete plugs in a casing string.*

"dwelling" *means any permanently or seasonally occupied residence, located and constructed in accordance with all applicable legislation, building codes, and by-laws. It does not include an employee residence, dormitory, or construction camp associated with an oil or gas activity.*

"floodplain" *means a mapped 1:100 year floodplain, or any other area prone to flooding that may be identified by the regulator based on evidence such as coastal hazard mapping, historical records, etc.*

"flowback water" *means water emitted by a well from the time of initial drilling, until the well goes into production. For wells that have been stimulated using hydraulic fracturing, flowback water is typically a mixture of fracture fluid and formation water.*

"Formation integrity test" *means a pressure test to determine if the geological formation and the casing shoe can withstand the maximum anticipated pressure during the drilling of the next section of the bore hole.*

"Formation leak-off test" *means a pressure test to determine the strength of the geological formation in order to establish a maximum allowable pressure that can be employed during drilling without allowing the drill fluid to leak into the surrounding formation.*

"formation water" *means naturally occurring water found within geological formations. When it comes to the surface along with oil and gas it is called produced water.*

"gathering line" *means a small diameter pipeline used to transport crude oil or gas from individual wells to a conditioning plant or a main pipeline.*

"hydraulic fracturing" *(sometimes referred to as "fracking" or "fracing") means injecting a liquid or gaseous fluid (water, nitrogen, polymer, or a petroleum-based fluid) at high enough pressures to fracture or crack the rock in the target zone. Hydraulic fracturing is a method of stimulating production from a formation of low permeability, by applying very high fluid pressure to the face of the formation, forcing the strata apart.*

"hydraulic fracturing program" *means a program comprised of one or more fracturing stages on the same well bore.*

"image log" *means the results of a procedure (e.g. resistivity, acoustic imaging, etc.) that provides an image of the wall of a well bore.*

"intermediate casing" *means steel well casing placed inside the surface casing and outside the production casing, that is used for well control or to protect non-saline groundwater.*

"kelly valve" *means a valve to protect well equipment from high pressure.*

"kick" *means an entry of water, gas, or oil into the well bore from the surrounding geological formation during drilling. It occurs when the pressure exerted by the weight of drilling fluid in the well bore is less than pressure exerted by the fluids in the formation being drilled.*

"liner" *means a casing string that does not extend to the top of the well bore, but instead is anchored or suspended from the bottom of another casing string.*

"non- municipal communal water supply" *means a potable water supply serving: a) a hospital, school, or nursing home; b) more than one dwelling unit (e.g. two or more dwellings, a mini home park, trailer park, residential subdivision, apartment building or condominium); or c) a campground; or d) more than one industrial or agricultural user.*

"non-saline groundwater" *means groundwater having a concentration of total dissolved solids of less than 4000 mg/L (i.e. 4000 ppm). It includes shallow, potable groundwater that takes part in the hydrologic cycle and typically excludes water from deeper formations that are isolated from the surface.*

"oil and gas activity" *means:*
a) geophysical exploration;
b) drilling and completion (e.g. hydraulic fracturing) of an oil or gas well;
c) production, gathering ,and processing of oil, natural gas or both, up-stream of a refinery; and
d) abandonment and site remediation.

"oil and gas facility" *means a facility used as part of an oil and gas activity including: an oil or gas well, a well pad and all related equipment used for oil or gas exploration or production, a battery, a gathering line, a storage tank, a freshwater impoundment, a gas conditioning plant or a compressor station.*

"oil or gas well'' *means a well constructed to intersect with oil and/or gas-bearing strata in order to explore for or produce oil or natural gas.*

"packer" *means an expandable device used to seal a well bore or annulus.*

"pass-by flow" *means a quantity of flow in a river or stream that must be allowed to pass by a water intake (i.e. remain in the river or stream) during the time that a withdrawal is occurring.*

"polished bore receptacle" *means a section of well casing that is designed to facilitate the connection of the well casing to a tie-back string.*

"produced water" *means water found in subsurface geological formations that comes to the surface along with oil and natural gas during hydrocarbon production.*

"production casing" *means the portion of the steel well casing that extends through the oil or natural gas-bearing geological formations.*

"production liner" *means a casing string used for oil or gas production, that does not extend to the top of the well bore, but instead is anchored or suspended from inside the bottom of the previous casing string.*

"pump and plug method" *means a technique for placing cement plugs at appropriate intervals along the well bore.*

"qualified professional engineer or geoscientist" *means a professional engineer or geo-scientist licensed to practice by the Association of Professional Engineers and Geoscientists of New Brunswick.*

"reduced capacity" *means local or regional lowering of water table or reduction in aquifer capacity not attributable to climatic variations or increased activity unrelated to the oil and gas exploration or production.*

"regulator" *means the provincial department or agency having jurisdiction.*

"secondary containment" *means one or more of the following: dikes, liners, pads, curbs, sumps, or other structures or equipment capable of containing leaks in a tank or container. The secondary containment may surround the entire site (e.g. a bermed well pad with an impermeable liner), or may surround a particular area (e.g. a liquid storage and handling area, or a storage tank). It must be of sufficient volume to contain 110% of the capacity of the largest single tank or of all the connected tanks (whichever is greater).*

"seismic source point" *means a location where kinetic energy is applied to the ground (e.g. a shot hole or vibroseis plate).*

"shot hole" *means a drilled hole, into which an explosive energy source (charge) is placed as part of a seismic testing program.*

"sour gas" *means natural gas that contains concentrations of hydrogen sulphide that would represent a risk to human health, should the natural gas escape.*

"stabbing valve" *means a valve at the top of a drill hole that can be closed to stop unexpected well flow.*

"stray gas" *means gaseous material that migrates from an oil or gas well or facility to a location where it may create a hazard.*

"stratigraphic bore hole" *means a hole drilled for the sole purpose of obtaining sub-surface geological information and not intended to be completed for oil or natural gas production.*

"surface hole" *means the hole that is drilled to allow installation of the surface casing.*

"surface casing" *means the steel casing that is inside the conductor casing or conductor pipe. It is a permanent structure of the well bore and extends from the ground surface to a specified depth. The primary purpose of surface casing is to protect non-saline groundwater.*

"tie-back string" *(tie-back tubing) means a section of tubing that is run from a polished bore receptacle to the surface (wellhead). A tie-back string is not cemented in place and can be used to provide the necessary well pressure during hydraulic fracturing.*

"tour sheets" *(tour reports) means drilling-related data collected by an automated electronic recoding system connected to a drill rig.*

"tubing" *means a small diameter pipe placed inside a well casing to conduct fracture fluid or oil and gas and help control the well.*

"true vertical depth" *means the vertical distance from a point in the well bore to a point at the surface, irrespective of the length of the well bore. (The length of the well bore is referred to as the measured depth).*

"unconventional oil or gas" *means oil or gas found in very fine-grained sedimentary rock (e.g. shale or sandstone) and tightly locked in very small spaces that requires special technologies, including hydraulic fracturing to drill and extract.*

"vacuum truck" *means truck equipped with a heavy duty vacuum and a collection tank, that is used to pick up, contain and transport liquids.*

"vibroseis" *means a method of seismic testing that employs a truck-mounted vibrating plate that is placed in contact with the ground.*

"watercourse" *means any incised channel or body of standing water, open to the atmosphere, with a bed containing exposed mineral or organic soil substrate; whether the flow/presence of water is permanent, intermittent or ephemeral. The definition includes the full width and length of the channel or water body, including bed, banks and sides. It includes portions of roadside, and rail side ditches that intercept and convey stream flow from off the right-of way. It excludes all other portions of roadside and rail side ditches and constructed agricultural ditches.*

"water supply" *means a water well or surface water source used for potable, industrial or agricultural purposes.*

"well" *means an oil or gas well.*

"well head" *means the part of a completed oil or gas well located at the ground surface. It typically includes an arrangement of valves and piping for pressure control.*

"well pad" *means the area occupied by an oil or gas well and related equipment including the well head, and the battery.*

"well bore" *means the drilled portion of an oil or gas well.*

"wetland" *means a wetland shown on the Regulated Wetlands Map maintained by the Department of Environment.*

"zone of critical cement" *means: (i) for surface casing strings greater than 90 metres in length, the bottom 20% of the casing string*, (ii) for surface casing strings of 90 metres or less in length, the zone of critical cement extends to the land surface; and (ii) other zones as may be determined by the regulator.*

** Provided that the zone is not more than 300 metres long or less than 90 metres long.*

LIST OF RECOMMENDATIONS

1.0 ADDRESSING POTENTIAL CONCERNS ASSOCIATED WITH OF GEOPHYSICAL (SEISMIC) TESTING

Implementing measures to reduce risks to public safety, private property and the environment during seismic testing.

Short Term Recommendations

1.1. ENHANCED SET-BACKS FOR EXPLOSIVE ENERGY SOURCES

The province should increase the legislated minimum set-back distances between explosive energy sources (i.e. shot holes) and water wells from the current 120 metres, to 180 metres. The set-back distance from dwellings, barns and other structures having a concrete base should be increased from the current 150 metres to 180 metres.

See also the "Pre- and Post-Seismic Water Well Testing" subheading under Section 5.0.

1.2. PROTECTING SURFACE WATER AND GROUNDWATER

It should be a requirement that all shot holes be drilled using methods or materials that are acceptable to the regulator.

1.3. ENHANCED MEASURES TO ADDRESS THE RELEASE OF WATER FROM SHOTHOLES

If groundwater water is released and comes to the surface as a result of the drilling of a shot hole or detonation of an explosive energy source, the geophysical operator should be required to ensure that: (a) all drilling that is in progress is discontinued; b) no explosive charge is loaded into the shot hole; (c) the flow of water from the shot hole is confined to the aquifer or stratum of origin in a manner that is acceptable to the regulator; d) step drilling procedures* are implemented for subsequent, adjacent shot hole drilling and (e) a report on the flowing hole is immediately submitted to the regulator.

** Step drilling procedures mean that the depths of subsequent shot holes in the vicinity where the water was encountered must be adjusted as required to avoid further release of water. A detailed description is provided in Exploration Directive 2006-17 Flowing Holes and Encountering Gas prepared by the Alberta Department of Sustainable Resource Development.*

1.4. RESPONDING TO GAS ENCOUNTERED IN A SHOTHOLE

It should be a requirement that if gas (e.g. methane) is encountered during the drilling of a shot hole, the operator must ensure that: (a) the gas is immediately confined to its source or place of origin in a manner that prevents an adverse effect on the environment, human health, property or public safety; and (b) immediately after the gas has been confined in accordance with clause (a), a report is submitted to the regulator.

1.5 PLUGGING AND ABANDONING SHOT HOLES

The operator of a seismic testing program should be required to ensure that shot holes are abandoned as follows: a) a plug must be placed in the shot hole at a depth of at least 1 metre below the surface of the ground; b) at least a 50 cm thickness of a bentonite* sealing product (or an equivalent sealing product that has been approved by the regulator) must be placed on top of the plug, followed by drill cuttings or other material obtained from the shot hole, and thoroughly tamped; c) all drill cuttings not

required to fill the hole must be spread evenly over the ground surrounding the hole; and d) all wires leading to the charge must be pulled tight and after the charge has been detonated, must be cut level with the surface of the ground.

** Bentonite is a form of clay. It makes a good sealant for a drilled hole because it expands when exposed to water.*

2.0 PREVENTING POTENTIAL CONTAMINANTS FROM ESCAPING THE WELL BORE

Maintaining well bore integrity and reducing the potential for unintentional releases of substances such as fracture fluids, drilling fluids, flowback water, produced water and natural gas from the horizontal or vertical segments of oil and gas wells.

Short Term Recommendations

2.1. USE OF PRESCRIBED DRILLING FLUIDS WHEN DRILLING THROUGH SHALLOW (NON-SALINE) GROUNDWATER

The driller of an oil or gas well should be required to use air, freshwater, freshwater-based, or another drilling fluid acceptable to the regulator during the drilling of a well until all porous strata that contain non-saline groundwater have been isolated from the drilling fluid by the installation and cementing of surface casing.

2.2. WELL CASING - GENERAL PROVISIONS

A well operator should be required to install steel or steel alloy casing that can withstand the forces of tension, collapse and burst to which that casing will be subject during its installation, cementing, subsequent drilling, hydraulic fracturing and oil and gas production. It should also be required that the casing be designed to withstand anticipated corrosive and other conditions that can be reasonably anticipated. At a minimum the casing should be required to meet the design criteria specified in the latest version of Alberta Energy Resources Conservation Board (ERCB) Directive 010 - Minimum Casing Design Requirements.

At a minimum, a well operator should be required to install casing that is manufactured to the specifications defined in American Petroleum

Institute (API) 5CT, Specification for Casing and Tubing and ISO 11960, Steel Pipes for use as Casing or Tubing for Wells and that the casing must meet or exceed the performance standards in API Bulletin TR5C3, Technical Report on Equations and Calculations for Casing, Tubing, and Line Pipe Used as Casing.

2.3. WELL CASING - PRESSURE RATING AND AGE

For wells that will be subjected to hydraulic fracturing as part of well completion, it should be required that all casing installed in the well bore, other than conductor pipe, be new (not previously used) casing with an internal pressure rating that is at least 20% greater than the anticipated maximum pressure to which the casing will be exposed during hydraulic fracturing and the lifetime of the well.

If a well bore will be hydraulically fractured five or more years after the casing and cementing was initially installed, it should be required that as part of the application for a permit to carry out this activity, the well operator provide evidence to the regulator (such as casing wear logs, cement evaluation logs, an assessment of casing corrosion and/or mechanical integrity tests) that the well cementing and casing is of sufficient strength and condition to maintain well bore integrity during the proposed hydraulic fracturing.

2.4. WELL CASING - JOINTS

It should be required that all joints in casings used in a well bore, including conductor casing but excluding a conductor pipe that is not used for well control purposes, be threaded rather than welded.

It should be required that welding at casing bowls be done in accordance with acceptable welding procedures developed from: a) API Specification 6A Specification for Wellhead and Christmas Tree Equipment; b) Canadian Standards Association (CSA) Z184 (Standards for Gas Pipeline Systems); c) National Association of Corrosion Engineers (NACE) MR-01-75 Materials for use in H2S-containing Environments in Oil and Gas Production; and d) Section IX of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

Threaded casing and tubing joint connection make-up and torque procedures should be required to meet the specifications defined in API RP 5C1, Recommended Practice for Care and Use of Casing and Tubing. It should also be required that for wells that will be completed using hydraulic fracturing, casing torque data be recorded in the daily tour sheets , retained by the well operator and made available to the regulator upon request.

It should be required that all joint connection compounds used by a well driller meet the performance requirement specifications as defined in API RP 5A3, Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements and ISO 13678, Evaluation and Testing of Thread Compounds for Use with Casing, Tubing and Line Pipe.

2.5. WELL CASING - SURFACE CASING VENTS

It should be a requirement that all wells completed to produce oil or natural gas (including wells that are shut in for future production) be equipped with surface casing vents that leave the annulus between the second casing string and the surface casing open to the atmosphere, except during a pressure test or while conducting maintenance or other work on the well. The intent is to ensure that any build-up of gas pressure in the annulus between the second casing string and the surface casing as a result of a leak will not result in the flow of gas into the surrounding aquifer or geological formation. In situations where

it is desirable to control surface casing vent flow, the well operator may choose to install a burst plate or pressure release valve on the casing vent.

It should be required that casing vents have a minimum diameter of 50 mm, extend at least 60 cm above ground, and terminate in the atmosphere in a manner so that any flow is directed either in a downward direction or parallel to the ground. The working pressure rating in kilopascals of all parts of the surface casing vent should be at least 25 times the numerical equivalent of the surface casing depth in metres.

A well operator should be required to check each well for evidence of surface casing vent flow: (a) within 90 days of drilling rig release or during initial completion of the well, whichever occurs first; (b) as routine maintenance throughout the life of the well*, and (c) during abandonment of the well.

It should be required that a well operator report any surface casing vent flow to the regulator without delay. In addition it should be required that a well operator, upon discovery of a surface casing vent flow that presents an immediate safety or environmental hazard or an occurrence of gas migration, must take immediate steps to rectify the situation**.

** See the "Monitoring of Oil and Gas Wells" subheading under Section 5.0.*

*** Alberta Energy and Utilities Board Interim Directive ID 2003-01 includes surface casing vent flow/gas migration testing, reporting, and repair requirements as well as method of classifying surface casing vent flows as either "serious" or "non-serious". These requirements should be implemented in conjunction with the above provision. See also the "Stray Gas Investigation and Response Guidelines" subheading elsewhere in this Section.*

2.6. WELL CASING - USE OF CONDUCTOR PIPE AND CASING

It should be required that a well operator install such conductor pipe as is necessary to maintain a stable well bore, prevent groundwater infiltration and keep the unconsolidated surface material in place during drilling operations.

Use of conductor casing to facilitate well control should be required when: (a) an operator drills in a location where formation pressures are not known, (b) there is potential to encounter a hydrocarbon-bearing zone during drilling of the surface hole, or (c) the required surface casing depth is greater than 450 metres.

2.7. WELL CASING - SURFACE CASING DEPTH

Surface casing should be required for all oil or natural gas wells drilled in New Brunswick and a driller should be required to ensure that the depth of the surface casing extends to the greater of: a) a depth of at least 25 metres below all porous strata that contain non-saline groundwater as determined by a qualified professional; or b) a calculated casing depth based on the most recent version Alberta Energy Resources Conservation Board (ERCB) Directive 008 Surface Casing Depth Minimum Requirements; or c) a depth calculated using another standard identified by the regulator.

It should be a requirement that: a) the surface casing must always be set into a competent zone that can withstand the anticipated pore pressure and fracture gradient of completing the next drilling section; and b) the surface casing must be run and cemented as soon as possible after the surface hole has been circulated and conditioned.

It should be a requirement that the depth of surface casing cannot be less than 10% of the true vertical

depth to which the well will be drilled, or less than 10% of the true vertical depth of the intermediate casing when intermediate casing is run.

Surface casing should not be permitted to extend into zones known to contain shallow gas. In the event that such a zone is encountered before the non-saline groundwater is cased off, the operator should be required to take any action required to get the well under control to prevent formation gas from entering zones of non-saline groundwater and notify the regulator within 12 hours of such an event. The well operator should not be allowed to use the surface casing string as the production casing string.

If a well control incident (kick) occurs while drilling the surface hole, the well operator should be required to immediately report the following information to the regulator: a) the well location; b) the time and date of occurrence; c) the depth and duration of occurrence; d) the kick volume; and e) the final drilling fluid weight that was required to control occurrence.

2.8. WELL CASING - MINIMUM BARRIER PROTECTION

It should be a requirement that casing for all wells subject to hydraulic fracturing be designed to provide both "primary" and "secondary" barrier protection during hydraulic facture stimulation operations through the use of a combination of intermediate casing, production casing, production liner, tubing and/or tie-back string. These primary and secondary barriers should be in addition to the required surface casing. Surface casing should never be exposed to any hydraulic fracture stimulation operation pressures.

The "secondary" barrier should be designed and installed in a manner that will: a) provide protection from leaks in the event of a mechanical failure of the "primary" barrier (the casing/tubing used to transport the fracture fluids into the formation under pressure) during hydraulic fracture stimulation operations; and b) provide well control and an ability to repair or replace the primary barrier in the event of a failure of the primary barrier.

Examples of acceptable well casing designs providing both primary and secondary barrier protection are provided below.

(1) If there is no intermediate casing, and the production casing is run to the surface:
   (a) the primary barrier - tie-back string or tubing with downhole mechanical isolation (i.e. packer or polished bore receptacle) as primary barrier used for hydraulic fracture stimulation; and
   (b) the secondary barrier - production casing.

(2) If the intermediate and production casing are both run to the surface:
   (a) the primary barrier - production casing; and
   (b) the secondary barrier - intermediate casing.

(3) If the intermediate casing is run to the surface and a production liner is run into the intermediate casing:
   (a) the primary barrier - tie-back string or tubing with downhole mechanical isolation (i.e. packer or polished bore receptacle) as primary barrier used for hydraulic fracture stimulation; and
   (b) the secondary barrier - production & intermediate casings

2.9. WELL CASING - USE OF PRODUCTION CASING

It should be a requirement that in wellbores where intermediate casing is not being used, production casing must be installed and run to surface and a tie-back string or tubing with downhole mechanical isolation (i.e. packer or polished bore receptacle) must be installed in the wellbore for use in all

hydraulic fracture stimulation operations.

In wellbores where intermediate casing is being used, the regulator should have the authority to grant approval for the use of a production liner instead of a production casing to surface. A request for use of a production liner should have to be made in writing and include supporting documentation showing that the intermediate casing is adequately engineered to ensure that public health and safety and environmental protection would not be compromised.

Where the use of a production liner is approved by the regulator, the operator should be required to use a tie-back string or tubing with downhole mechanical isolation (i.e. packer or polished bore receptacle) installed in the wellbore for use in all hydraulic fracture stimulation operations.

2.10. WELL CEMENTING - GENERAL PROVISIONS AND STANDARDS

It should be required that the casing in an oil or gas well be sufficiently cemented to: a) secure the casing in the well bore; b) effectively control the well and prevent the upward migration of fluids at all times and under all reservoir conditions (i.e. proper cementation of the well casing across vertically impermeable zones and ground water zones); c) ensure that all zones containing non-saline groundwater are isolated and sealed off to effectively prevent contamination or harm to such water; and d) ensure that all potentially productive zones, zones capable causing annular over-pressurization, or corrosive zones are isolated and sealed off to the extent that such isolation is necessary to prevent vertical migration of fluids or gases behind the casing (e.g. gas flow in the annulus).

In areas of known shallow gas that could cause poor cementing isolation and integrity, the operator should be required to investigate the use of gas migration mitigation methods such as cement systems that reduce cement slurry porosity and permeability, improve fluid loss control, and/or build gel strength rapidly.

It should be required that at a minimum: a) all cement must conform to API Specification 10A, Specifications for Cement and Material for Well Cementing (April 2002 and January 2005 Addendum) or equivalent; and b) the cement slurry must be prepared in a manner so as to minimize its free water content in accordance with the above API specification.

The operator should be required to select the cement mixture in light of the chemical properties of the geological strata surrounding the well bore to ensure that these properties will not have an adverse effect on the cement integrity over time (leaching, chemical reactions, etc.). Where necessary to prevent the vertical migration of fluids, prevent pollution and ensure well safety, the regulator should require that the operator employ a quality of cement better than that specified above, in any well or portion of a well. The regulator should also have the authority to require any necessary change to the cementing procedure.

It should be required that prior to cementing the surface, intermediate and production casings, the well bore be conditioned to ensure an adequate cement bond between the casing and the formation.

It should be required that the cement be pumped at a rate and in a flow regime that inhibits channelling of the cement in the annulus.

For all casing cementing operations, a representative of the well permit holder should be required to remain on site throughout the cementing process and monitor the cementing during the mixing and pumping. During placement of the cement, the well permit holder should be required to monitor pump rates to verify they are within design parameters, so as to ensure proper displacement efficiency.

It should be required that that well cementing reports be maintained by the well operator for the life of the well and submitted to the regulator on request. The cement reports should be required to include: (a) the volumes of cement pumped; (b) the types of cement used; (c) a description of cement additives that were employed; (d) the dates and times of cementing; (e) cement slurry weights; (f) volume of cement returns at surface (if any); (g) the cement level in annulus (if no returns) and (h) details of any cementing issues and/or remedial work.*
** See the "Remedial Cementing" subheading elsewhere in this Section.*

2.11. WELL CEMENTING - CENTRALIZERS

It should be required that all casing be adequately centralized. Minimum centralizer spacing should be as follows: a) surface casing must be centralized at the top and bottom of the casing and at 50 metre (maximum) intervals along the entire casing length; and b) intermediate and production casing must be centralized at the top and bottom of all productive formations and at 50 metre (maximum) intervals through areas that will be cemented, to the required top of cement.

It should be required that additional centralizers be placed when necessary to ensure that casing strings are centralized in a manner that will provide for proper zonal isolation by the cement.

It should be required that centralizers and their placement meet the minimum standards set out in American Petroleum Institute (API) RP 10D-2 Recommended Practice for Centralizer Placement and Stop Collar Testing which provides methods for determining the number and placement of centralizers in vertical and deviated well bores and API TR 10TR4 Technical Report on Considerations Regarding Selection of Centralizers for Primary Cementing Operations which contains centralizer selection guidelines (bow-string design, rigid blade design and solid design) for primary cementing operations.

2.12. WELL CEMENTING - EXTENT OF CONDUCTOR CASING CEMENT

It should be a requirement that: a) conductor casing be cemented to its full length; b) the drilled diameter of the bore hole be at least 100mm larger than the diameter of the conductor casing; (c) if the cement job fails to retain its integrity, drilling must be suspended and remedial action taken; and d) if a diverter is installed on the conductor casing, it must be cemented along its full length using the circulation method.

2.13. WELL CEMENTING - EXTENT OF SURFACE CASING CEMENT

It should be a requirement that: a) surface casing be run and cemented as soon as practicable after the hole has been circulated and conditioned; b) surface casing be cemented along its full length using the pump and plug method; c) the hole diameter be at least 25mm larger than the diameter of the surface pipe; d) fillers or additives that reduce the compressive strength of the cement cannot be used; e) the required cement volume be based on hole-size measurements, taken from a calliper log, plus a minimum of 25% excess cement volume; and d) flow returns be visually monitored.

2.14. WELL CEMENTING - EXTENT OF INTERMEDIATE CASING CEMENT

If intermediate casing is installed in an oil or gas well it should be a requirement that: a) all reasonable measures be taken to cement the intermediate casing to the surface; failing this, the intermediate casing must be cemented to a minimum of 200 metres (true vertical depth) above the casing shoe (bottom) of the surface casing; b) the cementing be accomplished using the pump and plug method unless the use of an alternative method is approved by the regulator; c) the required cement volume be based on hole-size measurements, taken from a calliper log, plus a minimum of 20% excess cement volume; and d) flow returns be visually monitored and the top of cement must be located by a cement top locating log and reported to the regulator if no returns are observed at surface.

Cement additives or alternatives that enhance the integrity of the cement bond, cement strength or zone containment should be permitted.

2.15. WELL CEMENTING - EXTENT OF PRODUCTION CASING CEMENT

It should be a requirement that: a) all reasonable measures be taken to cement the production casing to the surface; failing this, the production casing must be cemented to a minimum of 200 metres (true vertical depth) above the casing shoe of the previous casing; b) the cementing be accomplished using the pump and plug method unless the use of an alternative method is approved by the regulator; c) the required cement volume be based on hole-size measurements, taken from a calliper log, plus a minimum of 20% excess cement volume; and d) the top of cement be located by a cement top locating log and reported to the regulator if no returns are observed at surface.

If the requirement to install intermediate casing is waived by the regulator, then it should be required that the production casing be fully cemented to the surface.

When production liners are permitted by the regulator it should be required that they are cemented over their entire length.

2.16. WELL CEMENTING - LOCATING THE CEMENT TOP AND REMEDIAL CEMENTING

Surface Casing

If cement returns are not obtained at the surface or if the cement level in the annulus drops below the surface, then it should be required that the results of a cement top log and a proposed remedial cementing program be submitted to the regulator for approval prior to its implementation.

Intermediate Casing

If the required cement top has not been achieved, it should be a required that the results of the cement top log and a proposed remedial cementing program be submitted to the regulator for approval prior to its implementation.

Production Casing

If the required cement top has not been achieved, it should be required that the results of cement top log and a proposed remedial cementing program be submitted to the regulator for approval and implementation prior to commencement of hydraulic fracturing operations, or within 60 days of rig release, or prior to the commencement of well completion activities.

2.17. WELL CEMENTING - SETTING (WAIT) PERIOD AND REQUIRED STRENGTH

After the casing cement is placed behind any casing installed below the conductor pipe, the operator should not be allowed to disturb the casing until the cement achieves a minimum compressive strength of 3500 kPa and in any event, the casing should not be disturbed for a minimum of 8 hours.

Disturbing the casing includes: (a) releasing pressure on the cement head within 4 hours of cementing if casing equipment check valves did not hold or if the casing equipment was not equipped with check valves. After 4 hours, the pressure may be released at a continuous, gradual rate over the next 4 hours provided the floats are secure; (b) installation of a blow-out preventer; and
(c) running drill pipe or other mechanical devices into or out of the well bore with the exception of wireline tools used to determine the top or quality of cement
A well operator should be permitted to request approval from the regulator to reduce the prescribed 8 hour wait time prior to casing disturbance if: a) the operator has bench tested the actual cement batch and blend using mix water from the actual source for the job, and determined that 8 hours is not required to reach a compressive strength of 3500 kPa; or b) special cement or additives that reduce setting time are used. Such approval may be granted at the discretion of the regulator.

It should be required that the density of the cement slurry be based upon a laboratory free-fluid separation test demonstrating an average fluid loss of no more than 6 millilitres per 250 millilitres of cement tested in accordance with API Recommended Practice 10 B-2 Recommended Practice for testing Well Cements. Slurry should be mixed and pumped at a rate that ensures consistent slurry density.

The regulator should have the authority to require that a prescribed cement mixture be used in any well or any area, where local conditions suggest that a specific cement mixture is necessary.

It should be required that a casing pressure test* on casings or liners that will be exposed to hydraulic fracture stimulation pressures may not commence until at least 7 days after the primary cementing operations are completed on those casings or liners.

** See the "Pressure Testing the Well Bore and Surface Equipment" subheading elsewhere in this section.*

2.18. WELL CEMENTING - TESTING AND EVALUATION

Testing of Cement Characteristics

It should be required that: a) cement mixtures for which published performance data are not available, be tested by the operator or the company providing the cementing services; b) tests be made on representative samples of the basic mixture of cement and additives, using the water source that will be used to prepare the slurry; c) the tests be conducted using the equipment and procedures adopted by the American Petroleum Institute, as published in API RP 10B Recommended Practice for Testing Well Cements; and d) test data showing competency of the proposed cement mixture be furnished to the regulator on request.

To determine that the required compressive strength has been obtained, it should be required that operators use the typical performance data for the particular cement used in the well (including all additives and accelerators used in the slurry) at the following temperatures and at atmospheric pressure: a) for the cement in the zone of critical cement,

the test temperature must be within 5.5 degrees Celsius of the formation equilibrium temperature at the top of the zone of critical cement; and b) for the filler cement, the test temperature must be the temperature found 30 metres below the ground surface level, or 15 degrees Celsius, whichever is greater.

Formation Leak-Off Tests (LOT) / Formation Integrity Tests (FIT)

Unless determined otherwise by the regulator, a well permit holder should be required to conduct a formation leak-off or formation integrity test after drilling out below the surface and intermediate casing shoe in order to: a) verify the integrity of the cement in the casing annulus at the casing shoe; and b) determine that formation integrity at the casing shoe is adequate to meet the maximum anticipated well bore pressure throughout the next drilling section and/or at total depth.

Cement Evaluation Logs - General

When a cement evaluation log is required as described below, it should be required that it be interpreted and signed by a qualified professional.

Cement Evaluation Logs - Surface Casing

It should be a requirement that a well operator must run a cement evaluation log or other cement evaluation technique approved by the regulator, to determine the quality of cement outside the surface casing if: a) there is any reason to doubt the effectiveness of surface casing cementation as evidenced by abnormal monitoring indications during the cementing operation or upon post cement analysis; or b) a shallow gas zone is encountered prior to the setting of surface casing and the surface casing is set across the gas producing zone.

If the cement bond is not adequate to isolate the well bore from non-saline groundwater and prevent the upward migration of fluid within the annulus, remedial cementing will be required and a remedial plan must be submitted to the regulator for approval.

Cement Evaluation Logs - Intermediate Casing

It should be a requirement that a well operator must run a cement evaluation log or other cement evaluation technique approved by the regulator, capable of determining if hydraulic isolation has been achieved to isolate all hydrocarbon-bearing zones, porous (greater than 3% porosity) zones, and prevent the upward migration of fluid within the annulus. If the cement bond is not adequate to isolate these zones, remedial cementing will be required and a remedial plan must be submitted to the regulator for approval and must be implemented prior to drilling ahead.

Cement Evaluation Logs - Production Casing

It should be a requirement that prior to perforating the casing or initiating a hydraulic fracturing program a well operator must run a cement evaluation log or other cement evaluation technique approved by the regulator, capable of determining if hydraulic isolation has been achieved to isolate all hydrocarbon-bearing zones, porous (greater than 3% porosity) zones, and prevent the upward migration of fluid within the annulus. If the cement bond is not adequate to isolate these zones, remedial cementing will be required and a remedial plan must be submitted to the regulator for approval and must be implemented prior to commencing hydraulic fracturing.

2.19. WELL CEMENTING - WITNESSING AND NOTIFICATION

It should be a requirement that the regulator be notified at least 24 hours prior to commencement of surface casing cementing operations. The regulator may also require notification prior to the running and cementing of other casing strings on a case-by-case basis.

At the discretion of the regulator, it should be required that cementing not commence until a representative of the regulator is present.

2.20. CASING AND CEMENTING PLANS

It should be required that: a) detailed casing and cementing plans be submitted to the regulator in support of an application to approve a well; b) the above plans be available at the well site for the duration of casing and cementing operations; and c) any revisions to the plans made as a result of on-site modifications be documented by the operator, initialled and dated, and immediately submitted by phone and fax to the regulator for approval.

2.21. PRESSURE TESTING THE WELL BORE AND SURFACE EQUIPMENT

It should be a requirement that prior to drilling out the surface, intermediate, and production casing, the well operator ensure that the following components are pressure tested: each blow-out preventer, casing string, stabbing valve, inside blow-out preventer, lower kelly valve, choke manifold, bleed-off and kill line and all associated valves in compliance with Alberta Energy Resources Conservation Board (ERCB) Directive 036 Drilling Blowout Prevention Requirements and Procedures.

It should be a requirement that prior to the start of a hydraulic fracturing program, all cemented casing strings and all tubing strings to be utilized in the hydraulic fracturing operations be tested with fresh water, mud or brine to a pressure not less than 3500 kPa greater than the anticipated maximum pressure to be experienced during either the hydraulic fracturing or the life of the completion. If, at the end of 30 minutes of such testing, the pressure shows a drop of 5% or more from the original test pressure, hydraulic fracturing should not be permitted until the relevant condition is corrected. The condition of a casing removed from service in accordance with the preceding sentence should be deemed to be corrected only after the casing demonstrates less than a 5% drop in pressure after being subjected to a subsequent 30 minute pressure test of the type described above.

Prior to commencing a hydraulic fracturing stage and the pumping of hydraulic fracturing fluid, it should be required that the injection lines manifold, associated valves, fracture head or tree and any other wellhead component or connection not previously tested be tested with fresh water, mud or brine to at least the maximum anticipated treatment pressure for at least 30 minutes with less than a 5 % pressure loss. If, at the end of 30 minutes of such testing, the pressure shows a drop of 5% or more from the original test pressure, hydraulic fracturing should not be permitted until the relevant condition is corrected. The condition of a component removed from service in accordance with the preceding sentence should be deemed to be corrected only after the retested component assembly demonstrates less than a 5% drop in pressure after being subjected to a 30 minute pressure test of the type described above.

It should be required that records of all pressure tests be submitted to the regulator on request.

2.22. FRACTURING TREATMENT PLAN

At least 3 days prior to initiating a hydraulic fracturing program, a well operator should be required to submit a fracturing treatment plan to the regulator which includes: a) the date on which the hydraulic fracturing will commence; b) a profile of the anticipated pressures and fluid volumes for pumping each stage; c) a description of the planned treatment interval (i.e., location of top and bottom of perforations expressed in both True Vertical Depth and True Measured Depth; d) the total number of stages and total estimated volume of water* and fracture fluid that will be used for all stages of the hydraulic fracturing operation; e) casing and surface equipment test pressures; and f) the pre-fracturing checklist and certification (see item 2.23, below).

It should be a requirement that the above information be updated after the hydraulic fracturing program has been completed (to compare the planned characteristics of the hydraulic fracturing program with the actual characteristics) and included in the well completion report and submitted to the regulator within 30 days of the conclusion of hydraulic fracturing program.

It should be required that the Plan also verify that the well operator has made contact with any adjacent operators that are drilling, completing or operating an oil or gas well within 2,000 metres of the proposed hydraulic fracturing location, and that arrangements have been made to cooperate through notifications and monitoring of all drilling and completion operations, to reduce the possibility of unintended entry of water, gas, oil, or other formation fluid into a well bore.

** See also the "Water Use Reporting" subheading under Section 6.0.*

2.23. PRE-FRACTURING CHECK LIST AND CERTIFICATION

An operator of an oil or gas well that will be stimulated using hydraulic fracturing should be required to complete, sign and submit a Pre-Fracturing Checklist and Certification at least 3 days prior to commencement of a hydraulic fracturing program. The checklist should have to be signed and dated by an authorized representative of the operator. Among other things, the checklist should require the operator to attest that the operator has met or will meet all relevant casing, cementing and pressure testing requirements, and should require the operator to acknowledge their obligations to notify the regulator as described in this discussion document (e.g. unexpected loss of pressure during hydraulic fracturing, etc.).

2.24. PRESSURE MONITORING, MAXIMUM ALLOWABLE PRESSURE AND TERMINATION OF FRACTURING IN RESPONSE TO UNEXPECTED EVENTS

It should be required that the operator continuously monitor the following parameters during each stage of any hydraulic fracturing treatment: a) surface injection pressure; b) slurry rate; c) proppant concentration; d) fluid rate; and e) all annuli pressures.

It should be required that the hydraulic fracturing treatment pressure not exceed the test pressure of any given component at any time during hydraulic fracturing operations. Differential pressures across the walls of any casing string should not be allowed to exceed 80% of the casing's API rated minimum internal yield pressure, throughout the hydraulic fracturing treatment.

It should be required that hydraulic fracturing be immediately terminated and that the operator

report the occurrence to the regulator within 24 hours if: a) the pressure limit described in the preceding paragraph is exceeded; or b) a volume of fluid circulates to the surface that is in excess of a volume that could reasonably be expected due to temperature and pressure expansion; or c) any anomalous pressure and/or flow condition is indicated or occurring including a significant deviation from the treatment plan or; d) an operator has any reason to suspect a failure of a casing, or casing cement, or the lack of isolation of any sources of non-saline groundwater, (e.g. due to excessive fracture growth or due to intersection with another well bore).

If fracturing is terminated for any of the reasons described in this provision it should be a requirement that: a) the operator perform diagnostic testing as soon as is reasonably practical and if the testing reveals that a failure has occurred, then the operator must shut-in the well and isolate the perforated portion of the well casing as soon as is reasonably practical; and b) hydraulic fracturing not be allowed to recommence until the situation has been resolved to the satisfaction of the regulator.

2.25. CEASING ACTIVITIES WHEN NECESSARY TO PROTECT PUBLIC HEALTH, SAFETY AND THE ENVIRONMENT

If a well operator is not able to effectively repair a deficiency in the design, construction, completion or operation of an oil or gas well so as to protect public health, safety and the environment, including of all sources of non-saline groundwater and all surface waters potentially affected by the well, the regulator should have the authority to require that the well operator cease operations and plug and abandon the well in such a manner that it does not represent a hazard to public health, safety and the environment.

2.26. USE OF CERTIFIED WELL CONTROL PERSONNEL

It should be a requirement that: (a) the driller of an oil or gas well possess a valid first line supervisor's blow-out prevention certificate or well service blow-out prevention certificate issued by a recognized petroleum industry training service (e.g. ENFORM*) that addresses blow-out prevention and kick control procedures; (b) a well operator must provide both a well site representative (other than the rig manager) who is responsible for the supervision of the drilling/servicing operations, and an on-site rig manager who is responsible for the supervision of the drilling/servicing rig; (c) the well site representative and the rig manager must each possess a valid second line supervisor's well control certificate in well control procedures, issued by a recognized petroleum industry training service (e.g. ENFORM); (d) the well site representative and the rig manager must not supervise drilling or well servicing operations at more than one location simultaneously; and (e) the well site representative and the rig manager may make trips off-site, however they must be at all times be capable of returning to the site within a maximum of two hours.

If either of the above personnel are found to not possess a valid certificate as described above the regulator should have the authority to suspend drilling operations as soon as it is safe to do so and to require that operations not resume until such persons are replaced with personnel having the required certification.

** ENFORM is a safety association serving Canada's oil and gas industry.*

2.27. ENHANCING OPERATOR CERTIFICATION AND TRAINING REQUIREMENTS (TECHNICAL SKILLS)

The province should continue to review new training and accreditation standards in the oil and gas industry as they are developed and should require that key operational staff for oil and gas activities meet the latest applicable standards as a condition of working in New Brunswick.

2.28. REMOTE BLOW OUT PREVENTION ACTUATOR

It should be a requirement that blow out prevention equipment installed at wells that will be subject to hydraulic fracturing include a remote blow-out prevention (BOP) actuator that is: a) powered by a source other than rig hydraulics; and b) located at least 25 metres from the wellhead. It should be required that all lines, valves and fittings between the BOP and the remote actuator and any other actuator be flame resistant and have an appropriate rated working pressure.

2.29. ENHANCED BLOW-OUT PREVENTION MEASURES

It is recommended that the province enhance its existing blow-out prevention and control measures by adopting and imposing procedures for drilling and well servicing such as those set out in the latest versions of Alberta Energy Resources Conservation Board (ERCB) Directives 036 Drilling Blowout Prevention Requirements and Procedures and 037 Service Rig Inspection Manual.

When drilling in areas where shallow methane may be present, it should be required that adequate safety measures be taken, including the use of proper well control measures and flare lines or stacks.

2.30. STRAY GAS INVESTIGATION AND RESPONSE GUIDELINES

The province should develop a set of stray gas investigation and response guidelines for oil and gas activities. When an operator of an oil and gas activity becomes aware of a gas migration incident, the operator should be required to immediately investigate and respond to the incident in accordance with these guidelines.

2.31. ENHANCED WELL PLUGGING AND ABANDONMENT REQUIREMENTS

It is recommended that the province enhance its well plugging and abandonment requirements by adopting and imposing procedures such as those set out in the latest version of Alberta Energy Resources Conservation Board (ERCB) Directive 020 Well Abandonment.

2.32. FRACTURING FLUIDS AND TECHNOLOGIES

The Province should continue to monitor the on-going development of hydraulic fracturing technologies and should encourage the use of technologies and additives with the smallest possible environmental footprint as soon as such technologies and additives are commercially available and are proven to be effective in enhancing the yield from New Brunswick's oil or gas bearing formations.

3.0. ASSESSING GEOLOGICAL CONTAINMENT OUTSIDE THE WELL BORE

Reducing the potential for substances such as fracture fluids, drilling fluids, and natural gas to reach water wells or the surface via underground fractures, faults, abandoned oil or gas wells, or a confining layer that is otherwise inadequate.

Short Term Recommendations

3.1. ASSESSMENT OF GEOLOGICAL CONTAINMENT PRIOR TO HYDRAULIC FRACTURING

When requested by the regulator (e.g. prior to initiating a hydraulic fracturing program for the first time in a previously undrilled geologic basin and/or geographic region as determined by the regulator), it should be required that a well permit holder prepare an assessment of the ability of the intervening zone (between the oil or gas-bearing strata and the base of a non-saline groundwater aquifer) to contain the hydraulic fracturing treatment and prevent the vertical migration of fracturing fluid, formation water, hydrocarbons or other potential contaminants, to strata that contain non-saline groundwater. It should be required that: a) the results be interpreted, signed and sealed by qualified professional engineer or geoscientist with knowledge and understanding of stratigraphic and aquifer characteristics; and b) the assessment be provided to the regulator prior to the commencement of the hydraulic fracturing program.

It should be required that the above assessment: a) consider all relevant information available to the well operator such as well logs, image logs, core samples, diagnostic fracture injection testing, etc.; b) include a review of the location and extent of abandoned hydrocarbon wells, geologic faults (horizontal and vertical) and natural fracture zones to verify that such wells, faults and natural fracture zones will not permit the vertical migration of the fracturing fluids, formation water, hydrocarbons or other contaminants into strata that contain non-saline groundwater; c) consider the potential for induced fractures to form connections between the stimulated well and adjacent, producing or abandoned hydrocarbon wells; and d) include an analysis of the mobility of fracturing fluid in the strata between the perforated well casing and strata containing non-saline groundwater. The mobility analysis must consider the best available information about factors including but not limited to: hydraulic gradient, seepage velocity, required travel time, pore storage volume, and geochemistry (solubility, adsorption, etc.).

The well permit holder should be required to consider the results of the assessment described above in designing the hydraulic fracturing program so as to ensure that the fracturing fluids, formation water or hydrocarbons will not migrate vertically outside the well bore and thereby come into contact with any strata that contain non-saline groundwater.

If the above assessment suggests that there is a possibility that the induced fractures will extend to an aquifer containing non-saline groundwater, or to an adjacent hydrocarbon well bore, then hydraulic fracturing should not be permitted to occur unless appropriate mitigation is identified by the well operator and accepted by the regulator.

3.2. ANALYSIS OF THE RESPONSE OF GEOLOGICAL FORMATIONS TO HYDRAULIC FRACTURING

As part of any well completion activity that involves hydraulic fracturing, it should be a requirement that a well operator conduct sufficient analysis (e.g. microseismic monitoring, pressure curve analysis and/or other appropriate surveillance techniques) to fully understand the inherent stress regimes in

the geological formation and how the formation responded to hydraulic fracturing.

Within 30 days of the completion of a hydraulic fracturing program, the operator should be required to submit a report describing the fracture geometry that was achieved (i.e. the maximum horizontal and vertical extent of the fractures).

3.3. RESTRICTIONS AND SPECIAL REQUIREMENTS IN RELATION TO SHALLOW HYDRAULIC FRACTURING

Shallow hydraulic fracturing should be defined by the regulator as hydraulic fracturing taking place at a depth of less than 500 metres below the surface or alternatively, above any other depth that may be defined by the regulator based on site-specific geology.

The regulator should have the authority to allow shallow fracturing on a case-by-case basis, subject to the preparation of such additional studies, information and the use of such practices as the regulator may require. These may include some or all of the following: a) enhanced set-backs from surface features; b) enhanced pre and post fracturing environmental monitoring as determined by the regulator; c) specified composition of the fracturing fluid; d) additional financial security and liability insurance as determined by the regulator; e) reduced hydraulic fracturing treatment pressures and/or fluid volumes; and e) any other measures or information that the regulator may require.

Hydraulic fracturing for oil or gas exploration or production within aquifers containing non-saline groundwater should be prohibited in all cases.

4.0 MANAGING WASTES AND PREVENTING POTENTIAL CONTAMINANTS FROM ESCAPING THE WELL PAD

Reducing the potential for escape of substances at the surface due to spills, leaks, improper storage and handling of chemicals, and inadequate treatment or disposal of wastes such as flowback water and produced water.

Short Term Recommendations

4.1. WELL PAD CONSTRUCTION

It should be required that the design and construction of a proposed well pad incorporate measures to prevent the downward migration of potential contaminants from the surface into underlying groundwater systems. Such measures could include but are not limited to one or more impermeable liners under-laying the well pad or under-laying portions of the well pad where liquid storage and handling will take place.

Oil and gas operators should be required to submit the design of a proposed well pad (proposed fill materials, berms, liners, etc.) to the regulator for review and approval prior to well pad construction.

See also the "Storage Tanks - Secondary Containment", "Run-off Management Plan", and "Access Control" subheadings located elsewhere in this section. Well pad location is addressed in Section 9.0.

4.2. USE OF CLOSED LOOP DRILL FLUID SYSTEMS

The use of closed loop, pitless systems for the management of drilling fluid should be mandatory for oil and gas wells drilled in New Brunswick.

4.3. EMERGENCY CONTAINMENT OF HYDRAULIC FRACTURING FLUID

It should be required that an adequately sized, function-tested relief valve and an adequately sized diversion line be installed and used to divert flow from the casing being used for hydraulic fracturing to a covered, watertight tank, in case of hydraulic fracturing string failure. It should be required that the relief valve be set to limit the pressure inside the casing to no more than 95% of the lowest internal yield pressure rating of the casing.

When requested by the regulator, it should be required that the operator have a vacuum truck on stand-by at the well site during the pumping of hydraulic fracturing fluid and during the flowback phase.

Where applicable, alternative emergency containment features should be permitted by the regulator in the event that a well operator employs a small volume of fracture fluid or a hydraulic fracturing technology that does not involve the use of a fluid that is a liquid at aboveground temperatures and pressures.

4.4. WASTE MANAGEMENT PLAN

Developers and operators of oil or gas wells should be required to submit a waste management plan to the regulator for approval, prior to commencing operations. The plan should have to: a) demonstrate that due consideration has been given to minimizing and managing waste through recycling and re-use; b) describe the type(s) of waste that will be generated; c) describe how those wastes will be handled and stored; c) describe the proposed method(s) and location(s) of waste treatment, re-use, or disposal; and d) contain any other information that the regulator may require.

The regulator should also require that the waste management plan demonstrate how the developer or operator intends to comply with the requirements that are specified in the province's waste management guidelines (below) and contained in any conditions attached to permits, approvals or licences issued by the regulator, that address waste management.

4.5. WASTE MANAGEMENT GUIDELINES - GENERAL

The province should develop waste management guidelines to assist developers and operators of oil or gas wells in preparing the above waste management plan. Topics to be included in the guidelines should include (but are not limited to): a) storage, conveyance, treatment and disposal of flowback water and produced water; b) protocols for addressing naturally occurring radioactive materials; c) discharge criteria for treated waste; and d) waste disposal reporting and notification requirements.

Note: Additional details regarding the requirements to be contained in the Waste Management Guidelines and addressed in waste management plans are described in Sections 4.6 to 4.9, below.

4.6. WASTE MANAGEMENT GUIDELINES - WASTE CHARACTERIZATION

It should be required that all wastes generated at a well pad or recovered from a well bore be identified and characterised by the oil or gas well operator.

4.7. WASTE MANAGEMENT GUIDELINES - ON SITE DISPOSAL RESTRICTIONS

No on-site disposal of waste should be allowed except as explicitly permitted by both the regulator and the landowner. Drill cuttings, for example, if

properly segregated, characterised, dewatered and verified to be uncontaminated in accordance with a list of chemical criteria contained in the waste management guidelines, could be given consideration for on-site disposal or land spreading.

4.8. WASTE MANAGEMENT GUIDELINES - FLOWBACK WATER AND PRODUCED WATER

The use of excavated pits for the storage of flowback water or produced water should not be permitted. It should be required that all flowback and produced water recovered from an oil or gas well be conveyed by piping to covered, water-tight tanks equipped with secondary containment. It should also be required that tanks and piping used to store and transport flowback and produced water must be constructed of heat and corrosion-resistant materials compatible with operational pressures and with the known or anticipated chemical and physical properties of the water, in accordance with an approved waste management plan.

The regulator should identify recycling as the preferred method of managing flowback water and produced water. When recycling is not proposed, a well operator should be required to demonstrate to the satisfaction of the regulator that recycling of flowback and produced water is not feasible.

Subject to the above, the regulator should require that flowback and produced water be: a) treated in accordance with an approved waste management plan and placed in appropriate tankage for short term storage prior to re-use (e.g. in hydraulic fracture or drilling operations); or b) transported to an appropriate waste water treatment facility in the province for treatment and disposal or alternative uses (if the use of the receiving facility has been specifically approved by the regulator and subject to the terms and conditions of that approval); or c) transported to an appropriate, licensed waste treatment and disposal facility outside the province.

Recycled flowback or produced water should not be allowed for use in drilling until, in the opinion of a qualified professional retained by the well operator, all porous strata that contain non-saline groundwater have been isolated from the drilling fluid by the installation and cementing of surface casing.

The duration of on-site storage of flowback water should be limited to 90 days from the last day of well completion or servicing operations unless otherwise permitted by the regulator.

4.9. WASTE MANAGEMENT GUIDELINES - NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORMS)

It should be required that flowback water recovered after hydraulic fracturing operations, fluids recovered during the production phase (i.e. produced water), drill cuttings and used drill fluids be tested for NORMs by the well operator prior to their removal from the well site. The operator should be required to submit a report outlining the findings of the testing, to the regulator. The report should be required to: a) state whether NORMs were found in excess of criteria defined by the province; b) describe the NORM concentrations; and c) present a proposal on how the NORM-affected materials will be managed. It should be a requirement that the report be submitted to the regulator for review and approval prior to any NORM-affected materials leaving the site.

Radiation Survey

If NORMs are detected as a result of the initial testing as described above, periodic radiation surveys should be required at time intervals specified

by the regulator during the well completion and production phases. It should be required that: a) such surveys be performed on all accessible well piping, tanks, or equipment that could contain NORM scale build-up; b) the results be reported to the regulator, including the locations and concentrations of any NORM-affected tanks, piping or equipment; and c) approval from the regulator be obtained prior to removal of any NORM-affected piping, tankage or equipment from the site.

Subsequent Testing

If NORMs are detected as a result of the initial testing as described in the first paragraph of this provision, it should be required that periodic (monthly or as otherwise determined by the regulator) testing of produced water for NORMs continue during the life of the well, and that approval be obtained from the regulator prior to removal of any NORM-affected material from the site.

4.10. USE OF EXISTING WASTE WATER TREATMENT FACILITIES

Municipal waste water systems are typically not designed to deal effectively with the high concentrations of dissolved solids found in flowback and produced water. The same can be said of some industrial waste water treatment facilities. Therefore, if disposal of a waste fluid (e.g. flowback or produced water) at an existing (e.g. municipal or industrial) waste water treatment facility in New Brunswick is contemplated, the existing waste water treatment system would first have to be upgraded as required to ensure that effective treatment is provided. Toward this end, the waste water facility operator, in consultation with the well developer or operator and the regulator should be required to: a) fully characterize the concentrations of contaminants in the waste fluid; and b) install any necessary treatment processes to ensure that the waste water treatment system will have sufficient capacity and will be capable of addressing the contaminants found in the waste fluid, without impacting the long term viability or life span of the waste water treatment system and without causing other negative impacts including but not limited to adverse impacts on the quality of the receiving water.

As is currently the case, if the facility was not previously approved to accept the waste material the waste water facility operator would have to apply for and obtain an amendment to the facility's approval to operate, from the regulator*.

Downstream water quality monitoring should be required as a condition of the above mentioned approval for any wastewater treatment facility that discharges to surface water.

** Modification of an existing municipal or industrial wastewater treatment facility (i.e. a change in treatment process or increase in treatment capacity) would typically trigger a requirement for registration under the Environmental Impact Assessment Regulation, Clean Environment Act.*

4.11. PREVENTION, NOTIFICATION AND RESPONSE - SPILLS AND INCIDENTS

It should be a requirement that those conducting hydraulic fracturing develop and implement spill prevention plans (addressing spill containment, operational practices, etc.) and must report to the regulator, any non-routine event or occurrence that represents a risk to public safety, public health or the environment. Such events or occurrences may include but are not limited to: casing, drill pipe or hydraulic fracturing equipment failures, cement failures, spills, leaks, complaints of well water

contamination, etc. It should be required that the report be made within time frames established by the regulator.

Further to the above, the province should review its existing spill and leak notification and response requirements contained in instruments such as the Water Quality Regulation, Clean Environment Act, the Guideline for the Management of Contaminated Sites, etc., and ensure that they are sufficient to address spills and leaks that may result from oil and gas activities. Operators of oil and gas activities should be required to develop spill and leak notification and response protocols that are consistent with Provincial requirements.

See also the "Stray Gas Investigation and Response Guidelines" subheading under Section 3.0, the "Emergency Containment of Hydraulic Fracturing Fluid" subheading under Section 4.0 and the "Security and Emergency Planning" subheading under Section 8.0.

4.12. RUN-OFF MANAGEMENT PLAN

The province should require developers and operators of oil or gas wells to implement and maintain best management practices to control runoff generated by rainfall and snow melt, in a manner that minimizes erosion, and prevents the transport of sediment and other pollutants offsite. Towards this end, the province should develop guidelines for preparing run-off management plans for well pads. Developers and operators of oil or gas wells should be required to prepare and submit for approval, run-off management plans that are consistent with the guidelines.

4.13. CHEMICAL MANAGEMENT - GENERAL PROVISIONS

Chemical handling and storage requirements and standards are specified in the General Regulation under the Occupational Health and Safety Act and in conditions attached to Approvals to construct and operate issued under the Air Quality Regulation, Clean Air Act and the Water Quality Regulation, Clean Environment Act. No changes are proposed to this general framework*.

** Part VIII of the General Regulation, Occupational Health and Safety Act addresses a variety of issues pertaining to the storage and handling of chemicals. In addition, the Department of Environment has the ability to establish chemical storage and handling requirements using conditions attached to approvals to construct and operate facilities, issued under the Air Quality Regulation, Clean Air Act and the Water Quality Regulation, Clean Environment Act. The Department has previously attached conditions to the above noted approvals in relation to oil or gas wells. The conditions typically state that the approval holder must ensure that all chemicals stored at the facility are located in a dedicated chemical storage system. The system must be designed to ensure that all chemicals are: a) secured and sealed in chemically resistant containers; b) away from high traffic areas and protected from vehicle impacts; c) away from electrical panels; d) in a containment area that has secondary containment adequate to contain 110% of the volume of the largest container, designed to prevent the release or discharge of chemicals to the environment as a result of a spill; and e) in an area designed to prevent contact between incompatible chemicals.*

4.14. CHEMICAL MANAGEMENT - TRANSPORTATION

All transportation of substances and chemicals should continue to be performed in compliance with the applicable regulations for the transportation of dangerous goods*.

** The General Regulation made under the New Brunswick Transportation of Dangerous Goods Act, adopts the requirements of the federal Transportation of Dangerous Goods Regulations including requirements pertaining to classifications, shipping documents, safety marks, means of containment, training, and emergency response plans.*

See also the "Security and Emergency Planning for Oil and Gas Activities" subheading under Section 8.0 and the "Haul Route Planning" subheading under Section 9.0.

4.15. CHEMICAL MANAGEMENT - CHEMICAL INVENTORY

Developers and operators of oil and gas facilities should be required to maintain an inventory of chemicals used or stored at each facility location, including but not limited to fuel and other products used during drilling, completion, and workover operations, including hydraulic fracturing.

Operators maintaining chemical inventories under this section should be required to update these inventories as required throughout the life of an oil and gas facility. It should be required that these records be maintained in a readily retrievable format at the operator's local field office.

4.16. ACCESS CONTROL

It should be a requirement that if a well pad will be left unattended, all chemicals including chemical additives used for well stimulation and hydraulic fracturing must be removed from the site or secured from public access. It should be required that plugs, valves or other release mechanisms associated with storage tanks and containers be locked when not in use.

Where a battery is located within 800 metres of an occupied dwelling, school, picnic ground, campground, etc. it should be required that the battery be equipped with fencing at least two metres high, constructed of small mesh, industrial-weight fencing, and equipped with a gate that is locked when the well site is unattended. Where a battery is located elsewhere, it should be required that the battery be equipped with a cattle-type fence with a minimum of four-strand barbed wire and a gate.

Where a well head is located within 800 metres of an occupied dwelling, school, picnic ground, campground, etc., it should be required that the well owner enclose the well head and all associated equipment with a fence suitable for the prevention of tampering with wellhead equipment. The fence should be constructed of small mesh, industrial-weight fencing not less than two metres high and equipped with a gate that is locked when the well is unattended.

4.17. STORAGE TANKS - SECONDARY CONTAINMENT

It should be a requirement that: a) storage tanks associated with an oil and gas facility (except tanks or vessels used to store freshwater) and liquid mixing and staging areas be equipped with secondary containment; b) Underground storage tanks have an integral leak detection system installed between the two containment layers ; and c) all storage tanks be suitable for the intended use and designed in accordance with Underwriters Laboratories (UL), American Petroleum Institute (API), or other applicable standards.

4.18. ENHANCED PRECAUTIONS FOR SOUR GAS

The province should review and enhance its existing provisions for assessing the sulphur content of natural gas and managing sour gas, with reference to regulations in other jurisdictions such as British Columbia where sour gas is common*.

** To date no sour gas has been encountered in New Brunswick.*

Potential Longer Term Responses

4.19. IDENTIFYING ADDITIONAL WASTEWATER TREATMENT AND DISPOSAL OPTIONS

If it becomes apparent that the future scale of oil and gas activities will become large enough to require the establishment of centralized wastewater recycling, treatment or disposal facilities within New Brunswick by the oil and gas industry, the province should consider formulating a position regarding preferred options (locations, technologies, etc.) consistent with the province's environmental goals and objectives including the waste management and water conservation principles expressed in this document.

Note: Any proposal for a new waste water treatment or disposal facility would trigger a requirement for registration and review of the proposed facility under the Environmental Impact Assessment Regulation, Clean Environment Act.

5.0 MONITORING TO PROTECT WATER QUALITY

Monitoring groundwater and surface water to: a) ensure that the water-related safeguards included in this document are effective; and b) provide early warning of any problems. Monitoring at oil and gas wells to detect problems that may affect water quality.

Short Term Recommendations

5.1. PRE- AND POST SEISMIC WATER WELL TESTING

On June 23, 2011, the Government of New Brunswick announced that water samples from all potable water wells located within 200 metres of geophysical (seismic) testing (i.e. within 200 metres of a seismic source point) must be collected and analyzed prior to initiating seismic testing. The samples must be collected by an independent third party consultant hired by the seismic operator and must be analyzed by the Department of Environment's laboratory at the operator's expense. The purpose is to document the water quality in the well before nearby seismic testing takes place. Follow-up (post seismic) sampling and testing are also required, so that any impacts to water supplies as a result of the seismic testing can be identified and addressed*. The province has developed a Baseline Testing Standard for Water Wells in Proximity to Seismic Exploration, identifying the required timing of the sampling and the parameters that must be analyzed.

** See the "Water Supply Replacement or Restoration" subheading under Section 10.0.*

5.2. PRE- AND POST DRILL WATER WELL TESTING

On June 23, 2011, the Government of New Brunswick announced that water samples from all potable water wells located within 500 metres of the

wellhead of an oil or gas well must be collected and analyzed before drilling operations begin. The samples must be collected by an independent third consultant hired by the well operator and must be analyzed by the Department of Environment's laboratory at the operator's expense. The purpose is to document the water quality in the water well before drilling takes place. If the presence of methane gas is detected in water wells, samples must be collected and analysed using techniques allowing for the differentiation of thermogenic and biogenic gas. When an oil or gas well is drilled on a new well pad, it should be required that this sampling take place prior to the commencement of land clearing and well pad construction. Follow-up (post drilling and hydraulic fracturing) sampling and testing are also required, so that any impacts to water supplies as a result of the well pad construction, drilling, and hydraulic fracturing can be identified and addressed*. The province is in the process of developing a protocol identifying the required timing of the sampling and the parameters that must be analyzed.

When deemed necessary to supplement water well sampling requirements the regulator should require that one or more groundwater monitoring wells be constructed adjacent to selected well pads, to monitor groundwater quality in the unconsolidated overburden and detect contamination due to leaks or spills.

** See the "Water Supply Replacement or Restoration" subheading under Section 10.0.*

5.3. SURFACE WATER MONITORING

It is recommended that the province require surface water monitoring by developers and operators of well pads located within 150 metres of any watercourse. This should include: a) the collection and testing of water samples prior to the commencement of land clearing and well pad construction, at locations upstream and downstream of the well pad; b) additional sampling and testing at the same locations and for the same parameters during well construction and hydraulic fracturing; and c) such sampling and testing as may be required by the regulator based on subsequent activities taking place at the well pad (e.g. subsequent hydraulic fracturing programs, etc.). The province is in the process of developing a sampling and testing protocol to assist developers and operators of well pads in addressing this requirement.

5.4. MONITORING AT OIL AND GAS WELLS

It should be a requirement that an operator of an oil or gas well that has been completed to produce oil or natural gas submit to the regulator for approval, a monitoring plan for the well and implement the approved plan. The items that the plan must address should include the following as applicable: a) annulus pressures; b) well casing corrosion, equipment deterioration, or changes in well characteristics that could potentially indicate a deficiency in the production casing, intermediate casing, surface casing, casing cement, packers or any other aspect of well integrity necessary to ensure isolation from potable groundwater; and c) surface casing vent flow (see below).

A well operator should be required to equip each oil and gas well that has been completed to produce oil or natural gas with a system to detect leaks (e.g. a surface casing vent) and a well head that allows monitoring of pressures within each well bore casing. The well operator should be required to notify the regulator immediately on detection of a casing leak or failure and provide a report assessing the leak or failure, including a discussion of the cause, duration, proposed remedial program, and

measures to prevent future failures.

If a well operator has any reason to suspect a leak or deficiency as described above, then the well operator should be required to perform any necessary diagnostic testing on the well to determine whether a leak or deficiency has actually occurred. It should be required that the diagnostic testing be done as soon as is reasonably practical after the operator has cause to suspect a leak or deficiency, and if the testing reveals that a leak or deficiency has occurred then the operator should be required to: a) notify the regulator; b) promptly take all appropriate measures to prevent environmental contamination; and c) promptly commence remedial operations that are designed to repair the leak or deficiency.

See also the "Prevention, Notification and Response - Spills and Incidents" subheading under Section 4.0 and the "Stray Gas Investigation and Response Guidelines" subheading under Section 2.0.

Potential Longer Term Responses

5.5. ENHANCING THE PROVINCIAL WATER MONITORING NETWORK

In the longer term, if warranted by the future scale of oil and gas activities in New Brunswick consideration should be given to enhancing the provincial surface water and groundwater monitoring network as necessary to ensure that the province retains the ability to responsibly manage water resources in watersheds that are found to contain oil or natural gas resources.

6.0 PROVIDING FOR THE SUSTAINABLE USE OF WATER

Implementing measures in relation to oil and gas activities that will reduce freshwater consumption, conserve New Brunswick's potable water, and require the sustainable use of water by the operators of oil and natural gas activities.

Short Term Recommendations

6.1. WATER CONSERVATION AND RECYCLING

The regulator should identify recycling and re-use as the preferred method of managing flowback water, produced water and other waste water generated by the developers and operators of oil or gas wells. If recycling/re-use is not proposed, a well developer or operator should be required to demonstrate to the satisfaction of the regulator that recycling and re-use are not feasible.

6.2. ESTABLISHING A HIERARCHY OF PREFERRED WATER SOURCES

The regulator should require that developers and operators of oil or gas wells investigate all potential sources of water for drilling, hydraulic fracturing, and other well completion activities according to the following hierarchy in descending order of preference (from most preferred to least preferred): 1) treated/recycled wastewater from municipal or industrial sources, including flowback and produced water from oil or gas wells; 2) ocean water; 3) non-potable groundwater water (e.g. from deep, saline aquifers); 4) dugouts or catchments or other features that capture run-off or rainwater; 5) lakes or watercourses (including municipal water supplies drawn from lakes, watercourses or impoundments); 6) potable groundwater (including municipal water supplies drawn from groundwater).

If a developer or operator proposes to use Options 5 or 6 they should be required to justify this decision by stating why other water sources cannot be used. If proposed water use exceeds 50 cubic metres per day, the developer or operator should also be required to verify the sustainability* of the proposed water supply.

If the use of a water-based hydraulic fracturing treatment is proposed, the well developer or operator should be required to state why the use of waterless alternatives was not proposed.

** See "Assessment of Proposed Water Sources" below.*

6.3. ASSESSMENT OF PROPOSED WATER SOURCES

It should be a requirement that the rate of water withdrawals for use in drilling or completing oil or gas wells not exceed sustainable limits. In particular, no water use should be permitted that would cause non-saline groundwater to become depleted, or cause: a) a progressive lowering of groundwater levels; b) water quality degradation; or c) reduction of surface water flows to an extent that would adversely affect aquatic habitat, aquatic ecosystems, or other water users.

For water works having a capacity to withdraw groundwater at a rate exceeding 50 cubic metres per day, the regulator should continue to require the completion of a water supply source assessment by the proponent in accordance with its established Water Supply Source Assessment Guidelines*. These include: a) an aquifer testing protocol to evaluate whether or not any proposed water well(s) can provide and sustain the desired yield; b) a long term yield and drawdown projection; and c) an assessment of impacts on other water users.

It should be required that proposed withdrawals of surface water from rivers, lakes and streams, exceeding 50 cubic metres per day be accompanied by a source assessment including but not limited to information that demonstrates that a "pass-by flow" will be maintained, calculated on seasonal, site-specific basis to avoid significant adverse environmental impacts including: reduced stream flow, impacts on aquatic habitat and ecosystems, and impacts on other water users.

In cases where the same water source (i.e. the same water body or aquifer) will be used by more than one oil or gas well developer or operator or by a single developer/operator using more than one water supply system, then it should be required that the above assessments be based on cumulative water use.

If the developer or operator of an oil or gas well intends to obtain water from a municipal water supply, the regulator should require a prior assessment of the impact of the proposed use on the sustainability and reliability of the municipal water supply for its primary use (i.e. the provision of potable drinking water).

** A water supply source assessment would not be required for pumping of water from deep saline aquifers that are isolated from the surface and are not part of the hydrologic cycle.*

6.4. WATER USE PLANNING

Developers of oil or gas wells should be required to prepare and submit annual water use plans detailing the locations of their approved water sources, the estimated quantities and types of water (surface/ground, fresh/salt, treated or recycled, etc.), the potential timing of this use during the year, and the methods by which they plan on treating and

disposing of subsequent wastewater. This plan must also include contingencies for water sourcing should their primary approved water supply source(s) be disrupted (e.g. drought or equipment malfunction).

6.5. WATER USE REPORTING

Developers and operators of oil or gas wells should be required to report the amount of water they use for each purpose (drilling, cementing, hydraulic fracturing, etc.) and from each source, in a manner and frequency determined by the regulator.

Potential Longer Term Responses

6.6. WATER MANAGEMENT STRATEGY FOR OIL AND GAS DEVELOPMENT

In the longer term, the province should develop a water management strategy to ensure that water used in the development of natural gas is managed sustainably, optimizing its benefits to ecosystems, society and the economy. This strategy should be informed by the comprehensive water management strategy currently under development by the province.

6.7. WATER USE PERMITS

In the longer term, the province should consider the possibility of establishing a water use permitting and approval process for large volume water users within the province including developers and operators of oil and gas activities.

7.0 ADDRESSING AIR EMISSIONS INCLUDING GREENHOUSE GASES

Setting emission limits, monitoring emissions and planning for emission reductions.

Short Term Recommendations

7.1. EMISSION LIMITS

The regulator should identify and impose objective-based (i.e. outcome-based) emission limits for oil and gas facilities, where appropriate to ensure that: a) Canada's national ambient air quality standards and other air quality standards established by the province of New Brunswick, will be achieved and; b) maximum ground level concentrations set out in the Air Quality Regulation under the Clean Air Act will not be exceeded.

7.2. EMISSIONS MONITORING

The regulator should require that operators of oil and gas facilities conduct air emissions monitoring and/or calculate their emissions for appropriate activities. Results of emissions monitoring should be reported to the province.

7.3. AMBIENT AIR QUALITY MONITORING

The regulator should require that operators of oil and gas facilities design and implement an ambient air quality monitoring program, where appropriate. The scope of the program will depend on the potential for cumulative air quality impacts including the intensities and types of existing and proposed activities in a given area (e.g., trucking, types of pumps or generators, the presence of other oil or natural gas operators, the presence of other industrial activities, etc.). The program may be required to include any or all of the following

components: a) compilation of calculated emission factors showing total pollutant outputs in a given area; b) ground level impact modelling showing the potential impact on ambient air quality including potential levels of smog-forming chemicals such as ozone; c) real-time multi-parameter ambient monitoring stations; d) grab samples; and e) odour monitoring and upset or occurrence monitoring when odours or other unusual events are noticed.

7.4. EMISSION REDUCTION PLANS

The regulator should require that operators of oil and gas facilities prepare, adopt and follow a fugitive emissions management plan, where appropriate.

When requested by the regulator developers and operators of oil and gas facilities should be required to prepare and follow a greenhouse gas (GHG) emission reduction plan. The plan should describe proposed GHG reduction measures to be employed during well drilling, well completion, and the production, gathering and processing of oil and gas.

As part of the above it should be a requirement that to the extent possible, gases entrained in flowback or produced water are not vented directly to the atmosphere. Alternatives to venting include: a) capture for sale or on-site use or; b) flaring, if capture for sale or use is not feasible.

Note: The Government of Canada is in the process of developing greenhouse gas regulations for the oil and gas industry. These will be applied to oil and gas activities in New Brunswick and the rest of Canada, once they have been finalized.

7.5. GREENHOUSE GASES - REPORTING EMISSIONS

The regulator should require that operators of oil and gas facilities report their greenhouse gas emissions to the province, where appropriate, in a manner and frequency determined by the regulator.

Potential Longer Term Responses

7.6. ENHANCED AMBIENT AIR QUALITY MONITORING BY THE PROVINCE

In the longer term, the province should consider the strategic expansion of its ambient air quality monitoring network to improve coverage of areas affected by oil and gas development. This should address issues such as monitoring equipment requirements and monitoring locations.

8.0 ADDRESSING PUBLIC SAFETY AND EMERGENCY PLANNING

Planning for public safety and emergency response.

Short Term Recommendations

8.1. SECURITY AND EMERGENCY PLANNING FOR OIL AND GAS ACTIVITIES

When requested by the regulator, operators of oil and gas activities are currently required to submit to the regulator an emergency management program compliant with Canadian Standards Association Standard Z1600*, and a security management program compliant with Canadian Standards Association Standard Z246**. These programs must address all phases of oil and natural gas activities including: a) exploration; b) design, construction, start-up and operation of facilities; and c) abandonment and de-commissioning.

As part of the above, operators should be required to address security and emergency management risks outside of the physical footprint of their site operations (e.g. transportation systems, material storage locations etc.) including all off-site activities that take place in support of their operations.

** This standard outlines the requirements for a comprehensive emergency management program. It's goal is to establish the elements of a continuous improvement process to develop, implement, maintain, and evaluate emergency management and business continuity programs that address the functions of prevention and mitigation, preparedness, response, and recovery.*

*** This standard is designed to address the prevention and management of security risks that could result in a negative impact on people, the environment, assets, and economic stability.*

Note: See also the "Notification and Response Regarding Spills and Incidents" under Section 4.0 and the "Stray Gas Investigation and Response Guidelines" subheading under Section 2.0.

9.0 PROTECTING COMMUNITIES AND THE ENVIRONMENT

Addressing the challenges that oil and gas activities may represent for social and physical environments that are valued by New Brunswickers.

Short Term Recommendations

9.1. VEHICULAR TRAFFIC - OVERSIZE/OVERMASS LOADS AND WEIGHT RESTRICTIONS

Oversize/overmass loads and weight restrictions should continue to be managed using special permits issued under the Vehicle Dimensions and Mass Regulation of the Motor Vehicle Act.

Note: This means that transporters must ensure that the vehicle configurations they wish to operate in New Brunswick meet the all criteria established by the Department of Transportation, or that they are eligible for special permits that will allow them to operate under specific conditions.

9.2. VEHICULAR TRAFFIC - HAUL ROUTE PLANNING

When proposing an oil or gas activity, the proponent should be required to provide an estimate of the vehicular traffic that would be generated. The regulator should assess this information in consultation with the Department of Transportation and Infrastructure and/or local road authority to determine if preparation of a haul route plan is required. When requested by the regulator, the proponent should be required to submit for approval a haul route (road use) plan in advance of commencement of the oil and gas activity. The plan should include a description of the proposed haul route(s) including maps. The plan should also include measures designed to mitigate the impacts of trucking on: public safety, existing traffic patterns, the physical condition of roads and related infrastructure, and the environment. The content should address issues such as: estimated amount of trucking (number of trips, size of vehicles, etc.), hours of operations, off road parking/staging areas, dust management, etc. When preparing the plan the proponent should be required to consult with the Department of Transportation and Infrastructure and/or local road authority and also with the local school district to address the transportation and safety needs of children going to and from school (by car, bus bicycle or on foot). Consultation with other interested parties should also be required as determined by the regulator. The above plan should address the cumulative impacts of trucking planned by all oil and natural gas companies active in a single geographic area.

9.3. VEHICULAR TRAFFIC - ROAD USE AGREEMENTS AND ROAD SYSTEM INTEGRITY STUDIES

When requested by the regulator, in consultation with the Department of Transportation and Infrastructure and/or the local road authority*, the proponent of an oil or gas activity should be required to complete a road use agreement with the Department of Transportation and Infrastructure and /or the local road authority. The agreement should include a mechanism that will be used to: a) identify areas where upgrades and repairs are required prior to commencement of heavy trucking related to the oil and gas industry (e.g. culverts and bridges that may require reinforcing or upgrading); b) identify damage to roads and related infrastructure (culverts, bridges, etc.) caused by increased traffic generated by an oil or gas activity and c) assign costs for repairs and upgrades to the responsible oil or gas operator as appropriate.

It should be a requirement that the above road use agreement be developed on the basis of a road system integrity study, completed in advance of the commencement of the subject vehicle movements. The study should be designed and implemented at the expense of the operator of an oil or natural gas activity, in consultation with the Department of Transportation and Infrastructure and/or the local road authority. It should include a video record of the haul route, still photography, field measurements and written descriptions, etc. sufficient to: a) fully document existing road conditions including existing heavy truck traffic; b) assess the ability of roadways comprising the haul route(s) to accommodate anticipated truck traffic; and c) identify areas where upgrades and repairs are required prior to commencement of heavy trucking (e.g. culverts or bridges that may require reinforcing or upgrading).

** A decision as to whether or not a road use agreement and road system integrity study is required should be made on a case-by-case basis, considering factors such as the anticipated % increase in heavy truck traffic, the duration of the traffic increase and the design capacity and condition of the existing roads that will be utilized. Where the heavy truck traffic is generated by more than one road user, the cost of preparing the study should be shared among the different users.*

9.4. NOISE LEVEL LIMITS

It is recommended that maximum permissible levels of noise resulting from the construction and operation of oil and gas facilities be set at 50 dBA Leq for the daytime period (7 a.m. to 7 p.m.) and 40 dBA Leq for the night-time (7 p.m. to 7 a.m.). These noise levels should apply at the external wall of a noise receptor (e.g. a dwelling or other noise sensitive building). If there is no noise receptor within 1,500 metres, the noise levels should apply at a distance of 1,500 metres measured from the centre of the noise source (e.g. the centre of a well pad or compressor station).

The regulator should have the authority to allow adjustments* to the above basic sound levels on the basis of site-specific conditions such as the duration of the noise-generating activity and the proximity of the noise receptor to other noise-generating activities (e.g. a highway, airport, etc.).

If a new noise receptor is subsequently constructed near an existing oil and gas facility, the permissible sound level should be the existing noise level at the location of the new noise receptor, provided that the oil or gas facility is in compliance with the noise level limits described in the preceding paragraphs.

** Examples of such adjustments are available in the British Columbia Oil and Gas Commission's Noise Control Best Practices Guideline and Alberta Energy Resources Conservation Board (ERCB) Directive 038 Noise Control.*

9.5. NOISE MITIGATION AND MONITORING

If an oil or gas well, or a compressor station or a gas conditioning plant is proposed for a location within 1,500 metres of any dwelling, elementary school, middle school, high school, hospital, nursing home or other structure designed for human occupancy as may be identified by the regulator*, it should be a requirement that appropriate and effective noise mitigation features and practices be employed. These measures should be designed to ensure that noise levels do not exceed those described above.

It should be a requirement that all proposed noise mitigation features/measures be documented in a noise mitigation plan, (which includes a plan to monitor noise levels) and submitted to the regulator

for review and approval prior to commencement of the noise-generating activities.

The regulator should have the authority to vary or waive noise mitigation and monitoring requirements, if the facility operator and all owners and tenants of buildings within 1,500 metres of the noise source are parties to a written agreement specifying that the above measures are not required, or that alternative measures will be employed.

**The above provision is intended to establish requirements for buildings that were already in place at the time that an application to allow the oil or gas facility was received by the regulator.*

9.6. VISUAL IMPACT - MITIGATION PLAN

When requested by the regulator, a proponent of an oil or gas activity should be required to prepare and submit for review, a visual impact assessment and mitigation plan in relation to well pads, and other above ground structures such as compressor stations or gas conditioning plants. Among other things, the plan should address the impact of artificial lighting (including from flares).

9.7. FACILITY SITING RESTRICTIONS AND SET-BACKS - GENERAL PROVISIONS

It should be required that: a) well pads be located on the most level location obtainable that will accommodate the intended use; b) whenever possible, full consideration be given to locating oil and gas facilities in areas that has been previously disturbed; c) unless otherwise required by an agreement with a landowner, oil and gas facilities be located as far away as possible from property not included in the lease; and d) oil and gas facilities be located to avoid the fragmentation or bisection of forested land and agricultural fields to the extent practicable.

Note: The Department of Natural Resources screens out some lands when issuing calls for tender in relation to licences to search for oil and natural gas. These include national parks, existing and proposed protected natural areas, wellfields and watersheds used for municipal water supplies, First Nation lands and military lands.

9.8. AVOIDING FLOODPLAINS, WETLANDS AND WATERCOURSES

Floodplains

Well pads, pits or impoundments (i.e. for storing freshwater), batteries, gas conditioning plants and compressor stations (including related fill) should not be permitted within a floodplain.

Pipes and access roads should not be permitted within a floodplain except as part of a crossing that has received a permit under the *Watercourse and Wetland Alteration Regulation*, Clean Water Act*.

Watercourses and Wetlands

Oil or gas well heads should not be permitted within 100 metres of a watercourse or a wetland.

Well pads, pits or impoundments (i.e. for storing freshwater), batteries, gas conditioning plants and compressor stations should not be permitted within 30 metres of a watercourse or a wetland.

Pipes and access roads should not be permitted within 30 metres of a watercourse or a wetland, except as part of a crossing that has received a permit under the Watercourse and Wetland Alteration Regulation, Clean Water Act*.

**A Watercourse and Wetland Alteration Permit is required for activities involving ground disturbance and/or cutting of trees in or within 30 metres of watercourses and wetlands.*

9.9. AVOIDING MUNICIPAL AND COMMUNAL WATER SUPPLIES

Designated Municipal Water Supplies

Oil and gas facilities (excluding a facility used exclusively for the storage of freshwater) should not be permitted within or beneath wellfields or watersheds that have been designated as municipal water supplies under the provisions of a *Watershed Protected Area Designation Order* or a *Wellfield Protected Area Designation Order* issued under the Clean Water Act.

The following minimum set-backs should also apply. Well pads should not be permitted within: a) 250 metres of the wellhead of any municipal water supply well; or b) 250 metres of the nearest shoreline of a reservoir, natural lake or impoundment or surface water intake serving a municipal water supply; or c) 250 metres of any river or stream intake serving a municipal water supply.

Non-Designated Municipal Water Supplies

The restrictions and set-backs described under "Municipal Water Supplies" (above) should also apply to municipal wellfields that have been delineated but not yet designated under the above noted designation order.

The regulator should have the authority to impose site-specific well pad siting restrictions and set-backs in relation to an aquifer identified by the province as capable of providing a significant source of potable groundwater that could be developed into a municipal water supply in the future.

Non-Municipal Communal Water Supplies *

The 250 metre set-backs described under "Designated Municipal Water Supplies" (above) should also serve as a minimum set-back from non-municipal communal water supplies. *

The regulator should have the authority to increase the required setback based on the capacity of the communal water supply and local hydrogeological characteristics.

In implementing the requirements of this provision, the proponent of a well pad should be required to make diligent efforts to identify all water supplies in the vicinity; where "diligent efforts" means field investigations and contact with landowners and municipal officials, as well as record searches.

* This provision is intended to establish set-backs from communal water supplies that were already in place at the time that an application to allow construction of the well pad was received by the regulator.

9.10. AVOIDING INDIVIDUAL WATER WELLS AND OTHER NON-COMMUNAL WATER SUPPLIES

Well pads should not be permitted within 250 metres of a water well or a spring or a reservoir or a natural lake or a surface water intake serving a private, non-communal, potable water supply. *

The regulator should have the authority to reduce the set-back from a water well or a spring or a reservoir or a natural lake or a surface water intake serving a private, non-communal, potable water supply if: a) the owner of the well pad is also the owner of the water supply and receives the permission of the regulator; or b) the owner of the well pad obtains the written permission of both the owner of the water supply and the regulator.

In implementing the requirements of this provision, the proponent of a well pad should be required to make diligent efforts to identify all water supplies in the vicinity; where "diligent efforts" means field investigations and contact with landowners, and municipal officials as well as record searches.

** The above provision is intended to establish set-backs from water supplies that were already in place at the time that an application to allow construction of the well pad was received by the regulator.*

9.11. REQUIRED DISTANCES FROM BUILDINGS

An operator should not be permitted to locate an oil or gas well head or a battery or a flare, or a compressor station or a gas conditioning plant within: a) 500 metres of an elementary school, middle school, high school, hospital, or nursing home; b) 250 metres of a dwelling or other structure designed for human occupancy as may be identified by the regulator; or c) 100 metres of any other permanent building.

Note: The above provision is intended to establish set-backs from buildings that were already in place at the time that an application to allow the oil or gas facility was received by the regulator.

9.12. SITE RESTORATION GUIDELINES

The province should develop site restoration guidelines and ensure that the guidelines are applied on land that is no longer required for oil and gas facilities. Among other things, these guidelines should include the following requirements: a) topsoil located within the construction footprint of well pads and access roads must be stripped, stockpiled on site, and replaced during site reclamation; b) any compacted soils must be de-compacted; c) any altered surface drainage pattern or subsurface agricultural drainage system must be restored to its previous (pre-construction) condition; and d) an environmental site assessment must be conducted including environmental sampling and remediation of soil or groundwater contaminants in accordance with New Brunswick's Guideline for the Management of Contaminated Sites.

Other than the requirement to conduct an environmental site assessment and remediate environmental contaminants, or restore a wetland or watercourse in accordance with the requirements of the regulator, the regulator should have the authority to waive or amend the above restoration guidelines, in accordance with an agreement between a landowner and an oil or gas lease holder. This is provided that the agreement does not conflict with the facility owner's legal obligations as set out in legislation, or in conditions attached to Approvals, Permits, Licences, Certificates of Determination, etc.

9.13. SITE REMEDIATION STANDARDS FOR CONTAMINANTS

Unless otherwise determined by the regulator, cleanup of contaminated sites should be governed by New Brunswick's Guideline for the Management of Contaminated Sites.

10.0 REDUCING FINANCIAL RISKS TO LANDOWNERS AND THE PROVINCE AND PROTECTING LANDOWNER RIGHTS

Addressing financial risks that may result from oil and gas activities in New Brunswick, and recognizing that government has a role to play in protecting the rights of private landowners.

Short Term Recommendations

10.1. FINANCIAL SECURITY FOR DAMAGE

On June 23, 2011, Government announced the implementation of a requirement for oil and natural gas companies to provide a financial security to the province to protect property owners from the financial impacts of industrial accidents, including the loss or contamination of drinking water. The financial security must be provided by the successful bidder for rights in accordance with the Licence to Search and Lease Regulation under the Oil and Natural Gas Act and must remain in place during oil and gas exploration, development and production. The portion of the security not drawn upon by the province will be returned to the operator after an appropriate time frame to be determined by the regulator. The financial security will provide remedial action funding for certain damage or impairment to property that takes place within a specified time and at a specified distance from geophysical exploration or drilling of oil or gas wells.

The amount of the security for property damage has been set at $100,000 per licensee or lessee plus $1.00 per hectare allocated to an oil or gas company under the *Licence to Search and Lease Regulation*, Oil and Natural Gas Act.

In order for the province to access the remedial action funding, under prescribed circumstances*, it will be necessary to establish that damage or impairment to property has in fact occurred. For this reason, a landowner will have had to agree to allow the recording of pre-project information including: a) water well sampling (see the "Pre- and Post-seismic Water Well Testing" and the "Pre- and Post-Drill Water Well Testing" subheadings under Section 5.0); and b) any other pre-project monitoring or sampling that may be required.

It is recommended that the damage security requirement should also be imposed on companies who were already holders of rights as of June 23, 2011. This could be done when these rights are renewed or via conditions attached to subsequent permits, licences or approvals issued in accordance with regulations under the Oil and Natural Gas Act.

** See the "Water supply replacement or restoration" subheading, below.*

10.2. WATER SUPPLY REPLACEMENT OR RESTORATION

In order to implement the above financial security for damage, the province should establish a water supply replacement protocol which states that: a) the operator of a geophysical exploration program is presumed to be responsible for replacing or restoring a water supply located within 200 metres of a seismic energy source (vibroseis or explosive charge), if the supply is diminished in quality*, or reduced in capacity** below the needs of the water supply user within 6 months of the use of the seismic energy source; and b) an operator of an oil or gas well is assigned the responsibility for replacing or restoring a water supply located within 500 metres of the wellhead, if the supply is diminished in quality*, or reduced in capacity** below the needs of the water supply user subsequent to the drilling, or hydraulic fracturing of an oil or gas well.

In order to trigger this access to remedial action funding, it should be required that within the times and distances noted above, either of the following be true: a) one or more substances found at, used at or produced at the location of the seismic testing or the oil or gas well pad (including the well bore and the geological formations penetrated by the well bore) are found to have diminished the quality of the water supply (including the presence of methane gas in water wells where none was previously identified during pre-activity water well testing); or b) reduced the capacity of the water supply to the extent that becomes insufficient to meet the needs of the user. In the event that the oil or gas well operator does not act to rectify the situation the province would then draw funds from the financial security for damage and restore the water supply. The oil or gas well operator should have the opportunity to rebut this draw-down on financial security by presenting a preponderance of evidence to the regulator, that their operations were not the cause of the diminished quality or capacity of the water supply. Financial security funds would not be utilized in cases where the owner of a water supply refused to allow pre-seismic or pre-drilling water well sampling.

The water supply replacement protocol would apply to the activities of subcontractors employed by geophysical or oil or gas well operators but would not apply to impacts to a water supply caused by an activity that is unrelated to the activities of the geophysical operator or the oil or gas well operator or their subcontractors.

** See "diminished in quality" in the Definitions section of this document.*
*** See "reduced in capacity" in the Definitions section of this document.*

10.3. ENHANCED FINANCIAL SECURITY FOR WELL ABANDONMENT

The province currently requires oil and gas well operators to post a financial security that the province can draw on in the event that an oil or gas well is not properly plugged and abandoned. The amount of the required well abandonment security should be reviewed and adjusted as required to reflect the current cost of well abandonment in New Brunswick. The amount of the required security should be periodically re-assessed in the future.

The security should be in one of the following forms:

(a) a deposit of money;
(b) a negotiable bond signed over to the Province of New Brunswick;
(c) an irrevocable documentary credit or letter of credit from an institution acceptable to the Regulator, which is negotiable only by the Regulator; or
(d) a bond from a surety company licensed to do business in the province.

The security should only be returned to the well owner if: (a) an application for a well licence is refused by the regulator; or (b) the well owner transfers a well licence to another operator and the required security is received from the new operator, or (c) the well owner abandons the well in a manner that is satisfactory to the regulator.

10.4. MANDATORY LIABILITY INSURANCE FOR OPERATORS OF OIL AND GAS ACTIVITIES

The holders of permits, licences or approvals for oil and gas activities and facilities should be required to have in place sufficient liability insurance as determined by the regulator, to cover incidents caused by them or by their subcontractors, which may result in personal injury or damage to property

or the environment. It should also be a requirement that the insured party provide notice to the regulator of any changes to their insurance coverage, including cancellation.

10.5. REVENUE SHARING

On June 23, 2011, Government announced a commitment to develop a revenue-sharing formula so that landowners and communities can share in the financial benefits of the natural gas industry. The Natural Gas Group is therefore continuing to explore potential ways for the province to share gas revenue with landowners and communities that host natural gas production.

10.6. ESTABLISHMENT OF AN ORPHAN OIL AND GAS WELL FUND

The regulator should establish an industry-funded Orphan Oil and Gas Well Fund, to ensure that money is available to perform remedial plugging and abandonment of previously abandoned wells that develop leaks following the return of the well abandonment security to the former well operator.

10.7. LAND AGENT LICENSING AND STANDARDS OF CONDUCT

Those employed by oil and gas companies to undertake negotiations with landowners for access agreements should be required to be: a) certified by the Canadian Association of Petroleum Landsmen or b) certified by another equivalent organization satisfactory to the province; or c) licensed to practice in another Canadian jurisdiction that maintains a licensing requirement for land agents.

Potential Longer Term Responses

10.8. GUIDELINES FOR LEASE AGREEMENTS

In the longer term, the province should consider assembling and making public, information to assist landowners in their negotiations with oil and gas companies. This information could be based on guidelines that have already been prepared in other jurisdictions such as Alberta's "Negotiating Surface Rights" website which includes a well site negotiation checklist.

10.9. ENHANCED OCCURRENCE MANAGEMENT SYSTEM

In the longer term, the province should consider establishing an interdepartmental, electronic tracking system within government to record and manage occurrences and complaints concerning oil and gas activities. This could involve providing interdepartmental access to the Department of Environment's existing electronic occurrence tracking system.

10.10. CONFLICT RESOLUTION MECHANISM

In the longer term, the province should consider establishing a tribunal or commissioner with the power to hear and adjudicate conflicts between oil or gas companies and landowners, as an alternative to the courts.

10.11. FURTHER ADDRESSING THE FINANCIAL IMPACTS OF OIL AND GAS ACTIVITIES

In the longer term, the province should consider establishing a contingency fund to address environmental impacts of oil and gas activities that may occur in future.

In addition, the province should continue to examine its permit and application fee regime to ensure that the costs of inspection, enforcement, and reviews of submissions related to oil and gas activities are reflected in these fees.

11.0 SHARING INFORMATION

Ensuring that regulators, industry and all New Brunswickers have access to a common set of accurate information about oil and gas activities in New Brunswick.

Short Term Recommendations

11.1 PUBLICIZING THE PROVINCE'S ENVIRONMENTAL REQUIREMENTS AND STANDARDS FOR OIL AND GAS ACTIVITIES

The province should create a publicly accessible document that provides a comprehensive, plain language description of the specific environmental requirements and standards that the province imposes in relation to oil and gas activities and facilities.

11.2. PUBLIC DISCLOSURE OF ENVIRONMENTAL ASSESSMENT DATA

All data submitted to the Environmental Assessment Section should be made available upon request, in the language the data was submitted, with the exception of private or proprietary information which would be maintained in government offices. In the longer term the province should develop on-line access to environmental assessment data used in the review of oil and gas projects (see section 11.7 Enhanced On-line Access to Project Specific Information).

11.3. PRESCRIBED NOTIFICATION RADIUS FOR EIA DETERMINATION REVIEWS

As part of required public consultation activities for projects that are registered under the Environmental Impact Assessment Regulation, Clean Environment Act, prescribed, standardized landowner notification distances should be established and imposed for the oil and gas facilities described below.

The prescribed landowner notification and consultation distances should be as follows:

a) Gas processing plant or compressor station: 3,000 metres;
b) Well pad: 2,000 metres;
c) Gathering line: 200 metres; and
d) New access road: 200 metres.

11.4. PRESCRIBED NOTIFICATION RADIUS FOR SEISMIC TESTING

Seismic testing does not trigger a requirement for a project registration under the *Environmental Impact Assessment Regulation*, Clean Environment Act. Although some proponents of seismic testing programs in the province have used open houses and other communication strategies to make landowners aware of their activities, there is currently no prescribed notification distance within which landowners must be directly notified of proposed seismic testing programs. The province should therefore identify and impose such notification requirements on proponents of seismic testing programs.

11.5. DISCLOSURE OF FRACTURE FLUID ADDITIVES USED IN NEW BRUNSWICK

On June 23, 2011, Government announced a requirement for oil and gas companies to disclose all proposed and actual contents of all fluids and chemicals used in the hydraulic fracturing process. Disclosure protocols are being developed by the Natural Gas Group. Full disclosure to the regulator will be required. Public disclosure will also be required, with appropriate protection of propriety ingredients.

11.6. LIAISON COMMITTEES

When directed by the regulator to do so, the proponent of an oil or gas activity should be required to make a public offer to create and participate in a liaison committee with appropriate membership from interested parties (representatives of local governments, watershed groups, landowners, etc.). The purpose of the committee would include the exchange of information such as: a) the proponent's or operator's planned schedule of activities; and b) specific local issues, questions or concerns that may arise from time to time. Where appropriate, a committee could include representatives of more than one oil and gas operator active in the same general location. Once established, a liaison committee should remain in place throughout the operational life of a project, or until the committee members mutually agree that it is no longer required.

Potential Longer Term Responses

11.7. ENHANCED ON-LINE ACCESS TO PROJECT-SPECIFIC INFORMATION

In the longer term, the province should consider making all non-proprietary oil and gas project-specific records, reports and plans maintained in government offices, including environmental assessment data, publically available via the internet. The above information could include an electronic, geo-referenced, electronic database showing, or linked to information such as: a) conditions of approval that have been imposed on a developer or operator of an oil or gas facility; b) the locations of oil and gas wells; c) fracturing fluid disclosure information as described above; d) the results of environmental monitoring completed by a permit holder as a condition of a lease, licence, Certificate of Determination or approval (subject to privacy requirements for certain information such as the results of private well testing); and e) non-proprietary geological data generated by the drilling of oil or natural gas wells, that may be of interest to the academic community or the general public.

12.0 MAINTAINING AN EFFECTIVE REGULATORY FRAMEWORK

Fostering an informed, enforced and continuously improving set of environmental rules governing oil and gas activities in New Brunswick.

Short Term Recommendations

12.1. CONTINUING TO ENABLE PHASED REVIEWS OF PROJECTS

The current, phased environmental impact assessment (determination review) process for projects registered for review under the Environmental Impact Assessment Regulation, Clean Environment Act, should be continued.

Note: Commercial extraction or processing of combustible, energy yielding materials except fuel wood is an undertaking for the purposes of the Environmental Impact Assessment (EIA) Regulation under the Clean Environment Act and must be registered for review in accordance with the EIA Regulation. A phased approach to completing the required EIA is utilized in order to ensure that the early stages of an oil or natural gas extraction project (prior to commercial extraction) are included in the assessment.

12.2. ASSESSING ENFORCEMENT CAPABILITIES

The province should regularly assess the anticipated level of oil and gas activities and ensure that sufficient inspection and enforcement tools and resources are available.

Note: Additional recommendations will be contained in an enforcement plan that is being developed by the Natural Gas Group under separate cover.

12.3. IMPLEMENTATION OF THE RECOMMENDATIONS CONTAINED IN THIS DOCUMENT

The majority of the recommendations contained in this document can be implemented under the authority of existing legislation. Potential regulatory instruments include but are not limited to conditions attached to: a) licences and permits issued under the *Geophysical Exploration Regulation*, Oil and Natural Gas Act; b) well licence approvals issued under the *License to Search and Lease Regulation*, Oil and Natural Gas Act; c) other oil and natural gas tenure agreements issued under the Oil and Natural Gas Act; d) Certificates of Determination issued under the *Environmental Impact Assessment Regulation*, Clean Environment Act; and e) approvals and permits issued in accordance with regulations under the Clean Air Act, Clean Water Act and Clean Environment Act. In the longer term, Government could choose to incorporate some of the recommendations contained in this document in new legislation directed towards oil and gas activities.

Unless otherwise determined by the regulator, the recommendations contained in this document are intended to apply to new oil and gas facilities and are not intended to apply retroactively to facilities that have already been approved and constructed.

12.4. GATHERING ADDITIONAL SCIENTIFIC INFORMATION

The results of the various environmental monitoring requirements described in this document will contribute valuable information of assistance in the management of these activities in a New Brunswick context. In order to maximize this benefit, the province should also seek to foster partnerships with the federal government, academia, First Nations, non-governmental organizations and industry to

conduct additional research and monitoring to inform subsequent improvements to the province's environmental management of oil and gas activities in New Brunswick.

12.5. CONTINUOUS IMPROVEMENT

The principle of continuous improvement based on progressive experience with oil and gas activities in New Brunswick and elsewhere should guide the province in on-going efforts to strengthen and adjust its regulatory program. With this in mind, the province should undertake regular reviews of its regulations, policies and procedures, in consultation with industry and the citizens of New Brunswick and should continue to include in its regulatory regime the flexibility to assess, adopt and accommodate new, leading edge standards requirements, technologies and practices as they become available.

Potential Longer Term Responses

12.6. ENHANCING CROSS -DEPARTMENTAL COORDINATION

In the longer term, the province should consider developing a permanent, cross-departmental institutional arrangement such as an oil and gas commission that would enhance coordination in the regulation and supervision of oil and gas activities in New Brunswick.

12.7. ESTABLISHING OPERATOR TRAINING REQUIREMENTS (REGULATORY KNOWLEDGE)

In the longer term, the province should consider requiring that employees of oil and natural gas companies and well servicing companies active in the province (including company officers that have signing authority with respect to the submission of applications), attend a training session that provides an overview of their obligations under New Brunswick's environmental regulations and requirements for oil and gas activities. Training materials could be posted on a website that is also available to the public, to help foster knowledge about New Brunswick's environmental regulations and requirements among all interested parties.