MUSKWA-KECHIKA MANAGEMENT AREA HELIPORTABLE DRILLING FEASIBILITY STUDY

Prepared for:

BC Ministry of Sustainable Resource Management,
Muskwa-Kechika Advisory Board
and the
BC Oil and Gas Commission

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Note to Reader

This report was first released in June, 2002. The July 2003 revision has been produced to correct, clarify and expand on certain components of the economic evaluation in response to concerns raised by the Canadian Association of Petroleum Producers (CAPP). This opportunity was also used to make additional minor editorial and typographical corrections. CAPP has reviewed the revised portions of the Economic Report of the heliportable feasibility study. In their view, the underlying assumptions and basis for calculations are clearly and logically presented. CAPP's review does not represent an endorsement of the economic analysis or underlying assumptions.

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EXECUTIVE SUMMARY

Background on Heliportable Drilling, Regulatory and Policy Review

The potential use of helicopter supported drilling (heliportable drilling) for oil and gas exploration in environmentally sensitive areas of northeastern British Columbia been actively debated and considered for many years. It has thus far been rejected by either the proponent and/or the government based on concerns over safety, blow-out control, sour gas, cost, scheduling constraints, rig availability, lack of experience and availability of alternatives.

Despite these concerns, there remains a strong environmental interest in the potential application of heliportable drilling within environmentally sensitive areas of BC. This interest has been fueled in part by the awareness of heliportable drilling being successfully carried out elsewhere in the world, a belief that the concerns raised by heliportable drilling can ultimately be addressed and a concern that the significant ecological and social values of the Muskwa - Kechika Management Area (herein referred to as the MK) are deserving of exceptional protective measures where industrial development is to be allowed. The goal of the present study was to examine the costs, benefits and feasibility of helicopter-supported exploration drilling given the environmental operating conditions found in the MK.

Interviews conducted for the purpose of this study revealed that the industry's current concerns in regard to heliportable drilling are related to economics, safety and the availability of suitable equipment.

Existing legislation and regulations that are relevant to the question of helicopter-supported oil and gas operations were reviewed. Legislation and regulations included the *Petroleum and Natural Gas Act* and regulations, the BC Oil and Gas Handbook, the *Workers' Compensation Act* and companion Occupational Health and Safety Regulations, the *Muskwa-Kechika Management Area Act* and the Maximum Disturbance Review Criteria Code and Guideline. Based on this review and discussions with the Workers' Compensation Board of BC (WCB) and the BC Oil and Gas Commission (BC OGC), there are no significant regulatory constraints to heliportable drilling provided in the legislation and regulations.

Environmental Report

The Environmental Report provides background biophysical and resource management information on the MK of relevance to the feasibility of heliportable drilling. The environmental impacts of conventional roads and helicopters are discussed along with their implications for subsequent development and production.

The MK is 6.4 million hectares in size and remains one of North America's last true wilderness locations south of the 60th parallel. Activities in the MK are guided by the *Muskwa-Kechika*

Management Area Act that identifies the MK as an area of unique wilderness in northeastern BC that is endowed with a globally significant abundance and diversity of wildlife. The management intent for the MK is to maintain in perpetuity the wilderness quality and the diversity and abundance of wildlife and the ecosystems on which it depends, while allowing resource development and use in parts of the MK designated for those purposes including recreation, hunting, timber harvesting, mineral exploration and mining, oil and gas exploration and development.

Motorized vehicle travel is limited to designated routes within the MK that were determined on the basis of environmental sensitivity, public recommendation and past use.

Terrain conditions affect the level of difficulty and impact for both conventional and heliportable drilling operations. Narrow ridgelines and steeply sloping terrain are particularly difficult places to operate and to minimize impact. Conventional road construction in these areas, tends to result in much larger impacts due to soils handling requirements, particularly due to side cast fill. To some extent, these impacts can be reduced by end-hauling excavated material and then restoring this material following site abandonment. Surface stabilization and vegetation re-establishment in such sites is particularly challenging and requires long-term commitment and attention. Locations in deeply incised valleys and small cirques often have associated climatic conditions that would present greater constraints for helicopter operation due to phenomenon such as turbulence and down drafts. Higher altitude sites pose a further constraint on heliportable operations as a result of the reduced lifting capacity of helicopters with increasing altitude, though this is not an overriding constraint on heliportable operations.

Drilling programs within the eastern third of the MK will tend to encounter sweet Mississipian gas and as such, incur lower relative risk and risk management requirements than potentially Devonian plays to the west. However, as a matter of practice, drilling protocols in BC treat all wells as potentially sour. To the extent that a company's risk management protocol requires road access for sour gas exploratory wells, consideration or application of heliportable drilling would be restricted to easterly Mississippian formations. It would appear there may be somewhat greater potential for any blow-out event in Mississippian formations to include variable volumes of water and as such require an appropriate level of supervision and contingency planning. Easterly Mississippian plays will tend to be shallower than those in the westerly Devonian and as such potentially have access to a greater number of heliportable rigs. Regardless of sour gas presence, it is likely that generally larger (greater depth capability) heliportable rigs will be required for drilling targets in the western portion of the MK, though this will vary considerably with each location. As discussed in the Technical Report, larger heliportable drilling rigs are at this time, more commonly engaged outside of North America.

It is likely that drilling targets will tend to be identified on top of, or immediately adjacent to more mountainous topography, rather than in broad valley bottoms. These drilling targets will typically require more physical disturbance for conventional road accessed wells, likely require more ambitious directional drilling for conventionally accessed wells, as well as potentially pose more demanding flying conditions for a heliportable operation. Heliportable locations would likely result in less regulatory pressure for directional drilling to offset environmental impacts. In either case, the constraints on the access approach will be site-specific.

Climatic conditions occurring in the MK of relevance to heliportable drilling include cold temperatures, high winds, fog and low cloud cover and icing. The frequency of occurrence and location of these conditions is highly variable. The occurrence of "no fly" conditions for the purpose of heliportable drilling is expected to be uncommon and typically restricted to portions of a given day rather than preclude flying for the entire day.

Alpine tundra vegetation is highly sensitive to disturbance and is very slow to re-establish once disturbed. Unless alpine terrain is very gentle, low impact road construction (*e.g.*, using snow fill or other padding) is not possible. In this context, relatively greater impacts will occur using conventional road access compared with heliportable. Where there is a requirement to more aggressively reclaim and monitor alpine reclamation, a company could encounter potentially significant manpower and financial commitment. New road construction through forests within the MK would inevitably result in creation of a scar in the vegetation mosaic with attendant impact on the wilderness landscape aesthetic associated with the area. The presence of valley bottom areas dominated by willow, dwarf/scrub birch and/or meadows provides some opportunity for low impact road construction as an alternative to a heliportable operation. These vegetation communities provide the opportunity for construction of temporary winter access by walking over the vegetation and building snow/ice roads (with or without mowing) with potentially only minor impact to the landscape aesthetic and functional integrity of the affected vegetation communities.

The presence of high value and relatively high sensitivity fishery resources within the MK increases the need for fisheries specific research, planning, design and permitting where it involves conventional road construction. Heliportable access eliminates potential impacts caused by erosion, riparian habitat loss and human fishing pressure to fish and aquatic ecosystems associated with more conventional road access, as well as the costs and time associated with assessment and planning around these. Potential for spills during fuel hauling can arise with both conventional road accessed drilling programs as well as for heliportable drilling programs.

Wildlife can be significantly affected by both roads and helicopter activity though these impacts tend to be site-specific. In general, much greater and more prolonged impacts are typically associated with roads. Displacement effects related to roads and helicopters appears to be a function of their proximity to key habitats, the level of activity and the manner in which species are exposed to that activity. Where alternate low impact road access is not available, heliportable drilling operations provide a much greater opportunity to avoid long-term impacts to wildlife habitat and wildlife, particularly for lower success rate exploration drilling. However, there remains some potential that heliportable operations could result in significant short-term stress and displacement of wildlife. The potential for longer-term range abandonment could occur where frequent helicopter site visits are required to locations within critical wildlife habitat or which may require low level flying enroute to a given location. The species with greatest potential to be impacted in this regard are likely Stone's sheep and mountain goat due to their strong reaction to helicopters and low flying aircraft, as well as grizzly bear when this species may seasonally seek more open terrain.

Use and creation of conventional road access in this land use setting can, if sensitively planned, for some interests and individuals, create a desired and improved resource access alternative. For others, road development is believed to lead to a significant degradation of the environment and associated opportunities (*e.g.,* guide outfitting and trapping). Heliportable drilling has potential to alleviate some of these latter concerns, but it's associated noise and activity can impair recreational experiences. To some extent, these helicopter impacts can be avoided through planning flight patterns and seasonal and daily timing restrictions, keeping in mind however, the desirability of maximizing daylight flying hours.

Guide outfitting success depends largely on the ability of guide outfitters to provide a high quality wilderness experience and a reasonably good chance for the client to obtain a trophy animal. Road construction for oil and gas exploration and development results in relatively long-term alteration of the landscape aesthetic and solitude, and has the potential to result in generally increased human use for motorized and equestrian access, unless this is effectively controlled. This increased access has the potential to increase industrial and recreational noise levels, as well as increase wildlife displacement and mortality. While guide outfitters may benefit by some limited access development, the overall effect of conventional road construction degrades the wildland experience and reduces the guide outfitter's ability to compete in the market place. Secondary support services such as airlines, hotels and other local businesses may also be affected. Confining oil and gas activity to the winter period in general, reduces overall impacts to guide outfitting though still results in some long-term adverse impacts, particularly where roads result in the creation of long-term unregulated access and degradation of the visual landscape.

Conventional winter and all-weather road construction has been suggested to interfere with trapping activities by obstructing trapper movement, as well as indirectly through affecting furbearer habitat and movement patterns. Heliportable drilling would avoid these impacts.

Heliportable drilling avoids most of the long-term physical impacts of road development such as landscape modification and increased conventional access. These impacts are traded off with increased wide spread noise impacts and increased potential for displacement of sensitive high valued wildlife species in the MK such as Stone's sheep. Such impacts may be short-term where a well is unsuccessful, however, in the production scenario, helicopter noise impacts on the wilderness experience and wildlife would be extended through a longer period (*e.g.*, many years). Adjustments to flying routes, scheduling of flights and specifying the type of helicopter may offset some of these impacts. Such adjustments may or may not add additional flying time and costs to heliportable operations. Adjustments to seasonal flying opportunities would have to be reconciled with interests in maximizing the daylight hour flying opportunities.

Development of unrestricted conventional road access provides the potential opportunity for physically, improved access for equestrian users and clearly improves accessibility by motorized vehicle users. In the absence of effective management policies, this can in turn put motorized vehicle users in conflict with horse or foot-based recreationists including commercial backcountry operators not using motorized access. A helicopter based exploration program avoids the physical impacts of conventional road access and to some extent can be seen to replace the physical impacts with more intense acoustic impacts. Studies in other jurisdictions have confirmed that aircraft use is incompatible with the public's perception of the proper management and use of protected areas. Similar concerns were also raised for other forms of motorized recreation.

Conventional oil and gas access road development within areas also targeted for timber harvest affords some opportunity to subsidize road building costs for forest operators or mining interests and conversely road development by the forest industry provides some opportunity to subsidize or defray road building costs associated with oil and gas activity. In some cases, oil and gas access roads have advanced timber harvest schedules where the two activities overlap and would be avoided in cases where heliportable drilling occurs.

A range of mitigation measures are available to reduce the potential impacts of both a heliportable drilling operation and more conventional land-based access. The magnitude of difference in environmental impact between the two basic alternatives is site-specific and may range from negligible to very significant. While in most cases, relatively less physical impact will be associated with heliportable operations there may be cases where these exceed that of conventional low impact winter road construction. An example of this circumstance would be where a snow or ice fill road with minimal clearing requirements could be constructed in a narrow valley bottom adjacent to occupied sheep or goat habitat.

A decision to allow road access during the production phase would negate the long-term benefits of heliportable drilling for successful wells. Where roads are constructed for long-term production, potential indirect impacts on wildlife populations caused by displacement from human activity (as opposed to predator avoidance) could be minimized by reducing the level of human activity on these roads. This could be achieved by allowing winter only industrial use as well as gated access, combined with enforcement, monitoring and education programs to control public use. Further investigation of the costs and benefits of various forms of access during operations is warranted.

Consideration should be given to identifying and mapping areas where the potential for low impact alternatives exist, as well as areas which may be more suited to helicopter access only. In addition, the practicality and economics of heliportable only access to the operations phase of oil and gas development should also be explored further.

Technical Report

The technical feasibility of heliportable drilling depends in part on the availability of depth rated heliportable drilling rigs and the ability of helicopters to deliver a level of critical support necessary for mobilizing, drilling and completing a deep sour gas well. At least four heliportable rigs are available in North America and are reported to have capability to drill to 3,400 m depth. Heliportable rigs with capability to drill sour wells in excess of 5,000 m are working in other parts of the world and can be mobilized via heavy transport aircraft if rapid delivery is required (assuming they are free to be released). Obtaining the services of these larger rigs would require longer pre-planning for mobilization. While re-configuring a conventional rig to be heliportable is technically feasible, and perhaps half the cost of constructing a new heliportable rig, the drilling contractors approached during this study believed the construction of a purpose-built heliportable rig was a more appropriate engineering solution.

A range of heavy-lift helicopters capable of mobilizing all components of heliportable rigs and providing adequate support during potential heliportable operations are available in North America. Carefully planning helicopter use is required to maximize the efficiency of rig moves in order to adequately control the overall cost, time and safety of a heliportable drilling operation.

Assessing the ability of a heliportable drilling program in the MK to provide adequate emergency medical response capability and well control capability has been viewed as a fundamental determinant to the technical feasibility of heliportable drilling. While it is technically feasible to provide 24-hour helicopter support to a heliportable drill site, it is apparent that numerous remote work sites exist in BC which do not have guaranteed 24-hour emergency access for long-distance medical evacuation and at the same time comply with requirements of the Workers' Compensation Board of BC (WCB). The WCB has expressly stated that it would not prohibit heliportable drilling or require guaranteed 24-hour emergency access, provided normal requirements for remote work site medical facilities are met. Providing 24-hour emergency site access via helicopter would require a range of specific installations, equipment, planning and permitting. A key factor in the occurrence of accidents on drilling programs is the level of worker experience, the quality of supervision and worker attitude. Significant reduction in the likelihood of worker injury on a heliportable drilling program can be achieved by ensuring high levels of experience and training for all rig personnel.

At present, the probability of an uncontrolled blow-out during drilling appears to be in the range of 0.3 to 0.6 blow-outs/1,000 wells. The cause of most blow-outs during exploration drilling programs is human error. The potential to significantly reduce the risk of a blow-out on a heliportable drilling program could be achieved by requiring use of only highly trained and experienced crews and ensuring the well site has been stocked with adequate drilling supplies. In order to minimize the environmental risk associated with a blow-out at a heliportable well site, the site needs to be planned in consideration of blow-out response and management. In addition, risk could further be reduced by maintaining a reserve of at least three or more pieces of heavy equipment onsite (*e.g.,* one bulldozer, one crane and one back hoe). A protocol and arrangement for access to other heavy equipment and transport capability, at least during more critical phases of the drilling program, should also be in place.

During a blow-out where there is a perceived risk to human life, drilling crews are typically evacuated on foot outside of the immediate hazard zone via pre-determined routes. For a conventional road accessed well, the access road is not relied on as the primary emergency escape route but is instead among the alternatives, depending on conditions at the time of the blow-out. With provision of adequately planned emergency escape routes (*e.g.,* via foot or hand-cleared ATV routes), temporary accommodations and an air trailer or trailers (for sour gas wells), an equivalent level of worker and equipment protection as occurs at road accessed sites, can be achieved at a heliportable sour gas well.

In the event of a significant uncontrolled sour gas release where there is a perceived hazard to workers, the rig is typically ignited after a short period in order to eliminate the sour gas hazard and facilitate well control operations. In properly managed situations, the hazard associated with a sour gas blow-out at a heliportable drill site would be of short duration (*e.g.,* minutes) and the availability of long distance road access would be of no clear necessity. In rare cases where large volumes of sour water are being produced, rig ignition may be delayed until such time as liquid streams can be diverted to a separator and gas ignition achieved. More prolonged use of emergency air equipment may be required in these circumstances in the immediate vicinity of the well site.

The science and techniques used for blow-out control have advanced significantly in recent years such that more immediate well control or partial control (where the flow can be directed) can be achieved more rapidly by capping the existing well bore than by drilling a relief well. Controlling most blow-outs can be achieved within a period of days, or in some cases weeks. Once the flow is stopped by capping, a second rig can be deployed in a less urgent fashion. All of the equipment used for well capping can be maintained on a heliportable site or quickly flown in for this purpose. In rare cases where the drill casing cannot be reached by excavation, a relief rig may still be required. Where a relief rig is deemed necessary for control of a blow-out, conventionally accessed drilling sites are at an advantage since the pool of available relief rigs is in theory much larger and these can be delivered onsite and assembled in a more timely fashion. For a heliportable well site, providing relief well capability would require prior arrangement for a heliportable drilling rig and paying standby charges or relying on assumed availability. Services of heavy-lift helicopter transport for a contingency relief drilling rig are generally available on short notice. An alternate scenario involves construction of a conventional access road for relief well mobilization and incurring the associated environmental impacts.

A major concern during a blow-out is the release of liquids. Release volumes of salt water and other liquids can at times be large. Conventional road accessed well sites afford the opportunity to rapidly mobilize heavy equipment and to transport large volumes of liquids. This ability is not practically achievable on a heliportable well site but could be managed by contingency planning, proper site selection, ensuring proper site drainage, as well as having a reserve of heavy equipment onsite or readily available for transport and assembly.

It is recommended that if heliportable drilling is ultimately promoted in the MK, a set of best practices should be developed which would focus on the needs for overall heliportable planning and coordination, training requirements, supervision, environmental protection, blow-out prevention and response. The influence of underbalanced drilling on blow-out risk should be further evaluated. The potential applicability of emerging technology such as “casing drilling” to significantly extend the depth range and possible safety of heliportable rigs should be further monitored and explored. These undertakings should be collaboratively pursued through the Canadian Petroleum Safety Council or equivalent provincial body.

Economic Report

Previous heliportable feasibility evaluations, while recognizing the potential environmental advantages of heliportable drilling, have frequently identified the direct incremental cost of heliportable drilling as a key factor limiting the feasibility of heliportable drilling. The Economic Report identifies and explores a number of key cost factors associated with conventional versus heliportable drilling and draws on previous heliportable cost analyses conducted in northern BC. The major cost differences identified were associated with access. While total road costs and helicopter costs tend to go up with increasing distance, road related costs are much more variable due to specific terrain differences, assessment and engineering requirements, reclamation challenges from site to site and the potential significant influence of short-term and seasonal weather patterns. For heliportable drilling there is a relatively linear relationship between distance and cost. The influence of weather on heliportable transport cost is projected to be minor.

Depending on the site conditions, heliportable drilling appears to have greater potential to be more expensive than conventional surface access for programs requiring relatively short access but less expensive, considering direct costs alone, relative to longer more complex roads through sensitive terrain. The primary costs associated with heliportable drilling include those associated with potential foreign rig mobilization, mobilization of the drilling rig, drilling supplies and camp from the staging area, helicopter support during drilling, contingency stockpiling and potentially water supply.

Heliportable rigs, like conventional rigs, range in cost depending on their drilling depth capability. Mobilizing a medium to large heliportable local rig may cost in the vicinity of $500,000, while mobilizing the same rig from a foreign location to northern BC could be in the range of $1.5 million to $2.5 million CDN. At the time of this review, there were four heliportable rigs in Western Canada all depth rated to 3,400 m.

A conventional drilling rig can be converted to a heliportable rig, at a cost ranging from $2 million to $5 million CDN and would take perhaps four to six months. Rough cost estimates to custom build a heliportable rig were variable and dependent on whether the rig was built in Canada or the US. These rough estimates ranged from $12 million CDN to $20 million US. Costs to build a heliportable rig capable of drilling to 3,400 m were estimated at $6 million to $7 million CDN. Construction time to build a deep-rated heliportable rig was estimated to take approximately 8 to 10 months. While redesigning a conventional rig appears to be more cost effective than building a new heliportable rig, this approach is disfavored by the drilling contractors as it requires taking a conventional rig out of normal service and has potential to result in a less purpose-built design integrity.

Although the risk of a blow-out is very low, in most cases in the event of a blow-out, well control at a heliportable well site will be more efficiently and cost effectively controlled by capping rather than the use of a relief rig. In rare cases where a relief rig is required, this can be achieved either by mobilizing any available heliportable rigs with sufficient depth capability or by constructing a new access road to the well site and mobilizing a conventional rig. Substantial additional costs can be expected in either case. Costs associated with any requirement to guarantee a designated relief well throughout the drilling program would result in a further substantial cost that would have implications for overall cost and projected returns on investment. Blow-outs result in significantly increased costs for both conventional and heliportable exploration drilling programs. For a heliportable well site, the monetary costs can be expected to be substantially greater than with a conventional blow-out due to the potential need to fly in any additional heavy equipment and other blow-out containment supplies not stockpiled onsite. This cost can be substantially reduced by proper contingency planning and retention of some heavy equipment onsite.

If company policy or regulators required 24-hour well site access, helicopters, crews and landing areas would have to be set up for Night Visual Flying Rules and possibly a full Instrument Landing System. A 24-hour, on demand, helicopter serviced operation would require additional items and costs and add perhaps close to $1 million to the cost of a 90-day heliportable drilling program.

Weather delays encountered during either a conventional or heliportable operation can be expected to increase costs by incurring standby charges and/or by delaying completion of critical phases of the project. Weather delays associated with a conventional road accessed well site can occur in the summer as a result of rain, as a result of delays in freeze-up and early spring thaw. Weather delays associated with a heliportable well site occur as a result of high wind, low cloud and fog cover and icing conditions. Weather is expected to have greater cost implications for conventional road accessed well sites than heliportable well sites.

A primary cost difference between conventional road accessed drilling and heliportable drilling is that the heliportable option does not require construction or reclamation beyond the well site, camp and staging area. While impacts and reclamation costs can be significantly reduced with low impact winter roads, opportunities to carry out this practice in the MK are very site-specific. In general, road reclamation costs are expected to be equivalent to road construction costs.

Site-specific and judicious promotion of heliportable drilling within the MK has the potential to result in more sustainable long-term economic benefit and employment with a reduction in environmental and related social costs. Integration of heliportable technology into the petroleum sector in northeastern BC may somewhat diversify and strengthen the base for local contracting and joint ventures.

Recommendations include: developing a clear policy with regard to the use of heliportable drilling in the MK; preparing site specific guidelines which are identified prior to a land posting; and providing financial incentives to the petroleum industry where commitments are made to use heliportable drilling.

Synthesis, Conclusions and Recommendations

When considering the range of issues associated with heliportable exploration drilling, it is clear the government must balance a broader set of social and economic costs and benefits associated with heliportable drilling compared with the petroleum industry. Factors which affect the public and First Nation's acceptance of oil and gas development can still have significant cost implications for the industry through either delays required for consultation and/or pressure for activity exclusion or other restrictions. A range of cost and benefit variables associated with heliportable exploration drilling are summarized. Depending on the variable, the cost or benefit may be more immediately felt by the government, the public, industry or shared by all groups.

Heliportable drilling relative to conventional road access must be compared, on a site-specific basis, with whatever least impact, surface access alternative a given prospect may present. For example, a site may be readily accessed by an existing seismic line, road or snow road, and in doing so, must be compared to the "costs" associated with a heliportable approach (as well as some of the benefits).

Forcing a company to assume large incremental "costs" for marginal environmental or social benefit will create a general disincentive for exploration where the potential return on investment is perceived as low.

Based on review of the various costs and benefits, six *Critical Factors* were identified that are believed to represent the most important issues when considering the site-specific feasibility of heliportable drilling. These are: environmental sensitivity; availability of low impact alternatives; helicopter site risk; capital cost; blow-out risk and worker safety; and presence of sour gas.

Environmental sensitivity, availability of low impact alternatives and helicopter site risk have a direct bearing on capital cost and will vary widely from site to site. Industry's demonstrated ability to manage blow-out risk and to operate safely in sour gas environments, combined with the probable level of planning and expertise, which would be applied to heliportable drilling, suggests that blow-out risk and presence of sour gas, should be less critical considerations concerning heliportable drilling feasibility. These two factors are also relatively independent of cost. In the absence of adequate contingency planning, however, it is clear that a blow-out, involving high volume uncontrolled liquids release would have substantially greater cost implications on a heliportable project.

At least three approaches to decision making can be used in regard to assessing heliportable feasibility: formal quantitative cost-benefit analysis; quantitative ranking of individual sites or areas; and/or through a collaborative decision making process. None of these approaches are necessarily exclusive. Applying rankings and scores to the identified *Critical Factors* in terms of whether an individual site or region within the MK is more or less suitable for heliportable drilling can be used to systematically evaluate the overall feasibility of the site or area for heliportable drilling. It also illustrates the sensitivity of the evaluation to the various factors and the importance assigned to them. This approach is used on two hypothetical examples modeled after probable scenarios likely to be encountered in the MK.

In a general sense, there does not appear to be any basis for concluding that heliportable drilling in the MK is not feasible and should not be included in the range of low impact options acceptable to the MK resource managers. There will, however, be site-specific circumstances where it is relatively more or less feasible. Regulators could decide whether they were inclined to require heliportable drilling by location, by circumstance or to let the company decide.

Within the MK, it is clear there are likely to be locations proposed for drilling which will have conventional initial access "costs" exceeding that of heliportable access, where the environmental consequences of exploration roads will be high and where the potential economic reward of a prospect may be high. Heliportable drilling would appear to be a feasible, environmentally sound and safe approach to petroleum exploration in these cases.

In cases where estimated costs for heliportable drilling significantly exceed conventional surface access approaches (with expected emphasis on low impact approaches), the feasibility will depend on industry's valuation of the economic risks, the extent to which these can be offset by incentives and the government and industry's confidence in the proponent's ability to adequately manage environmental and human safety risks. From the information examined, there appears to be reasonably compelling evidence to suggest that these latter factors can be managed to a level at least equivalent to that associated with conventional surface accessed well sites.

A summary of the recommendations are as follows:

1. Heliportable drilling should be included in the range of land use management tools used by MK resource managers.
2. Developing a clear policy and guidelines with regard to the use of heliportable drilling in the MK should be undertaken in order to reduce uncertainty within the industry and among resource users prior to land posting.

3. In the event a policy decision is made which endorses the site-specific application of heliportable drilling, a set of best practices should be developed.
4. Consideration should be given to conducting an initial heliportable drill as a pilot study to facilitate the implementation and to promote refinement of any subsequent guidelines and procedures.
5. Identifying and mapping areas where the potential for low impact alternatives exist, as well as areas which may be more suited to helicopter access only should be considered.
6. Consideration should be given to increasing the feasibility of heliportable drilling by providing financial incentives to the petroleum industry where commitments are made to use this access approach.
7. The practicality and economics of heliportable only access for the operations phase of oil and gas development should be explored further.

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