



*Photo courtesy Devon Canada*

# **YUKON OIL AND GAS**

## **A Northern Investment Opportunity**

### **2005**



## Foreword

Yukon is an unexplored land with great potential. This publication will provide information of interest to company officials, landmen, geologists, engineers and others working in the oil and gas sector. It provides an overview of the oil and gas resource potential and describes recent activity, the structure of the oil and gas branches within the Yukon government, the status of First Nations land claims, and how the legislative regime was developed and works.

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## Yukon's Competitive Advantage

The oil and gas industry has the potential to be a major player in the ongoing development of the Yukon's economy. Significant unexplored and untapped resources, longer tenure terms and a stable political and legal framework make it a unique and competitive place to do business.

In economic terms, the Yukon has a very attractive climate for oil and gas investment and development. The Yukon has a competitive regime built on the experience and proven practices of other jurisdictions.

The Yukon's key advantages include:

- Progressive oil and gas legislation – the Yukon *Oil and Gas Act* (YOGA);
- One set of rules for industry based on a unique common regime jointly developed by Yukon and First Nation governments;
- A more generous and flexible land tenure structure with the maximum size of dispositions and length of tenure for permits greater than in any other Canadian jurisdictions;
- Competitive royalty rates;
- A well educated and skilled labour force with northern expertise;
- A well developed infrastructure that includes communications, an extensive network of paved roads and recently expanded electrical grid;
- Direct access to year-round ocean ports through Skagway and Haines, Alaska;



- Pipeline access – natural gas from southeast Yukon is transported via the Duke pipeline to processing facilities in British Columbia; and
- Renewed interest in northern pipelines which allow access to gas; and will tie in the Yukon's eight sedimentary basins, thereby allowing Yukon gas to be added to a pipeline(s).

## Oil and Gas Related Information

The Yukon government's Department of Energy, Mines and Resources is responsible for managing the natural resources within the territory. Two branches in the department deal with petroleum: the Oil and Gas Management Branch and the Oil and Gas Business Development and Pipeline Branch.

### Oil and Gas Management Branch

The Oil and Gas Management Branch manages the development of the petroleum industry in Yukon. The branch is responsible for managing oil and gas resources and regulating oil and gas activity. In carrying out its responsibilities, the branch is engaged in:

- producing and issuing maps;
- developing and implementing the common oil and gas regime, including the legislation, regulation, policies and processes;
- issuing and managing oil and gas rights;
- administering royalty revenues and disbursing Crown royalties to First Nations;
- issuing and managing activity licences;
- completing resource assessments and disseminating geological and resource related information; and
- supporting and coordinating capacity building, education programs, and oil and gas training.

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### Oil and Gas Business Development and Pipeline Branch

The Oil and Gas Business Development and Pipeline Branch is mandated to encourage the development of Yukon's resource potential and emerging oil and gas industry. It is responsible for:

- promoting northern infrastructure development, such as pipelines;
- coordinating employment and training initiatives;
- supporting the growth of Yukon's service and supply sector;
- negotiating benefits agreements;
- marketing Yukon's resource potential and development activities;
- managing Yukon's interests in offshore Beaufort Sea development;
- negotiating shared offshore management with Canada;
- liaising with industry; and
- representing the Yukon government on intergovernmental committees dealing with oil and gas and pipeline matters.

### Contact information:

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## Yukon Geological Survey

The Yukon Geological Survey was established in April 2003 with a mandate to provide the following programs and services:

- collecting baseline geoscience information;
- conducting geological mapping and regional geophysical and geochemical surveys;
- publishing, printing and distributing geoscience information;
- providing geoscience information over the Internet;
- providing information to a broad range of clients, including the petroleum and mineral industries, Yukon First Nations, schools and the general public;
- completing topical mineral deposit studies, placer deposit studies and surficial deposit mapping;
- reviewing and approving assessment reports;
- conducting mineral potential assessments for protected area and land use planning; and
- maintaining geoscience databases (e.g. Yukon MINFILE).

### For Yukon geological maps, reports and databases, please contact:

Geoscience Information and Sales  
c/o Whitehorse Mining Recorder  
102-300 Main Street  
Mailing Address  
P.O. Box 2703 (K-102)  
Whitehorse, YT Y1A 2C6  
Tel: (867) 667-5200  
Fax: (867) 667-5150  
E-mail: [geosales@gov.yk.ca](mailto:geosales@gov.yk.ca)

To speak to a geologist for more detailed information from the Yukon Geological Survey, call  
Tel: (867) 667-8508 or toll free: 1-800-661-0408 ext. 8508  
[www.geology.gov.yk.ca](http://www.geology.gov.yk.ca)

## Geological Survey of Canada

For access to Yukon well cores and related data at the Geological Survey of Canada (Calgary), please contact:

ALLAN SCOTT - Head, Core and Sample Library  
Geological Survey of Canada (Calgary)  
3303 - 33rd Street N.W.  
Calgary, AB T2L 2A7  
Tel: (403) 292-7057 Fax: (403) 292-5377  
E-mail: [ascott@nrcan.gc.ca](mailto:ascott@nrcan.gc.ca)

For Yukon geoscience publications at the Geological Survey of Canada (Calgary) Bookstore, please contact:

JODI FISKAR - Geological Survey of Canada (Calgary)  
3303 - 33 Street N.W.  
Calgary, AB T2L 2A7  
Tel: (403) 292-7030 Fax: (403) 299-3542  
E-mail: [web.gsc\\_calgary@nrcan.gc.ca](mailto:web.gsc_calgary@nrcan.gc.ca)  
[www.nrcan.gc.ca/gsc/calgary/products/index\\_e.html](http://www.nrcan.gc.ca/gsc/calgary/products/index_e.html)  
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## Government In the Yukon Territory

The Yukon is a territory within the Canadian confederation and has similar powers of a province. It has been a separate geographical and political entity within Canada since 1898, seven years before Alberta and Saskatchewan (which were part of the Northwest Territories until awarded provincial status in 1905).

The Yukon has authority over its land and resources through a process of negotiated devolution. Responsibility for onshore oil and gas resources was transferred to the Yukon government in November 1998. The management and administration of Yukon's water resources, mineral resources, forest resources, and responsibility for land was transferred on April 1, 2003.

With these responsibilities, the Yukon has the administrative powers of a province.

## First Nations and Land Claims

Land claims agreements address aboriginal rights, titles and interests of Yukon First Nations and transboundary First Nations groups. The agreements provide Yukon First Nations with specified rights in respect of land, resources and self-government. They also provide certainty with respect to land management and resource development, and provide a foundation for social and political development of the territory.

## Umbrella Final Agreement

Treaties were never concluded in the Yukon; therefore, the governments of Canada and Yukon are completing and implementing modern-day treaties for individual Yukon First Nations through the land claims process. These are based on the Umbrella Final Agreement (UFA).

The Umbrella Final Agreement, negotiated between the federal, territorial and Yukon First Nations governments, was signed in 1993. Each First Nation Final Agreement contains all of the text of the UFA with the addition of negotiated specific provisions which apply to the individual First Nation. Ten of 14 Yukon First Nations have comprehensive land claim agreements and accompanying self-government agreements in effect. The most recent agreement to come into effect was that of the Kwanlin Dun First Nation in late 2004.

## Land Categories

There are three different settlement land categories. They are:

**Category A settlement land** on which a Yukon First Nation has ownership of the surface and subsurface interests, including minerals and oil and gas, and exclusive rights to harvest fish and wildlife;

**Category B settlement land** on which a Yukon First Nation has ownership of surface and of some sub-surface interests, not including minerals and oil and gas, and the Yukon public continues to have access for non-commercial fish and wildlife harvesting; and

**Fee simple settlement land** on which a Yukon First Nation has the same fee simple title as other land registered in the Land Titles Office.

In areas where land claims agreements have not been concluded, the Yukon government must have the consent of First Nations prior to issuing oil and gas licences or rights. As claims are settled, Yukon will have more options in determining where dispositions can be issued.

## Yukon First Nations

As outlined in the Umbrella Final Agreement, Yukon First Nations will receive total settlement lands of approximately 41,500 square kilometres or about nine per cent of the total land area of the Yukon. A portion of this settlement land will include subsurface mineral and oil and gas rights, and this will encompass approximately six per cent of the Yukon.

Agreements are being implemented for 10 self-governing Yukon First Nations:

- Vuntut Gwitchin First Nation (1993)
- First Nation of the Nacho Nyak Dun (1993)
- Champagne and Aishihik First Nations (1993)
- Teslin Tlingit Council (1993)
- Selkirk First Nation (1997)
- Little Salmon/Carmacks First Nation (1997)
- Tr'ondëk Hwëch'in First Nation (formerly Dawson First Nation) (1998)
- Ta'an Kwach'an Council (2002)
- Kluane First Nation (2004)
- Kwanlin Dun First Nation (2004)

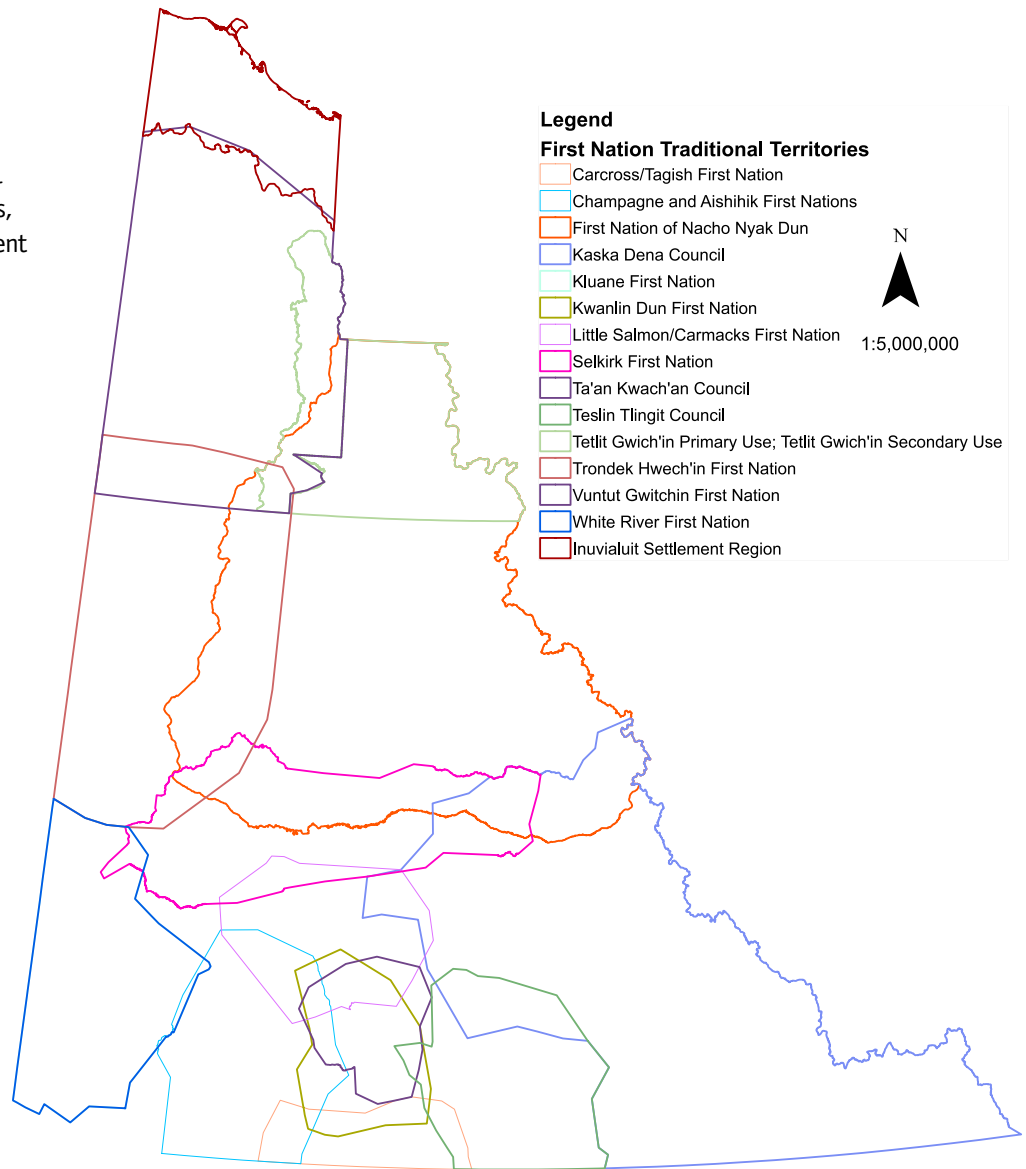
A recent ratification vote by the Carcross/Tagish First Nation failed to approve the land claim and self-government agreements. The White River First Nation has concluded their land claims negotiations. No date has been set for a ratification vote.

The following Yukon First Nations are not presently negotiating land claims or self-government agreements:

- Ross River Dena Council; and
- Liard River First Nation.

## Transboundary First Nations

Some Yukon First Nations share traditional use and occupancy of Yukon land with First Nations in both British Columbia and the Northwest Territories. In B.C., those First Nations are the Kaska Dena Council, the Tahltan Tribal Council and Taku River Tlingits. In the N.W.T., they are the Tetlit Gwich'in, the Inuvialuit and First Nations which make up the Dene/Metis. The Tetlit Gwich'in and the Inuvialuit have Transboundary Agreements which are in effect, while discussions with other Transboundary First Nations are still at an early stage. Discussions with other transboundary claimants, have not begun.



## Legislation, Regulations and Administration

The Yukon oil and gas regime has the following components:

Legislation: *Yukon Oil and Gas Act*

Regulations: The *Oil and Gas Transfer Regulations* and the *Oil and Gas Disposition Regulations* have been adopted.

**Three regulations are in the advanced stages of development. These are the Oil and Gas License Administration Regulations, the Oil and Gas Geoscience Exploration Regulations and the Drilling and Production Regulations.**

**The Oil and Gas Royalty Regulations have been drafted.**

**Other regulations pertaining to pipelines and gas plants will be required in the future and are in the early stages of being drafted.**

**Administration:** Administration is performed or coordinated through the Oil and Gas Management Branch within the Department of Energy, Mines and Resources in Whitehorse.

Copies of the legislation, regulations, guidelines and application forms can be obtained through the Department of Energy, Mines and Resources Web site at [www.yukonoilandgas.com](http://www.yukonoilandgas.com) or by contacting our office.

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## Fiscal Regime

The Yukon government is committed to developing a competitive and consistent oil and gas fiscal regime. In designing it, the government is mindful that Yukon is a resource rich frontier with challenging high cost investment opportunities.

### Royalties

Yukon is developing its royalty regulations and is planning to adopt an ad valorem royalty system.

The proposed base oil and gas royalty is 10 per cent and with increases to a maximum of 15 per cent in accordance with a price sensitive formula. A nominal royalty rate is proposed for an initial period of production.

### Rentals

Rentals are not set in regulation. Rather, rentals are indicated in the Call for Bids and set contractually in the permit. To date, rentals have been set at zero for the initial term of permits issued as a result of the sale. In the second term of the permits rentals will be \$5/hectare.



## Yukon Common Oil and Gas Regime

The Yukon government and First Nations have formed a partnership for the purposes of jointly developing a common Yukon-wide oil and gas regime. Under a common regime, Yukon and First Nations governments have the option of adopting the same legislation and regulations to manage their respective oil and gas resources. Together they have developed common legislation (*Yukon Oil and Gas Act*) and are presently working towards completion of common oil and gas regulations.

A common oil and gas regime will provide companies with a consistent, streamlined regulatory process throughout the territory. It promotes a stable political and legal climate for oil and gas companies to conduct their affairs.

## How the Common Regime Works

The common regime has several features:

### One Piece of Legislation

The *Yukon Oil and Gas Act* (YOGA), which consists of five parts, is the nucleus of the regime and addresses administration (Part 1), oil and gas rights (Part 2), operations (Part 3), and general matters such as audits, offences and penalties, and evidence (Part 4). Part 5 deals with transitional and commencement matters.

### YOGA Applies to all Oil and Gas Operations

The *Yukon Oil and Gas Act* was structured and written to apply to all oil and gas operations in the territory. For example, Part 3 of the Act, dealing with oil and gas operations, applies throughout Yukon. It is a law of general application where approved operations can relate to both First Nation and Yukon government lands. If the operations relate to First Nation lands, an agreement may be concluded with the relevant First Nation respecting the coordinated management and regulation of oil and gas activities, the recovery of oil or gas from a field or pool, and royalties.

## Adoption of Laws by Reference

To ensure that the same rules apply throughout Yukon, First Nations have the option of adopting by reference the *Yukon Oil and Gas Act* or parts of it relating to the disposition and management of oil and gas rights. At this time, no Yukon First Nation has passed any legislation relating to oil and gas.

## Integrated Management

The Act allows for the possibility that First Nation oil and gas interests form part of an overall, integrated management approach. Three examples of such provisions are:

- Grouping of Yukon government and First Nation permits or leases;
- Negotiating joint benefits agreements that pertain to both Yukon and First Nation lands between the Yukon government, affected First Nation(s) and the licensee; and
- Pooling and unitization could involve both Yukon government and First Nation lands.



Yukon businesses and First Nations take a tour of a pipeline near Fernie, B.C.

## Licensing Oil and Gas Activities

The disposition process confers specific oil and gas rights for certain locations but does not confer the right to undertake activity. Prior to any oil and gas exploration and development occurring, companies must obtain a licence pursuant to the *Yukon Oil and Gas Act* and the associated regulations: *Oil and Gas Licence Administration Regulations (draft)*, *Oil and Gas Geophysical Exploration Regulations (draft)*, and *Drilling and Production Regulations (draft)*.

The licensing process is a central element of the regime which ties together the geophysical, drilling and production, pipeline, and gas processing regulations. In order to obtain a licence, applicants must complete an environmental assessment. In order to proceed with a licensed operation for projects with expected expenditures of over \$1 million, a benefits agreement must be negotiated.

## Benefits Agreements

Normally, oil and gas activity cannot be carried out under the authority of a licence unless a benefits agreement is in effect. A benefits agreement is negotiated between three parties: the licensee, Yukon government and the affected First Nation(s). The agreement is to contain undertakings by the licensee to provide opportunities to First Nations, local community residents and other Yukon people for employment and training, and to supply goods and services to the licensee and contractors.

A benefits agreement is not required when the work is not expected to exceed \$1 million in any 12-month period.

An agreement must not place excessive financial burden on the licensee.

The benefits are to be directly related to the size of the project and are to be commensurate with the nature, scale, duration, scope and cost of the project.

The agreement may cover activities to be carried out under several licences, and the requirement may be waived under some circumstances.

## Environmental Assessment

All projects and activities will be subject to an environmental assessment before a licence is issued. Currently the assessment is done pursuant to Yukon legislation (*Yukon Environmental Assessment Act* or EAA) which mirrors the *Canada Environmental Assessment Act* (CEAA). An applicant is requested to provide information on the project and the surrounding environment as well as the environmental effects of the project and the mitigation to eliminate or reduce these effects. The branch seeks input from advisory committees and/or the public then determines whether the project may proceed, or whether further assessment is required.

Many oil and gas projects also require other federal and territorial permits and these other agencies also need to conduct an environmental assessment under CEAA or EAA. The branch works with these other agencies to coordinate the application submission requirements, environmental assessment process and the development of compatible licence terms and conditions. Coordinating with other agencies streamlines the assessment and licensing process and eliminates the potential for agencies to issue conflicting assessment decisions or licence terms and conditions.

The *Yukon Environmental and Socio-Economic Assessment Act* (YESAA), the legislation which gives effect to the Development Assessment Process, was given royal assent on May 8th, 2003 and came into effect November 2004. Assessments under this new legislation, however, will not be conducted until the accompanying regulations are passed, which is targeted for April 2005. This Act replaces EAA and will apply to all Yukon land and projects under the authority of federal, territorial and First Nations governments. YESAA will change the way environmental assessments are done in the Yukon. For example, a YESAA Board and Designated Offices will be established to conduct environmental and socio-economic assessments. The Yukon government will no longer be conducting assessments but will still retain decision-body responsibilities as defined in the legislation.





### Well Abandonment Deposit

A licensee has an obligation to properly abandon a well. This includes proper down-hole abandonment as well as the removal and disposal of the well-site surface equipment and cleaning up the well site or any other land on which the well site equipment was located. Orphan wells are a concern to all jurisdictions. To minimize the potential problems with orphan wells, Yukon has introduced innovative provisions with respect to well abandonment.

An application for a well licence or the registration for the transfer of a well licence must, as precondition to the approval of an application, be accompanied by a well abandonment deposit. Yukon has built flexibility into this requirement:

- The amount of deposit required can change depending on risk. The amount required is that estimated by the Minister as the abandonment cost of the well.
- Once the well has been properly abandoned, the deposit plus interest will be refunded. Therefore, responsible operators and owners will not be penalized.
- If a well has not been properly abandoned, the government may order the operator or the working interest owners to abandon the well. The government may also order that the well be abandoned at government expense and seek to recover costs by keeping the well abandonment deposit.

## Managing Oil and Gas Rights

Yukon's system for managing rights is a hybrid of the federal and provincial regimes, adapted to our unique circumstances. For instance, Yukon retained the federal system of land division that applies to Canada lands. Yukon also adopted a system for the registration of transfers and notices that is similar to Alberta. However, Yukon introduced some different features with respect to permits and leases, eligibility, issuing rights, rentals, and grouping and offsets.

### Permits and Leases

Yukon has adopted a system of permits and leases for conveying oil and gas rights. A permit enables exploration, while a lease is required for production. The maximum term for a permit is 10 years if certain requirements are met. The initial term (or term one) is for six years. The second term (or term two) is a four-year extension that may be granted if a well has been drilled or is in the process of being drilled before expiry of the initial term.

The initial term of a lease is 10 years with five-year renewals that are guaranteed as long as a company can demonstrate producibility.

### Eligibility

Only companies are eligible to directly acquire oil and gas rights. This restriction was introduced to ensure that rights holders have the ability to provide financial assurance under the *License Administration Regulations*. However, provisions to protect the rights of individuals who may acquire an interest in dispositions through share transfers, etc. have been added.

## Issuing Rights

Oil and gas rights are issued following a two-step process that ends with a Call for Bids on a specific parcel of land. The two steps are:

### 1. Call for Nominations

In preparation for Yukon's Call for Nominations input is gathered from government, interest groups, First Nations and Land Claim bodies. Based on this information, the Yukon government prepares a draft Call for Nominations and engages in government to government consultations with affected First Nations. Following the consultations, Yukon government will prepare and post the final Call for Nominations.

### 2. Call for Bids and issuance of dispositions

In preparation for Yukon's Call for Bids, a public review of the nominated parcels is conducted. Based on the input received, the Yukon government prepares and posts the final Call for Bids.

Through participation in this process, companies, First Nations and all Yukoners will be offered greater certainty and stability regarding land tenure.

Rights are issued through a competitive bidding process. The government uses one concept for issuing rights. Generally this will be either the total cash bid or the total cash value of a work expenditure bid. The cash value of work expenditures has been the criterion in Yukon's Calls for Bids to date. The successful bidder is required to submit a refundable work deposit equal to one quarter the value of the bid. The money deposited will be refunded on a pro-rata basis as work is performed and funds are spent.

The oil and gas disposition process takes approximately 10 months to complete and requires a good deal of consultative work by the Yukon government. Disposing rights in this way ensures that significant issues and concerns will be identified and addressed before rights are issued to a company. This approach provides companies constancy and assurance in land tenure.



## Dispositions of Oil and Gas Rights

### Federal government-issued Licences

<u>Disposition</u>	<u>Number</u>	<u>Location</u>
<u>Significant Discovery Licences</u>	7	<u>Eagle Plain</u>
	2	<u>Liard Plateau</u>
<u>Exploration Licences</u>	2	<u>North Coast</u>
<u>Production Leases</u>	4	<u>Kotaneelee</u>

There are existing oil and gas rights issued under the federal regime which have been grandfathered under the Yukon Oil and Gas Act.

Since 1999, Yukon has conducted three land sales and received work expenditure bids totalling approximately \$24 million.

Three permits in Eagle Plains were issued as a result of the first two sales. Anderson Exploration, now part of Devon, was the successful bidder for all three parcels.

In January 2002, Yukon concluded the third rights issuance. Hunt Oil of Canada Ltd. was the successful bidder for one parcel in the Peel Plateau with a work expenditure bid of \$1.1 million.

## Call for Nominations 2004

In March 2004, the Yukon issued its fourth Call for Nominations for oil and gas rights in two areas of North Yukon. The Call closed in May and allows industry to identify areas that are of interest to them. Once the nominations are received, a public consultation phase occurs to identify any environmental, socio-economic and surface access concerns. The government reviews the input and identifies specific parcels of land that will be offered to industry in a Call for Bids. A Call for Bids will occur in the Fall of 2004, after a public review of the nominated parcels.

## Exploration

### Industry

71 wells have been drilled in Yukon. More than 20 wells had hydrocarbon shows. Two wells are producing natural gas at the Kotaneelee field located in Liard Plateau in the southeast. These wells, producing approximately 14 Bcf of natural gas per year, are connected to the Duke Energy Gas Transmission Pointed Mountain gathering system that carries the gas south to Fort Nelson, B.C. for processing. Limited crude oil test production has occurred at Eagle Plain.

Since 1999, 14 geoscience exploration licences have been issued by the Yukon Oil and Gas Management Branch. Five 2D seismic surveys have been completed.

### Government Initiatives

#### North Yukon:

The Yukon government and the Geological Survey of Canada (GSC) cooperated on two high-resolution aeromagnetic surveys in the Peel Plateau, Bonnet Plume Basin and Eagle Plain. More than 62,000 line kilometres were flown at 800 metre spacing.

Visit <http://gdcinfo.agg.nrcan.gc.ca> for more information.

#### Southeast Yukon:

The Yukon government is continuing to work towards a land sale in southeast Yukon in 2004.

The GSC-led Central Foreland NATMAP project in southeast Yukon, southwest N.W.T. and northeast B.C. involved geological mapping and detailed thematic studies (stratigraphy and biostratigraphy, petroleum source-rock potential and mineral deposit studies) carried out in collaboration with the British Columbia Geological Survey, Yukon Geological Survey, Indian and Northern Affairs Canada (INAC), the Government of the N.W.T., and 12 universities. This project concludes in 2004. For more information, go to [http://nrcan.gc.ca/gsc/calgary/natmap/cf/index\\_e.html](http://nrcan.gc.ca/gsc/calgary/natmap/cf/index_e.html)

#### Whitehorse Trough:

Another cooperative GSC/Yukon Geological Survey project is underway in the Whitehorse Trough. It will include a 170-kilometre-long seismic survey across the northern end of the Trough, regional bed rock mapping and thematic studies (including stratigraphy, sedimentology, structure, maturation and petroleum source rock potential). A revised oil and gas resource assessment for the Trough will be produced at the end of the project.

#### Other:

The Yukon government is partnering in two other important GSC initiatives. The first is the Northern Basins Initiative which involves the compilation and geo-referencing of geoscience in the Yukon, NWT and Nunavut. This database will eventually be available over the web. The second major project, Mackenzie Corridor: Access to Northern Resources, will provide multi-thematic geoscience and petroleum potential maps. This project also involves the critical component of community outreach, helping Northerners access the information they need to deal with development issues.

## Access and Infrastructure

### Roads

The Yukon has more than 4,700 kilometres of roads that link to Alaska, the Northwest Territories, southern Canada and the United States. The year-round highway system is built and maintained to accommodate loads up to 77,000 kilograms, with weigh stations located throughout the Yukon. Bituminous Surface Treatments (BST) has been used on Yukon highways since the late 1970s in order to provide an improved level of service to the traveling public. There are approximately 1,860 kilometres of BST on the Yukon territorial highway system.

### Air

Whitehorse is home to an international airport, with direct flights daily from Edmonton, Calgary, Vancouver, Alaska, and the Northwest Territories. In the summer, there are regularly scheduled direct flights from Europe. There are 10 airports throughout the territory, with many smaller airstrips and aerodromes in remote areas.

### Pipelines

There is a great deal of interest in Yukon's oil and gas prospects; however, investment spending to date has been modest. A dramatic increase in oil and gas investment is anticipated once construction is announced of either (or both of) the Mackenzie Gas Project or the Alaska Highway Pipeline Project. Yukon believes that both the Alaska Highway pipeline and the Mackenzie Valley pipeline will be constructed, as northern natural gas will be needed to supply the growing North American demand. Yukon is preparing for the opportunities and benefits of both pipeline developments. We have concluded an agreement with the Northwest Territories government to ensure that both territories benefit from oil and gas exploration and pipeline development in the North.

### Pointed Mountain Pipeline

The Duke Energy Gas Transmission Pointed Mountain pipeline originates in the southwestern Northwest Territories and then moves into the Yukon past the Kotaneelee Gas Plant. It acts as a gathering and transportation system for the natural gas produced at the Kotaneelee field, where the only gas production in the Yukon occurs.

### Mackenzie Valley Pipeline Project

The Yukon government is actively taking measures to ensure that Yukon natural gas is not stranded and will have access to the proposed Mackenzie Valley pipeline. The government has been working with Yukon oil and gas permit holders and explorers to ensure that the Yukon's gas potential is identified and placed on the Mackenzie Valley Producers Group "radar screen." The Yukon is working with Devon Canada Corporation, Chevron Canada Resources, Hunt Oil Company of Canada and Northern Cross (Yukon) to collectively promote the potential natural gas reserves in northern Yukon. Yukon's position, similarly, is that gas originating in areas contiguous to an Alaska Highway Pipeline will enjoy similar access. In any circumstance, Yukon gas must have access to northern pipelines.

### Alaska Highway Pipeline Project

The original Alaska Highway Pipeline Project was awarded Certificates of Public Convenience and Necessity under the Northern Pipeline Act in Canada and by the Alaska Natural Gas Transportation Act in the United States in the late 1970s. Southern portions of the project, called the pre-build, were constructed in parts of Alberta, British Columbia and Saskatchewan in the 1980s and 1990s. Construction of the northern portion of the pipeline would complete the project.

Current proposals call for the construction of a pipeline from Prudhoe Bay to Fairbanks along the Trans Alaska Pipeline System (TAPS) right of way, and then from Fairbanks along the Alaska Highway right of way to Alberta. The project would deliver between 4.5 Bcf and 5.6 Bcf of gas per day and cost approximately \$20 billion US to construct.

The Alaska Highway Aboriginal Pipeline Coalition (AHAPC), initiated in July 2003, serves as a central coordinating organization on pipeline related matters for Yukon First Nations directly impacted along the Alaska Highway Pipeline corridor. The areas of particular focus for the AHAPC include the regulatory issues, environmental issues, socio-economic impacts of the pipeline, and impact benefits agreements. It continues to receive the encouragement and support of the Yukon government.

The Yukon government is preparing a pipeline strategy for both the Mackenzie Gas Project and the Alaska Highway Pipeline Project.

### Dempster Lateral

The Dempster Lateral was proposed in the 1977 National Energy Board Hearings as a method of moving Mackenzie Delta natural gas to market by connecting to the Alaska Highway Pipeline at Whitehorse. Today it is not actively being pursued.



## Yukon Oil and Gas Exploration Regions

Yukon occurs in the northern portion of the large geologic province known as the Cordillera, consisting of relatively young mountain belts ranging from Alaska to Mexico. Like most of the Cordillera, Yukon is composed of a diverse array of rock types that record more than a billion years of earth history.

In Yukon two main geologic components are largely separated by the Tintina Fault, a major northwest-trending fault with approximately 420 km of right lateral strike-slip displacement. Northeast of the Tintina Fault is a thick, older sequence of sedimentary rocks deposited upon a stable Precambrian cratonic basement marking the western margin of ancestral North America. These sedimentary rocks preserve an Early Paleozoic east to west transition from platform carbonate (east) to basinal shale (west). Platform carbonate deposition ceased in Middle Devonian and shale deposition extends far to the east. During Carboniferous and Triassic normal, clastic marine, shelf sedimentation resumed. Overlying these earlier sedimentary successions is a structural foreland belt and several intermontane basins developed in response to deformation and uplift of the western margin of North America during the Jurassic-early Tertiary Cordilleran deformation.

Southwest of the Tintina Fault the Yukon is composed of a younger, complex mosaic of suspect terranes that originated elsewhere and were amalgamated and accreted to the stable ancestral North America sedimentary package during the Cordilleran deformation. Eastern suspect terranes are pericratonic, and western terranes are underlain by oceanic crust.

Yukon contains eight structural and sedimentary basins suitable for the formation and preservation of hydrocarbons. Seven of these basins occur within the sedimentary rocks of ancestral North America, and one occurs within the suspect terranes southwest of Tintina Fault. Five of the basins occur in northern Yukon, and two are located in southern Yukon. Geology within the basins northeast of Tintina Fault is essentially the same as that in the Western Canada Sedimentary Basin.

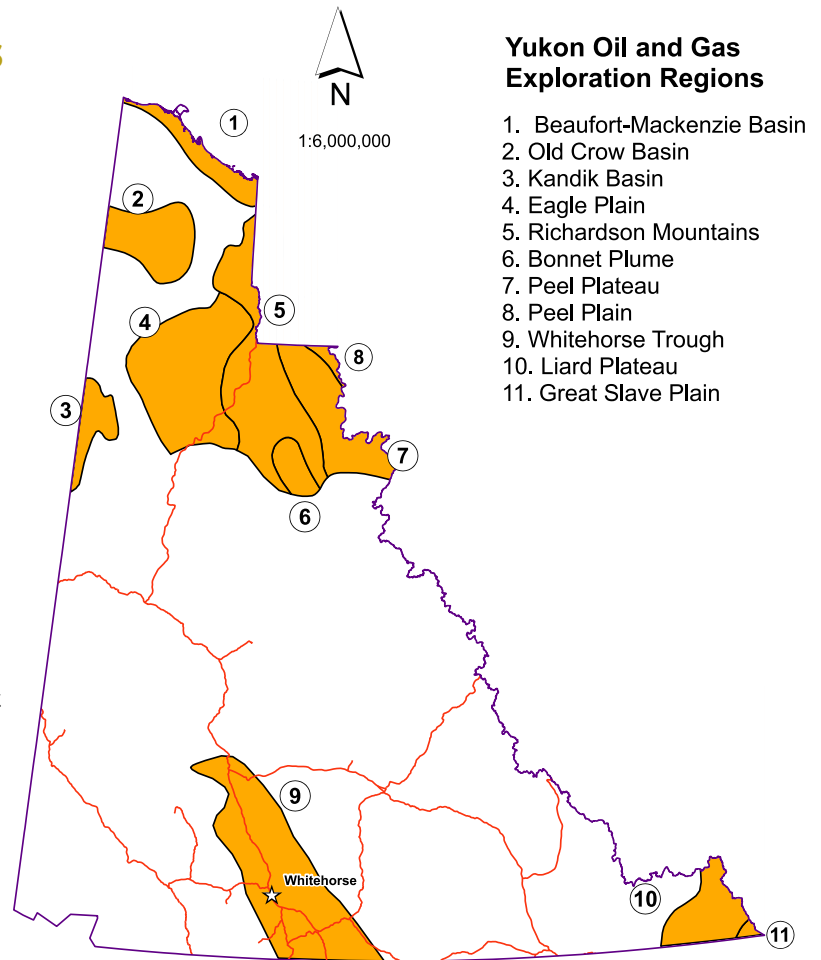
The only hydrocarbon production in Yukon comes from the Kotaneelee Field in the Liard Plateau area, located in the far southeast corner of the territory.

## Yukon Oil and Gas Resource Assessments

Oil and gas resource assessments for the different exploration areas of the Yukon have been completed by National Energy Board and Geological Survey of Canada. These assessments have been periodically updated to incorporate new geological field information from Yukon and exploration plays in other areas.

Most of these areas have little or no well information. Basin analysis was routinely undertaken to provide background for developing conceptual hydrocarbon plays. Since conceptual plays have no defined pools or discoveries, probability distributions of reservoir parameters such as prospect area, reservoir thickness, porosity, trap fill, and hydrocarbon fraction are compiled to aid in the assessment.

Hydrocarbon assessments completed by the Geological Survey of Canada are based on probabilistic methods using the PETRIMES software. NEB assessments were completed using the @RISK software extension to Excel spreadsheet software.



## Yukon Oil and Gas Exploration Regions

1. Beaufort-Mackenzie Basin
2. Old Crow Basin
3. Kandik Basin
4. Eagle Plain
5. Richardson Mountains
6. Bonnet Plume
7. Peel Plateau
8. Peel Plain
9. Whitehorse Trough
10. Liard Plateau
11. Great Slave Plain

Due to the nature of conceptual assessment results and since no discovered pool sizes are available to constrain sizes of undiscovered accumulations, the uncertainties in oil and gas play potential and pool size estimates for a given range of probabilities are necessarily greater than the ranges derived by discovery process analysis used for assessing mature plays.

## Coal Resources

Yukon has initiated an assessment of its natural gas from coal resources. There are numerous coal occurrences of varying ranks within the territory. The Bonnet Plume Basin in northeast Yukon is likely the most prospective natural gas from coal region.

Basin	Mean Gas Play Potential (Bcf)	Mean Oil Play Potential (MMbbls)	Discover Resource Gas (Bcf)	Discovered Resource Oil (MMbbls)	Wells to date
Kandik %	1,397	365	--	--	3
Beaufort-Mackenzie %	1,473	294	--	--	3
Bonnet Plume	800	0	--	--	0
Eagle Plain \$	6,054	436	83.7	11	33
Liard Plateau \$	4,429 *	15 ^	437	--	13
Old Crow	1,149	0	--	--	0
Peel Plateau and Plain	2,945	0	--	--	19
Whitehorse Trough %	7,325	94	--	--	0
Other	--	--	--	--	1

### TOTAL

21,143

1,189

521

11

72

\* mean marketable gas

^ mean marketable oil

\$ discovered resource based on NEB resource assessment report

% a portion of the play potential is outside the Yukon

**Beaufort-Mackenzie Basin Oil and Gas Resource Assessment**

2001 Geological Survey of Canada (Calgary) P. Hannigan



## Geological Summary

The Beaufort-Mackenzie basin of northern Yukon is an Arctic margin basin underlain by complexly faulted and folded Proterozoic through Tertiary sediments. The area is flanked to the south by exposed Proterozoic and Lower Paleozoic sediments of the British Mountains and Richardson Mountains. It contains four tectono-stratigraphic assemblages separated by major regional unconformities: a lowermost Proterozoic clastic assemblage forming the economic basement, Lower Paleozoic sedimentary rocks delineating a carbonate platform to marine basin transition with dominantly basinal shales in the area of interest, Carboniferous to Lower Cretaceous nonmarine clastic sedimentary rocks transitioning to shallow marine and intertidal deposits, and Lower Cretaceous to Tertiary northward prograding delta deposits. Upper Cretaceous sedimentary rocks include foreland flysch deposits from extensively eroding uplands of the Cordilleran Orogen.

The dominant structural fabric is related to Cretaceous-Tertiary contractional deformation of the Cordilleran Fold Belt during the Cordilleran Orogeny. Structures form an arcuate trend with east to southeast strikes in the northwestern Yukon rotating to a north-south trend in the eastern Yukon. Tight folds, thrust faults, strike-slip faults, and extensional faults all formed as part of this deformation. Earlier deformation features related to the Ellesmerian Orogeny and Jurassic-Cretaceous extension are locally discernable through the later overprinting.

## Exploration History

Seismic surveys in the Mackenzie Delta area in the early 1960's delineated large structures in favourable stratigraphic successions. These early surveys led to the drilling of two dry wells in 1962. Further exploration led to the discovery of oil in Cretaceous sandstones in 1969. In 1970 a major gas find was made in Lower Cretaceous sands. In 1977 the focus of exploration switched

offshore to Tertiary targets. In the Beaufort-Mackenzie region, 53 oil and gas discoveries, both onshore and offshore, have been made. Forty-four of these discoveries occur in the Tertiary basin. 247 wells have been completed to date. Drilling on the Yukon portion of the basin to the west has been very limited. Three wells were completed showing no hydrocarbons and limited reservoir potential.

## Plays

The potential for significant hydrocarbon accumulations in the region is derived from the combined presence of numerous and diverse trapping configurations, good to excellent petroleum source rocks in favourable stratigraphic positions and reservoir-quality strata in the sedimentary succession. However, significant risks associated with lack of porosity development in Paleozoic and Mesozoic strata and thermal maturity considerations reduce overall hydrocarbon potential. The complex geology and anticipated high exploration risks associated with all defined exploration plays in the region suggest that considerable seismic survey work and exploration drilling are required to properly evaluate the North Coast hydrocarbon potential.

There are no discovered reserves in the Yukon portion of the Beaufort-Mackenzie basin. Hydrocarbon resource assessment for the area encompasses portions of Yukon and GNWT. The assessment analyzed six conceptual and immature plays. The mean estimates for total oil and gas potential for all coastal plain plays are 294 MMBbls of oil and 1,473 Bcf of gas. The results indicate that four gas fields greater than 100 Bcf are expected in the region. Even though geological risk factors are substantial, significant gas potential is predicted.

Oil Plays (MMbbls)	No. fields (mean)	Mean play potential (in-place)	Play potential-80% (in-place)	Play potential-20% (in place)
South Delta-Mesozoic*	4	27	5	39
Herschel^	5	267	86	414
<b>Total Oil (MMbbls)</b>		<b>294</b>		
Gas Plays (Bcf)				
South Delta-Mesozoic*	8	86	38	124
South Delta-Paleozoic*	15	257	110	384
Herschel^	5	691	226	1,072
Yukon Coastal Plain	2.5	439	63	724
<b>Total Gas (Bcf)</b>		<b>1,473</b>		

Wells

Well Name	Class	Status	Gr. Elev (m)	Total Depth (m)	Spud	Rig Release
IOE Blow River YT E-47	Expl	D&A	112.2	4269.9	5/8/70	11/15/70
IOE Spring River YTN-58	Expl	D&A	92.7	2136.3	1/19/71	3/18/71
Pacific Imp et al Roland Bay YT L-41	Expl	D&A	12.5	2752.3	12/22/72	4/20/73

\* Yukon encompasses 2.5% of play area

^Yukon encompasses 81% of play area

Yukon Coastal Plain play is 100% within Yukon

no allowance is made for portion of play within Ivvavik National Park and Herschel Island Territorial Park

# Assessment completed using program PETRIMES

# Old Crow Basin Oil and Gas Resource Assessment

Old Crow Basin Resource Assessment (Hannigan, 2001) #

## Geological Summary

In northwestern Yukon, the Old Crow Basin is a Tertiary intermontane basin within the Northern Yukon Fold Complex. It is flanked by intensely deformed and uplifted Proterozoic to Mesozoic sedimentary rocks of the British Mountains, Richardson Mountains, Old Crow Range and Keele Range. The Old Crow Basin consists of essentially flat-lying Tertiary to Recent, nonmarine sediments with coals unconformably overlying a Proterozoic to Mesozoic basement with a suggested relief of up to 800 m. This basement relief is caused by either east-west trending marginal faults or syncline-anticline fold structures. Mesozoic strata are thought to be imperfectly preserved beneath this Eocene unconformity with their erosion occurring over the structural highs.

Rocks in the region have been deformed by two major orogenic episodes: an Early Devonian Ellesmerian compressional orogeny, and the latest Cretaceous to Tertiary Cordilleran compressional orogeny.

## Exploration History

Petroleum exploration in the Old Crow Basin has been quite limited. Approximately 2000 line-km of reconnaissance seismic was shot in the basin between 1969 and 1972. An extensive gravity survey was completed by Gulf Oil Canada Ltd. in 1973. No wells have been drilled. The nearest well is the Socony Mobil-W.M. Molar P-34 well drilled in northern Eagle Plain, 50 kilometres to the southeast.

## Plays

Tertiary sediments are likely too immature and sparingly structured to have significant hydrocarbon potential, although there is some potential for biogenic gas. There is little, if any, oil potential in the area.

Three conceptual gas plays and three speculative gas plays were defined in the Old Crow Basin area on the basis of petroleum geology considerations such as structural style, dominant reservoir lithology and thermal maturity. Conceptual gas plays for the Old Crow Basin consist of conglomerates of the Carboniferous Kekiktuk Formation, carbonates of the Carboniferous Lisburne Group and Mesozoic sandstones preserved beneath the Tertiary cover. The greatest gas potential or volume occurs in the Upper Paleozoic carbonate play.

Gas Plays (Bcf)	No. fields (mean)	Mean play potential (in place)		Play potential-80% (in place)	Play potential-20% (in place)
Kekiktuk conglomerate <sup>^</sup>	5	422	100	689	
Upper Paleozoic carbonate <sup>^</sup>	5	686	123	1,107	
Mesozoic clastic <sup>^</sup>	0.6	41	0	66	
<b>Total Gas (Bcf)</b>		<b>1,149</b>			

<sup>^</sup> no allowance is made for portion of play within Vuntut National Park

# Assessment completed using program PETRIMES

**Kandik Basin Oil and Gas Resource Assessment**

Kandik Basin Resource Assessment (Hannigan, Osadetz, Dixon and Bird, 2000) \*



## Geological Summary

Kandik Basin is a structural basin containing Paleozoic-Mesozoic sedimentary rocks within the Northern Yukon Fold Complex. It straddles the Yukon-Alaska border 650 kilometres north-northwest of Whitehorse and 907 kilometres southeast of Prudhoe Bay, Alaska. The basin is elongate to the southwest with about 60% of the area located in Alaska. It consists of three separate areas with preserved Mesozoic sedimentary rocks which are surrounded by exposed Precambrian-Paleozoic outcrops. To the south the Basin is bounded by the Tintina Fault with some 420 km of right-lateral strike-slip displacement.

Basin basement consists of marlstones, diamictites, quartzites and siliceous carbonates of the Proterozoic Tindir Group. Unconformably overlying these strata are numerous Lower Paleozoic carbonate-shale cycles with lesser intermittent siliciclastic sedimentation intervals. Recurrent Cretaceous marine clastic wedges separated by unconformities overlie the earlier interbedded carbonate-shale intervals. The uppermost succession consists of nonmarine conglomeratic sandstone and grit which unconformably overlie the Cretaceous marine succession. The area was unglaciated during the Pleistocene; alluvial sediments occur along river valleys.

The basin formed as a structurally controlled depositional site in late Early Cretaceous. Subsequent Cordilleran Orogen compressional tectonics in Late Cretaceous and early Tertiary produced folds and faults within the basin.

## Exploration History

Petroleum exploration in Kandik Basin began in 1970 with the drilling of the INC Husky Amoco Black-fly YT M-55 well. Inexco conducted a reflection and refraction seismic survey in the winter of 1971 which acquired approximately 180 line-km of data in three areas along the eastern margin of the basin. Two additional holes were drilled in 1971 (Porcupine YT G-31) and 1972 (Mallard YT O-18). All three holes were drilled on structures. None of the wells encountered hydrocarbons.

In Alaska three wells were drilled in the interval 1976-1977. Two of these wells were spudded north of the area considered to be part of Kandik Basin for assessment purposes.

## Plays

There are no discovered reserves in the basin. Oil staining has been observed in outcrop in carbonates and calcareous sandstone in the Alaska portion of the basin. Six conceptual oil and gas plays (three for oil and three for gas) were identified in the Kandik Basin. The Upper Cretaceous/Tertiary nonmarine play has limited extent, occurring dominantly in the southern part of the basin. Reservoirs for Mesozoic marine structural plays are dominantly clastic sedimentary rocks, and reservoirs for Paleozoic structural plays are mainly carbonate rocks. The Mesozoic marine structural oil play occurs entirely within Alaska. All plays are considered to have a high probability of existing. An important risk in each of the plays is the extent of erosion and unroofing which may have increased the chance of breached seal or closure.

Oil Plays (MMbbls)	No. fields (mean)	Mean play potential (in place)	Play potential-80% (in place)	Play potential-20% (in place)
Tertiary/Upper Cretaceous nonmarine <sup>§</sup>	30	222	76	388
Paleozoic marine <sup>#</sup>	3	143	20	245
Total Oil (MMbbls)		365		

Gas Plays (Bcf)	No. fields (mean)	Mean play potential (in place)	Mean play potential-80% (in place)	Mean play potential-20% (in place)
Tertiary/Upper Cretaceous nonmarine <sup>§</sup>	30	283	96	494
Mesozoic marine structural <sup>^</sup>	8	420	150	664
Paleozoic marine structural <sup>&amp;</sup>	10	694	239	1,101
Total Gas (Bcf)		1,397		

## Wells

Well Name	Class	Status	Gr. Elev (m)	Total Depth (m)	Spud	Rig Release
Inc Husky Amoco Black-Fly YT M-55	Expl	D&A	749.8	2069.6	1/13/70	4/1/70
Inexco Husky et al. Porcupine YT G-31	Expl	D&A	917.4	2657.9	12/31/71	3/24/72
Inexco et al. Mallard YT O-18	Expl	D&A	470.6	3200.1	5/2/72	8/19/72

<sup>§</sup>Yukon encompasses 35% of play area

<sup>^</sup>Yukon encompasses 45% of play area

<sup>#</sup>Yukon encompasses 15% of play area

<sup>&</sup>Yukon encompasses 52% of play area

\* Assessment completed using program PETRIMES

## Eagle Plain Oil and Gas Resource Assessment

Eagle Plain Resource Assessment (Bird, Chen, Osadetz, 2005) #

## Geological Summary

Eagle Plain, in northcentral Yukon, is an underexplored structural basin with proven Cretaceous, Carboniferous, and Devonian gas and oil measures within the Northern Yukon Fold Complex. It has a maximum sediment thickness of 5,800 m. During Cambrian through Carboniferous time it was the site of continuous subsidence and deposition as part of the western continental margin miogeocline. Lower Paleozoic platform carbonates of the Bouvette and Ogilvie formations are bounded and interfinger with carbonaceous basinal shales of Richardson Trough on the east. During Late Paleozoic sedimentation is dominated by clastic sediments with lesser carbonate. Paleozoic sedimentary rocks are in turn unconformably overlain by Cretaceous marine siltstone, shale and sandstone deposited as a foreland succession in response to Cordilleran deformation.

North-trending anticlines, synclines and thrust faults related to Cordilleran deformation occur throughout the basin. The basin is divided into the northern Bell sub-basin and the South Eagle sub-basin, the sub-basins being separated by the east-west trending Eagle Arch.

## Exploration History

Surface exploration began in the mid 1950's. The first well (Peel Plateau Eagle Plain YT No. 1 N-49) was completed in 1958. The first discovery well (Chance YT No. 1 M-08) was completed in 1960. The most recent wells were drilled in 1985. A total of 33 wells have been drilled; several of these contained hydrocarbons in one or more zones.

A total of 9,952 line kilometers of two-dimensional seismic survey lines have been completed in Eagle Plain with only 8% of that being shot since 1975. Seismic coverage is largely in the southern end of the basin. In most cases gravity and magnetic surveys were conducted concurrently with the seismic. Discovered resources contain 83.7 Bcf gas and 11.1 MMbbls oil. All of the currently discovered hydrocarbons are found in the South Eagle sub-basin.

## Plays

Fifteen different petroleum plays were identified in the Eagle Plain area (9 gas and 6 oil). These encompass a variety of structural and stratigraphic traps. Several plays are considered established as they have yielded proven discoveries. The others have petroleum shows in this basin or other basins and are therefore considered immature. Most of the wells drilled to date have stopped in Devonian and younger rocks; only six wells have tested the Lower Paleozoic stratigraphy

Gas Plays (Bcf)	No. fields (mean)	Mean play potential (in place)	Play potential-75% (in place)	Play potential-25% (in place)
Cretaceous stratigraphic gas	16	118	81	145
Cretaceous structural gas	16	231	165	279
Permian stratigraphic gas	16	2,160	1,333	2,701
Permian structural gas	5	72	34	95
Carboniferous stratigraphic gas	11	1,705	1,178	2,099
Carboniferous structural gas	6	118	68	150
L. Carboniferous stratigraphic gas	18	323	237	388
L. Paleozoic stratigraphic gas	20	879	607	1,061
L. Paleozoic structural gas	6	448	153	564
<b>Total Gas (Bcf)</b>	<b>114</b>	<b>6,054</b>		
<b>Oil Plays (MMbbls)</b>				
Cretaceous stratigraphic oil	7	40	25	51
Cretaceous structural oil	6	67	40	86
Permian structural oil	4	105	50	140
Carboniferous stratigraphic oil	5	78	45	101
Carboniferous structural oil	5	77	47	98
L. Carboniferous stratigraphic oil	5	69	43	88
<b>Total Oil (MMbbls)</b>	<b>32</b>	<b>436</b>		

# Assessment calculated using program PETRIMES

## Wells

Well Name	Class	Status	Gr. Elev (m)	Total Depth (m)	Spud	Rig Release
Peel Plateau Eagle Plains YT No 1 N-49	Strat	D&A	457.2	2895.6	1957/04/17	1958/07/16
Western Minerals Chance YT No 1 M-08	Strat	SP O&G	534	2635.9	1959/05/30	1960/05/25
Amerada et al Crown YT-A No 1 N-50	Expl	D&A	313	2439.6	1960/02/29	1960/09/08
SOBC Blackstone YT D-77	Expl	D&A	640.1	4028.5	1962/03/10	1963/01/08
Socony Mobil WM E Porcupine R YT K-56	Expl	D&A	494.1	2590.8	1963/03/26	1963/07/23
Socony Mobil WM Blackie #1 YT M-59	Expl	SP GAS	557.5	1931.8	1963/12/11	1964/03/27
Socony Mobil WM Whitestone YT N-26	Expl	D&A	691.3	2464.3	1964/04/07	1964/08/06
Socony Mobil WM Molar YT P-34	Expl	D&A	799.2	2653.0	1964/03/29	1964/08/13
Socony Mobil WM Chance YT G-08	Expl	SP O&G	518.8	1579.8	1964/12/04	1965/02/18
Socony Mobil WM Ellen YT C-24	Expl	D&A	410	2174.4	1964/12/25	1965/04/03
Socony Mobil WM W Parkin YT D-51	Expl	D&A	470.6	1508.8	1965/02/24	1965/04/03
Socony Mobil WM Birch YT B-34	Expl	D&A	663.5	1649.9	1965/04/08	1965/06/08
Socony Mobil WM N Cath YT B-62	Expl	OBS	534.9	2138.5	1965/04/16	1965/06/26
Socony Mobil WM S Tuttle YT N-05	Expl	D&A	500.5	3513.4	1965/02/18	1965/07/08
Canoe River Chance YT J-19	Dev	SP O&G	514.2	1446.3	1967/12/17	1968/02/17
Canoe River East Chance YT C-18	Expl	D&A	531.3	1540.8	1968/02/29	1968/04/06
Well Name	Class	Status	Gr. Elev (m)	Measured Depth (m)	Spud	Rig Release
Western Minerals N Hope YT N-53	Expl	D&A	346.3	4280.3	1970/04/18	1970/08/13
SOBC WM E Porcupine YT I-13	Expl	D&A	501.4	2439.6	1971/02/101	971/05/02
SOBC WM Shaeffer Ck YT O-22	Expl	D&A	347.2	3161.7	1971/01/12	1971/05/09
Chevron SOBC WM W Parkin YT C-33	Expl	D&A	514.5	1256.7	1971/11/29	1972/01/15
Chevron SOBC WM E Pine Creek YT O-78	Expl	D&A	384.4	947.6	1971/12/25	1972/01/26
Chevron SOBC WM Birch YT E-53	Expl	D&A	617.2	684.3	1972/01/20	1972/02/21
Chevron SOBC WM Whitefish YT I-05	Expl	D&A	342.3	1498.4	1972/02/23	1972/03/30
Chev SOBC Imp S Chance YT D-63	Expl	D&A	701	2020.8	1972/02/21	1972/05/01
Chevron SOBC WM E Porcupine YT F-18	Expl	D&A	518.5	2050.7	1972/03/06	1972/05/01
Chevron SOBC WM N Parkin YT D-61	Expl	D&A	483.1	3352.8	1972/01/04	1972/05/06
Chevron SOBC Gulf Ridge YT F-48	Expl	D&A	315.2	1868.7	1973/01/03	1973/04/02
Chevron SOBC WM Whitefish YT J-70	Expl	D&A	326.1	2127.5	1973/01/17	1973/04/10
Murphy Mesa PB S Whitestone YT N-58	Expl	D&A	886.1	2131.5	1973/02/10	1973/04/17
Duke Energy Gas Transmission Pointed Mountain et al Porcupine YT F-72	Expl	D&A	344.1	2251.9	1973/01/17	1974/04/06
Aquit Alder YT C-33	Expl	D&A	523.6	3714.0	1978/03/08	1979/03/04
Exco West Parkin YT D-54	Expl	D&A	502.5	1811.0	1984/12/20	1985/02/19
Exco et al N Chance YT D-22	Expl	D&A	531.5	1830.0	1985/03/011	985/04/09

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## Bonnet Plume Oil and Gas Resource Assessment

Bonnet Plume Basin Resource Assessment (Hannigan, 2000) #

## Geological Summary

The Bonnet Plume Basin is an intermontane, fault-bounded basin within the Northern Yukon Fold Complex located at the intersection of the north-trending Richardson fault array with the Mackenzie fold front. The basin developed as a depositional site in early Late Cretaceous in response to strike- and dip-slip faulting. It contains extensive non-marine late Cretaceous to Tertiary sandstone, shale, conglomerate and coal which constitute the Bonnet Plume Formation.

Unconformably underlying the Bonnet Plume Formation are Lower Paleozoic marine shales and limestones of the ancestral North America miogeocline. Most of the Bonnet Plume Basin coincides with the Richardson Trough, a north-trending zone of marine deep water shale and chert deposition with shallow water carbonate platform deposition occurring both to the west (Yukon Stable Block) and the east (Mackenzie-Peel shelf). This platform to basin transition is uniformly overlain by euxinic siliceous black shales of the Middle Devonian Canol Formation and shales and siltstones of the Late Devonian Imperial Formation.

Compressional deformation occurred during Late Cretaceous to Early Tertiary as part of the Cordilleran Orogen.

## Exploration History

No seismic surveys have been completed, and no wells have been drilled. The nearest well is the Toltec Peel River YT N-77, drilled 20 kilometres to the northwest in the Peel River valley in 1968. An east-west gravity profile was completed across the centre of the basin in 1979 to determine if gravity methods could be used to interpret structure in areas with limited surface control and no subsurface information.

The Bonnet Plume Formation contains some of the thickest and most extensive coal deposits in the Yukon. Drilling by Pan Ocean Oil of 37 shallow holes in 1978-1980 delineated a proven reserve in one deposit of 121 million tonnes. Coal within the basin is considered to have extensive coal-bed-methane potential.

## Plays

Three conceptual gas plays and three speculative gas plays have been identified within the Bonnet Plume Basin. Statistical analysis has been completed for the conceptual plays. Significant gas potential is predicted for stratigraphic and structural traps within the Lower Paleozoic facies transition from carbonate to shale. Gas potential from stratigraphic and structural traps related to the non-marine Bonnet Plume Formation is much smaller. Geochemical evidence indicates that there is probably not much oil potential in the area

Gas Plays (Bcf)	No. fields (mean)	Mean play potential (in place)	Play potential-80% (in place)	Play potential-20% (in place)
Lower Paleozoic carbonate \				
shale facies transition	6	720	291	1,068
Upper Cretaceous-Tertiary clastics	6	61	17	103
Upper Cretaceous clastic subthrust	2	19	5	31
Total Gas (Bcf)	14	800		

# Assessment completed using program PETRIMES

## Peel Plateau and Plain Oil and Gas Resource Assessment

Peel Plateau Resource Assessment (Osadetz, MacLean, Morrow, Dixon and Hannigan, 2005) #

## Geological Summary

The Peel Plateau and Plain is a prospective hydrocarbon region in the Northern Interior Platform north of the Mackenzie Mountains and east of the Richardson Mountains. It contains a Lower Cambrian to Upper Cretaceous stratigraphic succession with a maximum thickness of approximately 4.5 km. Geologically it is similar in setting to the Western Canada Sedimentary Basin.

Lower and Middle Paleozoic sedimentary rocks were deposited in a continental margin setting and contain the platform carbonate to basinal shale transition. Upper Paleozoic interbedded shales, siltstones and shales overlie this carbonate to shale transition. Locally isolated carbonate mounds may be present within this Upper Paleozoic clastic succession. The Paleozoic successions are unconformably overlain by a Mesozoic clastic succession of sandstone, siltstone and shale deposited within a developing foreland basin east of the Cordilleran Orogen.

The Peel Plateau encompasses all sedimentary rocks which exhibit folding and thrusting related to the Cordilleran Orogen. It has been subdivided into two structural domains with the surface trace of the Trevor fault being the boundary between the two domains. The Plateau domain west of the Trevor fault is underlain largely by Lower Paleozoic basinal shales of Richardson Trough. The Lower Paleozoic stratigraphy in the Peel Plateau domain east of the Trevor fault consists dominantly of platform carbonate. The Peel Plain is east of the Peel Plateau and corresponds to all the undisturbed, relatively flat-lying sedimentary rocks east of the Cordilleran Orogen deformation front.

## Exploration History

Surface exploration began in the mid 1950s. The first well (Shell Peel River YT-J21) was completed in 1965. Eighteen additional wells were drilled between 1965 and 1977 for a total of 42,319 metres. Drilling resulted in several gas shows but no established economic reserves or production.

Over 3,000 line-kilometers of seismic surveys were completed in the 1960s and 1970s. 500 line-kilometers of this data, ranging from fair to good quality, is available to the public in the information files of the National Energy Board.

## Plays

Peel Plateau and Plain was divided into three structural domains (two within Peel Plateau and one constituting Peel Plain) for assessment purposes. Eight gas plays have been identified within these three structural domains. The plays consist of different structural and stratigraphic traps in the Paleozoic sedimentary rocks and the overlying Mesozoic sedimentary rocks. Gas prospectivity increases in an overall easterly direction with the greatest prospectivity being for the Peel Plain. There is significant potential for natural gas with a summed mean play potential of approximately 2.9 Tcf in 88 pools. The largest pool is expected to occur in Mesozoic clastic rocks of the Peel Plain.

No crude oil potential was estimated due to the lack of suitable maturation and source

Gas Plays (Bcf)	No. fields (mean)	Mean play potential (in place)	Play potential-80% (in place)	Play potential-20% (in place)
<u>Peel Plateau west of Trevor fault</u>				
Upper Paleozoic clastics	1	3.7	< 9.1 (10%)	< 9.1 (10%)
<u>Peel Plateau west of limit of deformation</u>				
Paleozoic carbonate margin	7	157	45	257
Upper Paleozoic clastics	2	275	< 71 (70%)	488
Mesozoic clastics	12	465	259	656
<u>Peel Plain east of limit of deformation</u>				
Paleozoic carbonate platform	1	9.6	< 1.4	17.2
Horn Plateau reef	1	31	< 80 (8%)	< 80 (8%)
Upper Paleozoic clastics	9	256	112	389
Mesozoic clastics	55	1,748	853	2,636
<b>Total Gas (Bcf)</b>	<b>88</b>	<b>2,945</b>		

# Assessment calculated using program PETRIMES

## Wells

Well Name	Class	Status	Gr. Elev (m)	Total Depth (m)	Spud	Rig Release
Gulf Mobil Caribou YT N-25	Expl	D&A	487.7	3600.3	01-May-1974	31-Aug-1974
IOE Satah River YT G-72	Expl	D&A	86	2286.0	13-Jan-1967	09-Mar-1967
McD GCO Northup Taylor Lake YT K-15	Expl	D&A	464.8	2378.7	05-Feb-1969	29-Mar-1969
Mobil Gulf Peel YT H-71	Expl	D&A	506	3392.1	03-Feb-1977	12-Jun-1977
Pacific et al Peel YT F-37	Expl	D&A	48.8	3368.0	13-Feb-1972	20-Apr-1972
Shell Peel R YT 2B-06	Expl	D&A	62.5	1066.8	03-Jan-1967	25-Jan-1967
Shell Peel R YT B-06	Expl	D&A	61.6	430.4	14-Dec-1966	31-Dec-1966
Shell Peel R YT H-59	Expl	D&A	29.6	763.2	13-Mar-1967	01-Apr-1967
Shell Peel R YT I-21	Expl	D&A	377.3	2072.6	20-Feb-1966	30-Mar-1966
Shell Peel R YT J-21	Expl	D&A	41.8	1219.2	31-Jul-1965	01-Sep-1965
Shell Peel R YT K-09	Expl	D&A	345.4	1554.5	06-Feb-1967	07-Mar-1967
Shell Peel R YT K-76	Expl	D&A	72.5	1386.8	07-Oct-1965	25-Nov-1965
Shell Peel R YT L-01	Expl	D&A	390.8	1834.9	12-Dec-1965	07-Feb-1966
Shell Peel R YT L-19	Expl	D&A	91.4	1981.2	11-Apr-1966	2-Jun-1966
Shell Peel River YT M-69	Expl	D&A	282.5	3272.6	06-Oct-1974	04-Dec-1974
Shell Trail River YT H-37	Expl	D&A	385.3	3721.6	27-Nov-1973	26-Mar-1974
SkellyGetty Mobil Arctic Red YT C-60	Expl	D&A	86.9	2599.9	15-Jan-1972	26-Mar-1972
Toltec Peel River YT N-77	Expl	D&A	146.3	1122.6	07-Oct-1968	23-Jun-1970
Amoco PCB B-1 Cranswick YT A-42	Expl	D&A	613.3	4267.2	14-Apr 1972	20-Mar-1973

# Liard Plateau-Great Slave Plain Oil and Gas Resource Assessment

Liard Plateau Resource Assessment



## Geological Summary

The Liard Basin lies between the Rocky Mountains to the south and the Mackenzie and Franklin Mountains to the north. The area includes the physiographic Liard Plateau and portions of the southern Mackenzie and Franklin Mountains. It constitutes the northernmost extension of the Western Canada Sedimentary Basin.

Cambrian through Middle Devonian sedimentary rocks consist dominantly of miogeoclinal platform limestones and dolostones transitioning westward to marine shales. Within the carbonates is locally a Manetoe facies dolomite consisting of coarsely crystalline, diagenetic, hydrothermal dolomite. This diagenetic facies has cavernous porosity and is the principal reservoir and target for gas in the area.

Unconformably to conformably overlying the carbonates are fissile, grey to black marine shales of the Devonian to Carboniferous Besa River Formation. To the east the Besa River Formation is transitional to carbonates of the Flett and Prophet formations. The Carboniferous deltaic complex of the Mattson Formation overlies the marine shales of the Besa River Formation. The Mattson Formation delta prograded to the west-southwest. It contains friable and porous sandstones interbedded with siltstones and shales. Some coal measures are present. Permian and Triassic strata consist dominantly of shallow water shales and siltstones of the Fantasque and Toad-Grayling formations. Cretaceous marine sandstones and shales unconformably overlie all other units in the map area.

Several small hornblende-bearing Tertiary trachytes intrude the sedimentary rocks in the westernmost part of the basin.

Structures within the Liard Basin are characterized by northwesterly to northeasterly trending box folds and east-verging and west-verging thrust faults. Topographic lows are typically underlain by synclines containing Triassic and Cretaceous siliclastic sedimentary rocks.

## Exploration History

The first recorded evidence of active petroleum exploration was in 1955 with reconnaissance field work by California Standard (Chevron). The first well in the Yukon was SOBC Shell Beavercrow YT K-02 completed in 1963. Eleven wells have been completed in the Yukon. Approximately 570 line-kilometres of two-dimensional seismic has been completed.

Yukon contains portions of three fields: Beaver River Field, Kotaneelee Field, and La Biche field. The Beaver River field in Yukon is a former producer from well PanAm C-1 Beaver River YT G-01. Production from the Kotaneelee gas field is ongoing. Both of these fields consist of pools and prospects hosted in fractured, diagenetic hydrothermal dolomites of the Manetoe facies within carbonates of the Middle Devonian Arnica, Landry and Nahanni formations. Gas is structurally trapped in closures formed by anticlines, normal faults, and reverse faults. Seal and source for the reservoirs is provided by shales of the Besa River Formation. Commonly gas is trapped on top of water.

## Plays

Six expected plays were identified in the Liard Basin area. Five are gas with one (Cretaceous Chinkah clastics) being gas with potential oil. One play, the Manetoe facies dolomite play is established with proven discoveries, former production from the Beaver River gas field and current gas production from the Kotaneelee gas field (two wells, Duke Energy gas pipeline). This play is a sour, acid, dry gas play and is considered the most significant one for the region.

Gas Plays (Bcf)	No. fields (mean)	Mean play potential (in place)	Play potential-80% (in place)	Play potential-20% (in place)
Manetoe facies				
Cretaceous Chinkah clastics				
Permian Fantasque				
Carboniferous Mattson				
Carboniferous Prophet/Flett				
Devonian-Carboniferous Besa River				
<b>Total Gas (Bcf)</b>	<b>0</b>	<b>0</b>		

## Oil Plays (MMbbls)

Cretaceous Chinkah clastics				
<b>Total Oil (MMbbls)</b>	<b>0</b>	<b>0</b>		

## Wells

Well Name	Class	Status	Gr. Elev (m)	Total Depth (m)	Spud	Rig Release
SOBC Shell Beavercrow YT K-02	Expl	D&A	1129.3	3976.1	03/20/1962	01/11/1963
Pan Am et al A-1 Kotaneelee YT P-50	Expl	AB	446.8	4410.5	03/16/1962	08/23/1963
Canada S et al N Beaver R YT I-27	Dev	SP GAS	435.6	4418.1	03/24/1963	08/29/1964
Pan Am Shell Merrill YT L-60	Expl	D&A	590.4	1634.3	01/24/1969	03/06/1969
Pan Am Beaver YT G-01	Expl	AB GAS	792.5	4499.5	12/06/1968	08/20/1969
Gulf et al West Beaver Crow YT O-15	Expl	D&A	1144.8	1727.3	02/03/1970	06/01/1970
Bluemount et al Beavercrow YT B-16	Expl	D&A	1148.2	2288.4	02/03/1971	05/09/1971
Columbia et al Kotaneelee YT B-38	Dev	GAS	685.8	3898.1	04/06/1977	10/21/1977
Columbia et al Kotaneelee YT E-37	Dev	AB GAS	613.6	4191.0	01/21/1978	12/05/1978
Columbia et al Kotaneelee YT M-17	Dev	DISP	11.5	1332.0	01/01/1979	02/26/1979
Columbia et al Kotaneelee YT I-48	Dev	AB GAS	4430	4415.0	04/18/1979	04/11/1980
Columbia et al Kotaneelee YT I-48A	Dev	GAS	3915	3915.0	05/19/1991	07/18/1991
Devon et al Kotaneelee L-38	Dev	Drilling	805	-	08/22/2004	-

# Whitehorse Trough Oil and Gas Resource Assessment

Whitehorse Trough Resource Assessment (Osadetz, 2003) #

## Geological Summary

Whitehorse Trough in south-central Yukon is a mainly gas-prone basin containing Mesozoic to Cenozoic strata in an intensely faulted and folded intermontane setting. It is elongate and extends in a northwest-southeast trend from just north of Carmacks to the near Dease Lake, British Columbia.

Whitehorse Trough contrasts with all other hydrocarbon areas in Yukon in that it is underlain by oceanic basement of the allochthonous Stikine and Cache Creek suspect terranes. Basement therefore consists of basalt flows with associated shales, bedded cherts and limestones.

Whitehorse Trough was first initiated in Middle to Late Triassic as a forearc basin located immediately east of an emerging ancestral Lewes River volcanic arc and west of a west-dipping subduction zone. Deposition within the basin continued through Middle Jurassic with more than 7,000 metres of basin fill constituting the Lewes River and Laberge groups. Lithologic facies delineate a general west to east transition in depositional environments from prograding deltas with associated coarse and fine clastic rocks (west) to marine, fine clastic rocks (east). Conglomerate occurs throughout the succession as localized deposits. Limestone reefs are locally present in the lower part of the stratigraphy in linear belts along the west and central portions of the Trough.

Unconformably overlying this sequence is a succession of Jurassic to Lower Cretaceous fluvial conglomerates with associated sandstones and shales constituting the Tantalus Formation. This nonmarine succession marks closure of Whitehorse Trough and deposition of a molasse succession shed from uplift of the former trough and surrounding terranes.

The entire stratigraphic succession is intruded by Cretaceous to early Tertiary granitoids, mainly in the south part of the Trough. These granitoids formed largely in response to an east-dipping subduction zone located west of the Whitehorse Trough.

The dominant structural trend in Whitehorse Trough is northwest-southeast with abundant folds and faults. The core of the Trough is an anticlinorium with younger rocks occurring on both the west and east margins. Deformation occurred in the interval between Middle Jurassic and Middle Cretaceous.

## Exploration History

The first recorded active petroleum exploration was in the 1950s. Exploration was ongoing sporadically until 1981, consisting largely of evaluation of the stratigraphic sections for petroleum prospectivity. Since 1981 no permits have been issued for the area.

No private seismic surveys or wells have been completed for the area. During 2004 a two dimensional seismic survey was jointly funded by Yukon Geological Survey and Geological Survey of Canada across the northern part of the Trough. Results from that survey are still pending.

## Plays

Five gas plays and two oil plays were identified for Whitehorse Trough. Six of the plays are structural and only one is stratigraphic. The Tantalus plays include all the Mesozoic clastic rocks above the sub-Middle Jurassic unconformity and therefore includes the Tanglefoot Formation in the Laberge Group. The Takwahoni plays include the coarse clastic rocks in the Laberge Group, and the Inklin plays correspond to the fine clastic rocks in the Laberge Group. The Lewes River structural play includes all structural traps in the mainly clastic strata in the Lewes River Group. The Lewes River stratigraphic play is restricted to the Upper Triassic carbonate reefs in the Lewes River Group.

All plays are based on analogies with established plays in other basins. The plays are conceptual in nature and therefore highly risky.

Whitehorse Trough contains abundant bituminous to semi-anthracite grade coal measures in the Jurassic Laberge Group and the Jurassic-Cretaceous Tantalus Formation. Coals have been mined historically in the Carmacks area for local use. Potential for coal bed methane exists but has not been considered in this assessment.

<b>Gas Plays (Bcf)</b>	<b>No. fields (mean)</b>	<b>Mean play potential (in place)</b>	<b>Play potential-80% (in place)</b>	<b>Play potential-20% (in place)</b>
Takwahoni Structural	29	2,850		
Lewes River structural	10	3,600		
Inklin structural	20	779		
Lewes River stratigraphic	5	48		
Tantalus structural	5	48		
<b>Total Gas (Bcf)</b>	<b>69</b>	<b>7,325</b>		
<b>Oil Plays (MMbbls)</b>	<b>No. fields (mean)</b>	<b>Mean play potential (in place)</b>	<b>Play potential-80% (in place)</b>	<b>Play potential-20% (in place)</b>
Tantalus structural	1	11		
Takwahoni structural	3	83		
<b>Total Oil (MMbbls)</b>	<b>4</b>	<b>94</b>		

# Assessment completed using program PETRIMES

