NORTHEAST BRITISH COLUMBIA
NATURAL GAS
HISTORICAL DISCOVERY TRENDS
DECEMBER 31, 2013

Drummond Consulting

March, 2015

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FOREWORD

This report is a statistical summary of Northeast British Columbia Natural Gas taken from the British Columbia 2013 Gas Pool Reserves Database. The text files were processed, brought into Microsoft Access and additional data fields added so that pools could be aggregated by gas type, geographic area and stratigraphic age.

The report contains descriptions for all gas pools by area, zone, and discovery sequence. The report uses the ultimate potential numbers from a Drummond Consulting assessment of the Ultimate Natural Gas Resource of Northeast British Columbia as of December 31, 2013. Northeast British Columbia's conventional and unconventional ultimate marketable gas potential is estimated to be 99.4 trillion cubic feet (2,800.9 billion cubic metres). The ultimate marketable gas potential for British Columbia in the recent report “The Ultimate Potential for Unconventional Petroleum from the Montney Formation of British Columbia and Alberta”, November 2013, by the B.C. Ministry of Energy, Mines and Petroleum Resources, British Columbia Oil and Gas Commission, Alberta Energy Regulator, and the National Energy Board is 400 trillion cubic feet (11,337 billion cubic metres).

It is not the intent of this report to present conclusions, but rather to present a synthesis of the data. There is a minimum of evaluation or interpretation of the statistics and distributions. The data is presented in various forms, so that the user can use the information to make their own interpretation and application of the data. The report is mainly tables and charts with a minimum of text.

Statistical summaries are done for all Northeast British Columbia, for the seven major structural areas, and by eight generalized stratigraphic ages. The analysis of the pool data has been done using Excel data analysis to calculate the descriptive statistics.

Most of the discussion is concentrated on marketable gas. Statistics are given for gas-in-place, raw recoverable gas, and initial marketable gas, however, in general the analysis and charts contained herein focuses primarily on marketable gas. The data has also been subdivided by gas type, non-associated gas and combined associated/solution gas pools, and also includes statistics for producing and non-producing pools.

The statistical analysis of year-end 2013 Northeast British Columbia gas reserves data gives good indicators for what future discoveries could be. The report shows some of the types of summaries that can be made from the excellent data contained in the British Columbia Government reserves database. The study is meant as a reference tool to analyse past discovery trends. The charts and graphs should give a good idea of what historical trends have been, and these can realistically be used to make projections for the future.

NORTHEAST BRITISH COLUMBIA'S NATURAL GAS

Initial established natural gas reserves in Northeast British Columbia, as estimated by the British Columbia Oil and Gas Commission as of December 31, 2013 is, as follows:

	Billion cubic feet
Initial established gas-in-place	256,453
Initial recoverable raw gas reserves	74,590
Cumulative raw gas production	32,256
Remaining recoverable raw gas reserves	42,334
Initial marketable gas reserves	61,033
Cumulative marketed production	25,630
Remaining marketable reserves	35,403

The British Columbia database includes reserves and reservoir information on a total of 2,614 gas pools. Non-associated pools account for 2,456 (93.9%) of the pools containing 58,925 billion cubic feet (96.5%) of initial marketable gas. The 158 (6.1%) associated and solution gas pools have 2,107 (3.5%) billion cubic feet of initial marketable gas. For Northeast British Columbia the average non-associated pool size is 24.0 billion cubic feet of marketable gas, compared to 13.3 billion cubic feet for the associated and solution pools.

Distribution of natural gas in Northeast British Columbia by gas type, not including confidential pools, is as follows:

	(Billion cubic feet)		
	Non-Assoc.	Solution/Assoc.	Total
Number of pools	2,456	158	2,614
Gas-in-place	253,233	3,220	256,453
Initial raw gas	72,029	2,562	74,590
Initial marketable gas	58,925	2,107	61,033
Cum. marketed production	23,962	1,668	25,630
Rem. marketable reserves	34,963	440	35,403

The BC Oil and Gas Commission estimate of 42.3 trillion cubic feet for remaining established reserves of recoverable gas at December 31, 2013 is an increase of 2.1 trillion cubic feet since December 31, 2012. The flow diagram of figure 1 shows production, additions and reductions to reserves that occurred during 2013. New pool discoveries contributed 0.015 trillion cubic feet. Development drilling and re-evaluations added 3.627 trillion cubic feet.

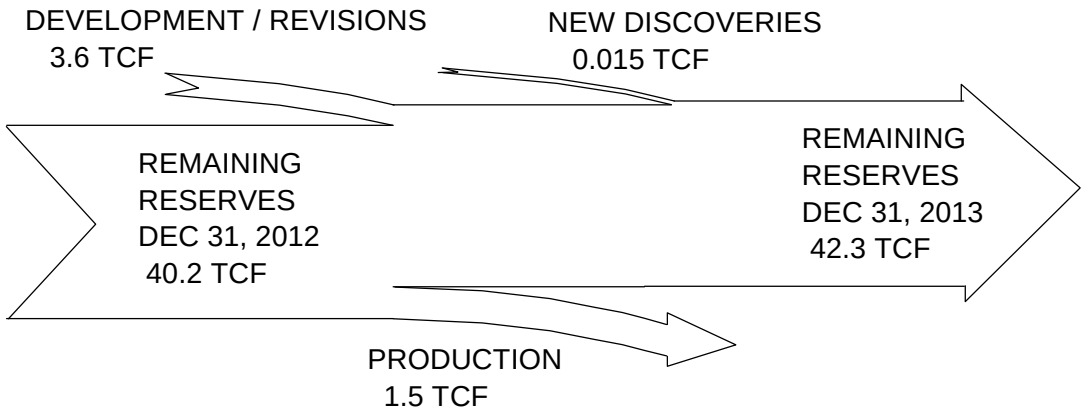


Figure 1 **Graphical summary of Northeast British Columbia's remaining recoverable gas reserves as of December 31, 2013, showing changes that occurred during 2013.**

Northeast British Columbia Natural Gas Ultimate Potential

The undiscovered natural gas potential for Northeast British Columbia is based on the assessment by Drummond Consulting completed in September 2011. The ultimate marketable gas potential is estimated to be 99.4 trillion cubic feet as of December 31, 2013.

The distribution of the ultimate marketable gas potential for Northeast British Columbia is shown in figure 2. Twenty six percent (25.6 trillion cubic feet) of the initial resource has been produced, with remaining reserves of 35.4 trillion cubic feet (35.6%) and 38.4 trillion cubic feet (38.6%) still to be discovered.

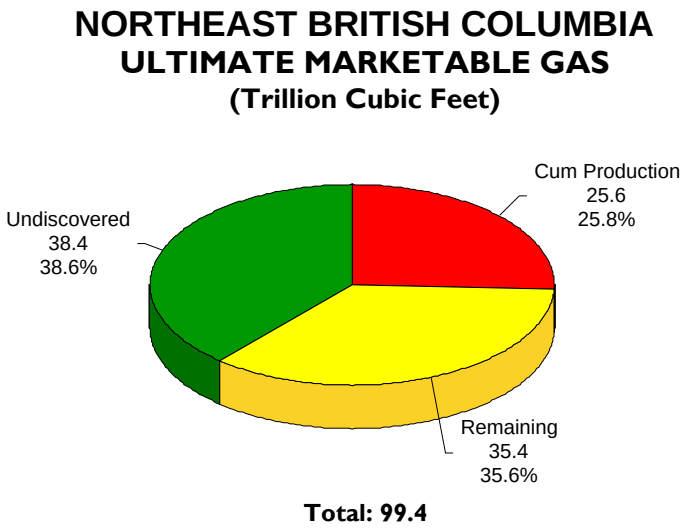


Figure 2 Northeast British Columbia Ultimate marketable gas potential as of December 31, 2013

Gas Reserves Statistics

Reserves statistics for Northeast British Columbia non-confidential gas pools as of December 31, 2013 are presented in Table 1.1. Descriptive statistics are given for initial established gas-in-place, raw recoverable, and marketable gas, subdivided by gas type. Total discovered gas-in-place is 256,453 billion cubic feet. Initial raw recoverable reserves are 74,590 billion cubic feet, for a

recovery factor of 29.1 %. Initial established marketable gas reserves are 61,033 billion cubic feet. Marketable gas recovery factors are 81.8 % of raw recoverable gas and 23.8% of gas-in-place.

A summary of some of the more important statistics for initial marketable gas is:

Number of Pools	2,614	
Initial established	61,033	billion cubic feet
Largest Pool	10,414	billion cubic feet
Average pool size	23.3	billion cubic feet
Median pool size	2.2	billion cubic feet
95th percentile	43.0	billion cubic feet

Pool Size Distribution

The distribution of Northeast British Columbia's initial marketable gas reserves by pool size is shown in figures 1.1, and 1.2. The class sizes used are only approximately lognormal, as the author prefers units of 1, 2, 5, 10, 20, etc., rather than statistically correct class intervals of 1, 2, 4, 8, 16, etc.

Figure 1.1 shows the data table, a summary of the statistics, and charts of the distributions for number of pools and volume of initial marketable gas, with bar charts showing the frequency distribution of pool sizes, and line graphs showing the cumulative frequency distribution. The charts of figure 1.2 combine the number of pools (line) and volumes (bars) into one chart. The top left chart A shows the proportion of cumulative production to remaining reserves and the top right chart B shows the number and volume distributions by gas type, non-associated and associated/solution. The bottom charts C and D are percentage plots of initial marketable gas volumes of the top charts.

The percentage plot of cumulative production and remaining reserves shows the smaller pool sizes have a slightly lower percentage of remaining marketable gas than do the larger pools. For pools greater than 50 billion cubic feet, remaining marketable reserves is 61.6% (29,860 billion cubic feet), compared to 44.2% (5,542 billion cubic feet) for pools less than 50 billion cubic feet. For the 14 pools greater than 500 billion cubic feet, 4.41% (25.7 Tcf) of the initial marketable gas is remaining reserves.

Non - Producing Pools

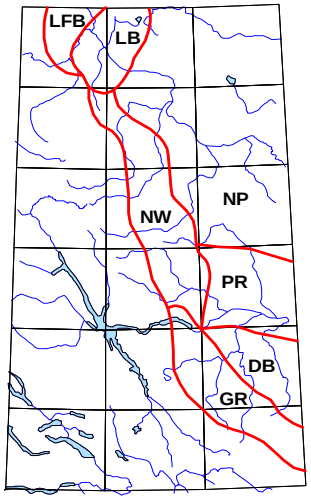
Producing pools are those, which have had production. Non-producing pools are those, which have zero production as of December 31, 2013.

The 217 pools in Northeast British Columbia with no production contain 588.0 billion cubic feet of initial marketable gas, for an average pool size of 2.7 billion cubic feet of initial marketable gas, and a median of 1.6 billion cubic feet. The largest pool with no production is the Groundbirch Doig J pool, discovered in 2008, with initial marketable gas reserves of 54.0 billion cubic feet.

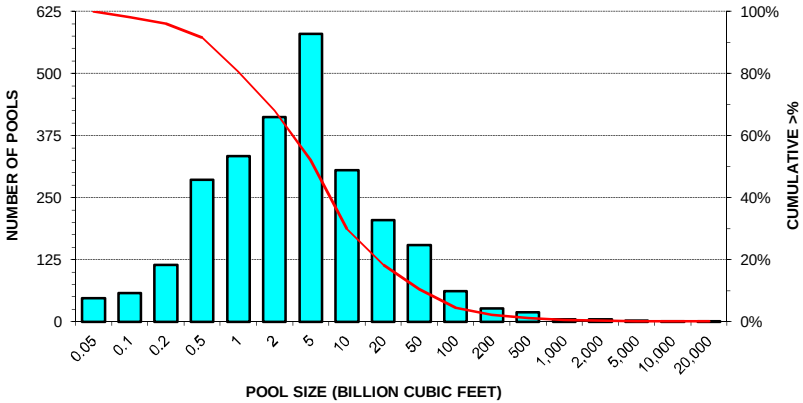
NORTHEAST BRITISH COLUMBIA
POOL SIZE DISTRIBUTION
INITIAL MARKETABLE GAS (Billion Cubic Feet)

Size Bcf	No. of Pools	IMG Bcf	% of Pools	Cum % Pools	% of IMG	Cum % IMG
0.05	47	1	1.80%	99.92%	0.00%	100.0%
0.1	58	4	2.22%	98.13%	0.01%	100.0%
0.2	114	17	4.36%	95.91%	0.03%	100.0%
0.5	286	97	10.94%	91.55%	0.16%	100.0%
1	333	247	12.74%	80.60%	0.40%	99.8%
2	412	600	15.76%	67.87%	0.98%	99.4%
5	580	1,884	22.19%	52.10%	3.09%	98.4%
10	305	2,141	11.67%	29.92%	3.51%	95.3%
20	205	2,869	7.84%	18.25%	4.70%	91.8%
50	154	4,680	5.89%	10.41%	7.67%	87.1%
100	61	4,170	2.33%	4.51%	6.83%	79.5%
200	26	3,516	0.99%	2.18%	5.76%	72.6%
500	19	6,250	0.73%	1.19%	10.24%	66.9%
1,000	5	3,588	0.19%	0.46%	5.88%	56.6%
2,000	5	7,699	0.19%	0.27%	12.61%	50.7%
5,000	2	5,326	0.08%	0.08%	8.73%	38.1%
10,000	1	7,529	0.04%	0.04%	12.34%	29.4%
20,000	1	10,414	0.04%	0.04%	17.06%	17.1%
Total	2,614	61,033				

Total Number of Pools	2,614
Initial Marketable Gas	61,033
Largest Pool	10,414
Mean Pool Size	23.35
Median Pool Size	2.23
95th Percentile	43.04
75th Percentile	6.49
25th Percentile	0.71
5th Percentile	0.13



NORTHEAST BRITISH COLUMBIA
POOL SIZE DISTRIBUTION INITIAL MARKETABLE GAS



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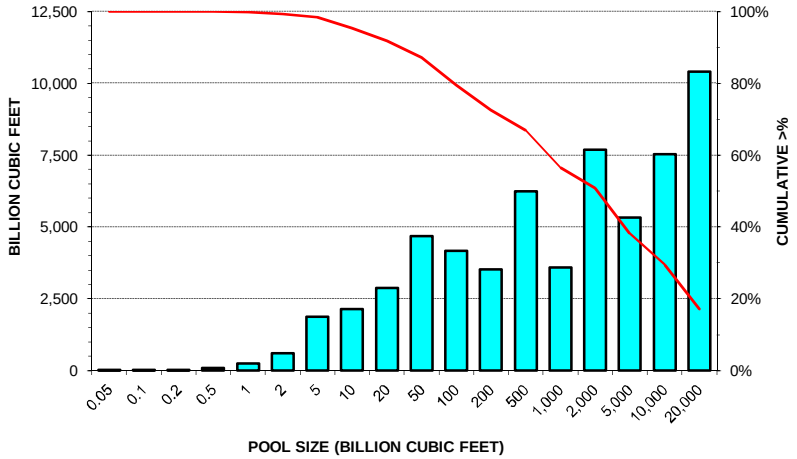
POOL SIZE DISTRIBUTION INITIAL MARKETABLE GAS



HISTORICAL DISCOVERY TRENDS

This section discusses the historical discovery trends of natural gas for Northeast British Columbia Further discussion of historical trends by geographic area and stratigraphic zone is included in the sections to follow.

The historical record has been analysed by year of discovery, decade of discovery, by equal sets of pools representing 10% of the total population, and the top 10 pools discovered each year. Descriptive statistics are done and these can be used to accurately define the distribution of discovered pools by year, decade, and sets of pools, to give a reasonable estimate for future discoveries and planning of exploration programs. Similar analysis is done by area and zone.

The creaming curves of figures 2.3 and 2.4 indicate Northeast British Columbia is still somewhat immature. Larger pools are still to be found and the growth percentile statistics of table 2.4 indicate that 5% of the pools to be discovered could be larger than 43.1 billion cubic feet.

The various discovery trend analyses show the discovery history for the 1980's through the 2000's are remarkably consistent. The averages show a steady decrease to 2008 and an increase for the most recent years. Recent gas discovery trends, suggest that the industry can expect similar performance for the next decade. Certain definite patterns and trends are clearly evident in the synthesis.

Year of discovery

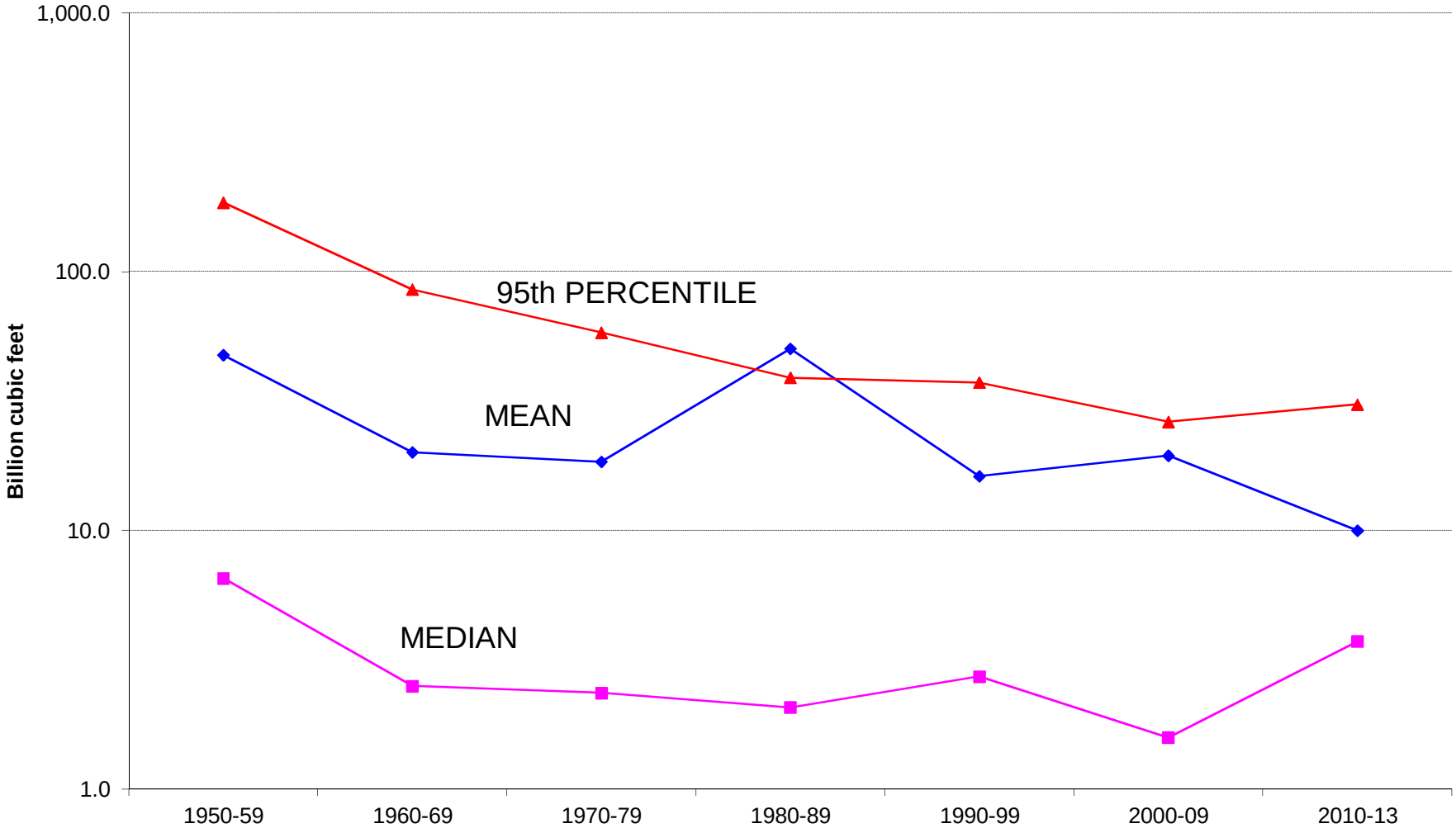
Statistics for Northeast British Columbia initial marketable gas by year of discovery are presented in table 2.1, and shown graphically in figure 2.1. Shown in the chart are the average (mean) and median pool sizes. The data shows the larger pools were discovered early in the history of the Northeast British Columbia gas industry. The off the chart spike in 1982 is due to the Regional Heritage Montney A pool. Other spikes in the average pool size are due to other regional fields. The median has been relatively constant throughout the period 1979 - 2008, with an average mean of 2.2 billion cubic feet.

For most of the areas the recent history (1900's and 2000's) indicates a fairly constant discovery record. This period can be used as a good indicator for discoveries in the next few years.

Top 10 pools per year

Table 2.2 shows marketable gas reserves in the 10 largest gas pools discovered each year. The marketable gas discovered per year by the top 10 pools is shown in figure 2.2. Ten year moving averages are plotted for volume of marketable gas and the percentage of gas represented by the top 10 pools. The data for the two years, 2009 and 2010 (2011 to 2013 information is still incomplete) indicates an average for the top 10 pools of about 185 billion cubic feet, representing 81.0% of the total gas discovered in the two years.

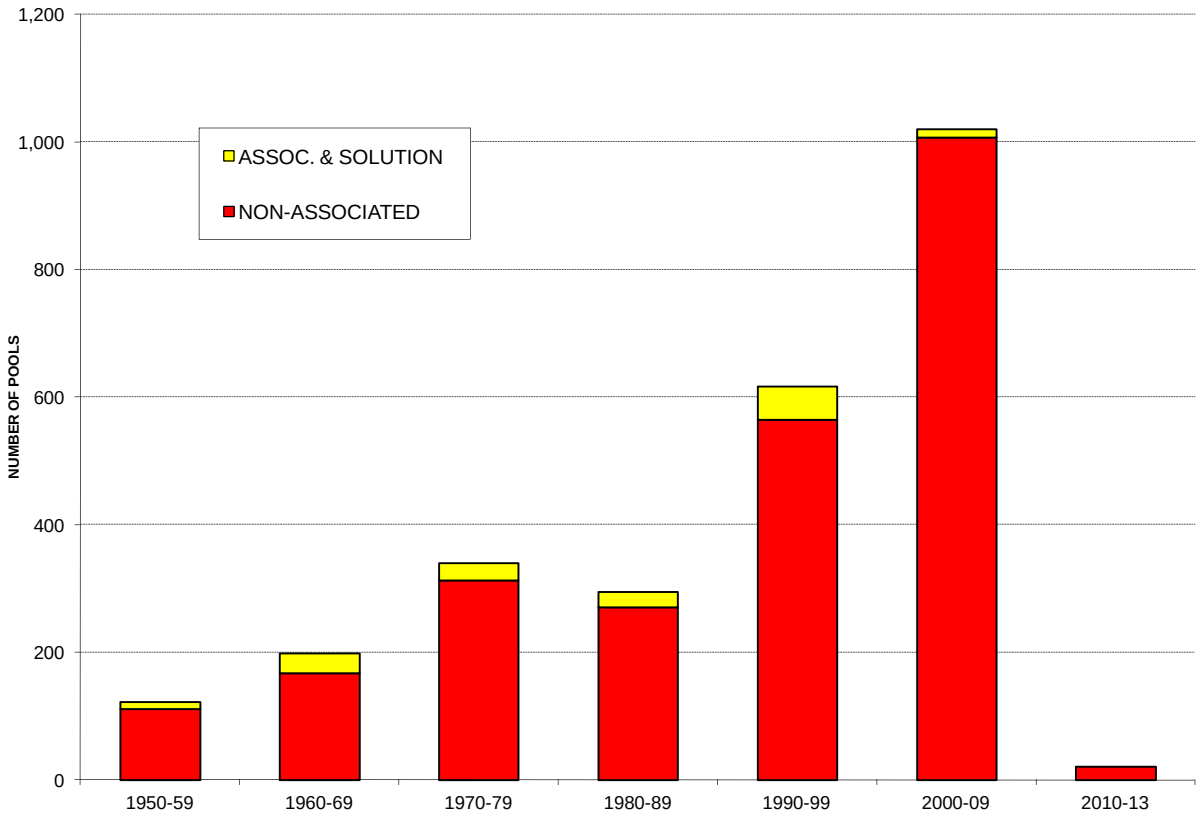
BRITISH COLUMBIA - INITIAL MARKETABLE GAS POOL SIZE BY DECADE DISCOVERED



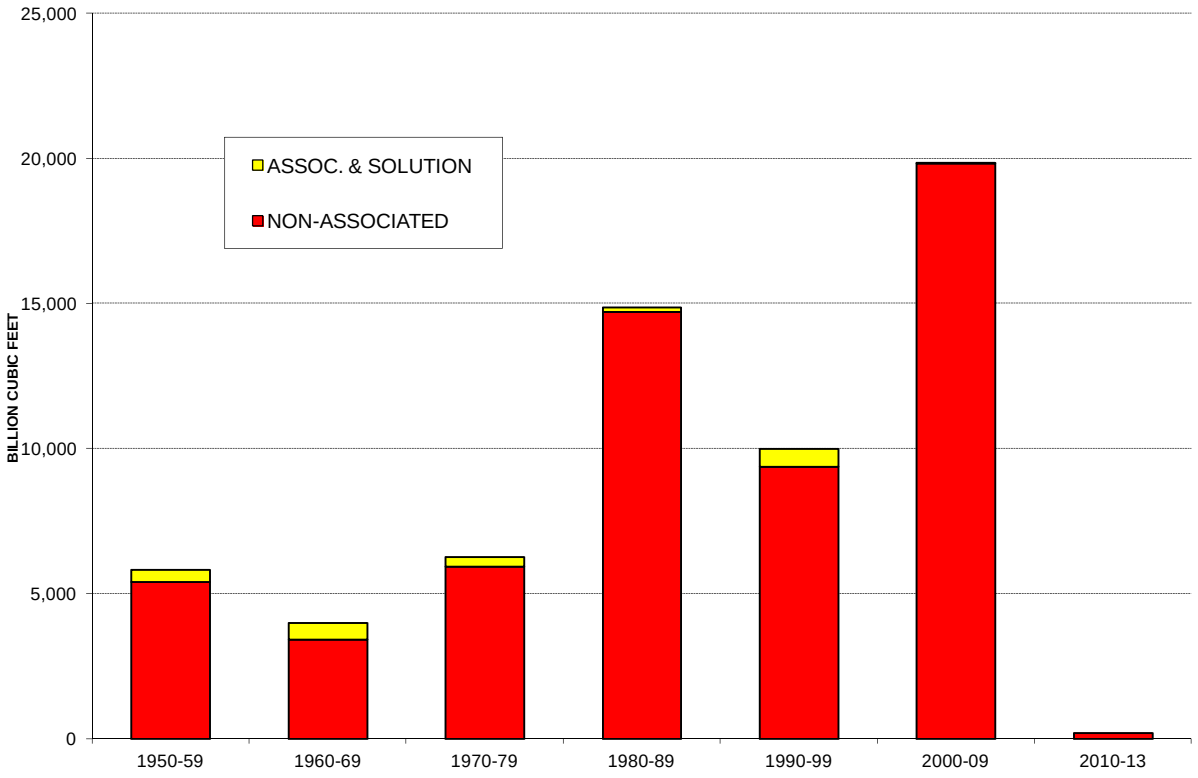
BCGas Stats2013 by Decade.xls

Figure 2.5

BRITISH COLUMBIA
NUMBER OF DISCOVERED GAS POOLS



BRITISH COLUMBIA INITIAL MARKETABLE GAS



AREA SUMMARY

The geographic areas used in this study are the structural areas similar to those used by the National Energy Board and B.C. Ministry of Energy, Mines and Petroleum Resources in their assessment of the undiscovered potential of Northeast British Columbia. The areas include the four plains areas, Deep Basin, Peace River Arch, Northern Plains and the Liard Basin and three foothills areas, Grizzly, Northwest and Liard.

The distribution of Northeast British Columbia's ultimate marketable gas by geographic area is shown in figure 3.1. The Northern Plains and the Peace River Arch, in total have 68.7% of Northeast British Columbia's ultimate potential. The largest is the Northern Plains, with 25.3 trillion cubic feet of ultimate marketable gas, followed by the Peace River Arch with 16.7 trillion cubic feet and the Northwest Foothills with 9.7 trillion cubic feet. The Northern Plains, Peace River Arch and Deep Basin have the largest undiscovered potential, 67.8% of the total. The Northern Plains is ranked first with undiscovered initial marketable gas potential of 13.8 trillion cubic feet, followed by the Peace River Arch with 5.9 trillion cubic feet, and the Deep Basin with 6.3 trillion cubic feet.

The areas with the largest percentage of marketable gas still to be discovered include the Liard Fold Belt (86.2%), Liard Basin (83.7%), Deep Basin (60.8%) and the Grizzly Foothills (54.0%). Areas with the smallest percentage of undiscovered gas are the Peace River Arch (26.1%), Northern Plains (35.3 %), and the Northwest Foothills (27.5%). For Northeast British Columbia 38.6% of the ultimate gas potential remains to be discovered.

For each of the geographic areas, the information in the report includes 1) the cumulative discovery plot with moving average curves, 2) tables and charts of pool size distribution, 3) distribution of marketable gas and statistics by stratigraphic horizon, 4) Statistics for sets of pools arranged in chronological order, with a plot showing the 95th percentile, mean and median, and 6) the first page of the list of pools ranked by initial marketable gas.

Figure 3.2 shows the stratigraphic distribution for each of the areas. Table 3.2 shows the geographic distribution of marketable gas by type, and table 3.1 includes the statistics for the areas by gas type. Associated and solution gas is located in the Liard Basin, Northern Plains, Peace River Arch, Northwest Foothills, and Deep Basin. For non-associated gas the Liard Basin has the highest percentage of marketable gas followed by the Peace River Arch and the Northwest Foothills. A more detailed map view of the distribution for each stratigraphic horizon by area is shown in the figures included under the specific zones. The geographic distribution of marketable gas by type is shown in the pie charts of Figure 3.3.

Figure 3.4 shows the geographic distribution by area of volumes and recovery factors for gas-in-place, initial raw recoverable, and initial marketable gas. For all gas pools the volumes are dominated by the Northern Plains and Peace River Arch, with the majority of both non-associated gas, and associated/solution gas.

Overall the recovery factors as a percentage of gas-in-place for non-associated gas pools are 28.4% for raw recoverable gas and 23.3% for marketable gas (table 3.2). For associated and solution gas pools, combined recovery factors are 79.6% for raw recoverable and 65.4% for marketable gas.

BRITISH COLUMBIA ULTIMATE GAS POTENTIAL (DECEMBER 31, 2013)

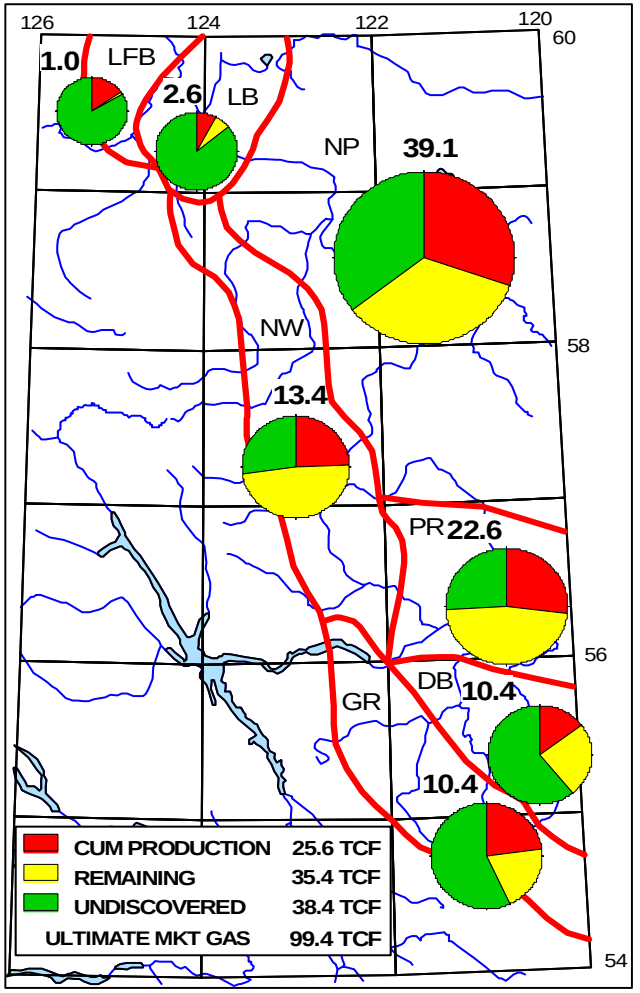
BRITISH COLUMBIA DISCOVERED GAS (Billion cubic feet)

AREA	Count	GIP	IRRG	IMG	CumMG	RemMG
DB	233	6,015.1	4,697.6	4,070.3	1,521.2	2,549.1
PR	812	108,080.2	19,225.5	16,675.6	6,127.3	10,548.2
NP	1,077	74,349.2	32,117.1	25,270.9	11,859.4	13,411.5
GR	134	7,950.1	6,565.9	4,784.0	2,534.2	2,249.8
NW	338	58,320.0	11,353.2	9,713.1	3,236.2	6,476.9
LB	14	1,450.8	421.5	357.8	205.9	151.9
LFB	6	287.1	209.5	160.9	145.7	15.2
Total	2,614	256,452.6	74,590.4	61,032.6	25,630.0	35,402.6

BRITISH COLUMBIA ULTIMATE GAS POTENTIAL (Billion cubic feet)

AREA	ULT_GIP	ULT_RRG	ULT_MG	UND_GIP	UND_RRG	UND_MG
DB	15,538.0	11,756.8	10,394.9	9,522.9	7,059.2	6,324.6
PR	116,374.6	26,176.5	22,578.1	8,294.3	6,951.0	5,902.6
NP	120,096.3	48,282.8	39,072.8	45,747.1	16,165.7	13,801.9
GR	17,228.3	13,552.9	10,397.3	9,278.1	6,987.0	5,613.2
NW	71,695.9	15,559.4	13,395.2	13,375.9	4,206.1	3,682.1
LB	11,095.6	3,024.3	2,591.7	9,644.8	2,602.7	2,233.8
LFB	1,872.2	1,182.7	985.4	1,585.2	973.2	824.5
Total	353,900.9	119,535.4	99,415.4	97,448.4	44,944.9	38,382.8

Undiscovered and Ultimate estimates - Drummond Consulting, 2013



DB	Deep Basin	NW	Northwest Foothills
PR	Peace River Arch	LB	Liard Basin
NP	Northern Plains	LFB	Liard Fold Belt
GR	Grizzly Foothills		

Explanation

Count	Number of pools	ULT_GIP	Ultimate gas-in-place
GIP	Initial gas-in-place	IGIP_RSV	Initial gas-in-place
IRRG	Initial raw recoverable gas	UND_GIP	Undiscovered gas-in-place
IMG	Initial marketable gas	ULT_MG	Ultimate marketable gas
CumMG	Cumulative marketed gas	IMG	Initial marketable gas
RemMG	Remaining marketable gas	UND_MG	Undiscovered marketable gas

STRATIGRAPHIC ZONES

The stratigraphic zones used in this report are by nine geological age groups. The nine stratigraphic zones are; Quaternary, Upper Cretaceous, Lower Cretaceous, Jurassic, Triassic, Permian/Upper Carboniferous, Mississippian, Upper Devonian and Middle Devonian. The Quaternary has only one pool, Helmet Quaternary A, with initial marketable gas of 464 million cubic feet.

The pie charts of figure 4.1 show the stratigraphic distribution of non-associated and associated /solution gas pools. For non-associated pools the Triassic is the most dominant with 38.4% (943) of the pools and 46.9% (27,631 Bcf) of the initial marketable gas. For associated/solution pools the Triassic is even more dominant with 72.2% of the pools and 57.8% of the initial marketable gas.

The stratigraphic distribution of all gas pools is shown in figure 4.3. The Triassic has 1,057 pools, 40.4% of the total. By initial marketable gas the Triassic has 47.1 % of the gas, followed by the Middle Devonian with 26.2%, and the Lower Cretaceous with 15.5%. The largest average pool sizes are in the Upper Devonian and Middle Devonian.

The bar charts of figure 4.2 show the volume of gas-in-place, raw recoverable gas and initial marketable gas by gas type. The charts on the right-hand side show the recovery factors for the various stratigraphic horizons (also see table 4.1). Marketable gas recovery factors for all pools range from 16.8% for the Triassic to 74.5% for the Upper Devonian. The overall recovery is 29.1% for recoverable raw gas and 23.8% of total gas-in-place is marketable. For non-associated pools the overall average recovery is 28.4% for recoverable raw gas and 23.3% marketable. For associated/solution pools the average recovery factors are 79.6% for recoverable gas and 65.4% for marketable gas.

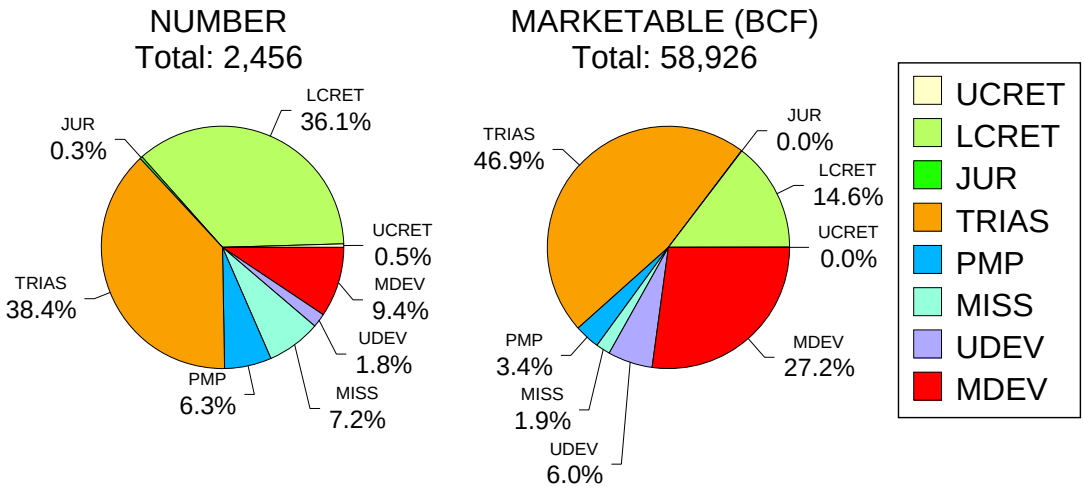
Table 4.2 gives the detailed statistics for initial marketable gas by type. For all pools the mean ranges from a low of 2.2 billion cubic feet for the Upper Cretaceous to a high of 76.7 billion cubic feet for the Upper Devonian. The corresponding median values are 1.2 billion cubic feet for the Upper Cretaceous and 5.9 billion cubic feet for the Upper Devonian. The 95th percentile values range from a low of 3.9 billion cubic feet for the Upper Cretaceous to a high of 287.9 billion cubic feet for the Upper Devonian.

Table 4.4 is a listing of the first 10 discoveries by finish drill date for each of the stratigraphic zones.

BRITISH COLUMBIA NATURAL GAS
STRATIGRAPHIC DISTRIBUTION

NON-ASSOCIATED GAS POOLS

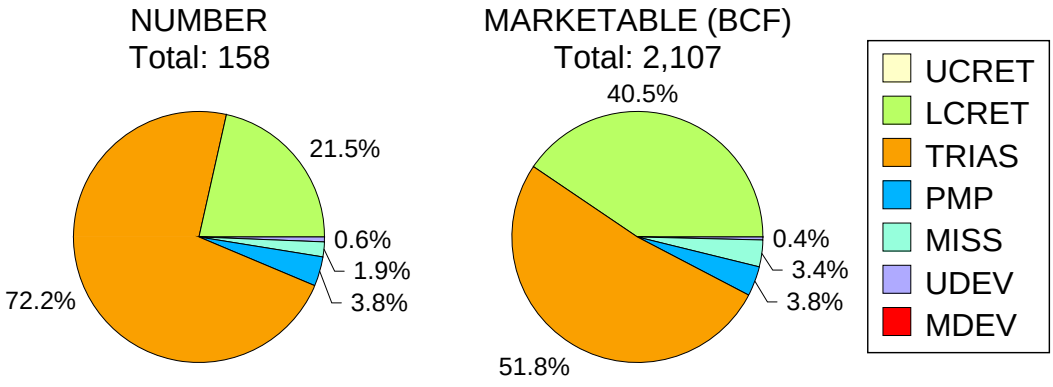
as of December 31, 2013



BRITISH COLUMBIA NATURAL GAS
STRATIGRAPHIC DISTRIBUTION

ASSOCIATED & SOLUTION GAS POOLS

as of December 31, 2013



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HISTORICAL DISCOVERY TRENDS
December 31, 2013

Drummond Consulting
March, 2015

Report Pricing ($ CDN)

	Unit Price	GST	Total Price
Report - PDF Version (Adobe Acrobat)	$500.00	$25.00	$525.00
Data Disk - PDF and all data files on CD	$3,500.00	$175.00	$3,675.00

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