

Ts'ude niline Tu'eyeta
(Ramparts River and Wetlands)
Candidate Protected Area
Quantitative Hydrocarbon Assessment

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Introduction

The Northwest Territories (NWT) Protected Areas Strategy (PAS) is a partnership process to establish protected areas in the NWT. The PAS process requires that as areas are identified, the known cultural, ecological and economic values are studied, documented and discussed. As part of this work, Non-Renewable Resource Assessments of mineral and hydrocarbon potential are conducted on areas of interest.

The Northwest Territories Geoscience Office completed a Phase I Non-renewable Resource Assessment of the Ts'ude niline Tu'eyeta Candidate Protected Area (Gal, 2007). This was a qualitative assessment of the hydrocarbon resources. The present study is a quantitative assessment of the undiscovered conventional oil and gas potential for the candidate area. The study uses the undiscovered oil and gas volumes from an unpublished report by Drummond Consulting (2008), Ultimate Oil and Gas Resources of the Sahtu Settlement Area. This report uses the geological plays defined by Gal, (2005; 2007). The geographic location of the Ts'ude niline Tu'eyeta Candidate Protected Area within the Sahtu Settlement Area is shown in Figure 1. A summary of the plays and a series of Excel maps of the oil and gas volumes for each play as well as aggregated results for all plays are displayed in Appendix I.

Geological Summary

This discussion will present only a brief summary of the geology of the Ts'ude niline Tu'eyeta Candidate Protected Area. For a more detailed discussion of the geology the reader is referred to Gal, (2005; 2007) and Pyle and Jones (2009).

The Ts'ude niline Tu'eyeta Candidate Protected Area is located in the Peel Plain and Plateau sedimentary basin areas of Mossop, et al (2004). Figure 2 from the proposal for Ts'ude niline Tu'eyeta Candidate Protected Area shows the wells drilled and hydrocarbon shows for the area. Exposed bedrock across the Ts'ude niline Tu'eyeta Candidate Protected Area is characterized by outcropping Proterozoic to Devonian strata in the Mackenzie Mountains to the south and Cretaceous strata at surface to the north in the interior plains of the Peel Plain, as shown on the geological map of Figure 2.

The Interior Platform Province of Peel Plain is characterized by a foreland basin along the Mackenzie Mountains front with a south-westerly dipping Phanerozoic section rising to the northeast. The stratigraphic section thickens from about 2100 metres in the north to greater than 4000 metres in the foredeep of the Mackenzie Mountains. As shown in Figure 3, the sedimentary section is comprised of a Cambrian through Devonian succession with unconformably overlying Cretaceous strata. The Mississippian Tuttle Formation occurs along the western margin of the area.

The stratigraphic position of geological plays with hydrocarbon potential is shown in Figure 3, with a description of the plays in Table 1. The geological plays, adapted from Gal, (2007) and Pyle and Jones (2009), quantitatively assessed for oil and gas potential include: Ordovician/Silurian Platform, Arnica/Landry Platform, Kee Scarp/Ramparts, Upper Devonian clastics, Tuttle sandstone and Cretaceous clastics. The Cambrian Mount Clark sandstone occurs to the east of the area. It may possibly occur within the area, but has not been assessed for this study due to insufficient data.

Play Name	Reservoir	Source	Seal	Trap	Comments
Cambrian Clastics	Mount Clark, Mount Cap fms.	Mount Cap Fm, Proterozoic shale	Mount Cap, Saline River fms.	Structural/stratigraphic, onlap and pinch- outs against basement highs. Isolated sand bodies. Unconformity related.	Gas play area lies to east of candidate area. No potential assessed, but possibly could occur in eastern part of the area
Ordovician /Silurian Platform	Mount Kindle, Franklin Mountain fms.	Devonian (?), Mount Kindle (?), Road River Group	Mount Kindle, Franklin Mountain, Fort Norman fms.' fault seal.	Structural, fault-bounded highs, folds near mountain front. Stratigraphic, reefal buildups, intra-formational porosity traps, diagenetic, porosity through dissolution of chert, fossils.	Gas play.
Arnica/Landry Platform	Arnica, Landry fms. Possibly Peel Fm and Bear Rock breccia.	Hare Indian Fm, Hume Fm, Landry Fm, Road River Group shales, Canol fm (?).	Landry, Hume, Fort Norman fms.	Stratigraphic/diagenetic-(dolomitized) Reactivated faults provide structure and fracturing (and dolomitization?). Possible stratigraphic buildups, and updip pinchouts/truncations, draped structures over sub-Devonian unconformity, structural traps near mountain front.	Gas and oil play. Minor oil from Landry Fm. in Shoals C-31. Gas at 88 mcf/d from Landry in Mountain River H-47. Gas and condensate discovery at Summitt Creek B- 44 in the Mackenzie Plain to the south.
Kee Scarp /Ramparts	Kee Scarp member, Ramparts Formation, possible Hume reef buildups.	Canol, Hare Indian	Canol, Imperial fm	Stratigraphic, reef and intra-reef facies or diagenetic porosity traps. Possible structural traps near mountain front.	Oil and gas play. Norman Wells field to the south has 301 million barrels recoverable oil. Ramparts Fm. restricted to east margin of area.
Upper Devonian Clastics	Imperial Fm interbedded silt / sandstone	Canol, Hare Indian, Imperial fms, Cretaceous shales	Imperial Fm interbedded shale	Structural/stratigraphic, onlap and pinch- outs against basement highs. Isolated or stacked sand bodies. Facies related (turbidite?) traps.	Gas play. Logs indicate gas charge in sandstone beds in Ramparts River F-46. Generally poor reservoir characteristics. Widespread distribution increases risk of breaching. Best potential in the west and southern (mountain front) part of study area.
Tuttle Sandstone	Tuttle Fm.	Imperial Fm, Tuttle Fm, Canol Fm, Cretaceous shale	Cretaceous shale, Imperial Fm, Tuttle Fm. Shale	Stratigraphic, channel sands, porous facies pinch-outs. Structural related to Laramide tectonism in disturbed belt.	Gas play, mainly to the west of the candidate area.
Cretaceous Clastics	Martin House, basal Slatrer River, Trevor formations.	Arctic Red, Slater River	Martin House and Arctic Red shales	Stratigraphic, channel fill, shore sands, facies pinch-outs, unconformity related. Structural domes and folds related to tectonism traps in disturbed belt.	Gas and oil play.

Table 1. Summary of hydrocarbon plays in the Ts'ude niline Tu'eyeta Candidate Protected Area, adapted from Gal (2007)

Methodology

The quantitative hydrocarbon assessment of the Ts' ude niline Tu'eyeta Candidate Protected Area is for conventional oil and gas resources only. There is no consideration of possible unconventional resources, as coal bed gas, shale oil or shale gas. The present study uses the assessed volumes of undiscovered oil and gas from Drummond Consulting, 2008, internal report, Ultimate Oil and Gas Resources of the Sahtu Settlement Area. The undiscovered oil and gas for each geological play of the Sahtu Settlement Area was distributed evenly by quarter grid across the play area. For the present study, a quarter grid assignment has been done for the Ts' ude niline Tu'eyeta Candidate Protected Area. The undiscovered oil and gas by play for these quarter grids is retrieved from the Sahtu study and compiled into a database for the Ts' ude niline Tu'eyeta Candidate Protected Area. The geological plays based on Gal (2005; 2007) are summarized in Table 1.

For this study the Palisade Corporation @Risk simulation add-in program for Excel was used to make assessments for all the plays defined by Gal (2005; 2007), that occur within the Ts' ude niline Tu'eyeta Candidate Protected Area. A description of resource estimation using @Risk is included as Appendix II. The simulations were done for the complete play, with a percentage applied for the study area to derive cumulative frequency distributions for the play within the Ts' ude niline Tu'eyeta Candidate Protected Area. The @ Risk simulations allows for both the mean and the median to be derived. In this manner a constant set of estimated values for both mean and median is achieved.

Oil and Gas Potential for the Ts' ude niline Tu'eyeta Candidate Protected Area

A good discussion of hydrocarbon resources was given in the report, Gal (2007), and the reader is referred to that report for more details. A detailed discussion of the petroleum system elements for the area is provided in Gal, et al, 2009a (Peel volume, chapter 10). Regional reviews of the oil and gas potential for the Mackenzie Valley are presented in Hannigan, et.al., 2006, and Morrow, et.al., 2006. Petrophysical properties for some of the plays in the area are provided in Hu and Hannigan, 2009.

There are no discovered oil or gas resources within the Ts' ude niline Tu'eyeta Candidate Protected Area. A list of wells drilled in and immediately adjacent to the Ts' ude niline Tu'eyeta Candidate Protected Area, with a summary of drill stem test results indicating both oil and gas shows, is shown in Table 2.

The undiscovered potential for the Ts' ude niline Tu'eyeta Candidate Protected Area is estimated to be 3,173 thousand cubic metres (20 million barrels) of recoverable oil and 5,987 million cubic metres (212.5 billion cubic feet) of recoverable gas. The undiscovered oil and gas resources by geological play for the Ts' ude niline Tu'eyeta Candidate Protected Area is summarized in Table 3, and a statistical summary with the distribution of the resource estimates is shown in Table 4.

QTR_ID	WELL NAME	YEAR	Total Depth (m)	Oldest Formation Reached	Formation Tested	Test Results
653012930NE	MOBIL HUME RIVER L-09	1971	2,606	Mt. Kindle	Mt Kindle	mud cut salt water
653013030NW	CANDEL MOBIL ET AL N RAMPARTS A-59	1973	3,205	Franklin Mtn	Mt Kindle	mud and fresh water
654012915NW	CHEVRON SPERRY CREEK N-58	1991	2,160	Franklin Mtn		Confidential
654013045NW	CANDEL ET AL TEXACO ARCTIC RED F-47	1973	2,371	Hume		No tests
655012845SE	IMPERIAL SANS SAULT NO. 1 (H-24)	1944	1,003	Arnica	Arnica	mud
655012900NW	ARCO ET AL MOUNTAIN RIVER H-47	1972	1,045	Mt. Kindle	Landry (Bear Rock)	Gas to surface at 88 mcf/d (2490 m3/d)
655012915SE	CANDEL ET AL SOBC MOUNTAIN R. A-23	1972	1,554	Mt. Kindle	Mt Kindle & Arnica	mud cut salt water
655013000NW	CHEVRON RAMPARTS RIVER F-46	1991	1,510			Confidential
660012900SW	ARCO CLARKE ET AL HUME RIVER D-53	1972	1,268	Mt. Kindle	Mt Kindle	salt water
660012900SW	TRIAD BP ARCO CC HUME R O-62	1970	1,402	Mt. Kindle	Mt Kindle	mud cut salt water
660012915NE	CHEVRON EAST HUME RIVER N-10	1990	445			Confidential
660012915NE	CHEVRON EAST HUME RIVER I-20	1990	365			Confidential
660012930NW	CHEVRON HUME RIVER I-66	1990	745			Confidential
661012900SW	TRIAD BP ARCO CC HUME R A-53	1969	1,158	Franklin Mtn	Franklin Mtn	muddy salt water
662012830NW	GLACIER ET AL HARE INDIAN NO 1 (H-48)	1960	169	Hume		No tests
662012830SW	GLACIER ET AL RAMPARTS NO 1 (I-55)	1960	471	Bear Rock	Hume	Gas to surface at 250 mcf/d
662013145NE	DECALTA TRNS GCOA ONTARATUE I-38	1972	2,288	Franklin Mtn	Franklin Mtn	salt water
663012900SW	ATLANTIC S.W. AIRPORT CREEK NO 1 (D-72)	1960	727	Arnica	Hume	mud
663012930NE	ATLANTIC N. CIRCLE RIVER NO 1 (A-37)	1961	691	Arnica	Arnica	mud and water
663013000NW	ATLANTIC CIRCLE RIVER NO 1 (K-47)	1961	811	Arnica	Hume	water
664013015NE	CANDEL ET AL MOBIL GRANDVIEW L-26	1972	2,396	Proterozoic	Mount Kindle	mud and fresh water
664013045SE	ATLANTIC ET AL ONTARATUE K-04	1965	2,728	Proterozoic	Tatsieta	water
654012845SE	TRIAD BP ARCO CC CARCAJOU L-24	1970	1,957	Mt. Kindle	Ramparts	mud and fresh water
660012845SE	ATLANTIC ET AL SHOALS C-31	1966	1,981	Mt. Kindle	Landry	1.5 m oil, 117 m water
663012845SW	ATLANTIC COLCAR MANITOU LK L-61	1966	1,724	Saline River	Mt Kindle & Franklin Mtn	mud cut salt water

Table 2. List of wells in and immediately adjacent to the Ts'ude niline Tu'eyeta Candidate Protected Area, with summary of test results

Natural Gas Resources of the Ts' ude niline Tu'eyeta Candidate Protected Area

There are no gas discoveries for the Ts' ude niline Tu'eyeta Candidate Protected Area.

The undiscovered natural gas potential for the Ts' ude niline Tu'eyeta Candidate Protected Area is estimated to be 9,120 million cubic metres (323.7 billion cubic feet) gas-in-place, 5,987 million cubic metres (212.5 billion cubic feet) recoverable, and 5,555 million cubic metres (197.2 billion cubic feet) of marketable gas. The cumulative frequency distribution for undiscovered gas is shown in Figure 4. There is an 80% probability the undiscovered recoverable gas is in the range of 2.47 to 10.53 billion cubic metres (92 to 363 billion cubic feet), with a mean of 5.99 billion cubic metres (212.5 billion cubic feet) at a probability of 39%. The median (50%) value is 4.97 billion cubic metres (178.88 billion cubic feet).

The distribution of recoverable gas resources by million cubic metres and billion cubic feet per quarter grid for the Ts' ude niline Tu'eyeta Candidate Protected Area is shown in Excel map format in Figures 5 and 6. The undiscovered gas potential, ranked by recoverable gas, for the various plays is shown in Table 3. The number one ranked play with the largest volume, 1,772 million cubic metres (62.9 billion cubic feet) of undiscovered recoverable gas is the Kee Scarp/Ramparts carbonate play. This play represents 29.6% of the total estimated ultimate natural gas potential for the Ts' ude niline Tu'eyeta Candidate Protected Area. The top four gas plays possibly have a large enough undiscovered resource to be considered for exploration. The Upper Devonian clastics play would be a secondary target, and the Tuttle sandstone play is essentially outside the area to the west.

Oil Resources of the Ts' ude niline Tu'eyeta Candidate Protected Area

There is no discovered oil resource for the Ts' ude niline Tu'eyeta Candidate Protected Area.

The undiscovered recoverable oil potential for the Ts' ude niline Tu'eyeta Candidate Protected Area is estimated to be 12.6 million cubic metres (79.4 million barrels) oil-in-place, and 3.2 million cubic metres (20.0 million barrels) of recoverable oil. The cumulative frequency distribution for undiscovered oil is shown in Figure 7. There is an 80% probability the undiscovered recoverable oil is in the range of 0.58 to 6.80 million cubic metres (3.54 to 43.17 million barrels), with a mean of 3.2 million cubic metres (20.0 million barrels) at a probability of 32%. The median (50%) value is 1.81 million cubic metres (11.18 million barrels).

The distribution of undiscovered recoverable oil resources by million cubic metres and million barrels per quarter grid for the Ts' ude niline Tu'eyeta Candidate Protected Area is shown in Excel map format in Figures 8 and 9. The undiscovered oil resource is expected to be located throughout most of the eastern and central parts of the Ts' ude niline Tu'eyeta Candidate Protected Area, with lower potential along the western edge.

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA UNDISCOVERED OIL AND GAS POTENTIAL

GAS - MILLION CUBIC METRES , OIL - THOUSAND CUBIC METRES

PLAY_NAME	Gas in Place	Recoverable Gas	Marketable Gas	Oil in Place	Recoverable Oil
Kee Scarp/Ramparts	2,887.5	1,772.4	1,659.1	10,863.2	2,893.6
Cretaceous Clastics	2,059.7	1,445.5	1,344.7	916.0	152.9
Arnica/Landry Platform	1,811.8	1,278.8	1,164.6	843.7	126.6
Ordovician/Silurian Platform	1,828.8	1,152.8	1,072.1	0.0	0.0
Upper Devonian Clastics	524.5	332.3	309.1	0.0	0.0
Tuttle Sandstone	7.8	5.3	5.0	0.0	0.0
Total	9,120.1	5,987.2	5,554.5	12,622.9	3,173.1

GAS - BILLION CUBIC FEET , OIL - MILLION BARRELS

PLAY_NAME	Gas in Place	Recoverable Gas	Marketable Gas	Oil in Place	Recoverable Oil
Kee Scarp/Ramparts	102.5	62.9	58.9	68.4	18.2
Cretaceous Clastics	73.1	51.3	47.7	5.8	1.0
Arnica/Landry Platform	64.3	45.4	41.3	5.3	0.8
Ordovician/Silurian Platform	64.9	40.9	38.1	0.0	0.0
Upper Devonian Clastics	18.6	11.8	11.0	0.0	0.0
Tuttle Sandstone	0.3	0.2	0.2	0.0	0.0
Total	323.7	212.5	197.2	79.4	20.0

Table 3. Undiscovered oil and gas for Ts'ude Niline Tu'eyeta Candidate Protected Area by play, ranked by recoverable gas. Geological plays from Gal (2007).

@RISK Output Results

Performed By: Ken Drummond

Date: March 3, 2010 9:21:30 AM

**TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED OIL AND GAS POTENTIAL**

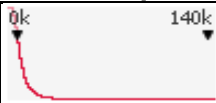
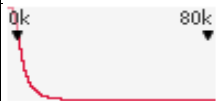
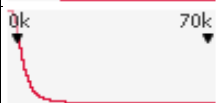
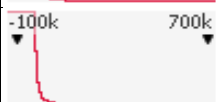
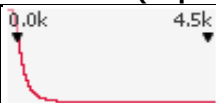
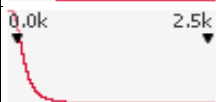
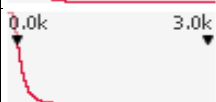
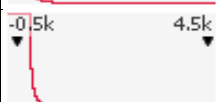
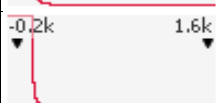
Name	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Candidate Protected Area (Metric Units)							
Gas-in-Place (E6m3) / DC7	K43		9,120.1	7,692.9	5,868.1	4,014.8	15,544.3
Recoverable Gas (E6m3) / DC7	K44		5,987.2	4,968.2	4,099.4	2,473.5	10,526.7
Marketable Gas (E6m3) / DC7	K45		5,554.5	4,598.7	3,759.9	2,367.3	9,743.5
Oil-in-Place (E3m3) / DC7	K46		12,622.9	7,567.8	17,946.3	2,631.8	26,318.6
Recoverable Oil (E3m3) / DC7	K47		3,173.1	1,806.4	4,662.0	576.3	6,799.1
Range: Ts'ude niline Tu'eyeta Candidate Protected Area (ImperialUnits)							
Gas-in-Place (BCF) / DC7	C43		323.7	273.2	209.7	143.0	553.5
Recoverable Gas (BCF) / DC7	C44		212.5	178.9	138.0	92.5	362.9
Marketable Gas (BCF) / DC7	C45		197.2	166.4	126.9	87.3	335.7
Oil-in-Place (MMB) / DC7	C46		79.4	47.6	114.1	16.4	167.1
Recoverable Oil (MMB) / DC7	C47		20.0	11.2	32.2	3.5	43.2

Table 4. Statistical summary of total undiscovered oil and gas for the Ts'ude niline Tu'eyeta Candidate Protected Area

The undiscovered recoverable oil potential for the various plays is shown in Table 3. The number one ranked play for recoverable oil is the Kee Scarp/Ramparts carbonate play with 2,894 thousand cubic metres (18.2 million barrels). This play represents 91.2% of the total estimated undiscovered oil potential for the Ts'ude niline Tu'eyeta Candidate Protected Area. This is the only oil play large enough to warrant any exploration. The other two oil plays could possibly be considered as a secondary objective for any gas exploration.

Conclusions

The undiscovered oil and gas resource for the Ts'ude niline Tu'eyeta Candidate Protected Area has been assessed at 3.2 million cubic metres (20.0 million barrels) of recoverable oil and 5,987.2 million cubic metres (212.5 billion cubic feet) of recoverable gas. Overall the undiscovered oil and gas resource is considered as moderate to high.

In general the quantitative assessment of the distribution of oil and gas potential for the Ts'ude niline Tu'eyeta Candidate Protected Area agrees closely with the qualitative evaluation by Gal, L.P., 2007, NWT Open Report 2007-01. The gas potential is highest (about $27 \times 10^6 \text{ m}^3/\text{quarter grid}$) in a southeast-northwest trending band across the central part of the Ts'ude niline Tu'eyeta Candidate Protected Area, decreasing along the northeast and northwest.

Oil potential is high (about $14.5 \times 10^3 \text{ m}^3/\text{quarter grid}$) over most of the Ts'ude niline Tu'eyeta Candidate Protected Area, with lower values (down to $1.3 \times 10^3 \text{ m}^3/\text{quarter grid}$) along the western boundary.

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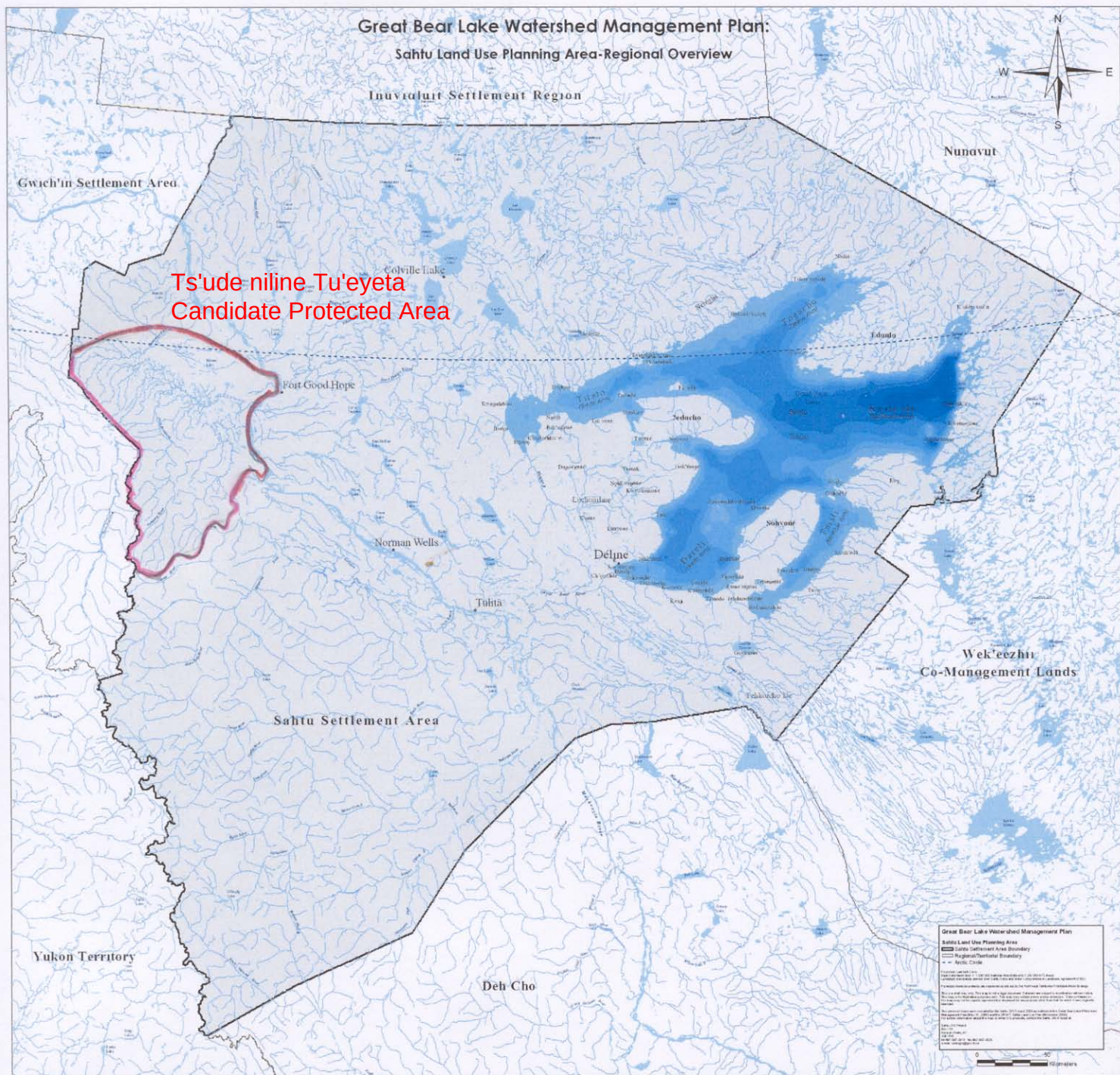


Figure 1. Index map showing Ts' ude niline Tu'eyeta Candidate Protected Area within the Sahtu Settlement Area (map from Great Bear Lake Management Plan - Sahtu GIS Project)

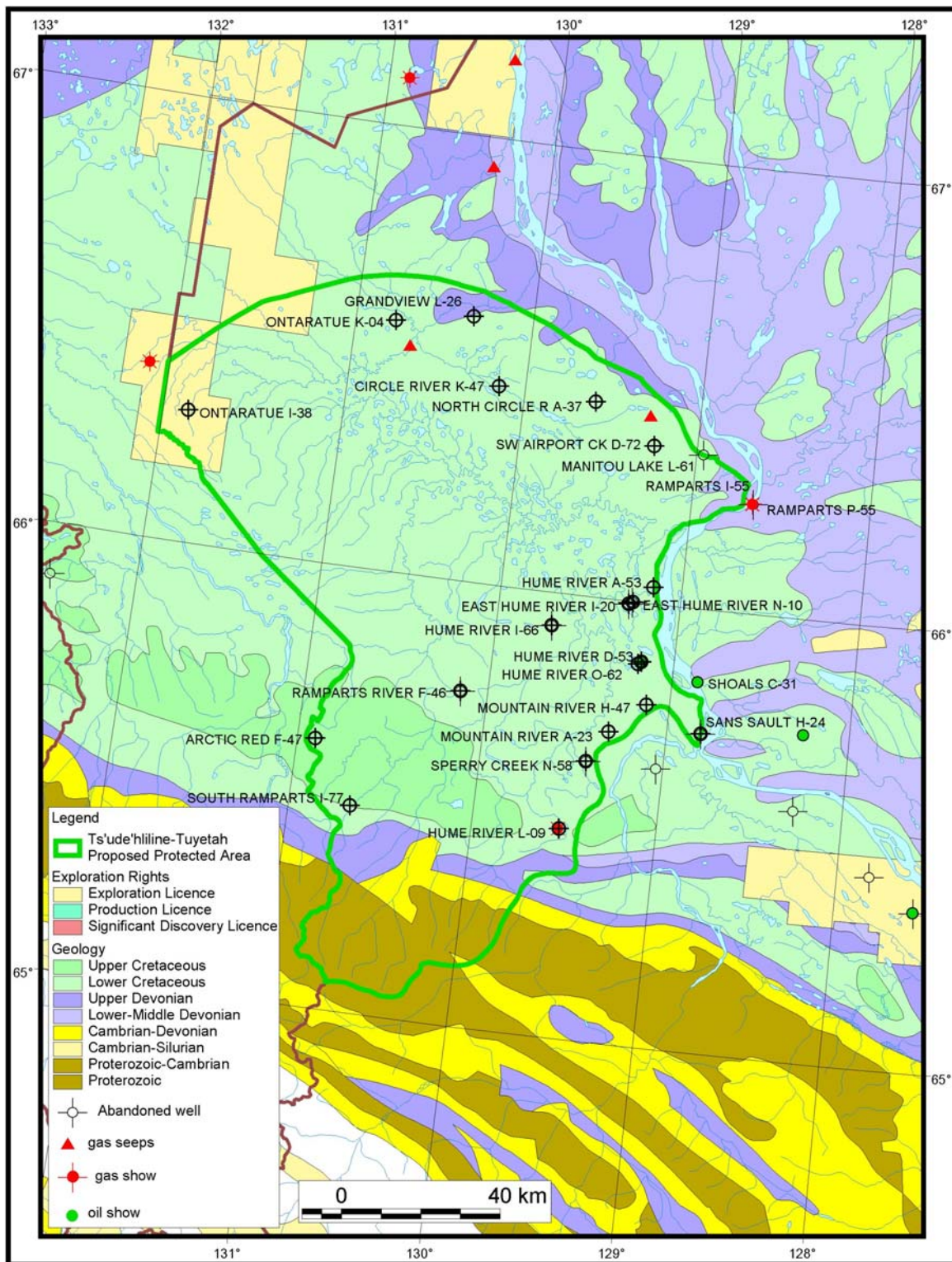
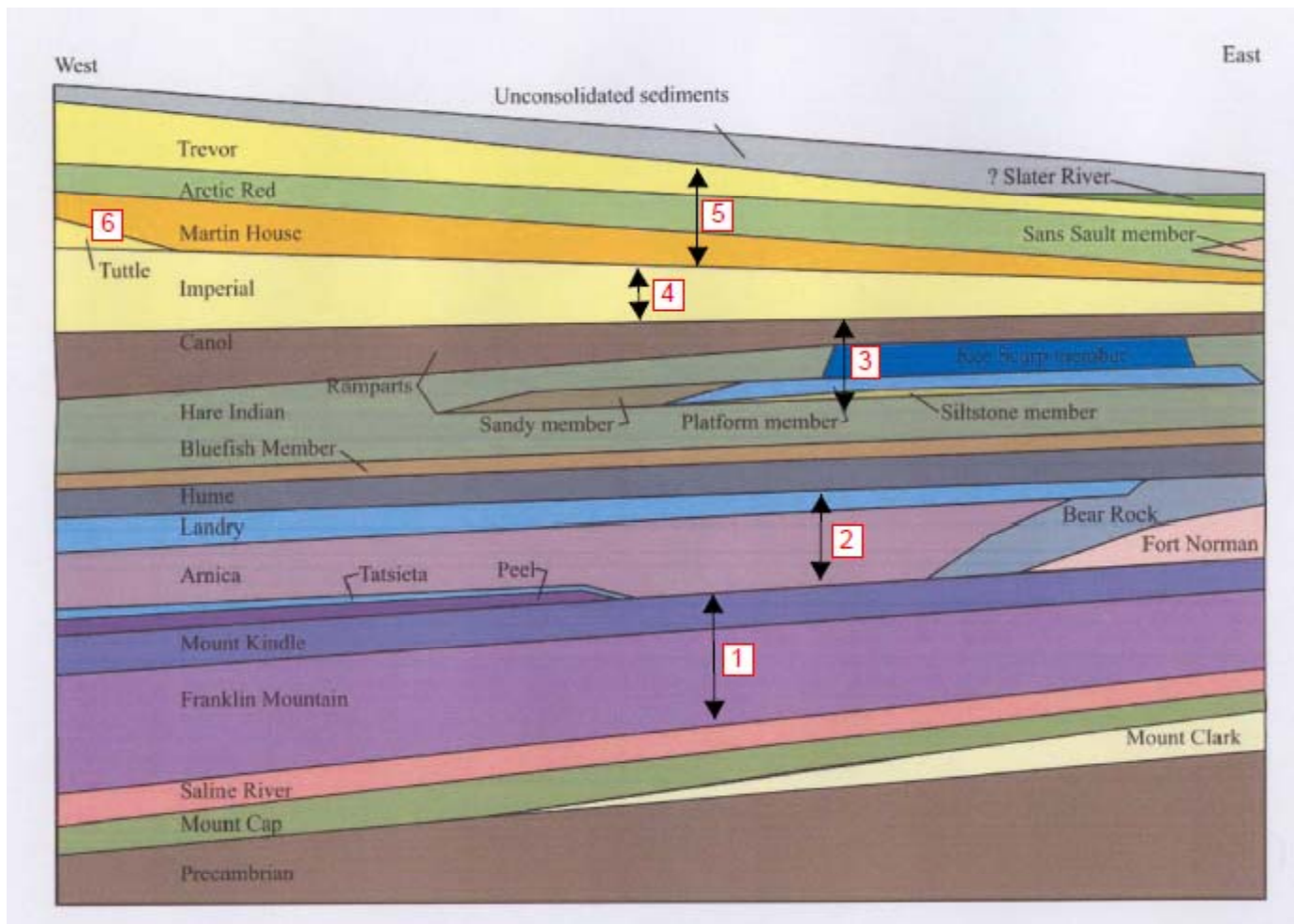


Figure 2. Geological map of the Ts' ude niline Tu'yeta Candidate Protected Area with well locations and hydrocarbon shows.
(From Ts'ude'hililne-Tu'yeta Candidate Protected Area proposal).

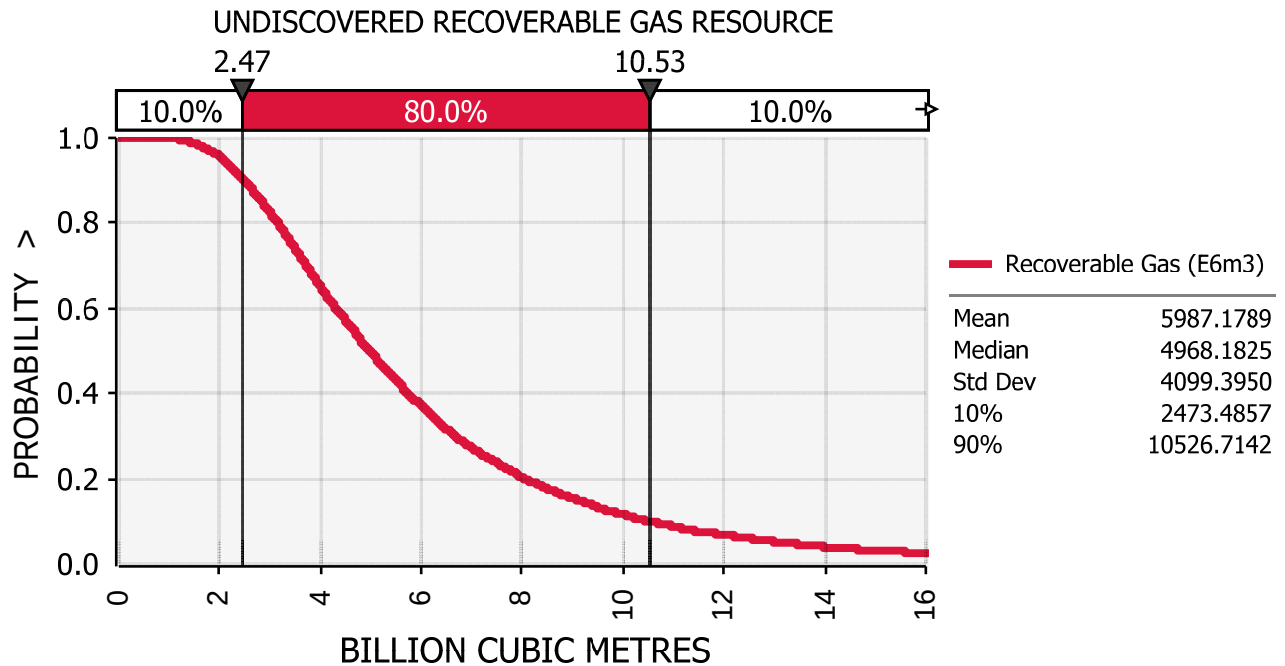


Index of Plays

1. Ordovician / Silurian Platform
2. Arnica / Landry Platform
3. Kee Scarp / Ramparts
4. Upper Devonian Clastics
5. Cretaceous Clastics
6. Tuttle Sandstone

Figure 3. Schematic stratigraphic section showing the geological plays quantitatively assessed for the Ts'ude niline Tu'eyeta Candidate Protected Area (Adapted from Gal (2007))

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

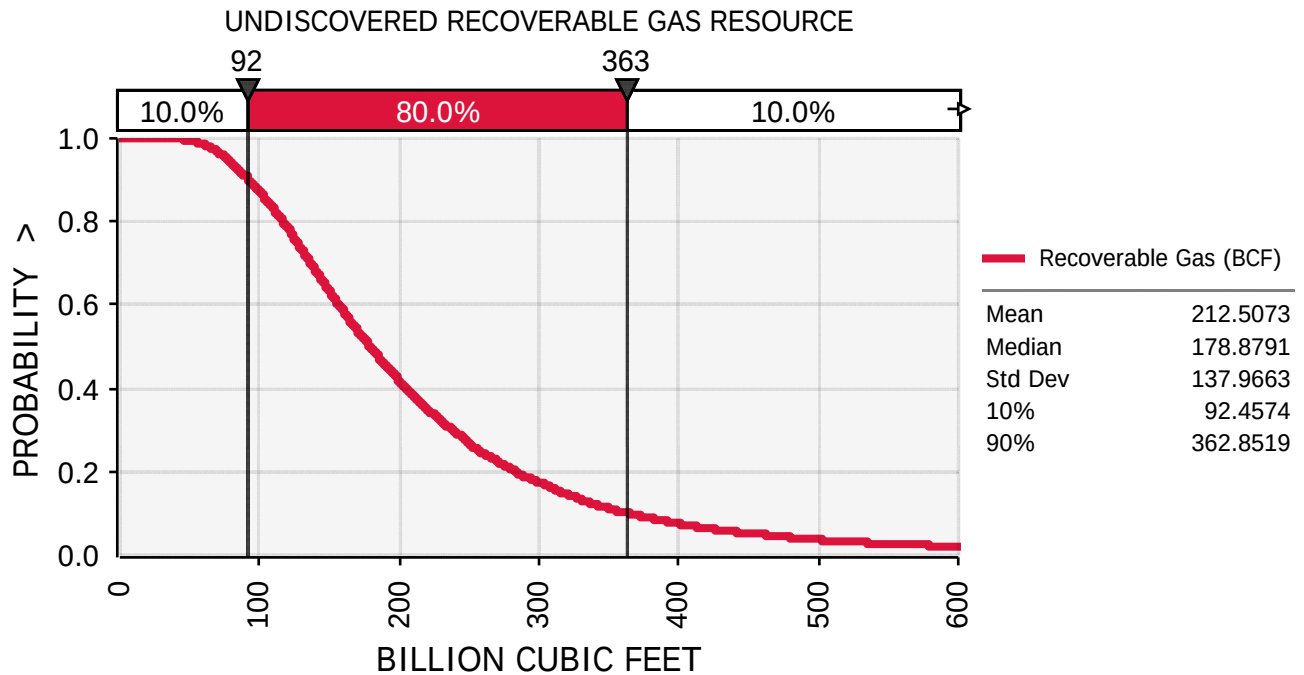


Figure 4. Cumulative frequency distribution of undiscovered recoverable gas for the Ts'ude niline Tu'eyeta Candidate Protected Area .

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS (10^6 m^3 /QUARTER GRID)

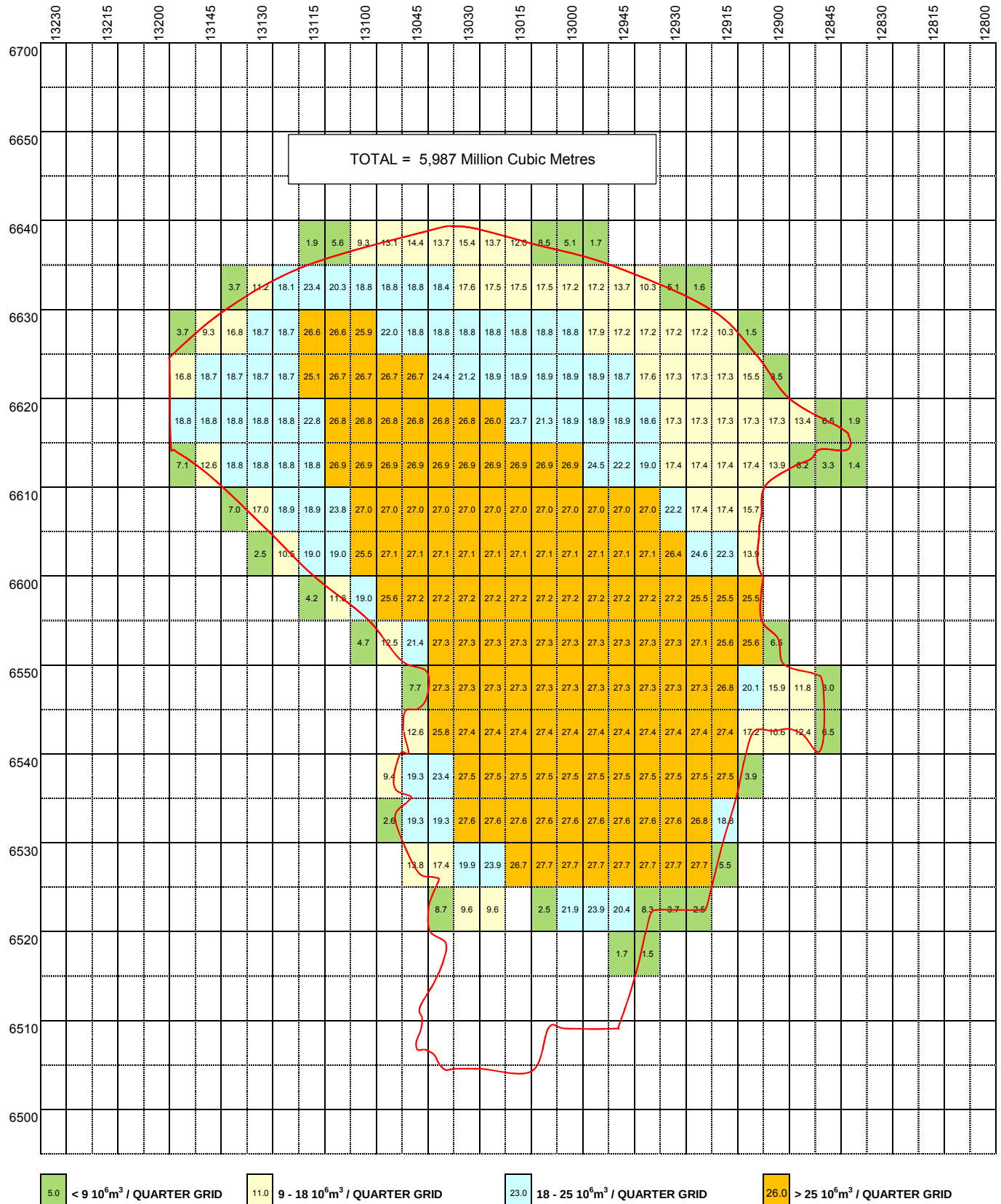


Figure 5. Ts'ude niline Tu'eyeta Candidate Protected Area - distribution of undiscovered recoverable gas (million cubic metres per quarter grid).

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS (BCF/QUARTER GRID)

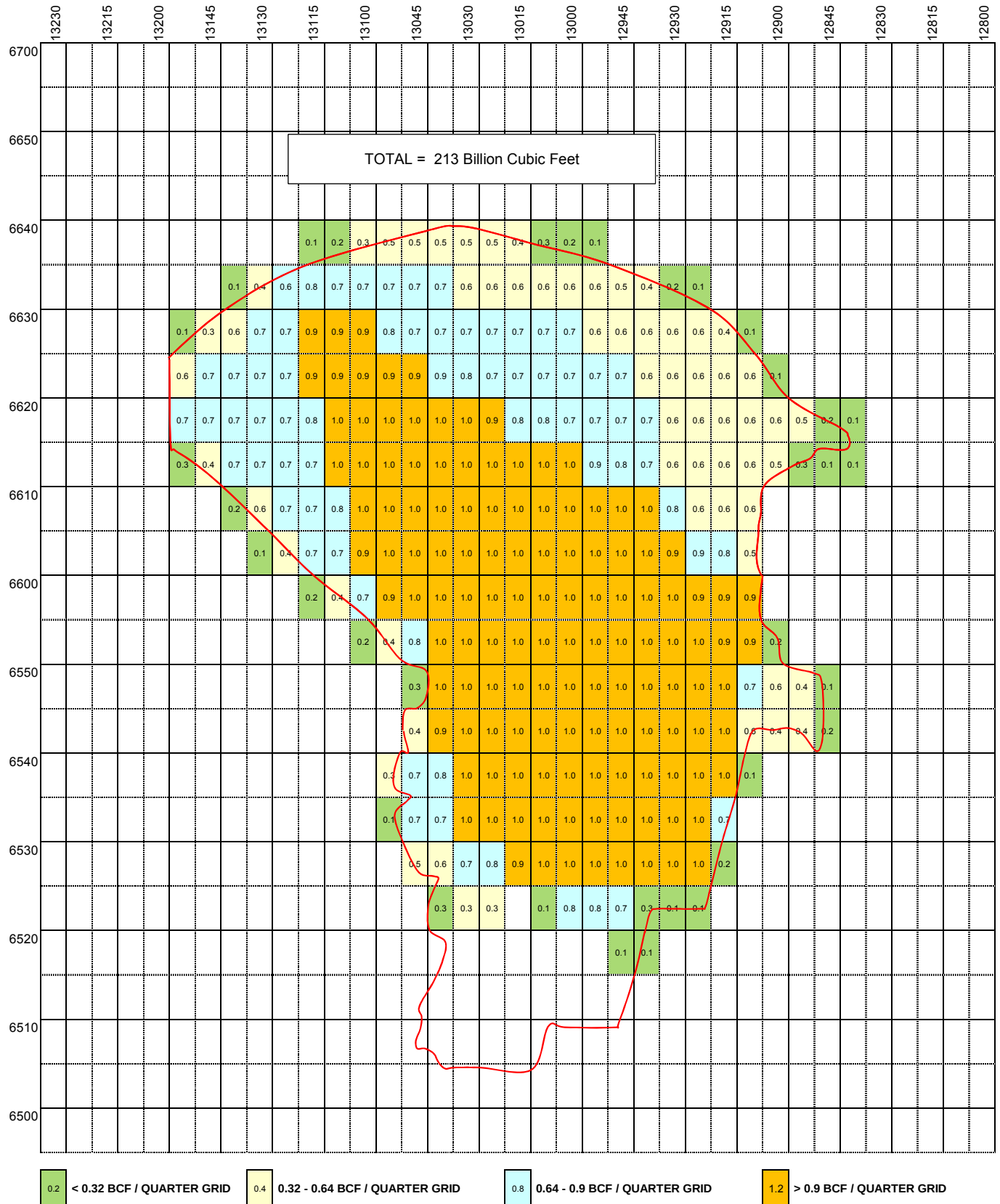
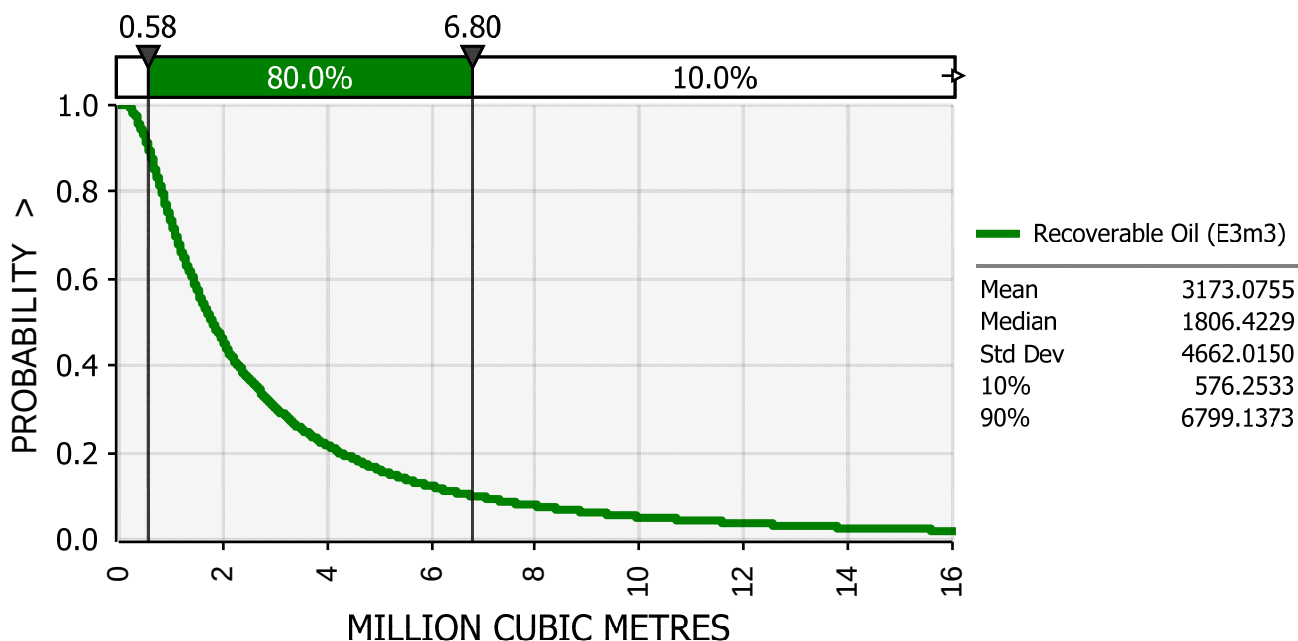


Figure 6. Ts'ude niline Tu'eyeta Candidate Protected Area - distribution of undiscovered recoverable gas (billion cubic feet per quarter grid).

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS RESOURCE



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE OIL RESOURCE

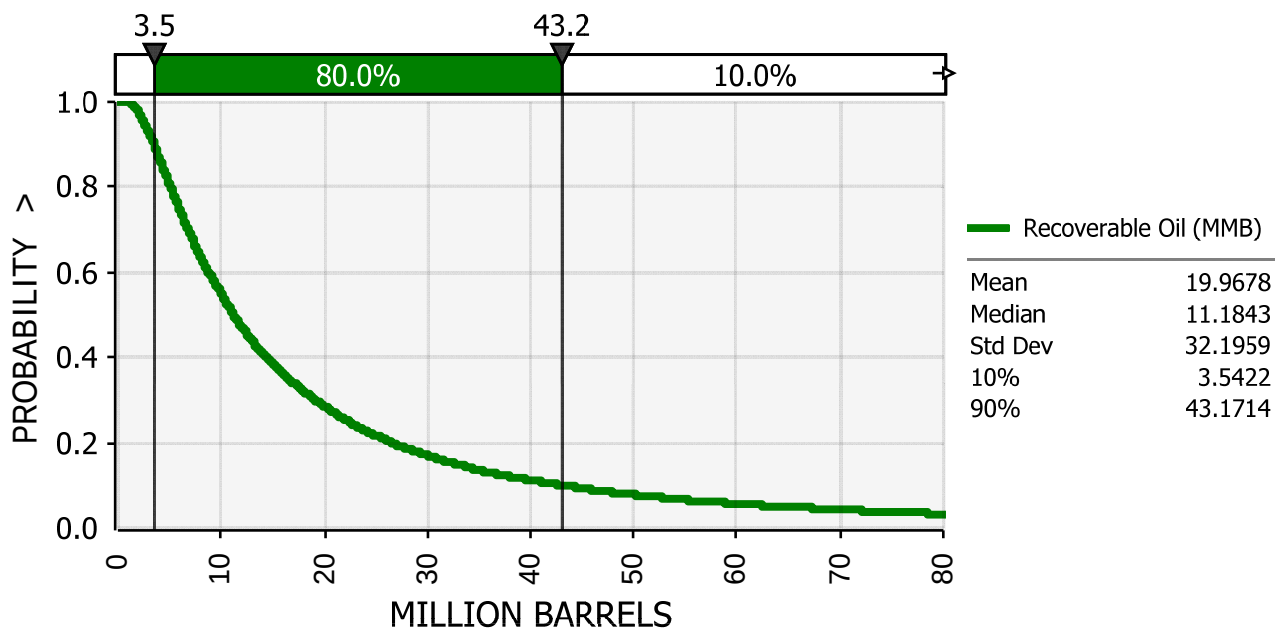


Figure 7. Cumulative frequency distribution of undiscovered recoverable oil for the Ts'ude niline Tu'eyeta Candidate Protected Area .

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE OIL (10^3 m^3 /QUARTER GRID)

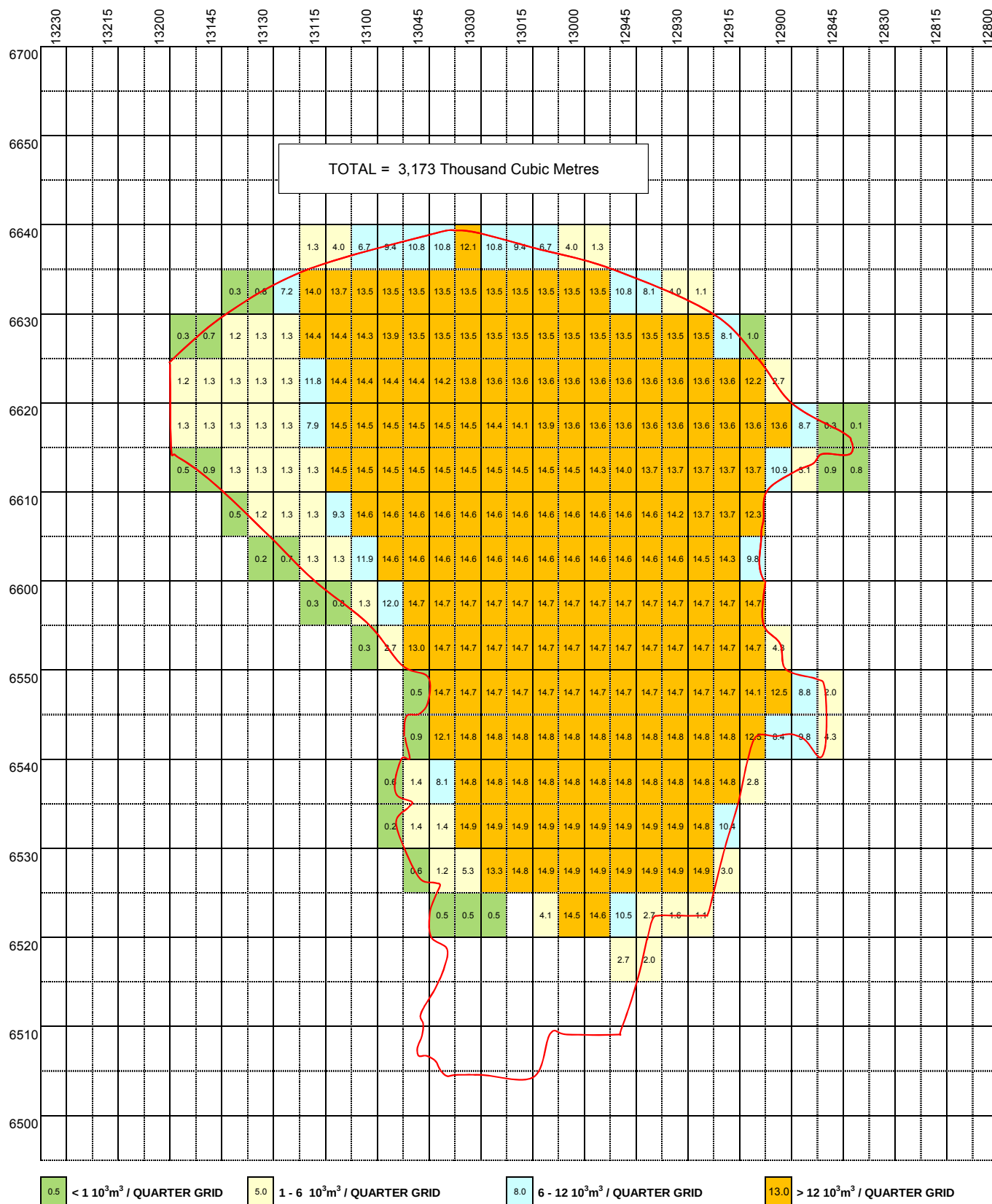


Figure 8. Ts'ude niline Tu'eyeta Candidate Protected Area - distribution of undiscovered recoverable oil (thousand cubic metres per quarter grid).

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE OIL (MB/QUARTER GRID)

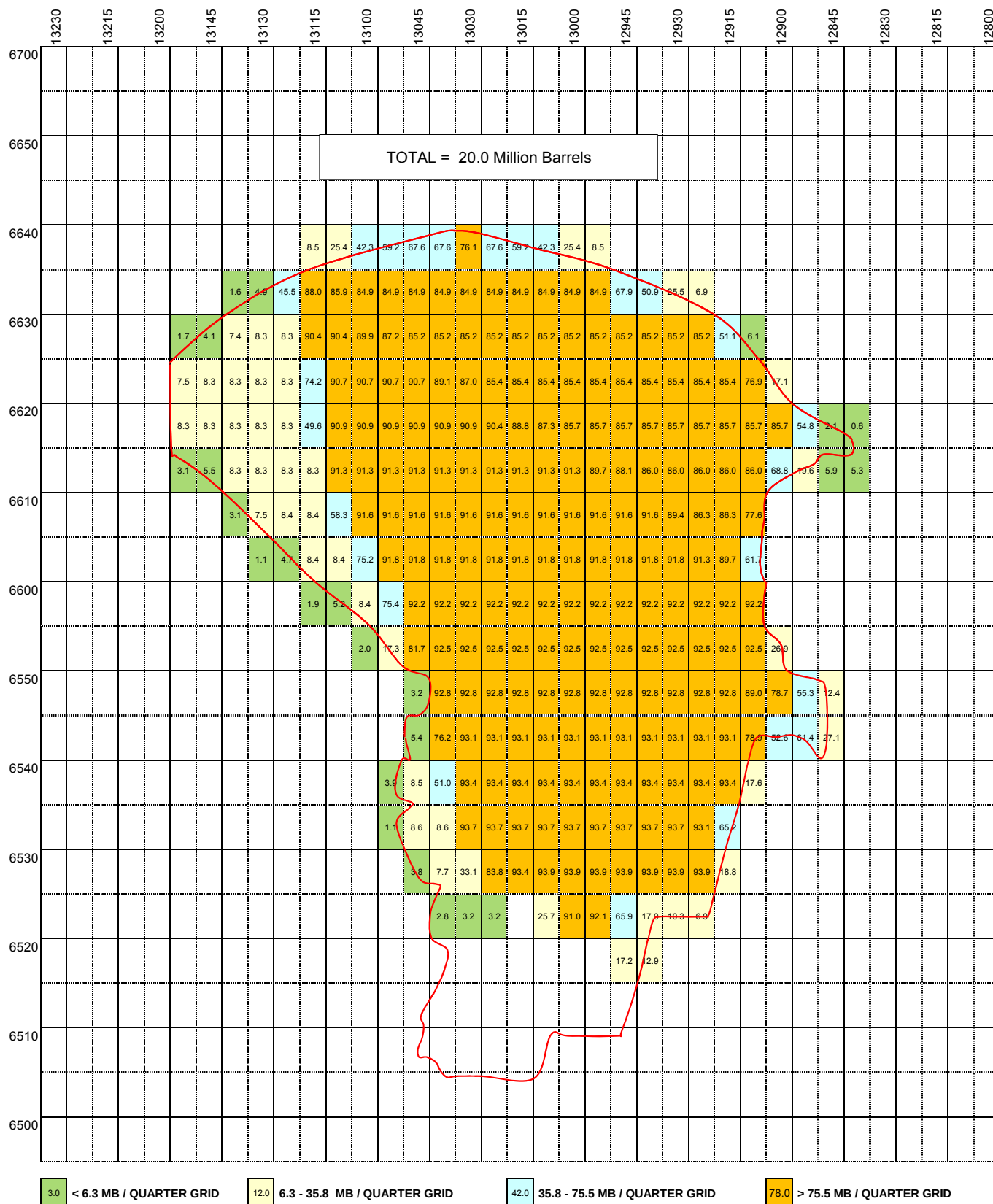


Figure 9. Ts'ude niline Tu'eyeta Candidate Protected Area - distribution of undiscovered recoverable oil (thousand barrels per quarter grid).

Appendix I

Play Summaries

Ts' ude niline Tu'eyeta Candidate Protected Area

Ordovician-Silurian Platform

Arnica / Landry Platform

Kee Scarp/Ramparts

Upper Devonian Clastics

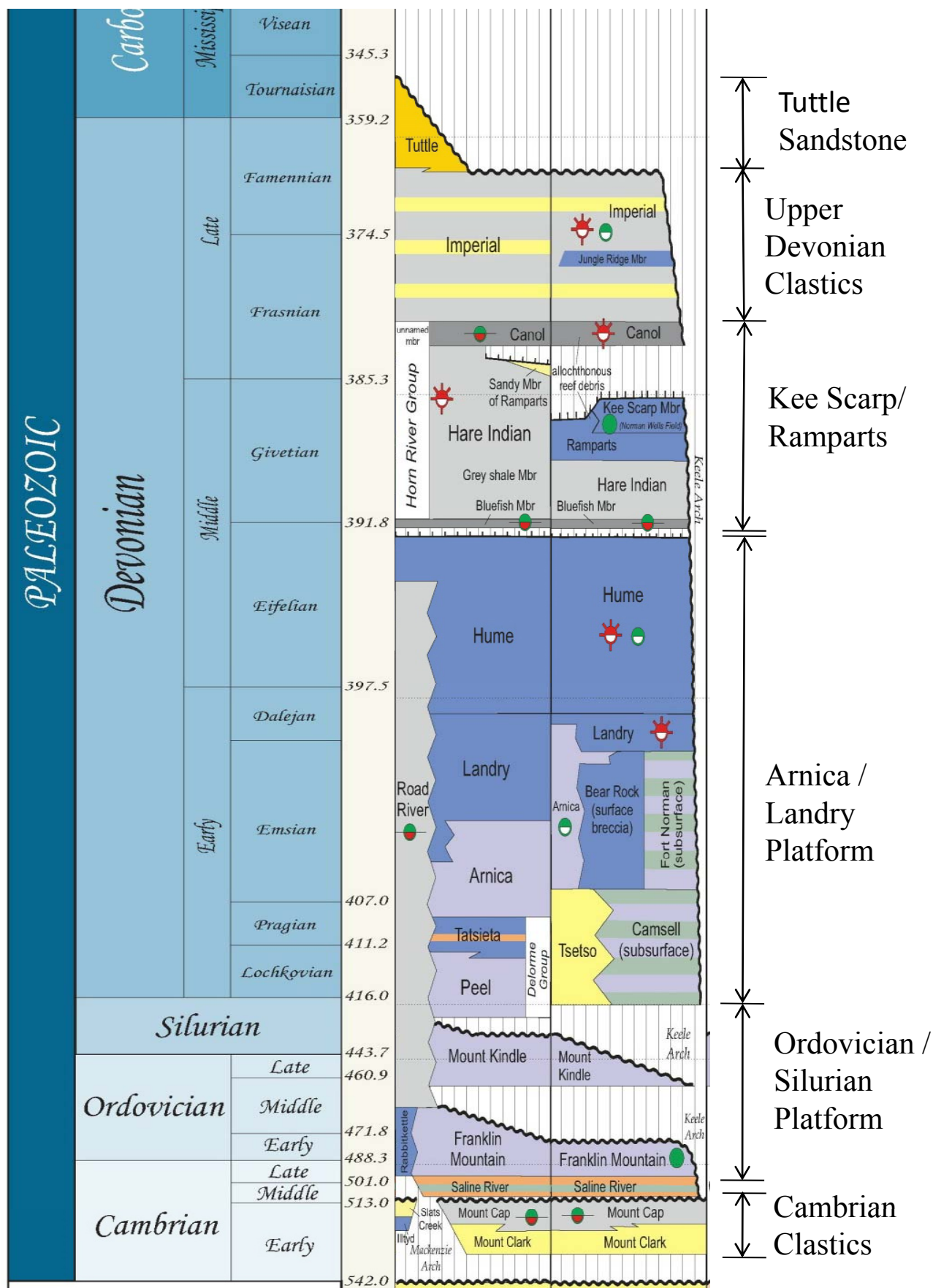
Tuttle Sandstone

Cretaceous Clastics

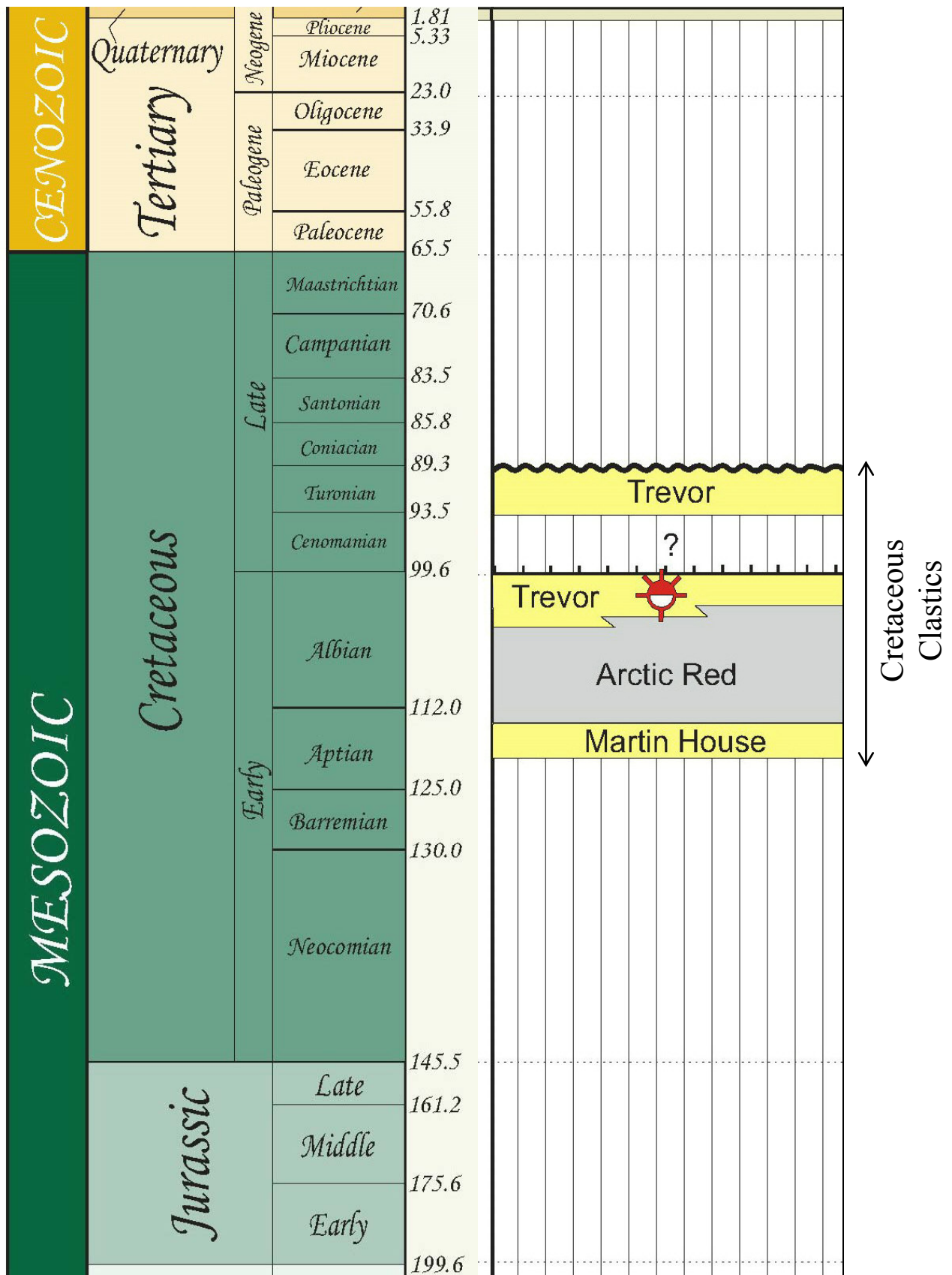
For a detailed description of the plays the reader is referred to Gal (2005,2007) and Pyle and Jones (2009) in the executive summary and relative chapters therein.

The relative stratigraphic position of the various plays is shown on the stratigraphic columns adapted from Jones and Gal (2007), which follows on the next two pages.

The summary page descriptions are for the full play area within the Sahtu Settlement Area (Figure 1), adapted from Drummond (2008). The resource volumes shown on the summary page are for the entire play within the Sahtu Settlement Area (Figure 1). The statistical distribution of the undiscovered oil and gas for the Ts' ude niline Tu'eyeta Candidate Protected Area is shown in the @Risk output results, in both metric and imperial units. The areal distribution of the undiscovered oil and gas by quarter grid for the Ts' ude niline Tu'eyeta Candidate Protected Area is shown on the Excel format maps in both metric and imperial units.



Stratigraphic Column (adapted from Jones & Gal (2007)) Showing Geological Plays for the Paleozoic of the Candidate Area



Stratigraphic Column (adapted from Jones & Gal (2007)) Showing Plays for the Mesozoic of the Candidate Area

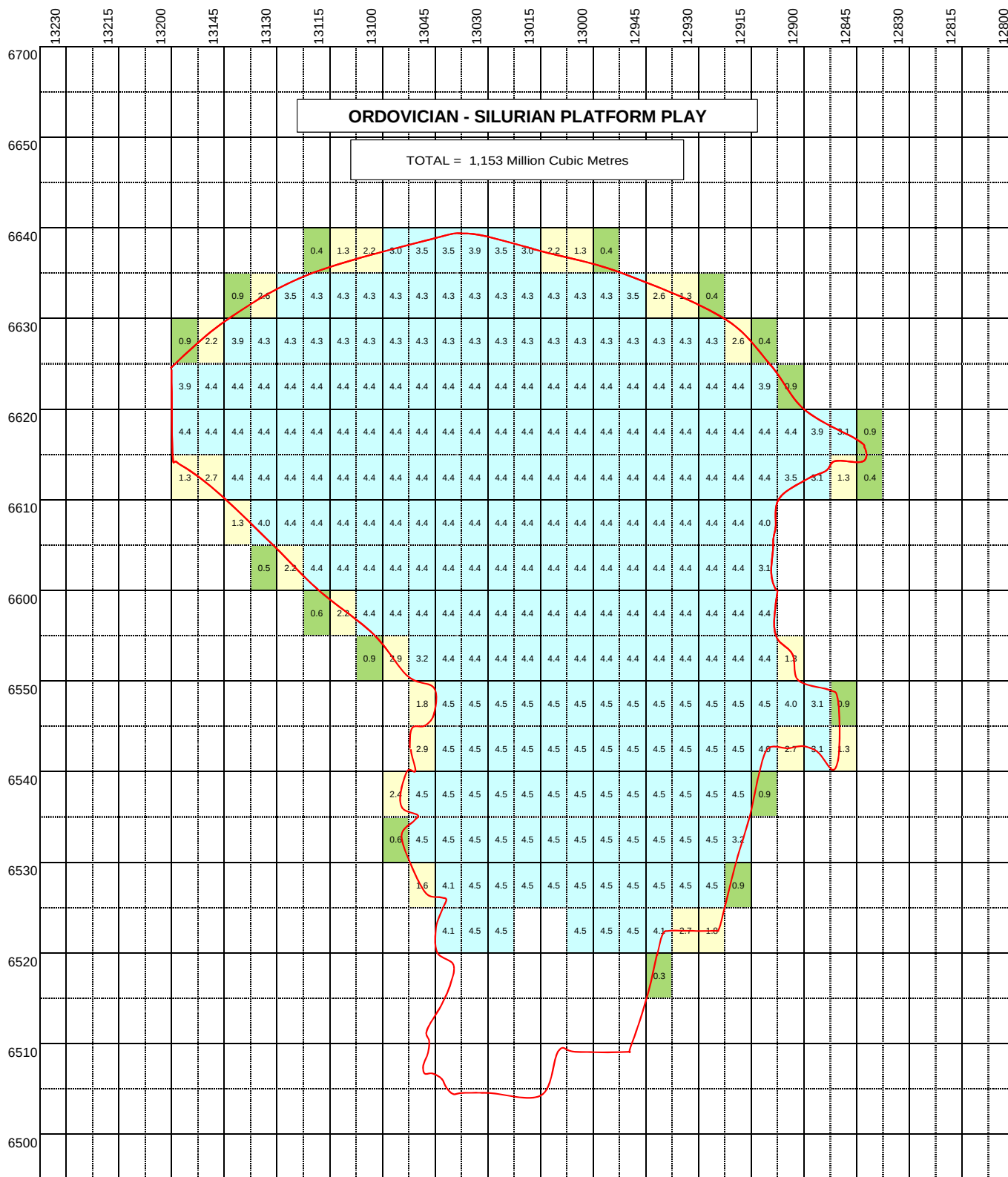
TS'UDE NILINE TU'EYETA
SUMMARY OF HYDROCARBON PLAY (ENTIRE SAHTU SETTLEMENT AREA)

(Adapted from Gal and Jones, (2003), Gal (2005, 2007))

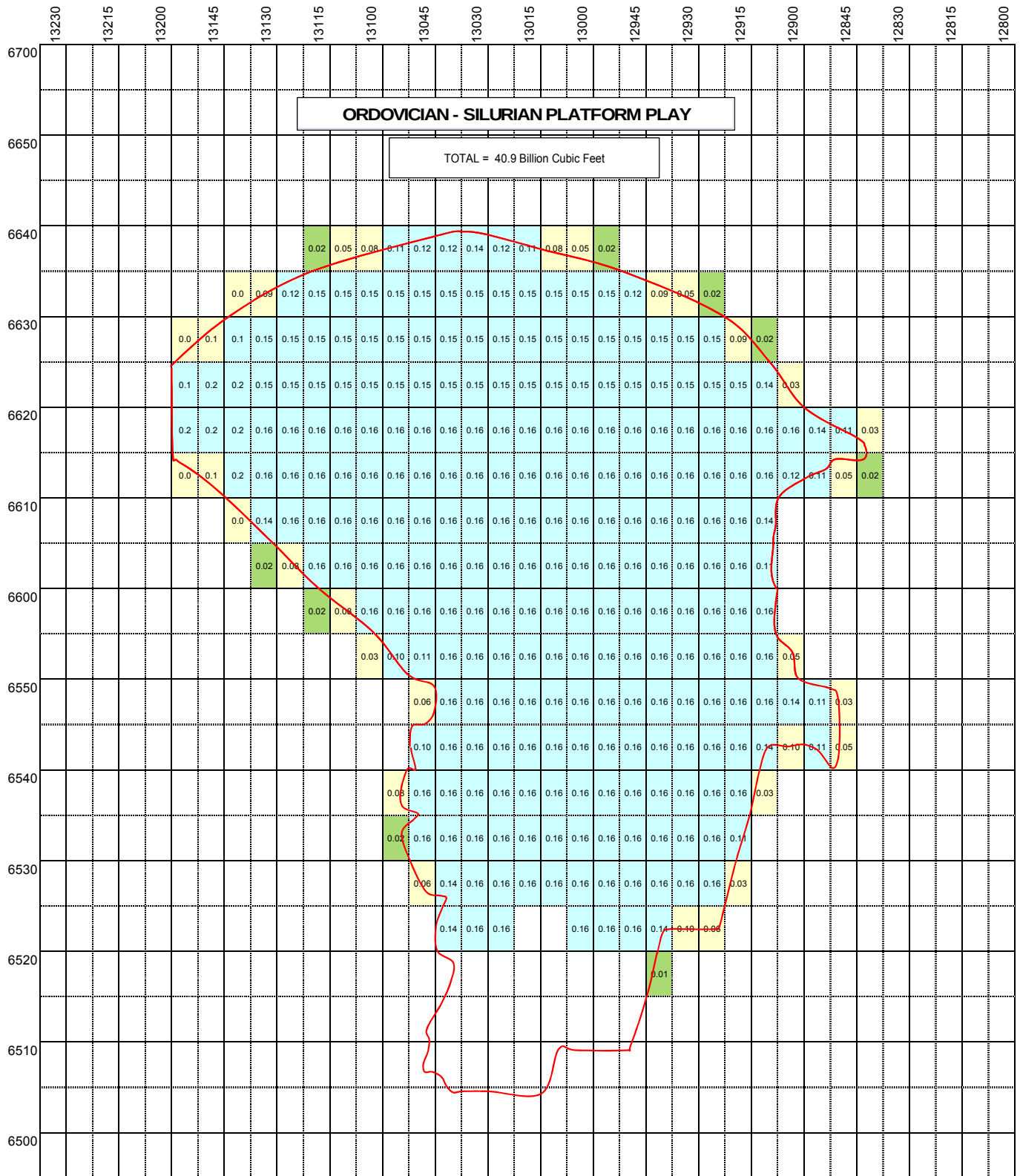
Play ID	OrdSil
Play Name	Ordovician/Silurian Platform
Play Description	One widespread platform carbonate play, covers most of the Sahtu Settlement Area, except across the Keele Arch.
References	Gal, 2005, 2007; Pugh, 1983; Gal and Pyle, 2006; Pyle and Gal, 2007; Pyle and Gal, 2009 (Peel volume chapter 4).
Reservoir Unit	Mount Kindle and Franklin Mountain fms
Distribution	South limit is outcrop edge; west limit is outcrop/Laramide deformation at Mackenzie Mountains front; east and southeast boundary is subcrop edge at Canadian Shield.
Source/Seal	Devonian evaporites (Bear Rock, Fort Norman fms), Road River Group, tight Mount Kindle Fm, tight Franklin Mountain fm.
Trap Style	Structural-highs, folds, fault bounded; fracture porosity; porosity enhanced through pre-Devonian erosion; stratigraphic-pinchouts and facies changes, reefal buildups.
Gas/Oil	Gas
Exploration Risks	Suitable source rock; breaching during hiatus (unconformities in sequence); development of porosity.
Mapped Area	15.827 Million Ha (39.110 Million Acres)
Significant fields/wells	No recovery of hydrocarbons. Gas cut mud in Aklavik F-38 and Tenlen A-73, live oil stain in Sammons H-55
Discovered Resources	No Discoveries
Undiscovered Recoverable Gas	12,619 Million cubic metres (447.91 Bcf)
Undiscovered Marketable Gas	11,736 Million cubic metres (416.55 Bcf)
Undiscovered Recoverable Oil	Gas play only

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS (10^6 m^3 /QUARTER GRID)



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE GAS (BCF/QUARTER GRID)

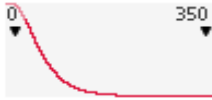


@RISK Output Results

Performed By: Ken Drummond

Date: March 2, 2010 9:44:40 AM

**Ts'ude niline Tu'eyeta Undiscovered Resource
Ordovician / Silurian Platform**

Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Ordovician/Silurian (Metric units)								
GAS IN PLACE (E6m3)	TotOrdSil	B18		1,828.755	1,594.334	1,044.134	739.806	3,210.722
RECOVERABLE GAS (E6m3)	TotOrdSil	B19		1,152.797	1,005.989	662.322	464.920	2,026.342
MARKETABLE GAS (E6m3)	TotOrdSil	B20		1,072.101	935.570	615.959	432.376	1,884.497
OIL IN PLACE (E3m3)	TotOrdSil	B21		0	0	0	0	0
RECOVERABLE OIL (E3m3)	TotOrdSil	B22		0	0	0	0	0
Range: Ts'ude niline Tu'eyeta Ordovician/Silurian (Imperial units)								
GAS IN PLACE (BCF)	TotOrdSil	B11		64.909	56.589	37.060	26.258	113.961
RECOVERABLE GAS (BCF)	TotOrdSil	B12		40.917	35.706	23.508	16.502	71.922
MARKETABLE GAS (BCF)	TotOrdSil	B13		38.053	33.207	21.863	15.347	66.888
OIL IN PLACE (MMB)	TotOrdSil	B14		0	0	0	0	0
RECOVERABLE OIL (MMB)	TotOrdSil	B15		0	0	0	0	0

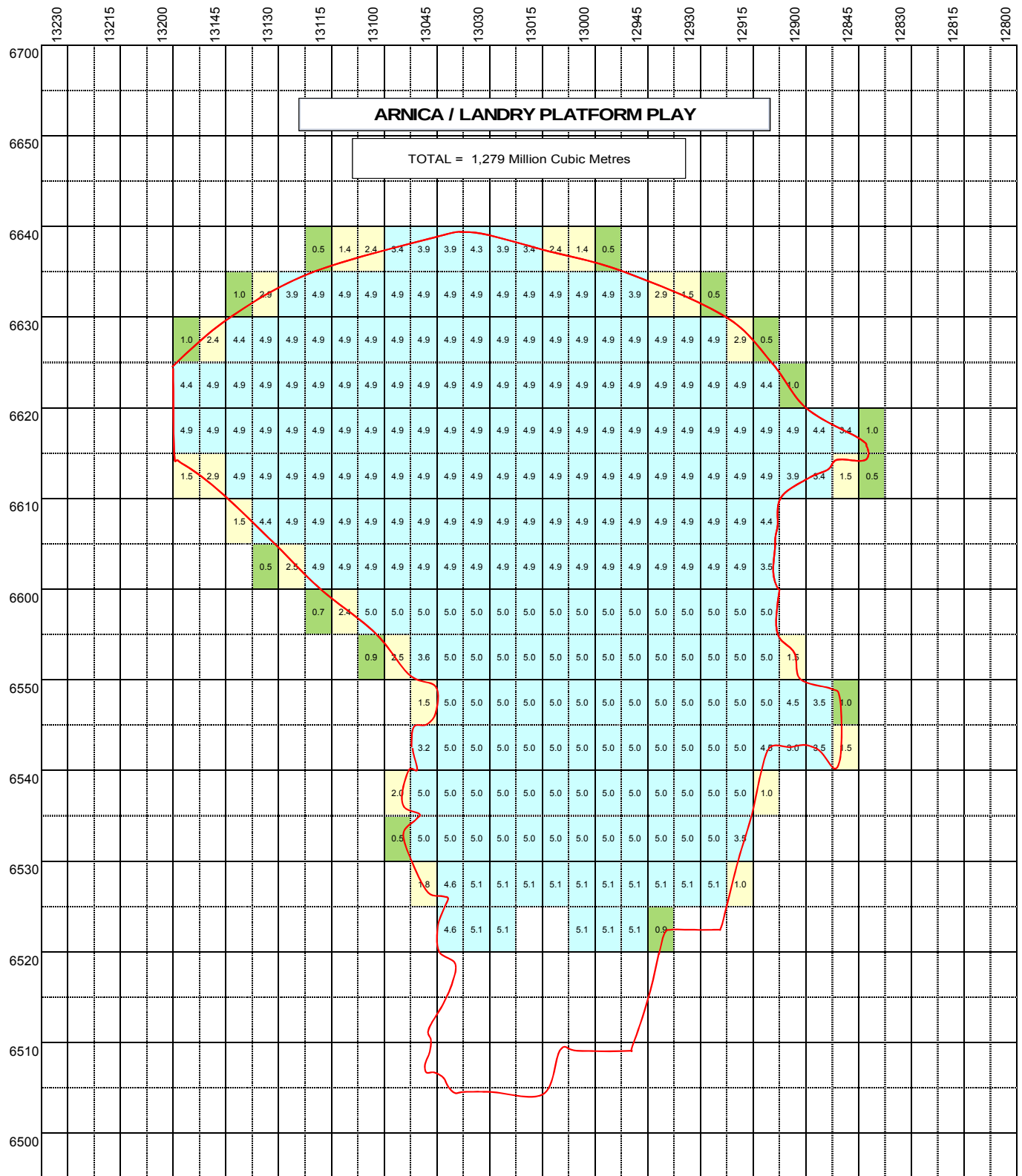
TS'UDE NILINE TU'EYETA
SUMMARY OF HYDROCARBON PLAY (ENTIRE SAHTU SETTLEMENT AREA)

(Adapted from Gal and Jones, (2003), Gal (2005, 2007))

Play ID	ArnL
Play Name	Arnica/Landry Platform
Play Description	Three play areas. Play Area 1 is the established play of the Summit Creek area. Area 3 is the in the Great Bear depression to the east, and Play Area 2 is the broad platform area extending to the north of the Mackenzie Plain into the Peel Basin and Anderson Plain. The Ts'ude niline Tu'eyeta Candidate Protected area is in play area 2.
References	Gal, 2005, 2007; Hansen et al, 2005; Pugh, 1983; Pyle and Gal, 2007; Gal et. al., 2009b (Peel volume chapter 6).
Reservoir Unit	Dolomitic Arnica/Landry formations, possible Peel and Bear Rock formations.
Distribution	Eastern boundary is outcrop/subcrop limit and/or facies change, south boundary is limit of deposition, west boundary is outcrop.
Source/Seal	Fort Norman Fm, possibly Road River, Hare Indian (Bluefish member), Canol, Hume, Headless and Funeral fms/ Headless Fm top seal, lateral seal Chinchaga Fm
Trap Style	Stratigraphic/diagenetic-post depositional leaching (sub-aerial exposure) has improved/created reservoir characteristics for Landry; local primary and secondary porosity in Arnica; possible minor buildups in platform; fracturing may also enhance reservoir characteristics; updip pinchouts, drape over Sub-Devonian unconformity, structural traps.
Gas/Oil	Gas, some oil
Exploration Risks	Top seals very risky (fractured); moderate reservoir quality; isolation from hydrocarbon charge
Mapped Area	8.222 Million Ha (20.316 Million Acres)
Significant fields/wells	Summit Creek B-44 oil, gas, condensate discovery, located in the Mackenzie Plain of the Sahtu Settlement Area.
Discovered Resources	1 Oil, Gas and Condensate Field.
Undiscovered Recoverable Gas	18,509 Million cubic metres (656.94 Bcf)
Undiscovered Marketable Gas	16,731 Million cubic metres (593.83 Bcf)
Undiscovered Recoverable Oil	10.49 million cubic metres (66.02 MMB)

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS (10^6 m^3 /QUARTER GRID)



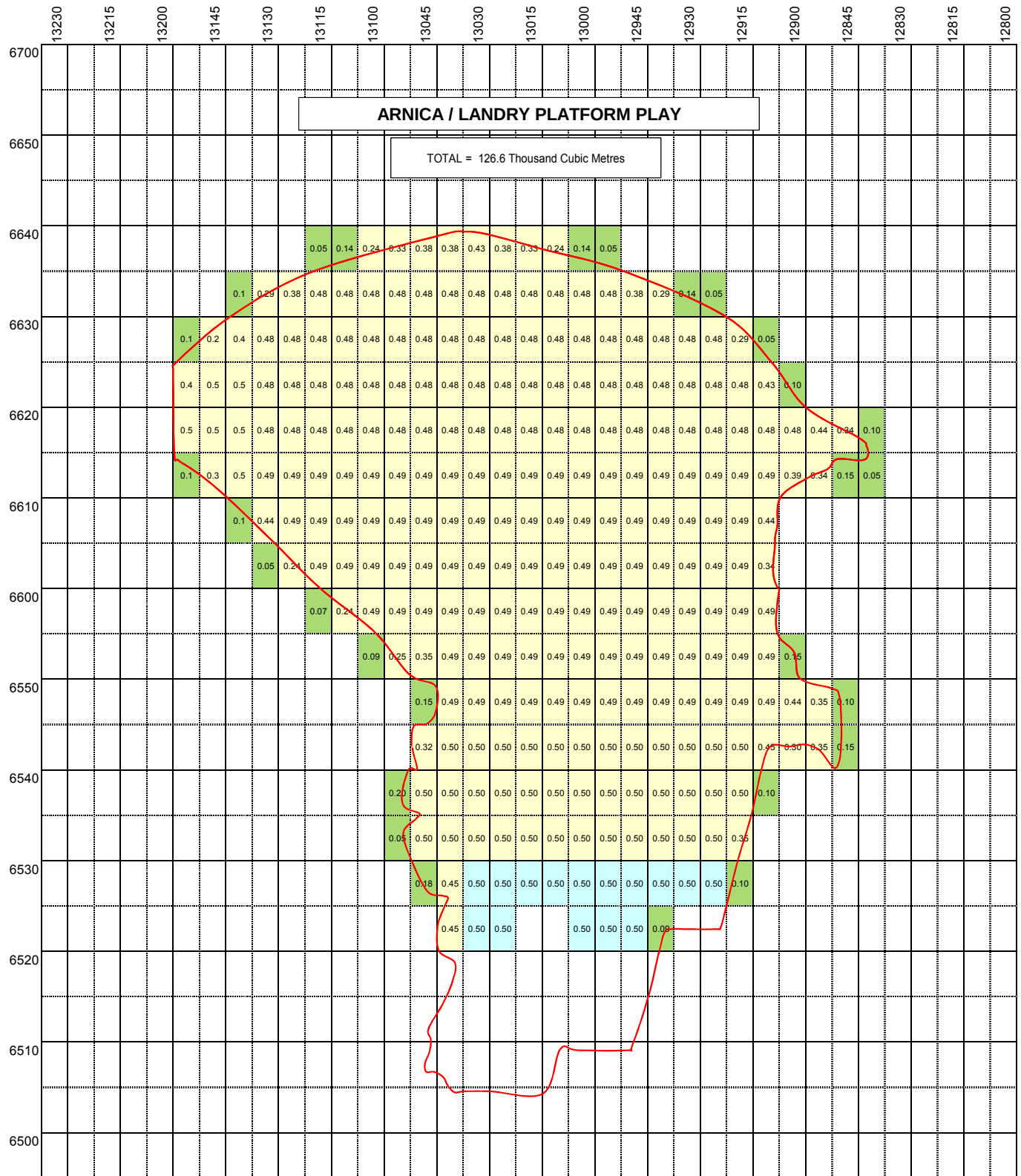
ARNICA / LANDRY PLATFORM PLAY

TOTAL = 45.4 Billion Cubic Feet

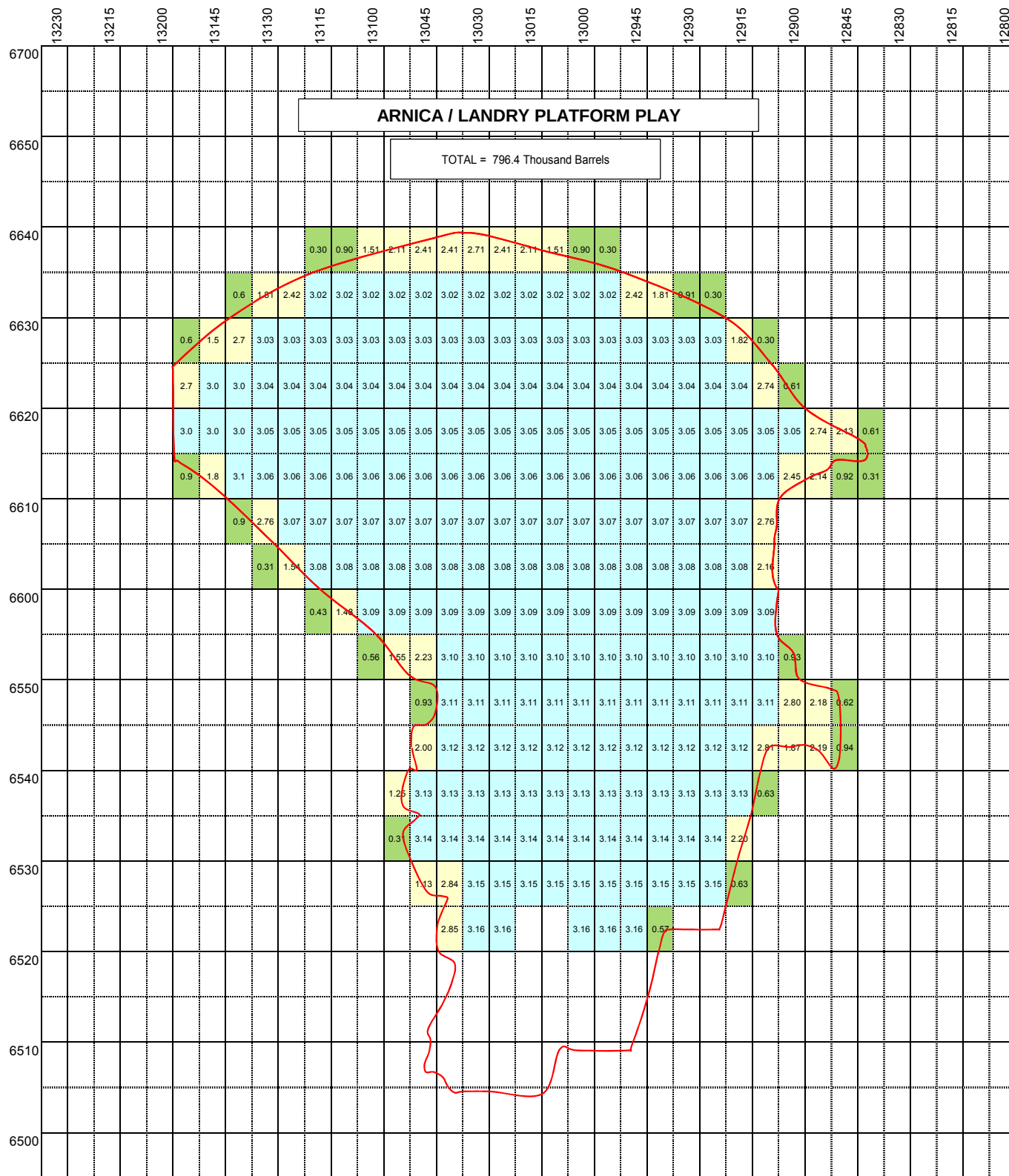
The map displays a grid of cells with numerical values, likely representing resource estimates. The grid is bounded by coordinates 13230 to 12800 on the x-axis and 6700 to 6500 on the y-axis. The cells are colored in shades of green, yellow, and cyan, representing different geological or resource categories. A red line outlines the main play area, with some cells outside the line also containing values.



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE OIL (10^3m^3 /QUARTER GRID)



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE OIL (MB/QUARTER GRID)

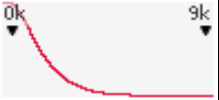
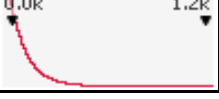
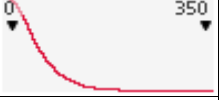
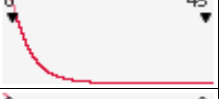


@RISK Output Results

Performed By: Ken Drummond

Date: March 2, 2010 10:26:42 AM

Ts'ude niline Tu'eyeta Undiscovered Resource Arnica / Landry

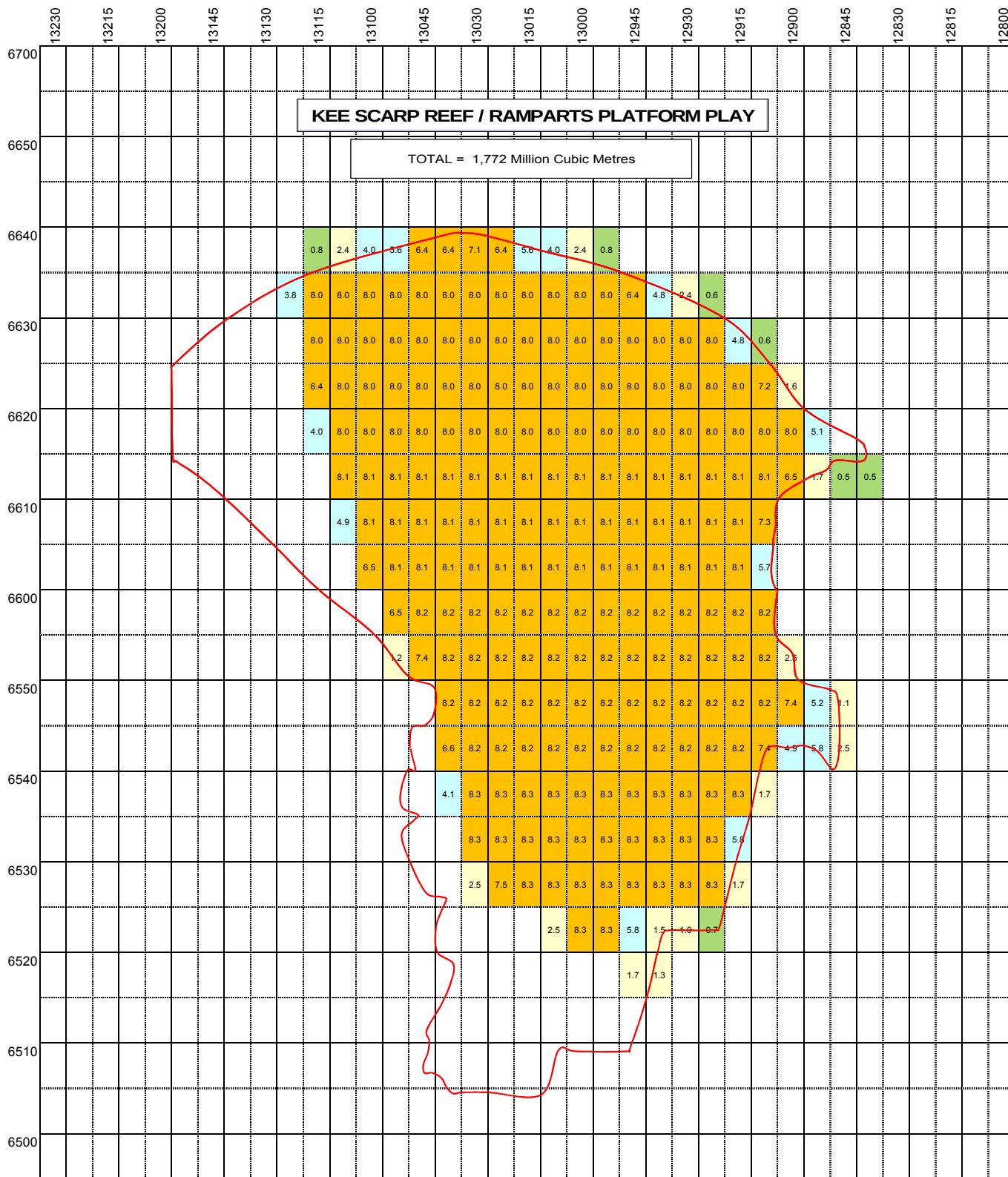
Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Arnica / landry (Metric units)								
GAS IN PLACE (E6m3)	ArnL2GStot	B18		1,811.776	1,555.169	1,092.611	685.582	3,269.170
RECOVERABLE GAS (E6m3)	ArnL2GStot	B19		1,278.783	1,099.116	773.910	477.498	2,320.600
MARKETABLE GAS (E6m3)	ArnL2GStot	B20		1,164.602	1,000.747	704.774	434.804	2,113.141
OIL IN PLACE (E3m3)	ArnL2GStot	B21		843.659	672.510	621.910	260.998	1,638.747
RECOVERABLE OIL (E3m3)	ArnL2GStot	B22		126.558	100.026	94.764	38.849	247.375
Range: Ts'ude niline Tu'eyeta Arnica / Landry (Imperial units)								
GAS IN PLACE (BCF)	ArnL2GStot	B11		64.307	55.199	38.781	24.334	116.035
RECOVERABLE GAS (BCF)	ArnL2GStot	B12		45.389	39.012	27.469	16.948	82.367
MARKETABLE GAS (BCF)	ArnL2GStot	B13		41.336	35.520	25.015	15.433	75.003
OIL IN PLACE (MMB)	ArnL2GStot	B14		5.309	4.232	3.914	1.642	10.312
RECOVERABLE OIL (MMB)	ArnL2GStot	B15		0.796	0.629	0.596	0.244	1.557

TS'UDE NILINE TU'EYETA
SUMMARY OF HYDROCARBON PLAY (ENTIRE SAHTU SETTLEMENT AREA)

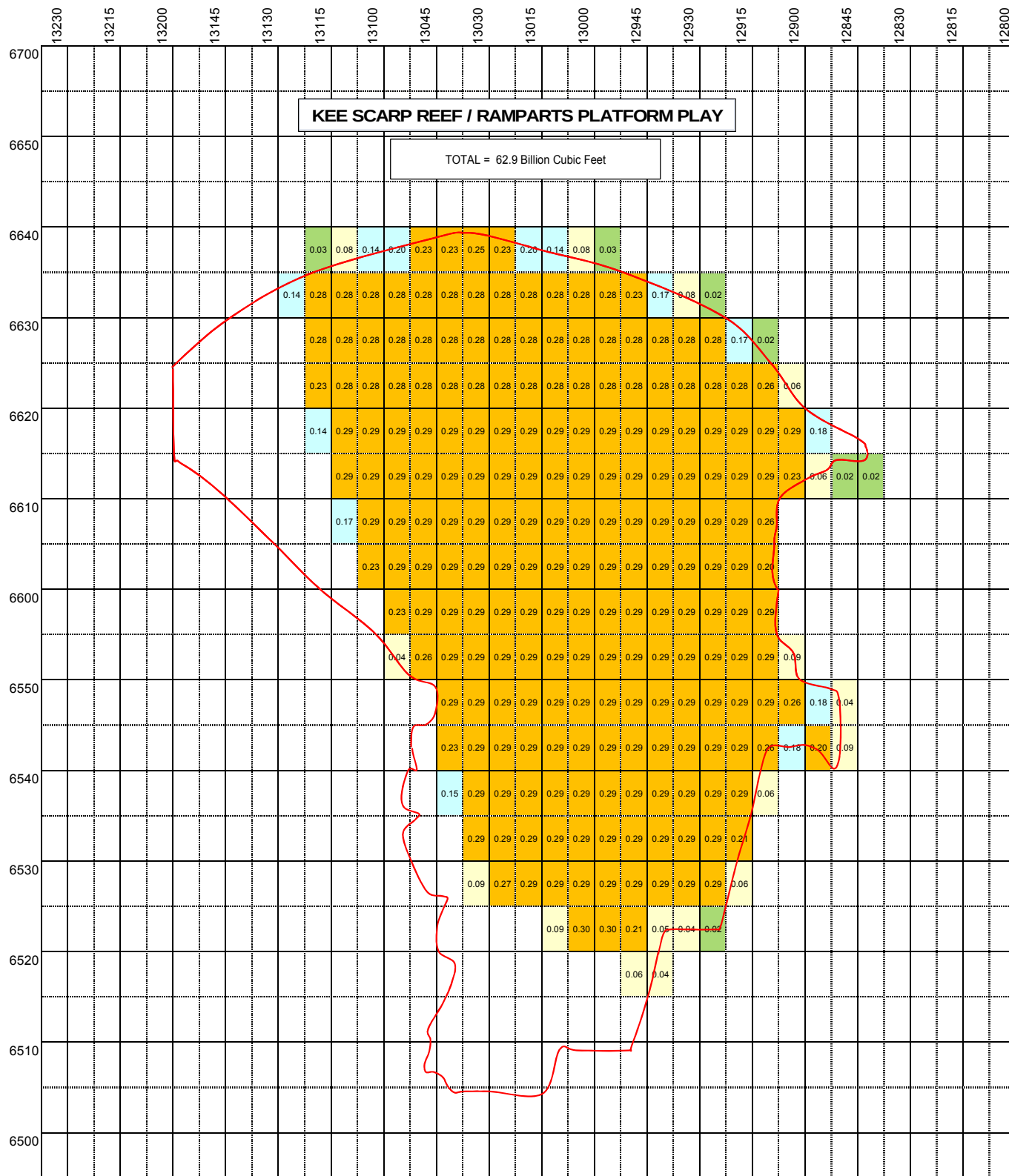
(Adapted from Gal and Jones, (2003), Gal (2005, 2007))

Play ID	KeeSc
Play Name	Kee Scarp/Ramparts
Play Description	The Kee Scarp (reefal facies of Ramparts Formation) play includes an established play with known and possible Kee Scarp reef development, including Norman Wells and a conceptual play, the regional extent of the Ramparts Formation subcrop.
References	Gal, 2005, 2007; Williams, 1985; Fischbuch, 1984; Gal, et.al., 2009b (Peel volume chapter 6).
Reservoir Unit	Kee Scarp reefal facies (includes Hume Formation), Ramparts platform.
Distribution	The play boundaries are erosional edges and outcrop in the east and southwest (Williams, 1985), and facies limits in the northwest and south.
Source/Seal	Canol, Hare Indian
Trap Style	Kee Scarp reef development, structural traps near mountain front.
Gas/Oil	Oil (with associated gas)
Exploration Risks	Reef development
Mapped Area	3.922 Million Ha (9.693 Million Acres)
Significant fields/wells	Norman Wells oil field in the Mackenzie Plain of the Sahtu.
Discovered Resources	1 Oil Field - 48 cubic metres (301.60 MB) recoverable oil.
Undiscovered Recoverable Gas	7,028 Million cubic metres (249.44 Bcf)
Undiscovered Marketable Gas	6,609 Million cubic metres (234.57 Bcf)
Undiscovered Recoverable Oil	19.66 million cubic metres (123.72 MMB)

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE GAS (106m3/QUARTER GRID)

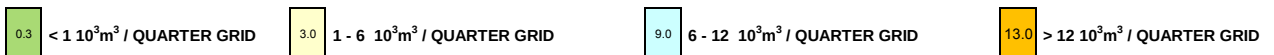
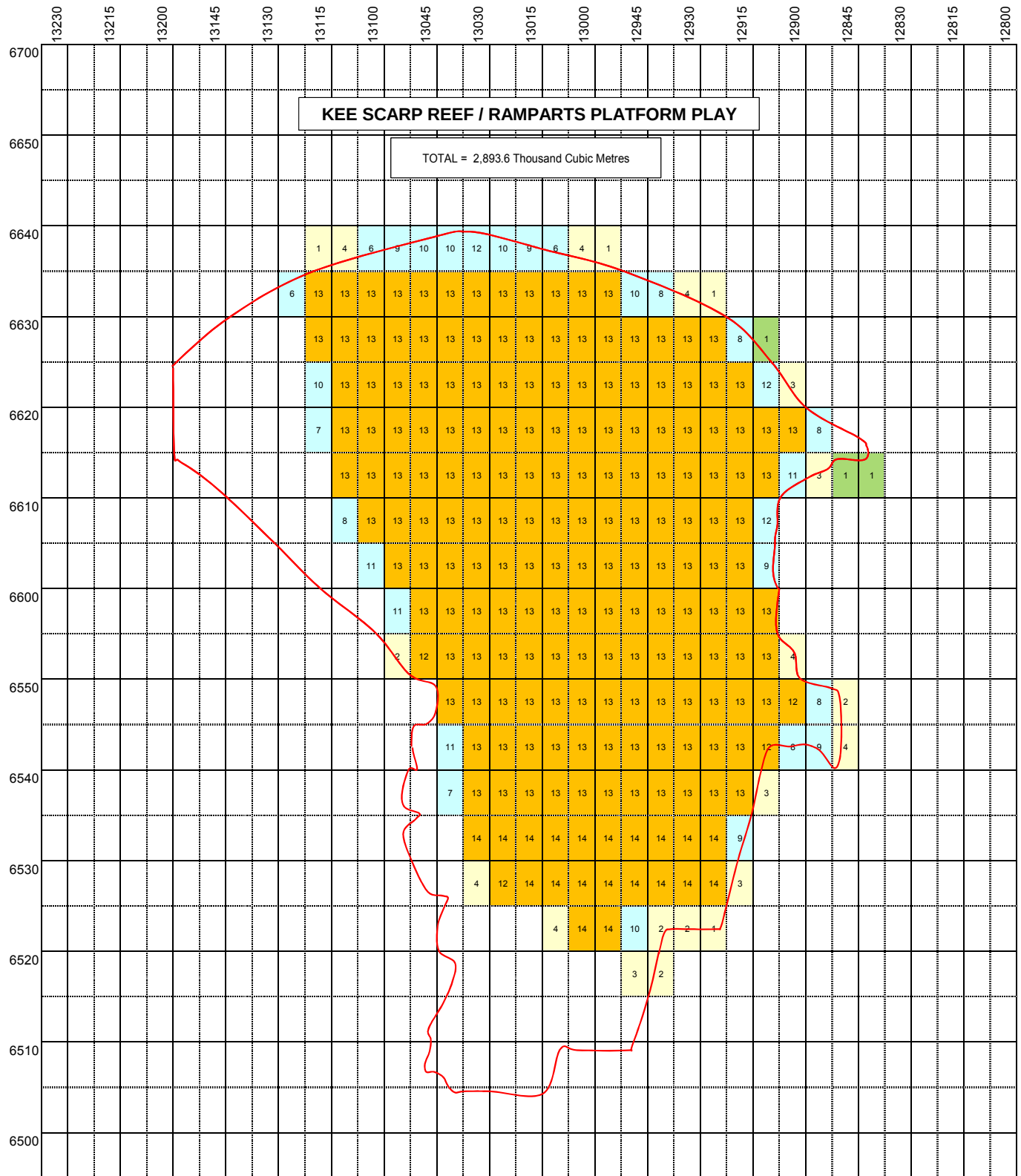


TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE GAS (BCF/QUARTER GRID)

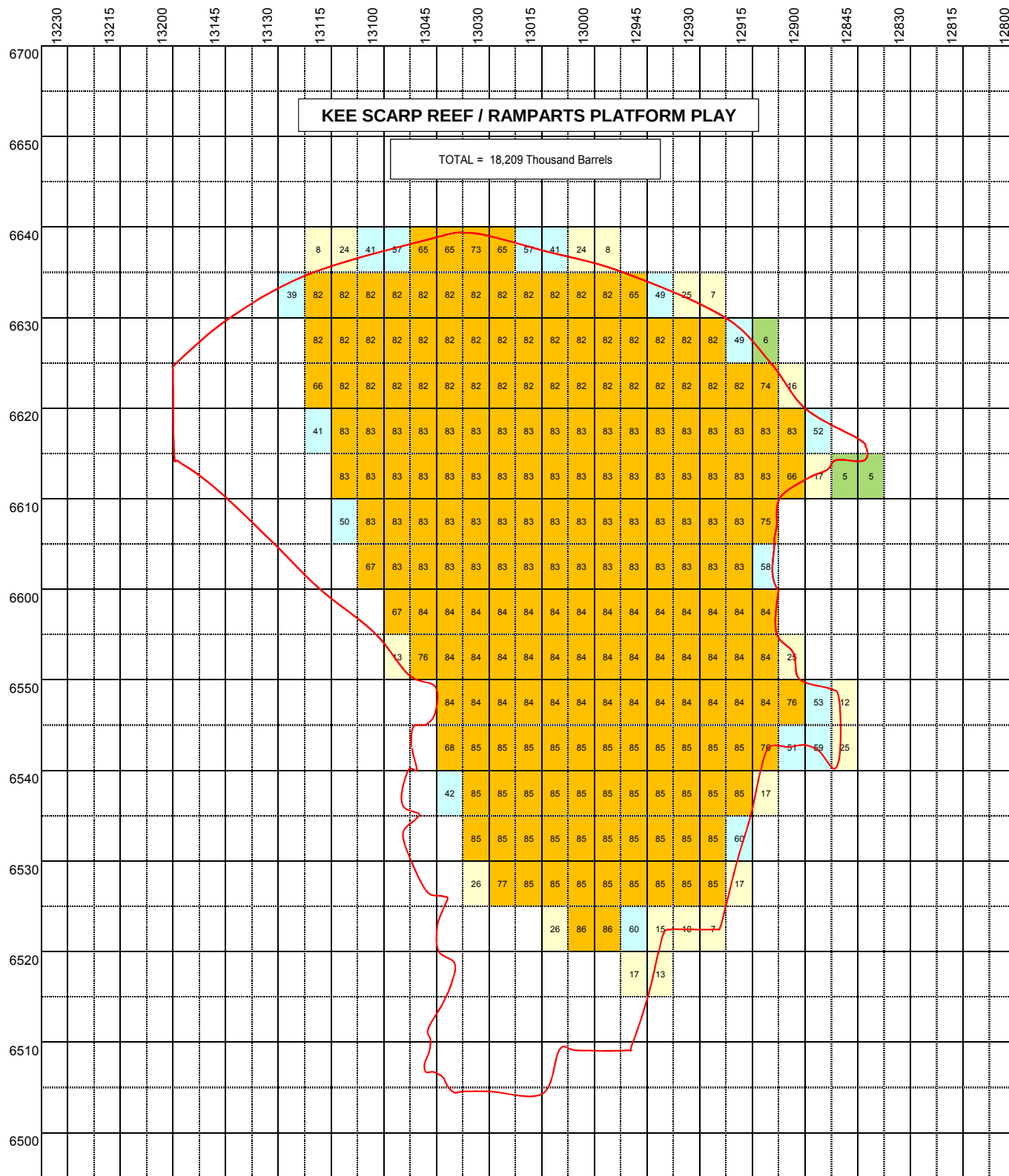


TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE OIL (10^3m^3 /QUARTER GRID)



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE OIL (MB/QUARTER GRID)



3.0

< 6 MB / QUARTER GRID

12.0

6 - 30 MB / QUARTER GRID

42.0

30 - 60 MB / QUARTER GRID

63.0

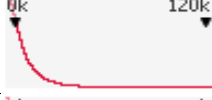
> 60 MB / QUARTER GRID

@RISK Output Results

Performed By: Ken Drummond

Date: March 2, 2010 8:53:52 AM

**Ts'ude niline Tu'eyeta Undiscovered Resource
Kee Scarp / Ramparts**

Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Kee Scarp Play 2 (Metric units)								
GAS IN PLACE (E6m3)	GS_KeeSc2	B24		2,887.490	2,296.804	2,130.785	897.186	5,617.046
RECOVERABLE GAS (E6m3)	GS_KeeSc2	B25		1,772.392	1,396.766	1,338.137	540.698	3,494.585
MARKETABLE GAS (E6m3)	GS_KeeSc2	B26		1,659.097	1,308.306	1,251.072	506.546	3,272.938
OIL IN PLACE (E3m3)	GS_KeeSc2	B27		10,863.210	8,374.965	8,780.024	3,146.381	21,804.900
RECOVERABLE OIL (E3m3)	GS_KeeSc2	B28		2,893.643	2,193.808	2,400.241	823.775	5,850.779
Range: Ts'ude niline Tu'eyeta Kee Scarp Play 2 (Imperial units)								
GAS IN PLACE (BCF)	GS_KeeSc2	B17		102.488	81.522	75.630	31.844	199.370
RECOVERABLE GAS (BCF)	GS_KeeSc2	B18		62.909	49.576	47.495	19.191	124.036
MARKETABLE GAS (BCF)	GS_KeeSc2	B19		58.887	46.437	44.405	17.979	116.169
OIL IN PLACE (MMB)	GS_KeeSc2	B20		68.361	52.702	55.252	19.800	137.215
RECOVERABLE OIL (MMB)	GS_KeeSc2	B21		18.209	13.805	15.104	5.184	36.818

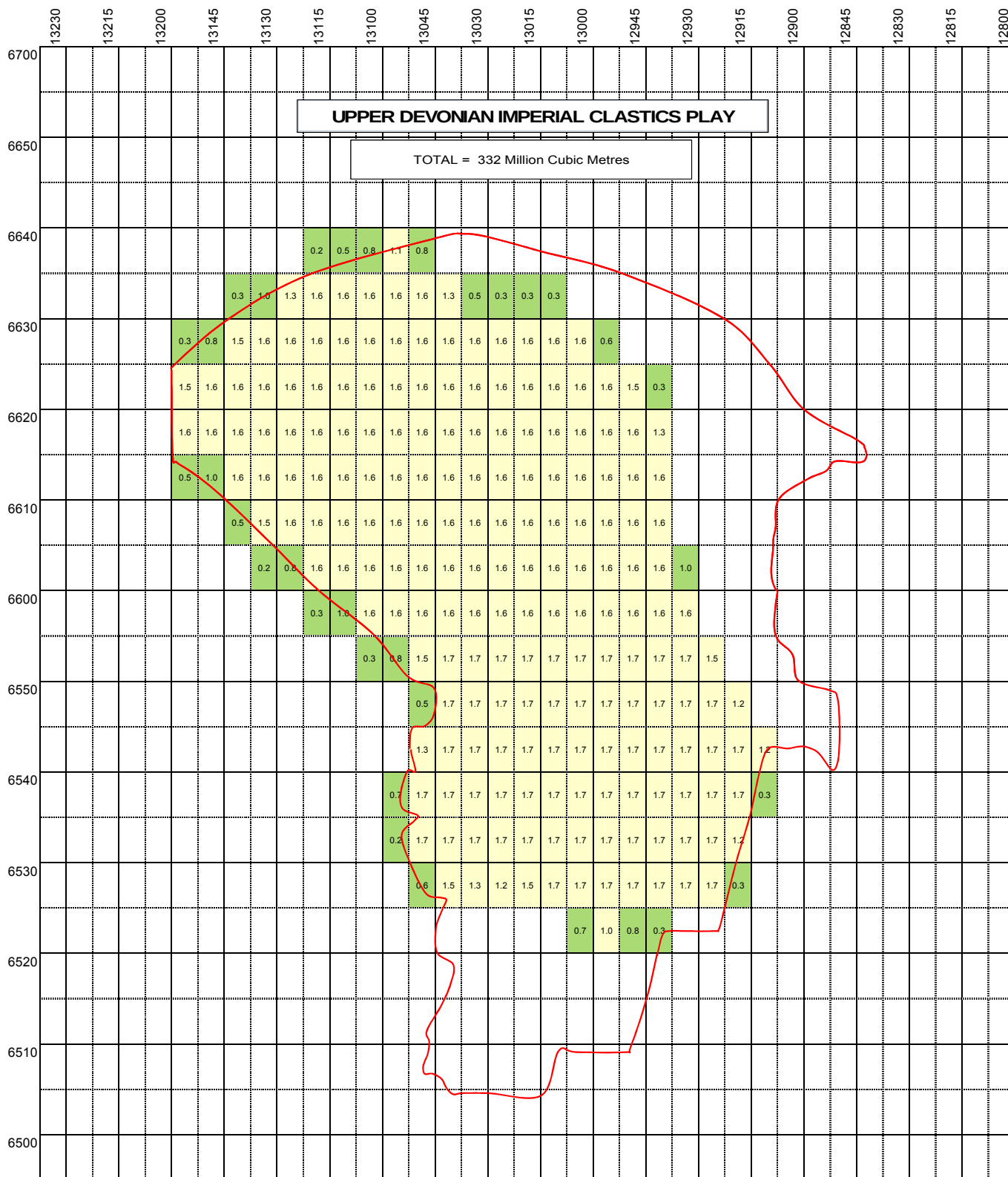
TS'UDE NILINE TU'EYETA
SUMMARY OF HYDROCARBON PLAY (ENTIRE SAHTU SETTLEMENT AREA)

(Adapted from Gal and Jones, (2003), Gal (2005, 2007))

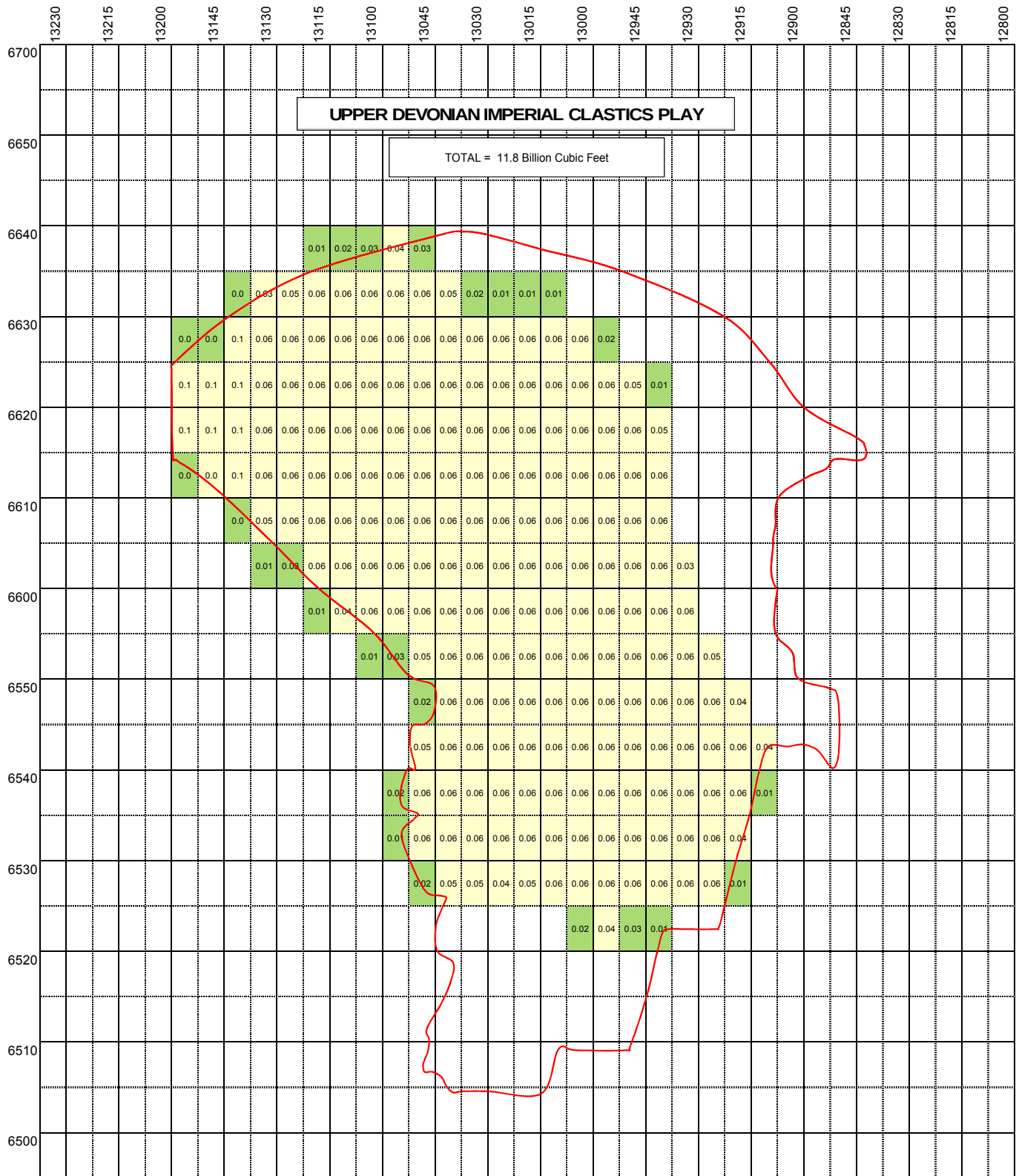
Play ID	Udev
Play Name	Upper Devonian Clastics
Play Description	The reservoirs are potential sandstones within the dominantly shale Imperial Formation.
References	Gal, 2005, 2007; Zantvoort, 2007: Hadlari et.al., 2009a (Peel volume chapter 7).
Reservoir Unit	Coarse grained clastics of the Imperial Formation
Distribution	The play is located primarily in the western part of the Sahtu Settlement Area, in the Mackenzie Plain and Peel Plain. It is limited to the northeast by the depositional edge.
Source/Seal	Imperial and Cretaceous shales
Trap Style	Structural and stratigraphic, onlap, pinchout, isolated sand bodies, facies related traps.
Gas/Oil	Gas
Exploration Risks	Breached reservoirs along the eastern edge.
Mapped Area	2.415 Million Ha (5.967 Million Acres)
Significant fields/wells	No recovery of hydrocarbons. Oil stain in samples and gas-cut mud on DST.
Discovered Resources	No Discoveries
Undiscovered Recoverable Gas	729 Million cubic metres (25.88 Bcf)
Undiscovered Marketable Gas	678 Million cubic metres (24.07 Bcf)
Undiscovered Recoverable Oil	Gas play only

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS (10^6m^3 /QUARTER GRID)



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE GAS (BCF/QUARTER GRID)

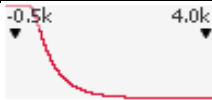
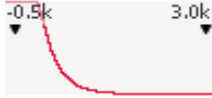
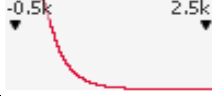
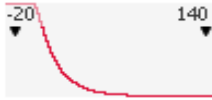


@RISK Output Results

Performed By: Ken Drummond

Date: March 2, 2010 11:55:28 AM

**Ts'ude niline Tu'eyeta Undiscovered Resource
Upper Devonian Clastics**

Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Upper Devonian Clastics (Metric units)								
GAS IN PLACE (E6m3)	RampartsUD ev1	B18		524.548	398.762	438.646	125.573	1093.593
RECOVERABLE GAS (E6m3)	RampartsUD ev1	B19		332.329	251.450	280.132	78.580	693.705
MARKETABLE GAS (E6m3)	RampartsUD ev1	B20		309.066	233.849	260.522	73.080	645.145
OIL IN PLACE (E3m3)	RampartsUD ev1	B21		0	0	0	0	0
RECOVERABLE OIL (E3m3)	RampartsUD ev1	B22		0	0	0	0	0
Range: Ts'ude niline Tu'eyeta Upper Devonian Clastics (Imperial units)								
GAS IN PLACE (BCF)	RampartsUD ev1	B11		18.618	14.154	15.569	4.457	38.816
RECOVERABLE GAS (BCF)	RampartsUD ev1	B12		11.796	8.925	9.943	2.789	24.622
MARKETABLE GAS (BCF)	RampartsUD ev1	B13		10.970	8.300	9.247	2.594	22.899
OIL IN PLACE (MMB)	RampartsUD ev1	B14		0	0	0	0	0
RECOVERABLE OIL (MMB)	RampartsUD ev1	B15		0	0	0	0	0

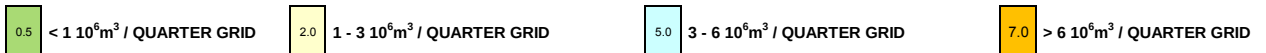
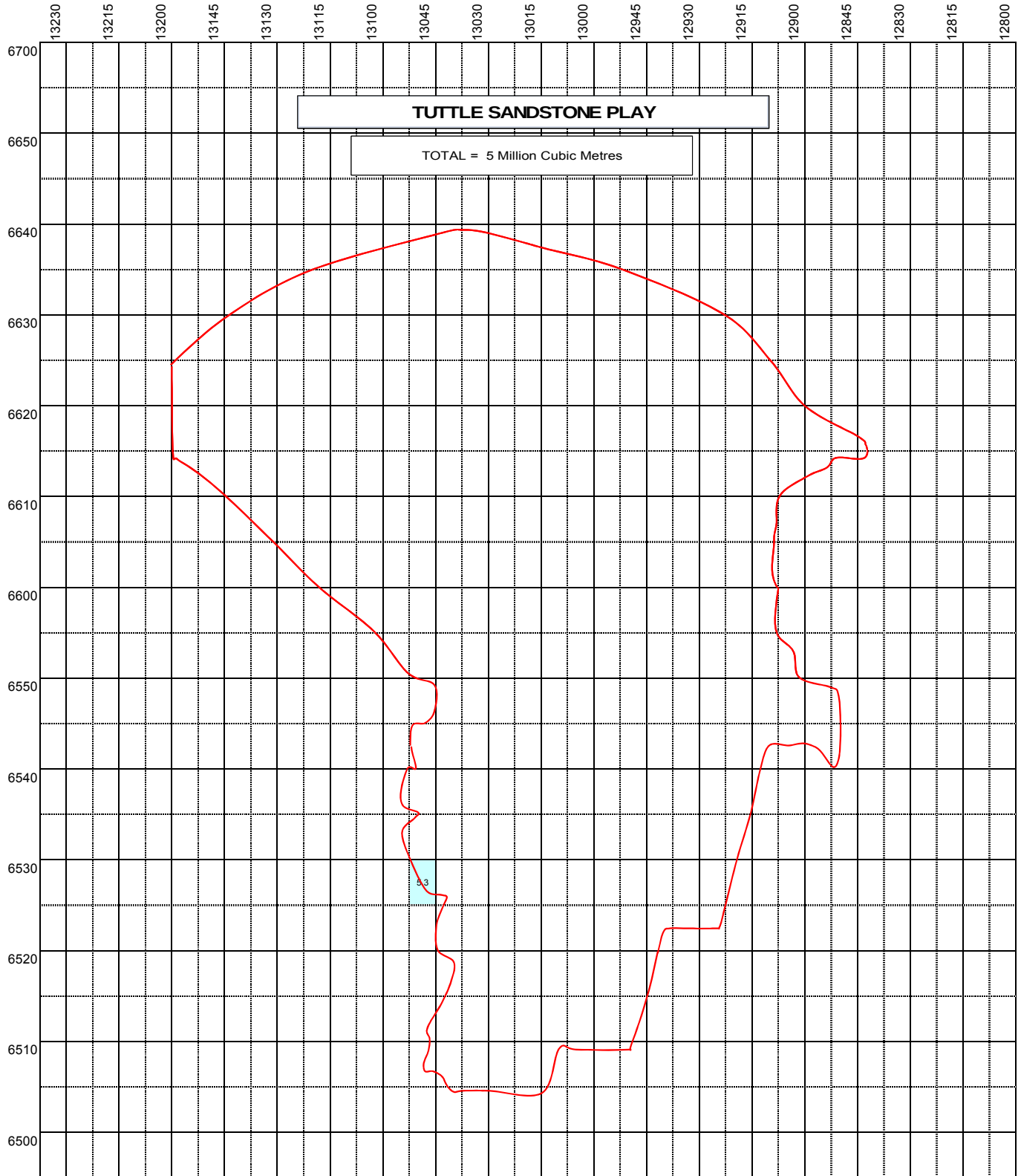
TS'UDE NILINE TU'EYETA
SUMMARY OF HYDROCARBON PLAY (ENTIRE SAHTU SETTLEMENT AREA)

(Adapted from Gal and Jones, (2003), Gal (2005, 2007))

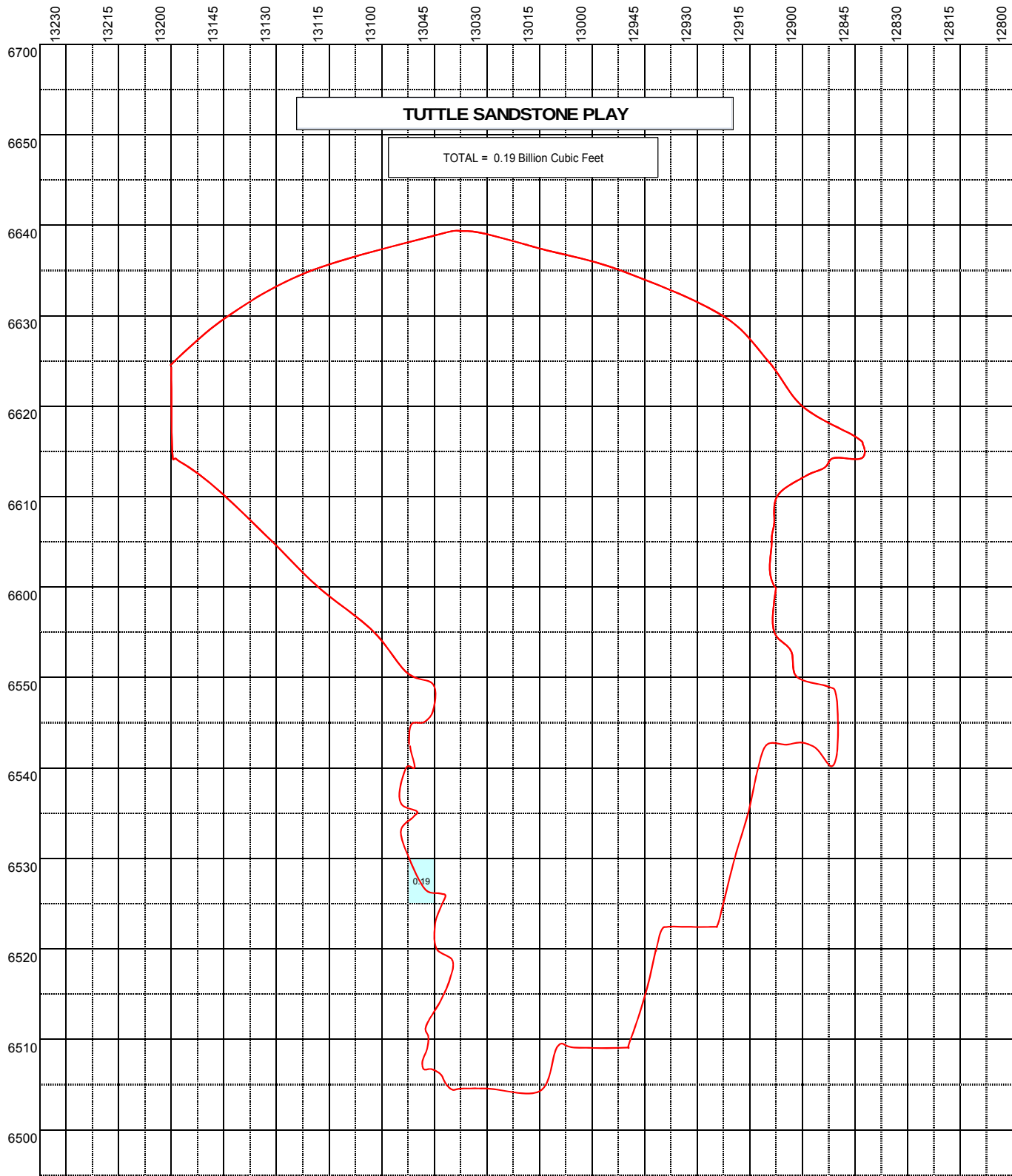
Play ID	Tutl
Play Name	Tuttle Formation
Play Description	The play includes sandstone reservoirs of the Mississippian Tuttle Formation in the western part of the Gwich'in Settlement Area. The play is mostly to the west of the Ts'ude niline Tu'eyeta Candidate Protected area, with only a small part in one quarter grid.
References	Gal, 2005, 2007; Lariviere and Gal, 2005; Fraser and Allen, 2007a; Fraser and Allen, 2007b; Allen et.al., 2009 (Peel volume chapter8).
Reservoir Unit	Tuttle Formation sandstone
Distribution	The Tuttle play occurs in the Gwich'in Settlement Area along the west, bordering the Yukon. The eastern limit is the subcrop of the Tuttle Formation.
Source/Seal	Imperial, Cretaceous shales, shales within Tuttle may be both source and seal.
Trap Style	Structural (folds, fault traps), Stratigraphic, channel sands, pinch-outs
Gas/Oil	Gas
Exploration Risks	Reservoir quality, trapping, and breaching of reservoir due to shallow depth.
Mapped Area	Not mapped in the Sahtu Settlement Area report
Significant fields/wells	Sainville D-08 gas to surface too small to measure. Gas has been discovered in the Eagle Plains in the Yukon to the west in the Birch and Chance fields.
Discovered Resources	No Discoveries
Undiscovered Recoverable Gas	Not assessed in the Sahtu Settlement Area report
Undiscovered Marketable Gas	Not assessed in the Sahtu Settlement Area report
Undiscovered Recoverable Oil	Not assessed in the Sahtu Settlement Area report

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS ($10^6 \text{m}^3/\text{QUARTER GRID}$)



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE GAS (BCF/QUARTER GRID)

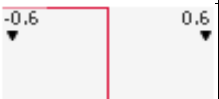


@RISK Output Results

Performed By: Ken Drummond

Date: March 2, 2010 12:16:15 PM

**Ts'ude niline Tu'eyeta Undiscovered Resource
Tuttle Clastics**

Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Tuttle Clastics (Metric units)								
GAS IN PLACE (E6m3)	GY_TutI	B18		7.797	6.376	5.378	2.554	14.971
RECOVERABLE GAS (E6m3)	GY_TutI	B19		5.331	4.356	3.701	1.730	10.242
MARKETABLE GAS (E6m3)	GY_TutI	B20		5.011	4.095	3.480	1.625	9.629
OIL IN PLACE (E3m3)	GY_TutI	B21		0	0	0	0	0
RECOVERABLE OIL (E3m3)	GY_TutI	B22		0	0	0	0	0
Range: Ts'ude niline Tu'eyeta Tuttle Clastics (Imperial units)								
GAS IN PLACE (BCF)	GY_TutI	B11		0.277	0.226	0.191	0.091	0.531
RECOVERABLE GAS (BCF)	GY_TutI	B12		0.189	0.155	0.131	0.061	0.363
MARKETABLE GAS (BCF)	GY_TutI	B13		0.178	0.145	0.124	0.058	0.342
OIL IN PLACE (MMB)	GY_TutI	B14		0	0	0	0	0
RECOVERABLE OIL (MMB)	GY_TutI	B15		0	0	0	0	0

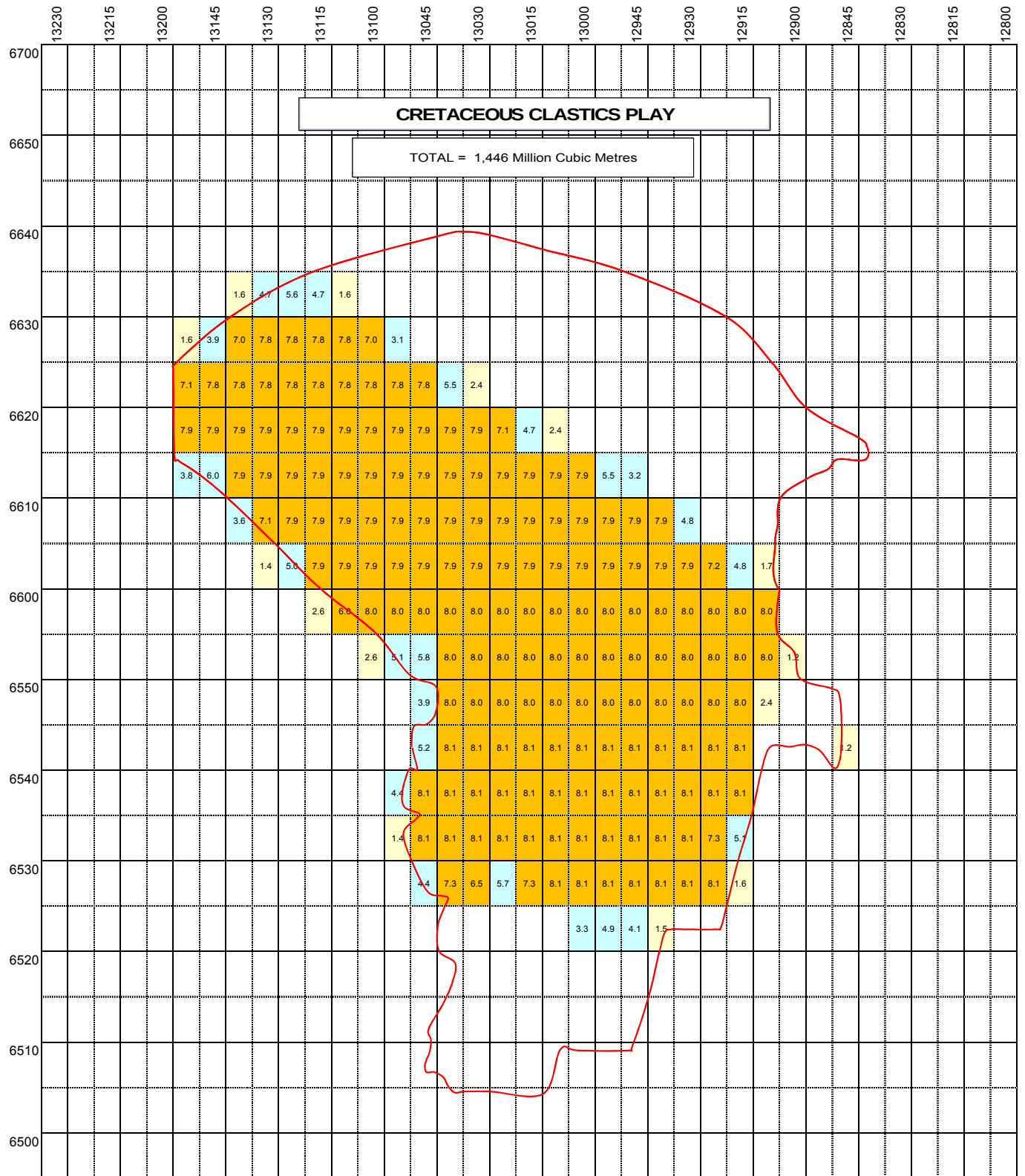
TS'UDE NILINE TU'EYETA
SUMMARY OF HYDROCARBON PLAY (ENTIRE SAHTU SETTLEMENT AREA)

(Adapted from Gal and Jones, (2003), Gal (2005, 2007))

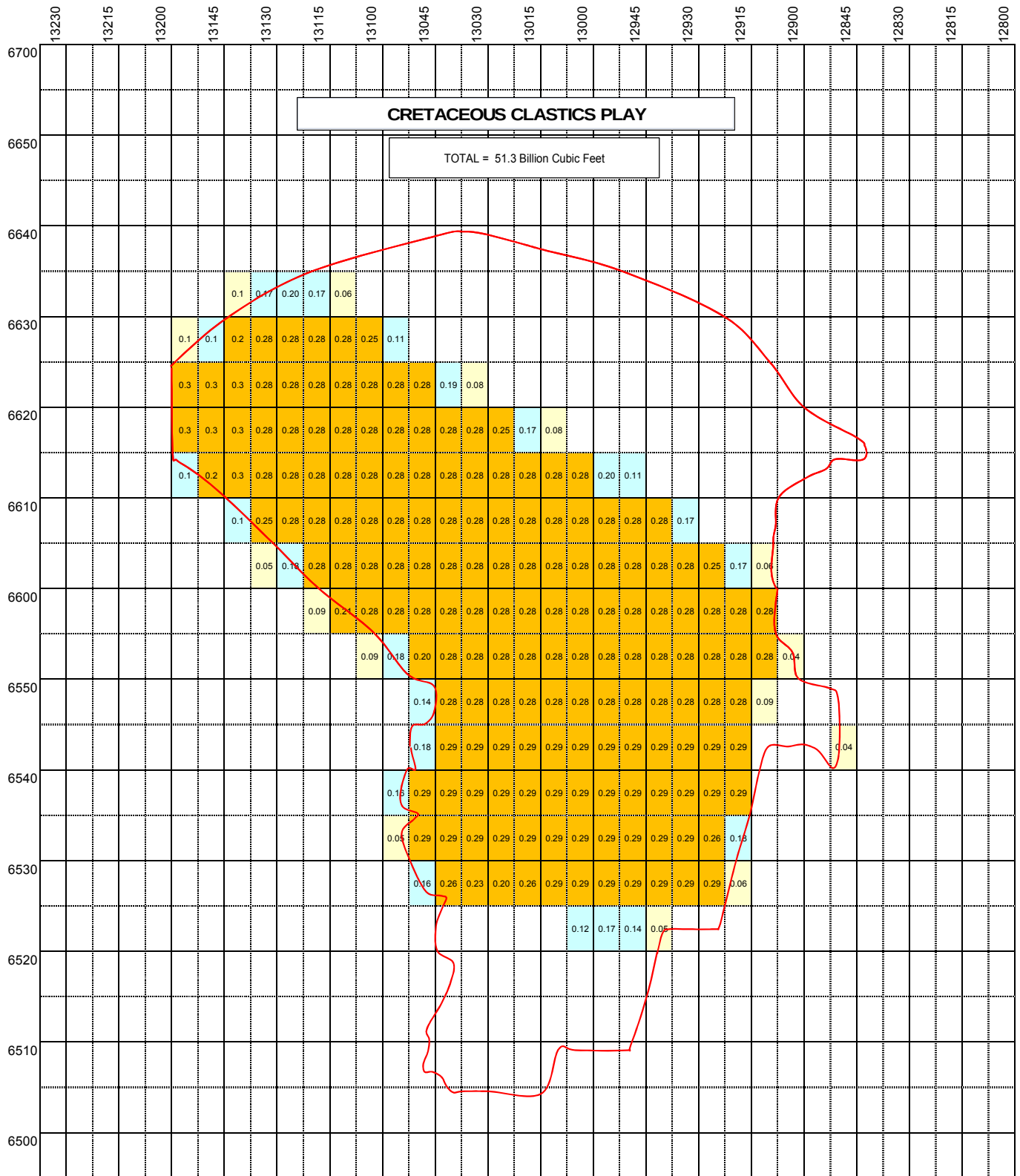
Play ID	Cret
Play Name	Cretaceous Clastics
Play Description	Cretaceous clastics occur in three play areas. Play Area 1 is the Peel Trough; Play Area 3 is the Mackenzie Plain; Play Area 4 is in the Great Bear Basin. The Ts'ude niline Tu'eyeta Candidate Protected area is in play area 1.
References	Gal, 2005, 2007; Dixon, 1999; Hadlari, 2006; Hadlari and Zantvoort, 2007; Hadlari, et.al., 2009b (Peel volume chapter 9).
Reservoir Unit	Lower Cretaceous fluvial and shallow marine clastics. Includes sandstones in the Martin House, Arctic Red, Trevor, and basal Slater River formations.
Distribution	Play areas defined by depositional and erosional edges within major depressions.
Source/Seal	Shales of the Arctic Red River Formation possibly both source and seal. Additional source may be the Star River Formation and from formations below the sub-Cretaceous unconformity.
Trap Style	Stratigraphic-valley fill, channel fill, near-shore sands on pre-Cretaceous unconformity
Gas/Oil	Gas (non-associated), minor oil
Exploration Risks	Breaching; reservoir quality
Mapped Area	5.646 Million Ha (13.953 Million Acres)
Significant fields/wells	East Mackay B-45 recovered oil from Paleozoic rocks immediately below the Cretaceous unconformity.
Discovered Resources	No Discoveries
Undiscovered Recoverable Gas	5,261 Million cubic metres (186.73 Bcf)
Undiscovered Marketable Gas	4,894 Million cubic metres (173.70 Bcf)
Undiscovered Recoverable Oil	0.55 Million cubic metres (3.48 MMB)

TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE GAS (10^6m^3 /QUARTER GRID)

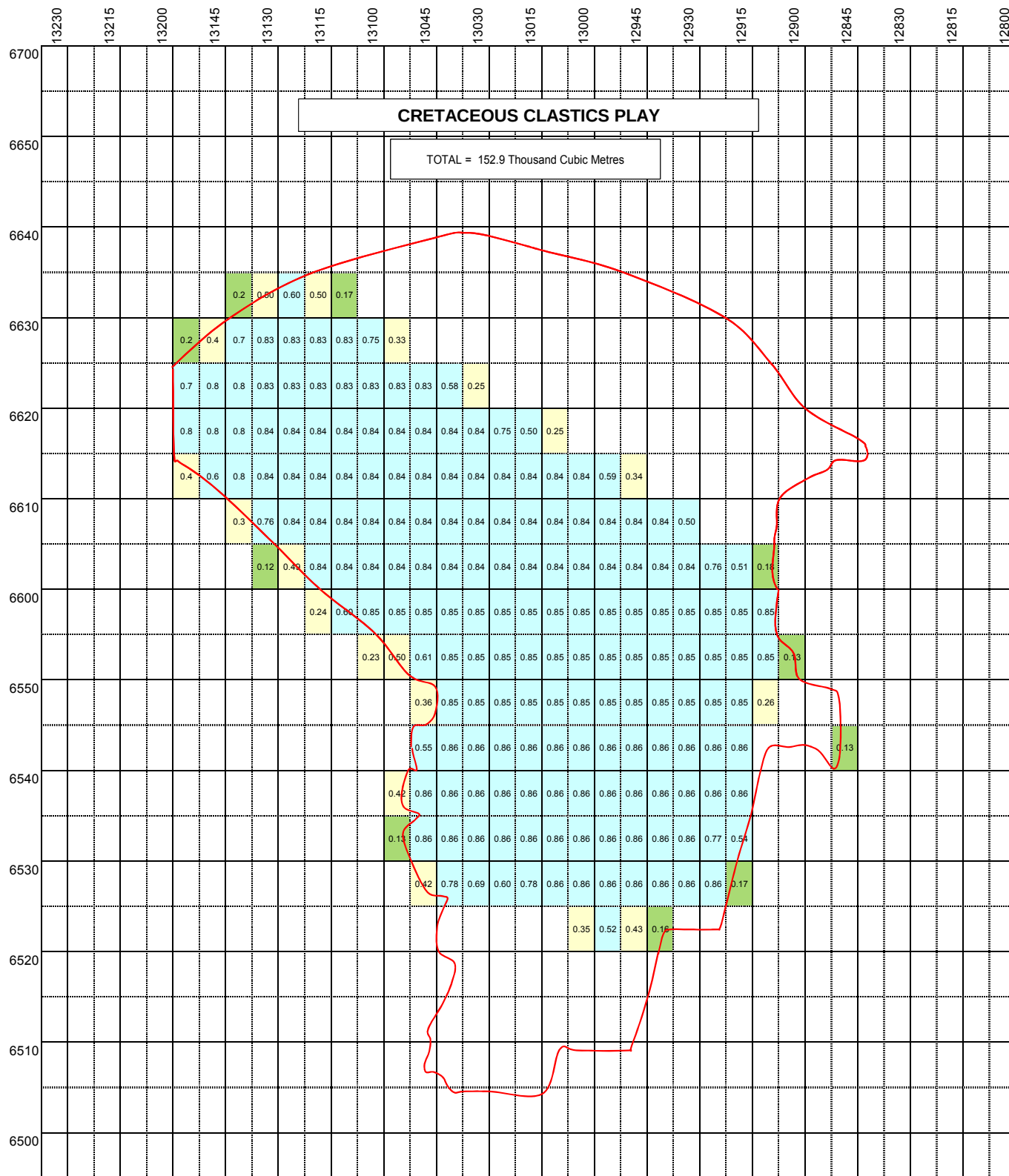


TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE GAS (BCF/QUARTER GRID)

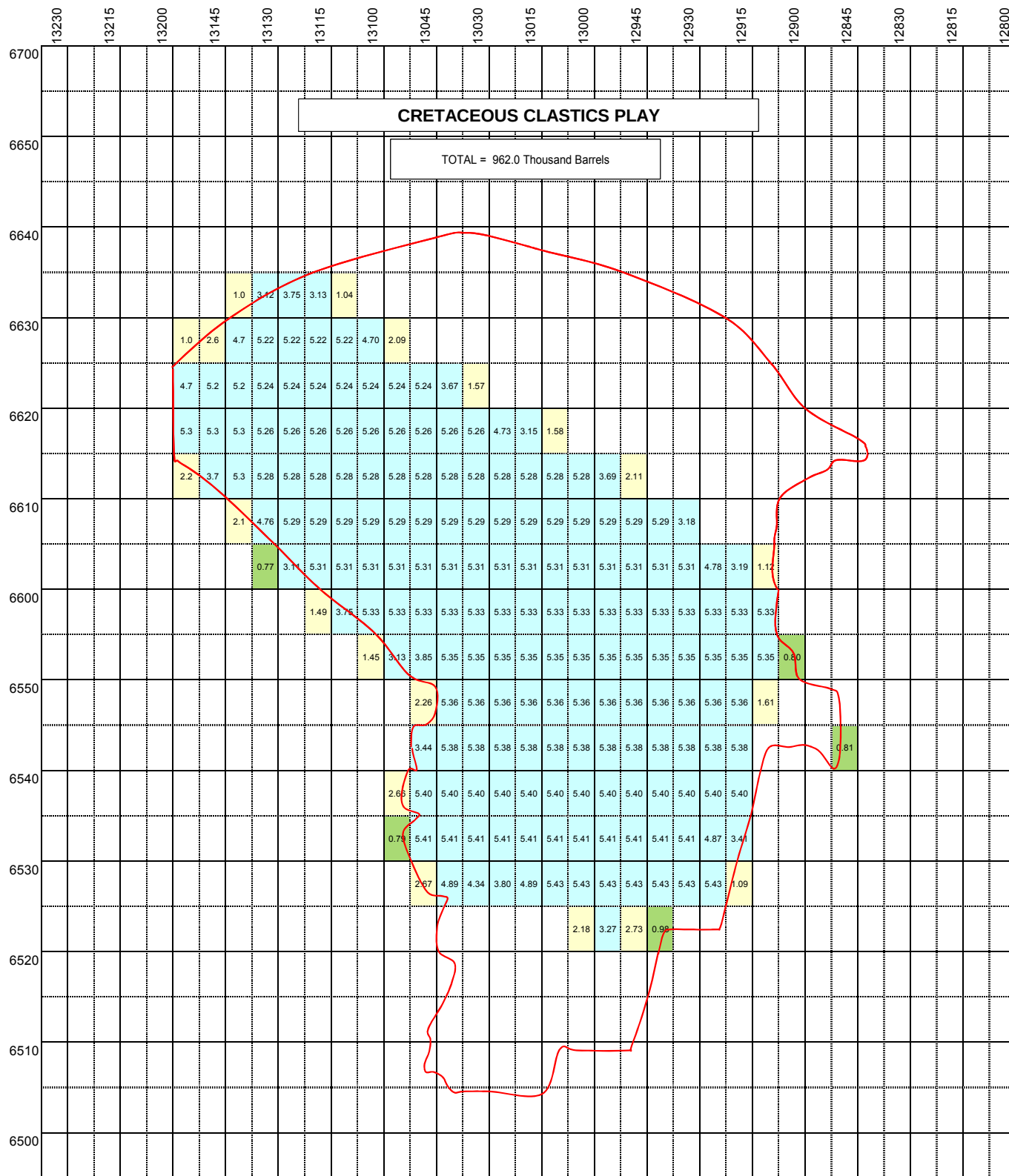


TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA

UNDISCOVERED RECOVERABLE OIL (10^3m^3 /QUARTER GRID)



TS'UDE NILINE TU'EYETA CANDIDATE PROTECTED AREA
UNDISCOVERED RECOVERABLE OIL (MB/QUARTER GRID)

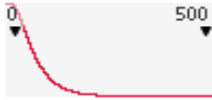


@RISK Output Results

Performed By: Ken Drummond

Date: March 2, 2010 1:37:18 PM

**Ts'ude niline Tu'eyeta Undiscovered Resource
Cretaceous Clastics**

Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ts'ude niline Tu'eyeta Cretaceous Clastics (Metric units)								
GAS IN PLACE (E6m3)	RampartsCret1	B18		2059.6960	1763.2130	1241.5240	798.7428	3712.7660
RECOVERABLE GAS (E6m3)	RampartsCret1	B19		1445.5470	1233.0730	882.3695	555.1889	2608.4010
MARKETABLE GAS (E6m3)	RampartsCret1	B20		1344.6640	1147.2270	820.7734	516.4064	2426.1290
OIL IN PLACE (E3m3)	RampartsCret1	B21		916.0090	741.7459	668.3809	286.5941	1763.8630
RECOVERABLE OIL (E3m3)	RampartsCret1	B22		152.8748	121.7717	115.8176	45.5367	300.1814
Range: Ts'ude niline Tu'eyeta Cretaceous Clastics (Imperial units)								
GAS IN PLACE (BCF)	RampartsCret1	B11		73.1063	62.5830	44.0663	28.3504	131.7799
RECOVERABLE GAS (BCF)	RampartsCret1	B12		51.3079	43.7664	31.3186	19.7058	92.5819
MARKETABLE GAS (BCF)	RampartsCret1	B13		47.7271	40.7194	29.1323	18.3292	86.1124
OIL IN PLACE (MMB)	RampartsCret1	B14		5.7643	4.6677	4.2060	1.8035	11.0998
RECOVERABLE OIL (MMB)	RampartsCret1	B15		0.9620	0.7662	0.7288	0.2865	1.8889

Appendix II

Resource Estimation Using @RISK with Excel

Undiscovered resource estimation is done using the Palisade Corporation @Risk add-in for Excel. The probabilistic methodology used has been adapted from Roadifer (1979). The methodology requires a set of input variables, which are sampled using a random sampling method such as Monte Carlo. The Monte Carlo simulation uses a range of input parameters to give a distribution of results. A probabilistic estimate of resources can be achieved by multiplying computer-generated numbers for volume, yield and risk (probability of success). The variable input parameters for the undiscovered resource methodology is summarized as follows:

Hydrocarbon Volume	Untested Play Area
Areal	Fraction of Untested Play Area in Trap
Average	Fill of Traps
	Net Pay
Yield	Porosity
Hydrocarbon	Saturation
Recovery	Factor
Risk	Probability of Hydrocarbons

$$\text{Hydrocarbon Volume} \times \text{Yield} \times \text{Risk} = \text{Undiscovered Resource}$$

@RISK

The @RISK program is an add-in, which adds simulation analysis capabilities to the Excel spreadsheet. It allows the user to define uncertain cell values as probability distribution functions in Excel. There are numerous distribution functions available, including triangular, lognormal, beta, cumulative, etc. The functions are entered for all the variables, as net pay, porosity, area, recovery factor, etc, used in the oil or gas equation. The equations for oil and gas, multiplying all the various variables, are entered into cells, which are designated as the output for @RISK. The program will then execute a Monte Carlo, or Latin Hypercube simulation a specified number of iterations (e.g. 5,000), and generate a cumulative frequency distribution, to give a range of probabilities for resource estimates. The program utilizes the graphics capabilities of Excel to generate graphical output for the results.

Probability Distribution Functions

Any number of distribution functions can be used for the various variables used in the template. The triangular distribution, which is the easiest to understand, was used for this study. The triangular distribution requires estimates of, minimum, maximum, and most likely, for each of the parameters.