

Input-Form Data for the U.S. Geological Survey Assessment of the Devonian and Mississippian Bakken and Devonian Three Forks Formations of the U.S. Williston Basin Province, 2013

By U.S. Geological Survey Bakken-Three Forks Assessment Team

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Input-Form Data for the U.S. Geological Survey Assessment of the Devonian and Mississippian Bakken and Devonian Three Forks Formations of the U.S. Williston Basin Province, 2013

By U.S. Geological Survey Bakken-Three Forks Assessment Team:

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Introduction

In 2013, the U.S. Geological Survey (USGS) assessed the technically recoverable oil and gas resources of the Bakken and Three Forks Formations of the U.S. portion of the Williston Basin (Gaswirth and others, 2013). The Bakken and Three Forks Formations were assessed as continuous and hypothetical conventional oil accumulations using a methodology similar to that used in the assessment of other continuous- and conventional-type assessment units (AUs) throughout the United States. The purpose of this report is to provide supplemental documentation and information used in the Bakken-Three Forks assessment.

Assessment Methodology

The 2000 Energy Policy and Conservation Act legislation requires the USGS to assess the undiscovered, technically recoverable oil and gas resources of priority geologic provinces of the United States using an unbiased and scientific-based assessment methodology. The USGS developed two peer-reviewed methodologies, one for conventional resources and one for continuous resources. Since 2000, these methodologies have been used in the assessments of provinces throughout the United States. The methodology for the assessment of conventional and continuous resources is summarized in several documents (Klett and Charpentier, 2003; Crovelli, 2005; Klett and Schmoker, 2005; Klett and others, 2005; Schmoker, 2005; Schmoker and Klett, 2005; Charpentier and Cook, 2012).

The assessment team developed a geologic framework for the priority basins and assessment areas. They also completed statistically based summary data forms that include descriptive information for each geologic assessment unit. The data were subsequently used in the assessment calculations.

Summary Data-Input Forms for Assessment

The data-input forms for the six Bakken Formation AUs (five continuous, one conventional) are provided in tables 1 and 3–7. The input forms for the two Three Forks AUs (one continuous, one conventional) are provided in tables 8 and 2.

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Table 1. Input parameters for the Middle Bakken Conventional Assessment Unit (50310101), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; mmboe, million barrels of oil equivalent; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit]

SEVENTH APPROXIMATION DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS (Version 6, 9 April 2003)

	IDENTIFICATION INFO	RMATION		
Assessment Geologist:	S. Gaswirth		Date:	29-Jan-13
Region:	North America		Number:	5
Province:	Williston Basin		Number:	5031
Total Petroleum System:	Bakken		Number:	503101
Assessment Unit:	Middle Bakken Conventional		Number:	50310101
Based on Data as of:	IHS Energy Group (2012), NRG	Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (200	08), Saskatchewan Ba	akken pool s	sizes used as
	analog			
	CHARACTERISTICS OF ASS	ESSMENT UNIT		
Oil (<20,000 cfg/bo overall)	or Gas (≥20,000 cfg/bo overall):	Oil		
What is the minimum accum (the smallest accumulation the smallest accu	ulation size? 0.5 nat has potential to be added to res	_mmboe grown erves)		
No. of discovered accumulat	ions exceeding minimum size:	Oil: 0		:0
Established (>13 accums.)	Frontier (1-13 accums.)	Hypothetic	al (no accum	x) X
Modian size (grown) of disce	vered oil accumulations (mmbo):			
Median size (grown) of disco	1st 3rd	2nd 3rd	3rd 3rd	4
Modian size (grown) of disce	vered gas accumulations (bcfg):			
Median size (grown) or disco	1st 3rd	2nd 3rd	3rd 3rd	4
Assessment-Unit Probabili Attribute	ties:	Probabilit	v of occurre	ence (0-1.0)
	oleum charge for an undiscovered			1.0
	voirs, traps, and seals for an undisc			1.0
	EVENTS: Favorable timing for an uno			1.0
			in num 5126.	1.0
Assessment-Unit GEOLOG	GIC Probability (Product of 1, 2, ar	nd 3):		1.0

UNDISCOVERED ACCUMULATIONS

No. of Undiscovered Accumulations: How many undiscovered accums. exist that are <u>></u> min. size?:

(uncertainty of fixed but unknown values)

Oil Accumulations: Gas Accumulations:	minimum (>0) minimum (>0)	1 0	mode mode	2 0	_ maximum _ maximum	10 0	
Sizes of Undiscovered Accumulat (varia	t ions: What are th ations in the sizes o		,				
Oil in Oil Accumulations (mmbo Gas in Gas Accumulations (bcfo): minimum_	0.5	median median	0.8	_ maximum _ maximum	10	

(uncerta	inty of fixed but unknown v	alues)	
Oil Accumulations:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	200	400	600
NGL/gas ratio (bngl/mmcfg)	35	85	115
<u>Gas Accumulations:</u> Liquids/gas ratio (bliq/mmcfg) Oil/gas ratio (bo/mmcfg)	minimum	mode	maximum

AVERAGE RATIOS FOR UNDISCOVERED ACCUMS., TO ASSESS COPRODUCTS

SELECTED ANCILLARY DATA FOR UNDISCOVERED ACCUMULATIONS

(variations in the propertie	es of undiscov	vered acc	umulations)		
Oil Accumulations:	minimum		mode		maximum
API gravity (degrees)	25		40		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					
Drilling Depth (m)	minimum 750	F75	mode 2000	F25	maximum 2750
<u>Gas Accumulations</u> : Inert gas content (%) CO ₂ content (%) Hydrogen-sulfide content (%) Depth (m) of water (if applicable)	minimum		mode		maximum
Drilling Depth (m)	minimum	F75	mode	F25	maximum

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES

Surface Allocations (uncertainty of a fixed value)

1. Montana		represents	15.76	_area % of th	e AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 15.00		maximum
Gas in Gas Accumulations: Volume % in entity					
2. North Dakota		represents	84.24	_area % of th	ie AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 85.00		maximum
Gas in Gas Accumulations: Volume % in entity					
3		_represents_		_area % of th	ie AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
4		represents		_area % of th	e AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
5		_represents_		_area % of th	e AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
6		represents		_area % of th	e AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO LAND ENTITIES

Surface Allocations (uncertainty of a fixed value)

1. Federal Lands		represents	8.55	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 9.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
2. Private Lands		_represents_	83.42	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 83.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
3. Tribal Lands		_represents_	3.82	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 3.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
4. Other Lands		represents	0.63	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 1.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
5. MT State Lands		_represents_	1.83	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 2.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
6. ND State Lands		_represents_	1.75	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 2.00		maximum
Gas in Gas Accumulations: Volume % in entity					

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS Surface Allocations (uncertainty of a fixed value)

1.	Bureau of Land Management (BLM)		represents	4.88	area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode 5.00		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
2.	BLM Wilderness Areas (BLMW)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
3.	BLM Roadless Areas (BLMR)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
4.	National Park Service (NPS)		represents	0.02	area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode 0.00		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
5.	NPS Wilderness Areas (NPSW)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
6.	NPS Protected Withdrawals (NPSP)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Ga	<u>s in Gas Accumulations:</u> Volume % in entity					

7. US Forest Service (FS)		represents	0.01	area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 0.00	maximum
Gas in Gas Accumulations: Volume % in entity				
8. USFS Wilderness Areas (FSW)		_represents_		_area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				
9. USFS Roadless Areas (FSR)		represents		_area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				
10. USFS Protected Withdrawals (FSP)		_represents_		_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				
11. US Fish and Wildlife Service (FWS)		_represents_	1.88	area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 2.00	maximum
Gas in Gas Accumulations: Volume % in entity				
12. USFWS Wilderness Areas (FWSW)		_represents_		area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				

13. USFWS Protected Withdrawals (FWSP)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
14. Wilderness Study Areas (WS)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
15. Department of Energy (DOE)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
16. Department of Defense (DOD)		represents	0.00	area % of t	he AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 0.00		maximum
Gas in Gas Accumulations: Volume % in entity					
17. Bureau of Reclamation (BOR)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
18. Tennessee Valley Authority (TVA)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					

19. Other Federal	re	epresents	1.76	area % of the AU	
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum	_	mode 2.00	maxir	num
<u>Gas in Gas Accumulations:</u> Volume % in entity		_			
20	re	epresents		area % of the AU	
20. <u>Oil in Oil Accumulations:</u> Volume % in entity	re minimum	epresents	mode	_area % of the AU maxir	num

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS

Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP)		represents	52.98	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 53.00	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
2. Northern Glaciated Plains (NGPL)		represents	22.92	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 23.00	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
3. Northwestern Glaciated Plains (NWGL)		represents	15.75	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 16.00	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
4. Northwestern Great Plains (NWGP)		represents	8.35	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 8.00	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
5		_represents_		_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
6		represents		_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				

Table 2. Input parameters for the Three Forks Conventional Assessment Unit (50310103), Bakken Total Petroleum System, WillistonBasin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil;mmboe, million barrels of oil equivalent; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit]

SEVENTH APPROXIMATION DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS (Version 6, 9 April 2003)

IDENTIFICATION INFORMATION

Assessment Geologist:	K. Marra	Date:	29-Jan-13				
Region:	North America	Number:	5				
Province:	Williston Basin	Number:	5031				
Total Petroleum System:	Bakken	Number:	503101				
Assessment Unit:	Three Forks Conventional	Number:	50310103				
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)	-					
Notes from Assessor:	Ancillary data from Pollastro (2008), Saskatchewan Ba	kken pool s	izes used as				
	analog						
CHARACTERISTICS OF ASSESSMENT UNIT							
Oil (<20,000 cfg/bo overall) o	Gas (≥20,000 cfg/bo overall):Oil						
What is the minimum accumulation size? 0.5 mmboe grown (the smallest accumulation that has potential to be added to reserves)							
No. of discovered accumulatic Established (>13 accums.)	ns exceeding minimum size: Oil: 0 Frontier (1-13 accums.)Hypothetica	Gas:					
			<u>) </u>				
Median size (grown) of discove	ered oil accumulations (mmbo):						
(3 , 1 , 1	1st 3rd 2nd 3rd	3rd 3rd					
Median size (grown) of discove	ered gas accumulations (bcfg):	-					
	1st 3rd 2nd 3rd	3rd 3rd					
Assessment-Unit Probabiliti Attribute		of occurre	<u>nce (0-1.0)</u>				
1. CHARGE: Adequate petrol	eum charge for an undiscovered accum. <u>></u> minimum siz	e:	0.7				
•	irs, traps, and seals for an undiscovered accum. \geq mini		1.0				
3. TIMING OF GEOLOGIC EV	ENTS: Favorable timing for an undiscovered accum. <u>></u>	minumum siz	ze: 1.0				
Assessment-Unit GEOLOGI	C Probability (Product of 1, 2, and 3):		0.7				

UNDISCOVERED ACCUMULATIONS

No. of Undiscovered Accumulations: How many undiscovered accur	ns. exist that are <u>></u> min. size?:					
(uncertainty of fixed but unknown values)						

	minimum (>0) minimum (>0)	1 0	mode mode	2 0	_ maximum _ maximum	10 0		
Sizes of Undiscovered Accumulations: What are the sizes (grown) of the above accums?: (variations in the sizes of undiscovered accumulations)								
Oil in Oil Accumulations (mmbo): Gas in Gas Accumulations (bcfg):	minimum minimum	0.5	median median	0.8	_ maximum maximum	5		

(uncertai	nty of fixed but unknown v		
Oil Accumulations:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	200	400	600
NGL/gas ratio (bngl/mmcfg)	35	85	115
<u>Gas Accumulations:</u> Liquids/gas ratio (bliq/mmcfg) Oil/gas ratio (bo/mmcfg)	minimum	mode	maximum

AVERAGE RATIOS FOR UNDISCOVERED ACCUMS., TO ASSESS COPRODUCTS

SELECTED ANCILLARY DATA FOR UNDISCOVERED ACCUMULATIONS

(variations in the properties of undiscovered accumulations)							
Oil Accumulations:	minimum		mode		maximum		
API gravity (degrees)	25		40		50		
Sulfur content of oil (%)	0.01		0.1		1		
Depth (m) of water (if applicable)							
Drilling Depth (m)	minimum 1250	F75	mode 2200	F25	maximum 3100		
<u>Gas Accumulations</u> : Inert gas content (%) CO ₂ content (%) Hydrogen-sulfide content (%) Depth (m) of water (if applicable)	minimum		mode		maximum		
Drilling Depth (m)	minimum	F75	mode	F25	maximum		

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES

Surface Allocations (uncertainty of a fixed value)

1. Montana		represents	24.20	_area % of t	ne AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 20.00		maximum
Gas in Gas Accumulations: Volume % in entity					
2. North Dakota		_represents_	45.54	_area % of t	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 75.00		maximum
Gas in Gas Accumulations: Volume % in entity					
3. <u>South Dakota</u>		_represents_	30.26	_area % of t	ne AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 5.00		maximum
Gas in Gas Accumulations: Volume % in entity					
4		_represents_		_area % of t	ne AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
5		represents		_area % of t	ne AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
6		represents		_area % of t	ne AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO LAND ENTITIES

Surface Allocations (uncertainty of a fixed value)

1. Federal Lands		represents	6.02	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 6.00		maximum
Gas in Gas Accumulations: Volume % in entity					
2. Private Lands		_represents_	82.62	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 83.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
3. Tribal Lands		_represents_	5.71	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 6.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity					
4. Other Lands		represents	0.68	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 1.00		maximum
Gas in Gas Accumulations: Volume % in entity					
5. MT State Lands		_represents_	1.41	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 1.00		maximum
Gas in Gas Accumulations: Volume % in entity					
6. ND State Lands		represents	2.18	_area % of th	ne AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 2.00		maximum
Gas in Gas Accumulations: Volume % in entity					

7.	SD State Lands		represents	1.38	area % of t	he AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode 1.00		maximum
Gas	s in Gas Accumulations: Volume % in entity					
8.			represents		area % of t	he AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	s in Gas Accumulations: Volume % in entity		· _			
9.			represents		area % of t	he AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum	· _	mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
10.			represents		area % of t	he AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	s in Gas Accumulations: Volume % in entity					
11.			represents		area % of t	he AU
	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
12.			represents		area % of t	he AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas	s in Gas Accumulations: Volume % in entity					

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS Surface Allocations (uncertainty of a fixed value)

1.	Bureau of Land Management (BLM)		represents	2.73	area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode 3.00		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
2.	BLM Wilderness Areas (BLMW)		_represents_		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
3.	BLM Roadless Areas (BLMR)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
4.	National Park Service (NPS)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
5.	NPS Wilderness Areas (NPSW)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					
6.	NPS Protected Withdrawals (NPSP)		represents		area % of th	ne AU
<u>Oil</u>	in Oil Accumulations: Volume % in entity	minimum		mode		maximum
<u>Ga</u>	<u>s in Gas Accumulations:</u> Volume % in entity					

7. US Forest Service (FS)		represents	2.48	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 2.50	maximum
Gas in Gas Accumulations: Volume % in entity				
8. USFS Wilderness Areas (FSW)		represents		_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				
9. USFS Roadless Areas (FSR)		represents		_area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				
10. USFS Protected Withdrawals (FSP)		_represents_		_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				
11. US Fish and Wildlife Service (FWS)		_represents_	0.44	_area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 0.50	maximum
Gas in Gas Accumulations: Volume % in entity				
12. USFWS Wilderness Areas (FWSW)		_represents_		_area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode	maximum

3. USFWS Protected Withdrawals (FWSP)		represents		_area % of the AU	
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
14. Wilderness Study Areas (WS)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
15. Department of Energy (DOE)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
16. Department of Defense (DOD)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
17. Bureau of Reclamation (BOR)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					
18. Tennessee Valley Authority (TVA)		represents		area % of t	he AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode		maximum
Gas in Gas Accumulations: Volume % in entity					

19. Other Federal	re	epresents	0.37	_area % of th	e AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum	_	mode 0.00		maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity		_			
20	re	epresents		area % of th	e AU
20. <u>Oil in Oil Accumulations:</u> Volume % in entity	re minimum	epresents_	mode	_area % of th	e AU maximum

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS

Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP)		represents	9.14	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 9.00	maximum
Gas in Gas Accumulations: Volume % in entity				
2. Northern Glaciated Plains (NGPL)		represents	8.27	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 8.00	maximum
Gas in Gas Accumulations: Volume % in entity				
3. Northwestern Glaciated Plains (NWGL)		represents	5.12	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 5.00	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
4. Northwestern Great Plains (NWGP)		_represents_	69.35	_area % of the AU
Oil in Oil Accumulations: Volume % in entity	minimum		mode 70.00	maximum
Gas in Gas Accumulations: Volume % in entity				
5. Powder River Basin (PRBA)		represents	8.11	_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode 8.00	maximum
<u>Gas in Gas Accumulations:</u> Volume % in entity				
6		represents		_area % of the AU
<u>Oil in Oil Accumulations:</u> Volume % in entity	minimum		mode	maximum
Gas in Gas Accumulations: Volume % in entity				

Table 3. Input parameters for the Elm Coulee-Billings Nose Continuous Oil Assessment Unit (50310161), Bakken Total Petroleum System,Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo,barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS (version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth					Date:	29-Jan-13	
Region: North America Number: 5						5		
						5031		
Total Petroleum System:	Total Petroleum System: Bakken Number: 5							
Assessment Unit:	Elm Coulee-Bill	ings Nose Co	ontinuous Oil			Number:	50310161	
Based on Data as of:	IHS Energy Gro	oup (2012), N	IRG Associate	s (2010)				
	-							
Notes from Assessor:	Ancillary data fr	om Pollastro	(2008)					
CHARACTERISTICS OF ASSESSMENT UNIT Assessment-unit type: oil (<20,000 cfg/bo)								
Number of tested wells: 1132 Number of tested wells with EUR > minimum: 1120 Historic success ratio, tested wells (%) 99 Assessment-Unit Probability: 99 What is the probability that at least one well within the AU will have 1.0								
				FOR AD	DITIONS TO	RESERVE	6	
1. Productive area of accu	imulation (acres)): (triangular)					
calculated mean	1,600,000	minimum _	1,400,000	mode	1,600,000	maximum	1,800,000	
2. Uncertainty about avera	age drainage are	a of wells (ad	cres): (triangu	lar)				
calculated mean	440	minimum _	320	mode	400	maximum	600	
3. Percentage of total ass	essment-unit are	ea that is unte	ested (%): (tria	angular)				
calculated mean	67	minimum _	51	mode	69	maximum	80	
4. Percentage of untested	l assessment-uni	it area in swe	et spots (%):	(triangula	ır)			
calculated mean	27	minimum _	24	mode	27	maximum	30	

	ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL								
	SWEET SPOTS								
5a. Fu	a. Future success ratio (%): (triangular)								
	calculated mean	99	minimum	98	mode	99	maximum	100	
5b. Un	certainty about average	e EUR (mmt	oo for oil; bcfg fo	or gas): (sh	nifted truncat	ed lognorm	al)		
	calculated mean	0.182	minimum	0.15	median	0.18	maximum	0.22	
	NON-SWEET SPOTS								
6a. Fu	ture success ratio (%):	(triangular)							
	calculated mean	90	minimum	85	mode	90	maximum	95	
6b. Un	certainty about average	e EUR (mmb	oo for oil; bcfg fo	or gas): (sh	nifted truncat	ed lognorm	al)		
	calculated mean	0.102	minimum	0.06	median	0.1	maximum	0.15	
	UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS (triangular)								
	<u>essment unit:</u> oil ratio (cfg/bo)			minimum 500		mode 1000		maximum 1500	
NGL	/gas ratio (bngl/mmcfg)		_	35		85		115	
	<u>ssessment unit:</u> ds/gas ratio (bliq/mmcf	g)							

SELECTED ANCILLARY DATA FOR UNTESTED WELLS

(no specified distribution type)

<u>Oil assessment unit:</u> API gravity of oil (degrees) Sulfur content of oil (%) Depth (m) of water (if applicable)	minimum 34 0.01		median 41 0.1	-	maximum 50 1			
Drilling depth (m)	minimum 2130	F75	median 2895	F25	maximum 3200			
<u>Gas assessment unit:</u> Inert-gas content (%) CO_2 content (%) Hydrogen sulfide content (%) Heating value (BTU)	minimum		median	-	maximum			
Depth (m) of water (if applicable) Drilling depth (m)	minimum	F75	median	- F25	maximum			
<u>Completion practices:</u> 1. Typical well-completion practices (conventional, open hole, open cavity, other) open hole								

	rypical well-completion practices (conventional, open noic, open cavity, other)	opennoie
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.9

1.	Montana	is	52.10 % of the AREA of the AU
	mean VOLUME % in entity 52.00		
2.	North Dakota	is	47.90 % of the AREA of the AU
	mean VOLUME % in entity 48.00		
3.		is	% of the AREA of the AU
	mean VOLUME % in entity		
4.		is	% of the AREA of the AU
	mean VOLUME % in entity		
5.		is	% of the AREA of the AU
	mean VOLUME % in entity		
6.		is	% of the AREA of the AU
	mean VOLUME % in entity		
7.	moon VOLUME % in ontity	is	% of the AREA of the AU
	mean VOLUME % in entity		
8.	mean VOLUME % in entity	is	% of the AREA of the AU
9.	mean VOLUME % in entity	is	% of the AREA of the AU
4.5			
10.	mean VOLUME % in entity	is	% of the AREA of the AU

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES Surface Allocations (uncertainty of a fixed value)

1.	Federal Lands		is	29.66 % of the AREA of the AU
		0.00		
2.	Private Lands		is	63.93 % of the AREA of the AU
0		4.00		
3.	Tribal Lands mean VOLUME % in entity		is	% of the AREA of the AU
4.	Other Lands		is	_0.7€_% of the AREA of the AU
	mean VOLUME % in entity 0	.50		
5.	MT State Lands mean VOLUME % in entity 2	.50	is	2.75 % of the AREA of the AU
6.	ND State Lands		is	% of the AREA of the AU
	mean VOLUME % in entity 3	.00		
7.	mean VOLUME % in entity		is	% of the AREA of the AU
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.	mean VOLUME % in entity		is	% of the AREA of the AU
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS Surface Allocations (uncertainty of a fixed value)

	Surface Alloca	tainty of a fixe	d value)			
1.	Bureau of Land Management (BLM)		is	1.1Í % of the AREA of the AU		
	mean VOLUME % in entity	1.00				
2.	BLM Wilderness Areas (BLMW)		is	% of the AREA of the AU		
	mean VOLUME % in entity					
3.	BLM Roadless Areas (BLMR)		is	% of the AREA of the AU		
	mean VOLUME % in entity					
4.	National Park Service (NPS)		is	1.66 % of the AREA of the AU		
	mean VOLUME % in entity	2.00				
5.	NPS Wilderness Areas (NPSW)		is	% of the AREA of the AU		
	mean VOLUME % in entity					
6.	NPS Protected Withdrawals (NPSP) mean VOLUME % in entity		is	% of the AREA of the AU		
7			io	26.95 $%$ of the ADEA of the AU		
7.	US Forest Service (FS) mean VOLUME % in entity	27.00	is	26.85 % of the AREA of the AU		
8.	USFS Wilderness Areas (FSW)		is	% of the AREA of the AU		
	mean VOLUME % in entity					
9.	USFS Roadless Areas (FSR)		is	% of the AREA of the AU		
	mean VOLUME % in entity					
10.	USFS Protected Withdrawals (FSP)		is	% of the AREA of the AU		
	mean VOLUME % in entity					

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS

		5 Dinings 14000				
ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISION (continued)						
11. US Fish and Wildlife Service (FWS)		is	% of the AREA of the AU			
mean VOLUME % in entity						
12. USFWS Wilderness Areas (FWSW)		is	% of the AREA of the AU			
mean VOLUME % in entity						
13. USFWS Protected Withdrawals (FWS	P)	is	% of the AREA of the AU			
mean VOLUME % in entity						
14. Wilderness Study Areas (WS)		is	% of the AREA of the AU			
mean VOLUME % in entity						
15. Department of Energy (DOE)		is	% of the AREA of the AU			
mean VOLUME % in entity						
16. Department of Defense (DOD)		is	% of the AREA of the AU			
mean VOLUME % in entity						
17. Bureau of Reclamation (BOR)		is	% of the AREA of the AU			
mean VOLUME % in entity						
18. Tennessee Valley Authority (TVA)		is	% of the AREA of the AU			
mean VOLUME % in entity						
19. Other Federal		is	0.00 % of the AREA of the AU			
mean VOLUME % in entity	0.00					
20		is	% of the AREA of the AU			
mean VOLUME % in entity						

	Surface Alloca	tions (unce	rtainty of a fixe	d value)
1.	Northern Glaciated Plains (NGPL)		is	29.40 % of the AREA of the AU
	mean VOLUME % in entity	29.00		
2.	Northwestern Glaciated Plains (NWGL)	is	0.73 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
3.	Northwestern Great Plains (NWGP)		is	69.87 % of the AREA of the AU
	mean VOLUME % in entity	70.00		
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS Surface Allocations (uncertainty of a fixed value)

Table 4. Input parameters for the Central Basin Continuous Oil Assessment Unit (50310162), Bakken Total Petroleum System, Williston BasinProvince. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil;bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS (version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Ass	sessment Geologist:	S. Gaswirth					Date:	29-Jan-13
	gion:	North America					Number:	5
Pro	ovince:	Williston Basin					Number:	5031
Total Petroleum System: Bakken							Number:	503101
Ass	sessment Unit:	Central Basin C	ontinuous O	il			Number:	50310162
Bas	sed on Data as of:	IHS Energy Gro	oup (2012), N	IRG Associate	s (2010)		
				(2222)				
NO1	tes from Assessor:	Ancillary data fr	om Pollastro	(2008)				
				S OF ASSESS				
Ass	sessment-unit type:	oil (<20,0	000 cfg/bo) heavy	X v oil (<10 API)	gas (>	20,000 cfg/bo)		-
	ll type: jor reservoir type (Cho	oose one.):	vertical			horizontal	Χ	-
	,	•		lo	w-perm	eability clastics	Х	
		coal		low-p	ermeabi	ility carbonates		-
						diatomite		-
Mir	nimum EUR per well	0.002	(mmbo for o	il AU; bcfg for	gas AU))		
Nu	mber of tested wells:	938						
	mber of tested wells w		num:	938				
His	toric success ratio, te	sted wells (%)	_	100				
			_					
Ass	sessment-Unit Probab	-						
	What is the probability							1.0
	production	n capacity of at le	east the minir	num EUR?				1.0
	NUMBER O	F UNDRILLED V		I POTENTIAL	FOR A	DDITIONS TO	RESERVE	S
1	Productive area of accu							
		, , ,						
	calculated mean	3,100,000	minimum_	2,800,000	mode_	3,100,000	maximum	3,400,000
2.	Uncertainty about avera	age drainage are	a of wells (a	cres): (triangu	ar)			
	calculated mean	440	minimum _	320	mode_	400	maximum	600
3.	Percentage of total ass	essment-unit are	ea that is unte	ested (%): (tria	angular)			
	calculated mean	86	minimum _	80	mode_	87	maximum	91
4.	Percentage of untested	l assessment-un	it area in swe	eet spots (%):	(triangu	lar)		
	calculated mean	41	minimum_	24	mode	29	maximum	70

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL								
SWEET SPOTS								
5a.	Future success ratio (%):	(triangular)						
	calculated mean	99	minimum	98	mode	99	maximum	100
5b.	5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)							
	calculated mean	0.254	minimum	0.225	median	0.25	maximum	0.325
NON-SWEET SPOTS								
6a. Future success ratio (%): (triangular)								
	calculated mean	88	minimum	80	mode	90	maximum	95
6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)								
	calculated mean	0.154	minimum	0.075	median	0.15	maximum	0.25
UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS (triangular)								
	<u>assessment unit:</u> as/oil ratio (cfg/bo)			minimum 500		mode 1000		maximum 1500
	GL/gas ratio (bngl/mmcfg)		_	35		85		115
	<u>s assessment unit:</u> quids/gas ratio (bliq/mmcfg	3)	_					

SELECTED ANCILLARY DATA FOR UNTESTED WELLS

(no specified distribution type)

<u>Oil assessment unit:</u> API gravity of oil (degrees) Sulfur content of oil (%) Depth (m) of water (if applicable)	minimum 34 0.01		median 41 0.1	- -	maximum 50 1
Drilling depth (m)	minimum 2130	F75	median 2895	F25	maximum 3200
Gas assessment unit: Inert-gas content (%) CO_2 content (%) Hydrogen sulfide content (%) Heating value (BTU) Depth (m) of water (if applicable)	minimum		median		maximum
Drilling depth (m)	minimum	F75	median	F25	maximum
Completion practices:					

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.996

1.	Montana		is	47.95 % of the AREA of the AU
	mean VOLUME % in entity	30.00		
2.	North Dakota		is	52.05 % of the AREA of the AU
	mean VOLUME % in entity	70.00		
3.			is	% of the AREA of the AU
	mean VOLUME % in entity			
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES Surface Allocations (uncertainty of a fixed value)

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS
Surface Allocations (uncertainty of a fixed value)

1.	Federal Lands		is	8.87 % of the AREA of the AU
	mean VOLUME % in entity	10.00		
2.	Private Lands		is	63.08 % of the AREA of the AU
	mean VOLUME % in entity	70.00		
3.	Tribal Lands		is	23.30 % of the AREA of the AU
	mean VOLUME % in entity	15.00		
4.	Other Lands		is	1.47 % of the AREA of the AU
	mean VOLUME % in entity	2.00		
5.	MT State Lands		is	1.35 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
6.	ND State Lands		is	1.93 % of the AREA of the AU
	mean VOLUME % in entity	2.00		
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS

	ALLOCATIONS OF POTENTIAL Surface Alloca			d value)
1.	Bureau of Land Management (BLM)		is	1.22 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
2.	BLM Wilderness Areas (BLMW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
3.	BLM Roadless Areas (BLMR)		is	% of the AREA of the AU
	mean VOLUME % in entity			
4.	National Park Service (NPS)		is	0.68 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
5.	NPS Wilderness Areas (NPSW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
6.	NPS Protected Withdrawals (NPSP)		is	% of the AREA of the AU
	mean VOLUME % in entity			
7.	US Forest Service (FS)	E 00	is	4.49 % of the AREA of the AU
	mean VOLUME % in entity	5.00		
8.	USFS Wilderness Areas (FSW) mean VOLUME % in entity		is	% of the AREA of the AU
9.	USFS Roadless Areas (FSR) mean VOLUME % in entity		is	% of the AREA of the AU
10.	USFS Protected Withdrawals (FSP)		is	% of the AREA of the AU
	mean volome /v montry			

Assessment Unit (name, no.) Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISION (continued)					
11. US Fish and Wildlife Service (FWS)		is	0.46 % of the AREA of the AU		
mean VOLUME % in entity	1.00				
12. USFWS Wilderness Areas (FWSW)		is	% of the AREA of the AU		
mean VOLUME % in entity					
13. USFWS Protected Withdrawals (FWSF	P)	is	% of the AREA of the AU		
mean VOLUME % in entity					
14. Wilderness Study Areas (WS)		is	% of the AREA of the AU		
mean VOLUME % in entity					
15. <u>Department of Energy (DOE)</u> mean VOLUME % in entity		is	% of the AREA of the AU		
16. Department of Defense (DOD)		is	% of the AREA of the AU		
mean VOLUME % in entity		10			
17. Bureau of Reclamation (BOR)		is	% of the AREA of the AU		
mean VOLUME % in entity					
18. Tennessee Valley Authority (TVA)		is	% of the AREA of the AU		
mean VOLUME % in entity					
19. Other Federal		is	2.02 % of the AREA of the AU		
mean VOLUME % in entity	2.00				
20		is	% of the AREA of the AU		
mean VOLUME % in entity					

Assessment Unit (name, no.) Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS

	Surface Allocat	t ions (uncer	tainty of a fixe	d value)
1.	Northern Glaciated Plains (NGPL)		is	77.18 % of the AREA of the AU
	mean VOLUME % in entity	77.00		
2.	Northwestern Glaciated Plains (NWGL))	is	6.23 % of the AREA of the AU
	mean VOLUME % in entity	6.00		
3.	Northwestern Great Plains (NWGP)		is	16.59 % of the AREA of the AU
	mean VOLUME % in entity	17.00		
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

Table 5. Input parameters for the Nesson-Little Knife Continuous Oil Assessment Unit (50310163), Bakken Total Petroleum System, WillistonBasin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel ofoil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS (version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist: Region: Province:	S. Gaswirth North America Williston Basin				Number:	29-Jan-13 5 5031	
Total Petroleum System							503101
Assessment Unit:	Nesson-Little K	nife Continue					50310163
Based on Data as of:	IHS Energy Gro			s (2010)		Number.	30310103
Dased on Data as of.	INS LINERBY ON	Jup (2012), 1		5 (2010)			
Notes from Assessor: Ancillary data from Pollastro (2008)							
	CHARACTERISTICS OF ASSESSMENT UNIT						
Assessment-unit type:	oil (<20,0	000 cfg/bo) heavy	X oil (<10 API)	gas (>2	0,000 cfg/bo)		
Well type: Major reservoir type (C	hoose one.):	vertical				Х	
	shale		lo	w-permea	ability clastics	Х	
	coal		low-p	ermeabili	ty carbonates		
					diatomite		
Minimum EUR per well	0.002	(mmbo for oi	il AU; bcfg for g	jas AU)			
Number of tested wells	: 1554						
Number of tested wells		num.	1554				
Historic success ratio,		_	100				
,		_					
Assessment-Unit Prob	ability:						
What is the probabil	-						
produc	tion capacity of at le	east the minir	mum EUR?				1.0
NUMBER		WELLS WIT	H POTENTIAL	FOR AD	DITIONS TO I	RESERVES	
1. Productive area of a				-			
calculated me	an 2,800,000	minimum _	2,600,000	mode_	2,800,000	maximum	3,000,000
2. Uncertainty about av	verage drainage are	a of wells (a	cres): (triangul	ar)			
calculated me	ean 440	minimum _	320	mode_	400	maximum	600
3. Percentage of total a	assessment-unit are	ea that is unt	ested (%): (tria	ingular)			
calculated me	ean <u>75</u>	minimum _	65	mode_	76	maximum	84
4. Percentage of untes	ted assessment-un	it area in swe	eet spots (%):	(triangulaı	r)		
calculated me	ean 53	minimum _	35	mode_	38	maximum	85

	ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL							
	SWEET SPOTS							
5a. Futu	re success ratio (%):	(triangular)						
	calculated mean	99	minimum	98	mode	99	maximum	100
5b. Unce	ertainty about average	e EUR (mmt	oo for oil; bcfg f	or gas): (sh	ifted truncate	ed lognorma	l)	
	calculated mean	0.302	minimum	0.26	median	0.3	maximum	0.35
			NON-S	WEET SPO	TS			
6a. Futu	re success ratio (%):	(triangular)						
	calculated mean	95	minimum	90	mode	95	maximum	100
6b. Unce	ertainty about average	e EUR (mmt	oo for oil; bcfg f	or gas): (sh	ifted truncate	ed lognorma	l)	
	calculated mean	0.178	minimum	0.125	median	0.175	maximum	0.25
UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS (triangular)								
	<u>ssment unit:</u> I ratio (cfg/bo)			minimum 500		mode 1000		maximum 1500
	as ratio (bngl/mmcfg)			35		85		115
	Gas assessment unit: Liquids/gas ratio (bliq/mmcfg)							

SELECTED ANCILLARY DATA FOR UNTESTED WELLS

(no specified distribution type)

<u>Oil assessment unit:</u> API gravity of oil (degrees) Sulfur content of oil (%) Depth (m) of water (if applicable)	minimum 34 0.01	 	median 41 0.1		maximum 50 1
Drilling depth (m)	minimum 2130	F75	median 2895	F25	maximum 3200
<u>Gas assessment unit:</u> Inert-gas content (%) CO ₂ content (%) Hydrogen sulfide content (%)	minimum	 	median		maximum

Heating value (BTU) Depth (m) of water (if applicable)		· -				
Drilling depth (m)	minimum	F75	median	F25	maximum	

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.95

		,	,	,
1.	North Dakota		is	100.00 % of the AREA of the AU
	mean VOLUME % in entity	100.00		
2.			is	% of the AREA of the AU
	mean VOLUME % in entity			
3.			is	% of the AREA of the AU
	mean VOLUME % in entity			
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.	mean VOLUME % in entity		is	% of the AREA of the AU
7.			is	% of the AREA of the AU
1.	mean VOLUME % in entity		13	
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES Surface Allocations (uncertainty of a fixed value)

		•		,
1.	Federal Lands		is	6.84 % of the AREA of the AU
	mean VOLUME % in entity	7.00		
2.	Private Lands		is	79.03 % of the AREA of the AU
	mean VOLUME % in entity	79.00		
2	Tribal Landa		ie	
3.	Tribal Lands		is	9.08 % of the AREA of the AU
	mean VOLUME % in entity	9.00		
4.	Other Lands		is	0.81 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
5.	ND State Lands		is	4.21 % of the AREA of the AU
	mean VOLUME % in entity	4.00		
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
_				
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS Surface Allocations (uncertainty of a fixed value)

	Surface Alloc	ations (unce	ertainty of a fix	(red value)
1.	Bureau of Land Management (BLM)		is	0.45 % of the AREA of the AU
	mean VOLUME % in entity	0.50		
2.	BLM Wilderness Areas (BLMW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
3.	BLM Roadless Areas (BLMR)		is	% of the AREA of the AU
	mean VOLUME % in entity			
4.	National Park Service (NPS)		is	0.08 % of the AREA of the AU
	mean VOLUME % in entity	0.00		
5.	NPS Wilderness Areas (NPSW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
6.	NPS Protected Withdrawals (NPSP)		is	% of the AREA of the AU
	mean VOLUME % in entity			
7.	US Forest Service (FS)		is	2.67 % of the AREA of the AU
	mean VOLUME % in entity	3.00		
8.	USFS Wilderness Areas (FSW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
9.	USFS Roadless Areas (FSR)		is	% of the AREA of the AU
	mean VOLUME % in entity			
10.	USFS Protected Withdrawals (FSP)		is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS (continued)							
11. US Fish and Wildlife Service (FWS)	is	0.38	% of the AREA of the AU				
mean VOLUME % in entity	0.50						
12. USFWS Wilderness Areas (FWSW)	is	3	_% of the AREA of the AU				
mean VOLUME % in entity							
13. USFWS Protected Withdrawals (FWSP)	is	3	_% of the AREA of the AU				
mean VOLUME % in entity							
14. Wilderness Study Areas (WS)	is	3	_% of the AREA of the AU				
mean VOLUME % in entity							
15. Department of Energy (DOE)	is	s	_% of the AREA of the AU				
mean VOLUME % in entity							
16. Department of Defense (DOD)	is	3	% of the AREA of the AU				
mean VOLUME % in entity							
17. Bureau of Reclamation (BOR)	is	s	% of the AREA of the AU				
mean VOLUME % in entity							
18. Tennessee Valley Authority (TVA)	is	3	_% of the AREA of the AU				
mean VOLUME % in entity							
19. Other Federal	is	3.25	_% of the AREA of the AU				
mean VOLUME % in entity	3.00						
20	is	3	_% of the AREA of the AU				
mean VOLUME % in entity							

	ALLOCATIONS OF PC Surface Alloc			O RESERVES TO ECOSYSTEMS xed value)	
1.	Northeastern Glaciated Plains (NEGP))	is	6.57 % of the AREA of the AL	J
	mean VOLUME % in entity	7.00			
2.	Northern Glaciated Plains (NGPL)		is	46.09 % of the AREA of the AL	i
	mean VOLUME % in entity	46.00			
3.	Northwestern Great Plains (NWGP)		is	47.34 % of the AREA of the AL	I
	mean VOLUME % in entity	47.00			
4.			is	% of the AREA of the AL	į
	mean VOLUME % in entity				
5.			is	% of the AREA of the AL	J
	mean VOLUME % in entity				
6.			is	% of the AREA of the AL	J
	mean VOLUME % in entity				
7.			is	% of the AREA of the AL	J
	mean VOLUME % in entity				
8.			is	% of the AREA of the AL	J
	mean VOLUME % in entity				
9.			is	% of the AREA of the AL	J
	mean VOLUME % in entity				
10.			is	% of the AREA of the AL	ļ
	mean VOLUME % in entity				

Table 6. Input parameters for the Eastern Transitional Continuous Oil Assessment Unit (50310164), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS

(version 1.2, July 20, 2012)

Region: North America Province: Williston Basin Total Petroleum System: Bakken						Number: Number:	29-Jan-13 5 5031 503101 50310164		
	CHARACTERISTICS OF ASSESSMENT UNIT								
Assessment-unit type:	oil (<20,0	000 cfg/bo)_ heavy	X oil (<10 API)	gas (>20),000 cfg/bo)				
Well type:		vertical			horizontal	Х			
Major reservoir type (Cho	oose one.): shale coal		lov low-pe	w-permea ermeabilit <u>y</u>	bility clastics y carbonates diatomite	X			
Minimum EUR per well	0.002	(mmbo for c	oil AU; bcfg for	· gas AU)					
Number of tested wells: Number of tested wells w Historic success ratio, te Assessment-Unit Probab What is the probability production	sted wells (%) ility:	– – e well within		ve			1.0		
NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES									
1. Productive area of acc	umulation (acre	s): (triangula	ar)						
calculated mear	1,900,000	minimum	1,800,000	mode_	1,900,000	maximum	2,000,000		
2. Uncertainty about aver	age drainage ar	ea of wells (acres): (triang	gular)					
calculated mear	440	minimum	320	mode_	400	maximum	600		
3. Percentage of total ass	essment-unit a	rea that is ur	ntested (%): (t	triangular)				
calculated mear	n <u>81</u>	minimum	70	mode_	79	maximum	93		
4. Percentage of untested	l assessment-u	nit area in sv	weet spots (%)): (triangı	ular)				
calculated mear	15	minimum _	10	mode_	15	maximum	20		

	ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL							
			SWE	ET SPOTS				
5a.	a. Future success ratio (%): (triangular)							
	calculated mean	99	_ minimum _	98	mode	99	_ maximum _	100
5b.	Uncertainty about average	EUR (mm	bo for oil; bcfg) for gas): (shifted trunc	ated logno	rmal)	
	calculated mean	0.431		0.375	median	0.425	maximum	0.55
			NON-S	WEET SPO	TS			
6a.	Future success ratio (%):	(triangular)	1					
	calculated mean	95	minimum	90	mode	95	maximum	100
6b.	Uncertainty about average	EUR (mm	bo for oil; bcfg) for gas): (shifted trung	ated logno	rmal)	
	calculated mean	0.231		0.175	median	0.225	maximum	0.35
	UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS (triangular)							
G	<u>assessment unit:</u> Sas/oil ratio (cfg/bo) IGL/gas ratio (bngl/mmcfg)		-	minimum 250 35		mode 500 85		maximum 750 115
-	<u>s assessment unit:</u> iquids/gas ratio (bliq/mmcfg])	_					

SELECTED ANCILLARY DATA FOR UNTESTED WELLS

(no specified distribution type)

<u>Oil assessment unit:</u> API gravity of oil (degrees) Sulfur content of oil (%) Depth (m) of water (if applicable)	minimum <u>34</u> 0.01	-	median 41 0.1		maximum 50 1
Drilling depth (m)	minimum 2130	F75	median 2895	F25	maximum 3200
<u>Gas assessment unit:</u> Inert-gas content (%) CO ₂ content (%) Hydrogen sulfide content (%) Heating value (BTU) Depth (m) of water (if applicable)	minimum	- - -	median		maximum
Drilling depth (m)	minimum	F75	median	F25	maximum
Completion practices:					

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	1

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES **Surface Allocations** (uncertainty of a fixed value)

1. North Dakota is 100.00 % of the AREA of the AU 100.00 mean VOLUME % in entity _____ % of the AREA of the AU is mean VOLUME % in entity % of the AREA of the AU 3. is mean VOLUME % in entity _____ % of the AREA of the AU is mean VOLUME % in entity 5. _____ % of the AREA of the AU is mean VOLUME % in entity 6. % of the AREA of the AU is mean VOLUME % in entity % of the AREA of the AU 7. _____ is mean VOLUME % in entity % of the AREA of the AU is 8. mean VOLUME % in entity

2.

4.

9.

10.

mean VOLUME % in entity

mean VOLUME % in entity

Page 4

is

is

% of the AREA of the AU

% of the AREA of the AU

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS
Surface Allocations (uncertainty of a fixed value)

1.	Federal Lands		is	8.71 % of the AREA of the AU
	mean VOLUME % in entity	9.00		
2.	Private Lands		is	69.52 % of the AREA of the AU
	mean VOLUME % in entity	69.00		
3.	Tribal Lands		is	17.74 % of the AREA of the AU
	mean VOLUME % in entity	18.00		
4.	Other Lands		is	1.03 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
5.	ND State Lands		is	3.01 % of the AREA of the AU
	mean VOLUME % in entity	3.00		
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

	Surface Allocations (uncertainty of a fixed value)							
1.	Bureau of Land Management (BLM)		is	0.02	% of the AREA of the AU			
	mean VOLUME % in entity	0.00						
2.	BLM Wilderness Areas (BLMW)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
3.	BLM Roadless Areas (BLMR)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
4.	National Park Service (NPS)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
5.	NPS Wilderness Areas (NPSW)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
6.	NPS Protected Withdrawals (NPSP)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
7.	US Forest Service (FS)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
8.	USFS Wilderness Areas (FSW)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
9.	USFS Roadless Areas (FSR)		is		% of the AREA of the AU			
	mean VOLUME % in entity							
10.	USFS Protected Withdrawals (FSP)		is		% of the AREA of the AU			
	mean VOLUME % in entity							

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS Surface Allocations (uncertainty of a fixed value)

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS (continued)								
11. US Fish and Wildlife Service (FWS)		is	1.85 % of the AREA of the AU					
mean VOLUME % in entity	2.00							
12. USFWS Wilderness Areas (FWSW)		is	% of the AREA of the AU					
mean VOLUME % in entity								
13. USFWS Protected Withdrawals (FWS	SP)	is	% of the AREA of the AU					
mean VOLUME % in entity								
14. Wilderness Study Areas (WS)		is	% of the AREA of the AU					
mean VOLUME % in entity								
15. Department of Energy (DOE)		is	% of the AREA of the AU					
mean VOLUME % in entity								
16. Department of Defense (DOD)		is	% of the AREA of the AU					
mean VOLUME % in entity								
17. Bureau of Reclamation (BOR)		is	% of the AREA of the AU					
mean VOLUME % in entity								
18. Tennessee Valley Authority (TVA)		is	% of the AREA of the AU					
mean VOLUME % in entity								
19. Other Federal		is	6.83 % of the AREA of the AU					
mean VOLUME % in entity	7.00							
20		is	% of the AREA of the AU					
mean VOLUME % in entity								

	Surface Alloca	rtainty of a fix	ed value)	
1.	. Northeastern Glaciated Plains (NEGP)			34.38 % of the AREA of the AU
	mean VOLUME % in entity	34.00		
2.	Northern Glaciated Plains (NGPL)		is	53.04 % of the AREA of the AU
	mean VOLUME % in entity	53.00		
3.	Northwestern Great Plains (NWGP)		is	12.58 % of the AREA of the AU
	mean VOLUME % in entity	13.00		
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS Surface Allocations (uncertainty of a fixed value)

Table 7. Input parameters for the Northwest Transitional Continuous Oil Assessment Unit (50310165), Bakken Total Petroleum System,Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil;bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS (version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist: Region: Province: Total Petroleum System: Assessment Unit: Based on Data as of: Notes from Assessor:	Agion:North AmericaNumber:bovince:Williston BasinNumber:tal Petroleum System:BakkenNumber:sessment Unit:Northwest Transitional Continuous OilNumber:sed on Data as of:IHS Energy Group (2012), NRG Associates (2010)Number:								
CHARACTERISTICS OF ASSESSMENT UNIT									
Assessment-unit type:	oil (<20,0)00 cfg/bo) heavv	X oil (<10 API)	_ gas (>20	0,000 cfg/bo)		-		
Well type: Major reservoir type (Cho						X	-		
	shale coal		lo low-p	w-permea ermeabilit	ability clastics y carbonates diatomite	X	-		
Minimum EUR per well	0.002	(mmbo for o	il AU; bcfg fc	r gas AU))				
Number of tested wells: 56 Number of tested wells with EUR > minimum: 54 Historic success ratio, tested wells (%) 98 Assessment-Unit Probability: 98 What is the probability that at least one well within the AU will have									
production	n capacity of at l						1.0		
1. Productive area of acc	NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES 1. Productive area of accumulation (acres): (triangular)								
calculated mear	1,866,667	_ minimum	500,000	_ mode	2,000,000	maximum	3,100,000		
2. Uncertainty about aver	age drainage are	ea of wells (a	cres): (trian	gular)					
calculated mear	440		320	mode	400	maximum	600		
3. Percentage of total ass			. , .	,			00 F		
calculated mear	97	minimum	94	_ mode	98.8	maximum	99.5		
4. Percentage of untestee	d assessment-ur	nit area in sw	eet spots (%): (triangu	ılar)				
calculated mear	23		10	_ mode	15	maximum	45		

	ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL									
	SWEET SPOTS									
5a.	a. Future success ratio (%): (triangular)									
	calculated mean	88	minimum	80	mode	90	maximum	95		
5b.	Uncertainty about average	EUR (mmb	oo for oil; bcfg	for gas):(shifted trunc	ated logno	rmal)			
	calculated mean	0.154	minimum	0.075	median	0.15	maximum	0.25		
	NON-SWEET SPOTS									
6a.	Future success ratio (%):	(triangular)								
	calculated mean	43	minimum	10	mode	40	maximum	80		
6b.	Uncertainty about average	EUR (mmb	oo for oil; bcfg	for gas):(shifted trunc	ated logno	rmal)			
	calculated mean	0.055	_ minimum	0.005	median	0.05	maximum	0.15		
	UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS (triangular)									
	<u>assessment unit:</u> Gas/oil ratio (cfg/bo)			minimum 350		mode 700		maximum 1050		
	IGL/gas ratio (bngl/mmcfg)		_	35		85		115		
	<u>s assessment unit:</u> iquids/gas ratio (bliq/mmcfg	1)	_							

SELECTED ANCILLARY DATA FOR UNTESTED WELLS

(no specified distribution type)

<u>Oil assessment unit:</u> API gravity of oil (degrees) Sulfur content of oil (%) Depth (m) of water (if applicable)	minimum 34 0.01		median 41 0.1	-	maximum 50 1
Drilling depth (m)	minimum 2130	F75	median 2895	F25	maximum 3200
<u>Gas assessment unit:</u> Inert-gas content (%) CO_2 content (%) Hydrogen sulfide content (%) Heating value (BTU) Depth (m) of water (if applicable)	minimum		median	-	maximum
Drilling depth (m)	minimum	F75	median	F25	maximum
Completion practices:					

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.88

1.	Montana		is	82.36 % of the AREA of the AU
	mean VOLUME % in entity	80.00		
2.	North Dakota		is	17.64 % of the AREA of the AU
	mean VOLUME % in entity	20.00		
3.			is	% of the AREA of the AU
	mean VOLUME % in entity			
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES Surface Allocations (uncertainty of a fixed value)

1.	Federal Lands		is	1.09 % of the AREA of the AU
	mean VOLUME % in entity	1.09		
2.	Private Lands		is	62.12 % of the AREA of the AU
	mean VOLUME % in entity	62.00		
3.	Tribal Lands		is	27.38 % of the AREA of the AU
	mean VOLUME % in entity	27.91		
4.	Other Lands		is	0.37 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
5.	MT State Lands		is	8.21 % of the AREA of the AU
	mean VOLUME % in entity	7.00		
6.	ND State Lands		is	0.83 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS Surface Allocations (uncertainty of a fixed value)

	Surface Allocat	ions (uncer	rtainty of a fixed	l value)
1.	Bureau of Land Management (BLM)		is	0.12 % of the AREA of the AU
	mean VOLUME % in entity	0.12		
2.	BLM Wilderness Areas (BLMW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
3.	BLM Roadless Areas (BLMR)		is	% of the AREA of the AU
	mean VOLUME % in entity			
4.	National Park Service (NPS)		is	% of the AREA of the AU
	mean VOLUME % in entity			
5.	NPS Wilderness Areas (NPSW) mean VOLUME % in entity		is	% of the AREA of the AU
6.	NPS Protected Withdrawals (NPSP)		- is	% of the AREA of the AU
0.	mean VOLUME % in entity		. 13	
7.	US Forest Service (FS)		is	% of the AREA of the AU
	mean VOLUME % in entity			
8.	USFS Wilderness Areas (FSW)		is	% of the AREA of the AU
	mean VOLUME % in entity			
9.	USFS Roadless Areas (FSR)		is	% of the AREA of the AU
	mean VOLUME % in entity			
10.	USFS Protected Withdrawals (FSP)		is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS Surface Allocations (uncertainty of a fixed value)

ALLOCATIONS OF POTENTIAL ADDITIONS (continue)	S TO RESERVES TO FEDERAL LAND SUBDIVISION ued)	18
11. US Fish and Wildlife Service (FWS)	is 0.97 % of the AREA of the AU	
mean VOLUME % in entity 0.97	-	
12. USFWS Wilderness Areas (FWSW)	is% of the AREA of the AU	
mean VOLUME % in entity	_	
13. USFWS Protected Withdrawals (FWSP)	is% of the AREA of the AU	
mean VOLUME % in entity	-	
14. Wilderness Study Areas (WS)	is% of the AREA of the AU	
mean VOLUME % in entity	_	
15. Department of Energy (DOE)	is% of the AREA of the AU	
mean VOLUME % in entity	-	
16. Department of Defense (DOD)	is 0.00 % of the AREA of the AU	
mean VOLUME % in entity 0.00	_	
17. Bureau of Reclamation (BOR)	is% of the AREA of the AU	
mean VOLUME % in entity	-	
18. <u>Tennessee Valley Authority (TVA)</u>	is% of the AREA of the AU	
mean VOLUME % in entity	_	
19. <u>Other Federal</u>	is% of the AREA of the AU	
mean VOLUME % in entity	_	
	is% of the AREA of the AU	
mean VOLUME % in entity	_	

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS

	Surface Allocation	ons (uncer	tainty of a fixed	t value)
1.	Northern Glaciated Plains (NGPL)		is	55.85 % of the AREA of the AU
	mean VOLUME % in entity	55.85		
2.	Northwestern Glaciated Plains (NWGL)		is	44.15 % of the AREA of the AU
	mean VOLUME % in entity	44.15		
3.			is	% of the AREA of the AU
	mean VOLUME % in entity			
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

Table 8. Input parameters for the Three Forks Continuous Oil Assessment Unit (50310166), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS (version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Reg Pro Tota Ass Bas	sessment Geologist: gion: vince: al Petroleum System: sessment Unit: sed on Data as of: res from Assessor:							29-Jan-13 5 5031 503101 50310166		
Ass	CHARACTERISTICS OF ASSESSMENT UNIT Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) heavy oil (<10 API)									
	ll type: jor reservoir type (Cho	o se one.): shale coal	-	low- low-perr	permea neability	bility clastics y carbonates	X X			
Nur Nur His	Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU) Number of tested wells: 924 Number of tested wells with EUR > minimum: 914 Historic success ratio, tested wells (%) 99 Assessment-Unit Probability: 99 What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0									
	NUMBER OF UN	DRILLED WE	ELLS WITH	POTENTIAL	FOR A	DDITIONS T	O RESER	/ES		
1.	Productive area of accucation calculated mean	·	, , , ,		mode	10,000,000	maximum	25,000,000		
2.	Uncertainty about avera	• •			•	,				
3.	calculated mean Percentage of total ass						maximum	600		
4.	calculated mean Percentage of untested				-		maximum	99.2		
	calculated mean					• ,	maximum	90		

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL								
	SWEET SPOTS							
5a. Futur	5a. Future success ratio (%): (triangular)							
	calculated mean	88	minimum	80	mode	90	maximum	95
5b. Unce	5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)							
	calculated mean	0.222	minimum	0.18	median	0.22	maximum	0.275
			NON-SV	VEET SPO	OTS			
6a. Futur	e success ratio (%):	(triangula	ar)					
	calculated mean 43 minimum 10 mode 40 maximum 80							
6b. Unce	rtainty about average	e EUR (m	mbo for oil; b	cfg for gas): (shifted t	runcated l	ognormal)	
	calculated mean	0.085	minimum	0.01	median	0.08	maximum	0.2
	UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS (triangular)							
Gas/oil	Oil assessment unit:minimummodemaximumGas/oil ratio (cfg/bo)7609601160							
NGL/ga	NGL/gas ratio (bngl/mmcfg) 35 85 115							
	Gas assessment unit: Liquids/gas ratio (bliq/mmcfg)							

SELECTED ANCILLARY DATA FOR UNTESTED WELLS

(no specified distribution type)

<u>Oil assessment unit:</u> API gravity of oil (degrees) Sulfur content of oil (%) Depth (m) of water (if applicable)	minimum 34 0.01		median 41 0.1		maximum 50 1
Drilling depth (m)	minimum 2200	F75	median 3250	F25	maximum 3400
Gas assessment unit: Inert-gas content (%) CO ₂ content (%) Hydrogen sulfide content (%) Heating value (BTU) Depth (m) of water (if applicable)	minimum		median		maximum
Drilling depth (m)	minimum	F75	median	F25	maximum
Completion practices:					

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole	
2.	Fraction of wells drilled that are typically stimulated	1	
3.	Predominant type of stimulation (none, frac, acid, other)	frac	
4.	Historic fraction of wells drilled that are horizontal	1	

	Surface Anoca		anity of a fi	
1.	Montana		is	25.18 % of the AREA of the AU
	mean VOLUME % in entity	25.00		
2.	North Dakota		is	74.82 % of the AREA of the AU
	mean VOLUME % in entity	75.00		
3.			is	% of the AREA of the AU
	mean VOLUME % in entity			
4.			is	% of the AREA of the AU
	mean VOLUME % in entity			
5.			is	% of the AREA of the AU
	mean VOLUME % in entity			
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES

Surface Allocations (uncertainty of a fixed value)

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS
Surface Allocations (uncertainty of a fixed value)

1.	Federal Lands		is	6.68 % of the AREA of the AU
	mean VOLUME % in entity	7.00		
2.	Private Lands		is	77.56 % of the AREA of the AU
	mean VOLUME % in entity	78.00		
3.	Tribal Lands		is	10.42 % of the AREA of the AU
	mean VOLUME % in entity	10.00		
4.	Other Lands		is	1.03 % of the AREA of the AU
	mean VOLUME % in entity	1.00		
5.	MT State Lands		is	1.85 % of the AREA of the AU
	mean VOLUME % in entity	2.00		
6.	ND State Lands		is	2.46 % of the AREA of the AU
	mean VOLUME % in entity	2.00		
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			

	Surface Allocations (uncertainty of a fixed value)						
1.	Bureau of Land Management (BLM)		is	0.46 % of the AREA of the AU			
	mean VOLUME % in entity	0.50					
2.	BLM Wilderness Areas (BLMW)		is	% of the AREA of the AU			
	mean VOLUME % in entity						
3.	BLM Roadless Areas (BLMR)		is	% of the AREA of the AU			
	mean VOLUME % in entity						
4.	National Park Service (NPS)		is	0.28 % of the AREA of the AU			
	mean VOLUME % in entity	0.30					
5.	NPS Wilderness Areas (NPSW)		is	% of the AREA of the AU			
	mean VOLUME % in entity						
6.	NPS Protected Withdrawals (NPSP)		is	% of the AREA of the AU			
	mean VOLUME % in entity						
7.	US Forest Service (FS)		is	3.14 % of the AREA of the AU			
	mean VOLUME % in entity	3.20					
8.	USFS Wilderness Areas (FSW)		is	% of the AREA of the AU			
	mean VOLUME % in entity						
9.	USFS Roadless Areas (FSR)		is	% of the AREA of the AU			
	mean VOLUME % in entity						
10.	USFS Protected Withdrawals (FSP)		is	% of the AREA of the AU			
	mean VOLUME % in entity						

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS Surface Allocations (uncertainty of a fixed value)

	THIEET OF		
ALLOCATIONS OF POTENTIAL AD	DITIONS - (continue)		ES TO FEDERAL LAND SUBDIVISIONS
11. US Fish and Wildlife Service (FWS)		is	1.05 % of the AREA of the AU
mean VOLUME % in entity	1.00		
12. USFWS Wilderness Areas (FWSW)		is	% of the AREA of the AU
mean VOLUME % in entity			
13. USFWS Protected Withdrawals (FW)	SP)	is	% of the AREA of the AU
mean VOLUME % in entity			
14. Wilderness Study Areas (WS)		is	% of the AREA of the AU
mean VOLUME % in entity			
15. Department of Energy (DOE)		is	% of the AREA of the AU
mean VOLUME % in entity			
16. Department of Defense (DOD)		is	0.00 % of the AREA of the AU
mean VOLUME % in entity	0.00		
17. Bureau of Reclamation (BOR)		is	% of the AREA of the AU
mean VOLUME % in entity			
18. Tennessee Valley Authority (TVA)		is	% of the AREA of the AU
mean VOLUME % in entity			
19. Other Federal		is	1.75 % of the AREA of the AU
mean VOLUME % in entity	2.00		
20		is	% of the AREA of the AU
mean VOLUME % in entity			

	ALLOCATIONS OF POTE Surface Allocati			RESERVES TO ECOSYSTEMS xed value)
1.	Northeastern Glaciated Plains (NEGP)		is	25.16 % of the AREA of the AU
	mean VOLUME % in entity	25.16		
2.	Northern Glaciated Plains (NGPL)		is	41.50 % of the AREA of the AU
	mean VOLUME % in entity	41.50		
3.	Northwestern Glaciated Plains (NWC	GL)	is	8.62 % of the AREA of the AU
	mean VOLUME % in entity	8.62		
4.	Northwestern Great Plains (NWGP)		is	24.66 % of the AREA of the AU
	mean VOLUME % in entity	24.66		
5.	Powder River Basin (PRBA)		is	0.07 % of the AREA of the AU
	mean VOLUME % in entity	0.06		
6.			is	% of the AREA of the AU
	mean VOLUME % in entity			
7.			is	% of the AREA of the AU
	mean VOLUME % in entity			
8.			is	% of the AREA of the AU
	mean VOLUME % in entity			
9.			is	% of the AREA of the AU
	mean VOLUME % in entity			
10.			is	% of the AREA of the AU
	mean VOLUME % in entity			