

## Cook Inlet Play 1: Tertiary Oil Play

### Geological Assessment

*GRASP UAI: AAAAAACAB*

*Play Area: 825 square miles*

*Play Water Depth Range: 50-200 feet*

*Play Depth Range: 4,000-10,000 feet*

*Play Exploration Chance: 0.225*

<b>Play 1, Tertiary-Oil, Cook Inlet (Federal) OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil &amp; Gas</b>			
Assessment Results as of November 2005			
<b>Resource Commodity (Units)</b>	<b>Resources *</b>		
	<b>F95</b>	<b>Mean</b>	<b>F05</b>
BOE (Mmboe)	0	358	1,034
Total Gas (Tcfg)	0.000	0.126	0.377
Total Liquids (Mmbo)	0	336	967
Free Gas** (Tcfg)	0.000	0.000	0.000
Solution Gas (Tcfg)	0.000	0.126	0.377
Oil (Mmbo)	0	336	967
Condensate (Mmbc)	0	0	0

\* Risked, Technically-Recoverable  
 \*\* Free Gas Includes Gas Cap and Non-Associated Gas  
 F95 = 95% chance that resources will equal or exceed the given quantity  
 F05 = 5% chance that resources will equal or exceed the given quantity  
 BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas  
 Mmb = millions of barrels  
 Tcf = trillions of cubic feet

**Table 1**

Play 1, the “Tertiary Oil” play, is the second most important play (of four plays) in the Cook Inlet OCS Planning Area, with approximately 29% (358 Mmboe) of the Planning Area energy endowment (1,225 Mmboe). The overall assessment results for play 1 are shown in [table 1](#). Oil forms 94%

of the hydrocarbon energy endowment of play 1 with the remainder being solution gas. [Table 5](#) reports the detailed assessment results by commodity for play 1.

[Table 3](#) summarizes the volumetric input data developed for the *GRASP* computer model of Cook Inlet play 1. [Table 4](#) reports the risk model used for play 1. The location of play 1 is shown in [figure 1](#).

Play 1 is restricted to the northernmost part of the Planning Area, north of the Augustine-Seldovia arch. It is southern limit of the Cook Inlet Tertiary oil play, which is productive to the north in State of Alaska waters and onshore. Magoon (1994) refers to the play there as the Tuxedni-Hemlock petroleum system. Almost 80 % of the production is from the Oligocene Hemlock Conglomerate and the source rock is the Middle Jurassic Tuxedni Group. Sandstones in the lower Tyonek Formation of Miocene age accounts for most of the remainder of the oil production. The Tertiary rocks in the basin are non-marine. The sandstones were deposited in fluvial channels or alluvial fans in response to variation in uplift histories of adjacent tectonic blocks (Swenson, 2002).

The first oil discovery in the basin was the Swanson River field on the Kenai Peninsula in 1957. The largest field discovered to date is the McArthur River field in Cook Inlet, with approximately 649 Mmbo of ultimately recoverable reserves. The eight producing fields are largely depleted. According to the Division of Oil and Gas in the Alaska Department of Natural Resources (ADNR, 2006) this play has produced 1.318 Bbo through 2005. Approximately 94.1 Mmbo

of proven reserves remain, not including the unknown reserves of the Cosmopolitan Unit.

The nearest discovery to the Planning Area is on the Cosmopolitan Unit, which straddles the State-Federal boundary offshore from the southern Kenai Peninsula. The discovery well, the Pennzoil Starichkof State No. 1, was drilled in 1967 and encountered oil in the lower Tyonek Formation. An offset well was drilled downdip, but the pay zone was water wet so the prospect was abandoned. The State and Federal leases were acquired and unitized by ConocoPhillips and partners in the 1990's. In 2001, the ConocoPhillips Hansen No. 1 well, along with a subsequent sidetrack, established producible zones in the Tyonek Formation and the underlying Hemlock Conglomerate. Both units were tested at flow rates greater than 500 BOPD with 25° API oil. As of this writing, 3-D seismic data are being acquired and evaluated over the Cosmopolitan Unit and future drilling and development plans are awaiting those results. If successful, it will be the first production from Federal waters in lower Cook Inlet, although most of the oil pool is in State waters.

Potential traps in play 1 include anticlines cored by reverse faults and stratigraphic traps in fluvial channels and alluvial fans. All of the fields in upper Cook Inlet and onshore are in structural traps, so the stratigraphic trap concept has not been thoroughly explored anywhere in the forearc basin. The limited areal extent of play 1 is the major constraint on resource potential in Federal waters. The source-rock and reservoir-rock viability are well established in the play. Because of proximity to infrastructure, the economically recoverable resources in play 1 are the highest of the four plays in the Planning Area.

A maximum of 19 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 1. These 19 pools range in mean conditional (un-risked) recoverable volumes from 13 Mmboe (pool rank 19) to 229 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 50 Mmboe (F95) to 567 Mmboe (F05). [Table 2](#) shows the conditional sizes of the 10 largest pools in play 1.

<b>Play 1, Tertiary Oil, Cook Inlet (Federal) OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools</b>			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	50	229	567
2	26	118	277
3	17	78	175
4	14	58	129
5	11	47	103
6	10	39	86
7	9	34	74
8	8.4	31	65
9	7.9	28	58
10	7.3	25	53

\* Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file  
 F95 = 95% chance that resources will equal or exceed the given quantity  
 F05 = 5% chance that resources will equal or exceed the given quantity  
 BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

**Table 2**

In the computer simulation for play 1 a total of 33,579 “simulation pools” were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 12 contains the largest share (9,308, or 27.7%) of simulation pools (conditional, technically

recoverable BOE resources) for play 1. Pool size class 12 ranges from 64 to 128 Mmboe. The largest simulation pool for play 1 falls within pool size class 16, which ranges in size from 1,024 to 2,048 Mmboe. [Table 6](#) reports statistics for the simulation pools developed in the *GRASP* computer model for play 1.

**GRASP Play Data Form (Minerals Management Service - Alaska Regional Office)**

**Basin:** Lower Cook Inlet  
**Play Number:** 1  
**Play UAI Number:** AAAACAB

**Assessor:** Comer / Larson  
**Play Name:** Tertiary Oil Play

**Date:** March, 2005

**Play Area (mi<sup>2</sup>; millions of acres):** 825 (0.528)  
**Reservoir Thermal Maturity, % Ro:**

**Play Depth Range, feet:** 4,000 - 6,000 - 10,000  
**Expected Oil Gravity, ° API:** 30  
**Play Water Depth Range, feet:** 50 - 150 - 200  
**Prospect Distance from shore, miles:** 25

**POOLS Module (Volumes of Pools, Acre-Feet)**

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input	0				0.4	---				0.75			~
Prospect Area (acres)-Model Output	400	1727	2155	3118	4700	5656.0 / 3786.5	7085	8831	10252	12788	16401	19360	20000
Fill Fraction (Fraction of Area Filled)	0.2	0.21	0.25	0.31	0.4	0.4303 / 0.17064	0.52	0.59	0.65	0.75	0.88	0.97	1
Productive Area of Pool (acres)	105	542	722	1168	1994	2699.86 / 2315.16	3403	4533	5505	7342	10152	12599	14067
Pay Thickness (feet)	19	48	57	74	100	110.674 / 52.868	135	159	177	208	250	282	526

**MPRO Module (Numbers of Pools)**

Play Level Chance	0.75	Prospect Level Chance	0.3	Exploration Chance	0.225
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Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		[ See Risking Sheet ]	

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	6	8	9	11	14	14.93 / 4.59	17	19	21	23	27	27	28
Numbers of Pools in Play	~	~	F74.05 = 0	F70 = 1	3	3.36 / 2.75	5	6	7	8	9	10	19

Minimum Number of Pools	0	Mean Number of Pools	3.36	Maximum Number of Pools	19
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**POOLS/PSRK/PSUM Module (Play Resources)**

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	153	234	252	286	328	334.954 / 70.119	376	405	426	459	499	528	700
Gas Recovery Factor (Mcfg/acre-foot)	375	556	594	663	750	762.558 / 141.960	848	906	947	1012	1090	1145	1476
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	143	193	220	274	350	374.603 / 142.092	447	510	558	637	739	815	1110
Condensate Yield ((bbl/Mmcfg)	20	40	42	47	52	52.692 / 8.796	58	62	64	68	73	76	100
Pool Size Distribution Statistics from POOLS (1,000 BOE):	$\mu$ (mu) = 11.1488808		$\sigma^2$ (sigma squared) = 0.873838509				Random Number Generator Seed = 701141						

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0
Probability Any Pool is 100% Oil	1	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	N/A
Probability Any Pool is 100% Gas	0		

**Table 3.** Input data for Cook Inlet play 1, 2006 assessment.



**GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results**

Minerals Management Service - Alaska OCS Region  
 GRASP Model Version: 8.29.2005)  
 Computes the Geologic Resource Potential of the Play

**Play UAI: AAAAACAB**                      **Play No. 1**

World Level - World Level Resources  
 Country Level - UNITED STATES OF AMERICA  
 Region Level - MMS ALASKA REGION  
 Basin Level - **COOK INLET**  
**Play Level - 1 Tertiary - Oil**  
 Geologist Larson / Comer  
 Remarks 2005 Assessment  
 Run Date & Time: Date 19-Sep-05 Time 13:59:10

**Summary of Play Potential**

Product	MEAN	Standard Deviation
<b>BOE (Mboe)</b>	358,010	360,780
<b>Oil (Mbo)</b>	335,630	338,130
<b>Condensate (Mbc)</b>	0	0
<b>Free (Gas Cap &amp; Nonassociated) Gas (Mmcf)</b>	0	0
<b>Solution Gas (Mmcf)</b>	125,780	132,850

10000 (Number of Trials in Sample)  
 0.7402 (MPhc [Probability] of First Occurrence of Non-Zero Resource)  
 Windowing Feature: used

**Empirical Probability Distributions of the Products**

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcf)	Solution Gas (Mmcf)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	80,585	75,796	0	0	26,916
65	140,250	131,490	0	0	49,238
60	190,640	178,550	0	0	67,963
55	239,590	224,840	0	0	82,920
50	287,300	270,000	0	0	97,193
45	333,320	312,750	0	0	115,550
40	381,600	357,660	0	0	134,550
35	435,700	408,250	0	0	154,230
30	494,140	462,830	0	0	175,960
25	557,060	520,530	0	0	205,290
20	630,440	591,720	0	0	217,620
15	720,250	675,140	0	0	253,470
10	840,370	788,260	0	0	292,870
8	900,120	842,810	0	0	322,080
6	984,020	925,040	0	0	331,500
5	1,033,700	966,680	0	0	376,820
4	1,097,200	1,028,000	0	0	389,340
2	1,316,400	1,232,900	0	0	468,960
1	1,539,800	1,445,900	0	0	527,530
0.1	2,189,100	2,069,800	0	0	670,380
0.01	2,546,600	2,379,000	0	0	941,990
0.001	2,689,000	2,562,600	0	0	710,130

**Table 5.** Assessment results by commodity for Cook Inlet play 1, 2006 assessment.

Basin: COOK INLET Play 01 - Tertiary - Oil UAI Key: AAAAACAB				Model Simulation "Pools" Reported by "Fieldsize.out" GRASP Module																		
Classification and Size				Pool Count Statistics			Pool Types Count		Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range		Pool Resource Statistics (MMBOE)					
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg	Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Total Resource	Average Resource	
1	0.0312	0.0625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
2	0.0625	0.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
3	0.125	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
4	0.25	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
5	0.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
6	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
7	2	4	44	0.131034	0.0044	0.005944	0	44	0	0	0	1	1	0	0	0	1	1	2.060994	3.968162	141.260061	3.210456
8	4	8	327	0.973823	0.0327	0.044171	0	327	0	0	0	1	2	0	0	0	1	2	4.021079	7.995041	2091.290000	6.395383
9	8	16	1642	4.889961	0.1642	0.221802	0	1642	0	0	0	1	3	0	0	0	1	3	8.006253	15.999015	20415.200000	12.433130
10	16	32	4836	14.401858	0.4836	0.653249	0	4836	0	0	0	1	5	0	0	0	1	5	16.001076	31.980925	116927.728000	24.178604
11	32	64	8791	26.180054	0.8791	1.187492	0	8791	0	0	0	1	7	0	0	0	1	7	32.000987	63.999246	414276.408000	47.125061
12	64	128	9308	27.719706	0.9308	1.257328	0	9308	0	0	0	1	7	0	0	0	1	7	64.002936	127.989462	851546.852000	91.485481
13	128	256	5832	17.367998	0.5832	0.787789	0	5832	0	0	0	1	6	0	0	0	1	6	128.010678	255.979097	1035804.000000	177.607071
14	256	512	2324	6.920992	0.2324	0.313927	0	2324	0	0	0	1	4	0	0	0	1	4	256.017375	511.819022	807456.609000	347.442596
15	512	1024	441	1.313321	0.0441	0.05957	0	441	0	0	0	1	2	0	0	0	1	2	512.626223	1016.226000	289707.590000	656.933289
16	1024	2048	34	0.101254	0.0034	0.004593	0	34	0	0	0	1	1	0	0	0	1	1	1031.616000	1645.675000	41752.991000	1.228029
17	2048	4096	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
18	4096	8192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
19	8192	16384	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	
Totals			33579	100	3.3579	4.535864	Above Class	0	0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	

Number of Pools not Classified: 0	Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.	Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.
Number of Pools below Class 1: 0		
Number of Trials with Pools: 7403		

**Table 6.** Statistics for simulation pools created in computer sampling run for Cook Inlet play 1, 2006 assessment.

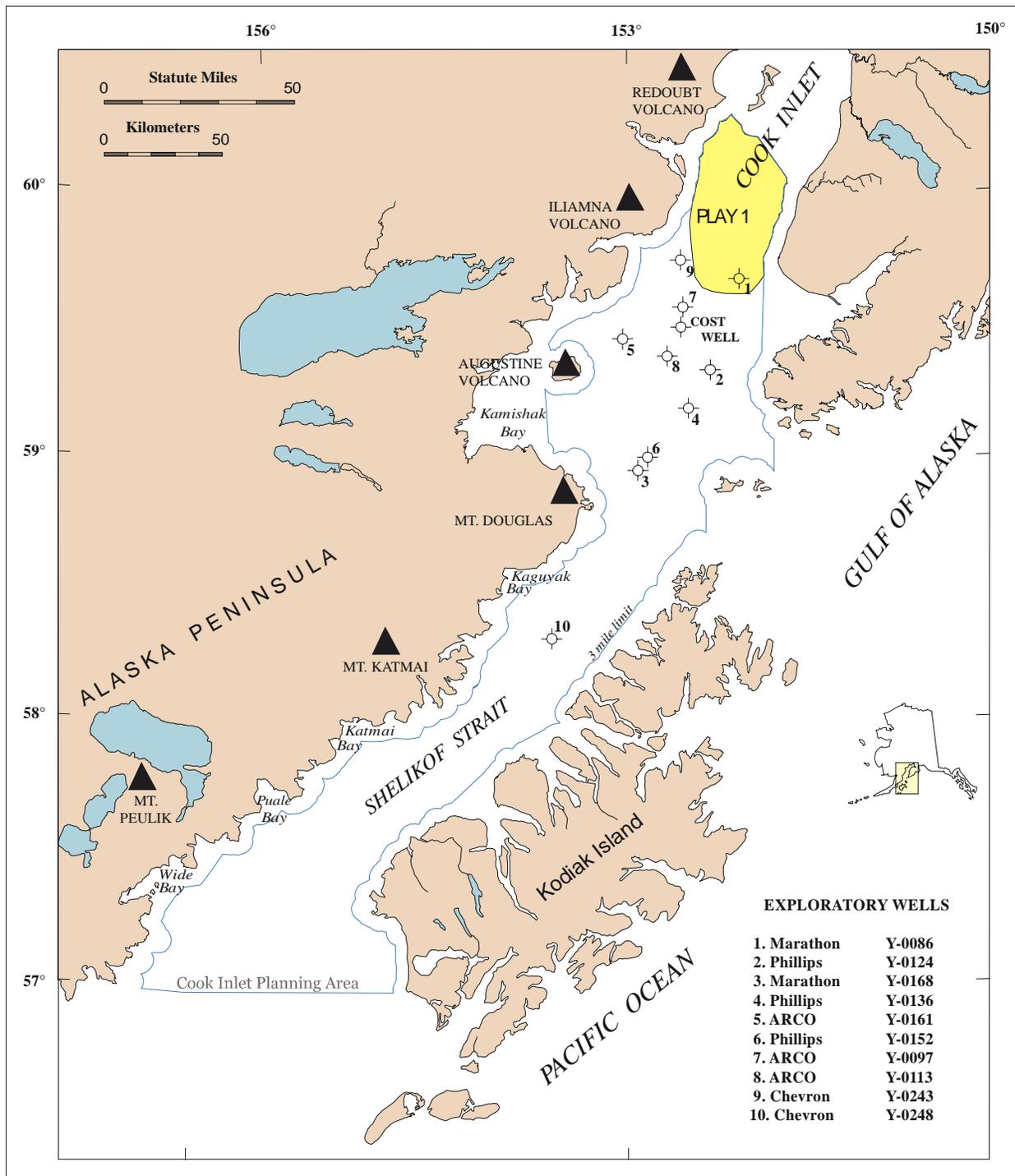


Figure 1. Map location of Cook Inlet play 1, 2006 assessment.