COOK INLET GAS

Presentation to the Regulatory Commission of Alaska by
Department of Natural Resources
Division of Oil and Gas
Division of Geophysical and Geological Surveys
October 15, 2007

Presenters

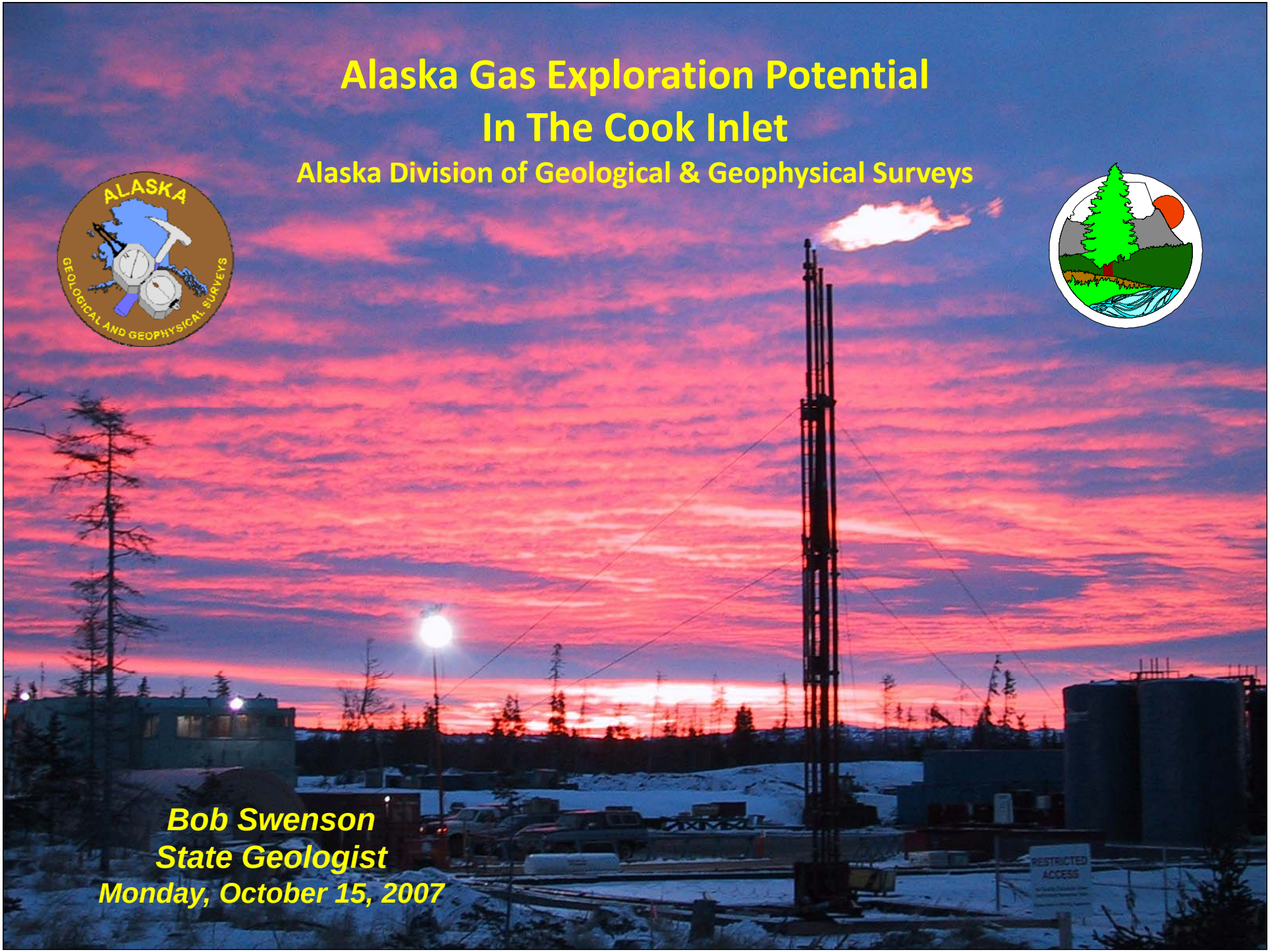
- DNR Staff-
  - Kevin Banks, Director DOG
  - Bob Swenson, Director DGGS
  - Julie Houle, Section Chief, Resource Evaluation
  - Will Nebesky, Commercial Analyst
  - Kurt Gibson, Deputy Director, DOG

How the RCA can influence the supply and price of Cook Inlet gas

- Price-review of utility supply contracts
- Deliverability-rulings on pipeline applications
- Market-review of gas purchase contracts

Alaska Gas Exploration Potential In The Cook Inlet

Alaska Division of Geological & Geophysical Surveys



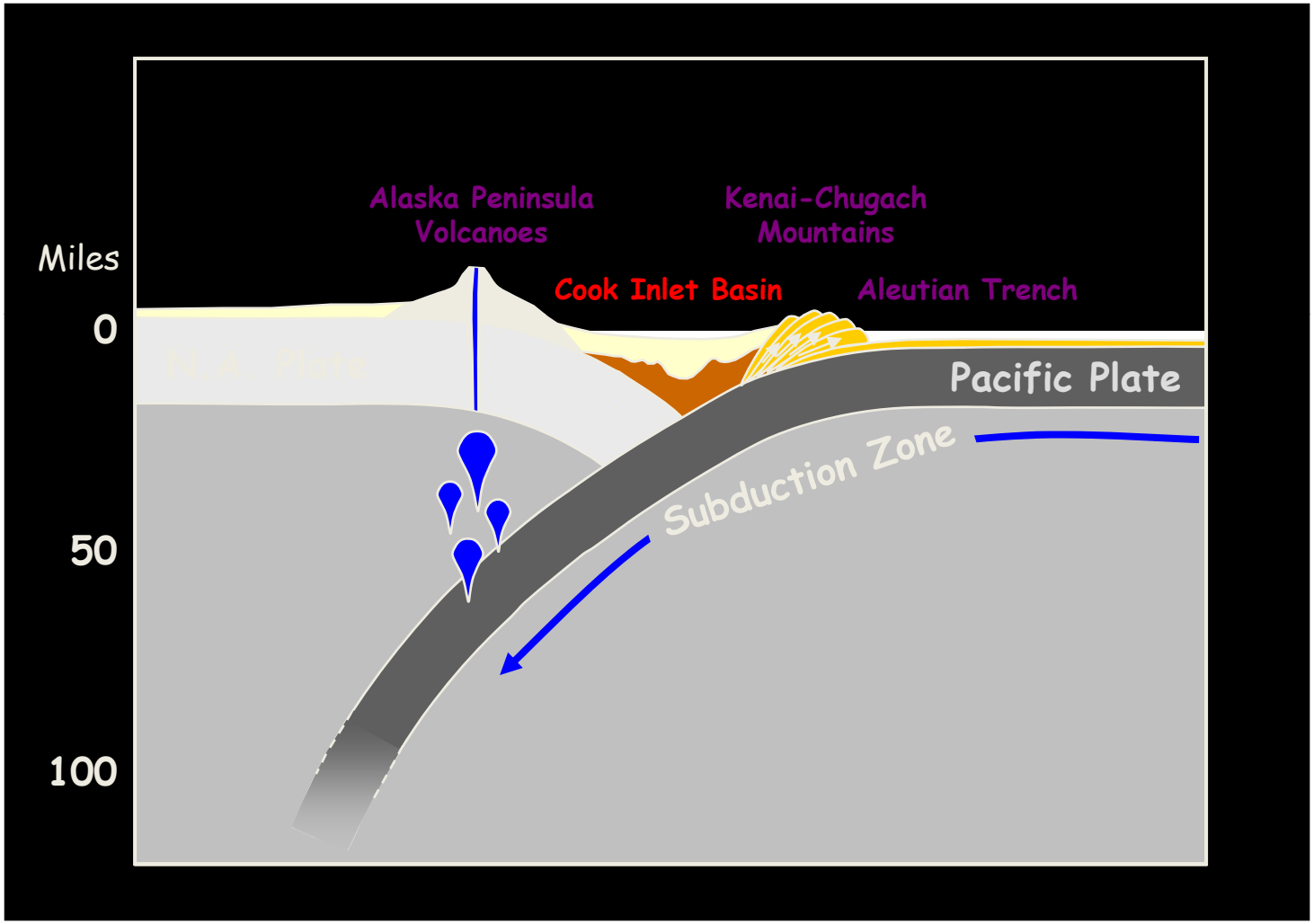
Bob Swenson
State Geologist
Monday, October 15, 2007

Cook Inlet Geology

- Of the 8+ TCF of gas reserves found, nearly all were discovered while looking for oil on big structural plays
- Because of historic over-supply and limited market, there has been minimal focused exploration for gas in the Cook Inlet
- Oil and Gas exploration is inherently risky, with a low chance of economic success
- The best chance of success is achieved when numerous geologic concepts are tested
- Market certainty, modern high resolution geologic data, and non-volatile pricing are key to meeting economic risk thresholds
- In the Cook Inlet, most of the “easy”(inexpensive) gas has been found

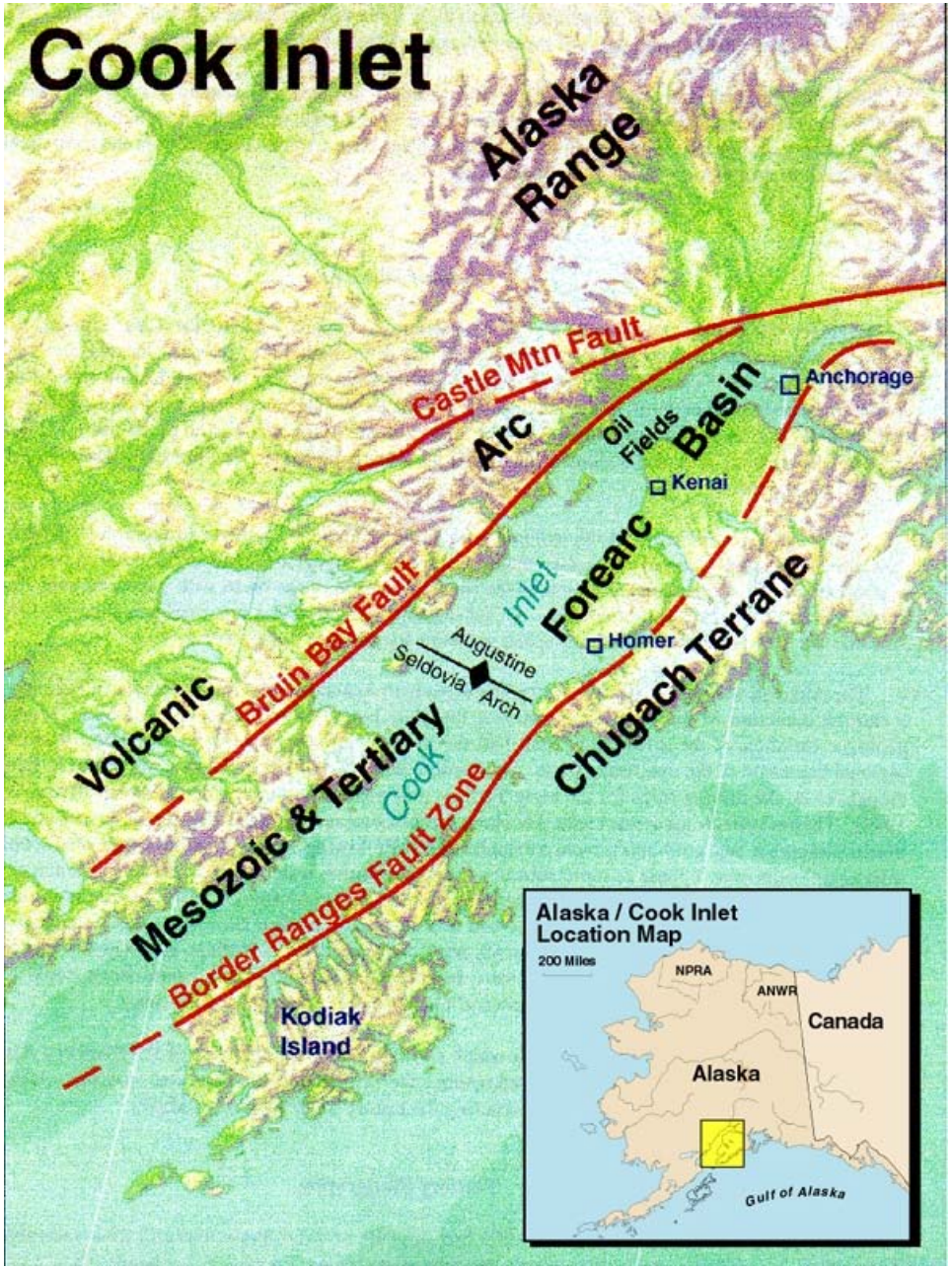
UPPER COOK INLET BASIN
Basin / Reservoir Origins

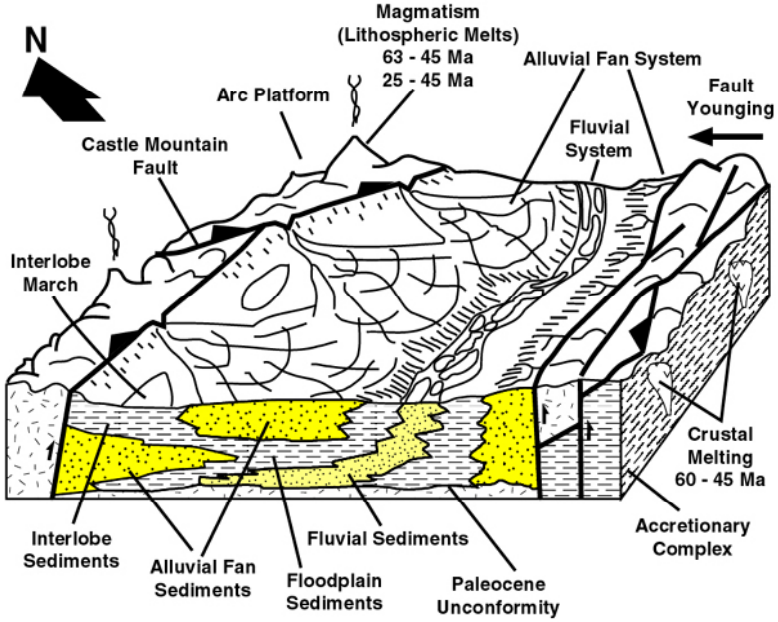
NW SE

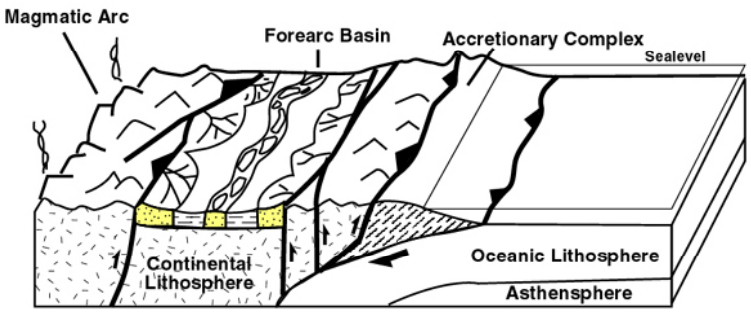


Modified from:
Tornqvist, T., 2005, Principles of Sedimentology and Stratigraphy, University of Chicago, http://www.uic.edu/classes/geol/eaes350/

Importance of Provenance

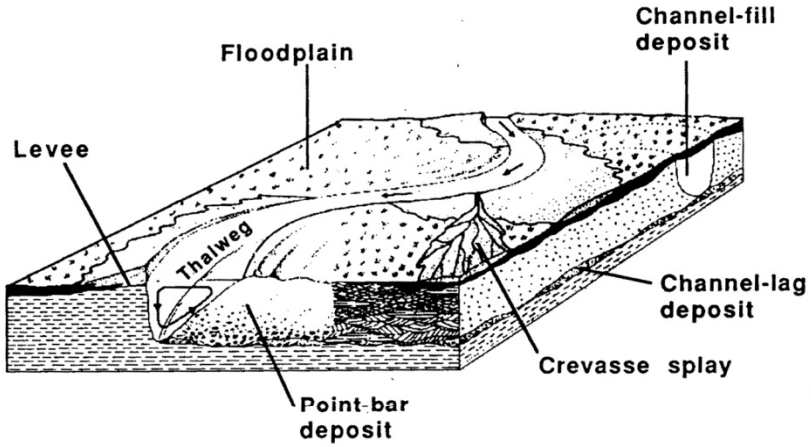


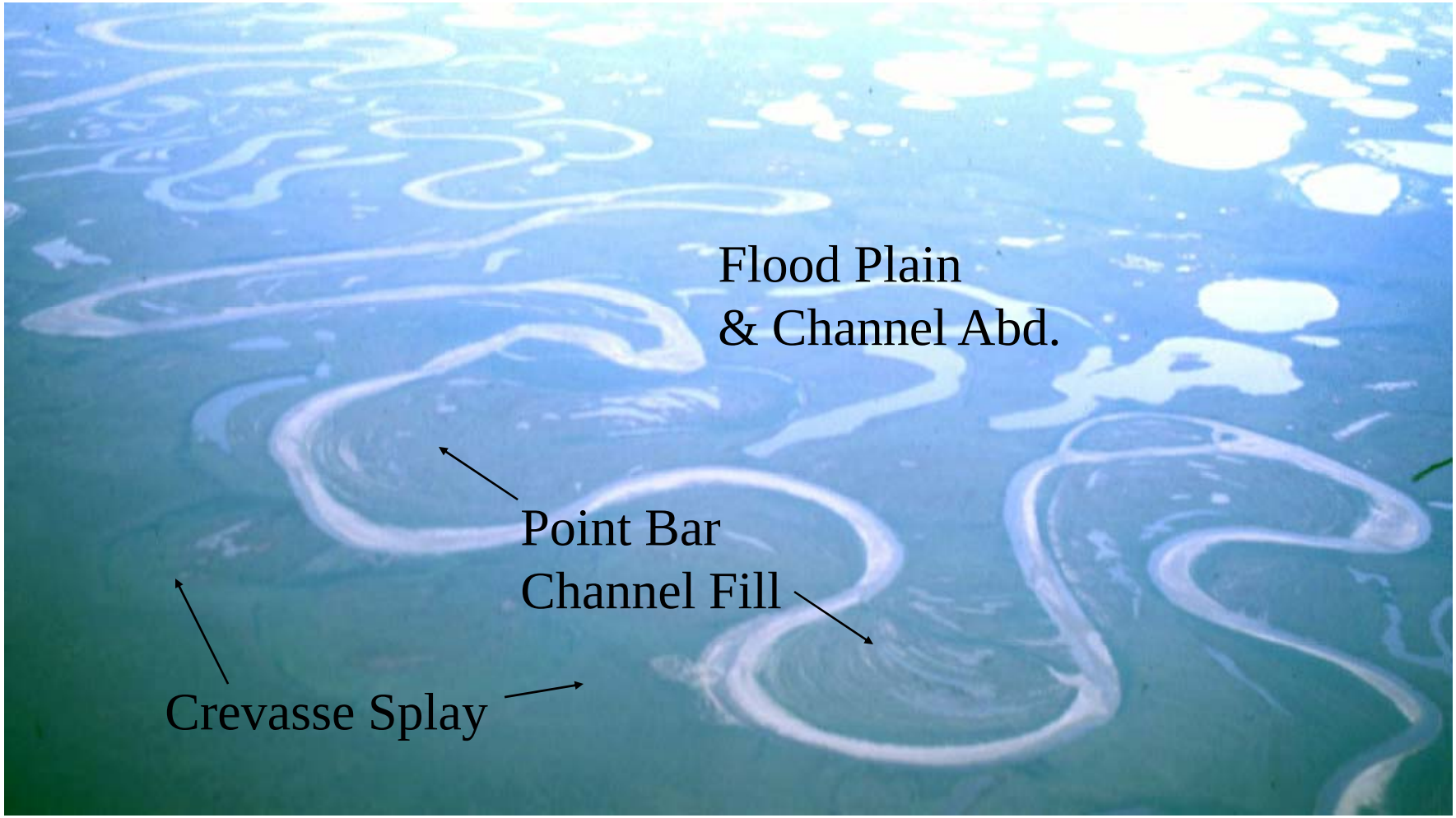




McGowen, et. al., 1994

Tertiary Basin Depositional Systems

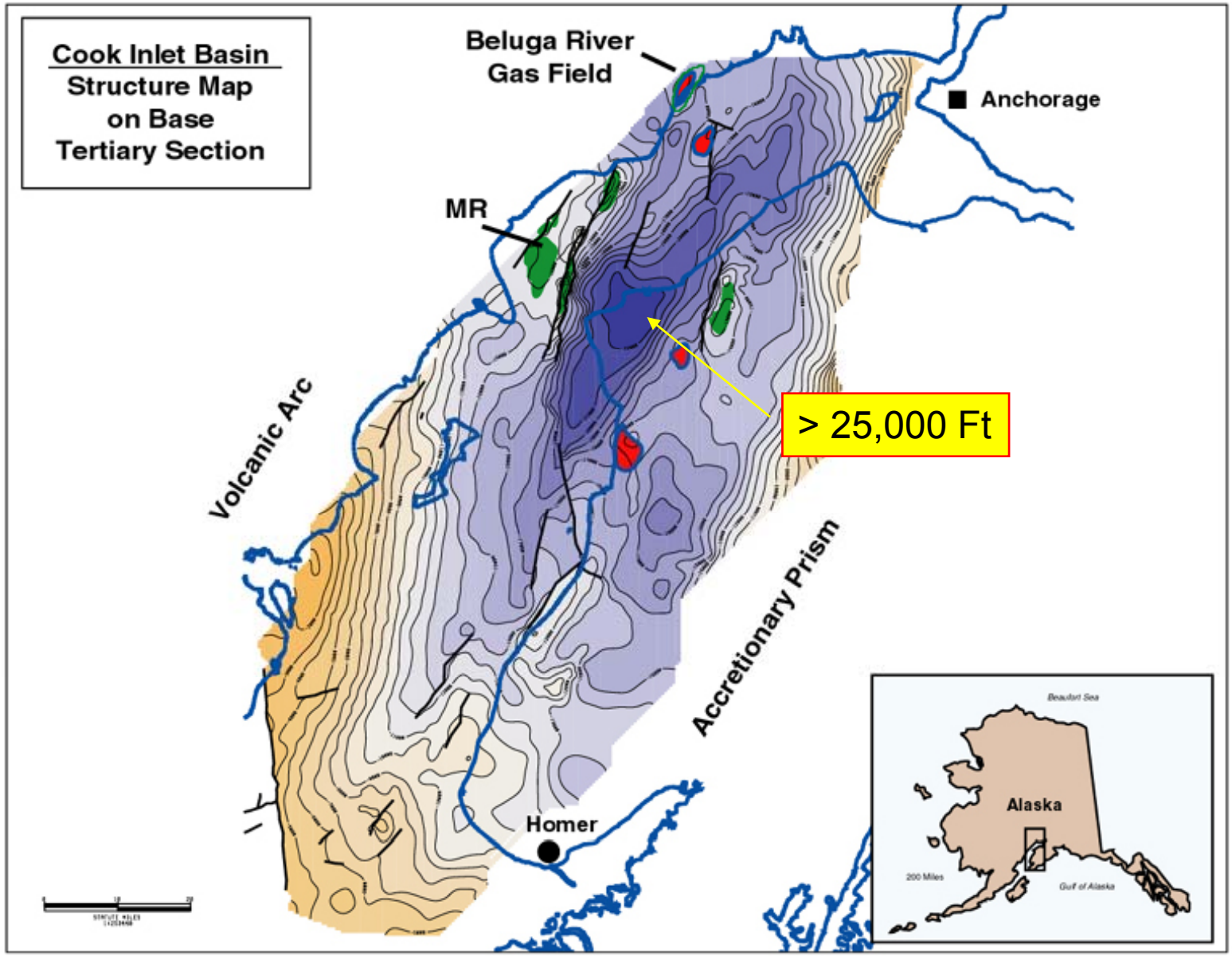




Outcrop of Tertiary Non-Marine Sediments

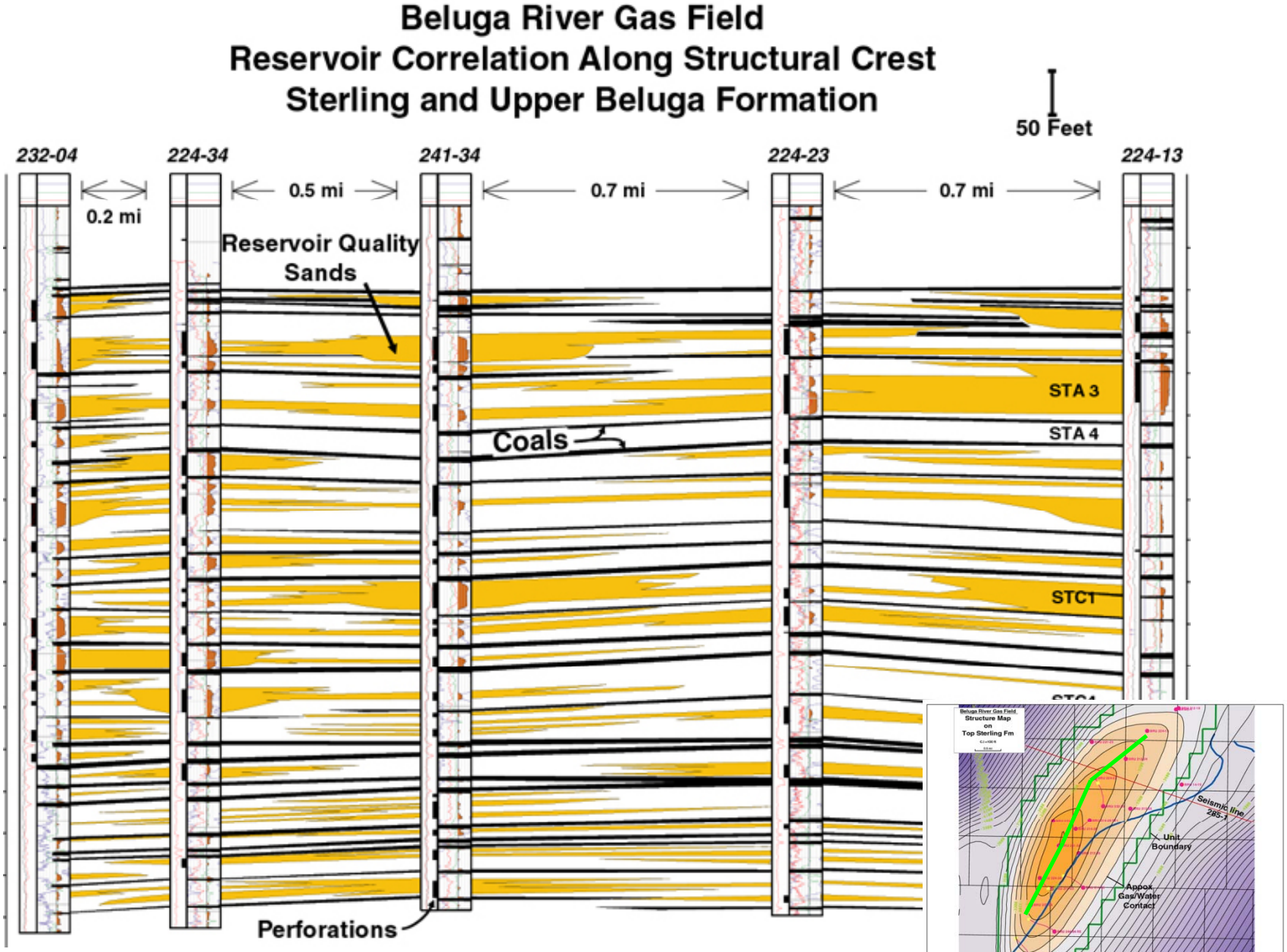
Roy D. Merritt, DGGS 08/95

Tertiary Reservoir Section



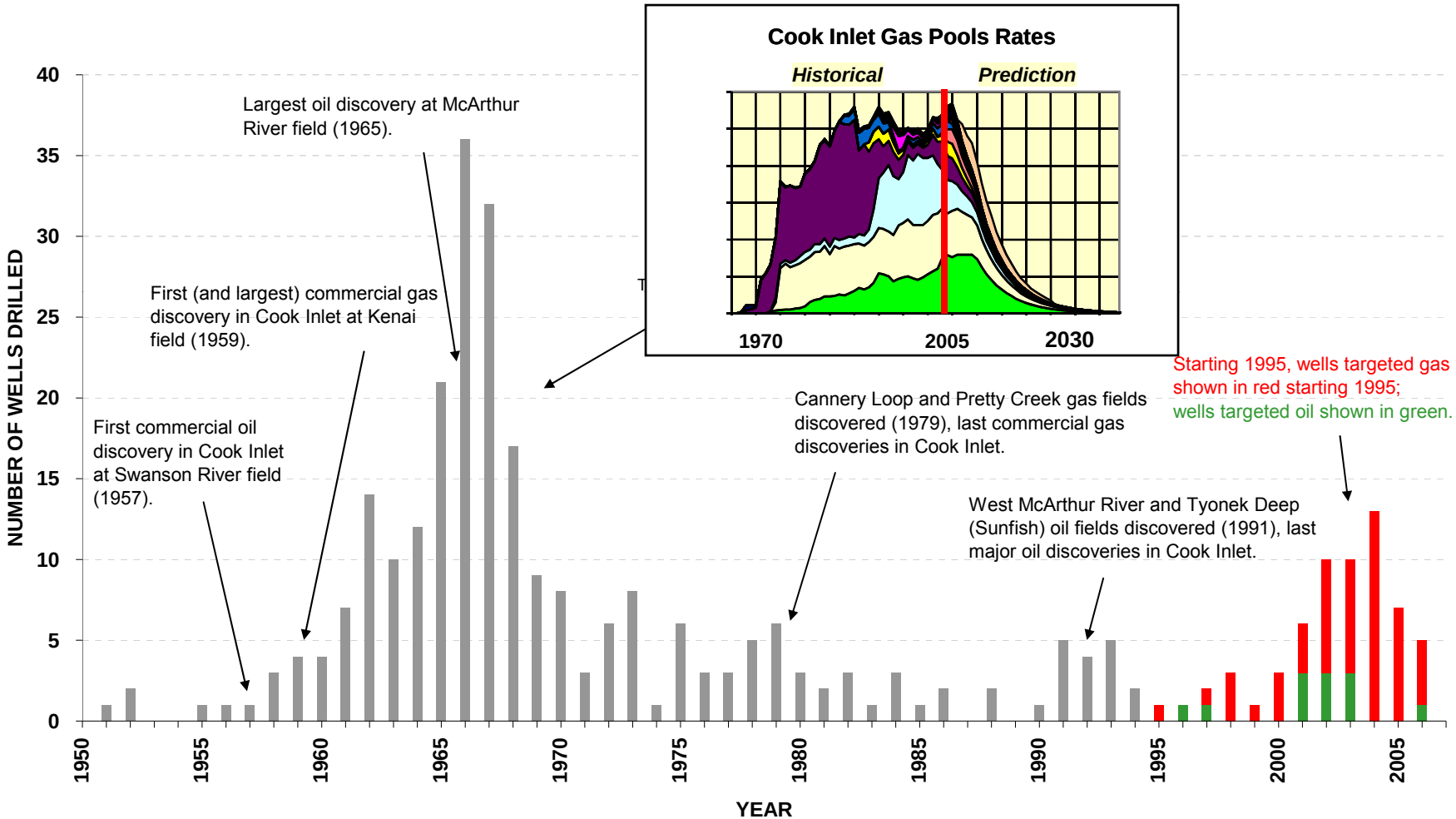
From Swenson, 2005, courtesy of Arco Alaska

Sand Distribution in a Fluvial System



From Swenson, 1997, courtesy of ConocoPhillips, Chevron, MLP

Cook Inlet Exploration Wells Drilled, 1950 - 2006



Is there more gas to be found?

- Yes

Where will it be found?

- In existing fields
- In new exploration play types

What are the hurdles?

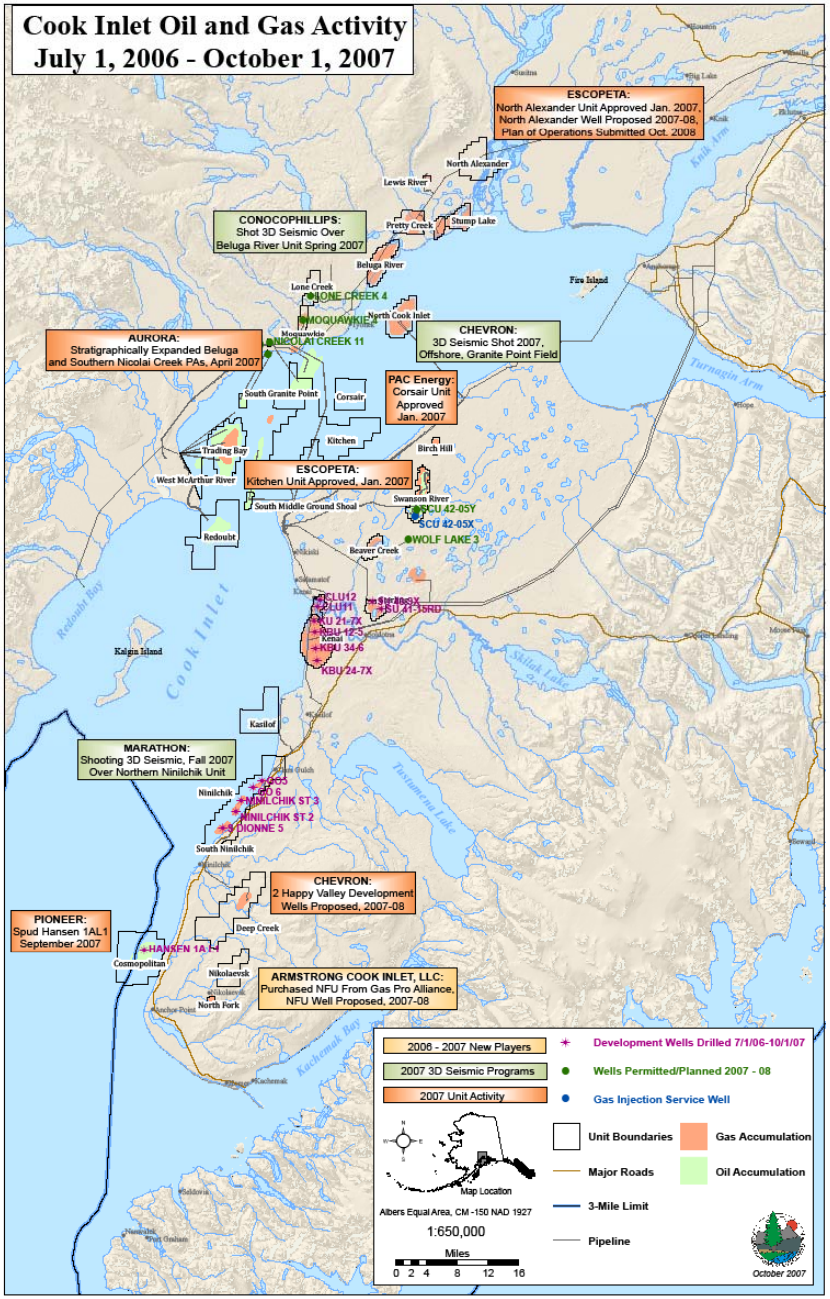
- Expensive data and drilling costs
- Limited market
- Complicated land access

Cook Inlet Gas Exploration Activities

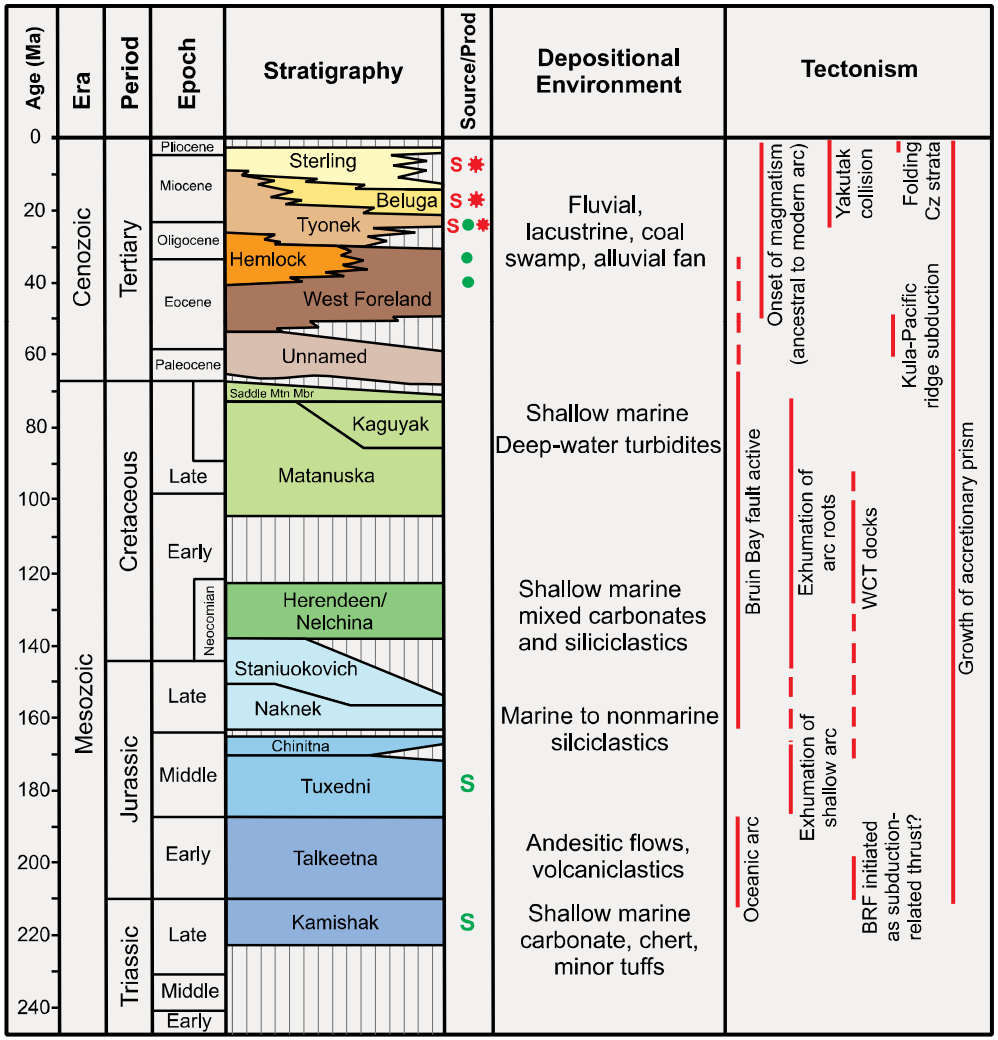
October 2007

Julie Houle
Section Chief, Resource Evaluation
Division of Oil and Gas

Alaska Department of
Natural Resources

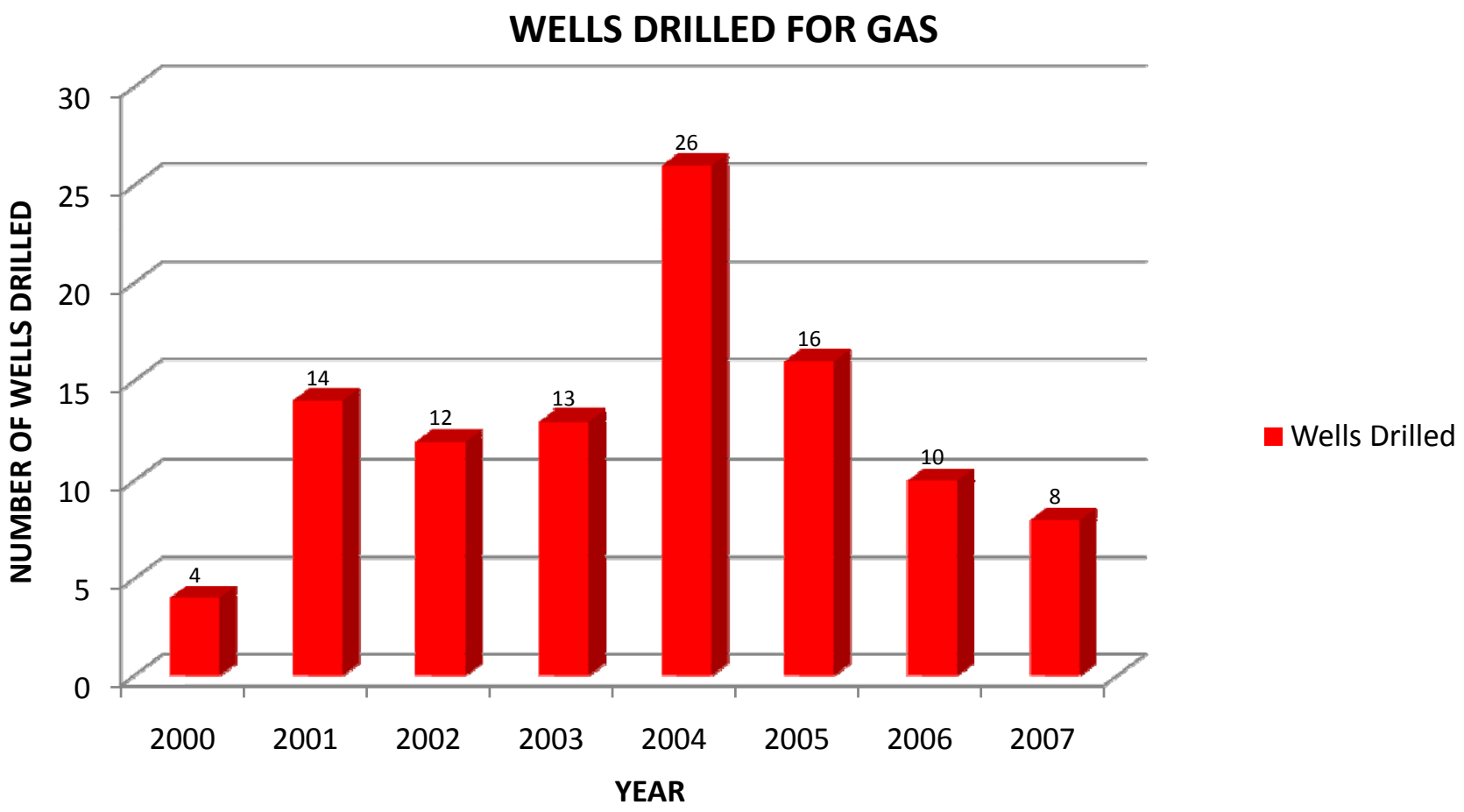

Cook Inlet Oil and Gas Activity
July 1, 2006 - October 1, 2007
ESCOPETA:
North Alexander Unit Approved Jan. 2007,
North Alexander Well Proposed 2007-08,
Plan of Operations Submitted Oct. 2008
CONOCOPHILLIPS:
Shot 3D Seismic Over
Beluga River Unit Spring 2007
AURORA:
Stratigraphically Expanded Beluga
and Southern Nicolai Creek PAs, April 2007
CHEVRON:
3D Seismic Shot 2007,
Offshore, Granite Point Field
PAC Energy:
Corsair Unit
Approved
Jan. 2007
ESCOPETA:
Kitchen Unit Approved, Jan. 2007
MARATHON:
Shooting 3D Seismic, Fall 2007
Over Northern Ninilchik Unit
CHEVRON:
2 Happy Valley Development
Wells Proposed, 2007-08
PIONEER:
Spud Hansen 1AL1
September 2007
ARMSTRONG COOK INLET, LLC:
Purchased NFU From Gas Pro Alliance,
NFU Well Proposed, 2007-08
North Alexander
Lewis River
Pretty Creek
Stump Lake
Beluga River
Lone Creek
LONE CREEK 4
North Cook Inlet
MOQUAWKIE 4
NICOLAI CREEK 11
Fire Island
South Granite Point
Corsair
Kitchen
Birch Hill
Trading Bay
West McArthur River
Swanson River
SCU 42-05Y
SCU 42-05X
WOLF LAKE 3
Redoubt
Beaver Creek
KCLU12
KCLU11
KU 21-7X
KBU 12-5
KBU 34-6
KBU 24-7X
Kenai
Kalgin Island
Cook Inlet
Redoubt Bay
Kasilof
Ninilchik
NINILCHIK ST 3
NINILCHIK ST 2
DIONNE 5
South Ninilchik
Deep Creek
HANSEN 1A
Cosmopolitan
Nikolaevsk
North Fork
Kachemak Bay
Tustumena Lake
Skilak Lake
Turnagin Arm
Knik Arm
2006 - 2007 New Players
2007 3D Seismic Programs
2007 Unit Activity
Development Wells Drilled 7/1/06-10/1/07
Wells Permitted/Planned 2007 - 08
Gas Injection Service Well
Unit Boundaries
Gas Accumulation
Major Roads
Oil Accumulation
3-Mile Limit
Pipeline
Map Location
Albers Equal Area, CM -150 NAD 1927
1:650,000
Miles
0 2 4 8 12 16
October 2007

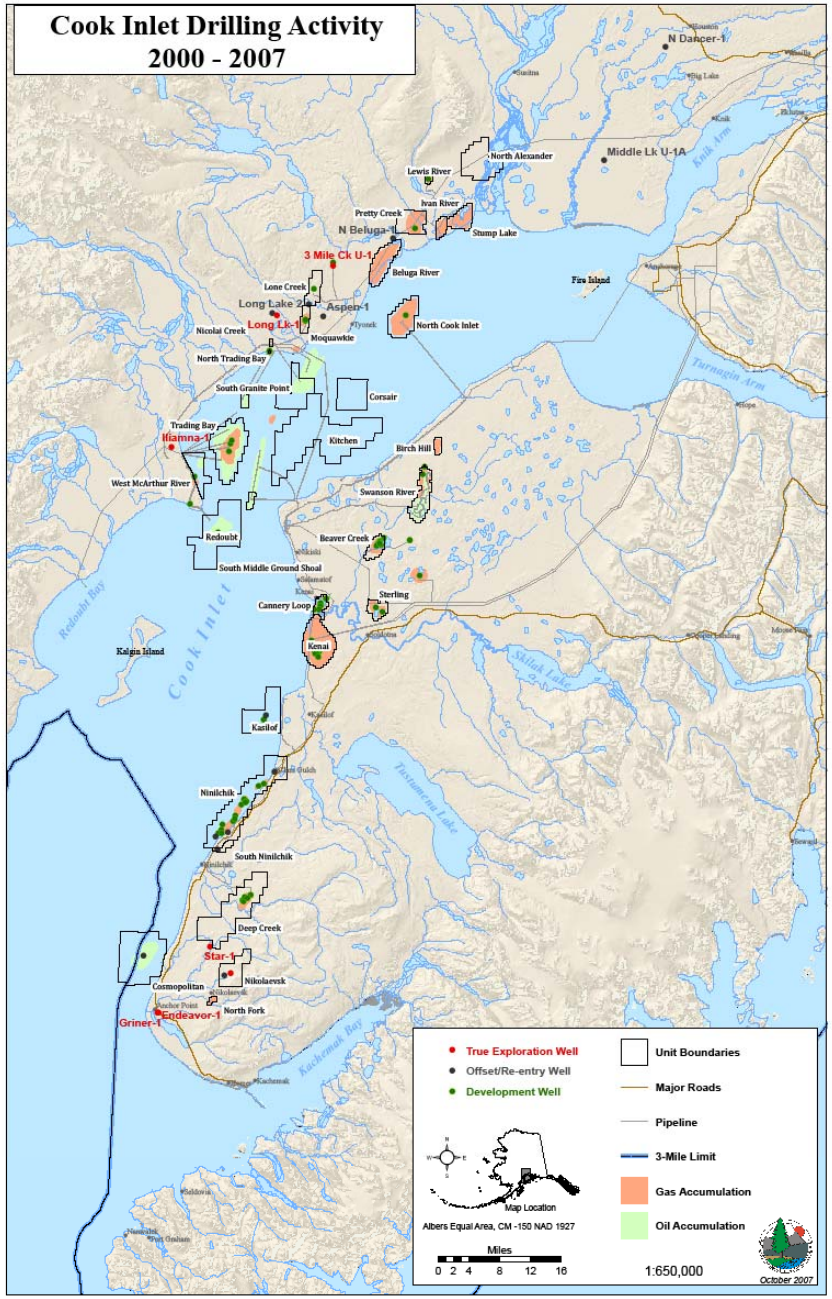
Cook Inlet Stratigraphy



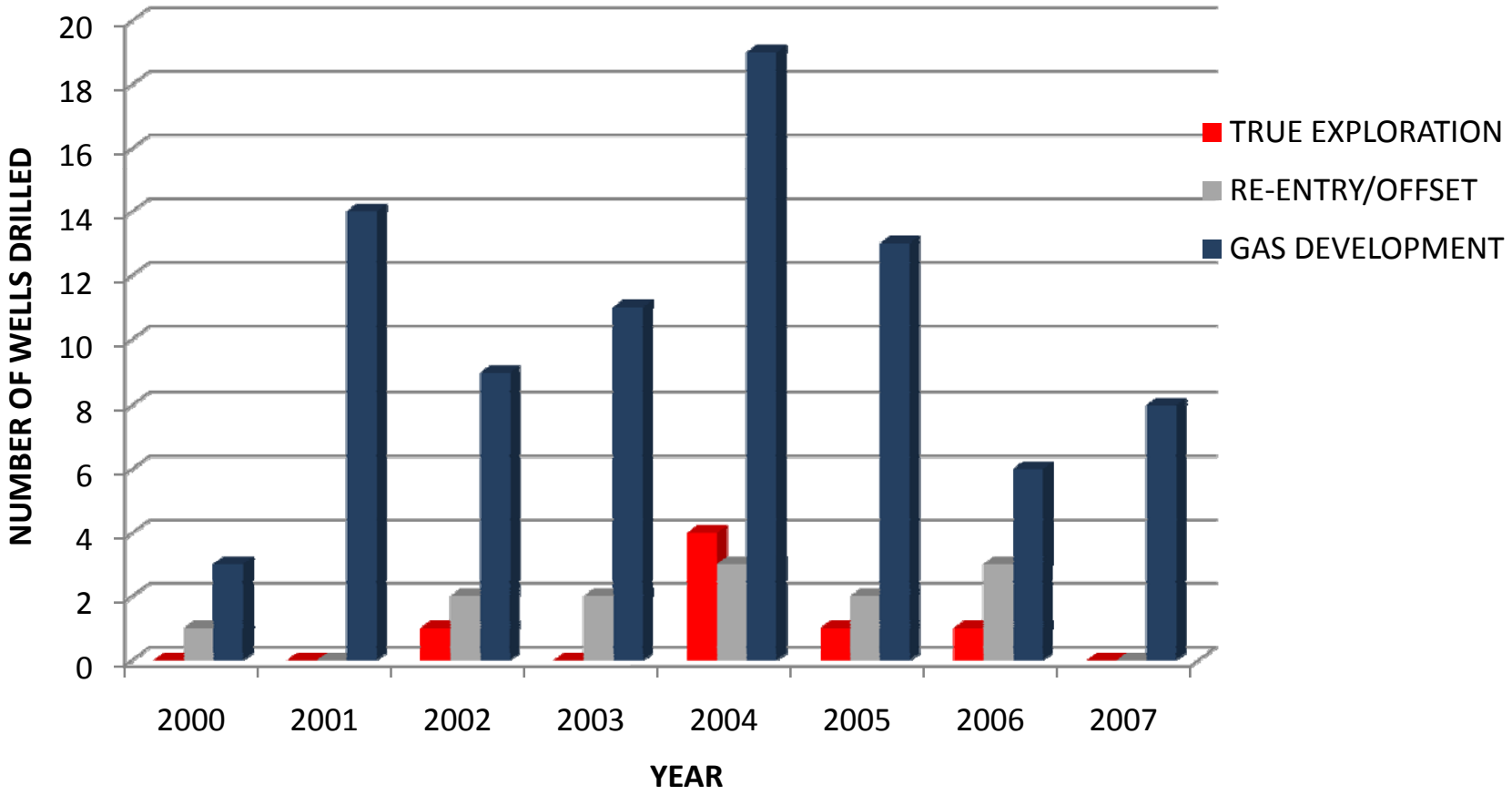
Redrawn from Curry and others (1993) and Swenson (2003); additional information from Plafker and others (1989) and Nokleberg and others (2004)

Total Wells Drilled for Gas 2000-2007

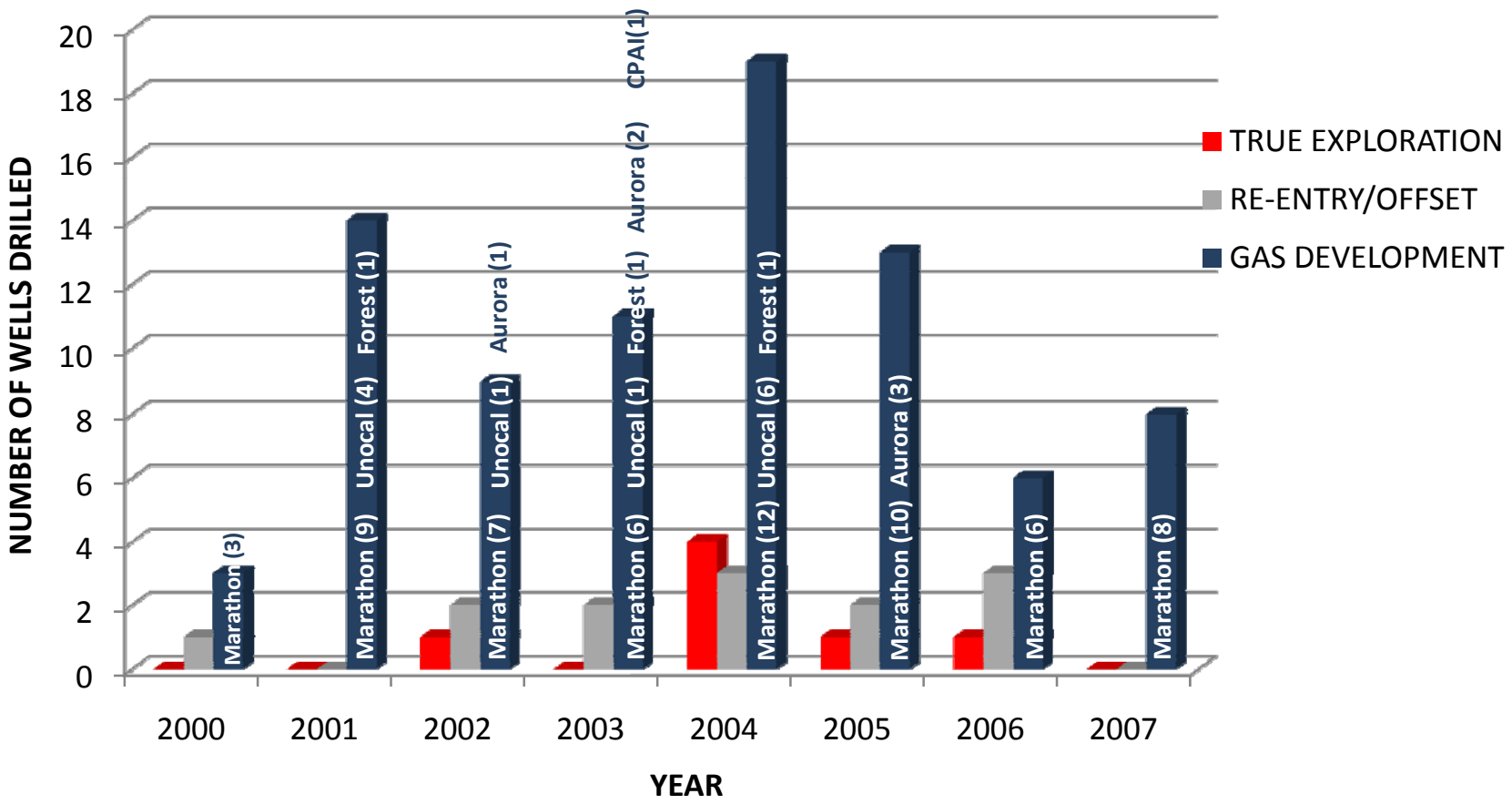



Cook Inlet Drilling Activity
2000 - 2007
N Dancer-1
Middle Lk U-1A
North Alexander
Lewis River
Ivan River
Pretty Creek
N Beluga-1
Stump Lake
3 Mile Ck U-1
Beluga River
Fire Island
Lone Creek
Long Lake 2-1
Aspen-1
Long Lk-1
North Cook Inlet
Nicolai Creek
Moquawkie
North Trading Bay
South Granite Point
Corsair
Trading Bay
Iliamna-1
Kitchen
Birch Hill
West McArthur River
Swanson River
Redoubt
Beaver Creek
South Middle Ground Shoal
Sterling
Cannery Loop
Kenai
Kalgin Island
Cook Inlet
Redoubt Bay
Kachemak Bay
Kasilof
Ninilchik
South Ninilchik
Deep Creek
Star-1
Nikolaevsk
Cosmopolitan
North Fork
Endeavor-1
Griner-1
True Exploration Well
Offset/Re-entry Well
Development Well
Unit Boundaries
Major Roads
Pipeline
3-Mile Limit
Gas Accumulation
Oil Accumulation
Map Location
Albers Equal Area, CM -150 NAD 1927
Miles
0 2 4 8 12 16
1:650,000
October 2007

Cook Inlet Gas Wells 2000-2007



Cook Inlet Gas Wells 2000-2007

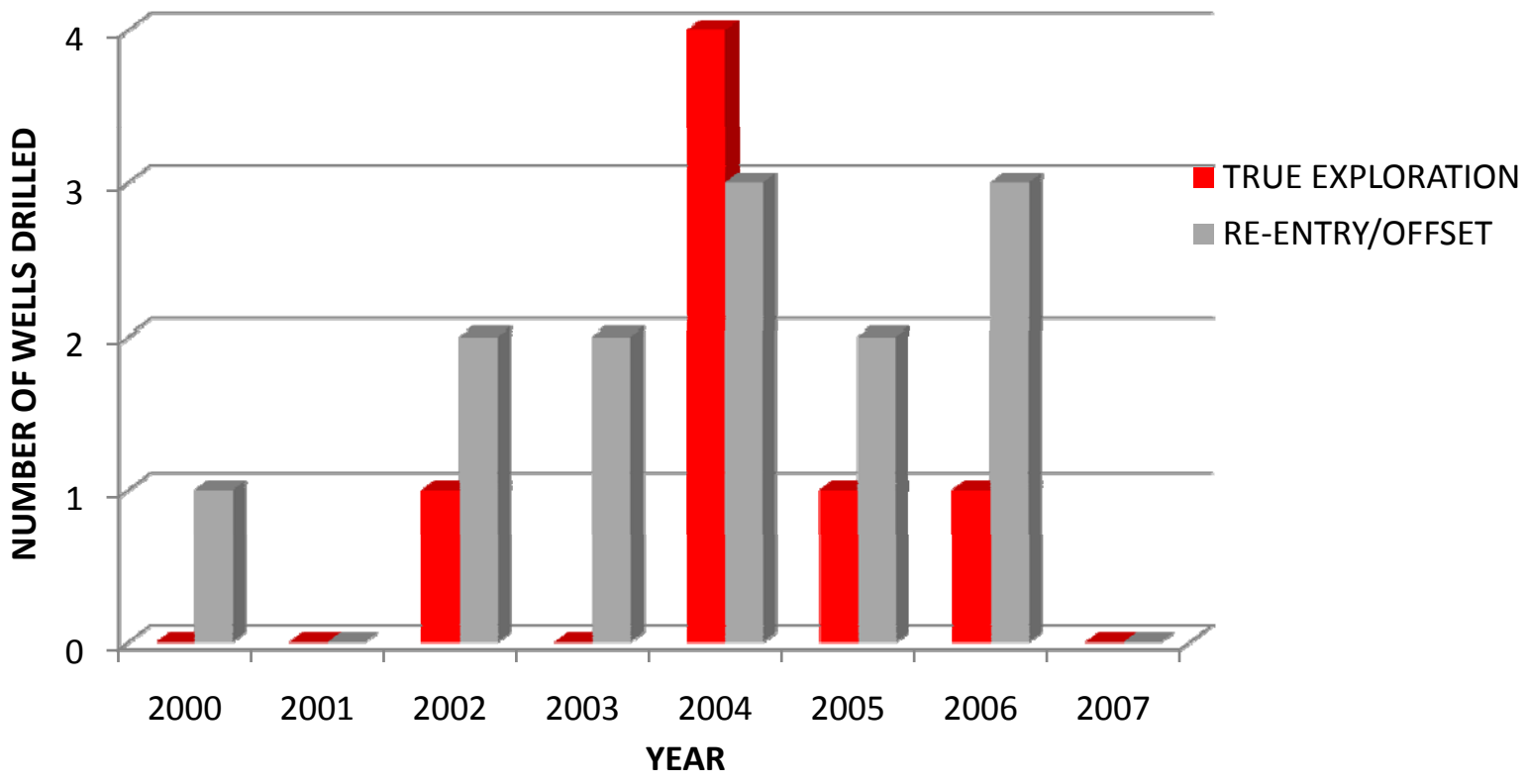


Cook Inlet Gas Development Wells 2000-2007

- Marathon: 61 wells
- Unocal: 12 wells
- Aurora: 6 wells
- Forest: 3 wells
- Conoco Phillips: 1 well

- Total Gas Development Wells: 83 wells

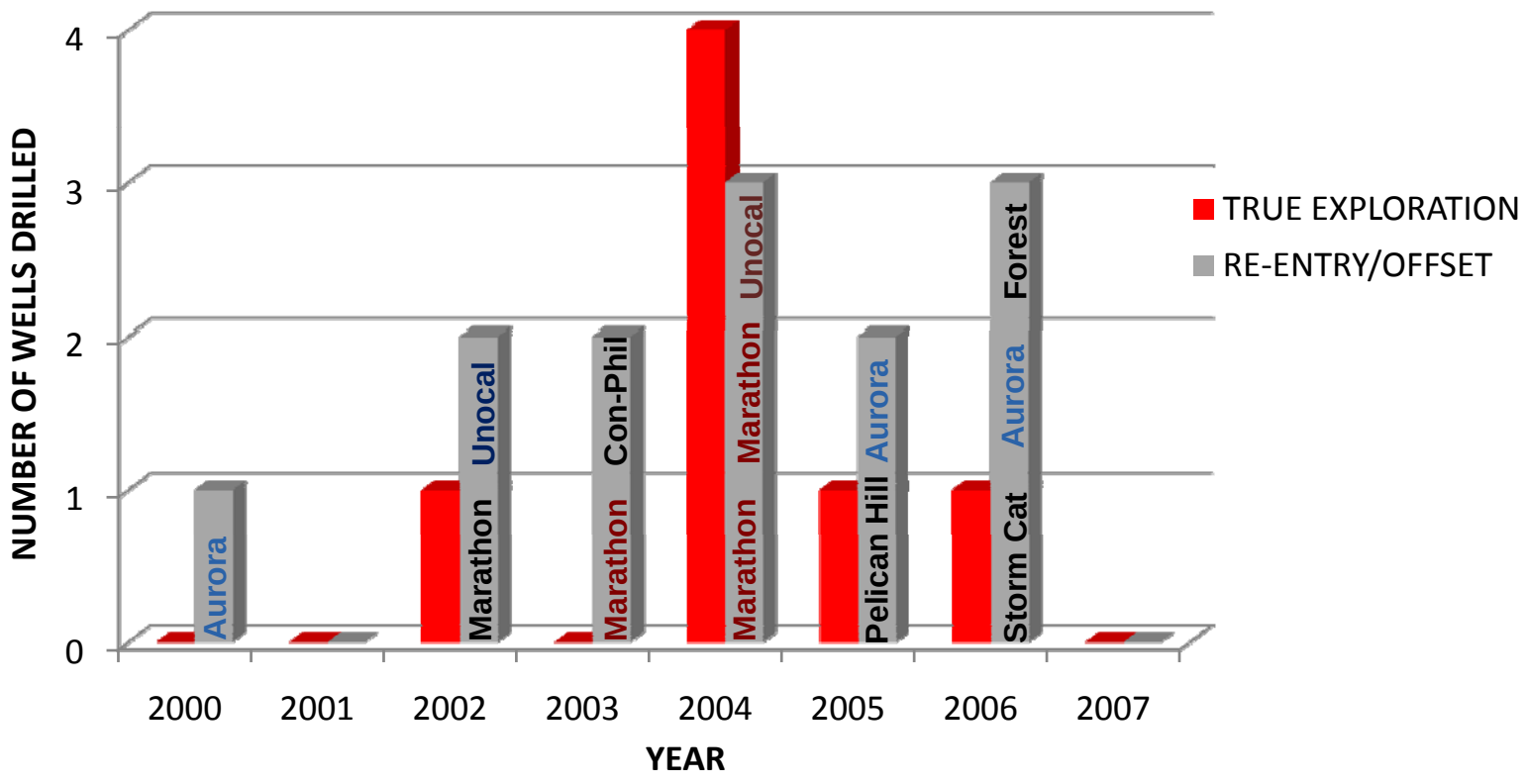
Cook Inlet Exploration Wells

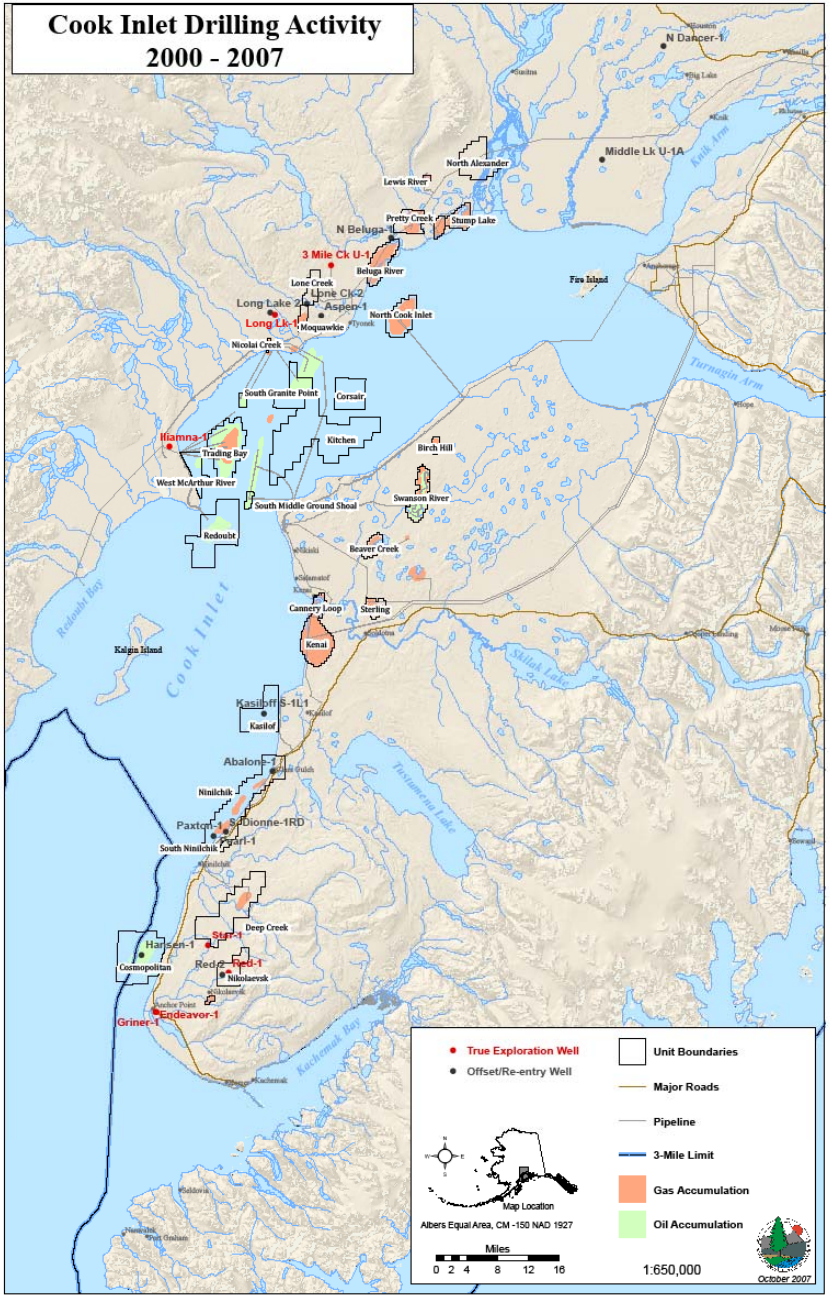


AOGCC - Definition of Exploration Well

20 AAC 25.990 (25) “exploratory well” means a well drilled to discover or to delineate a pool;

Cook Inlet Re-entry & Offset Wells



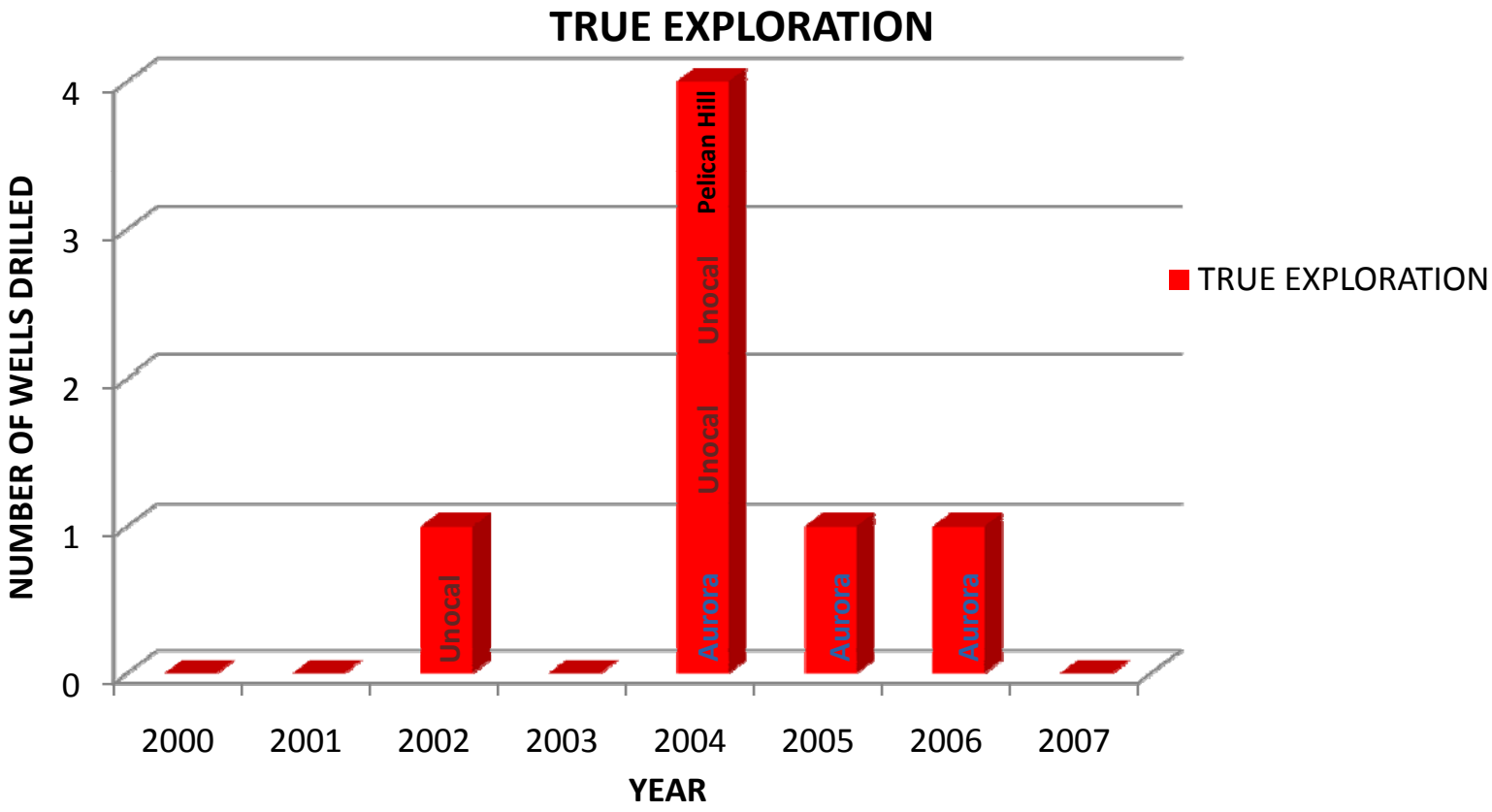

Cook Inlet Drilling Activity
2000 - 2007
N Dancer-1
Middle Lk U-1A
North Alexander
Lewis River
Pretty Creek
Stump Lake
N Beluga-1
3 Mile Ck U-1
Beluga River
Lone Creek
Lone Ck-2
Long Lake 2
Aspen-1
Long Lk-1
Moquawkie
North Cook Inlet
Nicolai Creek
Fire Island
Turnagin Arm
South Granite Point
Corsair
Iliamna-1
Trading Bay
Kitchen
Birch Hill
West McArthur River
South Middle Ground Shoal
Swanson River
Redoubt
Beaver Creek
Cannery Loop
Sterling
Kenai
Redoubt Bay
Cook Inlet
Kalgin Island
Skilak Lake
Kasiloff S-1L1
Kasilof
Abalone-1
Ninilchik
Paxton-1
S Dionne-1RD
Pearl-1
South Ninilchik
Tustumena Lake
Deep Creek
Hansen-1
Cosmopolitan
Red-2
Red-1
Nikolaevsk
Endeavor-1
Griner-1
Kachemak Bay
True Exploration Well
Offset/Re-entry Well
Unit Boundaries
Major Roads
Pipeline
3-Mile Limit
Gas Accumulation
Oil Accumulation
Map Location
Albers Equal Area, CM -150 NAD 1927
Miles
0 2 4 8 12 16
1:650,000
October 2007

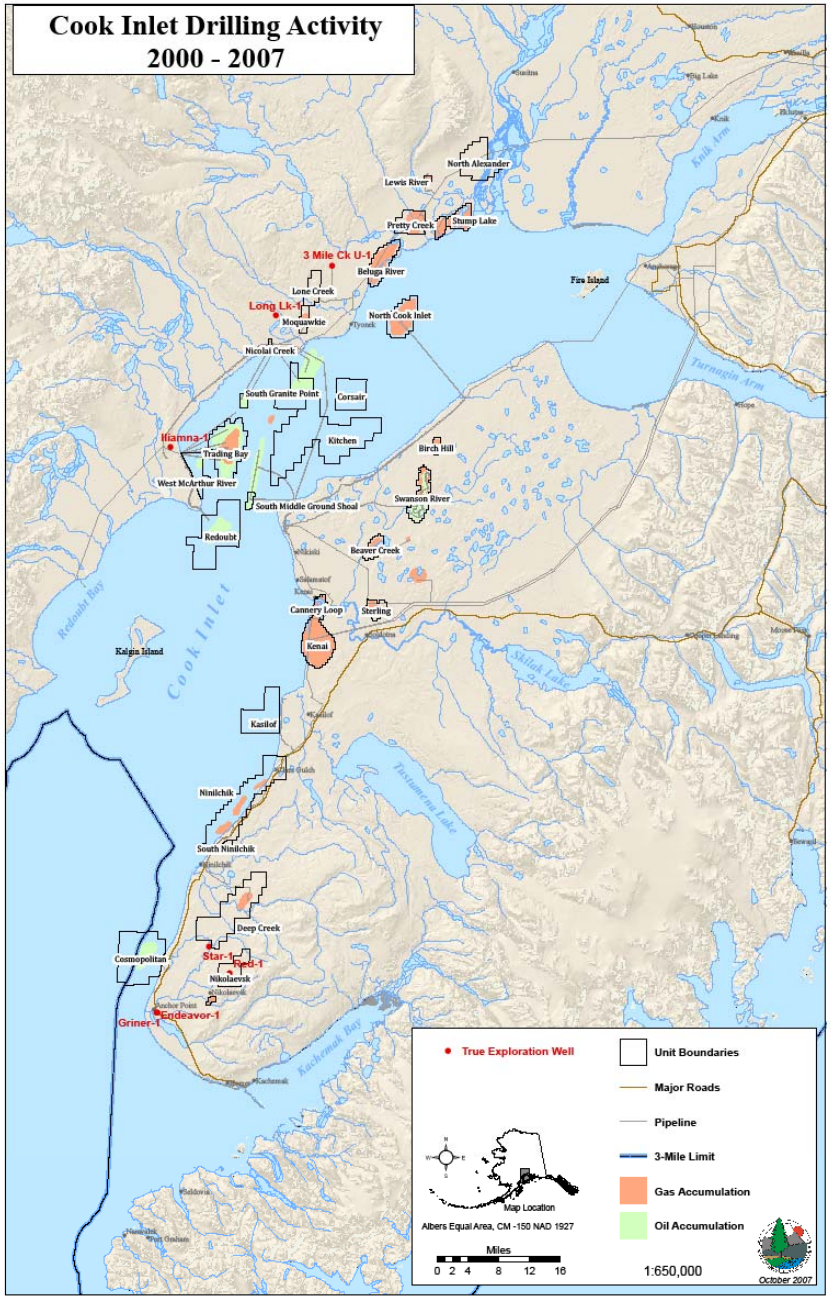
Cook Inlet Re-entry/Offset Wells 2000-2007

- Marathon: 4 wells
- Unocal: 2 wells
- Aurora: 3 wells
- Forest: 1 wells
- Conoco Phillips: 1 well
- Pelican Hill: 1 well
- Storm Cat: 1well

- Total Re-entry/Offset Wells: 13 wells

Cook Inlet True Exploration Wells




Cook Inlet Drilling Activity
2000 - 2007
North Alexander
Lewis River
Pretty Creek
Stump Lake
3 Mile Ck U-1
Beluga River
Fire Island
Lone Creek
Long Lk-1
Moquawkie
North Cook Inlet
Nicolai Creek
South Granite Point
Corsair
Kitchen
Iliamna-1
Trading Bay
Birch Hill
West McArthur River
Swanson River
South Middle Ground Shoal
Redoubt
Beaver Creek
Cannery Loop
Sterling
Kenai
Kalgin Island
Cook Inlet
Redoubt Bay
Kasilof
Ninilchik
South Ninilchik
Deep Creek
Cosmopolitan
Star-1
Red-1
Nikolaevsk
Endeavor-1
Griner-1
Kachemak Bay
Kenai Lake
Skilak Lake
Tustumena Lake
Turnagain Arm
Knik Arm
True Exploration Well
Unit Boundaries
Major Roads
Pipeline
3-Mile Limit
Gas Accumulation
Oil Accumulation
Map Location
Albers Equal Area, CM -150 NAD 1927
Miles
0 2 4 8 12 16
1:650,000
October 2007

Cook Inlet True Exploration Wells 2000-2007

- Unocal: 3 wells
- Aurora: 3 wells
- Pelican Hill: 1 well

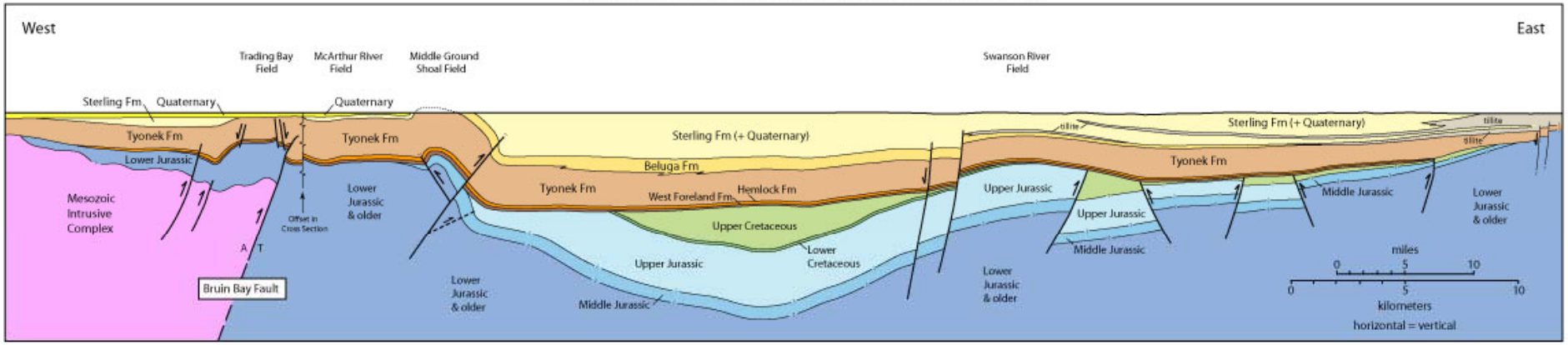
- Total True Exploration Wells: 7 wells

Existing Cook Inlet Gas Storage

- Pretty Creek – Chevron
  - 0.7 BCFY capacity
  - Lease and permit approved by DNR Sept. 2005
- Kenai Gas Field – Marathon
  - 6 BCFY capacity
  - Lease and permit approved by DNR May 2006
- Swanson River – Chevron
  - Federal BLM management
  - 1 BCFY capacity

Cook Inlet Geologic Cross Section

Upper Cook Inlet Geologic Cross Section

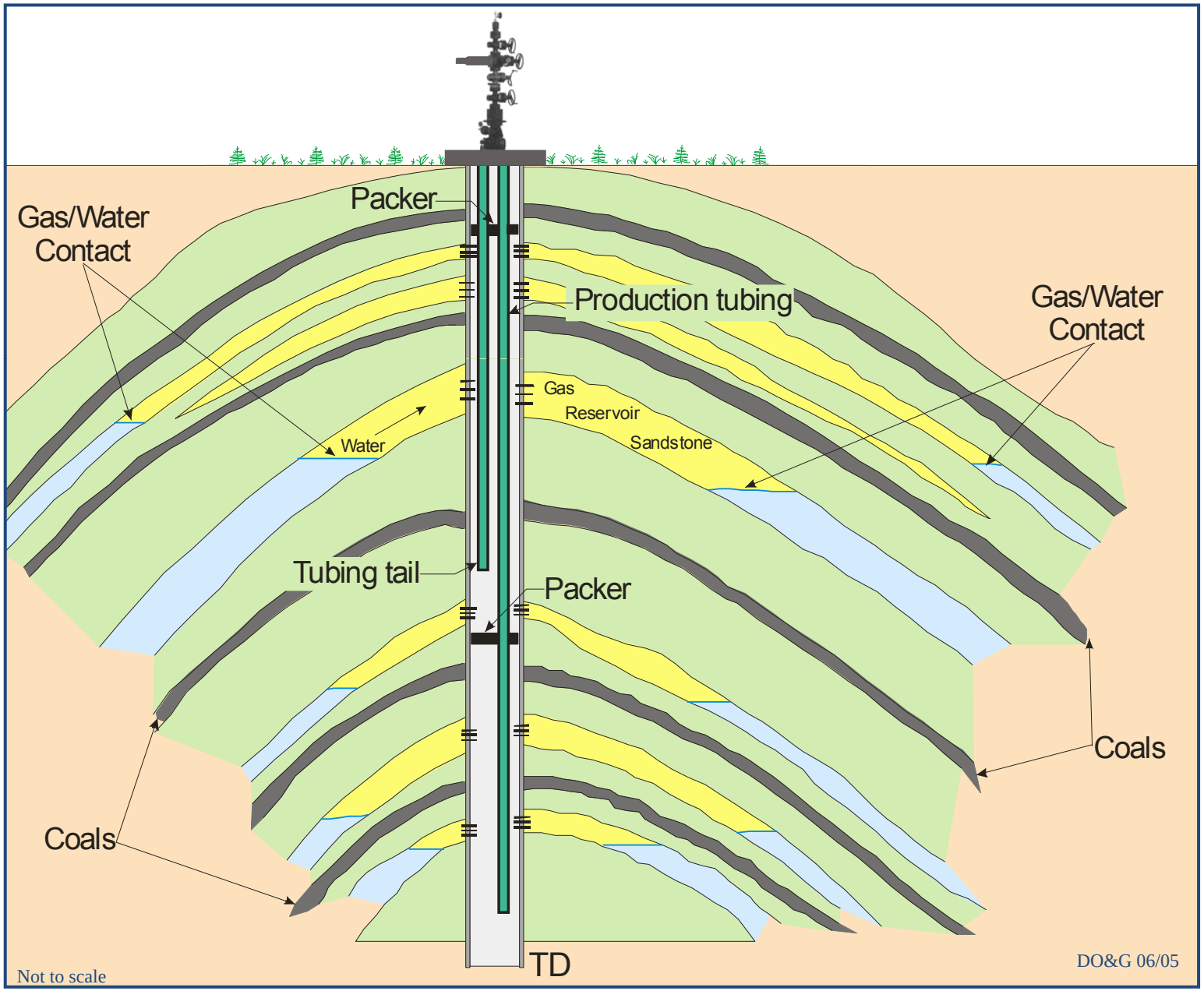


Modified from Hauessler and others (2000), revised from Boss and others (1976)

What happens to Beluga Fm west of MGS anticline? And to Quaternary east of it? Is there Q on structure?

Typical Production String Configuration

Finding gas in Existing Fields



Cook Inlet Summary of Oil Fields –

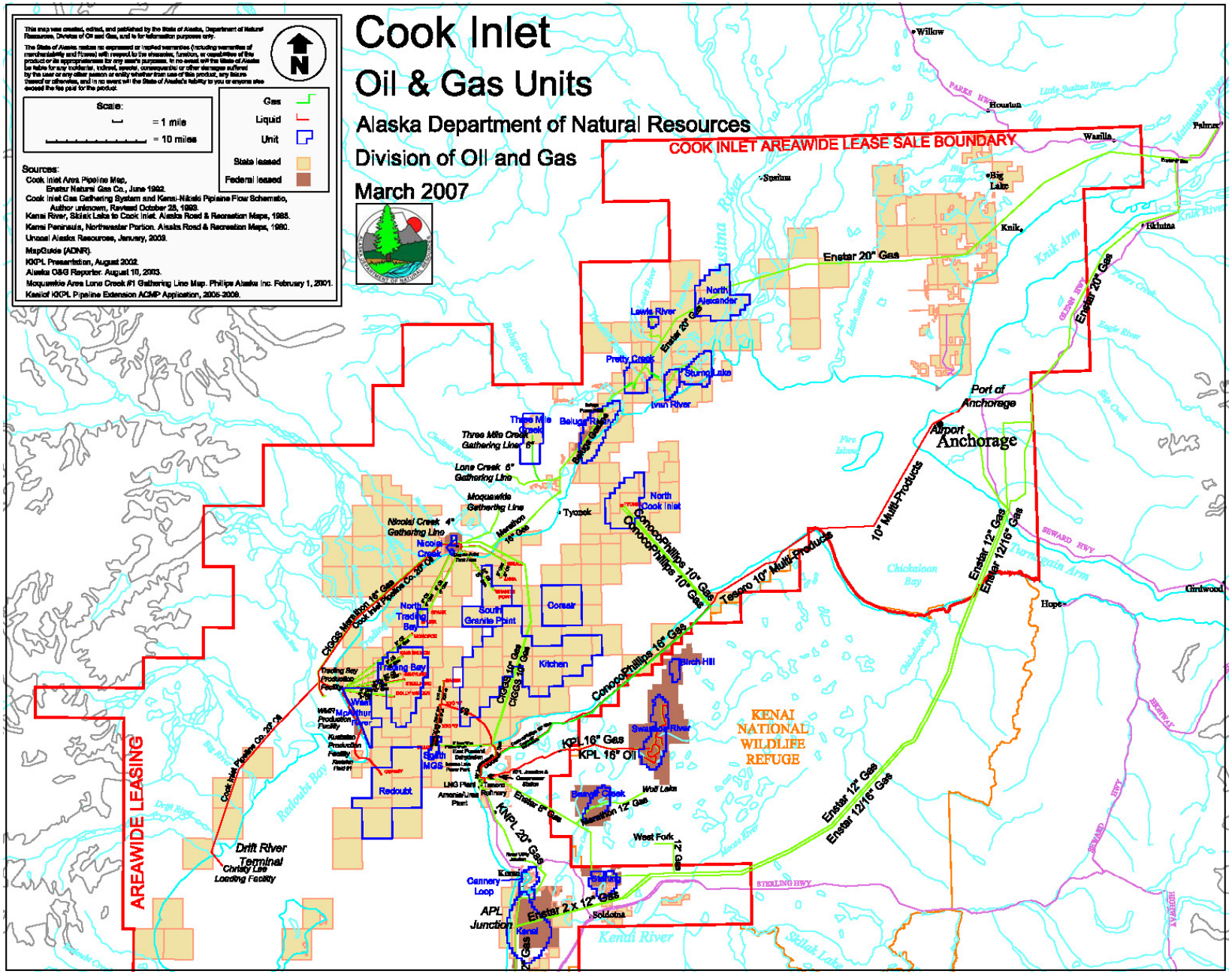
- Cosmopolitan Unit – Conoco Phillips (Oil discovered in 1967 by Penzoil)
  - Currently drilling Hansen 1A L1 delineation well (oil)
  - Hansen #1 well P&Aed, Forest reported successful results, no word from Conoco Phillips yet
  - Hansen #1A well completed as oil producer, test production was trucked to Nikisiki refinery
- Middle Ground Shoals Field – Unocal & XTO
  - XTO continues operations at two platforms
  - Unocal has ceased operations at this field and placed its two platforms (Dillon and Baker) in “lighthouse mode”
- Redoubt Unit – Forest Oil (Oil discovered in 1968 by Pan Am)
  - Production began Dec. 9, 2002
  - Drilling results indicated field is more complicated than previously thought; reserve estimate reduced
  - Waterflood
  - RU#3 well began producing fuel gas on 7/28/2003
- Trading Bay Unit/McArthur River Field – Unocal
  - T.B.U. #K-13 came on production at 7,100 BOPD, highest rate of any well in Cook Inlet
  - Chevron refocusing efforts to develop this field
  - Plan of Development states drilling of Grayling gas sands in 2007, Tyonek.

Cook Inlet Economic Challenges
Infrastructure & Deliverability
Exploration Economics

Will Nebesky, Commercial Analyst

Part 1. Infrastructure Access & Upgrades

- Infrastructure initially piecemeal, segmented, and exclusive
  - Pipelines built initially to serve specific markets
- Recent examples of liberalization
  - CIGGS Common Carriage
  - Beluga Bi-directional Flow
- Infrastructure upgrades now underway to address deliverability
- Goals
  - Connect the production & consumption dots with non-exclusive access
  - To deliver gas when and where its needed from multiple sources


Cook Inlet
Oil & Gas Units
Alaska Department of Natural Resources
Division of Oil and Gas
March 2007
This map was created, edited, and published by the State of Alaska, Department of Natural Resources, Division of Oil and Gas, and is for information purposes only.
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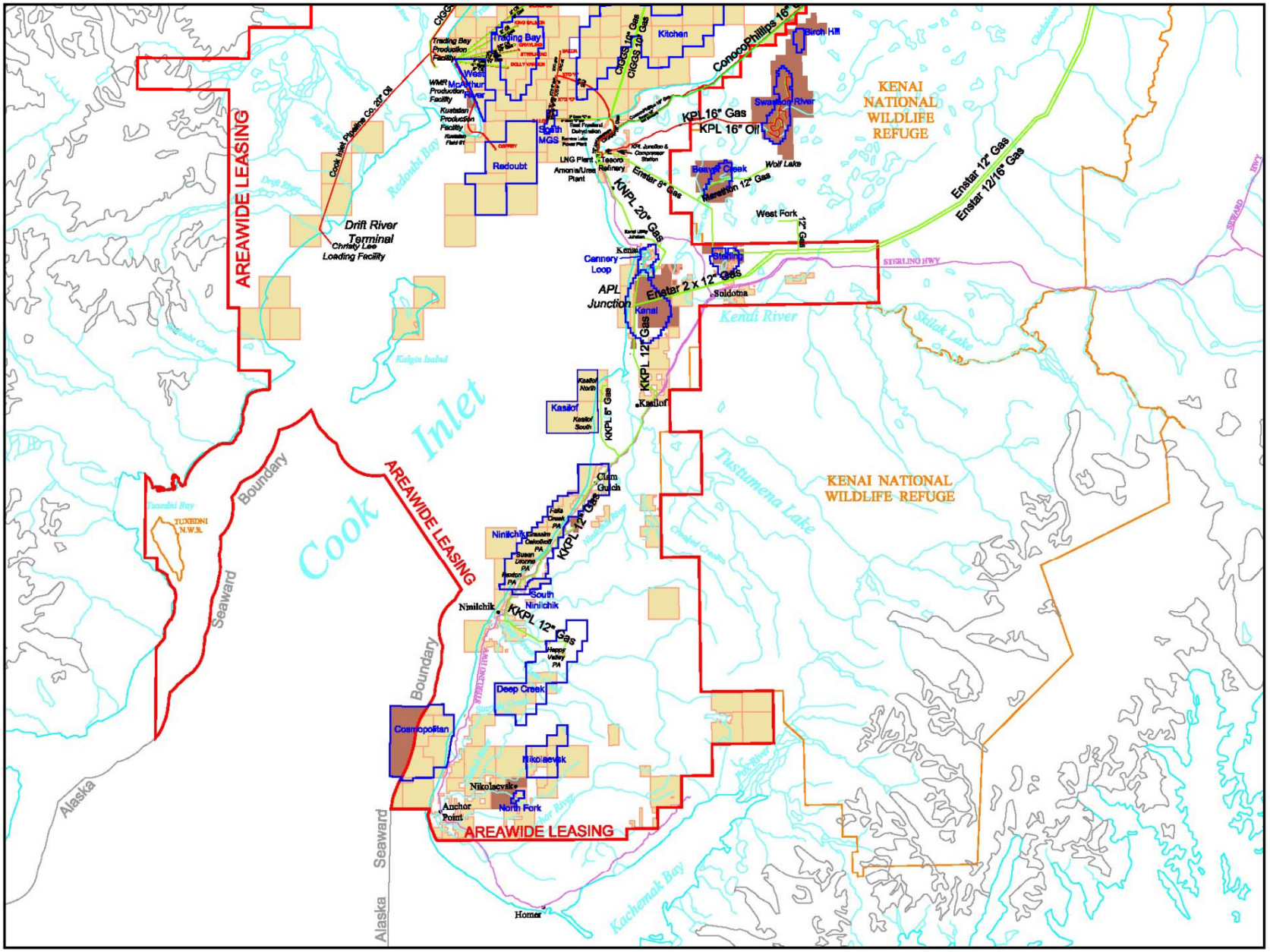
N
Scale:
= 1 mile
= 10 miles
Gas
Liquid
Unit
State leased
Federal leased
Sources:
Cook Inlet Area Pipeline Map, Enstar Natural Gas Co., June 1992.
Cook Inlet Gas Gathering System and Kenai-Nikiski Pipeline Flow Schematic, Author unknown, Revised October 28, 1993.
Kenai River, Skilak Lake to Cook Inlet. Alaska Road & Recreation Maps, 1985.
Kenai Peninsula, Northeastar Portion. Alaska Road & Recreation Maps, 1990.
Unocal Alaska Resources, January, 2003.
MapGuide (ADNR).
KKPL Presentation, August 2002.
Alaska O&G Reporter. August 18, 2003.
Moquawkie Area Lone Creek #1 Gathering Line Map. Phillips Alaska Inc. February 1, 2001.
Kesiol KKPL Pipeline Extension ACMP Application, 2005-2008.
COOK INLET AREAWIDE LEASE SALE BOUNDARY
AREAWIDE LEASING
KENAI NATIONAL WILDLIFE REFUGE
Wilkow
Houston
Palmer
Wasilla
Big Lake
Knik
Eklutna
Susitna
Enstar 20" Gas
North Alexander
Lewis River
Pretty Creek
Stump Lake
Ivan River
Three Mile Creek
Beluga River
Three Mile Creek Gathering Line 6"
Lone Creek 6" Gathering Line
Moquawkie Gathering Line
Nicolai Creek 4" Gathering Line
Nicolai Creek
Marathon 16" Gas
Tyonek
North Cook Inlet
ConocoPhillips 10" Gas
Tesoro 10" Multi-Products
10" Multi-Products
Port of Anchorage
Airport
Anchorage
Enstar 12" Gas
Enstar 12/16" Gas
Chickaloon Bay
Turnagain Arm
Hope
Girdwood
North Trading Bay
South Granite Point
Corsair
Kitchen
Birch Hill
Trading Bay
Trading Bay Production Facility
West McArthur River
Wilson Production Facility
Kustatan Production Facility
South MGS
Redoubt
Redoubt Bay
CIGGS Marathon 16" Gas
Cook Inlet Pipeline Co. 20" Oil
CIGGS 12" Gas
CIGGS 20" Gas
ConocoPhillips 16" Gas
KPL 16" Gas
KPL 16" Oil
Swanson River
Wolf Lake
Beaver Creek
Marathon 12" Gas
West Fork
12" Gas
LNG Plant
Ammonia/Urea Plant
Tesoro Refinery
Enstar 6" Gas
KNPL 20" Gas
Drift River Terminal
Christy Lee Loading Facility
Cannery Loop
Kenai
APL Junction
Enstar 2 x 12" Gas
Soldotna
Kenai River
Skilak Lake
STERLING HWY
SEWARD HWY
GLENN HWY
Knik Arm
Eagle River
Little Susitna River
Matanuska River
Knik River
Big River
Drift River
Moose River
Chickaloon River
Fire Island
Ship Creek
Chulitna River
Beluga River
Trading Bay
Stump Lake



AREAWIDE LEASING
Cook Inlet
Drift River Terminal
Christy Lee Loading Facility
Cook Inlet Pipeline Co. 20" Oil
Redoubt Bay
Redoubt
Trading Bay
Trading Bay Production Facility
West McArthur River
WMR Production Facility
Kustatan Production Facility
South MGS
LNG Plant
Amonia/Urea Plant
Tesoro Refinery
Kitchen
CIGGS 10" Gas
CIGGS 10" Gas
ConocoPhillips 16"
Birch Hill
Swanson River
KPL 16" Gas
KPL 16" Oil
Wolf Lake
Beaver Creek
Marathon 12" Gas
Enstar 8" Gas
KNPL 20" Gas
West Fork
12" Gas
Enstar 12" Gas
Enstar 12/16" Gas
KENAI NATIONAL WILDLIFE REFUGE
Kenai
Cannery Loop
APL Junction
Enstar 2 x 12" Gas
Sterling
Soldotna
Kenai
Kenai River
Skilak Lake
STERLING HWY
KKPL 12" Gas
Kasilof
Kasilof North
Kasilof South
KKPL 6" Gas
Kalgin Isalnd
Clam Gulch
Ninilchik
Falls Creek PA
Cassiar Cakebrd PA
Susan Dronne PA
Paxton PA
South Ninilchik
KKPL 12" Gas
Happy Valley PA
Deep Creek
Cosmopolitan
Nikolaevsk
Anchor Point
North Fork
Homer
Kachemak Bay
Tustumena Lake
Tuxedni Bay
TUXEDNI N.W.R.
Seaward Boundary
Alaska

Recent Pipeline Access Improvements

- **CIGGS 3rd Party Access**
  - RCA accepted (in June 2007) a settlement agreement that provides for common carriage under an agreed tariff rate methodology
  - Chevron and Marathon retain the rights to use the remaining capacity

- **Granite Point-Beluga Pipeline Bi-Directional Flow**
  - 2006 settlement provides for bi-directional flow
  - North to south flow in the Beluga line enables increased volumes and allows fields north of Granite Point to export gas through CIGGS to industrial facilities at Nikiski and or other east-side markets

Continuing Pipeline/ Infrastructure Deliverability Issues

- **KNPL/APL Junction interconnect** –Upgrade added so KNPL can feed the Enstar line (to Anchorage). CIGGS gas can also be fed into the KNPL and into Enstar system. Bi-directional flow of the KNPL may be next.

- **KNPL/Swanson River**– A KNPL-SRPL upgrade will add bi-directional capability in fall 2007, enabling gas flow from SR Field into the KNPL. The KNPL-SRPL "Jumper" was originally installed to allow gas to flow from KNPL out to SR Field for EOR purposes. That connection is being modified to allow gas to flow back into the KNPL line and then on to the Enstar system starting at Kenai Field to transport storage gas to residential users on peak days.

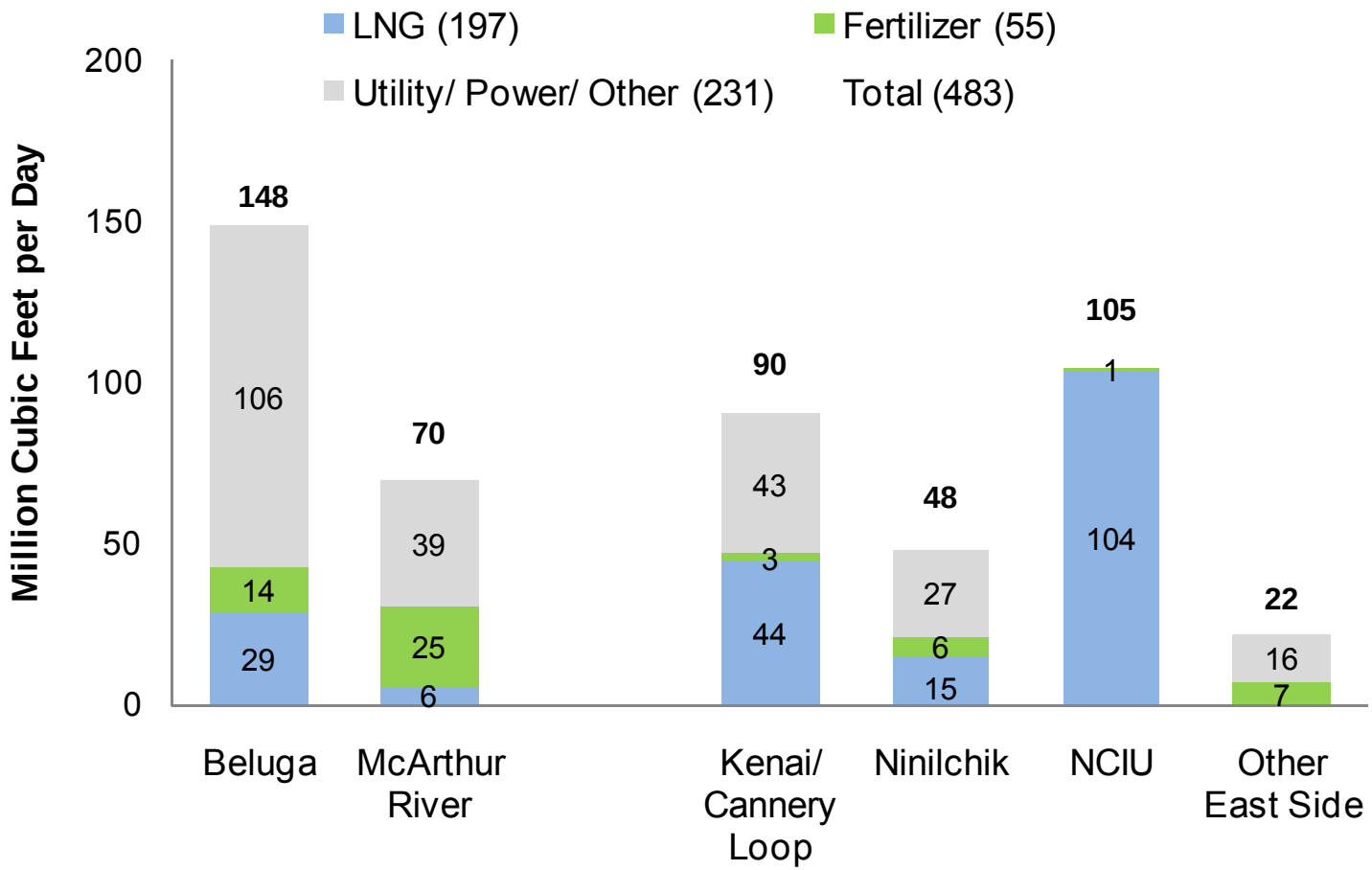
- **NCI/CIGGS** –ConocoPhillips and Marathon have postponed installation of a coupling meter that would get NCI gas into the CIGGS and KNPL lines at the KPL Junction.

- **8" Royalty Line** – The Royalty Pipeline can accommodate gas flows out of SWR field into the Royalty PL and the Enstar system. But on cold, high usage days, the SRPL capacity exceeds the Royalty PL capacity, creating a bottleneck. Adding compression to this may be added to boost throughput.

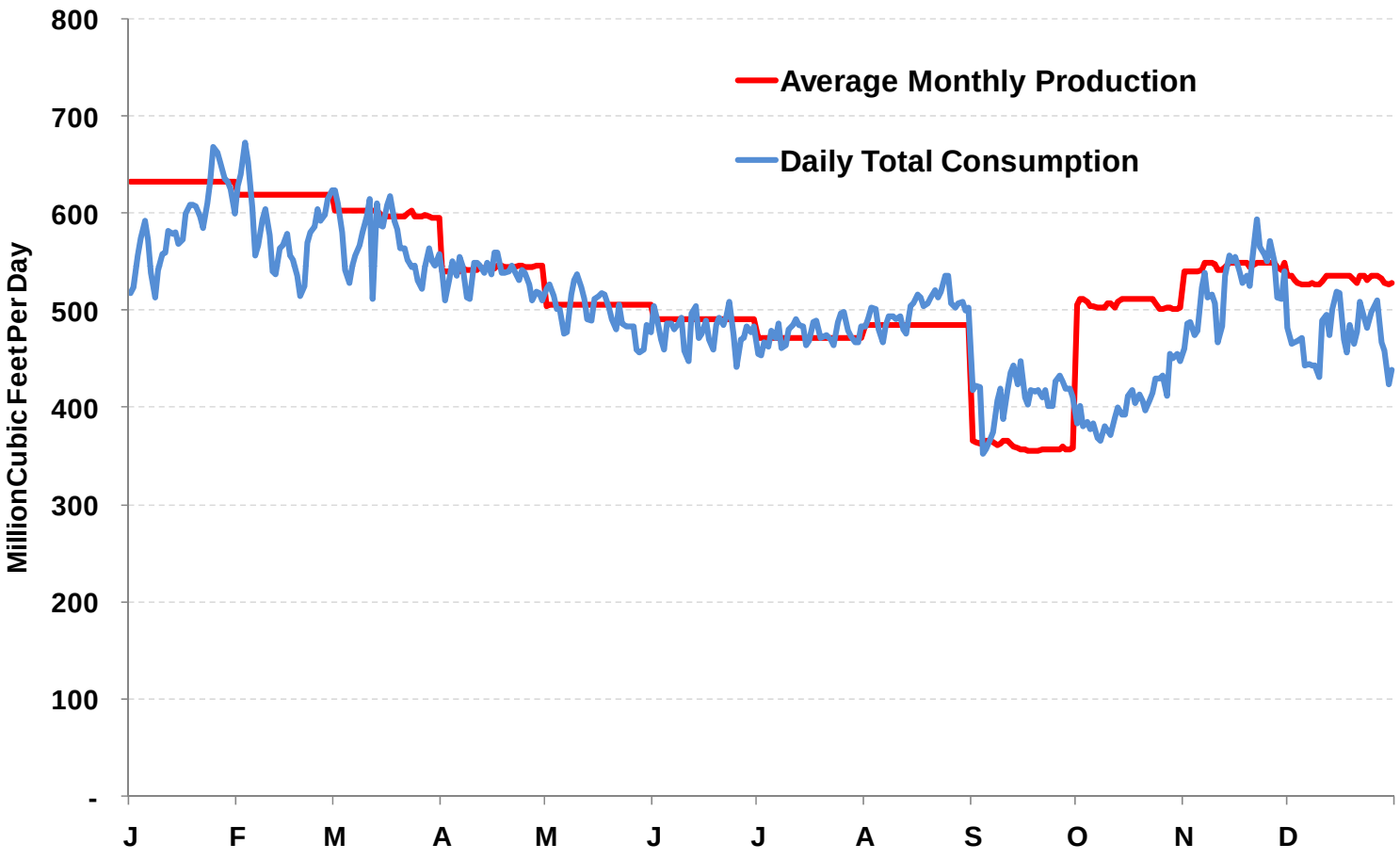
- **CIGGS** – Adding compression would allow to flow from east-to-west.

- **Other Debottlenecking** – Enstar may increase its through-town distribution system pipeline pressures to allow East-side gas to flow through Anchorage into MatSu Valley.

Cook Inlet Gas Usage by Field in 2006



The Deliverability Challenge: Cook Inlet Production and Consumption in 2006

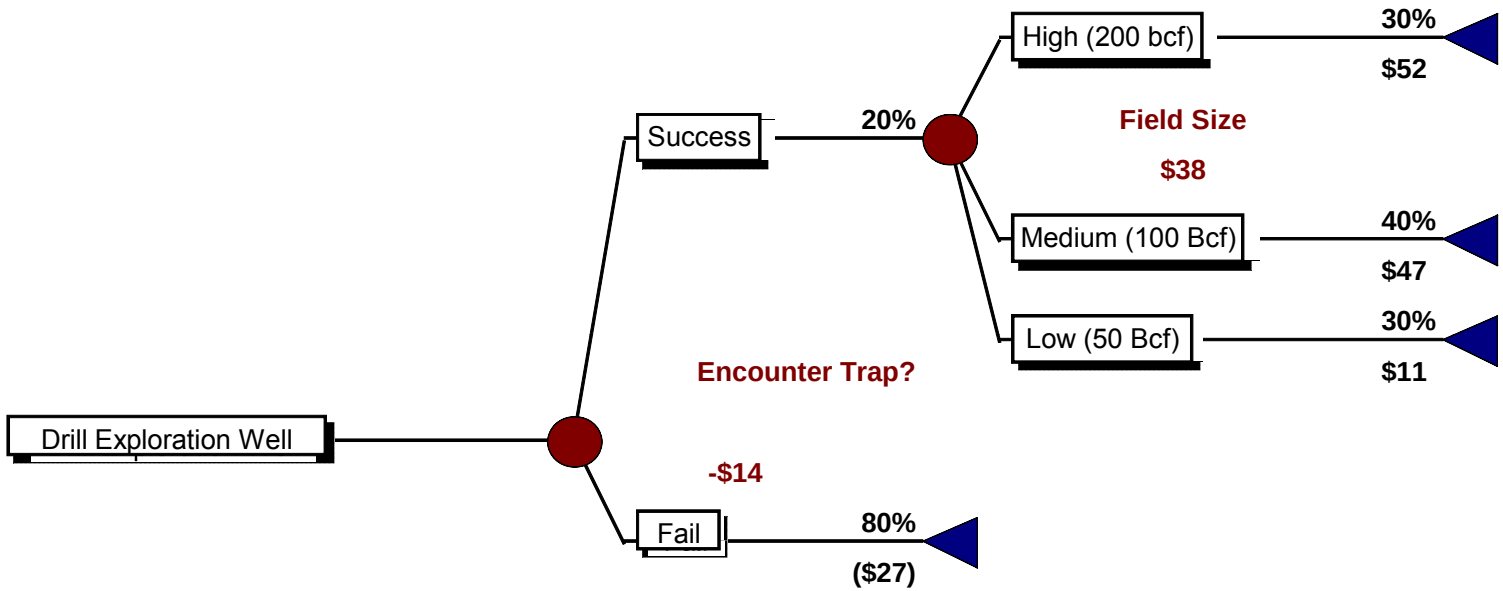


Sources: AOGCC and Enstar.

Part 2. The Exploration Challenge

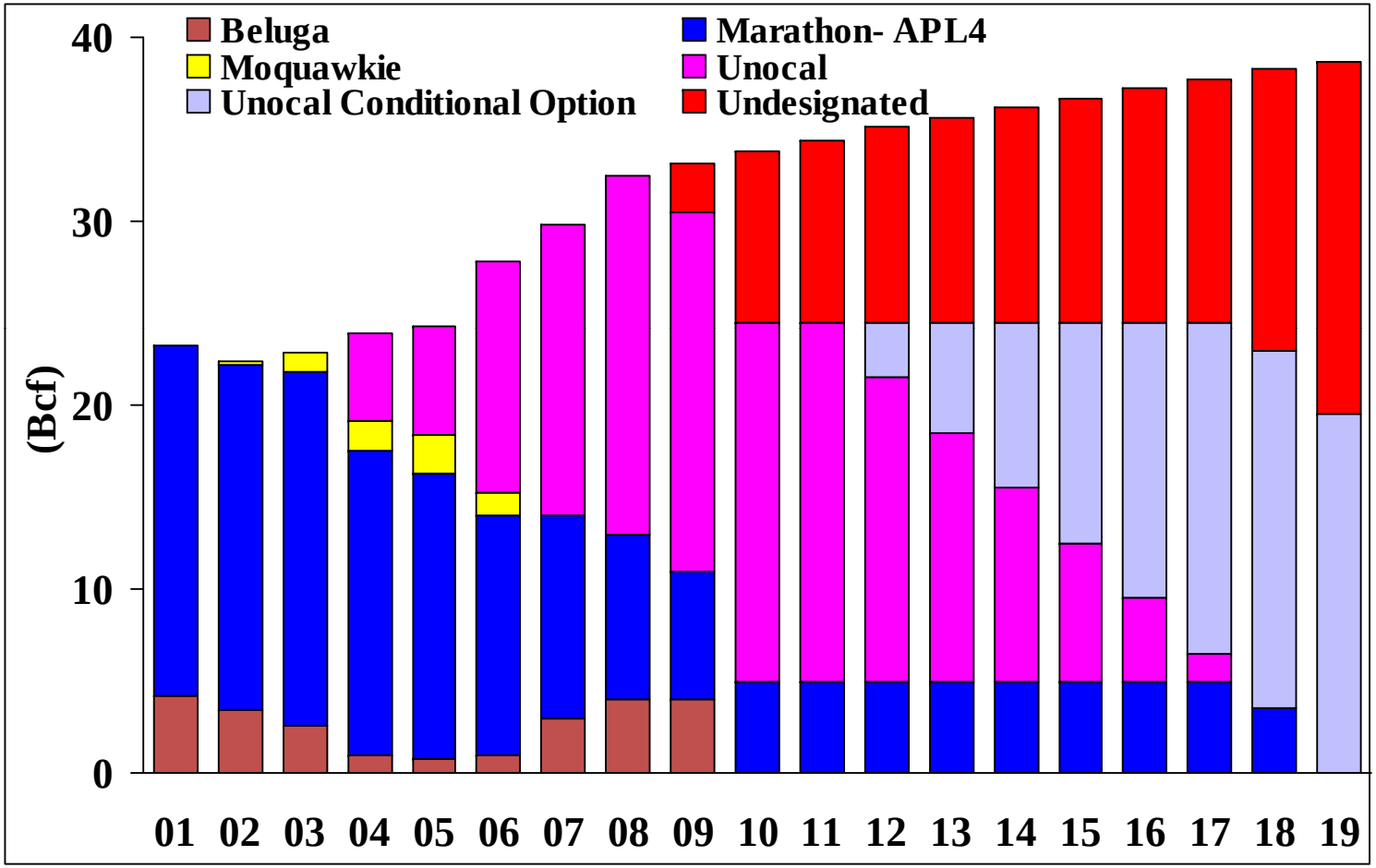
- Exploration and Development of Reserves is Risky and Costly
- Transparent and Adequate Price Signals are Necessary to Attract Exploration Investment
- Market Liquidity-the ability to sell the gas you find-is also Necessary for Investment

The Investment Decision Process



Three Types of Risk:

- Resource
- Cost
- Market (Price and Access)


Beluga
Moquawkie
Unocal Conditional Option
Marathon- APL4
Unocal
Undesignated
(Bcf)
40
30
20
10
0
01
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03
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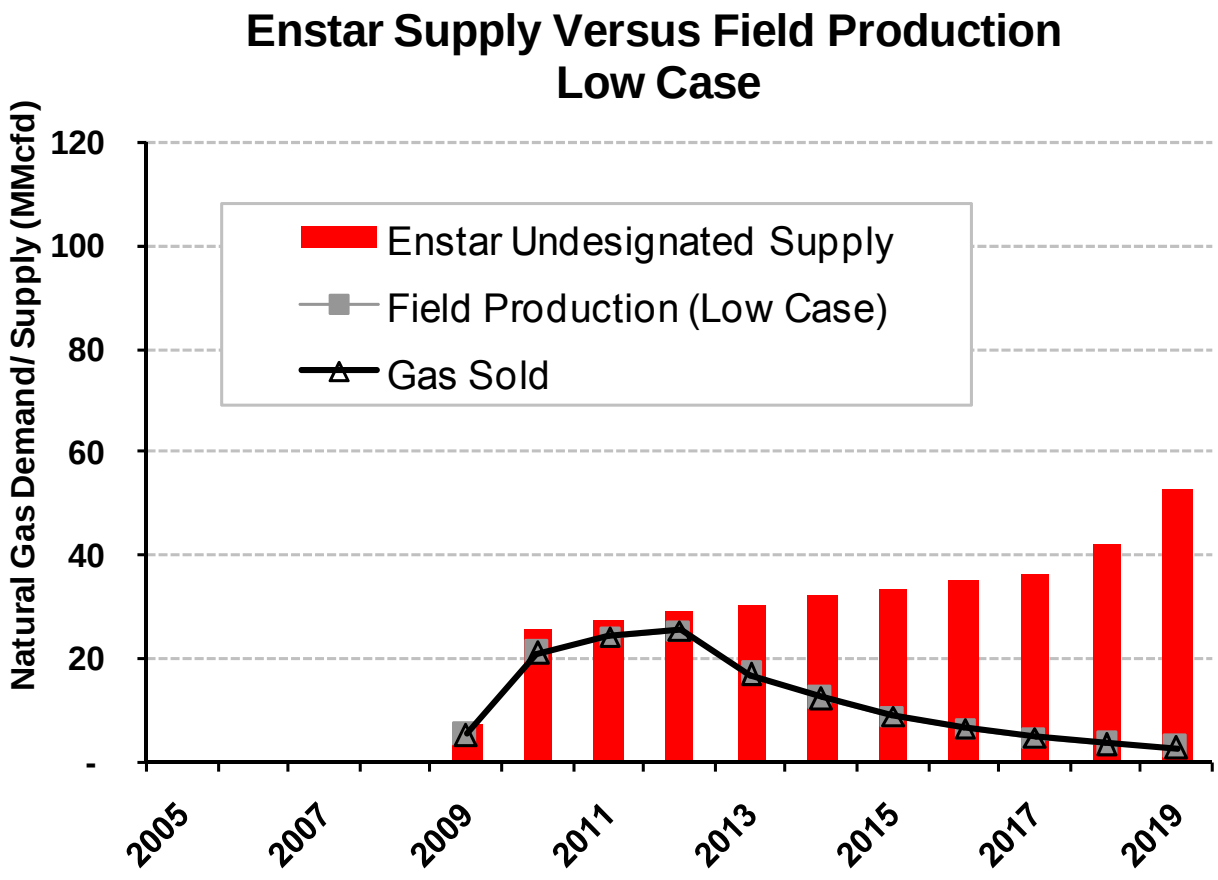
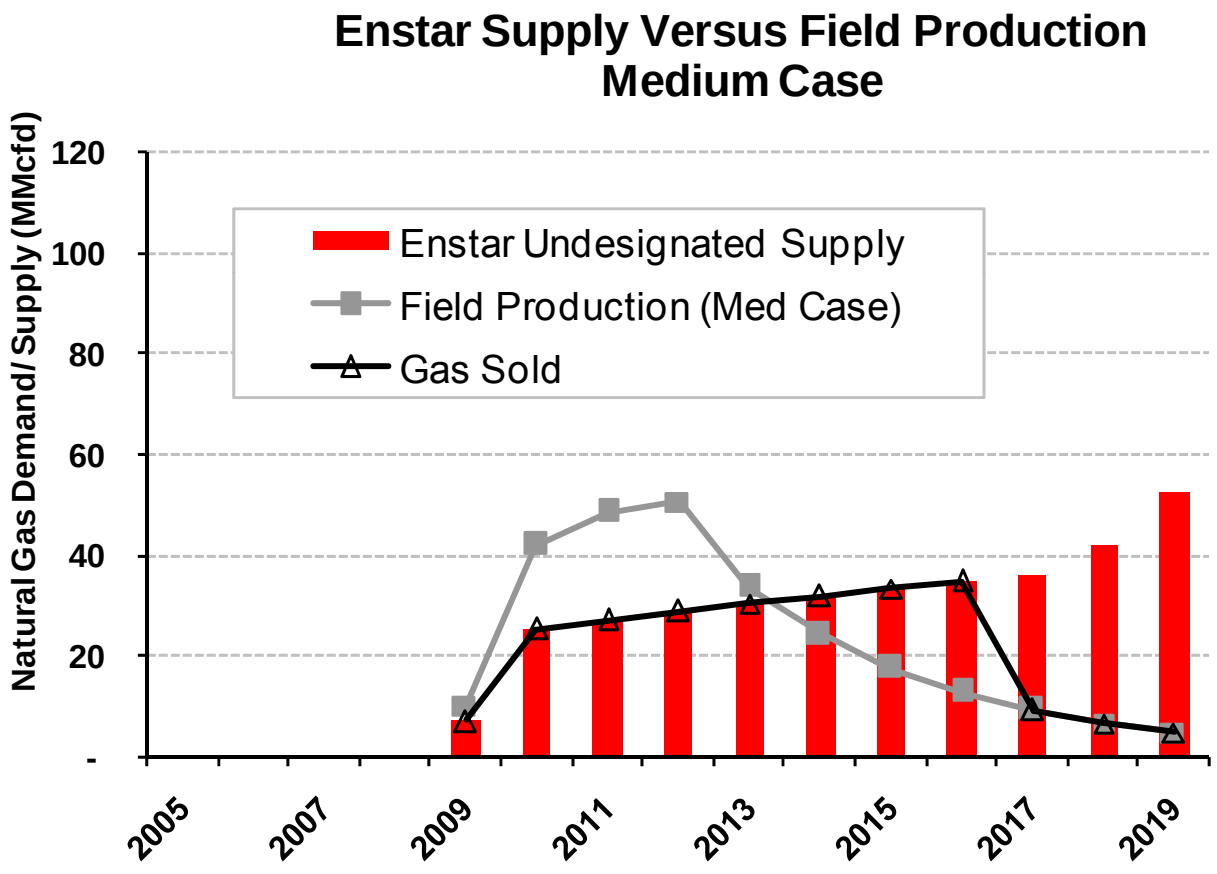
19

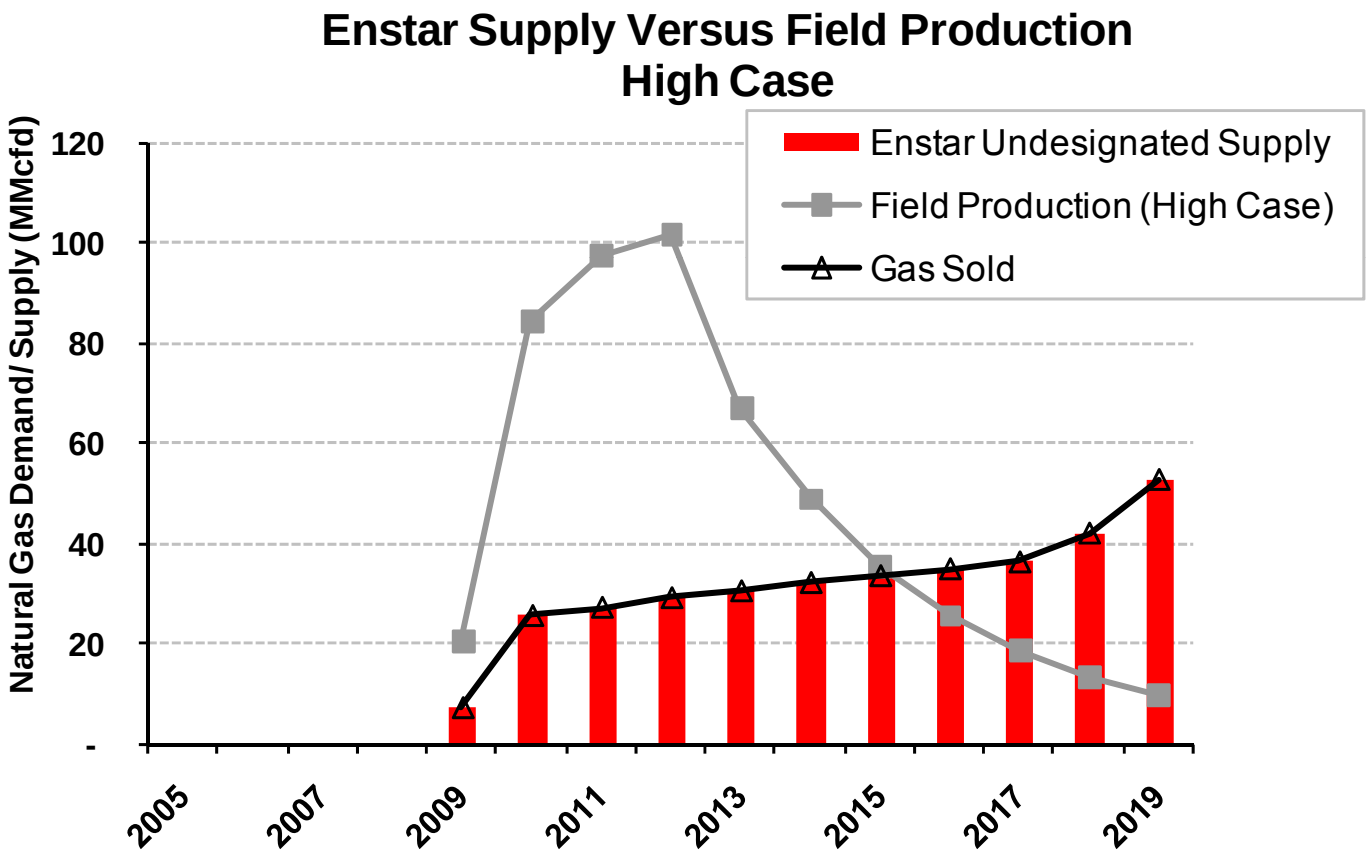
Low Case – No Market Constraint



Medium Case:
Production Constrained by Market

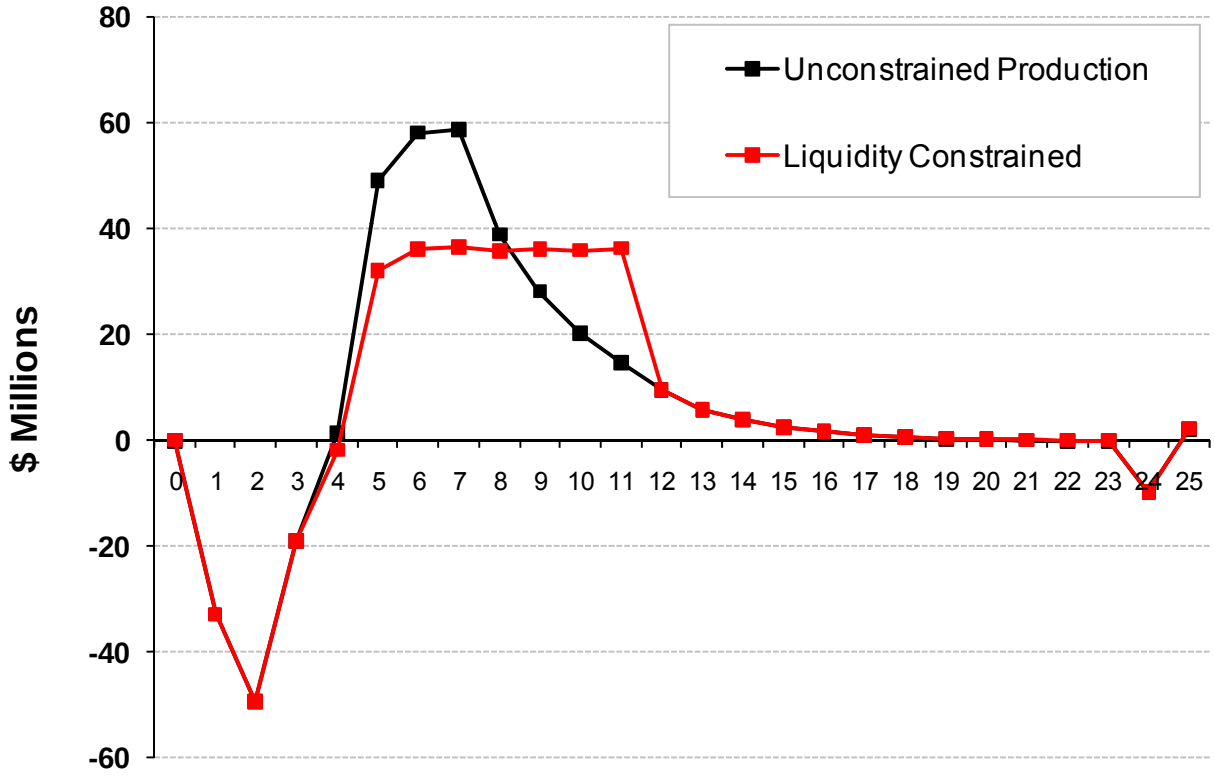


High Case:
Production Constrained by Market

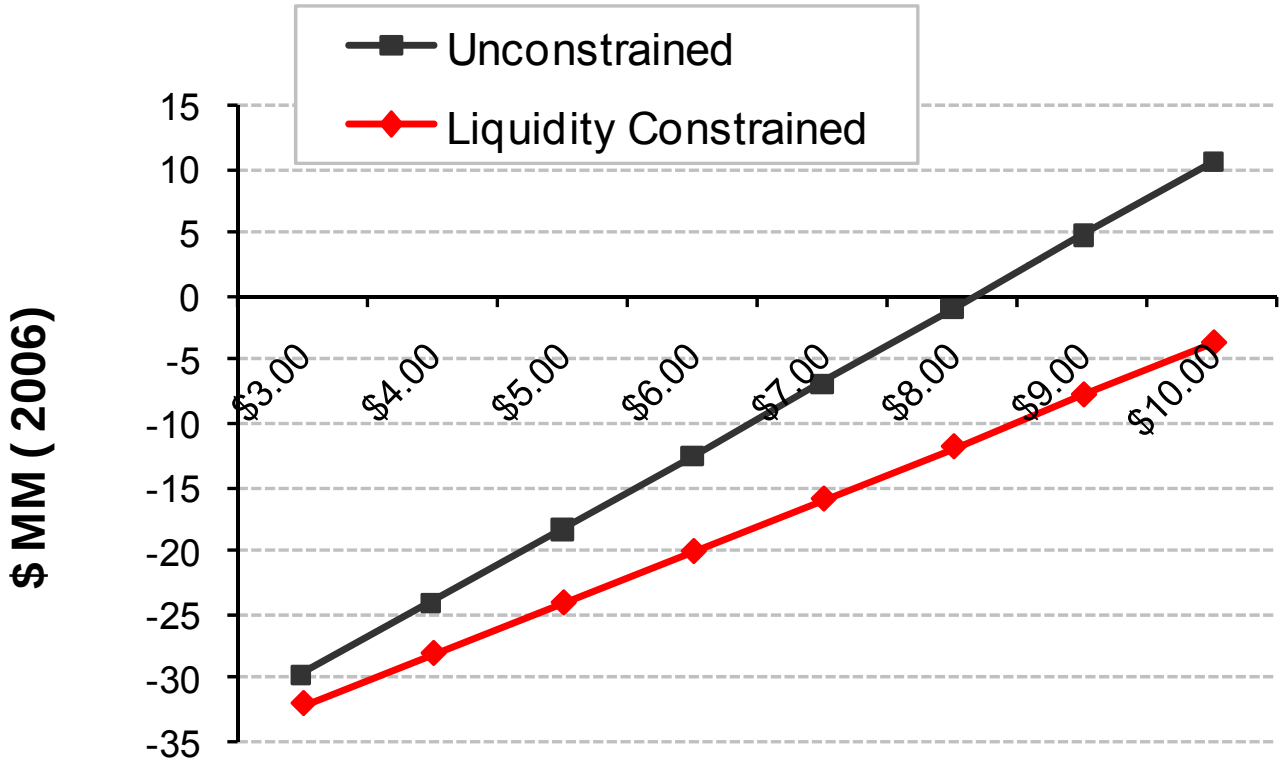


Liquidity Constraint Effects

$7.00 Gas Price



Expected Monetary Value



Conclusion

- Infrastructure Bottlenecks Affect Deliverability & Markets
- Price <u>and</u> Market Access Determine Investment Opportunities
- Limited Market Access
  - Affects ability to Monetize Investment
  - A Significant Barrier to Entry

Incentives to Expand Cook Inlet Gas Market

Kurt Gibson,
Deputy Director DOG

Price Matters

- Transparent price methodology
- Expected price is significant factor in investment decisions
- Commercial goal of recovering value of investment
- Recent and significant cost increases
- Demand destruction and the death spiral

Contract Flexibility

- Full requirements not the only option
- Term variations
- Load variations
- Volume commitments
- Value of different suppliers for varying loads

Gas Storage

- Unbundled cost in contract
- Third party storage?
- Cost recoverable in contracts
- Impact on exploration incentives?

Summary

- Price-investment decisions are influenced by expected cost recovery and transparency
- Deliverability-current infrastructure has bottlenecks that inhibit efficient gas sales
- Market-long term full requirements contracts may limit players in the market and ultimately limit utility options