Natural Gas Storage in Alaska

Presentation to the
South Central Alaska Energy Forum

Brian E. Havelock
Alaska Department of Natural Resources
Division of Oil & Gas

September 20, 2006

Presentation Outline

1. Introduction to Underground Gas Storage
2. Gas Storage in Alaska
3. Gas Storage Authorization and Leasing
4. Value of Storage Gas
5. Demand for Gas in Cook Inlet
6. Demand for Gas Storage in Cook Inlet
7. Alaska Gas Storage Deliverability
8. Conclusions

Introduction to Gas Storage

Underground gas storage is injecting surplus gas production (not for the purposes of EOR) into a depleted or nearly depleted reservoir for later withdrawal to meet demand.

In the US, gas is stored underground in salt caverns, depleted oil and gas reservoirs, and aquifers.

In Alaska gas is only stored underground in depleted reservoirs.

The best candidates for storing gas are **reservoirs** that are:

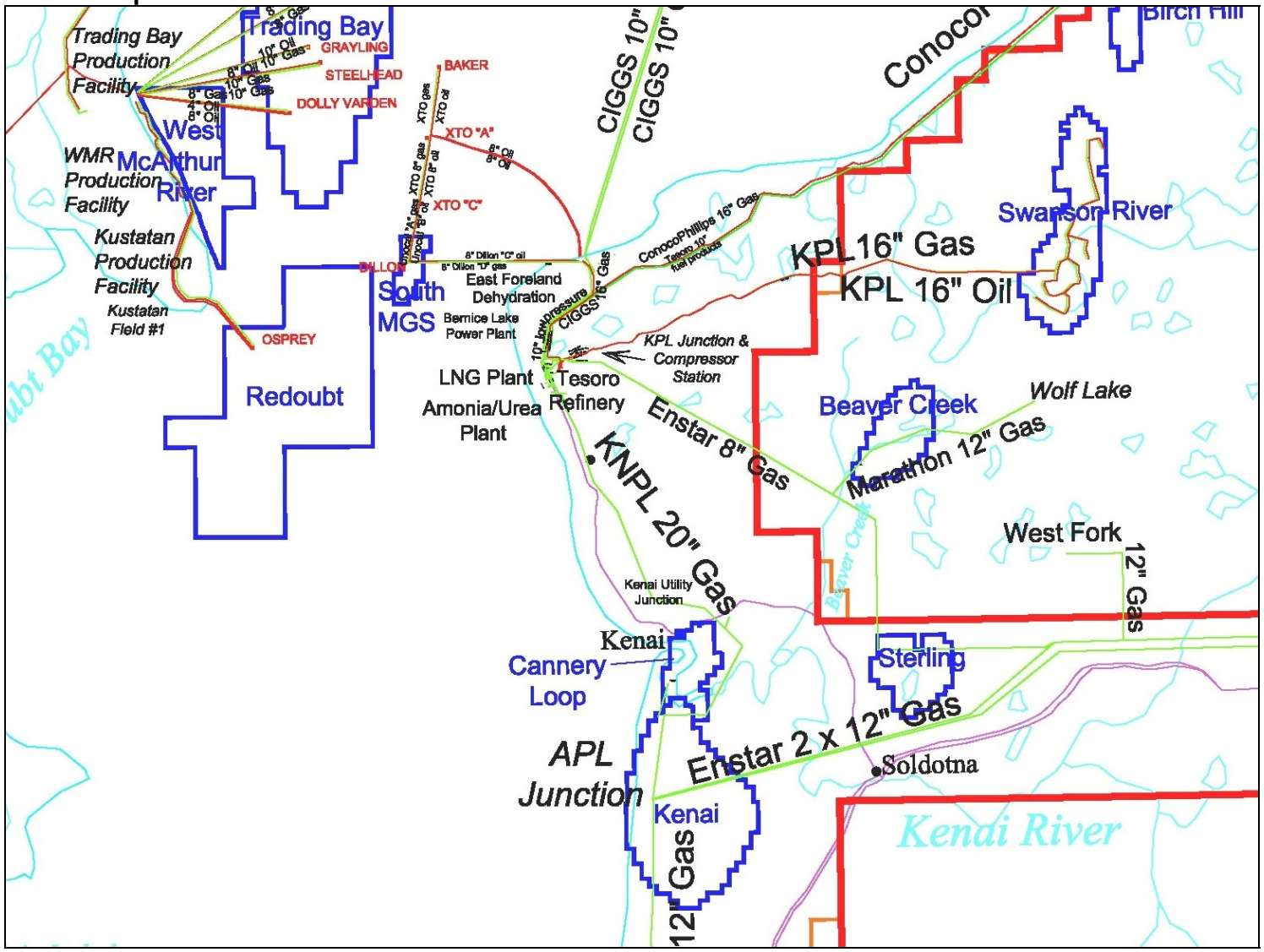
- trapped and capped with tank-like characteristics, distinct structure, and evidence of pressure depletion without support (ex., no water drive);
- not completely depleted, some residual gas saturation remaining;
- located strategically along key delivery pipelines or near primary markets.

Storage facilities are designed for **seasonal** system supply or to meet **peak-day** and **hourly** demand.

Storage facilities in Alaska:

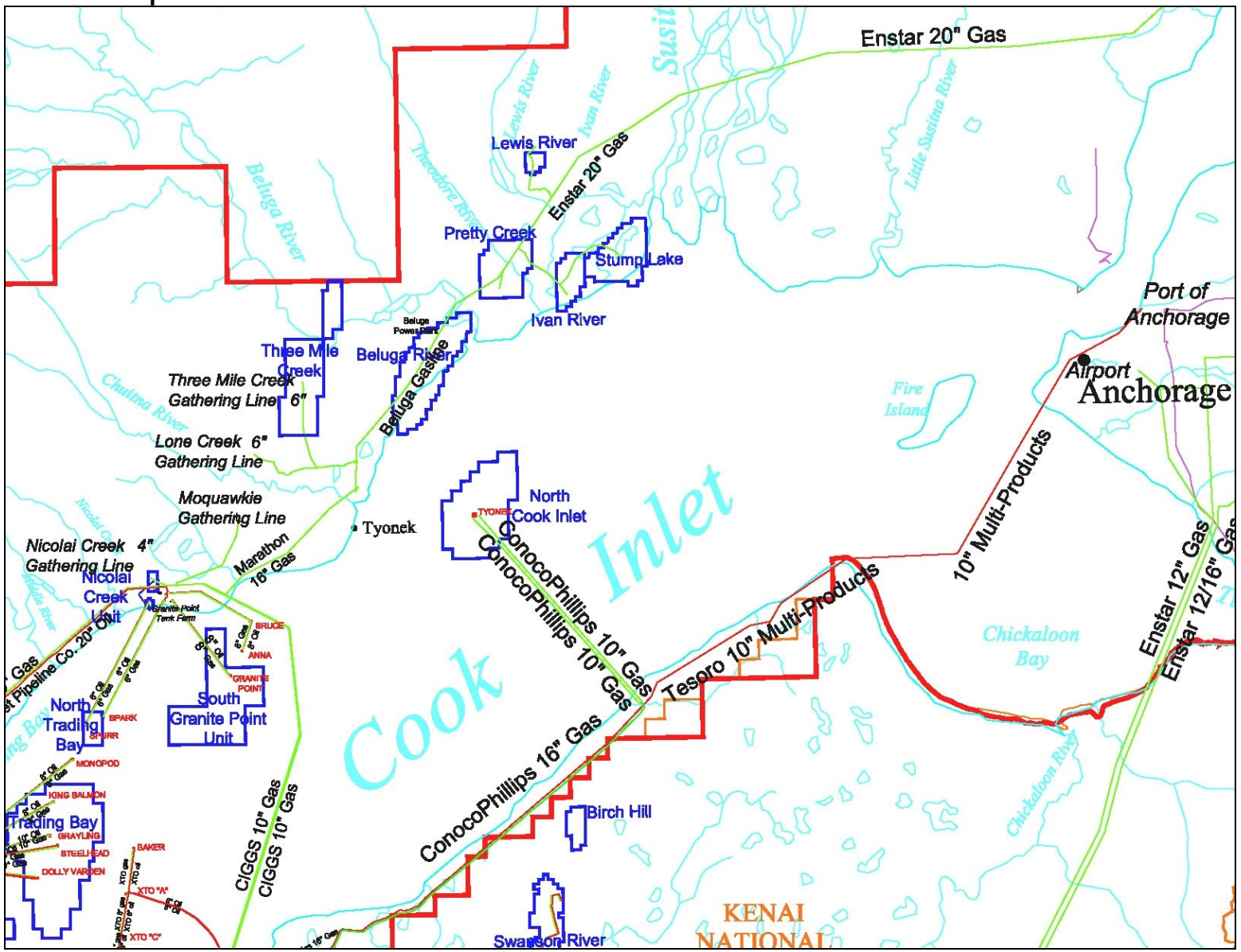
Facility	Formation	Operator
Swanson River	Tyonek 64-5 Tyonek 77-3	Chevron
Pretty Creek	Beluga 51-5	Chevron
Kenai Field	Sterling 6	Marathon

Cook Inlet Pipelines and Fields



B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Pipelines and Fields



B. Havelock, ADNR, Division of Oil & Gas, September 2006

Gas Storage Terminology

Total Capacity – maximum volume of gas that can be stored in an underground storage facility as determined by the physical characteristics of the reservoir.

Cushion Gas --volume intended as permanent inventory in a storage reservoir to maintain adequate pressure and deliverability rates throughout the withdrawal season.

Working Gas -- volume of gas in the reservoir above the designed level of the cushion gas.

--gas available to the marketplace.

--cycled in and out of the facility in a given year.

Deliverability – amount of gas that can be delivered (withdrawn) from a storage facility on a daily basis.

Deliverability factors:

- Total gas-in-place volume in the reservoir
- Reservoir pressure
- Compression capability of the surface facilities
- Configuration and Capacity of surface facilities and pipelines
- Number and capacity of producers and injector wells

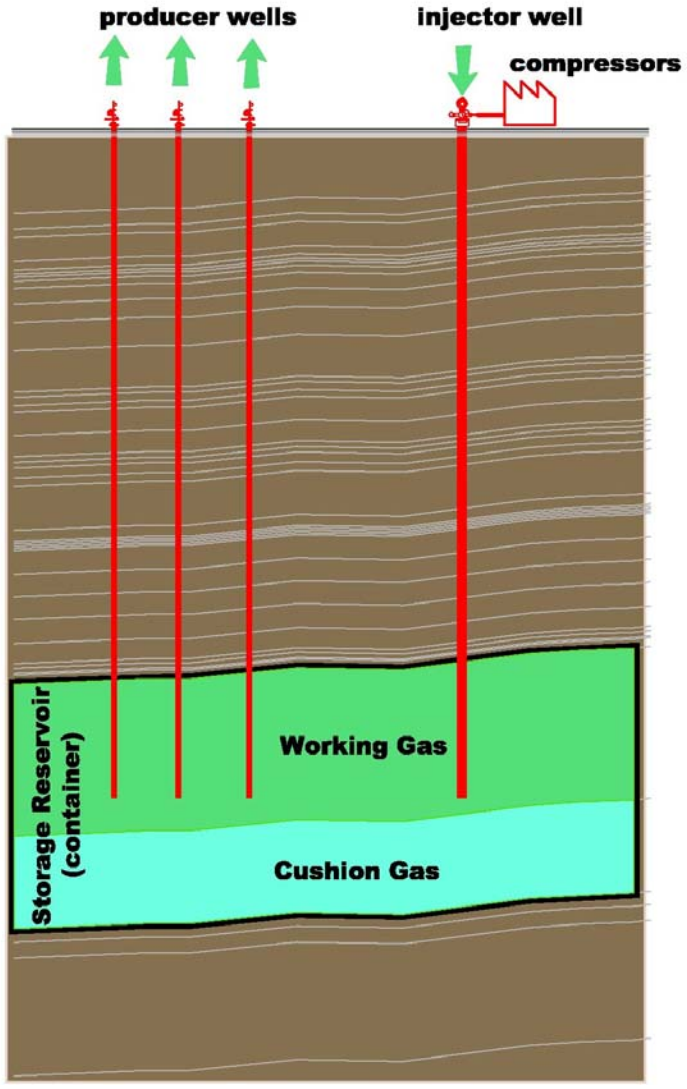
adapted from Natural Gas in the United States, EIA, 2001

Storage Operations

- Gas injected into a reservoir is cycled rates that depend on the characteristics of the reservoir and operational experience.
  - If working gas is not cycled properly, it can be lost.
  - Injection season- April through September or early October.
  - Early season cold weather can reduce storage gas in place and deliverability. Late season cold can reduce the next season's injection needs.
  - Weather and gas demand forecasting are a primary focus for storage facility optimization.
  - Storage optimization is not always the parent company focus.

Source: FERC Staff Report, September 30, 2004.

Depleted Sand Reservoir
Gas Storage Facility



B. Havelock, ADNR, Division of Oil & Gas, September 2006

Milestones for Alaska Gas Storage

June 1, 2001 BLM approves Alaska's first gas storage agreement at Swanson River Field.

July 29, 2005 Governor Murkowski's Agrium Task Force recommends that government and industry support and promote the establishment of new natural gas storage facilities within the Cook Inlet Basin to address the issue of natural gas deliverability shortfalls in winter.

Sept. 13, 2005 DNR approves Unocal's Pretty Creek gas storage lease, effective October 1, 2005.

October 1, 2005 BLM approves storage in the 77-3 Tyonek sand at Swanson River (first injection, December 2005).

May 8, 2006 DNR approves Alaska's largest gas storage facility: Marathon's Kenai Sterling Pool 6, effective May 1.

June 2006 Agrium credits staying open during the winter industrial curtailment of 2005-2006 to Swanson River Gas Storage deliveries.

Gas Storage Authorization

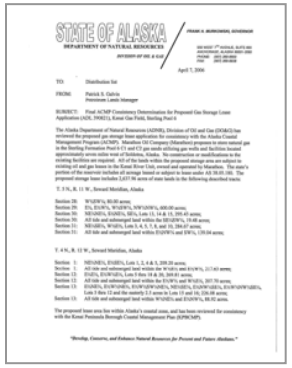
1. AOGCC Storage Injection Order (all lands)

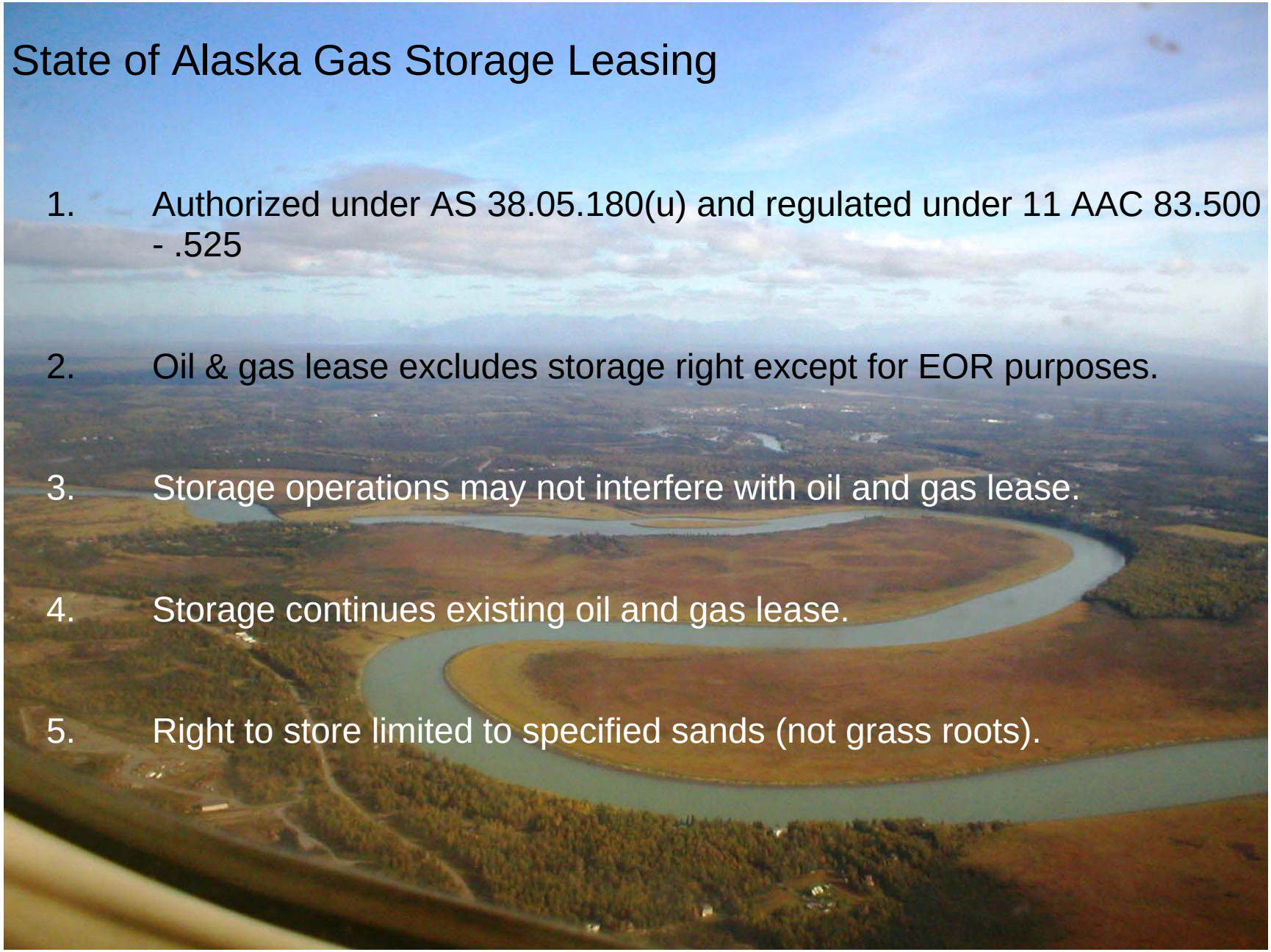
   - Underground Storage Regulations – 20 AAC 25.252
   - Ensure Protection of Drinking Water Sources
   - Demonstration of Mechanical Integrity
   - Well Integrity and Confinement
   - Maximum Reservoir Pressure
   - Performance Monitoring and Reporting

2. BLM Gas Storage Agreement/Royalty Gas Payout Agreement (federal lands)

   - Native Gas Reserve Determination and Production Allocation
   - Royalties on Produced Gas
   - Reports

3. ADNR **Gas Storage Lease** and ACMP Consistency Review (State lands)





State of Alaska Gas Storage Leasing

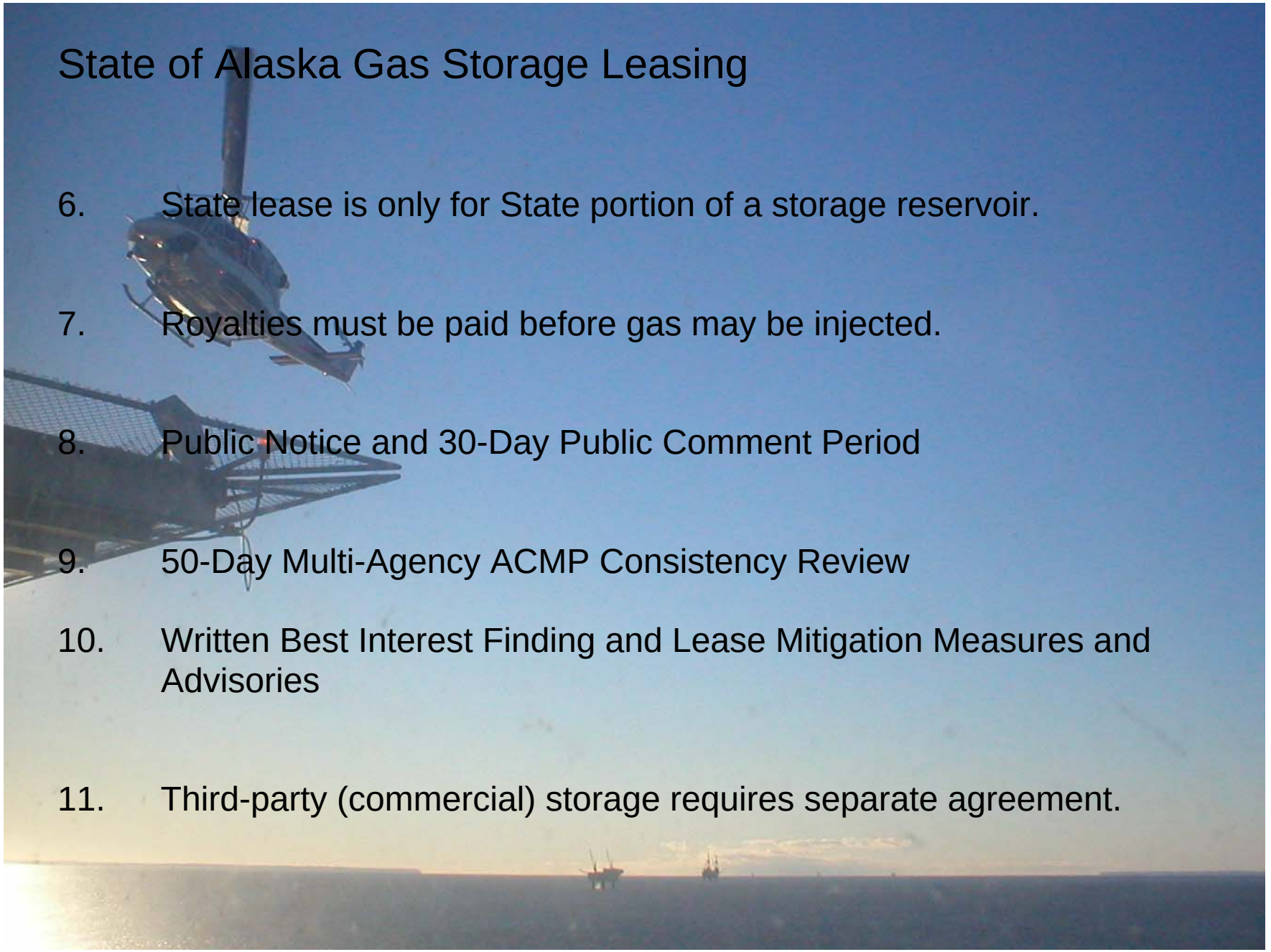
1. Authorized under AS 38.05.180(u) and regulated under 11 AAC 83.500 - .525

2. Oil & gas lease excludes storage right except for EOR purposes.

3. Storage operations may not interfere with oil and gas lease.

4. Storage continues existing oil and gas lease.

5. Right to store limited to specified sands (not grass roots).



State of Alaska Gas Storage Leasing

6. State lease is only for State portion of a storage reservoir.

7. Royalties must be paid before gas may be injected.

8. Public Notice and 30-Day Public Comment Period

9. 50-Day Multi-Agency ACMP Consistency Review

10. Written Best Interest Finding and Lease Mitigation Measures and Advisories

11. Third-party (commercial) storage requires separate agreement.

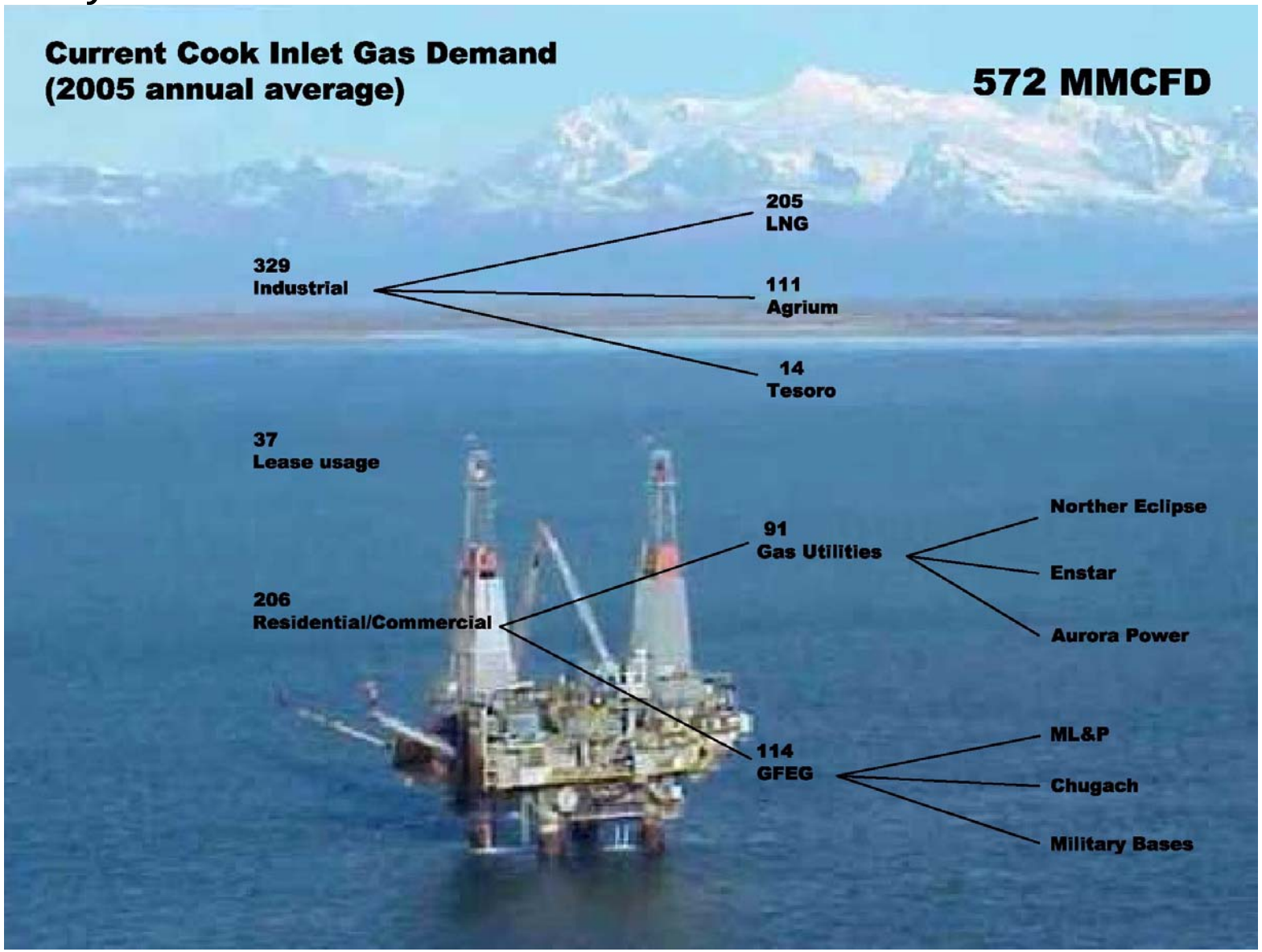
Gas Storage Lease -- Key Terms

- Annual Storage Development Plan
- Native Gas Royalty
- Fees
- Plan of Operations Permit and Bonding
- Storage Limitation
- Required Operations
- Gas Measurement and Reporting Obligations

Value of Storage Gas

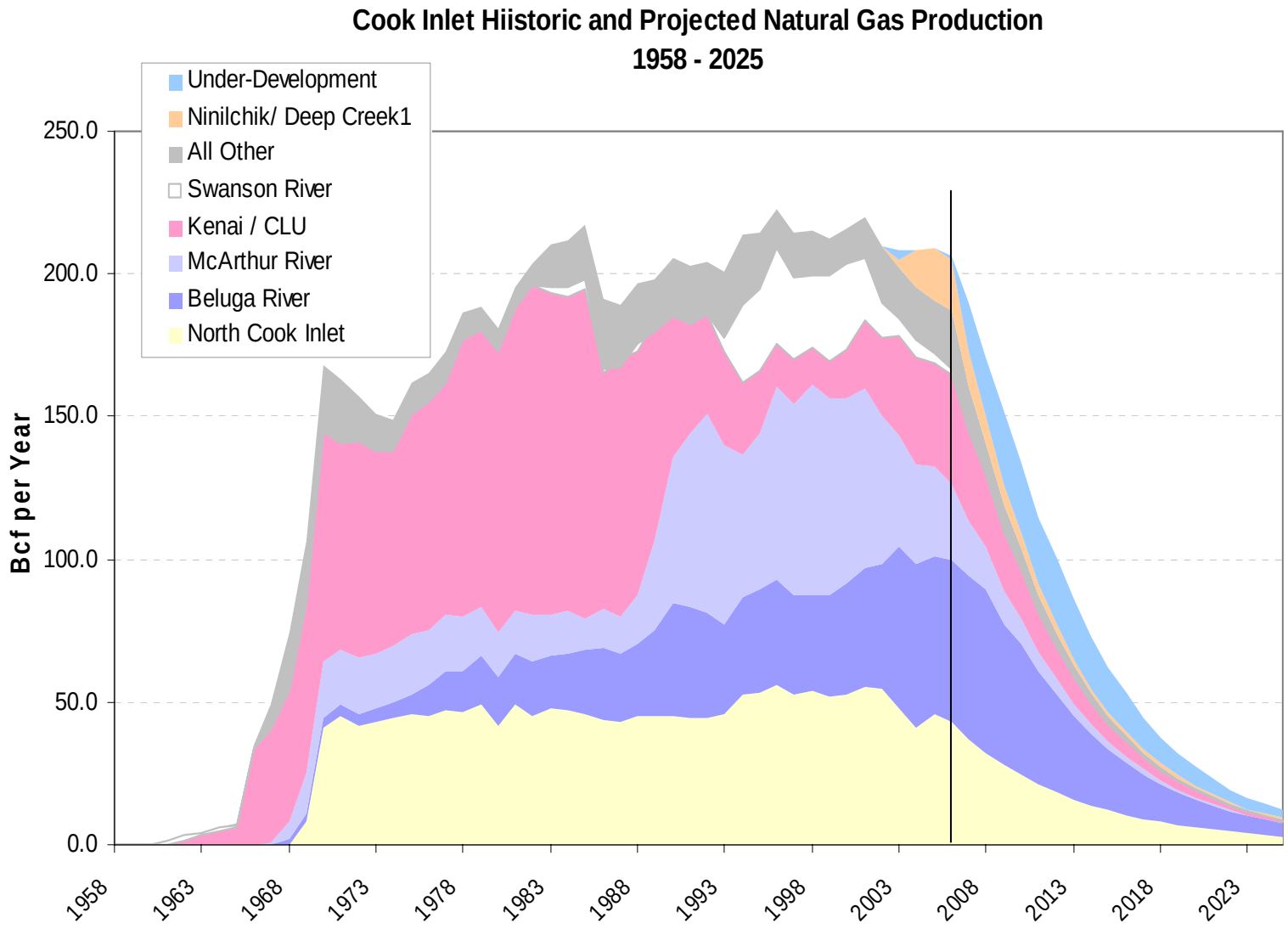
1. Location
2. Seasonal value of stored gas
3. Facility capacity
4. Operational flexibility
5. Availability of substitutes for storage gas
6. Cost of storage and transportation
7. Price volatility
    - Not a factor in Alaska (yet), but big driver in Lower 48

Daily Demand



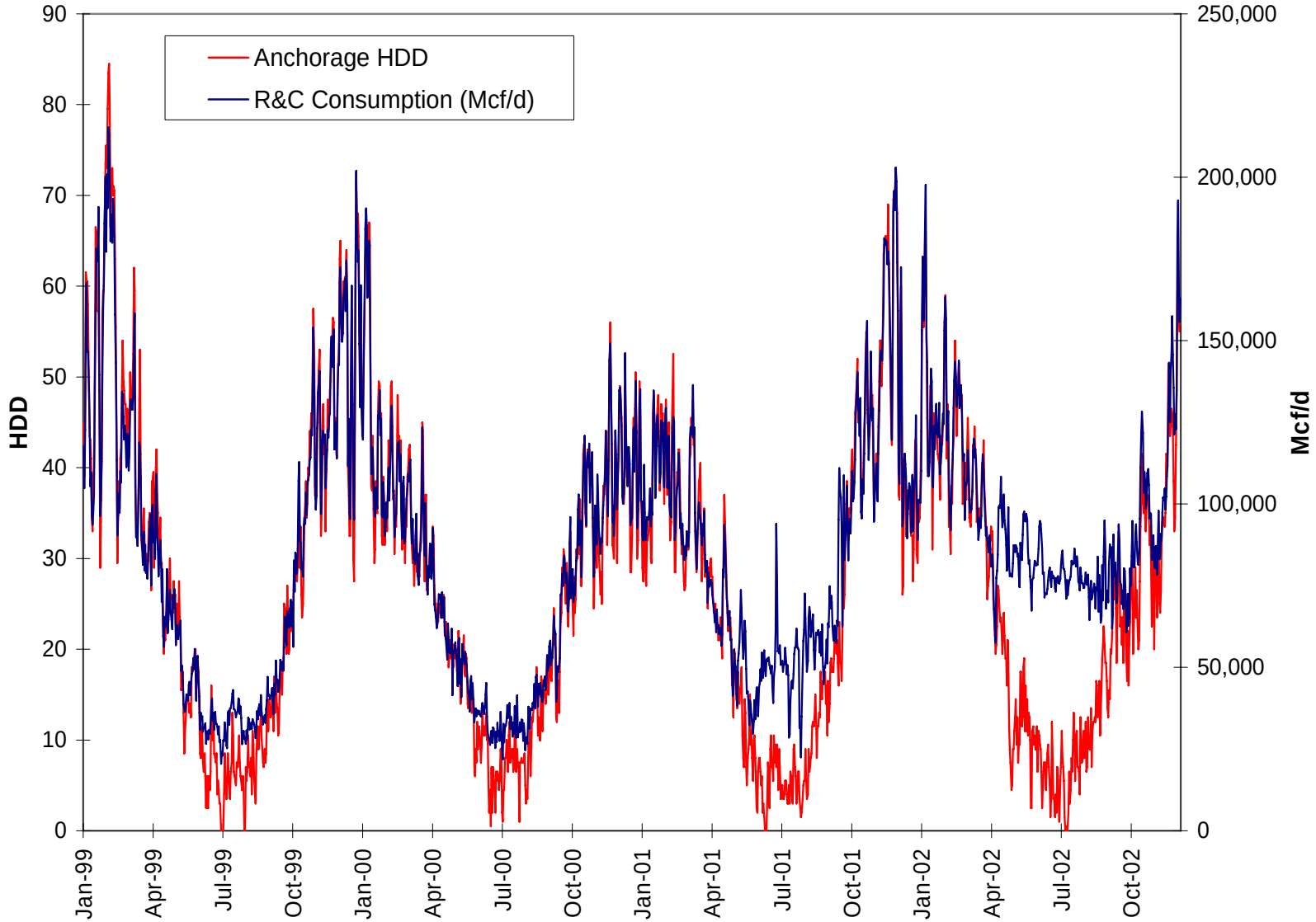
B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Gas Reserves



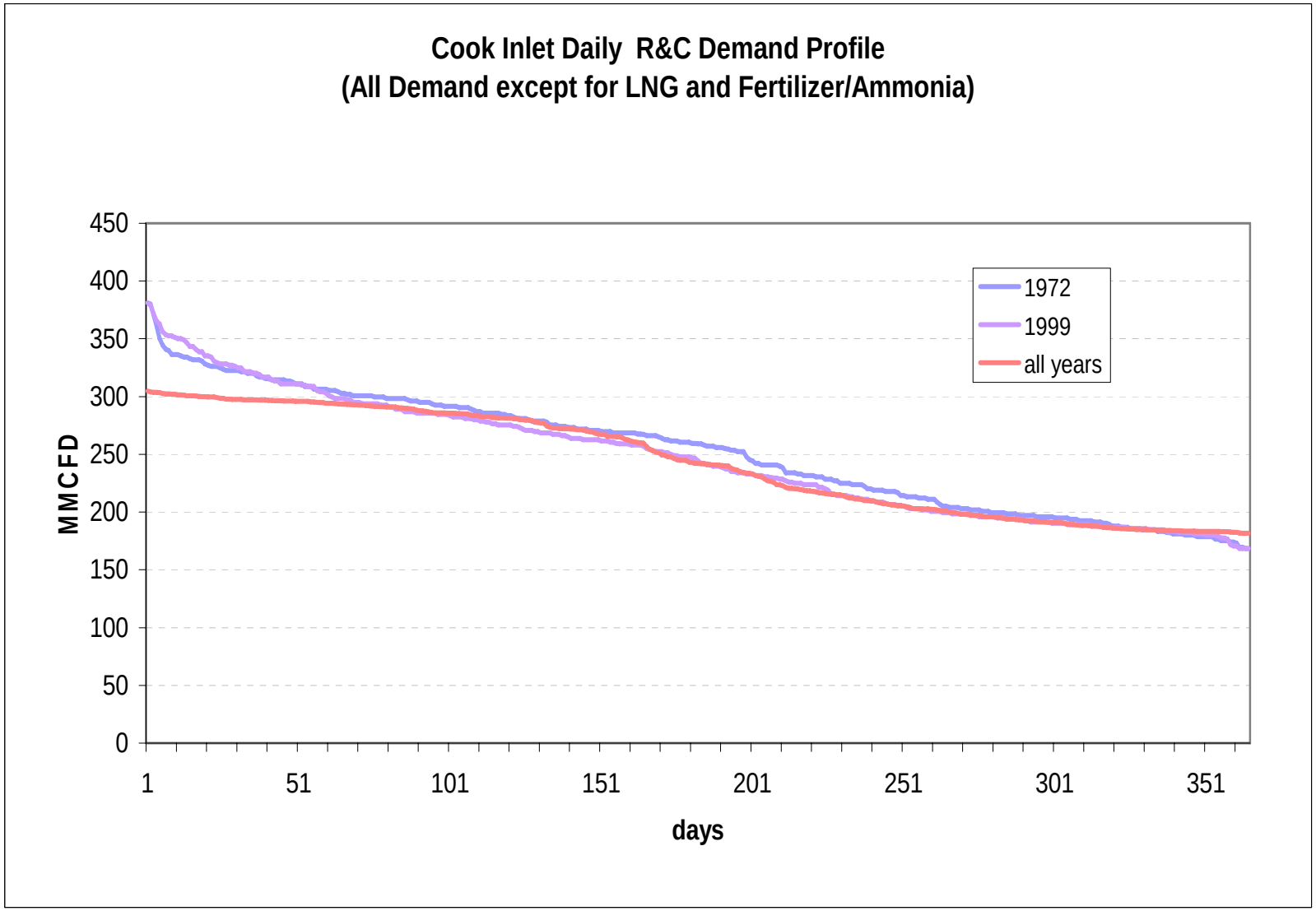
B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Residential and Commercial Seasonal Demand



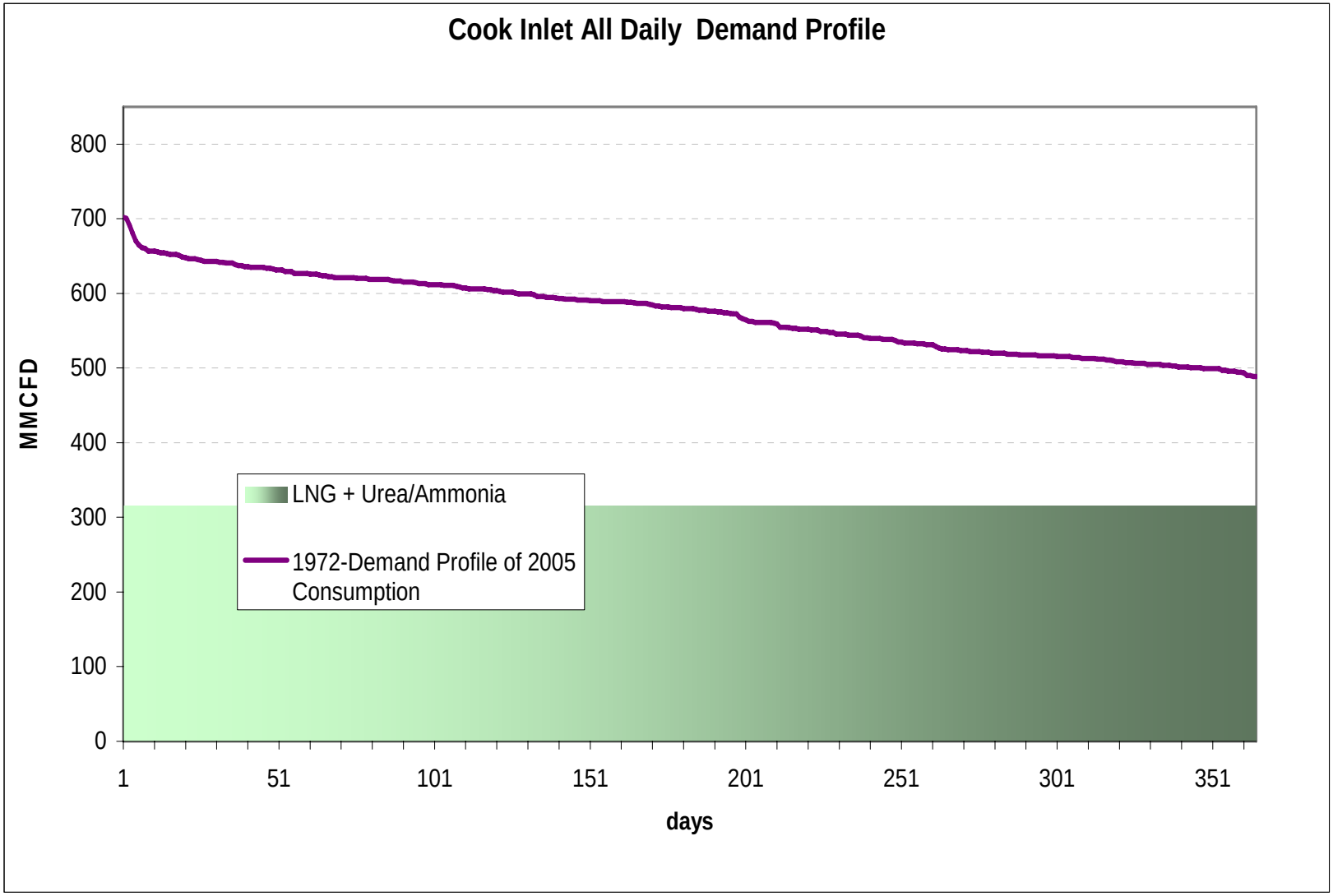
B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Demand Load Profile



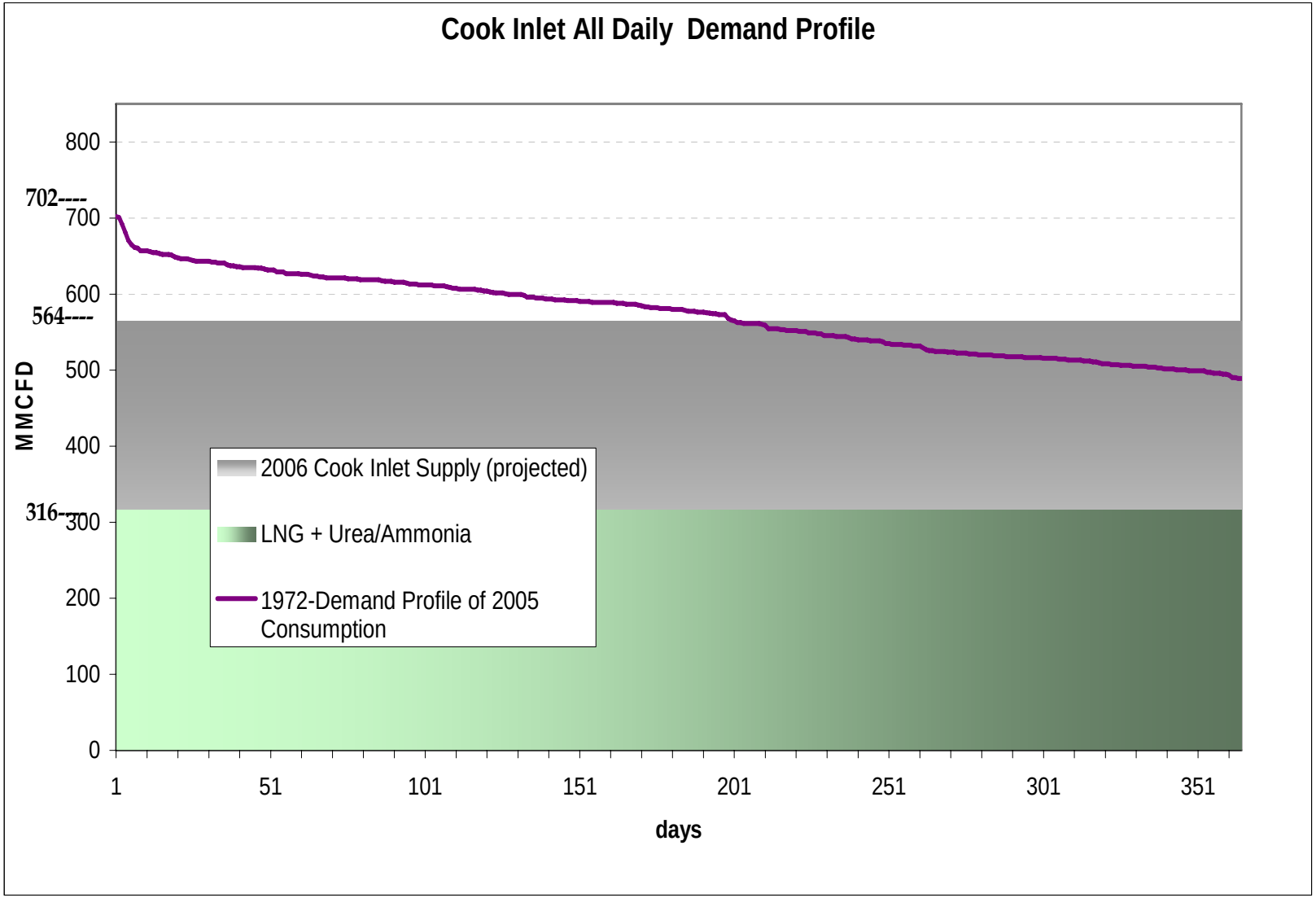
B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Demand Load Profile



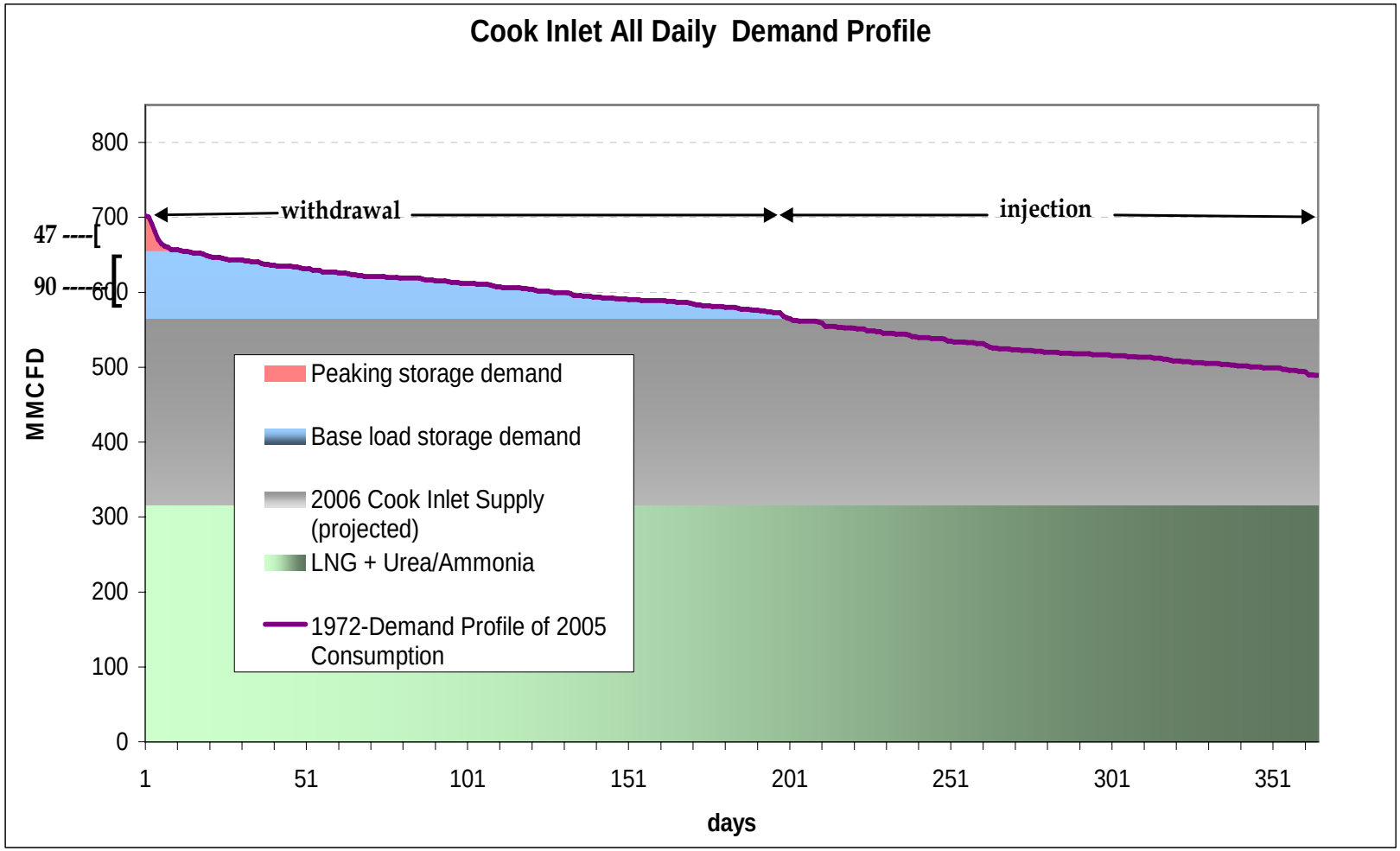
B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Demand Load Profile



B. Havelock, ADNR, Division of Oil & Gas, September 2006

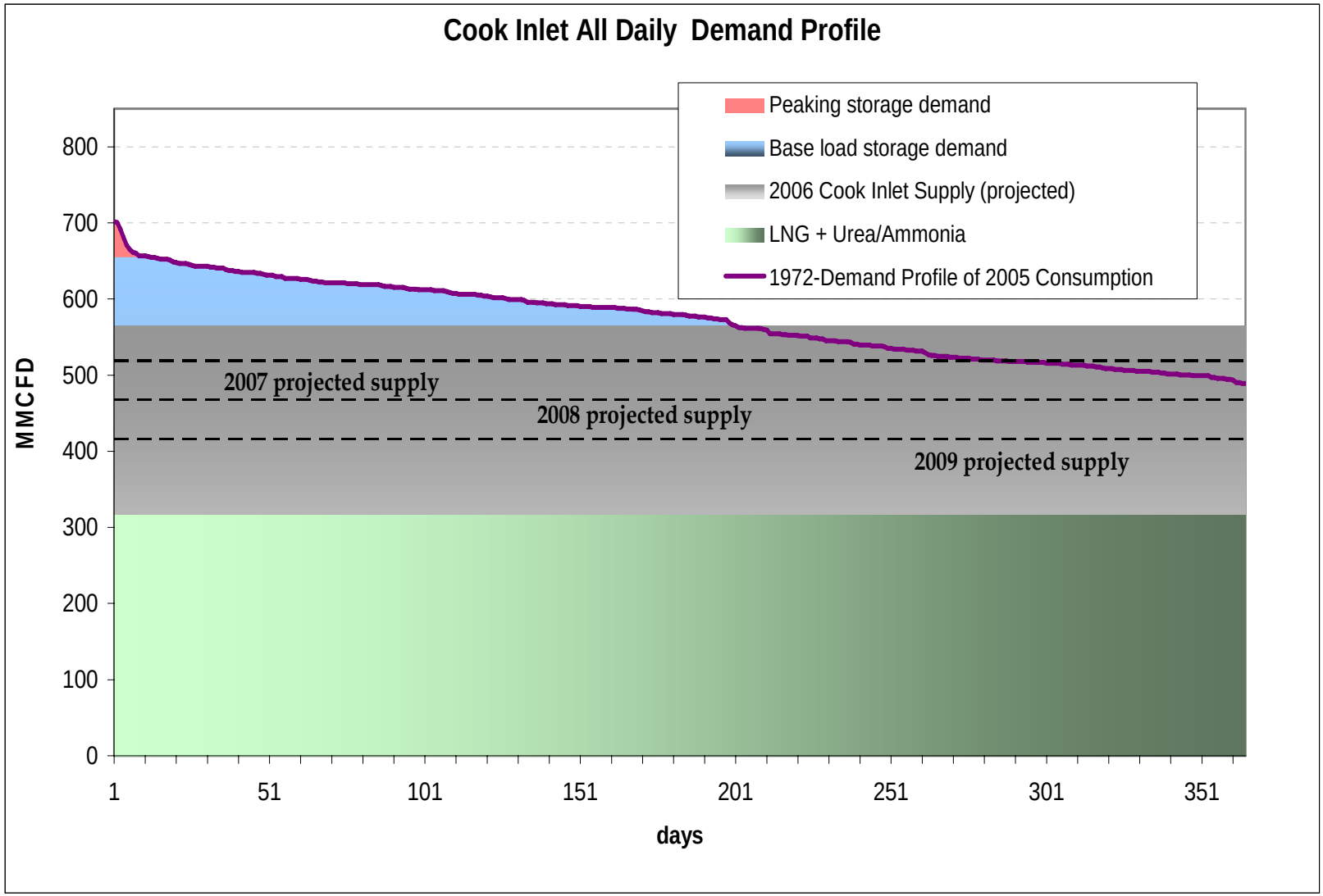
Current Storage Demand



Assumes 2005-level Industrial Demand flat throughout the year.
Peaking storage demand duration 14 days for total annual demand estimate of 0.2 bcf/year working gas.
Base load storage demand duration 201 days for a total annual demand estimate of 9.6 bcf/year working gas.
Maximum base load and peak shaving storage capacity demand estimated at 90 and 47 MMCFD, respectively.
Annual production is adjusted throughout the year to meet demand by choking back and shutting-in wells, thus the 2006 supply line is not expected to be flat.

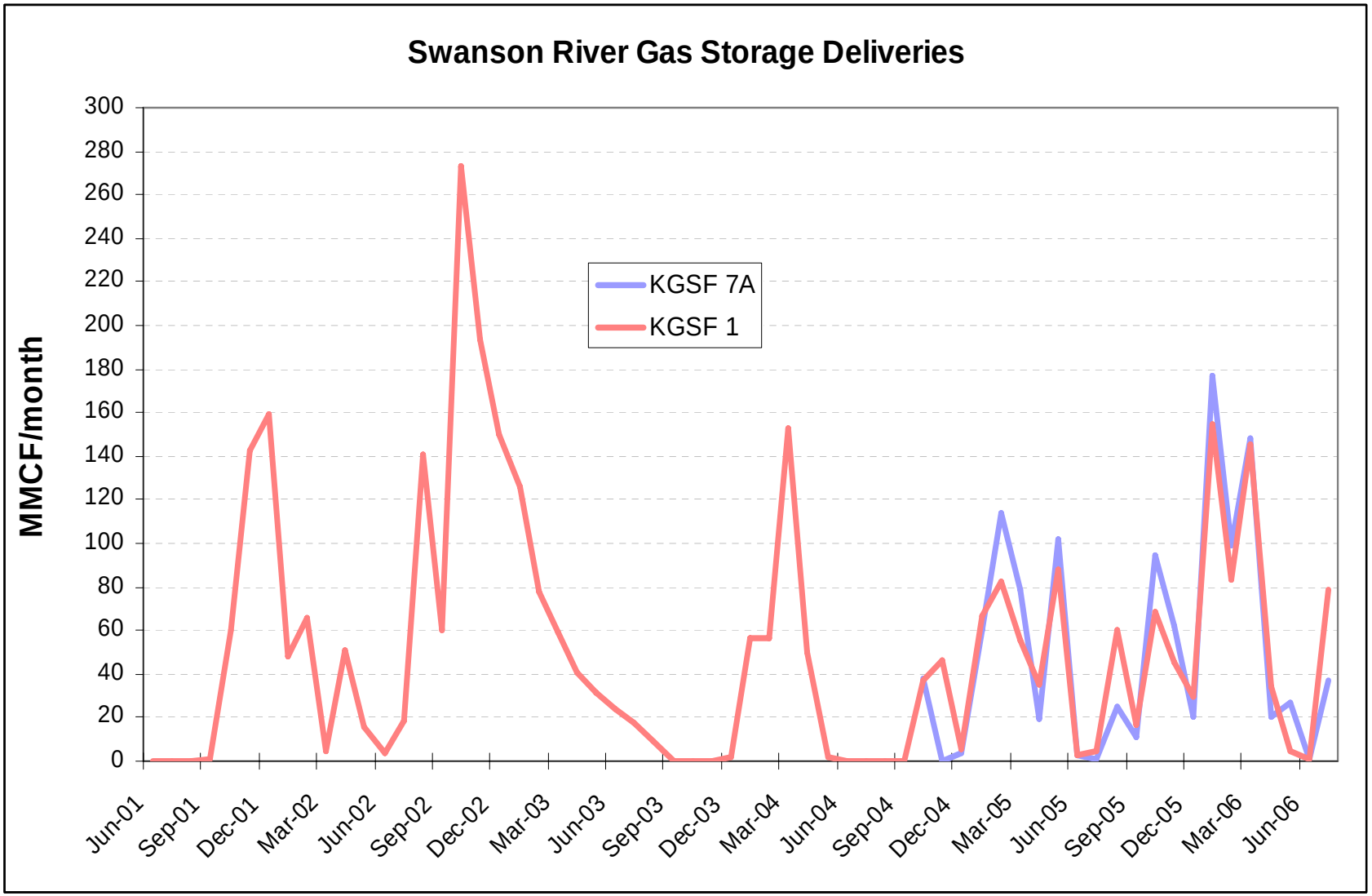
B. Havelock, ADNR, Division of Oil & Gas, September 2006

Decline in Production Forecasted



B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Gas Storage Provides Seasonal Supply to Industrial Market



B. Havelock, ADNR, Division of Oil & Gas, September 2006

Cook Inlet Gas Storage Deliverability

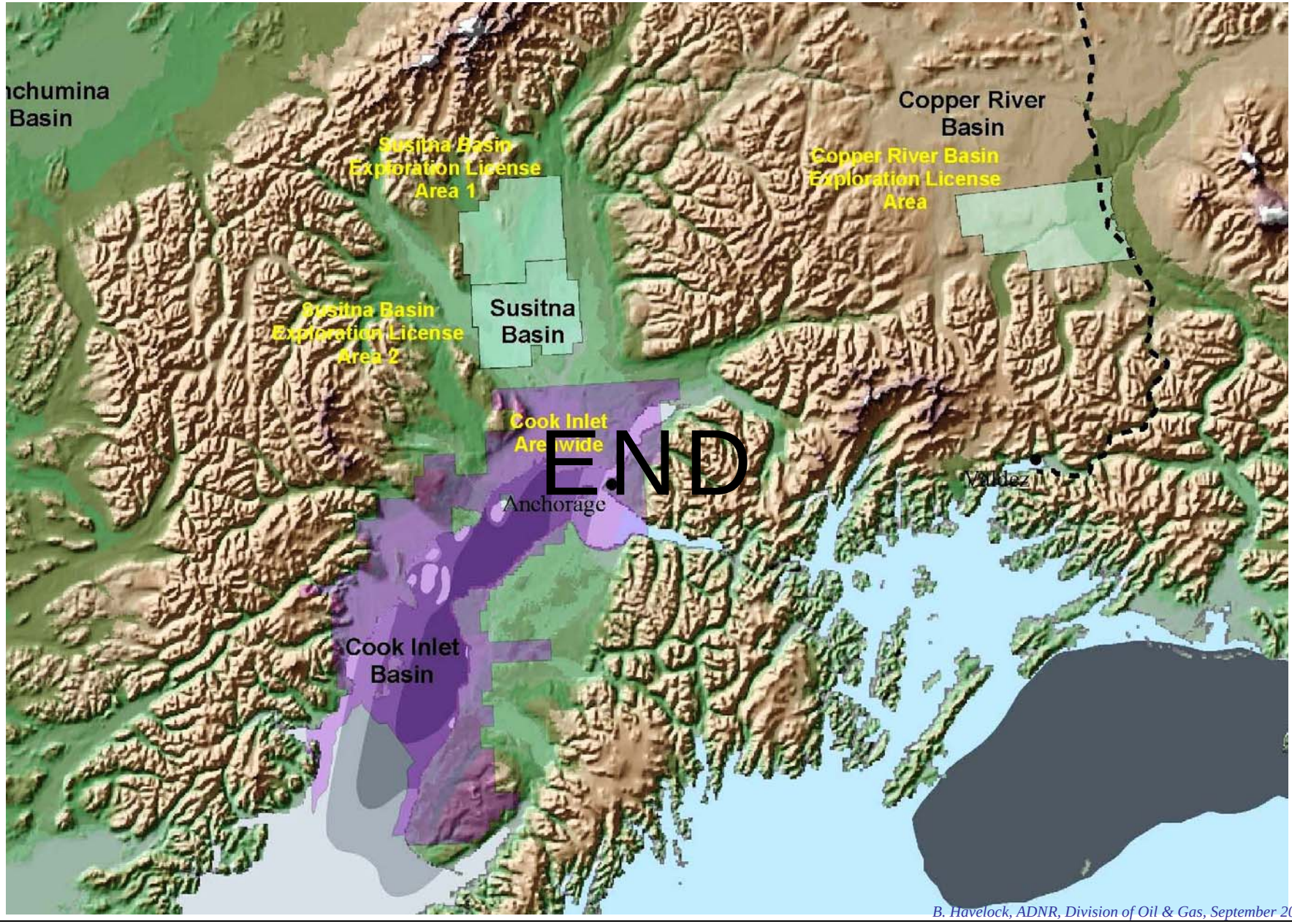
Cook Inlet Gas Storage Deliverability (MMCFD)

Facility	# wells	Peak delivery/well (average)	Feb 06 rate	Historical average produced volume	Total daily peak delivery	Total daily average delivery	Working Gas (BCF/Yr)
SWANSON RIVER	2	10.4	9.2	3.7	20.8	7.4	2.2
KENAI POOL 6	9	6.7	3.7	-	60.3	33.3	6
PRETTY CREEK	1	7.3	-	2.4	7.3	2.4	0.7
TOTAL	12				88.4	43.1	8.9

Notes:
Peak deliverability rates vary widely at Pool 6. Peak delivery for Pretty Creek based on PCU#4 well production history.
Pool 6 working gas capacity may be expanded to 11 or more BCF, but total gas-in-place limited to 50 BCF under the current lease.
Maximum injection rates range from 20 MMCFD to 55 MMCFD.

Conclusions

1. Storage promotes conservation.
2. Storage balances seasonal demand swings.
3. 2006 gas supply deficit ~ 3 BCF
4. Reserves are declining and deficit will grow to 17.6 BCF next year, 55.6 BCF by 2009.
5. Producers will only prove and produce what they can sell.
6. Base load storage maximum capacity is 88 MMCFD, almost enough to meet demand, but facilities may only be able to deliver half that.
7. Cook Inlet needs additional working gas capacity and daily, especially peak deliverability, to meet current seasonal demand swings.
8. Storage can alleviate daily demand swings, but it cannot solve the greater problem of supply; you can't inject gas you don't have.



B. Havelock, ADNR, Division of Oil & Gas, September 2006