

# HISTORICAL AND PROJECTED OIL AND GAS CONSUMPTION

JANUARY 1990

# PRODUCTION FORECAST AND AVAILABLE ROYALTY OIL

THOUSANDS OF BARRELS PER DAY

TABLE 2.2

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 TOTAL (MMbbl)

## PRODUCTION FORECAST

|                    | 1990         | 1991         | 1992         | 1993         | 1994         | 1995         | 1996         | 1997         | 1998       | 1999       | 2000       | 2001       | 2002       | 2003       | 2004       | 2005       | 2006       | 2007       | 2008       | 2009       | 2010       | 2011       | 2012       | 2013       | 2014       | 2015       | TOTAL            |         |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------------|---------|
| <b>NORTH SLOPE</b> |              |              |              |              |              |              |              |              |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |                  |         |
| Prudhoe Bay [1]    | 1,331        | 1,198        | 1,102        | 1,014        | 932          | 857          | 789          | 728          | 668        | 614        | 553        | 498        | 448        | 403        | 363        | 328        | 284        | 247        | 215        | 187        | 163        | 138        | 118        | 100        | 85         | 72         | 4,902,315        |         |
| Kuparuk [2]        | 300          | 300          | 280          | 250          | 220          | 190          | 175          | 150          | 125        | 105        | 90         | 75         | 65         | 55         | 45         | 35         | 30         | 25         | 20         | 15         | 10         | 5          | 0          | 0          | 0          | 0          | 0                | 938,225 |
| Lisburne           | 40           | 40           | 40           | 40           | 40           | 37           | 34           | 31           | 28         | 25         | 21         | 19         | 13         | 9          | 5          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0                | 154,030 |
| Endicott           | 100          | 100          | 85           | 75           | 70           | 65           | 60           | 55           | 50         | 45         | 40         | 20         | 10         | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0                | 282,875 |
| Milne Point        | 30           | 25           | 20           | 16           | 13           | 10           | 8            | 7            | 6          | 5          | 5          | 5          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0                | 54,750  |
| West Sak           | 0            | 6            | 6            | 6            | 12           | 12           | 12           | 12           | 25         | 50         | 50         | 75         | 75         | 100        | 100        | 150        | 150        | 140        | 120        | 95         | 75         | 60         | 50         | 40         | 30         | 20         | 0                | 632,910 |
| Point McIntyre     | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0                | 237,250 |
| Beaufort Sea       | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0                | 178,485 |
| Niakuk             | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0                | 52,925  |
| <b>SUBTOTAL</b>    | <b>1,801</b> | <b>1,669</b> | <b>1,553</b> | <b>1,481</b> | <b>1,367</b> | <b>1,251</b> | <b>1,149</b> | <b>1,057</b> | <b>955</b> | <b>893</b> | <b>863</b> | <b>785</b> | <b>695</b> | <b>642</b> | <b>580</b> | <b>567</b> | <b>515</b> | <b>468</b> | <b>426</b> | <b>379</b> | <b>326</b> | <b>268</b> | <b>220</b> | <b>175</b> | <b>149</b> | <b>124</b> | <b>7,431,765</b> |         |

## COOK INLET

|                     |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|
| Granite Point       | 7.3         | 7.3         | 6.9         | 6.2         | 5.6         | 5.1         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 14,016 |
| McArthur River      | 19.5        | 19.5        | 18.5        | 16.7        | 15.0        | 13.5        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 30,368 |
| Trading Bay         | 2.4         | 2.4         | 2.3         | 2.1         | 1.8         | 1.6         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 3,723  |
| Middle Ground Shoal | 7.5         | 7.5         | 7.1         | 6.4         | 5.8         | 5.2         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 11,680 |
| <b>SUBTOTAL</b>     | <b>36.7</b> | <b>36.7</b> | <b>34.8</b> | <b>31.4</b> | <b>28.2</b> | <b>25.4</b> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 70,518 |

## AVAILABLE ROYALTY OIL

|                    |              |              |              |              |              |              |              |              |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |                  |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------------|
| <b>STATE TOTAL</b> | <b>1,838</b> | <b>1,706</b> | <b>1,588</b> | <b>1,512</b> | <b>1,395</b> | <b>1,276</b> | <b>1,149</b> | <b>1,057</b> | <b>955</b> | <b>893</b> | <b>863</b> | <b>785</b> | <b>695</b> | <b>642</b> | <b>580</b> | <b>567</b> | <b>515</b> | <b>468</b> | <b>426</b> | <b>379</b> | <b>326</b> | <b>268</b> | <b>220</b> | <b>175</b> | <b>149</b> | <b>124</b> | <b>7,502,283</b> |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------------|

## NORTH SLOPE

|                 |            |            |            |            |            |            |            |            |            |            |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         |
|-----------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|---------|
| Prudhoe Bay     | 166        | 150        | 138        | 127        | 117        | 107        | 99         | 91         | 84         | 77         | 69         | 62        | 58        | 50        | 45        | 41        | 36        | 31        | 27        | 23        | 20        | 17        | 15        | 13        | 11        | 9         | 612,789        |         |
| Kuparuk [2]     | 38         | 38         | 35         | 31         | 28         | 24         | 22         | 19         | 16         | 13         | 11         | 9         | 8         | 7         | 6         | 4         | 4         | 3         | 3         | 2         | 1         | 1         | 0         | 0         | 0         | 0         | 0              | 117,028 |
| Lisburne [2]    | 5          | 5          | 5          | 5          | 5          | 5          | 4          | 4          | 4          | 3          | 3          | 2         | 2         | 1         | 1         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0              | 19,254  |
| Endicott [3]    | 14         | 14         | 12         | 11         | 10         | 9          | 8          | 8          | 7          | 6          | 6          | 3         | 1         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0              | 39,603  |
| Milne Point [4] | 5          | 5          | 4          | 3          | 2          | 2          | 1          | 1          | 1          | 1          | 1          | 1         | 1         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0              | 9,283   |
| West Sak [2]    | 0          | 1          | 1          | 1          | 2          | 2          | 2          | 3          | 3          | 6          | 6          | 9         | 9         | 13        | 13        | 19        | 19        | 19        | 18        | 15        | 12        | 9         | 8         | 6         | 5         | 4         | 0              | 79,114  |
| Point McIntyre  | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0              | 29,656  |
| Beaufort Sea    | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0              | 22,311  |
| Niakuk          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0              | 6,816   |
| <b>SUBTOTAL</b> | <b>228</b> | <b>212</b> | <b>197</b> | <b>187</b> | <b>173</b> | <b>158</b> | <b>145</b> | <b>133</b> | <b>121</b> | <b>112</b> | <b>108</b> | <b>98</b> | <b>87</b> | <b>80</b> | <b>73</b> | <b>71</b> | <b>64</b> | <b>59</b> | <b>53</b> | <b>47</b> | <b>41</b> | <b>34</b> | <b>28</b> | <b>22</b> | <b>19</b> | <b>16</b> | <b>835,663</b> |         |

## COOK INLET

|                     |            |            |            |            |            |            |            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |
|---------------------|------------|------------|------------|------------|------------|------------|------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|
| Granite Point       | 0.9        | 0.9        | 0.8        | 0.8        | 0.7        | 0.6        |            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,752 |
| McArthur River      | 2.4        | 2.4        | 2.3        | 2.1        | 1.9        | 1.7        |            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 4,686 |
| Trading Bay         | 0.3        | 0.3        | 0.3        | 0.3        | 0.2        | 0.2        |            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 576   |
| Middle Ground Shoal | 0.9        | 0.9        | 0.8        | 0.8        | 0.7        | 0.7        |            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,802 |
| <b>SUBTOTAL</b>     | <b>4.6</b> | <b>4.6</b> | <b>4.4</b> | <b>4.4</b> | <b>3.9</b> | <b>3.5</b> | <b>3.2</b> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 8,815 |

## STATE TOTAL

|                    |            |            |            |            |            |            |            |            |            |            |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |
|--------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| <b>STATE TOTAL</b> | <b>233</b> | <b>216</b> | <b>201</b> | <b>191</b> | <b>176</b> | <b>161</b> | <b>145</b> | <b>133</b> | <b>121</b> | <b>112</b> | <b>108</b> | <b>98</b> | <b>87</b> | <b>80</b> | <b>73</b> | <b>71</b> | <b>64</b> | <b>59</b> | <b>53</b> | <b>47</b> | <b>41</b> | <b>34</b> | <b>28</b> | <b>22</b> | <b>19</b> | <b>16</b> | <b>944,478</b> |
|--------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|

## IN-KIND ROYALTY OIL SALES

|                        |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         |        |
|------------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|---------|--------|
| Mapco                  | 35         | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35        | 35             | 179,850 |        |
| GVEA [7]               | 4          | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4         | 4              | 6,786   |        |
| Tesoro (Old) [8]       | 41         | 37        | 34        | 31        | 28        |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         | 62,424 |
| Tesoro (New) [9]       | 23         |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         | 8,421  |
| Chevron [10]           | 16         | 14        | 13        | 12        | 11        |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         | 24,427 |
| PetroStar [11]         | 6          | 5         | 4         | 3         | 3         |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         | 8,760  |
| Chinese Petroleum [12] | 3.5        | 0.8       |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |         | 1,570  |
| <b>STATE TOTAL</b>     | <b>129</b> | <b>96</b> | <b>90</b> | <b>85</b> | <b>81</b> | <b>38</b> | <b>35</b> | <b>291,238</b> |         |        |

## IN-VALUE ROYALTY OIL

|                    |            |            |            |            |           |            |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                |
|--------------------|------------|------------|------------|------------|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| <b>STATE TOTAL</b> | <b>104</b> | <b>120</b> | <b>111</b> | <b>106</b> | <b>95</b> | <b>123</b> | <b>110</b> | <b>98</b> | <b>86</b> | <b>77</b> | <b>73</b> | <b>63</b> | <b>52</b> | <b>45</b> | <b>73</b> | <b>71</b> | <b>64</b> | <b>59</b> | <b>53</b> | <b>47</b> | <b>41</b> | <b>34</b> | <b>28</b> | <b>22</b> | <b>19</b> | <b>16</b> | <b>653,239</b> |
|--------------------|------------|------------|------------|------------|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|

Note: numbers may not sum to totals due to rounding errors.

[1] Oil, condensate and MGLs.  
 [2] 12.5% of production.  
 [3] 14.0% of production (weighted average).  
 [4] 18.0% of production (weighted average).  
 [5] 16.25% of production.  
 [6] 6.25% of production.  
 [7] 2.667% of Prudhoe Bay production. Contract expires June 30, 1996.  
 [8] Maximum 24.533% of Prudhoe Bay production. Contract expires January 1, 1995.  
 [9] Maximum 13.667% of Prudhoe Bay production. Contract expires January 1, 1995.  
 [10] Maximum 9.6% of Prudhoe Bay production. Contract expires January 1, 1995.  
 [11] 6,500 BPD of Kuparuk River Unit royalty oil. Initial purchase would be 6,000 BPD. Contract expires September 30, 1996.  
 [12] 97% of west-side Cook Inlet royalty production. One-year contract expires November 30, 1990. Production in 1991, accounts for Drift River Terminal shutdown in 1990.



**STATE OF ALASKA**

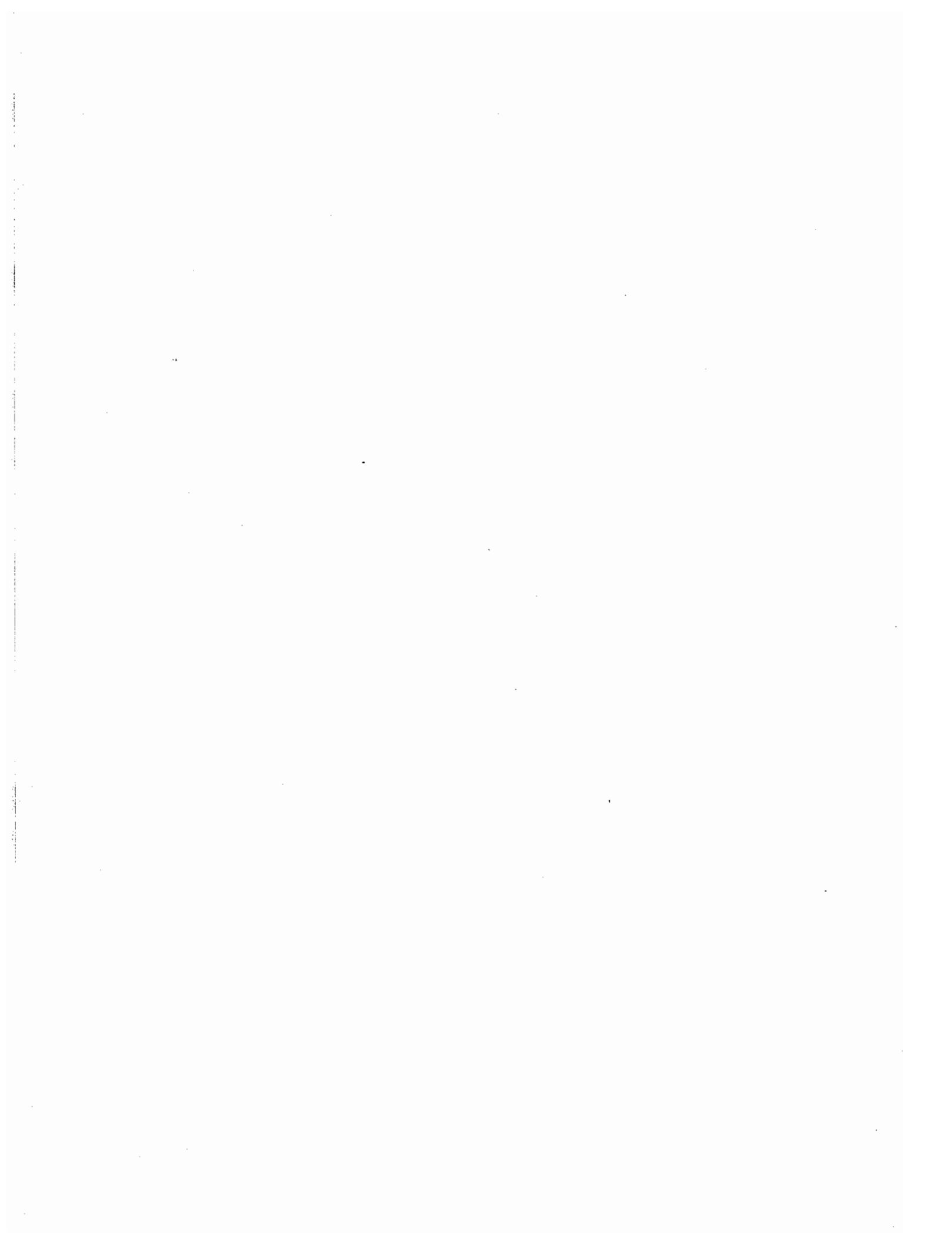
**HISTORICAL AND PROJECTED  
OIL AND GAS CONSUMPTION**

**Steve Cowper  
Governor**

**Lennie Gorsuch  
Commissioner  
Department of Natural Resources**

**January 1990**

**Prepared for the Second Session  
Sixteenth Alaska Legislature**



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## AUTHORITY

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The Division of Oil and Gas issues a revised supply and demand report each year to comply with AS 38.05.183(d), which states:

*"(d) Oil or gas taken in kind by the state as its royalty share may not be sold or otherwise disposed of for export from the state until the commissioner determines that the royalty-in-kind oil or gas is surplus to the present and projected intrastate domestic and industrial needs. The commissioner shall make public, in writing, the specific findings and reasons on which his determination is based and shall, within 10 days of the convening of a regular session of the legislature, submit a report showing the immediate and long-range domestic and industrial needs of the state for oil and gas and an analysis of how these needs are to be met." (See Appendix D for discussion of statutory definitions.)*



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## EXECUTIVE SUMMARY

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This report compares estimates of the quantity of available Alaska oil and natural gas reserves with estimates of how much oil (refined products) and gas Alaska will consume in the 15 year period between 1988 and 2002.

CHAPTER 1 briefly describes the state's royalty oil program.

CHAPTER 2 lists high-, mid- and low-range estimates of oil and gas reserves and their respective royalty shares. Mid- and low-range estimates assume relatively stable oil prices. High-range estimates assume increasing oil prices and additional enhanced oil recovery efforts. The lower figures, therefore, are prudent values for making long range policy considerations. The mid-range estimate for oil is 7.0 billion barrels of oil, which will yield an estimated 897 million barrel state royalty share. The mid-range estimate for gas is 31.7 trillion cubic feet, of which the state's share will be 3.8 trillion cubic feet. The North Slope will produce about 99% of the state's royalty oil and a little over 90% of the royalty gas.

The chapter includes an estimate of North Slope production for the 25 years between 1990 and 2015.

The chapter also discusses factors which may affect the state's oil and gas reserves.

CHAPTER 3 presents historical data on production and consumption of Alaska oil and gas. Prudhoe Bay oil production peaked in 1987, declined slightly in 1988 and declined substantially in 1989. North Slope regional production peaked in 1988.

Between 1977 and 1988, annual fuel consumption grew from 0.7 to 1.9 billion gallons, and annual gas consumption grew from 205 to 409 billion cubic feet.

CHAPTER 4 forecasts how much oil and gas will be consumed in Alaska between 1990 and 2004. Alaska will probably consume about 26 billion gallons of fuels and 5 trillion cubic feet of gas during that period. Consumption growth rates will be considerably lower than in the early and mid-1980s. Between 1990 and 2004, estimated an-

nual growth in consumption may be as low as 1% for both oil and gas.

CHAPTER 5 compares estimates of state reserves and future production with estimates of future consumption. The comparison shows that not only are current reserves more than adequate to meet the demands of Alaskans for the next 15 years, but that significant quantities are surplus to requirements and, therefore, are available for export from the state.

The supply and demand projections in this report are accurate only if their underlying assumptions are accurate. Demand is difficult to predict because in-state consumption is influenced by economic and population growth which in turn is influenced in large part by world energy and natural resource prices. For example, development of a new hydroelectric project in South Central Alaska (other than Bradley Lake) or a coal-fired electric generation project could dramatically affect the in-state demand for natural gas, particularly after the late 1990s. Future expansion of the natural gas, ammonia-urea or petrochemical export market would similarly affect in-state natural gas availability, as well as prices.

A wide range of probabilities also affects supply projections. The mid-range estimates of oil and gas reserves are likely outcomes; however, a gas pipeline from the North Slope remains very uncertain and development of certain proven oil and gas fields beyond existing infrastructure is questionable at today's oil prices. Undiscovered resources are highly speculative, and are not relevant to this projection. Even if these undiscovered resources exist (which they may not), there is no guarantee that they will be discovered or developed in time (or if ever) to assure long-range continuity. For the most part, major oil and gas firms will search for and develop reserves in response to world market conditions, not because of surplus or deficit conditions in Alaska's relatively small intrastate market.



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## CHAPTER 1

### ROYALTY OIL PROGRAM

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When a landowner leases or sells the right to explore for and develop oil and gas, it usually reserves to itself a percentage of the oil and gas ultimately produced if exploration is successful. That percentage is known as a royalty interest or royalty share. The State of Alaska holds a royalty interest in the lands it has leased for oil and gas exploration and development and receives royalty payments and "in-kind" royalty oil from oil and gas production in Cook Inlet and on the North Slope.

Alaska Statutes and state oil and gas lease terms allow the state to take its royalty share of oil and gas either "in-kind" or "in-value." When the state takes its share of production in-kind, the Commissioner of the Department of Natural Resources, acting on behalf of the state, sells the oil or gas through negotiated contracts or competitive sales. When the state takes its royalty share in-value (i.e., as money), individual lessees market the state's royalty portion with their equity production and pay the state the value they receive for the product.

Presently, the state takes North Slope royalty oil both in-value and in-kind. All four in-state refiners, Chevron, Tesoro, Petro Star/Chevron, and MAPCO, hold long term contracts with the state to purchase royalty oil. Tesoro, however has announced that it does not intend to renew its contract with the state. The state also has a long-term contract with Golden Valley Electric As-

sociation in Fairbanks. Tables 2.2 and 2.3 depict estimated North Slope and Cook Inlet production to the year 2014 as well as the state's existing royalty oil contract obligations for that period.

The state began taking all Cook Inlet royalty oil in-kind in early October 1985 in preparation for offering it for export. In late October the U. S. Department of Commerce announced its intent to permit the export of Cook Inlet crude oil in one-year contracts. The Department of Natural Resources subsequently has issued three consecutive one-year contracts with Chinese Petroleum Corporation of Taiwan.

The first contract extended from July 9, 1987 to July 8, 1988 and exported 3,600 barrels per day. The second contract ran from December 1, 1988 to November 30, 1989 and exported about the same volume. In the interim between July and December 1988, the state received in-value payments for its Cook Inlet royalty oil. The third contract, which began on December 1, 1989, will export about 3,200 barrels per day.

The "Free Trade" bill with Canada will allow the export of up to 50,000 barrels per day of Alaska North Slope crude to Canada, presumably Vancouver. The U.S. currently exports small quantities of crude and refined products (less than 100,000 barrels per day) to Canada. Canada is a major exporter of crude oil to the U.S. with daily exports averaging more than 550,000 barrels of crude oil.



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## CHAPTER 2

### RESERVE ESTIMATES AND ROYALTY SHARE

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#### Introduction

This chapter discusses estimates of Alaska's oil and gas reserves and the state's royalty share of these reserves. The reserve estimates have been developed for three different cases. Analysts used the specific royalty terms of individual oil and gas lease contracts to calculate the state's royalty share of the reserves in each field. The low-range estimates assume falling oil and gas prices and/or poorer-than-predicted reservoir performance. The mid-range estimates assume relatively stable oil and gas prices and anticipated reservoir performance. The high-range estimates assume rising oil and gas prices and/or better-than-predicted reservoir performance.

Estimated oil and gas reserves and royalty share are shown in Table 2.1. Cook Inlet and the North Slope estimates were derived from different information sources, and within each region reserves are classed as "proven and developed" or "proven but undeveloped or shut-in." These sub-categories distinguish those volumes of oil and gas which are readily marketable from those which need additional investment in facilities and transportation systems which, in turn, will delay their development.

#### Cook Inlet

Considerable information exists about the oil and gas reserves and potential in the Cook Inlet area. While there has been renewed interest in Cook Inlet exploration, infill drilling programs, and remedial field work, we do not anticipate that significant new reserves will be added in the near future. Recent changes in working interest ownership of several Cook Inlet gas fields have resulted in the development of some of these previously shut-in fields. The reserves are assumed to remain constant for low-, mid- and high-range estimates. Cook Inlet reserves account for about 1.8% of the low, 1.2% of the mid, and 0.8% of the high estimates of statewide total oil and gas reserves.

#### North Slope

Oil and gas reserve estimates shown in Table 2.1 are for currently leased state lands. Operators produce North Slope oil from the Sadlerochit and the Lisburne reservoirs in the Prudhoe Bay Unit, the Kuparuk River reservoir in the Kuparuk River Unit, and the Endicott reservoir in the Duck Is-

land Unit. Production from the Kuparuk River reservoir in the Milne Point Unit which was shut-in January 1987, resumed in April of 1989. Average production in 1989 has been 12,00 barrels per day, but is expected to rise to 30,000 barrels per day in 1990.

Additional enhanced oil recovery operations at Prudhoe Bay Unit, over and above those already in operation, recovery of additional gas condensate and gas liquids from the Sadlerochit and Lisburne gas caps and enhanced oil recovery from the Kuparuk and Lisburne reservoirs represent an oil resource (versus oil reserves) of about two billion additional barrels of liquids which may or may not be economically recoverable sometime in the future.

The economics of enhanced oil recovery operations are extremely sensitive to incremental capital costs, changing markets and expected wellhead crude oil prices (which are influenced in part by pipeline tariffs, royalties and taxes). Systematic recovery of liquids from the Sadlerochit and Lisburne gas caps (and absent major gas sales, simultaneous reinjection of the dry gas back into the reservoirs) would require additional investment by the respective gas cap owners.

Depending on the nature of the liquids recovered and intended for sale, the owners of the Trans-Alaska Pipeline System (TAPS) may also have to invest in additional infrastructure, as well as retrofit existing pipeline, storage and shipping facilities to ship portions of these gas liquids. In the fall of 1988, the three major gas owners in the Prudhoe Bay Unit (ARCO, Exxon and BP America) announced that a major new gas project they were reviewing (called "Super Spike") did not appear to be economically feasible at that time. Prospects for the Super Spike project do not look favorable at this time.

Installation and start up of the world's largest central gas facility at Prudhoe Bay in 1986 was designed to separate gas liquids and gas condensate from the produced gas stream, and it is a major step in establishing the infrastructure that will be needed to proceed with any future large-scale gas sales or expanded gas cycling or gas cap liquid recovery projects. The currently configured plant separates propane, butane and heavier

hydrocarbon liquids from the produced gas stream and it could be modified to recover ethane. In addition to the heavier hydrocarbon liquids being shipped through TAPS today, significant ethane, propane and butane could be shipped through TAPS if the pipeline system and the storage and loading facilities at Valdez were modified. However, until a long term market can be identified for some or all of these three products, no major new gas liquids sale project will proceed.

Conversion of any of the above 'resources' to the 'proven reserves' category and the timing of that conversion must be viewed with extreme caution at this point. However, because billions of barrels of oil will remain in the ground at the Prudhoe Bay and Kuparuk River Units after completion of existing primary and secondary oil recovery operations, sufficient economic incentives to develop additional economic means of enhanced oil

recovery will exist well into the future. For instance, Prudhoe Bay Sadlerochit Reservoir's ultimate recovery was originally estimated to be 9.6 billion barrels but has slowly risen to 11 to 12 billion barrels. If this current estimate holds true, some 11 to 12 billion barrels will remain in place. However, new enhanced oil recovery technologies, increased infill drilling and horizontal drilling technology may increase the 11 to 12 billion barrel recovery figure even further.

Various North Slope leaseholders are continuing their experiments to economically produce the vast amounts of "heavy," low gravity oil in the shallow Tertiary and Cretaceous age sands primarily located west of Prudhoe Bay field in the Kuparuk River Unit area. Technology and equipment already exist to produce these types of oil deposits in more temperate, less costly operating and marketing climates. However, permafrost considerations, surface-related permitting, construc-

### ESTIMATED REMAINING RESERVES AND ROYALTY SHARE

TABLE 2.1

|  | OIL (MILLIONS OF BARRELS) |              |               |               |               |              |               |               |               | GAS (BILLIONS OF CUBIC FEET) |              |               |            |               |            |               |              |              |
|--|---------------------------|--------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|------------------------------|--------------|---------------|------------|---------------|------------|---------------|--------------|--------------|
|  | RESERVES                  |              |               | ROYALTY SHARE |               |              | RESERVES      |               |               | ROYALTY SHARE                |              |               | RESERVES   |               |            | ROYALTY SHARE |              |              |
|  | LOW                       | MID          | HIGH          | LOW           | MID           | HIGH         | LOW           | MID           | HIGH          | LOW                          | MID          | HIGH          | LOW        | MID           | HIGH       | LOW           | MID          | HIGH         |
| <b>NORTH SLOPE</b>                                   |                           |              |               |               |               |              |               |               |               |                              |              |               |            |               |            |               |              |              |
| <b>DEVELOPED</b>                                     |                           |              |               |               |               |              |               |               |               |                              |              |               |            |               |            |               |              |              |
| East Barrow  | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 7                            | [1]          | 7             | [1]        | 7             | [1]        | ---           | ---          | ---          |
| Endicott   | 215                       | [2]          | 280           | [2]           | 415           | [2]          | 30            | 39            | 58            | 582                          | [2]          | 782           | [2]        | 1,182         | [2]        | 81            | 109          | 165          |
| Kuparuk River Unit                                   | 685                       | [2]          | 885           | [2]           | 1,085         | [2]          | 88            | 111           | 136           | 395                          | [2]          | 520           | [2]        | 670           | [2]        | 49            | 65           | 84           |
| Lisburne reservoir                                   | 80                        | [2]          | 150           | [2]           | 350           | [2]          | 10            | 19            | 44            | 788                          | [2]          | 888           | [2]        | 988           | [2]        | 98            | 111          | 123          |
| Milne Point Area                                     | 30                        | [2]          | 50            | [2]           | 80            | [2]          | 5             | 9             | 14            | ---                          | ---          | ---           | ---        | ---           | ---        | ---           | ---          | ---          |
| Prudhoe Bay Unit                                     | 4,400                     | [2]          | 4,700         | [2]           | 5,400         | [2]          | 550           | 588           | 675           | 25,840                       | [3]          | 25,840        | [3]        | 25,840        | [3]        | 3,230         | 3,230        | 3,230        |
| South Barrow   | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 5                            | [1]          | 5             | [1]        | 5             | [1]        | ---           | ---          | ---          |
| <b>UNDEVELOPED</b>                                   |                           |              |               |               |               |              |               |               |               |                              |              |               |            |               |            |               |              |              |
| Beaufort Sea   | 0                         | [2]          | 150           | [2]           | 300           | [2]          | 0             | 30            | 60            | ---                          | ---          | ---           | ---        | ---           | ---        | ---           | ---          | ---          |
| Pt. Thomson/Flaxman Id                               | 0                         | [2]          | 0             | [2]           | 300           | [2]          | 0             | 0             | 38            | 0                            | [2]          | 0             | [2]        | 5,000         | [2]        | 0             | 0            | 625          |
| West Sak   | 0                         | [2]          | 500           | [2]           | 3,000         | [2]          | 0             | 63            | 375           | ---                          | ---          | ---           | ---        | ---           | ---        | ---           | ---          | ---          |
| Niakuk   | 0                         | [2]          | 50            | [2]           | 80            | [2]          | 0             | 6             | 10            | ---                          | ---          | ---           | ---        | ---           | ---        | ---           | ---          | ---          |
| Point McIntyre                                       | 150                       | [2]          | 200           | [2]           | 300           | [2]          | 19            | 25            | 38            | ---                          | ---          | ---           | ---        | ---           | ---        | ---           | ---          | ---          |
| <b>SUBTOTAL</b>                                      | <b>5,560</b>              |              | <b>6,965</b>  |               | <b>11,310</b> |              | <b>700</b>    | <b>889</b>    | <b>1,447</b>  | <b>27,617</b>                |              | <b>28,042</b> |            | <b>33,692</b> |            | <b>3,459</b>  | <b>3,515</b> | <b>4,228</b> |
| <b>COOK INLET</b>                                    |                           |              |               |               |               |              |               |               |               |                              |              |               |            |               |            |               |              |              |
| <b>PROVEN AND DEVELOPED</b>                          |                           |              |               |               |               |              |               |               |               |                              |              |               |            |               |            |               |              |              |
| Beaver Creek   | ---                       | 1            | [1]           | ---           | ---           | 0            | ---           | ---           | ---           | 152                          | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 0            |
| Beluga River   | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 691                          | [2]          | ---           | ---        | ---           | ---        | ---           | ---          | 52           |
| Cannery Loop   | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 148                          | [2]          | ---           | ---        | ---           | ---        | ---           | ---          | 8            |
| Granite Point  | ---                       | 16           | [1]           | ---           | ---           | 2            | ---           | ---           | ---           | 12                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 2            |
| Ivan River, Lewis River,<br>Pretty Creek, Stump Lake | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | ---                          | ---          | 499           | [2]        | ---           | ---        | ---           | ---          | 62           |
| Kenai  | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 572                          | [2]          | ---           | ---        | ---           | ---        | ---           | ---          | 12           |
| McArthur River                                       | ---                       | 40           | [1]           | ---           | ---           | 5            | ---           | ---           | ---           | 589                          | [2]          | ---           | ---        | ---           | ---        | ---           | ---          | 74           |
| Middle Ground Shoal                                  | ---                       | 8            | [1]           | ---           | ---           | 1            | ---           | ---           | ---           | 5                            | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 1            |
| North Cook Inlet                                     | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 686                          | [2]          | ---           | ---        | ---           | ---        | ---           | ---          | 86           |
| Swanson River  | ---                       | 8            | [1]           | ---           | ---           | 0            | ---           | ---           | ---           | 148                          | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 0            |
| Trading Bay  | ---                       | 1            | [1]           | ---           | ---           | <1           | ---           | ---           | ---           | 30                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 4            |
| <b>PROVEN BUT UNDEVELOPED OR SHUT-IN</b>             |                           |              |               |               |               |              |               |               |               |                              |              |               |            |               |            |               |              |              |
| Birch Hill   | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 11                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 0            |
| Falls Creek  | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 13                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 2            |
| Nicolai Creek  | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 3                            | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | <1           |
| North Fork   | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 12                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | <1           |
| Sterling   | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 23                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | <1           |
| West Foreland  | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 20                           | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | 0            |
| West Fork  | ---                       | ---          | ---           | ---           | ---           | ---          | ---           | ---           | ---           | 6                            | [1]          | ---           | ---        | ---           | ---        | ---           | ---          | <1           |
| <b>SUBTOTAL</b>                                      | <b>---</b>                | <b>74</b>    | <b>---</b>    | <b>---</b>    | <b>---</b>    | <b>8</b>     | <b>---</b>    | <b>---</b>    | <b>---</b>    | <b>3,619</b>                 | <b>---</b>   | <b>---</b>    | <b>---</b> | <b>---</b>    | <b>---</b> | <b>---</b>    | <b>---</b>   | <b>299</b>   |
| <b>STATE TOTAL</b>                                   | <b>5,634</b>              | <b>7,039</b> | <b>11,384</b> | <b>708</b>    | <b>897</b>    | <b>1,455</b> | <b>31,236</b> | <b>31,661</b> | <b>37,311</b> | <b>3,758</b>                 | <b>3,814</b> | <b>4,528</b>  |            |               |            |               |              |              |

[1] As of 1/1/90. Alaska Oil and Gas Conservation Commission, "Estimate of Oil Reserve in Alaska" and "Estimate of Gas Reserves in Alaska". Estimates as of 1/1/89, adjusted for 1989 production.  
 [2] As of 1/1/90. William Van Dyke, Division of Oil and Gas.  
 [3] As of 1/1/90, not adjusted for future fuel use. William Van Dyke, Division of Oil and Gas.  
 21:12/12/89

tion and operating constraints, and the projected wellhead price of the produced oil have stymied commercial development of these relatively shallow (but very large) resources

ARCO completed one major pilot production project in the Kuparuk River Unit and laboratory research continues in an effort to improve project performance and economics. ARCO has drilled one well in a proposed 25 well program as part of a second major "West Sak" pilot production project in the Kuparuk River Unit. The operator will use a well spacing pattern which is less dense than was used in the first pilot project and will test various well bore completion techniques again in an attempt to improve individual well production rates. ARCO will also conduct a water flood program to test the influence of the larger well spacing on oil recovery and well performance. Unfortunately, the second West Sak pilot is currently suspended, and it is not known when, or if, ARCO will resume its West Sak testing program.

During 1989 Conoco drilled four test wells in Milne Point Unit to test the extensive shallow oil sands in that unit. With the resumption of production operations at Milne Point Unit, Conoco hopes to also begin commercial production from the shallow oil sands in the very near future.

Technology exists to produce in the range of 300,000 barrels per day of oil from the shallow north slope oil sands, but current economics do not appear to favor any type of full-scale development. In the Kuparuk River Unit, the Kuparuk River reservoir owners and the West Sak reservoir owners are discussing facilities-sharing agreements because they would greatly reduce the future West Sak development costs. As unused production and processing capacity in the Kuparuk oil production facilities become available in the late 1990s, the West Sak reservoir may be brought on line to offset some of the declining production. Development of the West Sak reserves will also require drilling many hundreds of additional wells and the construction of many more drillsites and pipelines. These costs cannot be avoided by use of facility sharing agreements.

Tables 2.2 and 2.3 list production forecasts for some of the fields listed in Table 2.1. Figure 2.1 graphs the estimates of total production and Figures 2.2 and 2.3 graph the estimates of the royalty share. North Slope oil production will decline further in 1990. The decline is beginning earlier and will be steeper than earlier forecasts

indicated. Total oil production from state-owned lands will decline through the 1990s.

Currently, North Slope natural gas is not exported. Both the Alaska Natural Gas Transportation System (ANGTS) and the Trans-Alaska Gasline System (TAGS) are proposed means of moving North Slope gas to market. To date, neither project has secured financing or a guaranteed market. The continued volatility and uncertainty in oil and gas prices, the relatively abundant worldwide supplies of natural gas, and the sheer magnitude and cost of the proposed pipeline projects combine to make the prospective purchasers of the gas, the financial institutions, and the projects' sponsors all very cautious at this time. Efforts to secure markets for the gas continue. However, start up of the ANGTS or TAGS project cannot be expected until financing for one or both projects is arranged, and financing likely will not be finalized until long-term sales agreements for the gas are guaranteed. In addition, the lessees (primarily ARCO, Exxon and BP (Alaska) Inc.) have not agreed to sell the gas to either pipeline company.

Esso Resources Canada, Gulf Canada Resources and Shell Canada applied to the Canadian National Energy Board in 1988 for permission to export gas from the Canadian Beaufort Sea and MacKenzie River Delta to the United States. In October 1989 these companies received conditional approval for the export. Foothills Pipe Lines (the Canadian sponsor of the ANGTS project) has filed an application with the Canadian National Energy Board to build the MacKenzie Valley gas pipeline. This project would be in direct competition with Alaska North Slope gas for potential U. S. markets, but it might also be an incentive to re-evaluate the once-proposed gas pipeline from Prudhoe Bay east across the Arctic National Wildlife Refuge to the Canadian MacKenzie River Delta area. Such a pipeline probably would be much cheaper to build than either ANGTS or TAGS. At this time no estimates of construction or transportation costs are available for this type of proposal. In addition, ANWR legislation under consideration by Congress would expressly prohibit the construction of a pipeline eastward across wilderness areas in ANWR to the U.S. - Canada border.

BP (Alaska) Inc. proposes to develop the Niakuk reservoir, located about one mile offshore in the Beaufort Sea just north of Prudhoe Bay. BP estimates that the reservoir could produce up to 20,000 barrels per day of oil beginning in 1992 or

TABLE 2.2

PRODUCTION FORECAST AND AVAILABLE ROYALTY OIL

| THOUSANDS OF BARRELS PER DAY     | 1990  | 1991  | 1992  | 1993  | 1994  | 1995  | 1996  | 1997  | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015      | TOTAL (MMbbl) |         |
|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----------|---------------|---------|
| <b>PRODUCTION FORECAST</b>       |       |       |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               |         |
| <b>NORTH SLOPE</b>               |       |       |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               |         |
| Prudhoe Bay [1]                  | 1,331 | 1,198 | 1,102 | 1,014 | 932   | 857   | 789   | 728   | 668  | 614  | 553  | 498  | 448  | 403  | 363  | 328  | 284  | 247  | 215  | 187  | 163  | 138  | 118  | 100  | 85   | 72        | 4,902,315     |         |
| Kuparuk                          | 300   | 300   | 280   | 250   | 220   | 190   | 175   | 160   | 128  | 105  | 90   | 76   | 65   | 55   | 45   | 35   | 30   | 25   | 20   | 15   | 10   | 5    | 0    | 0    | 0    | 0         | 0             | 936,225 |
| Lisburne                         | 40    | 40    | 40    | 40    | 37    | 34    | 31    | 28    | 25   | 21   | 19   | 13   | 8    | 6    | 5    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 154,030 |
| Endicott                         | 100   | 100   | 85    | 75    | 60    | 55    | 50    | 45    | 40   | 35   | 30   | 25   | 20   | 15   | 10   | 5    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 282,875 |
| Milne Point                      | 30    | 25    | 20    | 16    | 13    | 10    | 8     | 7     | 6    | 5    | 5    | 5    | 5    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 54,750  |
| West Sak                         | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| Point McIntyre                   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| Beaufort Sea                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| NIUKUT                           | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| SUBTOTAL                         | 1,801 | 1,699 | 1,553 | 1,481 | 1,367 | 1,251 | 1,149 | 1,057 | 958  | 883  | 803  | 735  | 685  | 642  | 580  | 527  | 468  | 428  | 379  | 326  | 268  | 220  | 175  | 149  | 124  | 7,502,283 |               |         |
| <b>AVAILABLE ROYALTY OIL</b>     |       |       |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               |         |
| <b>NORTH SLOPE</b>               |       |       |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               |         |
| Prudhoe Bay                      | 166   | 150   | 138   | 127   | 117   | 107   | 99    | 91    | 84   | 77   | 69   | 62   | 56   | 50   | 45   | 41   | 36   | 31   | 27   | 23   | 20   | 17   | 15   | 13   | 11   | 9         | 812,789       |         |
| Kuparuk [2]                      | 38    | 38    | 35    | 31    | 28    | 24    | 22    | 19    | 16   | 13   | 11   | 9    | 8    | 7    | 6    | 4    | 4    | 3    | 3    | 2    | 1    | 1    | 0    | 0    | 0    | 0         | 0             | 117,028 |
| Lisburne [2]                     | 5     | 5     | 5     | 5     | 5     | 4     | 4     | 4     | 4    | 3    | 3    | 2    | 2    | 1    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 19,254  |
| Endicott [3]                     | 14    | 14    | 12    | 11    | 10    | 9     | 8     | 8     | 7    | 6    | 6    | 3    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 39,603  |
| Milne Point [4]                  | 5     | 5     | 4     | 3     | 2     | 2     | 1     | 1     | 1    | 1    | 1    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 9,293   |
| West Sak [2]                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| Point McIntyre                   | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| Beaufort Sea                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| NIUKUT                           | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0         | 0             | 0       |
| SUBTOTAL                         | 228   | 212   | 197   | 187   | 173   | 158   | 145   | 133   | 121  | 112  | 100  | 90   | 87   | 80   | 73   | 71   | 64   | 59   | 53   | 47   | 41   | 34   | 28   | 22   | 19   | 16        | 95,063        |         |
| <b>COOK INLET</b>                |       |       |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               |         |
| Granite Point                    | 0.9   | 0.9   | 0.9   | 0.8   | 0.7   | 0.6   |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 1,782   |
| McArthur River                   | 2.4   | 2.4   | 2.3   | 2.1   | 1.9   | 1.7   |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 4,686   |
| Trading Bay                      | 0.3   | 0.3   | 0.3   | 0.3   | 0.2   | 0.2   |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 575     |
| Middle Ground Shoal              | 0.9   | 0.9   | 0.9   | 0.8   | 0.7   | 0.7   |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 1,802   |
| SUBTOTAL                         | 4.6   | 4.6   | 4.4   | 3.9   | 3.5   | 3.2   |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 8,615   |
| STATE TOTAL                      | 233   | 216   | 201   | 191   | 178   | 161   | 145   | 133   | 121  | 112  | 100  | 90   | 87   | 80   | 73   | 71   | 64   | 59   | 53   | 47   | 41   | 34   | 28   | 22   | 19   | 16        | 94,478        |         |
| <b>IN-KIND ROYALTY OIL SALES</b> |       |       |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               |         |
| Mapco                            | 35    | 35    | 35    | 35    | 35    | 35    | 35    | 35    | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35        | 35            | 178,850 |
| GVEA [7]                         | 4     | 4     | 4     | 4     | 4     | 4     | 4     | 4     | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4         | 4             | 6,786   |
| Tesoro (Old) [8]                 | 41    | 37    | 34    | 31    | 29    |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 62,424  |
| Tesoro (New) [9]                 | 23    | 21    | 19    | 18    | 16    |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 35,285  |
| Chevron [10]                     | 16    | 14    | 13    | 12    | 11    |       |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 24,427  |
| PetroStar [11]                   | 6     | 5     | 4     | 3     | 3     | 3     |       |       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |           |               | 8,760   |
| Cook Inlet [12]                  | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5  | 0.5       | 0.5           | 1,278   |
| SUBTOTAL                         | 128   | 116   | 109   | 102   | 97    | 93    | 93    | 93    | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93   | 93        | 93            | 317,610 |
| IN-VALUE ROYALTY OIL             | 104   | 100   | 92    | 89    | 79    | 123   | 110   | 98    | 86   | 77   | 73   | 63   | 62   | 45   | 73   | 71   | 64   | 59   | 53   | 47   | 41   | 34   | 28   | 22   | 19   | 16        | 628,668       |         |

Note: numbers may not sum to totals due to rounding errors.

- [1] Oil, condensate and NGLs.
- [2] 12.5% of production.
- [3] 14.0% of production (weighted average).
- [4] 16.0% of production (weighted average).
- [5] 16.25% of production.
- [6] 6.25% of production.
- [7] 2.667% of Prudhoe Bay production. Contract expires June 30, 1996.
- [8] Maximum 24.533% of Prudhoe Bay production. Contract expires January 1995.
- [9] Maximum 13.867% of Prudhoe Bay production. Contract expires August 20, 1986 but has the option of renominating on six months notice.
- [10] Tesoro denominated the entire volume under this contract effective January 1, 1995.
- [11] Maximum 9.6% of Prudhoe Bay production. Contract expires January 1, 1995.
- [12] 6,500 BPD of Kuparuk River royalty oil. Initial purchase would be 6,000 BPD. Contract expires September 30, 1996.

TABLE 2.3

PRODUCTION FORECAST AND AVAILABLE ROYALTY OIL, FOR PRODUCING NORTH SLOPE FIELDS

| THOUSANDS OF BARRELS PER DAY     | PRODUCTION FORECAST |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      | TOTAL (MMbbl) |      |      |      |      |      |      |      |      |      |
|----------------------------------|---------------------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|---------------|------|------|------|------|------|------|------|------|------|
|                                  | 1990                | 1991  | 1992  | 1993  | 1994  | 1995  | 1996  | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |               | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| <b>PRUDHOE BAY [1]</b>           | 1,331               | 1,198 | 1,102 | 1,014 | 932   | 857   | 789   | 729  | 668  | 614  | 563  | 498  | 448  | 403  | 363  | 328  | 294  | 247           | 215  | 187  | 163  | 136  | 118  | 100  | 85   | 72   |      |
| Amarada                          | 0.54%               | 7     | 6     | 5     | 5     | 5     | 5     | 4    | 4    | 4    | 3    | 3    | 3    | 2    | 2    | 2    | 2    | 2             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    | 0    |
| Arco                             | 21.76%              | 290   | 261   | 240   | 221   | 203   | 187   | 172  | 158  | 145  | 134  | 108  | 96   | 86   | 79   | 71   | 62   | 54            | 47   | 41   | 36   | 30   | 26   | 22   | 19   | 16   |      |
| BP                               | 50.66%              | 675   | 607   | 559   | 514   | 472   | 434   | 400  | 368  | 339  | 311  | 280  | 252  | 227  | 204  | 185  | 144  | 125           | 109  | 95   | 83   | 70   | 60   | 51   | 43   | 36   |      |
| Chevron                          | 0.67%               | 9     | 8     | 7     | 7     | 6     | 6     | 5    | 5    | 4    | 4    | 3    | 3    | 3    | 2    | 2    | 2    | 2             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| Exxon                            | 21.76%              | 290   | 261   | 240   | 221   | 203   | 187   | 172  | 158  | 145  | 134  | 108  | 96   | 86   | 79   | 71   | 62   | 54            | 47   | 41   | 35   | 30   | 26   | 22   | 19   | 16   |      |
| LL&E                             | 0.04%               | 1     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Marathon                         | 0.05%               | 1     | 1     | 1     | 1     | 1     | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| Mobil                            | 1.89%               | 25    | 23    | 21    | 19    | 18    | 16    | 15   | 14   | 13   | 12   | 10   | 9    | 8    | 7    | 6    | 5    | 4             | 4    | 4    | 3    | 3    | 2    | 2    | 2    | 1    |      |
| Phillips                         | 1.89%               | 25    | 23    | 21    | 19    | 18    | 16    | 15   | 14   | 13   | 12   | 10   | 9    | 8    | 7    | 6    | 5    | 4             | 4    | 4    | 3    | 3    | 2    | 2    | 2    | 1    |      |
| Shell                            | 0.14%               | 2     | 2     | 2     | 1     | 1     | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Texaco                           | 0.55%               | 7     | 7     | 6     | 6     | 5     | 5     | 4    | 4    | 4    | 3    | 3    | 3    | 2    | 2    | 2    | 2    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| <b>KUPARUK</b>                   | 300                 | 300   | 280   | 250   | 220   | 190   | 175   | 150  | 125  | 105  | 90   | 75   | 65   | 55   | 45   | 35   | 30   | 25            | 20   | 15   | 10   | 5    | 0    | 0    | 0    | 0    |      |
| Arco                             | 53.01%              | 159   | 158   | 148   | 133   | 117   | 101   | 83   | 66   | 56   | 46   | 40   | 34   | 29   | 24   | 19   | 16   | 13            | 11   | 8    | 5    | 3    | 0    | 0    | 0    | 0    |      |
| BP                               | 37.56%              | 113   | 113   | 105   | 94    | 83    | 71    | 66   | 58   | 47   | 39   | 34   | 28   | 24   | 21   | 17   | 13   | 11            | 9    | 8    | 6    | 4    | 2    | 0    | 0    | 0    |      |
| Chevron                          | 0.11%               | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Exxon                            | 0.22%               | 1     | 1     | 1     | 1     | 1     | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| Mobil                            | 0.37%               | 1     | 1     | 1     | 1     | 1     | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| Union                            | 4.25%               | 13    | 13    | 12    | 11    | 9     | 8     | 7    | 6    | 5    | 4    | 4    | 3    | 3    | 2    | 2    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| <b>LISBURNE</b>                  | 40                  | 40    | 40    | 40    | 40    | 37    | 34    | 31   | 28   | 25   | 21   | 19   | 13   | 9    | 5    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Arco                             | 40.00%              | 16    | 16    | 16    | 16    | 16    | 16    | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16            | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   |      |
| BP                               | 20.00%              | 8     | 8     | 8     | 8     | 8     | 8     | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8             | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    |      |
| Exxon                            | 40.00%              | 16    | 16    | 16    | 16    | 16    | 16    | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16            | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   |      |
| <b>ENDICOTT</b>                  | 100                 | 100   | 95    | 76    | 65    | 60    | 55    | 50   | 45   | 40   | 20   | 10   | 0    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Amoco                            | 10.49%              | 10    | 10    | 9     | 6     | 7     | 7     | 6    | 6    | 5    | 4    | 2    | 1    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Arco                             | 0.02%               | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| BP                               | 57.83%              | 58    | 58    | 49    | 43    | 40    | 38    | 35   | 32   | 29   | 26   | 23   | 12   | 6    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| CIRI                             | 0.65%               | 1     | 1     | 1     | 1     | 1     | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    |      |
| Doyon                            | 0.13%               | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Exxon                            | 21.02%              | 21    | 21    | 18    | 16    | 15    | 14    | 13   | 12   | 11   | 9    | 8    | 4    | 2    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| NAANA                            | 0.39%               | 0     | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Unocal                           | 10.52%              | 11    | 11    | 9     | 8     | 7     | 6     | 6    | 5    | 5    | 4    | 2    | 1    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| <b>MILNE POINT</b>               | 30                  | 25    | 20    | 16    | 13    | 10    | 8     | 7    | 6    | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5             | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5    |      |
| Chevron                          | 17.37%              | 5     | 4     | 3     | 3     | 2     | 2     | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |      |
| Conoco                           | 72.15%              | 22    | 18    | 14    | 12    | 9     | 7     | 6    | 5    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4             | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    |      |
| Oxy                              | 10.49%              | 3     | 3     | 2     | 2     | 1     | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1             | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |      |
| <b>TOTAL</b>                     | 1,801               | 1,663 | 1,527 | 1,365 | 1,275 | 1,159 | 1,066 | 999  | 877  | 794  | 709  | 617  | 536  | 467  | 413  | 361  | 314  | 272           | 235  | 202  | 173  | 143  | 118  | 100  | 85   | 72   |      |
| <b>AVAILABLE ROYALTY OIL</b>     |                     |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
| Prudhoe Bay [2]                  | 168                 | 150   | 138   | 127   | 117   | 107   | 99    | 91   | 84   | 77   | 69   | 62   | 58   | 50   | 45   | 41   | 36   | 31            | 27   | 23   | 20   | 17   | 15   | 13   | 11   | 9    |      |
| Kuparuk [2]                      | 38                  | 38    | 35    | 31    | 28    | 24    | 22    | 19   | 16   | 13   | 11   | 9    | 8    | 7    | 6    | 4    | 4    | 3             | 3    | 2    | 1    | 1    | 0    | 0    | 0    | 0    |      |
| Liburme [2]                      | 5                   | 5     | 5     | 5     | 5     | 5     | 4     | 4    | 4    | 4    | 3    | 3    | 2    | 2    | 1    | 1    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Endicott [3]                     | 14                  | 14    | 12    | 11    | 10    | 9     | 8     | 8    | 7    | 6    | 6    | 3    | 1    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| Milne Point [4]                  | 6                   | 5     | 4     | 3     | 2     | 2     | 2     | 1    | 1    | 1    | 1    | 1    | 1    | 0    | 0    | 0    | 0    | 0             | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |      |
| <b>TOTAL</b>                     | 228                 | 211   | 193   | 176   | 161   | 146   | 135   | 122  | 111  | 100  | 90   | 78   | 67   | 58   | 52   | 45   | 39   | 34            | 29   | 25   | 22   | 18   | 15   | 13   | 11   | 9    |      |
| <b>IN-KIND ROYALTY OIL SALES</b> |                     |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
| Mapco                            | 35                  | 35    | 35    | 35    | 35    | 35    | 35    | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35            | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   |      |
| GVEA [5]                         | 4                   | 4     | 4     | 4     | 4     | 4     | 4     | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4             | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    |      |
| Teeco (Old) [6]                  | 41                  | 37    | 34    | 31    | 29    |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
| Teeco (New) [7]                  | 23                  | 21    | 19    | 18    | 16    |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
| Chevron [8]                      | 18                  | 14    | 13    | 12    | 11    |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
| Petrostar [9]                    | 6                   | 5     | 4     | 3     | 3     |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
| <b>TOTAL</b>                     | 125                 | 116   | 109   | 102   | 97    | 38    | 35    | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35            | 35   | 35   | 35   | 35   | 35   | 35   | 35   | 35   |      |
| <b>IN-VALUE ROYALTY OIL</b>      |                     |       |       |       |       |       |       |      |      |      |      |      |      |      |      |      |      |               |      |      |      |      |      |      |      |      |      |
|                                  | 103                 | 95    | 84    | 74    | 64    | 108   | 100   | 87   | 76   | 65   | 55   | 43   | 32   | 23   | 52   | 45   | 39   | 34            | 29   | 25   | 22   | 16   | 15   | 13   | 11   | 9    |      |

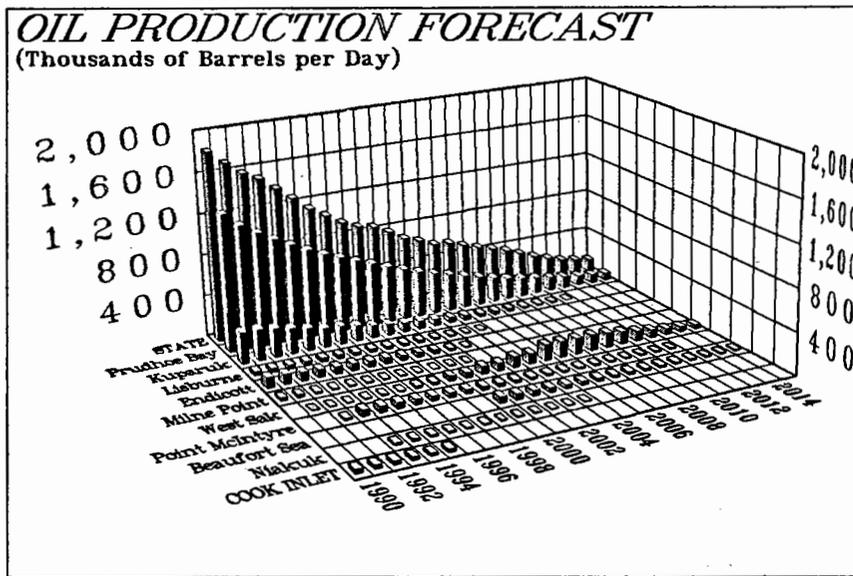


FIGURE 2.1

1993 if development plans are approved in a timely manner. The proposal includes a 6,600-foot, gravel-fill causeway which state and federal agencies are now reviewing. The U. S. Army Corps of Engineers had issued a preliminary finding that the causeway was unacceptable as proposed but has since withdrawn that finding. Permit applications are also still pending with state agencies. The North Slope Borough has approved the application. State agencies might not approve the project, or BP may be required to substantially modify its design.

In early 1988, Alaska became the number one oil producing state in the nation. However, with the ongoing decline in production at Prudhoe Bay, Texas has again regained the number one producing spot.

Prudhoe Bay's current production rate of 1.40 million barrels per day of crude oil and condensate is expected to continue its slow decline in 1990. The actual rate of the decline will be influenced by the level of infill development drilling, rate of development of the field's West End and P Pad, scheduling of well workovers and equipment repairs, water and miscible gas injection rates, and the capabilities of the installed and to-be-installed gas handling and water handling facilities.

The Prudhoe Bay owners have approved the construction of GHX-1, a major new gas handling expansion project, and construction is underway at this time. The project is designed to boost the amount of gas that can be produced, handled and

reinjecting from about 3.5 billion cubic feet per day to just over 5 billion cubic feet per day. Bottlenecks in gas processing facilities and insufficient gas compressor capacity are causing a gas overload in the field production facilities as gas production from the field increases. Operators are reducing oil production rates because the gas processing facilities cannot handle the increased amount of gas associated with

the higher oil production rates. The average oil production rate in 1990 might not reach the allowed annual average 1.5 million barrels of oil per day. Start up of the GHX-1 facilities in late 1990 will alleviate some of the gas overload. The producers are already studying a second project, GHX-2, which would boost the gas handling capacity in the field to about 7.5 billion cubic feet per day.

Start-up of the GHX-1 project (and the potential for the GHX-2 project) will help slow the decline of oil production at Prudhoe Bay. If additional gas handling facilities are not installed, the decline will be much more rapid than currently anticipated. In relative terms, more and more gas will be produced along with each barrel of oil as oil production continues over the years. If this additional gas cannot be processed and reinjected, the oil production rate will have to be cut back even further.

Expansion of the Prudhoe Bay field water handling facilities is also underway. Major construction projects are planned for 1990 to boost water handling capacity. These improvements will also help to keep the oil production decline rate from rapidly escalating.

Even with these major gas and water handling improvements, the oil production rate will continue to drop. Facility and pipeline down time is increasing year to year as corrosion and mechanical wear take their toll. The TAPS pipeline required significant maintenance and repair in 1989,

**A AVAILABLE ROYALTY OIL FORECAST, BY TYPE**  
(Thousands of Barrels per Day)

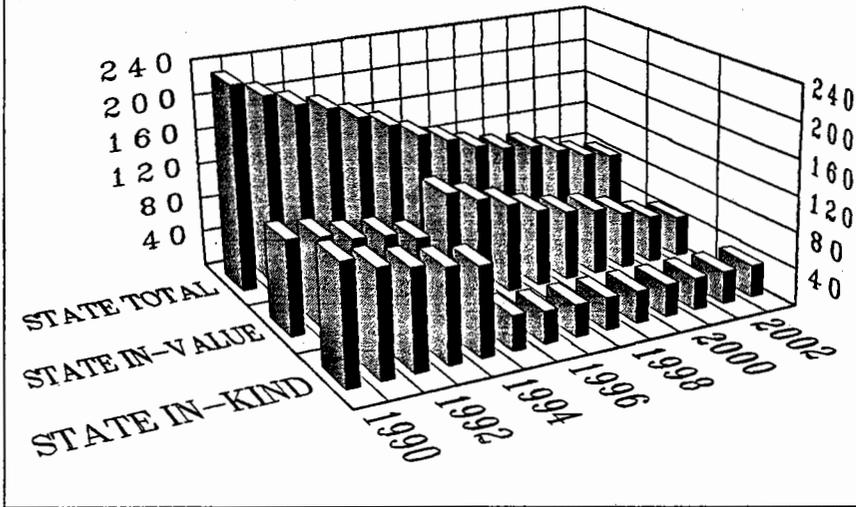


FIGURE 2.2

and operators plan major corrosion related work for 1990, including the replacement of a nine-mile segment of the TAPS line.

Infill drilling and development of peripheral drill sites continues in the Kuparuk River field. In addition, lessees will expand an enhanced oil recovery project (miscible gas injection) in the field. Supplies of sufficient volumes of miscible gas injectant limit the area in the field that can be affected at any one time.

**Exploration Activity**

Exploratory drilling activity in 1989 showed a marked increase over the past few years. On the North Slope, primary operations were onshore drilling south of the Kuparuk River Unit and in the Point McIntyre/Gwydyr Bay area. Offshore in the Beaufort Sea, Chevron's Karluk #1 was the only exploratory well completed. In the federal OCS portion of the Beaufort Sea Amoco completed its Belcher #1 well. Meanwhile, in the Chukchi Sea,

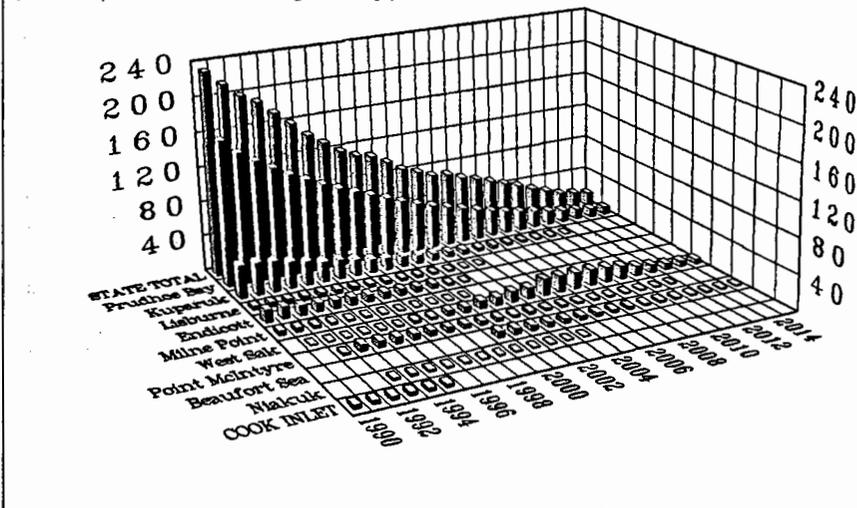
Shell was active drilling one well and starting two others.

South of the Kuparuk River Unit, three lessees (BP, Texaco and Unocal) conducted drilling operations in 1989, and Texaco and BP have acquired permits to drill additional wells in the area. No results have been released for those wells drilled in 1989. In the Point McIntyre area, ARCO drilled three wells and announced a major oil discovery.

Press reports stated that the reservoir may hold up to 300 million barrels of recoverable oil. Because of the reservoir's close proximity to the existing Prudhoe Bay/Lisburne infrastructure, development of the Point McIntyre reservoir should proceed rather quickly. The reservoir could be producing as early as 1992. ARCO also drilled an exploratory well just west of the Point McIntyre area but did not release any results from that well. Three more delineation wells are scheduled for the Point McIntyre area this winter as well as one more well immediately west of that area.

FIGURE 2.3

**A AVAILABLE ROYALTY OIL FORECAST, BY FIELD**  
(Thousands of Barrels per Day)



In the Duck Island/Endicott area, BP is conducting a long term production test at its Sag Delta #9 location and is planning to drill an exploratory well (Sag Delta #12) just southwest of the Endicott reservoir. ARCO plans to drill at least two delineation wells in the Kuparuk River Unit this winter and one well in the Hemi Springs Unit area. In addition, ARCO commenced drilling of the Stinson well #1 offshore in the Camden Bay area in the fall of 1989.

Numerous exploration activities are scheduled for 1990. In addition to the planned wells mentioned above, Shell intends to return to the Chukchi Sea, Amoco has a well approved for the eastern Beaufort Sea Outer Continental Shelf, Exxon has a well planned for the Point Thomson Unit, Conoco has a well planned in the Mikkelson Bay area

and ARCO has a well planned in the Kavik area. Overall, the pace of exploratory drilling activity on the north slope is encouraging for 1990.

In the Cook Inlet area, remedial well work and infill drilling at currently producing fields continue at a good pace. While no new exploratory wells were drilled in 1989, collection of seismic data continued and lessees plan up to four exploratory wells in 1990. The recent sales or trades of lease interests and operatorships in the Cook Inlet area have resulted in better lease positions for certain companies, which are now planning new exploration activities. In addition, leases issued in the early 1980s are about to expire; some additional drilling activity is anticipated as these leases approach the end of their primary term.



# HISTORICAL OIL PRODUCTION [1]

MILLIONS OF BARRELS PER YEAR

PRODUCTION BY FIELD

TYPE \*

|  | 1970  | 1971   | 1972   | 1973   | 1974   | 1975   | 1976   | 1977    | 1978    | 1979    | 1980    | 1981    | 1982    | 1983    | 1984    | 1985    | 1986    | 1987    | 1988    | 1989    | DEPLETION |     |
|--|-------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----------|-----|
|  |       |        |        |        |        |        |        |         |         |         |         |         |         |         |         |         |         |         |         | [Esf]   | (Mbb)     | %   |
| Beaver Creek                                 | O     | 0.000  | 0.000  | 0.416  | 0.376  | 0.322  | 0.302  | 0.276   | 0.223   | 0.211   | 0.214   | 0.180   | 0.182   | 0.170   | 0.159   | 0.146   | 0.158   | 0.165   | 0.141   | 0.235   | 3.896     | 80% |
| Endicott                                     | O     | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.011   | 8.796   | 37.441  | 35.662  | 81.910    | 23% |
| Granite Point                                | O     | 7.522  | 5.577  | 4.663  | 4.767  | 4.361  | 4.471  | 4.711   | 4.862   | 4.613   | 4.384   | 3.975   | 3.467   | 3.550   | 3.287   | 3.052   | 3.169   | 2.790   | 2.664   | 2.601   | 112.105   | 86% |
| Katalia                                      | N     | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.154     | 0%  |
| Kenai  | N     | 0.002  | 0.001  | 0.002  | 0.000  | 0.001  | 0.001  | 0.000   | 0.001   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.012     | na  |
| Kuparuk                                      | O     | 0.006  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000   | 0.000   | 0.000   | 0.000   | 1.092   | 32.406  | 39.876  | 46.169  | 79.630  | 83.900  | 102.448 | 110.865 | 108.238 | 613.928   | 41% |
| Lieburne                                     | O     | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.707   | 1.072   | 1.287   | 0.256   | 0.000   | 3.346     | na  |
| McArthur River                               | O     | 40.165 | 40.837 | 40.774 | 38.884 | 36.145 | 35.810 | 33.235  | 30.223  | 25.440  | 20.895  | 18.022  | 16.806  | 13.564  | 11.707  | 7.454   | 7.942   | 7.375   | 7.143   | 7.001   | 535.828   | 83% |
| Mdl. Gmd. Shoal                              | O     | 12.719 | 11.304 | 9.720  | 10.239 | 9.001  | 8.670  | 8.864   | 7.616   | 6.362   | 5.423   | 4.854   | 4.291   | 3.573   | 3.236   | 3.100   | 3.250   | 2.834   | 2.736   | 2.745   | 158.568   | 96% |
| Milne Point                                  | O     | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 7.335     | 13% |
| Prudhoe Bay                                  | [2] N | 1.183  | 1.157  | 0.922  | 0.944  | 2.170  | 4.804  | 115.258 | 397.679 | 468.412 | 555.394 | 555.170 | 558.892 | 590.798 | 561.952 | 568.534 | 561.538 | 572.370 | 569.415 | 502.548 | 6,562.009 | 58% |
| Redoubt Shoal                                | I     | 0.879  | 0.833  | 0.762  | 0.817  | 1.640  | 2.147  | 3.811   | 2.151   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.230   | 14.598  | 19.274  | 18.487  | 54.488    | na  |
| Swanson River                                | O     | 12.408 | 11.466 | 8.896  | 10.064 | 9.765  | 8.754  | 7.591   | 5.981   | 4.870   | 4.344   | 3.728   | 2.938   | 2.992   | 2.517   | 2.165   | 2.055   | 2.030   | 2.126   | 1.875   | 211.337   | 96% |
| Trading Bay                                  | O     | 9.800  | 8.744  | 8.585  | 7.825  | 7.552  | 6.128  | 5.368   | 4.278   | 3.567   | 2.882   | 1.698   | 1.384   | 1.081   | 1.077   | 1.029   | 1.046   | 0.835   | 0.866   | 1.248   | 91.205    | 99% |
| Weet Sak                                     | O     | 0.039  | 0.039  | 0.025  | 0.051  | 0.043  | 0.031  | 0.028   | 0.044   | 0.019   | 0.014   | 0.009   | 0.005   | 0.002   | 0.004   | 0.004   | 0.002   | 0.001   | 0.000   | 0.000   | 1.368     | 0%  |
| <b>PRODUCTION BY REGION</b>                  |       |        |        |        |        |        |        |         |         |         |         |         |         |         |         |         |         |         |         |         |           |     |
| STATE  | O     | 83.614 | 78.785 | 73.561 | 73.139 | 72.244 | 71.980 | 67.009  | 447.806 | 511.335 | 591.646 | 567.336 | 618.910 | 625.524 | 630.401 | 666.233 | 661.372 | 715.955 | 736.185 | 677.981 | 8,417.868 |     |
| TOTAL NORTH SLOPE                            | O     | 84.144 | 79.494 | 74.169 | 73.961 | 73.036 | 72.745 | 67.779  | 172.215 | 448.820 | 511.970 | 592.128 | 687.874 | 619.409 | 625.908 | 631.079 | 662.958 | 732.495 | 757.910 | 695.912 | 8,488.605 |     |
| TOTAL COOK INLET                             | O     | 1.199  | 1.157  | 0.922  | 0.944  | 2.170  | 4.804  | 115.258 | 397.679 | 468.412 | 555.394 | 555.170 | 558.892 | 590.798 | 561.952 | 568.534 | 561.538 | 572.370 | 569.415 | 502.548 | 6,562.009 |     |
| TOTAL TAPS THROUGHPUT AT PUMP STATION #1 [3] | O     | 82.415 | 77.628 | 72.638 | 72.198 | 70.074 | 68.111 | 62.404  | 50.128  | 42.923  | 36.252  | 31.072  | 27.405  | 24.783  | 21.961  | 16.946  | 17.619  | 16.149  | 15.998  | 16.705  | 1,113.112 |     |
| TOTAL  | N     | 82.945 | 78.338 | 73.247 | 73.007 | 70.867 | 69.076 | 63.175  | 56.957  | 50.941  | 43.558  | 36.734  | 31.810  | 27.904  | 22.340  | 17.199  | 17.904  | 16.378  | 16.892  | 16.727  | 1,123.548 |     |

\* O = oil, N = natural gas liquids (NGL), I = injected.

[1] Alaska Oil and Gas Conservation Commission (OGCC). "Alaska Production Summary by Field and Pool", monthly report.

[2] Includes condensates. OGCC data reported 1,514,646 bbls cumulative production of NGL as of 1984 but did not report yearly production in preceding years.

[3] 1977-81: Alaska Oil and Gas Conservation Commission, "Statistical Report."

1982-88: Alyeska Pipeline Service Co.

31:12/13/89

## CHAPTER 3

# HISTORICAL OIL AND GAS PRODUCTION AND CONSUMPTION

### Oil Production

All Alaska oil is produced from Cook Inlet and the Prudhoe Bay vicinity on the central North Slope. Cook Inlet fields began production in the late 1950s and peaked by 1970. Some of the fields are now near depletion. The region has produced a cumulative 1.1 billion barrels of crude oil and annual production fell to 16 million barrels in 1989. Prudhoe Bay began commercial produc-

tion in 1977 when the Trans-Alaska Pipeline System (TAPS) opened. Since then, North Slope fields have produced 8.5 billion barrels of crude oil. Prudhoe Bay production peaked in 1987 at 587 million barrels though regional production peaked in 1988. State and regional production data are presented in Table 3.1 and Figures 3.1 and 3.2.

**HISTORICAL STATE OIL PRODUCTION**  
(Millions of Barrels per Year)

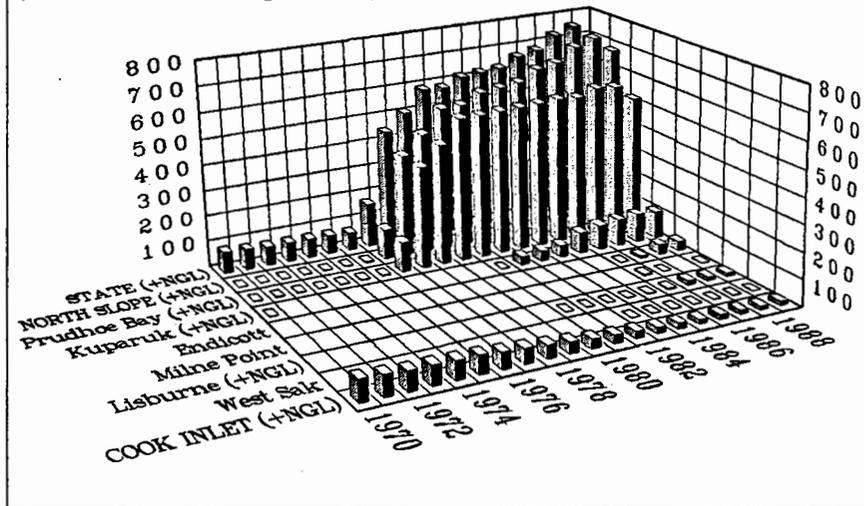


FIGURE 3.1

FIGURE 3.2

**HISTORICAL COOK INLET OIL PRODUCTION**  
(Millions of Barrels per Year)

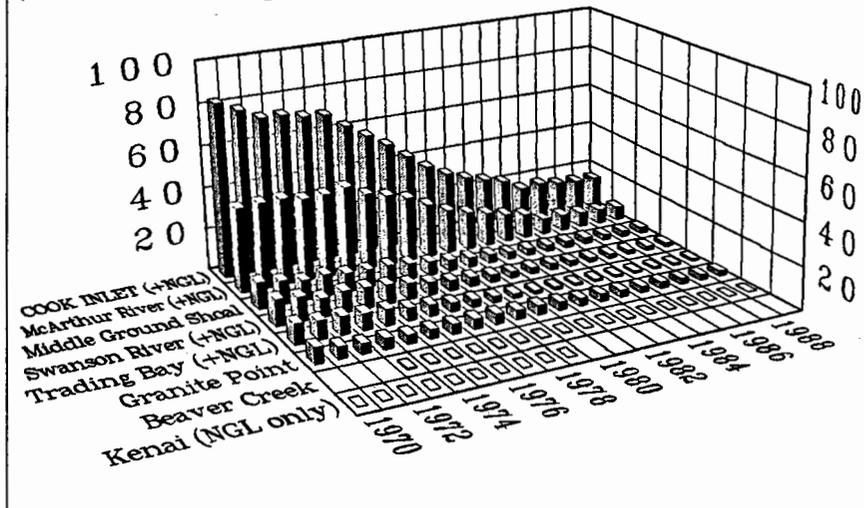


TABLE 3.2

HISTORICAL GAS PRODUCTION [1]

| BILLIONS OF CUBIC FEET PER YEAR |     | 1970    | 1971    | 1972    | 1973    | 1974    | 1975    | 1976    | 1977    | 1978    | 1979    | 1980    | 1981    | 1982      | 1983      | 1984      | 1985      | 1986      | 1987      | 1988      | 1989      | DEPLETION (MBbl) % |            |
|---------------------------------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|------------|
| PRODUCTION BY FIELD             |     |         |         |         |         |         |         |         |         |         |         |         |         |           |           |           |           |           |           |           |           |                    |            |
| Albert Kaloa                    | D   | 0.085   | 0.024   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.119 0%           |            |
| Beaver Creek                    | C   | 0.000   | 0.000   | 0.000   | 0.054   | 0.020   | 0.218   | 0.166   | 0.113   | 0.237   | 0.088   | 0.090   | 0.137   | 0.317     | 0.252     | 0.234     | 10.833    | 17.694    | 16.476    | 14.307    | 12.346    | 89.579 37%         |            |
|                                 | D   | 0.000   | 0.000   | 0.000   | 0.153   | 0.130   | 0.104   | 0.095   | 0.090   | 0.092   | 0.088   | 0.080   | 0.080   | 0.082     | 0.082     | 0.101     | 0.094     | 0.078     | 0.053     | 0.039     | 0.000     | 1.632 [2]          |            |
|                                 | Inj | 0.000   | 0.000   | 0.000   | 0.000   | 0.019   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.547 na           |            |
| Beluga River                    | D   | 3.571   | 4.055   | 4.142   | 4.929   | 5.586   | 6.840   | 11.211  | 13.353  | 14.253  | 16.984  | 17.002  | 17.248  | 18.653    | 18.084    | 19.833    | 22.571    | 26.357    | 23.985    | 26.586    | 21.091    | 307.855 31%        |            |
| Birch Hill                      | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.065 0%           |            |
| Cannery Loop                    | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 20.206 12%         |            |
| East Barrow                     | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 8.161 42%          |            |
| Endicott                        | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 63.053 2%          |            |
|                                 | Inj | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 97.296 89%         |            |
| Granite Point                   | D   | 9.211   | 7.758   | 5.773   | 4.518   | 3.265   | 3.390   | 3.205   | 3.634   | 3.855   | 3.287   | 3.233   | 3.509   | 2.780     | 2.578     | 2.340     | 2.147     | 2.415     | 2.431     | 2.643     | 2.465     | 1,974.103 70%      |            |
| Kenai                           | D   | 80.612  | 72.164  | 76.007  | 71.345  | 68.511  | 77.175  | 79.467  | 81.886  | 97.290  | 97.029  | 98.848  | 105.800 | 115.913   | 113.328   | 111.772   | 116.644   | 82.714    | 90.497    | 76.299    | 66.303    | 1,974.103 70%      |            |
| Kuparuk                         | C   | 0.002   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.615   | 22.989    | 44.391    | 57.508    | 104.465   | 114.889   | 124.744   | 119.853   | 103.714   | 683.358 23%        |            |
|                                 | Inj | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 17.822    | 38.277    | 47.800    | 85.809    | 90.449    | 89.191    | 87.908    | 78.779    | 539.384 1%         |            |
| Lewis River                     | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 4.190 1%           |            |
| Lisburne                        | C   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.359     | 0.154     | 0.343     | 1.644     | 1.338     | 0.346     | 0.046     | 0.123     | 272.731 3%         |            |
|                                 | Inj | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 244.091 na         |            |
| McArthur River                  | D   | 13.708  | 14.284  | 13.724  | 12.153  | 11.335  | 11.776  | 10.314  | 10.232  | 9.279   | 7.453   | 6.755   | 6.411   | 6.362     | 5.319     | 5.834     | 4.073     | 4.397     | 3.587     | 4.120     | 4.497     | 2,429.081 na       |            |
|                                 | C   | 4.699   | 4.245   | 4.861   | 4.985   | 4.961   | 7.997   | 6.825   | 7.737   | 7.662   | 7.758   | 7.547   | 7.555   | 6.719     | 7.831     | 9.242     | 6.903     | 9.163     | 9.891     | 12.603    | 12.603    | 172.689 [2]        |            |
| Mdl. Grnd. Shoal                | D   | 6.137   | 5.147   | 4.075   | 4.828   | 4.352   | 4.199   | 4.347   | 4.108   | 3.260   | 2.744   | 2.628   | 2.502   | 2.276     | 2.368     | 2.210     | 2.129     | 1.213     | 1.285     | 1.223     | 1.159     | 78.115 64%         |            |
| Milne Point                     | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.097     | 0.239     | 0.514     | 0.493     | 0.396     | 0.311     | 0.411     | 0.516     | 3.109 [2]          |            |
|                                 | Inj | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 2,429 0%           |            |
| Moquawick                       | D   | 0.093   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.915 0%           |            |
| Nicola Creek                    | D   | 0.202   | 0.142   | 0.068   | 0.000   | 0.011   | 0.083   | 0.108   | 0.032   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.915 0%           |            |
| North Cook Inlet                | D   | 40.847  | 45.051  | 41.580  | 42.709  | 44.238  | 46.622  | 45.081  | 47.181  | 48.757  | 49.448  | 42.015  | 50.520  | 45.368    | 47.877    | 48.981    | 45.819    | 43.838    | 42.889    | 44.989    | 44.301    | 1,982.287 67%      |            |
| North Fork                      | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.105 1%           |            |
| Pretty Creek                    | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.105 1%           |            |
| Pruddhoe Bay                    | D   | 0.037   | 0.389   | 0.658   | 0.869   | 2.009   | 3.046   | 5.077   | 94.336  | 307.966 | 432.475 | 597.148 | 847.788 | 768.885   | 818.963   | 848.674   | 838.813   | 970.290   | 1,228.527 | 1,404.992 | 1,382.852 | 10,430.788 4%      |            |
|                                 | Inj | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 9,431.012 na       |            |
| South Barrow                    | D   | 0.619   | 0.827   | 0.675   | 0.707   | 0.765   | 0.798   | 0.798   | 0.832   | 0.879   | 0.913   | 1.027   | 1.009   | 0.532     | 0.541     | 0.650     | 0.878     | 0.589     | 0.622     | 0.598     | 0.701     | 19.123 79%         |            |
| Sterling                        | D   | 0.285   | 0.287   | 0.172   | 0.027   | 0.032   | 0.035   | 0.035   | 0.029   | 0.024   | 0.025   | 0.026   | 0.023   | 0.024     | 0.022     | 0.018     | 0.012     | 0.002     | 0.000     | 0.000     | 0.000     | 0.288 6%           |            |
| Swaneone River                  | D   | 60.398  | 69.599  | 67.441  | 74.067  | 80.889  | 90.868  | 101.427 | 106.911 | 106.934 | 116.068 | 119.034 | 103.692 | 105.334   | 97.607    | 98.710    | 92.104    | 96.104    | 82.928    | 101.718   | 101.988   | 1,965.862 0%       |            |
|                                 | C   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 1,965.862 0%       |            |
| Trading Bay                     | D   | 73.139  | 73.882  | 76.133  | 87.779  | 86.778  | 97.978  | 113.279 | 118.279 | 114.557 | 120.630 | 120.630 | 106.137 | 113.023   | 96.353    | 93.687    | 89.025    | 93.802    | 85.688    | 99.199    | 103.563   | 2,217.701 na       |            |
|                                 | Inj | 6.959   | 8.919   | 5.594   | 3.429   | 3.228   | 2.522   | 2.392   | 2.810   | 2.367   | 1.651   | 1.419   | 1.178   | 1.205     | 0.993     | 0.941     | 1.115     | 0.994     | 0.991     | 1.120     | 1.178     | 63.164 69%         |            |
| West Fork                       | D   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.411     | 0.531     | 0.626     | 0.417     | 0.385     | 0.443     | 0.191     | 3.845 [2] |                    |            |
| West Sak                        | C   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.066     | 0.087     | 0.037     | 0.022     | 0.000     | 0.000     | 0.000     | 0.000     | 1,542.20%          |            |
|                                 | C   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000     | 0.000              |            |
| PRODUCTION BY REGION            |     |         |         |         |         |         |         |         |         |         |         |         |         |           |           |           |           |           |           |           |           |                    |            |
| STATE                           | D   | 131.093 | 126.852 | 126.887 | 124.661 | 126.034 | 138.908 | 143.726 | 151.210 | 167.168 | 173.221 | 167.201 | 182.551 | 190.837   | 197.690   | 200.297   | 206.370   | 182.121   | 188.390   | 187.019   | 186.622   | 3,531.838          |            |
|                                 | C   | 87.449  | 103.566 | 97.236  | 99.846  | 105.165 | 115.702 | 126.856 | 222.721 | 453.783 | 663.771 | 730.308 | 785.657 | 896.270   | 972.271   | 1,012.061 | 1,144.448 | 1,196.232 | 1,517.670 | 1,794.964 | 1,736.397 | 13,866.049         |            |
| GROSS                           |     | 218.542 | 229.419 | 224.122 | 224.507 | 231.219 | 254.610 | 270.581 | 373.931 | 600.951 | 736.993 | 897.509 | 948.208 | 1,089.100 | 1,169.961 | 1,212.057 | 1,350.818 | 1,390.818 | 1,300.353 | 1,704.030 | 1,952.003 | 1,925.019          | 17,419.887 |
|                                 | Inj | 73.139  | 73.882  | 76.133  | 87.779  | 86.812  | 97.978  | 113.370 | 118.279 | 114.557 | 120.630 | 120.630 | 106.137 | 113.023   | 96.353    | 93.687    | 89.025    | 93.802    | 85.688    | 99.199    | 103.563   | 12,492.855         |            |
| NET                             |     | 145.403 | 155.537 | 147.989 | 136.728 | 144.407 | 156.635 | 157.211 | 187.434 | 214.395 | 226.511 | 230.340 | 249.949 | 290.413   | 282.226   | 302.442   | 329.098   | 270.478   | 309.623   | 404.460   | 398.949   | 4,926.932          |            |
| NORTH SLOPE                     | D   | 0.819   | 0.627   | 0.675   | 0.707   | 0.765   | 0.798   | 0.798   | 0.832   | 0.879   | 0.913   | 1.027   | 1.009   | 0.532     | 0.541     | 0.650     | 0.878     | 0.589     | 0.622     | 0.598     | 0.701     | 24.264             |            |
|                                 | C   | 1.039   | 0.989   | 0.668   | 0.699   | 2.009   | 3.046   | 5.077   | 94.336  | 307.966 | 432.475 | 597.148 | 847.788 | 768.885   | 818.963   | 848.674   | 838.813   | 970.290   | 1,228.527 | 1,404.992 | 1,382.852 | 11,488.389         |            |
| GROSS                           |     | 1.857   | 1.616   | 1.      |         |         |         |         |         |         |         |         |         |           |           |           |           |           |           |           |           |                    |            |

## Gas Production

All of Alaska's natural gas is produced from Cook Inlet, the central North Slope, and two small fields near Barrow. Cook Inlet produces both casinghead and dry gas from a mix of oil fields, gas fields and oil fields with gas caps. Gas production from this region began in the late 1950s and peaked between 1982 and 1984. Cumulative production is 3.7 trillion cubic feet, net of injection, including the 193 billion cubic feet produced in 1989.

North Slope gas is produced as a by-product of oil production. The only market for the gas is as fuel for field and pipeline operations, and consequently, operators inject 80% of the gas back into the reservoirs. A cumulative 1.2 trillion cubic feet, net of injection, have been produced, including the 204 billion cubic feet produced in 1989. Gas reinjection at all the North Slope fields helps maintain reservoir pressure, acts as a secondary and tertiary recovery agent, and conserves the gas for possible future sale. Table 3.2 shows field and regional gas production from 1971 to 1989 and Figures 3.3 and 3.4 show gross and net production for those years.

## Oil Consumption

All the oil consumed in Alaska is consumed as refined fuels, some of which is refined in-state and some of which is imported. No data source satisfactorily reports how much fuel is refined in state nor how much is imported, but Depart-

ment of Revenue reports of fuel sales for 1977 to 1989 indicate how much fuel is consumed in state. Data quality between 1977 and 1984 is unconfirmed, but data from 1985 to 1989 are considered good. In the 14 year reporting period, consumption grew from 750 million gallons per year to 1,961 million gallons. Fuel sale data are reported in Table 3.3 and Figure 3.5.

## Gas Consumption

The major feature of Cook Inlet natural gas is that it is connections by pipeline with local markets. Regional consumption in 1989 was 207 billion

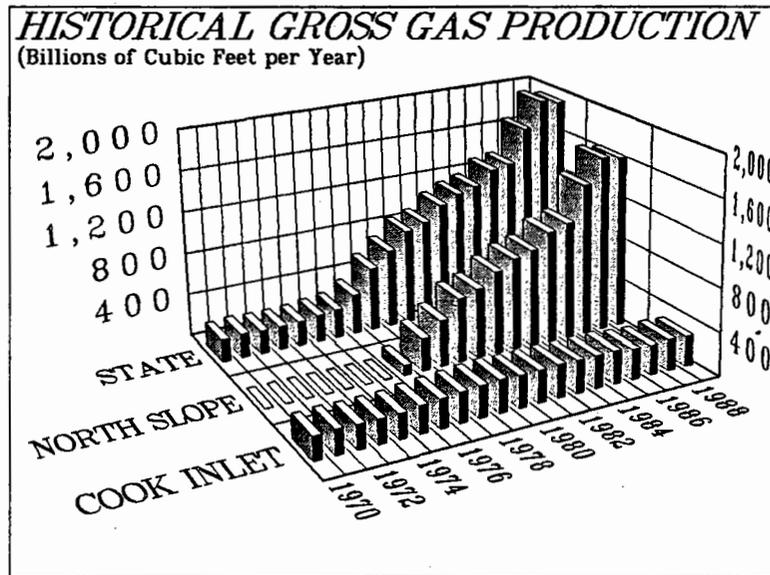
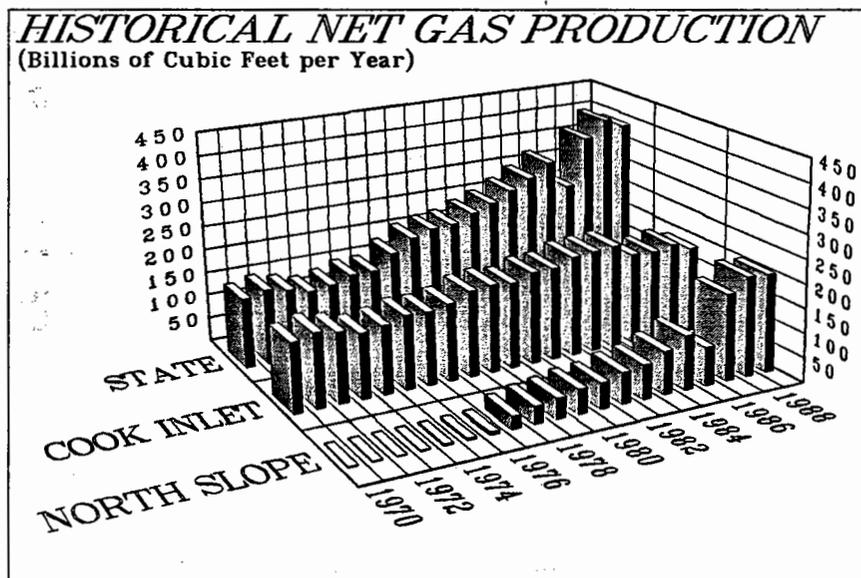


FIGURE 3.3

FIGURE 3.4



# HISTORICAL OIL CONSUMPTION [1]

TABLE 3.3

MILLIONS OF GALLONS PER YEAR

|                   | 1977           | 1978           | 1979           | 1980           | 1981             | 1982             | 1983             | 1984             | 1985             | 1986             | 1987             | 1988             | 1989             |
|-------------------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| <b>FUEL SALES</b> |                |                |                |                |                  |                  |                  |                  |                  |                  |                  |                  |                  |
| Aviation Gas      | 16,770         | 15,830         | 16,925         | 16,912         | 18,754           | 16,596           | 15,244           | 17,399           | 17,997           | 17,815           | 18,492           | 19,314           | 18,658           |
| Exempt            | 1,521          | 0,685          | 0,552          | 0,558          | 0,574            | 0,589            | 0,498            | 0,574            | 0,515            | 0,858            | 0,384            | 0,743            | 0,638            |
| Taxable           | 15,249         | 15,145         | 16,373         | 16,354         | 18,180           | 16,007           | 14,746           | 16,825           | 17,482           | 16,957           | 18,108           | 18,571           | 18,020           |
| Aviation Jet      | 330,744        | 363,607        | 415,164        | 418,184        | 400,177          | 432,366          | 517,575          | 611,314          | 518,092          | 592,620          | 644,477          | 684,510          | 678,908          |
| Exempt            | 227,581        | 250,601        | 288,974        | 286,110        | 247,619          | 99,957           | 242,815          | 311,820          | 223,635          | 290,654          | 318,349          | 333,703          | 313,334          |
| Taxable           | 103,163        | 113,006        | 126,190        | 130,074        | 152,558          | 332,409          | 274,760          | 299,494          | 294,457          | 311,966          | 326,128          | 351,207          | 365,574          |
| Marine Gas        | 11,766         | 7,714          | 8,296          | 7,598          | 7,602            | 7,878            | 8,568            | 8,955            | 14,664           | 10,464           | 11,510           | 10,554           | 10,631           |
| Exempt            | 5,707          | 0,554          | 0,292          | 0,025          | 0,085            | 0,032            | 0,052            | 0,120            | 0,251            | 0,291            | 0,183            | 0,075            | 0,179            |
| Taxable           | 6,059          | 7,160          | 8,004          | 7,573          | 7,517            | 7,846            | 8,516            | 8,835            | 14,413           | 10,173           | 11,327           | 10,479           | 10,452           |
| Marine Diesel     | 38,613         | 51,985         | 59,492         | 67,711         | 72,282           | 99,443           | 147,569          | 124,416          | 98,675           | 105,218          | 171,769          | 158,027          | 174,705          |
| Exempt            | 6,396          | 10,116         | 6,325          | 5,370          | 5,153            | 30,443           | 75,395           | 50,874           | 9,724            | 10,097           | 83,120           | 43,828           | 30,905           |
| Taxable           | 32,217         | 41,869         | 53,167         | 62,341         | 67,129           | 69,000           | 72,174           | 73,542           | 88,951           | 95,121           | 88,649           | 115,199          | 143,800          |
| Other Gas         | 186,213        | 187,359        | 181,329        | 177,353        | 186,446          | 210,644          | 197,966          | 223,178          | 235,081          | 234,482          | 221,259          | 222,162          | 209,237          |
| Exempt            | 5,094          | 8,290          | 7,527          | 8,162          | 9,064            | 12,809           | 10,887           | 11,028           | 15,353           | 21,558           | 17,541           | 15,040           | 10,967           |
| Taxable           | 181,119        | 179,069        | 173,802        | 169,191        | 177,382          | 197,835          | 187,081          | 212,150          | 219,728          | 212,924          | 203,718          | 207,122          | 198,270          |
| Other Diesel      | 165,752        | 184,876        | 269,377        | 302,647        | 326,440          | 411,125          | 420,279          | 436,308          | 643,430          | 897,970          | 843,045          | 858,228          | 868,107          |
| Exempt            | 48,160         | 54,050         | 120,960        | 120,939        | 117,074          | 187,856          | 178,494          | 190,891          | 369,279          | 559,413          | 583,308          | 576,131          | 590,462          |
| Taxable           | 119,592        | 130,826        | 148,417        | 181,708        | 209,366          | 223,269          | 241,785          | 245,417          | 274,151          | 338,557          | 259,740          | 282,097          | 277,645          |
| <b>TOTAL</b>      | <b>749,858</b> | <b>811,371</b> | <b>950,583</b> | <b>988,405</b> | <b>1,011,701</b> | <b>1,178,052</b> | <b>1,307,203</b> | <b>1,421,570</b> | <b>1,527,939</b> | <b>1,858,569</b> | <b>1,910,552</b> | <b>1,954,195</b> | <b>1,960,248</b> |

## SHIPMENTS: LIFTINGS AT VALDEZ [2]

MILLIONS OF BARRELS PER YEAR

|       | 1977   | 1978    | 1979    | 1980    | 1981    | 1982    | 1983    | 1984    | 1985    | 1986    | 1987    | 1988    |
|-------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| TOTAL | 96,669 | 394,080 | 484,394 | 548,895 | 547,026 | 583,370 | 592,319 | 596,588 | 643,512 | 603,026 | 700,878 | 736,047 |

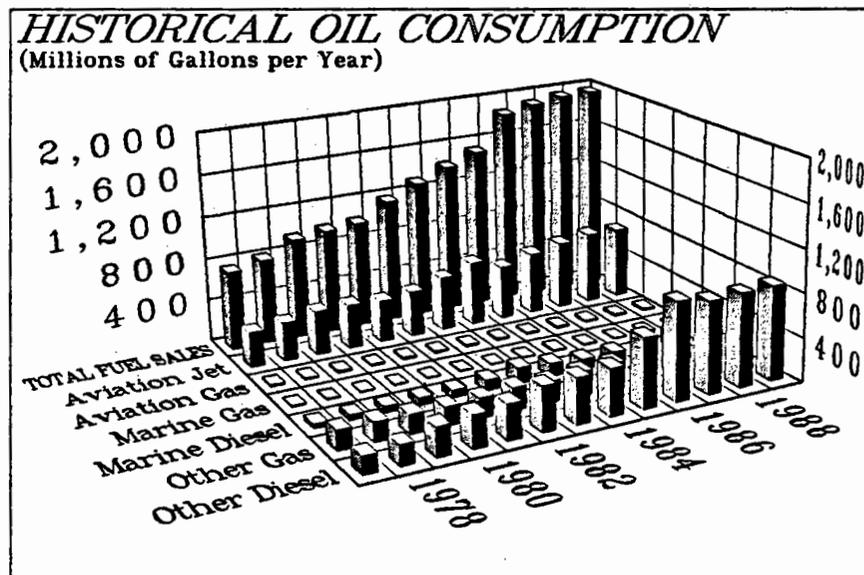
[1] Alaska Department of Revenue, "Report of Motor Fuel Sold or Distributed in Alaska."

[2] 1977-81: Alaska Oil and Gas Conservation Commission, "Statistical Report."

1982-88: Alyeska Pipeline Service Co.

32;12/14/89

FIGURE 3.5

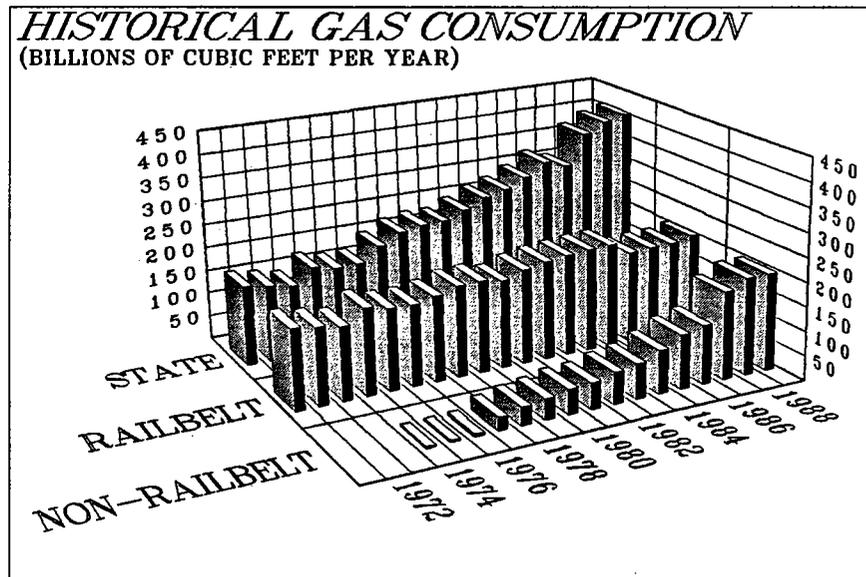


cubic feet, net of injection. The major users of the gas produced net of injection were: LNG, 28%; ammonia-urea production, 23%; electricity generation, 22%; and gas utilities, 11%, and field operations, 10%.

In contrast to the Cook Inlet region, the North Slope region produces an immense amount of casinghead gas but the only market for this gas is as fuel for the oil production facilities. Field

operations consumed most of the 1989 net North Slope production, 161 billion cubic feet, and an additional 17 billion cubic feet were sold to TAPS. It is interesting to note that since 1987 Prudhoe Bay field operations alone have consumed more gas than total commercial use in Cook Inlet. Table 3.4 and Figure 3.6 show state and regional gas consumption data from 1971 to 1987.

FIGURE 3.6



# HISTORICAL GAS CONSUMPTION

BILLIONS OF CUBIC FEET PER YEAR

TABLE 3.4

| STATE                       | 1971   | 1972   | 1973   | 1974   | 1975    | 1976    | 1977    | 1978    | 1979    | 1980    | 1981    | 1982    | 1983    | 1984    | 1985    | 1986    | 1987    | 1988    | 1989    | [Enr] |
|-----------------------------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| <b>Field Operations [1]</b> | 45.25  | 36.56  | 20.90  | 82.48  | 31.639  | 28.322  | 49.859  | 55.180  | 57.865  | 62.001  | 62.166  | 72.876  | 77.590  | 95.248  | 110.025 | 120.130 | 157.110 | 172.509 | 181.932 |       |
| <b>Vented and Flared</b>    | 33.18  | 20.96  | 6.93   | 9.05   | 10.557  | 6.674   | 15.729  | 8.183   | 4.551   | 4.846   | 5.660   | 6.993   | 5.084   | 6.075   | 6.330   | 6.897   | 15.898  | 8.977   | 9.004   |       |
| <b>Used on Leases</b>       | 10.96  | 14.86  | 12.42  | 41.40  | 17.963  | 18.424  | 29.966  | 35.055  | 38.123  | 43.575  | 44.524  | 52.724  | 58.893  | 68.481  | 84.654  | 85.183  | 123.778 | 147.703 | 151.590 |       |
| <b>Shrinkage</b>            | 1.11   | 0.72   | 1.55   | 2.01   | 3.119   | 3.224   | 3.145   | 2.847   | 2.847   | 2.432   | 2.434   | 2.602   | 2.728   | 2.657   | 1.773   | 1.468   | 1.730   | 1.734   | 3.205   |       |
| <b>Other</b>                | 0.00   | 0.00   | 0.00   | 0.02   | 0.000   | 0.000   | 0.019   | 0.019   | 12.344  | 11.142  | 9.480   | 10.567  | 10.887  | 15.036  | 17.268  | 24.582  | 16.504  | 14.095  | 18.133  |       |
| <b>Sold [1]</b>             | 121.72 | 123.72 | 130.94 | 130.05 | 141.754 | 145.763 | 155.785 | 172.101 | 177.616 | 174.200 | 190.873 | 199.914 | 207.167 | 219.840 | 219.400 | 194.653 | 220.979 | 226.067 | 226.067 |       |
| <b>Power generation</b>     | 14.69  | 16.38  | 16.70  | 17.45  | 25.461  | 27.613  | 29.590  | 29.937  | 33.376  | 33.755  | 33.947  | 36.222  | 36.661  | 37.000  | 41.337  | 44.767  | 41.242  | 42.720  | 41.428  |       |
| <b>Public [2][3]</b>        | 8.14   | 8.91   | 10.63  | 11.78  | 19.619  | 22.189  | 23.590  | 24.811  | 28.390  | 28.992  | 29.396  | 31.392  | 32.055  | 32.662  | 36.807  | 40.236  | 36.585  | 37.904  | 41.428  |       |
| <b>Military [2]</b>         | 6.55   | 6.47   | 6.07   | 5.68   | 5.842   | 5.424   | 5.000   | 5.125   | 4.996   | 4.763   | 4.561   | 4.830   | 4.598   | 4.338   | 4.530   | 4.531   | 4.657   | 4.816   | 4.768   |       |
| <b>Gas Utilities</b>        | 10.24  | 13.10  | 14.76  | 15.13  | 12.092  | 12.551  | 12.693  | 13.745  | 14.362  | 15.921  | 16.213  | 19.564  | 19.518  | 20.911  | 24.872  | 23.721  | 23.558  | 23.768  | 24.036  |       |
| <b>Residential [2][3]</b>   | 5.44   | 6.03   | 6.52   | 6.72   | 5.548   | 5.916   | 6.010   | 6.827   | 7.228   | 8.173   | 8.385   | 10.520  | 10.609  | 11.507  | 12.898  | 12.421  | 12.520  | 12.811  | 12.976  |       |
| <b>Commercial [2]</b>       | 4.80   | 7.07   | 8.24   | 8.41   | 6.544   | 6.635   | 6.973   | 6.916   | 7.134   | 7.748   | 7.828   | 8.044   | 8.909   | 9.404   | 11.974  | 11.300  | 11.038  | 10.957  | 11.060  |       |
| <b>LNG [4]</b>              | 63.24  | 59.87  | 60.99  | 61.67  | 64.777  | 63.509  | 66.912  | 60.874  | 64.111  | 54.844  | 68.823  | 64.438  | 67.729  | 65.892  | 65.177  | 61.908  | 60.879  | 63.325  | 68.735  |       |
| <b>Ammonia-Urea [5]</b>     | 19.49  | 20.56  | 20.64  | 22.10  | 23.888  | 24.257  | 26.920  | 49.979  | 51.857  | 54.899  | 53.896  | 55.220  | 50.338  | 50.083  | 50.688  | 36.733  | 45.230  | 41.882  | 48.222  |       |
| <b>Producers [6]</b>        | —      | —      | —      | —      | 12.477  | 11.588  | 6.703   | 6.523   | 6.958   | 6.190   | 6.001   | 11.383  | 12.698  | 16.362  | 17.532  | 14.785  | 16.733  | 8.772   | 16.342  |       |
| <b>Exchange [7]</b>         | —      | —      | —      | —      | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   |       |
| <b>Refiners [8]</b>         | —      | —      | —      | —      | 3.268   | 1.765   | 0.199   | 0.237   | 0.285   | 0.380   | 0.316   | 0.486   | 0.502   | 0.838   | 1.308   | 1.133   | 0.669   | 0.000   | 0.000   |       |
| <b>TAPS [9]</b>             | 0.00   | 0.00   | 0.00   | 0.00   | 0.000   | 0.000   | 1.754   | 6.949   | 6.648   | 10.866  | 11.108  | 11.952  | 13.277  | 12.856  | 14.381  | 15.168  | 16.624  | 17.855  | 16.809  |       |
| <b>Unaccounted [10]</b>     | 14.06  | 0.83   | 3.32   | 0.89   | 0.209   | 4.460   | 10.324  | 1.467   | (1.228) | (0.852) | 1.031   | 0.649   | 6.454   | 1.798   | 0.107   | (2.559) | 15.448  | 27.848  | 30.307  |       |
| <b>TOTAL</b>                | 196.97 | 190.28 | 151.84 | 183.13 | 173.383 | 174.065 | 204.644 | 227.281 | 235.481 | 236.209 | 253.039 | 272.790 | 284.757 | 303.089 | 328.426 | 314.783 | 377.489 | 398.379 | 408.589 |       |
| <b>RAILBELT</b>             |        |        |        |        |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |       |
| <b>Field Operations [1]</b> | 45.25  | 36.56  | 20.90  | 49.83  | 28.830  | 24.467  | 24.416  | 25.949  | 24.101  | 22.304  | 20.559  | 20.957  | 19.380  | 22.468  | 18.637  | 18.408  | 18.529  | 19.951  | 21.067  |       |
| <b>Vented and Flared</b>    | 33.18  | 20.96  | 6.93   | 7.98   | 9.498   | 5.421   | 4.848   | 3.970   | 2.710   | 3.045   | 3.175   | 3.494   | 2.580   | 3.280   | 2.693   | 3.095   | 2.746   | 3.230   | 3.051   |       |
| <b>Used on Leases</b>       | 10.96  | 14.86  | 12.42  | 36.85  | 16.215  | 15.822  | 16.404  | 16.228  | 14.564  | 14.608  | 14.950  | 14.861  | 14.056  | 14.597  | 13.971  | 13.845  | 14.651  | 15.458  | 15.846  |       |
| <b>Shrinkage</b>            | 1.11   | 0.72   | 1.55   | 2.01   | 3.119   | 3.224   | 3.145   | 2.826   | 2.847   | 2.432   | 2.434   | 2.602   | 2.728   | 2.657   | 1.773   | 1.468   | 1.730   | 1.734   | 3.205   |       |
| <b>Other</b>                | 0.00   | 0.00   | 0.00   | 0.00   | 0.000   | 0.000   | 0.019   | 0.019   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   |       |
| <b>Sold [1]</b>             | 121.72 | 123.72 | 130.94 | 130.51 | 140.717 | 143.710 | 152.437 | 164.300 | 166.106 | 162.201 | 178.082 | 185.913 | 192.578 | 192.782 | 199.311 | 174.563 | 177.660 | 177.471 | 185.501 |       |
| <b>Power generation</b>     | 14.69  | 16.38  | 16.70  | 17.45  | 25.461  | 27.613  | 29.590  | 29.718  | 33.141  | 33.620  | 33.632  | 35.818  | 36.169  | 36.520  | 40.851  | 44.208  | 40.698  | 42.100  | 45.616  |       |
| <b>Public [2]</b>           | 8.14   | 8.91   | 10.63  | 11.78  | 19.619  | 22.189  | 23.590  | 24.592  | 28.155  | 28.757  | 29.071  | 30.988  | 31.573  | 32.182  | 36.321  | 39.077  | 36.041  | 37.264  | 40.827  |       |
| <b>Military [2]</b>         | 6.55   | 6.47   | 6.07   | 5.68   | 5.842   | 5.424   | 5.000   | 5.126   | 4.996   | 4.763   | 4.561   | 4.830   | 4.598   | 4.338   | 4.530   | 4.531   | 4.657   | 4.816   | 4.768   |       |
| <b>Gas Utilities</b>        | 10.24  | 13.10  | 14.76  | 15.13  | 12.092  | 12.551  | 12.693  | 13.454  | 14.045  | 15.521  | 15.778  | 19.025  | 19.111  | 20.903  | 24.419  | 23.235  | 23.063  | 23.249  | 23.584  |       |
| <b>Residential [2]</b>      | 5.44   | 6.03   | 6.52   | 6.72   | 5.548   | 5.916   | 6.010   | 6.828   | 7.134   | 7.773   | 7.950   | 9.981   | 10.202  | 10.998  | 12.445  | 11.935  | 12.027  | 12.292  | 12.534  |       |
| <b>Commercial [2]</b>       | 4.80   | 7.07   | 8.24   | 8.41   | 6.544   | 6.635   | 6.973   | 6.916   | 7.134   | 7.748   | 7.828   | 8.044   | 8.909   | 9.404   | 11.974  | 11.300  | 11.038  | 10.957  | 11.060  |       |
| <b>LNG [46]</b>             | 63.24  | 59.87  | 60.99  | 61.67  | 64.777  | 63.509  | 66.912  | 60.874  | 64.111  | 54.844  | 68.823  | 64.438  | 67.729  | 65.892  | 65.177  | 61.908  | 60.879  | 63.325  | 68.735  |       |
| <b>Ammonia-Urea [5]</b>     | 19.49  | 20.56  | 20.64  | 22.10  | 23.888  | 24.257  | 26.920  | 49.979  | 51.857  | 54.899  | 53.896  | 55.220  | 50.338  | 50.083  | 50.688  | 36.733  | 45.230  | 41.882  | 48.222  |       |
| <b>Producers [6]</b>        | —      | —      | —      | —      | 12.477  | 11.588  | 6.703   | 6.523   | 6.958   | 6.190   | 6.001   | 11.383  | 12.698  | 16.362  | 17.532  | 14.785  | 16.733  | 8.772   | 16.342  |       |
| <b>Exchange [7]</b>         | —      | —      | —      | —      | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   |       |
| <b>Unaccounted [10]</b>     | 14.06  | 0.83   | 3.32   | 0.89   | 0.202   | 4.192   | 8.928   | 0.852   | (1.809) | (1.573) | 0.412   | 0.629   | 6.533   | 1.002   | (3.359) | (5.304) | (6.943) | (8.522) | 1.681   |       |
| <b>TOTAL</b>                | 196.97 | 190.28 | 151.84 | 180.34 | 169.547 | 168.177 | 176.853 | 190.249 | 192.207 | 184.505 | 198.641 | 206.870 | 211.958 | 215.220 | 217.948 | 192.871 | 196.189 | 197.422 | 206.568 |       |
| <b>NON-RAILBELT</b>         |        |        |        |        |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |       |
| <b>Field Operations [1]</b> | —      | —      | —      | 2.65   | 2.808   | 3.858   | 24.444  | 29.231  | 33.783  | 39.697  | 41.607  | 51.921  | 58.210  | 74.732  | 91.388  | 101.722 | 138.581 | 152.558 | 160.885 |       |
| <b>Vented and Flared</b>    | —      | —      | —      | 1.08   | 1.061   | 1.254   | 10.882  | 2.313   | 1.840   | 1.801   | 2.485   | 3.490   | 2.524   | 5.814   | 3.437   | 5.802   | 12.952  | 6.747   | 5.953   |       |
| <b>Used on Leases</b>       | —      | —      | —      | 1.56   | 1.747   | 2.602   | 13.562  | 16.828  | 23.559  | 28.967  | 29.644  | 37.664  | 44.837  | 53.864  | 70.693  | 71.338  | 109.127 | 132.245 | 136.742 |       |
| <b>Shrinkage</b>            | —      | —      | —      | 0.00   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   | 0.000   |       |
| <b>Other</b>                | —      | —      | —      | 0.02   | 0.000   | 0.000   | 0.000   | 0.092   | 6.364   | 8.929   | 9.490   | 10.567  | 10.849  | 15.034  | 17.268  | 24.582  | 16.502  | 14.095  | 18.133  |       |
| <b>Sold [1]</b>             | —      | —      | —      | 0.14   | 1.037   | 2.054   | 3.347   | 7.802   | 9.512   | 12.007  | 12.791  | 14.000  | 14.589  | 15.088  | 20.091  | 42.719  | 48.399  | 41.166  | 48.399  |       |
| <b>Power generation [3]</b> | —      | —      | —      | —      | —       | —       | —       | 0.219   | 0.235   | 0.235   | 0.316   | 0.404   | 0.482   | 0.480   | 0.468   | 0.559   | 0.544   | 0.620   | 0.601   |       |
| <b>Gas Utilities [3]</b>    | —      | —      | —      | —      | —       | —       | —       | 0.291   | 0.317   | 0.400   | 0.435   | 0.539   | 0.507   | 0.508   | 0.466   | 0.466   | 0.463   | 0.519   | 0.442   |       |
| <b>Refiners [8]</b>         | —      | —      | —      | —      | —       | —       | —       | 0.237   | 0.285   | 0.380   | 0.316   | 0.496   | 0.502   | 0.838   | 1.308   | 1.133   | 0.669   | 0.000   | 0.000   |       |
| <b>TAPS [9]</b>             | —      | —      | —      | —      | —       | —       | —       | 6.949   | 6.648   | 10.866  | 11.106  | 11.952  | 13.277  | 12.856  | 14.381  | 15.166  | 16.624  | 17.855  | 16.809  |       |
| <b>Unaccounted [10]</b>     | —      | —      | —      | —      | (2.231) | 0.269   | 1.394   | 0.616   | 0.579   | 0.941   | 0.619   | 0.619   | (0.079) | 0.306   | 3.463   | 2.657   | 24.389  | 29.405  | 23.314  |       |
| <b>TOTAL</b>                | —      | —      | —      | 2.786  | 3.845   | 5.910   | 27.791  | 37.033  | 43.275  | 5       |         |         |         |         |         |         |         |         |         |       |

- [1] Alaska Oil and Gas Conservation Commission, "Report of Gas Disposition," monthly reports.
- [2] Sum of sales from Beluga gas field in: Alaska Oil and Gas Conservation Commission, "Report of Gas Disposition" and 1971-82: Annual reports from Alaska Pipeline Co., ENSTAR and Kenal Utility Service Co. to Alaska Public Utilities Commission 1983-88: Enstar Natural Gas Co.
- [3] Barrow Utilities and Electric Cooperative Inc..
- [4] 1971-74: Stanford Research Institute, "Natural Gas Demand and Supply to the Year 2000 in the Cook Inlet Basin of South Central Alaska," Nov. 1977.  
1975-78: Sum of 1) production from Kenal and Beaver Creek gas fields in: Alaska Oil and Gas Conservation Commission, "Report of Gas Disposition," and 2) sales from North Cook Inlet gas field in: Alaska Oil and Gas Conservation Commission, "Kenal Gas Sales."
- [5] 1980-88: Royalty reports from producers to Division of Oil and Gas.  
1971-74: Stanford Research Institute, "Natural Gas Demand and Supply to the Year 2000 in the Cook Inlet Basin of South Central Alaska," Nov. 1977.  
1975-78: Sum of 1) sales from Kenal and Beaver Creek gas fields to Collier Chemical in: Alaska Oil and Gas Conservation Commission, "Kenal Gas Sales," and 2) sales from McArthur River gas field in: Alaska Oil and Gas Conservation Commission, "Monthly Report of Gas Disposition."
- [6] 1980-88: Royalty reports from producers to Division of Oil and Gas.  
Royalty reports from Union to Division of Oil and Gas, item: Pentol Gas.
- [7] Royalty reports from Union and Marathon to Division of Oil and Gas, item: Union-Marathon Exchange.
- [8] Royalty reports from Union to Division of Oil and Gas, item: Alaska Pipeline-Nikeiki, Chevron Pentol Gas and Metering.
- [9] Royalty reports from ARCO to Division of Oil and Gas.
- [10] Calculated difference between "Sold" and sum of listed "Sold" items.

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**PROJECTED DEMAND FOR OIL**

**TABLE 4.1**

| MILLIONS OF GALLONS PER YEAR | 1980         | 1981         | 1982         | 1983         | 1984         | 1985         | 1986         | 1987         | 1988         | 1989         | 2000         | 2001         | 2002         | 2003         | 2004         | TOTAL         |
|------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|
| <b>STATE</b>                 |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |               |
| Vehicle Transportation       | 1,325        | 1,338        | 1,347        | 1,364        | 1,377        | 1,390        | 1,405        | 1,422        | 1,442        | 1,462        | 1,485        | 1,508        | 1,528        | 1,548        | 1,568        | 21,506        |
| Jet Fuel                     | 698          | 708          | 720          | 734          | 747          | 760          | 776          | 790          | 807          | 824          | 843          | 862          | 877          | 893          | 909          | 11,944        |
| Civilian Domestic            | 380          | 390          | 400          | 412          | 423          | 434          | 446          | 459          | 474          | 489          | 505          | 522          | 535          | 550          | 564          | 6,982         |
| Military and International   | 316          | 318          | 320          | 322          | 323          | 329          | 333          | 338          | 343          | 349          | 358          | 364          | 372          | 381          | 394          | 4,962         |
| Gasoline                     | 246          | 247          | 245          | 246          | 244          | 243          | 242          | 242          | 242          | 242          | 242          | 243          | 243          | 244          | 244          | 3,655         |
| Aviation                     | 18           | 18           | 18           | 18           | 18           | 18           | 18           | 18           | 18           | 18           | 18           | 19           | 19           | 19           | 19           | 276           |
| Highway                      | 220          | 218          | 218          | 217          | 216          | 215          | 214          | 214          | 214          | 214          | 214          | 214          | 214          | 215          | 215          | 3,233         |
| Marine                       | 9            | 9            | 9            | 9            | 9            | 9            | 9            | 9            | 9            | 9            | 10           | 10           | 10           | 10           | 10           | 143           |
| Diesel                       | 381          | 382          | 382          | 385          | 386          | 386          | 388          | 390          | 393          | 396          | 400          | 404          | 408          | 412          | 415          | 5,908         |
| Highway                      | 272          | 272          | 271          | 272          | 272          | 272          | 272          | 273          | 274          | 276          | 277          | 279          | 281          | 283          | 285          | 4,132         |
| Marine                       | 109          | 110          | 111          | 112          | 113          | 114          | 116          | 117          | 119          | 121          | 123          | 125          | 128          | 127          | 129          | 1,771         |
| Space Heat                   | 159          | 159          | 159          | 161          | 161          | 162          | 162          | 163          | 164          | 164          | 165          | 166          | 167          | 168          | 168          | 2,449         |
| Utility Generation           | 38           | 40           | 41           | 42           | 43           | 44           | 45           | 46           | 47           | 48           | 49           | 50           | 51           | 52           | 53           | 688           |
| Industry                     | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 1,574         |
| Pipeline Fuel                | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 84           | 1,260         |
| Electricity Generation       | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 21           | 314           |
| <b>TOTAL</b>                 | <b>1,827</b> | <b>1,839</b> | <b>1,852</b> | <b>1,872</b> | <b>1,887</b> | <b>1,900</b> | <b>1,917</b> | <b>1,935</b> | <b>1,958</b> | <b>1,979</b> | <b>1,994</b> | <b>2,020</b> | <b>2,048</b> | <b>2,077</b> | <b>2,106</b> | <b>26,217</b> |
| <b>RAILBELT</b>              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |               |
| Vehicle Transportation       | 964          | 960          | 968          | 1,008        | 1,018        | 1,029        | 1,040        | 1,054        | 1,070        | 1,088        | 1,106        | 1,127        | 1,142        | 1,158        | 1,174        | 15,986        |
| Jet Fuel                     | 576          | 584          | 593          | 603          | 613          | 624          | 635          | 648          | 662          | 677          | 693          | 710          | 722          | 734          | 748          | 9,819         |
| Civilian Domestic            | 312          | 319          | 327          | 336          | 345          | 354          | 363          | 374          | 386          | 399          | 412          | 427          | 438          | 449          | 460          | 5,700         |
| Military and International   | 284          | 285          | 286          | 287          | 289          | 271          | 272          | 274          | 276          | 278          | 280          | 283          | 284          | 286          | 288          | 4,123         |
| Gasoline                     | 184          | 182          | 181          | 180          | 179          | 178          | 178          | 177          | 177          | 178          | 178          | 179          | 180          | 181          | 181          | 2,095         |
| Aviation                     | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 15           | 16           | 16           | 227           |
| Highway                      | 163          | 162          | 160          | 160          | 159          | 158          | 157          | 157          | 157          | 157          | 157          | 158          | 159          | 159          | 160          | 2,383         |
| Marine                       | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 6            | 85            |
| Diesel                       | 224          | 224          | 224          | 225          | 226          | 226          | 227          | 228          | 230          | 233          | 235          | 238          | 241          | 244          | 247          | 3,472         |
| Highway                      | 148          | 147          | 147          | 147          | 147          | 147          | 147          | 148          | 148          | 149          | 150          | 151          | 153          | 154          | 156          | 2,236         |
| Marine                       | 76           | 77           | 77           | 78           | 79           | 79           | 80           | 81           | 82           | 84           | 85           | 87           | 88           | 88           | 89           | 1,230         |
| Space Heat                   | 57           | 57           | 57           | 57           | 57           | 57           | 57           | 57           | 58           | 58           | 59           | 60           | 60           | 60           | 61           | 870           |
| Utility Generation           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 10           | 11           | 162           |
| Industry                     | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0             |
| <b>TOTAL</b>                 | <b>1,052</b> | <b>1,057</b> | <b>1,065</b> | <b>1,074</b> | <b>1,085</b> | <b>1,095</b> | <b>1,107</b> | <b>1,121</b> | <b>1,138</b> | <b>1,156</b> | <b>1,175</b> | <b>1,198</b> | <b>1,212</b> | <b>1,229</b> | <b>1,245</b> | <b>17,007</b> |
| <b>NON-RAILBELT</b>          |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |               |
| Vehicle Transportation       | 340          | 348          | 349          | 356          | 359          | 361          | 365          | 368          | 372          | 375          | 379          | 381          | 386          | 390          | 395          | 6,821         |
| Jet Fuel                     | 119          | 124          | 127          | 131          | 134          | 136          | 140          | 142          | 145          | 147          | 150          | 152          | 156          | 159          | 163          | 2,125         |
| Civilian Domestic            | 68           | 71           | 73           | 76           | 78           | 80           | 83           | 85           | 88           | 90           | 93           | 95           | 98           | 101          | 104          | 1,282         |
| Military and International   | 52           | 53           | 54           | 56           | 56           | 56           | 57           | 57           | 57           | 57           | 57           | 57           | 57           | 57           | 57           | 639           |
| Gasoline                     | 64           | 64           | 64           | 65           | 65           | 64           | 64           | 64           | 64           | 64           | 64           | 64           | 63           | 63           | 63           | 959           |
| Aviation                     | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 3            | 51            |
| Highway                      | 57           | 57           | 57           | 58           | 57           | 57           | 57           | 57           | 57           | 57           | 58           | 58           | 58           | 58           | 58           | 651           |
| Marine                       | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 4            | 58            |
| Diesel                       | 157          | 158          | 158          | 160          | 160          | 160          | 161          | 162          | 163          | 164          | 165          | 166          | 167          | 168          | 168          | 2,438         |
| Highway                      | 124          | 124          | 124          | 125          | 125          | 126          | 126          | 127          | 128          | 128          | 128          | 129          | 129          | 129          | 129          | 1,696         |
| Marine                       | 33           | 33           | 34           | 34           | 35           | 35           | 36           | 36           | 37           | 37           | 37           | 38           | 38           | 39           | 39           | 541           |
| Space Heat                   | 101          | 102          | 103          | 104          | 105          | 105          | 106          | 106          | 106          | 107          | 107          | 107          | 108          | 108          | 109          | 1,583         |
| Utility Generation           | 29           | 30           | 31           | 32           | 33           | 34           | 35           | 36           | 37           | 38           | 39           | 40           | 42           | 43           | 43           | 536           |
| Southeast                    | 8            | 9            | 10           | 11           | 11           | 12           | 12           | 13           | 13           | 14           | 14           | 15           | 15           | 16           | 17           | 190           |
| Rest of State                | 20           | 21           | 21           | 22           | 22           | 22           | 23           | 23           | 24           | 24           | 24           | 25           | 25           | 26           | 26           | 347           |
| Industry                     | 106          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 105          | 1,574         |
| <b>TOTAL</b>                 | <b>575</b>   | <b>583</b>   | <b>587</b>   | <b>598</b>   | <b>601</b>   | <b>604</b>   | <b>610</b>   | <b>614</b>   | <b>620</b>   | <b>624</b>   | <b>629</b>   | <b>632</b>   | <b>639</b>   | <b>645</b>   | <b>652</b>   | <b>9,213</b>  |

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## CHAPTER 4 CONSUMPTION FORECAST

### NOTE TO THIS EDITION

The Institute of Social and Economic Research (ISER) prepared the following projection for the Division of Oil and Gas (DO&G) in December 1986. The projection has not been recast because most of its assumptions and the long-term forecasts are reasonable and have been little affected by population and economic changes of the past three years. The methods and assumptions used to generate the forecasts are included in Appendix B of the January 1987 report and are not reprinted in this edition.

DO&G has updated the projection in two ways. First, the gas demand category "Nonrailbelt, Industry: Petroleum Production" has been increased by 87 billion cubic feet per year to account for the very large increase in gas consumption by Prudhoe Bay facilities. Second, the projection has been extended to 2004 by applying the original projections long-term growth factors to each use category.

### Summary

Consumption of oil and gas in most major categories is forecast to increase at a modest rate in future years. Projections for oil demand are presented in Table 4.1 and Figure 4.1 and for gas demand in Table 4.2 and Figure 4.2.

Total consumption of liquid petroleum will increase from 1.6 billion gallons in 1990 to 1.9 billion gallons in 2004. This represents a 1 percent annual growth rate. Space heating use of petroleum will be flat. Vehicle transportation use will increase 1 percent annually. The use of fuel oil for electricity generation reflects the recent and planned introduction of several hydroelectric facilities which replace fuel oil generation. How-

ever, in the long run, fuel oil consumption increases, and the 15-year growth rate is projected to be 2 percent annually. Industrial use of petroleum liquids will remain constant.

Consumption of natural gas will grow from 346 billion cubic feet in 1990 to 364 billion cubic feet in 2004, an annual growth of less than 1 percent. Industrial use will continue to consume the majority, growing from 280 billion cubic feet in 1990 to 294 billion cubic feet in 2004, or under 1 percent annual growth. Over the next 15 years, use of gas for space heating will increase very little from 26 billion cubic feet in 1990 to 28 billion cubic feet in 2004. Use of gas for electricity generation will remain nearly constant at about 40 billion cubic feet annually.

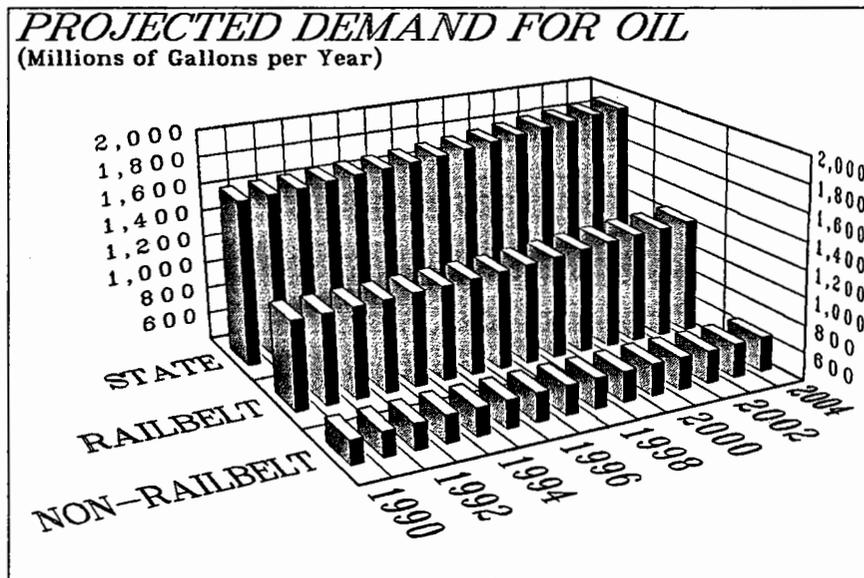
### Transportation Liquid Fuels

Transportation fuel consumption will grow moderately in future years, increasing from 1.3 billion gallons in 1990 to 1.6 billion gallons in 2004. Jet fuel consumption will grow most rapidly (2 percent annually) while diesel fuel consumption will grow slowly, and gasoline use will fall slowly.

Total consumption projected over the 15-year period from 1990 to 2004 is 2.2 billion gallons.

### Space Heating

FIGURE 4.1



Outside the railbelt, fuel oil is the dominant means of space heating. Fuel oil consumption for this use is approximately constant, 159 million gallons in 1990 and 168 million gallons in 2004. Natural gas use will grow slowly from 26 billion cubic feet in 1990 to 28 billion cubic feet in 2004. Barrow, on the North Slope, is the only location outside of the railbelt presently served by natural gas.

### Utility Electricity Generation

Fuel oil use for utility electricity generation will grow at an average annual rate of 2 percent. This is due to demand growth in areas where power generation from natural gas and hydroelectric plants is not available.

Natural gas use for utility electricity generation will decline in the near term from its current level of 40 billion cubic feet, when the Bradley Lake hydroelectric project backs out some gas use starting in the 1990s. Subsequently, its use will grow

and regain the current level by the year 2000. The projection does not anticipate any new coal-fired generating plants.

### Industrial Fuel Use

The major industrial use of fuel oil (not including transportation) is in the petroleum industry. Pipeline fuel for the Alyeska pipeline is the largest element of this use. In addition, a significant amount of fuel is used for electricity generation. Both of these uses are projected at constant levels.

Increased use of natural gas in future years will be related to petroleum production. This increase will be concentrated on the North Slope where more equipment for intensive secondary and enhanced recovery methods will consume larger amounts of energy. Production of ammonia-urea, the other large use of natural gas, will continue to require a constant amount of natural gas.

## PROJECTED DEMAND FOR GAS

TABLE 4.2

BILLIONS OF CUBIC FEET PER YEAR

|                                | 1990       | 1991       | 1992       | 1993       | 1994       | 1995       | 1996       | 1997       | 1998       | 1999       | 2000       | 2001       | 2002       | 2003       | 2004       | TOTAL        |
|--------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|
| <b>STATE</b>                   |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |              |
| Space Heat                     | 26         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 28         | 28         | 28         | 408          |
| Utility Generation             | 40         | 40         | 36         | 36         | 36         | 37         | 37         | 38         | 38         | 39         | 40         | 40         | 41         | 42         | 43         | 580          |
| Industry                       | 280        | 284        | 289        | 289        | 289        | 289        | 289        | 289        | 289        | 289        | 289        | 289        | 291        | 292        | 294        | 4,332        |
| Ammonia-Urea Production        | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 750          |
| Military Power Generation      | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 66           |
| Petroleum Production           | 225        | 230        | 235        | 235        | 235        | 235        | 235        | 235        | 235        | 235        | 235        | 235        | 236        | 236        | 239        | 3,516        |
| <b>TOTAL</b>                   | <b>346</b> | <b>351</b> | <b>351</b> | <b>352</b> | <b>352</b> | <b>353</b> | <b>353</b> | <b>354</b> | <b>354</b> | <b>355</b> | <b>356</b> | <b>357</b> | <b>359</b> | <b>362</b> | <b>364</b> | <b>5,319</b> |
| <b>RAILBELT</b>                |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |              |
| Space Heat                     | 26         | 26         | 26         | 26         | 26         | 26         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 27         | 399          |
| Utility Generation             | 39         | 39         | 35         | 35         | 36         | 36         | 36         | 37         | 37         | 38         | 39         | 40         | 40         | 41         | 42         | 571          |
| Industry                       | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 87         | 1,304        |
| Ammonia-Urea Production        | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 50         | 750          |
| Military Power Generation      | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 4          | 66           |
| Petroleum Production           | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 33         | 488          |
| <b>TOTAL</b>                   | <b>152</b> | <b>152</b> | <b>148</b> | <b>149</b> | <b>149</b> | <b>149</b> | <b>150</b> | <b>150</b> | <b>151</b> | <b>152</b> | <b>153</b> | <b>153</b> | <b>153</b> | <b>153</b> | <b>153</b> | <b>2,269</b> |
| <b>NON-RAILBELT</b>            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |            |              |
| Space Heat                     | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 1          | 1          | 1          | 1          | 1          | 7            |
| Utility Generation             | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 1          | 9            |
| Industry: Petroleum Production | 193        | 197        | 202        | 202        | 202        | 202        | 202        | 202        | 202        | 202        | 202        | 202        | 204        | 205        | 207        | 3,029        |
| <b>TOTAL</b>                   | <b>194</b> | <b>198</b> | <b>203</b> | <b>205</b> | <b>207</b> | <b>208</b> | <b>3,045</b> |

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**PROJECTED DEMAND FOR GAS**  
(Billions of Cubic Feet per Year)

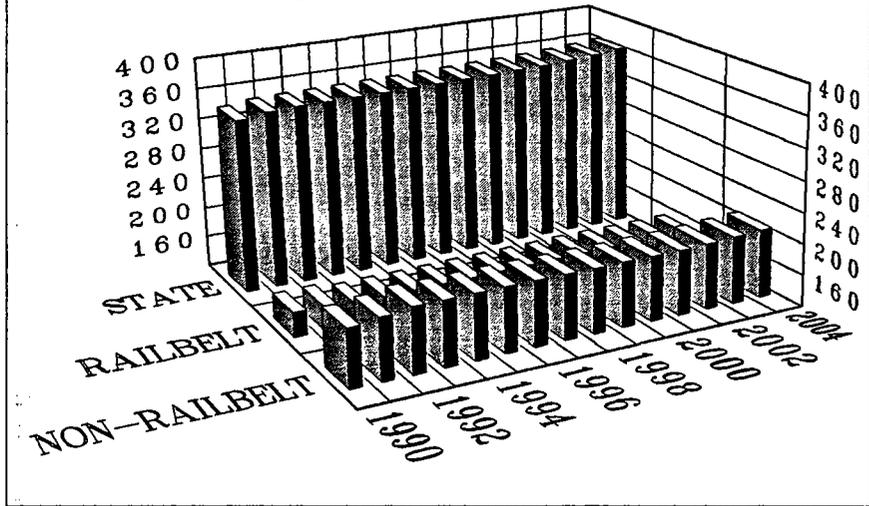


FIGURE 4.2



## CHAPTER 5

### ANALYSIS OF SURPLUS

#### NOTE TO THIS EDITION

ISER compiled the following analysis of surplus in December 1986 to supplement the consumption projections in Chapter 4. The eventual surplus of state oil and gas will probably be greater than predicted here because the 1986 analysis understated the factors which reduce consumption. Table 5.2 notes that only two variables, reserve estimates and export of LNG, have much influence on calculations of surplus, and Tables 2.1 and 3.2 show no dramatic change in either of these variables over the last three years.

#### Summary

Under reasonable assumptions about available reserves and in-state consumption, the current inventories of both oil and gas are more than adequate for the next 15 years.

#### Liquid Petroleum

A direct barrel-for-barrel comparison between demand for refined products and availability of crude oil is unrealistic since a barrel of crude oil does not yield a barrel of specific refined products. Outputs and efficiencies differ between refineries, and a given refinery can alter its product output over time. Table 5.1 shows that the cumulative 15-year Alaska demand for refined petroleum products is approximately 936 million barrels. This is about 39 million barrels more than the reserves of royalty crude oil, but is only 13 percent of total crude oil reserves in the state. Assuming

that on a statewide basis the refineries convert two-thirds of their crude oil feedstock into refined products used in Alaska, then the total volume of royalty oil available over the next 15 years more or less equals the projected consumption levels of refined products over that same time period. Because North Slope oil production began to decline in 1988 and is expected to decline each year thereafter, the annual volume of available royalty oil will fall below the projected refined products consumption level in the mid 1990's if one uses an unrealistic barrel-for-barrel comparison. Using a conversion factor for crude oil to refined products of two-thirds results in the volume of royalty oil available on an annual basis falling below the consumption level of refined products in the late 1990s.

Historically, in-state refiners have purchased both state royalty oil and oil sold by the individual lessees (BP, Exxon, ARCO, Texaco, etc.). Price terms, contract length, and transportation considerations are a few of the factors that enter into that decision-making process. It is realistic to assume that in-state refiners will, at least on a limited basis, continue to purchase non-royalty oil as refinery feedstock. However, it is unrealistic to assume that state royalty oil will or should provide the only source of feedstock for in-state refiners over the next 15 years. At present, the state takes approximately 3,200 barrel per day of Cook Inlet royalty oil in-kind. That oil is currently being exported to Taiwan. The state takes North Slope royalty oil both in-kind and in-value, but no North Slope royalty oil is exported because of continued federal restrictions on the export of ANS crude oil.

Based on current projections, sufficient in-state feedstocks will be available regardless of the supply sources chosen by the in-state refiners. No attempt has been made to compare the total volume of petroleum products produced at Alaska refineries with the total volume of petroleum

#### SURPLUS OIL AND GAS

|                           | OIL                   |              | GAS                      |                |
|---------------------------|-----------------------|--------------|--------------------------|----------------|
|                           | (MILLIONS OF BARRELS) |              | (BILLIONS OF CUBIC FEET) |                |
|                           | TOTAL                 | ROYALTY      | TOTAL                    | ROYALTY        |
| <b>STATE</b>              |                       |              |                          |                |
| Estimated reserves [1]    | 7,039                 | 897          | 31,661                   | 3,814          |
| Estimated consumption [2] | 936                   | 936          | 5,319                    | 5,319          |
| <b>SURPLUS (DEFICIT)</b>  | <b>6,103</b>          | <b>(39)</b>  | <b>26,342</b>            | <b>(1,505)</b> |
| <b>COOK INLET</b>         |                       |              |                          |                |
| Estimated reserves [1]    | 74                    | 8            | 3,619                    | 299            |
| Estimated consumption [2] | 607                   | 607          | 2,269                    | 2,269          |
| <b>SURPLUS (DEFICIT)</b>  | <b>(533)</b>          | <b>(599)</b> | <b>1,350</b>             | <b>(1,970)</b> |
| <b>NORTH SLOPE</b>        |                       |              |                          |                |
| Estimated reserves [1]    | 6,965                 | 889          | 28,042                   | 3,516          |
| Estimated consumption [2] | 329                   | 329          | 3,045                    | 3,045          |
| <b>SURPLUS (DEFICIT)</b>  | <b>6,636</b>          | <b>560</b>   | <b>24,997</b>            | <b>470</b>     |

[1] From Table 2.1.

[2] From Tables 4.1 and 4.2. Assumes that one barrel of crude oil yields 28 gallons of fuel.

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products consumed in the state. Currently, the capacity of Alaska refineries exceeds Alaskan consumption. But, owing to technical constraints, the product mix which the refineries can produce does not match the product mix demanded. The resulting cross-hauling of crude oil out of Alaska and refined products (motor oils, specialty lubricants, etc.) into the state is a common feature of petroleum markets, and does not represent an inefficient distribution of refining capacity or mismatch of supply and demand.

### Natural Gas

Table 5.1 indicates that the cumulative 15-year Alaska demand for natural gas is 5.3 trillion cubic feet of gas. This is about 1.5 billion cubic feet more than the state royalty share of gas in the combined current inventory at Cook Inlet and on the North Slope.

Since natural gas is traditionally transported by pipeline, analysis of particular markets for gas which are linked or could be linked by pipeline to supplies are relevant for the determination of excess supply. Table 5.1 shows that North Slope royalty gas could meet that region's demand for the next 15 years. It also shows that total Cook Inlet reserves could meet regional demand, though the demand could not be met with royalty gas alone. At present, the state takes no royalty gas in-kind. Again, it is unrealistic to assume that state royalty gas should satisfy all in-state consumption of natural gas.

### Projections Beyond Current Inventory

We assume reserves represent a 15-year inventory of petroleum in the ground. Because a very sizable investment is required to develop a petroleum reservoir, reserves will be "proven up" at a rate to maintain sufficient inventory consistent with demand. Premature or excess development, like excess inventories, results in unnecessary carrying costs to lease (reservoir) owners and will be avoided if possible. This is the basis for the 15-year time horizon for demand used in this analysis. As time passes, consumption will stimulate the search for new reserves to replace those produced, and market forces will work to keep supply and demand in balance.

### Sensitivity of Results

The net surpluses of oil and gas calculated in this chapter are largely insensitive to a reasonable range of changes in the assumptions underlying

the projections. These are discussed in turn and shown in Table 5.2.

### Economic Growth

Faster population growth will accelerate the use of liquid fuels relative to the use of natural gas because a larger portion of liquid fuel use is population sensitive. Even so, the net surplus of petroleum liquids would be reduced only marginally by growth of population based on a rapid economic growth scenario (see Appendix B of the 1986 report).

### Export of Gas

To the extent natural gas is exported, it is unavailable for the local market. Cumulative exports over the next 15 years from current operations are projected to be about 1,005 billion cubic feet. If a new export facility were to be constructed in Cook Inlet, it is anticipated that exploration for natural gas in Cook Inlet would accelerate (it is currently at a near standstill) and additional reserves would likely be discovered, once again creating a demand/supply balance.

### Natural Gas Availability in Fairbanks

If natural gas became available in Fairbanks, at least some space heating in Fairbanks would be converted to gas. This could increase annual natural gas consumption as fuel oil use was backed out. Fuel oil use could fall by 8 million gallons annually.

Natural gas consumption for space heating might eventually capture 75 percent of the market. If gas became available in 1993 and captured this share of the market by 1997, gas consumption for space heat could increase 30 billion cubic feet, and fuel oil consumption could fall by 175 million gallons over the projection period.

The net surplus of gas would fall only marginally as a result of these changes, and the net surplus of liquid fuels would increase only marginally.

**SENSITIVITY ANALYSIS OF OIL AND GAS SURPLUS** TABLE 5.2

|                                    | Reduction in Net Surplus |     |
|------------------------------------|--------------------------|-----|
|                                    | Oil                      | Gas |
| LOW RESERVE ESTIMATE               | 24%                      | 1%  |
| RAPID POPULATION GROWTH            | 1%                       | <1% |
| EXPORT OF LNG                      | —                        | 9%  |
| NATURAL GAS AVAILABLE IN FAIRBANKS | <1%                      | <1% |





# APPENDIX A

## OIL AND GAS FIELD DATA

| LOCATION<br>(NS = North Slope<br>CI = Cook Inlet<br>(W) = west side<br>(E) = east side<br>(M) = mid-channel) | PRODUCTION STATUS          | OPERATOR | OWNERS  | OIL INTEREST   | GAS INTEREST   |
|--|----------------------------|----------|---|--|--|
| <b>BELUGA RIVER</b><br>CI (W), Onshore   | Began production: 1/68     | Arco     | Arco<br>Chevron<br>Shell  | 0.00000000%<br>0.00000000%<br>0.00000000%  | 33.33333333%<br>33.33333333%<br>33.33333333%   |
| <b>CANNERY LOOP</b><br>CI (E), Onshore   | Began production: 1988     | Union    | Beluga<br>Burglin<br>Call<br>CIRI<br>CPC<br>Marathon<br>Unocal<br>Tyonic Deep<br>CIRI<br>Marathon<br>Other<br>Union<br>Upper Tyonic<br>CIRI<br>Marathon<br>Other<br>Union | 0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000% | 0.59123000%<br>2.36491000%<br>17.11924000%<br>5.88081000%<br>14.49744000%<br>59.54837000%<br>48.26808000%<br>12.03670000%<br>18.56524000%<br>21.12998000%<br>47.83619000%<br>16.10048000%<br>8.28603000%<br>27.77730000% |
| <b>DUCK ISLAND UNIT (ENDICOTT RESERVOIR)</b><br>NS, On/Offshore  | Began production: 1987     | BP       | Amoco<br>Arco<br>BP<br>CIRI<br>Doyon<br>Exxon<br>NANA<br>Unocal   | 0.02340000%<br>0.00340000%<br>56.78250000%<br>0.64560000%<br>0.12910000%<br>21.02060000%<br>0.38740000%<br>10.51740000%  | 0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%   |
| <b>FALLS CREEK</b><br>CI (E), Onshore  | Shut-in 1961               | Chevron  |   |  |  |
| <b>GRANITE POINT</b><br>CI (W), Offshore   | Began production: 12/67    | Union    | ADL 17586<br>Amoco<br>Chevron<br>Texaco<br>ADL 17587<br>Amoco<br>Chevron<br>Texaco<br>ADL 18742<br>Amoco<br>Chevron<br>Texaco<br>ADL 18761<br>Mobil<br>Union              | 62.50000000%<br>12.50000000%<br>25.00000000%<br>62.50000000%<br>12.50000000%<br>25.00000000%<br>62.50000000%<br>12.50000000%<br>25.00000000%<br>62.50000000%<br>12.50000000%<br>25.00000000%<br>75.00000000%<br>25.00000000%   | 62.50000000%<br>12.50000000%<br>25.00000000%<br>62.50000000%<br>12.50000000%<br>25.00000000%<br>62.50000000%<br>12.50000000%<br>25.00000000%<br>75.00000000%<br>25.00000000%   |
| <b>GWYDYR BAY UNIT AREA</b><br>NS, On/Offshore   | Field delineation underway | Arco     |   |  |  |
| <b>HEMI SPRINGS UNIT AREA</b><br>NS, Onshore   | Field delineation underway | Arco     |   |  |  |
| <b>IVAN RIVER</b><br>CI (W), Onshore   | Shut-in 1966, suspended    | Chevron  |   |  |  |
| <b>KAVIK</b><br>NS, Onshore  | Suspended                  | Arco     |   |  |  |
| <b>KENAI</b><br>CI (E), Onshore  |                            |          | Sterling Gas Participating Area<br>CIRI<br>Fed<br>Marathon<br>Other<br>Union  | 0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%<br>0.00000000%  | 46.80200000%<br>33.19300000%<br>8.27550000%<br>3.45400000%<br>8.27550000%  |

| LOCATION<br>(NS = North Slope<br>CI = Cook Inlet<br>(W) = west side<br>(E) = east side<br>(M) = mid-channel) | PRODUCTION STATUS                       | OPERATOR                  | OWNERS   | OIL INTEREST  | GAS INTEREST  |
|--|---|---------------------------|--|---|---|
| <b>KUPARUK</b><br>NS, Onshore  | Began production: 12/81                 | Arco                      | Arco<br>BP<br>Chevron<br>Exxon<br>Mobil<br>Union   | 56.3009600%<br>38.7564300%<br>0.1090000%<br>0.2180000%<br>0.3660000%<br>4.2496100%  | 56.3009600%<br>38.7564300%<br>0.1090000%<br>0.2180000%<br>0.3660000%<br>4.2496100%                                  |
| <b>LEWIS RIVER</b><br>CI (W), Onshore  | Began production: 1984                  | UNOCAL                    | Participating Area #1<br>CIRI, Oxy,<br>Union<br>Participating Area #2<br>CIRI, Oxy,<br>Union   | 0.0000000%<br>0.0000000%  | 100.0000000%<br>100.0000000%  |
| <b>LISBURNE RESERVOIR</b><br>NS, Onshore   | Began production: 1986                  | Arco                      | Arco<br>BP<br>Exxon  | 40.0000000%<br>20.0000000%<br>40.0000000%   | 0.0000000%<br>0.0000000%<br>0.0000000%  |
| <b>MCARTHUR RIVER</b><br>CI (W), Offshore  | Began production: 12/69                 | Arco<br>Marathon<br>Union | Hemlock Zone<br>Arco<br>Marathon<br>Union<br>Middle Kenai Zone<br>Marathon<br>Union<br>West Foreland<br>Marathon<br>Union  | 36.8710000%<br>31.5645000%<br>31.5645000%<br>51.0000000%<br>49.0000000%<br>51.0000000%<br>49.0000000%   | 36.8710000%<br>31.5645000%<br>31.5645000%<br>51.0000000%<br>49.0000000%<br>51.0000000%<br>49.0000000%               |
| <b>MIDDLE GROUND SHOAL</b><br>CI (E), Offshore   | Began production: 9/67                  | Amoco                     | ADL 17595<br>Amoco<br>Chevron<br>Texaco<br>ADL18754<br>Shell<br>ADL 18756<br>Shell<br>ADL 18744<br>Amoco<br>Chevron<br>Texaco<br>ADL 18746<br>Amoco<br>Chevron<br>Texaco | 82.5000000%<br>12.5000000%<br>25.0000000%<br>100.0000000%<br>100.0000000%<br>62.5000000%<br>12.5000000%<br>25.0000000%<br>62.5000000%<br>12.5000000%<br>25.0000000% | 82.5000000%<br>12.5000000%<br>25.0000000%<br>100.0000000%<br>100.0000000%<br>0.0000000%<br>0.0000000%<br>0.0000000% |
| <b>MILNE POINT</b><br>NS, Onshore  | Began production: 1985                  | Chevron                   | Chevron<br>Conoco<br>Oxy<br>Milne Point Development, Well C-4<br>Chevron<br>Cities<br>Conoco   | 17.3735200%<br>72.1493300%<br>10.4771500%<br>20.1769300%<br>12.1677400%<br>67.6553300%  | 0.0000000%<br>0.0000000%<br>0.0000000%<br>0.0000000%<br>0.0000000%<br>0.0000000%                                    |
| <b>NICOLAI CREEK</b><br>CI (W), On/Offshore  | Began production: 10/68,<br>now shut in | Texaco                    |  |   |   |
| <b>NORTH COOK INLET</b><br>CI (M), Offshore  |   | Phillips                  | Phillips   | 0.0000000%  | 100.0000000%  |
| <b>NORTH FORK</b><br>CI (E), Onshore   | Shut-in 1965                            | Chevron                   |  |   |   |
| <b>POINT THOMSON UNIT AND FLAXMAN ISLAND</b><br>NS, On/Offshore  | Shut-in                                 | Exxon                     |  |   |   |
| <b>PRETTY CREEK UNIT AREA</b><br>CI (W), Onshore   | Began production: 1986                  | Union                     | Texaco<br>Union  | 0.0000000%<br>0.0000000%  | 11.0000000%<br>89.0000000%  |

| LOCATION<br>(NS = North Slope<br>CI = Cook Inlet<br>(W) = west side<br>(E) = east side<br>(M) = mid-channel) | PRODUCTION STATUS                      | OPERATOR        | OWNERS  | OIL<br>INTEREST  | GAS<br>INTEREST   |
|--|--|-----------------|---|--|---|
| <b>PRUDHOE BAY (SADLEROCHIT RESERVOIR)</b><br>NS, Onshore  | Began production: 10/69                | Arco, BP        | Amarada<br>Arco<br>BP<br>Chevron<br>Exxon<br>L L & E<br>Marathon<br>Mobil<br>Phillips<br>Shell<br>Texaco  | 0.5379191%<br>21.7799635%<br>50.6848339%<br>0.6717745%<br>21.7776490%<br>0.0397591%<br>0.0499044%<br>1.8915771%<br>1.8805235%<br>0.1376744%<br>0.5484215%          | 0.0000000%<br>42.5649413%<br>13.8398950%<br>0.4830700%<br>42.5647901%<br>0.0000000%<br>0.0000000%<br>0.2843866%<br>0.2629370%<br>0.0000000%<br>0.0000000% |
| <b>STERLING</b><br>CI (E), Onshore   | Began production: 5/62,<br>now shut-in | Union           |   |  |   |
| <b>STUMP LAKE UNIT AREA</b><br>CI (W), Onshore   | Suspended                              | Chevron         |   |  |   |
| <b>TRADING BAY</b><br>CI (W), Offshore   | Began production: 12/67                | Tesoro<br>Union | Monopod A-15<br>Marathon<br>Union<br>Monopod A-6<br>Marathon<br>Union<br>Monopod Non-Pool<br>Marathon<br>Union<br>Spark - ADLs 18776, 35431<br>Marathon<br>Spurr 1 - ADL 17597<br>Marathon<br>Union | 50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>100.0000000%<br>50.0000000%<br>50.0000000% | 50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>50.0000000%<br>100.0000000%<br>50.0000000%<br>50.0000000%                      |
| <b>WEST FORK</b><br>CI (E), Onshore  | Shut-in                                |                 |   |  |   |
| <b>WEST SAK RESERVOIR</b><br>NS, Onshore   |  | ARCO, Conoco    |   |  |   |

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# APPENDIX B CRUDE OIL ANALYSES

| CRUDE                          | NORTH SLOPE [1] |           |              | CRUDE                      | COOK INLET  |         |
|--------------------------------|-----------------|-----------|--------------|----------------------------|-------------|---------|
|                                | SADLEROCHIT     | KUPARUK   | WEST SAK [2] |                            | DRIFT RIVER | NIKISKI |
| Gravity, °API                  | 26.4            | 23        | 22.4         | Gravity, °API @ 60         | 35.3        | 34.6    |
| Kin.Vis. @ 60 °F               | 42.42           | cSt 79.98 | 95.92        | Spec.Grav. @ 60 °          | 0.8483      | 0.8519  |
| Sulfur wt%                     | 1.06            | 1.76      | 1.82         | Kin.Vis. @ 65 °F           | 6.94        | 7.34    |
| Nitrogen, ppm                  | 2090            | 1980      | —            | @ 90 °F                    | 6.77        | 7.17    |
| Carbon residue wt              | 4.4             | 7.37      | 7.62         | @ 122 °F                   | 3.39        | 3.55    |
| H <sub>2</sub> S, lb/1,000 bbl | 0.35            | <5        | —            | Sulfur, wt%                | 0.09        | 0.10    |
| Salt, lb/1,000 bbl             | 32.7            | —         | —            | Nitrogen wt%               | 0.13        | 0.14    |
| Ni/V, ppm                      | 11/26           | 19/57     | 22/61        | Carbon wt%                 | 86.83       | 87.09   |
| RVP, psi                       | 3.55            | 2.8       | 2.7          | Hydrogen wt%               | 12.81       | 12.80   |
| Pour Pt, °F                    | 0               | -55       | -50          | Oxygen wt%                 | 0.09        | 0.15    |
| Neut. no. (D974)               | 1.12            | —         | 0.68         | Sed. and water, vol        | 0.05        | 0.1     |
| C4 AND LIGHTER                 | —               | —         | —            | Water, by dist., vol       | Nil         | 0.05    |
| Yield, vol%                    | 1.17            | —         | 0.63         | RVP, psi                   | 7.5         | 7.85    |
| C5 AND LIGHTER                 | —               | —         | —            | Pour Pt, °F                | 0           | -5      |
| Yield, vol%                    | —               | 2.12      | —            | Flash Pt., PMCC, °         | <0          | <0      |
| C5 - 150 °F                    | —               | —         | —            | BADGER DISTILLATION        | —           | —       |
| Yield, vol%                    | 2.2             | 1.8       | 1.9          | C5 AND LIGHTER             | —           | —       |
| Sulfur, wt%                    | <0.001          | 0.006     | 0.004        | Yield, vol%                | 0.4         | 0.7     |
| RON clear                      | 71.5            | —         | —            | Composition                | —           | —       |
| MON clear                      | 69.8            | —         | —            | Methane                    | 0.02        | Traces  |
| RON + 0.5g TEL/g               | 78.4            | —         | —            | Ethane                     | 11.07       | 7.75    |
| 150 - 380 °F                   | —               | —         | —            | Propane                    | 61.74       | 59.81   |
| Yield, vol%                    | 15.6            | 14.5      | 14.4         | Iso-Butane                 | 11.72       | 12.46   |
| Sulfur, wt%                    | 0.013           | 0.018     | 0.018        | Normal Butane              | 13.00       | 16.83   |
| Paraffins, vol%                | 39.7            | 38.3      | 36.4         | Iso-Pentane                | 1.52        | 2.03    |
| Naphthenes, vol%               | 43.3            | 47        | 48.2         | Normal Pentane             | 0.93        | 1.12    |
| Aromatics, vol%                | 17.0            | 14.7      | 15.4         | IBP - 120 °F               | —           | —       |
| 380 - 650 °F                   | —               | —         | —            | Yield vol%                 | 1.3         | 2.0     |
| Yield, vol%                    | 28.6            | 26.9      | 27.5         | Gravity, API @ 60          | X           | X       |
| Gravity, API                   | 33.1            | —         | 31.6         | 120 - 374 °F               | —           | —       |
| Sulfur, wt%                    | 0.414           | 0.66      | 0.700        | Yield vol%                 | 31.4        | 29.5    |
| Pour Pt, °F                    | -25             | -25       | -35          | Gravity, API @ 60          | 59.3        | 57.2    |
| Cetane No.                     | 45.8            | 45.4      | 42.1         | 374 - 440 °F               | —           | —       |
| N <sub>2</sub> , total, ppm    | 79              | —         | —            | Yield vol%                 | 6.0         | 6.5     |
| Vis. cSt @ 100 °F              | —               | 3.083     | 3.34         | Gravity, API @ 60          | 40.9        | 40.6    |
| Aromatics, vol%                | 33.6            | 30.0      | 31.4         | 440 - 610 °F               | —           | —       |
| 650 - 840 °F                   | —               | —         | —            | Yield vol%                 | 17.6        | 15.7    |
| Yield, vol%                    | 16.4            | 18.9      | 16.6         | Gravity, API @ 60          | 35.3        | 35.5    |
| Gravity, API                   | 23.8            | 20.5      | 21.1         | 610 + Resid                | —           | —       |
| Sulfur, wt%                    | 1.10            | 1.79      | 1.81         | Yield vol%                 | 41.3        | 43.9    |
| Aniline Pt. °C                 | 74.7            | 104.3     | —            | Gravity, API @ 60          | 18.1        | 18.2    |
| Pour Pt, °F                    | 70              | 50        | 60           | DISTILLATION CURVE, VOL, % | —           | —       |
| Kin.Vis. @ 100 °F              | —               | 34.2      | 43.99        | IBP                        | 86          | 84      |
| Carbon Residue,                | 0.012           | wt% 0.01  | —            | 2%                         | 131         | 120     |
| Total Nitrogen, pp             | 950             | 600       | 840          | 4%                         | 134         | 130     |
| Basic Nitrogen                 | 0.03            | wt% 0.02  | 0.023        | 6%                         | 140         | 145     |
| V/Ni, ppm                      | —               | <1        | —            | 8%                         | 150         | 165     |
| 650 + RESIDUAL                 | —               | —         | —            | 10%                        | 163         | 195     |
| Yield, vol%                    | 52.4            | 56        | 55.6         | 12%                        | 192         | 213     |
| Gravity, API                   | 15              | 11.7      | 10.8         | 14%                        | 211         | 219     |
| Sulfur, wt%                    | 1.63            | 2.59      | 2.53         | 16%                        | 220         | 239     |
| Carbon Residue,                | 8.82            | wt% 12.61 | wt% 13.15    | 18%                        | 240         | 254     |
| Total Nitrogen, pp             | 3600            | —         | —            | 20%                        | 257         | 272     |
| Pour Pt, °F                    | 80              | 40        | 45           | 22%                        | 273         | 292     |
| Kin.Vis. @ 210 °F              | 47.54           | 97.15     | 135.3        | 24%                        | 292         | 307     |
| Kin.Vis. @ 275 °F              | 15.55           | —         | —            | 26%                        | 309         | 324     |
| Pentane insoluble,             | —               | —         | 14.97        | 28%                        | 325         | 341     |
|                                |                 |           |              | 30%                        | 340         | 361     |
|                                |                 |           |              | 32%                        | 361         | 390     |
|                                |                 |           |              | 34%                        | 395         | 420     |
|                                |                 |           |              | 36%                        | 420         | 430     |
|                                |                 |           |              | 38%                        | 430         | 440     |
|                                |                 |           |              | 40%                        | 440         | 460     |
|                                |                 |           |              | 42%                        | 455         | 475     |
|                                |                 |           |              | 44%                        | 475         | 490     |
|                                |                 |           |              | 46%                        | 495         | 510     |
|                                |                 |           |              | 48%                        | 510         | 525     |
|                                |                 |           |              | 50%                        | 525         | 540     |
|                                |                 |           |              | 52%                        | 545         | 555     |
|                                |                 |           |              | 54%                        | 601         | X       |
|                                |                 |           |              | 56%                        | 607         | X       |

[1] Aalund, L.R., "Guide to Export Crudes for the '80s," Oil and Gas Journal, Dec. 19, 1983.

[2] Crude not in production, but pilot program is underway in Kuparuk area to determine feasibility. Assay sample obtained during drill stem test and may not be representative of the entire accumulation.



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## APPENDIX C

### DEFINITIONS OF STATUTORY TERMS

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AS 38.05.183 states that oil and gas taken in-kind as the state's royalty share of production may not be sold or otherwise disposed of for export from the state until the Commissioner of Natural Resources determines that the royalty-in-kind oil or gas is surplus to the present and projected intrastate domestic and industrial needs for oil and gas.

The statute contains several key terms whose meaning must be resolved before an estimate can be made of oil and gas surplus to the state's needs. These key terms are: 1) "oil and gas," 2) "export," 3) "present," 4) "projected," 5) "domestic," 6) "industrial," 7) "intrastate," and 8) "how these needs are to be met." Each key term affects the size of the estimated demand for oil and gas in Alaska and consequently, the size of the projected surplus or deficit. The meaning of each term is discussed below.

#### Oil and Gas

Crude oil and natural gas are fluids containing hydrocarbon compounds produced from naturally occurring petroleum deposits. Typical crude oil contains several hundred chemical compounds. The lightest of these are gases at normal temperatures and pressure, described as "natural gas." These light fractions of the crude oil stream include both hydrocarbon and non-hydrocarbon gases, such as water, carbon dioxide, hydrogen sulfide, helium, or nitrogen. The principal hydrocarbons are methane (CH<sub>4</sub>), ethane (C<sub>2</sub>H<sub>6</sub>), propane (C<sub>3</sub>H<sub>8</sub>), butanes (C<sub>4</sub>H<sub>10</sub>), and pentanes (C<sub>5</sub>H<sub>12</sub>). The gaseous component found most often and in largest volumes is, typically, methane. Heavier fractions of the crude stream are usually liquids. If a given hydrocarbon fraction is gaseous at reservoir temperatures and pressures, but is recoverable by condensation (cooling and pressure reduction), absorption, or other means, it is classified by the American Gas Association (AGA) as a natural gas liquid (NGL). Natural gas liquids include ethane if ethane is recovered from the gas stream as a liquid. A related term is liquefied petroleum gas (LPG), composed of hydrocarbons which liquefy under moderate pressure under normal temperatures. LPG usually refers to propane and butane. A second related term is condensate, which refers to LPG plus heavier NGL component (natural

gasoline). The lightest hydrocarbon fraction is methane, which is almost never recovered as a liquid, and which makes up the bulk of pipeline gas. If a natural gas stream contains few hydrocarbons which are commercially recoverable as liquids, it is considered "dry gas" or "lean gas." The distinction between "wet" and "dry" is usually a legal one, which varies from state to state. "Crude oil" usually means the non-gaseous portion of the crude oil stream.

Natural gas may occur in reservoirs which are predominately gas-bearing or in reservoirs in which the gas is in contact with petroleum liquids. Non-associated gas is natural gas from a reservoir where the gas is neither in contact with nor dissolved in crude oil. Associated gas occurs in contact with crude oil, but is not dissolved in it. A gas cap on a crude oil reservoir is a typical example of associated gas. Dissolved gas is dissolved in petroleum liquids and is produced along with them. Dissolved and associated gases are usually good sources of NGL while non-associated gases are often "dry."

The distinction between natural gas and its NGL components is important to a study of the supply and demand of royalty oil and gas because natural gas liquids have a multitude of uses when separated from the gas stream. For example, propane is both produced in Alaska and sold in Alaska as bottled gas for residential, commercial, and limited transportation uses, while butane is used for blending in gasoline and military jet fuel and as a refinery fuel. In addition, Marathon Oil uses LPG to enrich crude oil at its Trading Bay facility. It ships the combined fluids to the Drift River terminal for export. Potential uses for NGL also include the enriching ("spiking") of pipeline gas and crop drying. Several years ago the Dow-Shell Petrochemical Group and Exxon studied the feasibility of utilizing the NGL contained in Prudhoe Bay natural gas as the basis for an Alaska petrochemicals industry. Since the state has the option of considering NGL separately from the gas stream, two definitions of natural gas consumption and reserves are possible. One of these would consider natural gas liquids as part of the gas stream. The second definition would treat the markets for LPG and ethane separately from those for gas. This requires a separate estimate of LPG

consumption and gas liquids reserves. In this report, demand for LPG and ethane is estimated separately from that for gas; however, no separate estimate is made of gas liquids reserves.

#### **Export**

Taken in context, this term appears to mean the direct physical shipment of oil and gas out of the state. However, when one considers the fact that much of Alaska's industrial use of oil and gas is processed directly for export markets, the meaning of export versus "intrastate" is not so obvious. For example, it appears that processing of gas into another product, e.g., anhydrous ammonia, would probably be an "industrial" use rather than "export" of gas, even though the ammonia is mostly exported. Liquefaction to change the phase of the gas is a less obvious case. The liquefaction of natural gas is considered a transportation process in this report. Still more troublesome is the use of gas and oil for transportation related to export. Is the gas and oil consumed in TAPS pipeline pump stations, for example, an "industrial" use in state? Or is it really "export" of that energy, since it is consumed in the exporting process? There is no reason why the state may not be approached in the future to commit royalty oil and gas to quasi-export uses. Indeed, ALPETCO (later, Alaska Oil Company) made a top dollar offer for royalty oil ultimately destined (as petrochemical products) for out-of-state markets. Though they made the offer, they did not make payments in full. Also, the state once committed royalty gas to the El Paso gas pipeline proposal for export of Prudhoe Bay gas, which involved liquefaction. Neither proposal was clearly for in-state industrial use. In this report, industrial demand is treated with multiple definitions as outlined later in the chapter to show how different definitions of "export" affect the estimate of total consumption in Alaska.

#### **Present**

The problem here is that the term "present" may mean "latest year" consumption, "average recent year" consumption, "weather-adjusted" consumption, or "worst case" consumption. In the residential and commercial sector particularly, each definition gives a somewhat different answer because of the variability of weather.

The "worst case" consumption calculation can result in considerably higher gas consumption than the most recent year, if the most recent year happens to have been a relatively warm one. While it is not correct forecasting procedure to make long run forecasts of intrastate residential

consumption of natural gas which assume worst case forecasts for every year, it may be prudent in practice to reserve part of the State's gas and oil supply for bad weather. For forecasting, variability of weather makes the picking of a starting value for consumption somewhat tricky. In this report, Rail Belt consumption is based on average weather years. For the remainder of the state, trended per capita consumption is used, which approximates average weather conditions.

#### **Projected**

This is a very difficult concept, since many different projections of consumption would be possible even if it were possible to agree on a single concept defining consumption. Rates of economic development, population growth, and relative energy prices are key features of any consumption forecast, but assumptions concerning any of these variables are necessarily controversial. This report describes a range of possible consumption figures under precisely articulated definitions of consumption and varying paces of economic, population, and fuel price growth.

#### **Domestic**

Domestic consumption appears to mean Alaska residential consumption. As we saw above under the subheading "present", it is not at all obvious which definition of domestic consumption is the most appropriate, even when the identity of the customer is not in dispute. Some multifamily residential use may be described as "commercial", obscuring the definition of the customer and causing forecasting problems for natural gas. The definition of "domestic" considered in this report includes multifamily residential in "residential" or "domestic" use.

#### **Industrial**

As described above, "industrial" energy use has a number of potential definitions. Since one intent of giving in-state industrial needs priority over export uses of royalty oil and gas seems to be encourage in-state economic activity, a day-to-day working definition of this industrial priority is that the royalty reserves be committed to the market which has the largest potential economic impact in Alaska. For forecasting purposes, however, it is difficult to say which markets will prove to be of the most economic benefit to the state. As a compromise, we will adopt four alternative definitions of "industrial" in this study.

The four alternative definitions of industrial use of oil and gas used in this report are outlined below,

beginning with the most restrictive and moving to the most liberal.

**Definition 1:** Industrial use consists of any consumption of natural gas, petroleum, or their products in combustion (except that required to export oil or gas); or the chemical transformation of natural gas, petroleum, or their products into refined products for local markets. This definition explicitly excludes the exported products from refineries, as well as uses which merely change the physical form of the product (gas conditioning or liquification) for export, or which move the product to an export market (pipeline fuel, fuel used on lease, shrinkage, injection, vented and flared gas).

**Definition 2:** Industrial use consists of any consumption of natural gas, petroleum, or their products in combustion (except in oil and gas production and transportation); or the chemical transformation of natural gas, petroleum, or their products into refined products. This definition counts feedstocks for

petrochemical plants and refineries as industrial consumption. It also counts energy consumed by an LNG facility as industrial consumption. It excludes the feedstocks of LNG plants; and fuel consumption by conditioning plants, pump stations, fuel used on lease, shrinkage, injection and flared gas.

**Definition 3:** Industrial use consists of any consumption of natural gas, crude oil, or their products in combustion (except in oil and gas transport and extraction) or their chemical

transformation into refined products. This definition permits the feedstocks of refineries to be counted as industrial consumption. It excludes fuels used in pump stations, in conditioning plants, fuel used on lease, and gas shrinkage, injection, or venting.

**Definition 4:** Industrial use consists of any use of natural gas, crude oil, or their products in combustion, or their transformation into chemically different products. This definition permits feedstocks of refineries to be counted as industrial consumption, as well as energy consumption in conditioning plants and pump stations. It excludes injected gas, which is ultimately recoverable for other uses, and LNG processing, which is considered an export. Definition 4 will be used for the purposes of this report.

None of the four definitions treats industrial use (including transportation) to include gas injected to enhance oil recovery, since in theory this gas remains part of the ultimately recoverable gas reserves of the state. Thus, it is not "consumed."

#### **Intrastate**

It is unclear what is meant by intrastate consumption. Some uses, such as combustion of oil and gas products in fixed capital facilities in Alaska, are reasonably easy to categorize as

intrastate. There are several uses in transportation which are not obviously within Alaska. These categories include the fuel burned in marine vessels such as cargo vessels, ferries, and fishing boats, and fuel burned in international interstate air travel. There are multiple ways to approach the definition of this consumption. The first is a sales definition: the fuel used in transportation which is sold in Alaska. The second approach is to base consumption on fuel used in Alaska or related to Alaska's economy and population, regardless of the point of sale. This results in three logical definitions, described below:

**Definition 1:** Intrastate consumption in transportation includes all sales of fuels to motor vehicles, airplanes, and vessels in Alaska, including bonded fuels. It excludes fuel consumed by motor vessels which was purchased in other states, and fuel consumed by airlines between Alaska locations unless the fuel was sold in Alaska. It also excludes out of state military fuel purchases.

**Definition 2:** Intrastate consumption includes fuel consumed by motor vessels, airlines, and vehicles engaged in Alaskan economic activity. It includes use of fuel by American fishing boats in Alaskan waters regardless of where the fuel was purchased, use of fuel purchased in Washington State by Alaska State ferries, and fuel consumed by ships and aircraft involved in Alaska trade. It excludes sales to aircraft on international flights (bonded and unbonded), but includes military out of state purchases.

**Definition 3:** The final definition is a compromise between the first two. It includes all fuel purchased within the state, plus military uses, but excludes fuel purchased out of state except for military uses.

The basic definition in this report is the third definition. By excluding bonded and exempt jet fuel, the report also approximates Definition 2. Lack of data on out-state purchases by the military makes Definition 1 impractical.

### **How These Needs Are To Be Met**

Any analysis of how the oil and gas needs of the intrastate domestic and industrial sector are to be met could include several sources of supply: state royalty oil and gas, in-state oil and gas reserves under other ownership, probable extensions of proven reserves, and imports of crude oil, petroleum products, and (in theory) natural gas.

## APPENDIX E

### ALASKA REFINERIES AND TRANSPORTATION FACILITIES

| PLANT  | UNIT         | UNIT CAPACITY  | PRODUCT AND MARKET AREA  |
|--|--------------|----------------|--|
| <b>OIL REFINERIES</b>                        |              |                |  |
| CHEVRON<br>Nikiski, 1963                     | Crude        | 25,000 Bbl/d   | Gasoline, unfinished; lower 48<br>JP 4; Alaska<br>Jet A; Alaska<br>Furnace Oil; Alaska<br>Diesels; Alaska<br>Fuel Oil; lower 48<br>Asphalt; Alaska                           |
| MAPCO<br>North Pole, 1977                    | Crude        | 90,000 Bbl/d   | Gasolene, leaded; Alaska<br>Gasoline, unleaded; Alaska<br>JP 4; Alaska<br>Jet A; Alaska<br>Diesel, #1; Alaska<br>Diesel, #2; Alaska<br>Diesel, #4; Alaska<br>Asphalt; Alaska |
| TESORO<br>Nikiski, 1969                      | Crude        | 80,000 Bbl/d   | Propane; Alaska  |
|  | Hydrocracker | 9,000 Bbl/d    | Gasoline, unleaded; Alaska   |
|  | PowerFormer  | 12,000 Bbl/d   | Gasoline, regular; Alaska  |
|  | PRIP         | 4,000 Bbl/d    | Gasoline, premium unleaded; Alaska   |
|  | LPG          | 2,800 Bbl/d    | JP 4; Alaska   |
|  | Hydrogen     | 12,800 Mcf/d   | Jet A; Alaska  |
|  | Sulfur       | 15 T/d         | Diesel, #2; Alaska<br>Fuel Oil, #6; lower 48<br>Sulfur; lower 48   |
| PETRO STAR<br>North Pole, 1985               | Crude        | 7,000 Bbl/d    | Kerosine; Fairbanks area   |
| <b>GAS PROCESSING PLANTS</b>                 |              |                |  |
| PHILLIPS-MARATHON LNG PLANT<br>Nikiski, 1969 | LNG          | 230,000 Mcf/d  | LNG; Japan: 440,000Bbl/10 days   |
| UNOCAL CHEMICAL PLANT<br>Nikiski, 1969       | Ammonia      | 1,300,000 T/yr | Anhydrous Ammonia; West Coast and export   |
|  | Urea         | 1,000,000 T/yr | Urea prills and granules; West Coast and export  |

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SURVEY OF OPERATING REFINERIES IN THE U.S. [1]

| No. | Plants                 | Crude Capacity |            | Vacuum    | Thermal   | Distill.  | Thermal | Cat Cracking |           | Charge Capacity (b/d) |           |           | Production Capacity (b/d) |         |         | Hydrogen (MMcfd) | Coke (t/d) |
|-----|------------------------|----------------|------------|-----------|-----------|-----------|---------|--------------|-----------|-----------------------|-----------|-----------|---------------------------|---------|---------|------------------|------------|
|     |                        | b/d            | b/cd       |           |           |           |         | Ops.         | Ops.      | Re-                   | Hydro-    | Cat       | Hydro-                    | Cat     | Alky.   |                  |            |
|     |                        |                |            |           |           |           |         | Fresh        | forming   | cracking              | Hydro-    | Hydro-    | Poly.                     | Isomer- |         |                  |            |
|     |                        |                |            |           |           |           |         | Feed         | cracking  | refining              | treating  | ization   |                           |         |         |                  |            |
| 9   | Alabama                | 138,750        | 143,900    | 48,000    | 10,000    | ---       | ---     | ---          | 27,000    | ---                   | 13,000    | 43,500    | ---                       | ---     | 20,500  | 8.0              | 400        |
| 6   | Alaska                 | 217,000        | 294,437    | 6,000     | 14,000    | ---       | ---     | ---          | 12,000    | 9,000                 | ---       | 12,000    | ---                       | ---     | 9,000   | 12.8             | ---        |
|     | ARCO, Kuparuk          | 12,000         | 12,000     | ---       | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | ---     | ---              | ---        |
|     | ARCO, Prudhoe Bay      | 14,000         | 18,000     | ---       | 14,000    | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | ---     | ---              | ---        |
|     | Chevron, Kenal         | 22,000         | 22,500     | ---       | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | 6,000   | ---              | ---        |
|     | Mapco, North Pole      | 90,000         | 94,737     | 6,000     | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | 2,500   | 2,000   | ---              | ---        |
|     | Petro Star, North Pole | 7,000          | 7,200      | ---       | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | ---     | ---              | ---        |
|     | Tesoro, Kenal          | 72,000         | 80,000     | ---       | ---       | ---       | ---     | ---          | 12,000    | 9,000                 | ---       | 12,000    | ---                       | ---     | ---     | 12.8             | ---        |
| 1   | Arizona                | 5,710          | 6,000      | 2,000     | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | 1,160   | ---              | ---        |
| 3   | Arkansas               | 58,570         | 61,000     | 30,500    | ---       | ---       | 775     | 18,500       | 9,000     | ---                   | ---       | 20,000    | 4,800                     | 3,000   | 4,000   | 2.8              | ---        |
| 31  | California             | 2,278,583      | 2,418,830  | 1,350,265 | 503,200   | 1,350,265 | 14,000  | 645,500      | 561,500   | 385,000               | 525,000   | 949,450   | 127,200                   | 18,700  | 28,900  | 94,754           | 20,092     |
| 2   | Colorado               | 72,000         | 76,000     | 23,000    | ---       | ---       | ---     | 23,000       | 16,500    | 19,000                | ---       | 26,000    | 3,800                     | ---     | 7,400   | ---              | ---        |
| 1   | Delaware               | 140,000        | 150,000    | 95,000    | 46,000    | ---       | ---     | 65,000       | 56,000    | 19,000                | ---       | 110,000   | 13,500                    | 3,370   | ---     | 40.0             | 2,180      |
| 2   | Georgia                | 36,800         | 40,000     | 5,000     | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | 27,500  | ---              | ---        |
| 2   | Hawaii                 | 129,500        | 135,000    | 66,000    | 13,000    | ---       | ---     | 22,000       | 12,000    | 16,000                | ---       | 14,500    | 5,625                     | 1,500   | 1,300   | 19.5             | ---        |
| 6   | Illinois               | 920,600        | 977,000    | 361,000   | 106,400   | 342,000   | 12,400  | 342,000      | 284,300   | 66,000                | 35,000    | 548,800   | 91,000                    | 30,200  | 36,900  | 66.8             | 6,300      |
| 4   | Indiana                | 422,900        | 441,000    | 232,200   | 28,500    | 168,000   | 4,000   | 168,000      | 96,000    | ---                   | 80,000    | 152,800   | 33,900                    | 36,000  | 4,500   | ---              | 1,550      |
| 8   | Kansas                 | 344,025        | 363,583    | 124,650   | 55,680    | 127,000   | 5,000   | 127,000      | 86,300    | ---                   | 44,000    | 165,300   | 38,100                    | 43,469  | 2,500   | ---              | 2,070      |
| 2   | Kentucky               | 218,900        | 226,300    | 92,000    | 57,600    | 100,000   | ---     | 100,000      | 53,000    | ---                   | 40,000    | 142,300   | 13,000                    | 17,600  | 7,900   | ---              | ---        |
| 17  | Louisiana              | 2,274,516      | 2,374,300  | 909,300   | 408,500   | 736,500   | 13,300  | 736,500      | 484,300   | 149,000               | 301,000   | 942,600   | 202,200                   | 78,300  | 37,000  | 55,500           | 14,776     |
| 4   | Michigan               | 120,100        | 127,095    | 30,000    | ---       | ---       | ---     | 45,500       | 33,500    | ---                   | 18,800    | 40,000    | 9,600                     | 6,000   | ---     | 10,000           | ---        |
| 2   | Minnesota              | 285,600        | 299,220    | 192,000   | 58,000    | 78,000    | 1,000   | 78,000       | 55,500    | ---                   | 86,500    | 127,000   | 19,150                    | 23,300  | ---     | 20.0             | 2,800      |
| 5   | Mississippi            | 358,600        | 378,879    | 265,600   | 70,000    | 72,000    | 2,000   | 72,000       | 65,600    | 68,000                | 194,000   | 58,800    | 18,700                    | 5,500   | 5,000   | 217.5            | 3,450      |
| 4   | Montana                | 137,200        | 143,000    | 55,250    | 7,700     | 50,600    | 7,700   | 50,600       | 35,800    | 4,900                 | 14,000    | 100,200   | 11,670                    | 5,800   | 23,500  | 19.3             | 435        |
| 1   | Nevada                 | 4,500          | 4,700      | 2,900     | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | ---     | ---              | ---        |
| 6   | New Jersey             | 464,250        | 486,368    | 249,400   | 31,500    | 256,000   | 26,000  | 256,000      | 89,500    | ---                   | 65,000    | 270,600   | 30,500                    | 43,000  | 8,500   | 11.0             | 1,010      |
| 3   | New Mexico             | 72,800         | 77,107     | 13,900    | ---       | ---       | ---     | 27,100       | 17,400    | ---                   | ---       | 28,100    | 5,400                     | 4,000   | 4,100   | ---              | ---        |
| 1   | New York               | 42,750         | 45,000     | 27,000    | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | 17,000  | ---              | ---        |
| 1   | North Dakota           | 58,000         | 60,000     | ---       | ---       | ---       | ---     | 28,000       | 12,100    | ---                   | ---       | 16,600    | 5,100                     | 4,000   | ---     | ---              | ---        |
| 4   | Ohio                   | 482,650        | 508,000    | 183,000   | 29,900    | 176,000   | 8,800   | 176,000      | 160,800   | 86,200                | 23,000    | 169,500   | 26,600                    | 65,400  | 2,100   | 65.0             | 1,250      |
| 6   | Oklahoma               | 387,500        | 404,316    | 141,400   | 20,500    | 136,500   | 5,940   | 136,500      | 91,000    | 5,000                 | 20,000    | 137,000   | 36,100                    | 29,400  | 9,500   | 10.0             | 1,040      |
| 1   | Oregon                 | 15,000         | 15,789     | 16,000    | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | ---     | ---              | ---        |
| 8   | Pennsylvania           | 730,400        | 768,000    | 320,180   | ---       | ---       | ---     | ---          | ---       | ---                   | ---       | ---       | ---                       | ---     | ---     | ---              | ---        |
| 1   | Tennessee              | 57,000         | 60,000     | 12,000    | 355,000   | 1,616,500 | 134,250 | 1,616,500    | 1,150,900 | 276,500               | 50,000    | 430,900   | 49,000                    | 21,050  | 21,310  | 49.5             | ---        |
| 31  | Texas                  | 4,058,350      | 4,294,500  | 1,826,300 | 8,500     | 1,616,500 | 9,100   | 1,616,500    | 1,150,900 | 827,000               | 2,248,950 | 301,750   | 301,750                   | 304,215 | 88,800  | 614.0            | 11,694     |
| 6   | Utah                   | 154,500        | 160,400    | 45,500    | ---       | ---       | ---     | 55,400       | 29,100    | ---                   | 7,100     | 35,100    | 14,500                    | 8,050   | 1,700   | ---              | ---        |
| 1   | Virginia               | 51,000         | 53,000     | 29,000    | 13,500    | 27,500    | 2,000   | 27,500       | 8,750     | ---                   | ---       | 25,000    | 2,400                     | ---     | ---     | ---              | ---        |
| 7   | Washington             | 489,675        | 489,517    | 220,500   | 70,000    | 102,500   | 13,000  | 102,500      | 119,800   | 52,000                | 25,600    | 180,000   | 27,900                    | 4,250   | 16,800  | 80.0             | 3,500      |
| 2   | West Virginia          | 15,500         | 16,000     | 10,850    | ---       | ---       | ---     | ---          | 4,900     | 4,500                 | ---       | 3,900     | ---                       | ---     | ---     | ---              | ---        |
| 7   | Wisconsin              | 32,000         | 34,000     | 20,500    | ---       | ---       | ---     | ---          | 8,000     | ---                   | ---       | 6,800     | 1,300                     | ---     | ---     | ---              | ---        |
| 5   | Wyoming                | 163,500        | 171,500    | 75,600    | 6,600     | 64,500    | 10,000  | 64,500       | 36,850    | ---                   | 21,000    | 58,950    | 10,700                    | 1,800   | 1,500   | ---              | ---        |
| 188 | TOTAL                  | 15,635,738     | 16,478,278 | 7,088,395 | 1,928,090 | 5,252,900 | 295,065 | 5,252,900    | 3,913,920 | 1,201,100             | 2,366,700 | 7,111,850 | 1,110,395                 | 782,604 | 234,569 | 2,430.2          | 73,646     |

[1] Gwyn, Debra A., "Annual Refining Survey," Oil & Gas Journal, v. 87, no. 12, March 20, 1989, pp. 70-72. b2:12/06/89

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**APPENDIX F**  
**OIL AND GAS FIELD MAPS**

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# NORTH SLOPE UNIT MAP

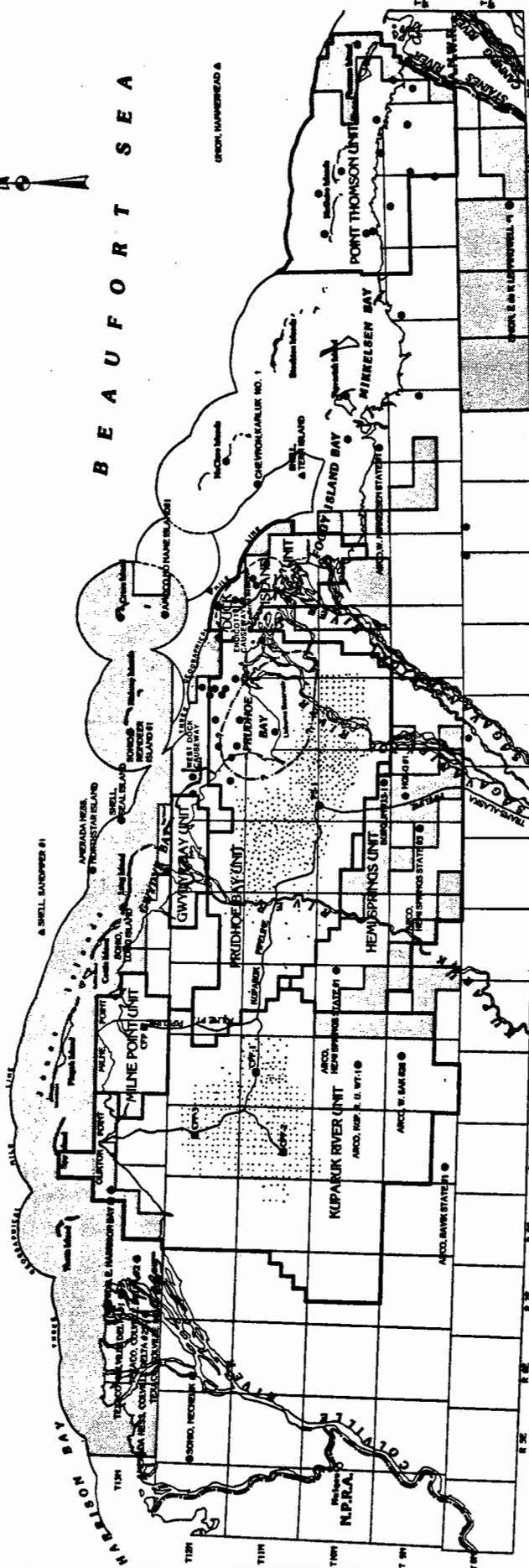
ALASKA DEPARTMENT OF NATURAL RESOURCES, DIVISION OF OIL AND GAS  
 COMPILED BY O.D. SMITH, CARTOGRAPHER

TOWNSHIP 102N 24

SECTION 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20



B E A U F O R T S E A



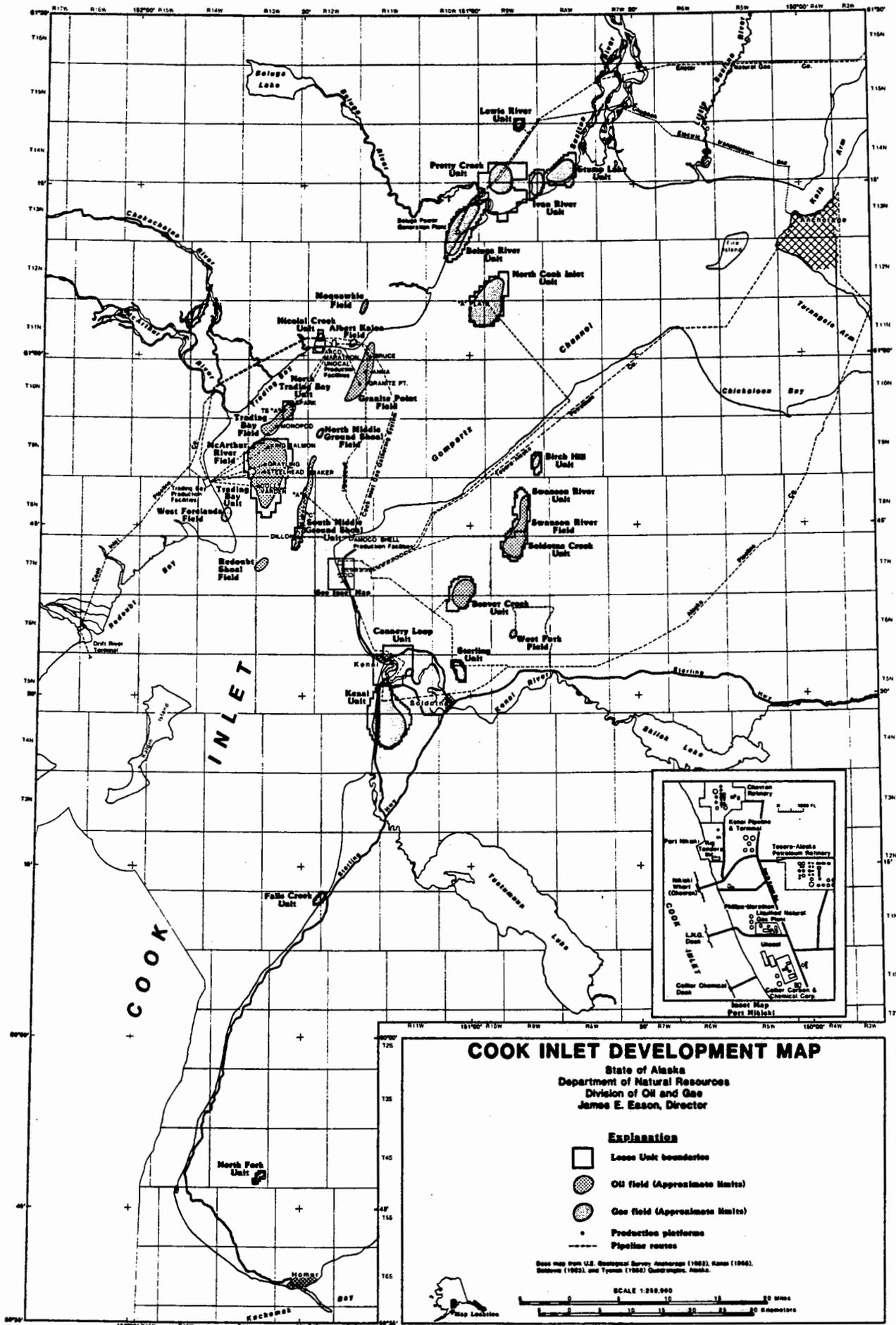
## EXPLANATION

- |  |                                  |  |                                    |  |                         |
|--|----------------------------------|--|------------------------------------|--|-------------------------|
|  | Pump Station #1                  |  | PS-1                               |  | Net Profit Share Leases |
|  | Central Production Facility      |  | CFP                                |  | Central Facilities Pad  |
|  | Selected State Exploratory Wells |  | Selected Federal Exploratory Wells |  | Libburne Reservoir      |
|  | Endfoot Reservoir                |  | Oil and Gas Unit Boundaries        |  |                         |
|  | Development Oil Wells            |  |                                    |  |                         |

BASE MAP : Transferred from S.T.M. Projection by U.S.G.S., Original Scale 1:250,000, 4th Township - Unit Boundaries.



12/89





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## **APPENDIX G**

### **ACKNOWLEDGEMENTS**

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This document was prepared by the staff of the State of Alaska, Department of Natural Resources, Division of Oil and Gas:

- **James Eason, Director**
- **Bill Van Dyke, Petroleum Manager**
- **Dick Beasley, Geologist and Principal Document Editor**
- **Ed Phillips, Petroleum Economist**
- **Roberta Keith, Secretary**
- **Mike Prichard, Cartographer**
- **Dan Smith, Cartographer**
- **Ed Park, Auditor**

The consumption forecast was prepared by the Institute of Social and Economic Research, University of Alaska, Anchorage:

- **Scott Goldsmith, Associate Professor of Economics**

