

**STATE OF ALASKA  
OIL AND GAS CONSERVATION COMMISSION  
333 West 7<sup>th</sup> Avenue, Suite 100  
Anchorage Alaska 99501**

Re:    **The APPLICATION OF CONO-**            )    **Area Injection Order No. 18B**  
      **COPHILLIPS ALASKA Inc.**            )    Colville River Field  
      ("CPAI") for an amendment of Area    )    Colville River Unit  
      Injection Order No. 18A to expand the   )    Alpine Oil Pool  
      enhanced oil recovery project in the    )    )  
      Alpine Oil Pool, Colville River Field,   )    October 7, 2004  
      North Slope, Alaska.                 )    )

**IT APPEARING THAT:**

1. By application dated July 22, 2004, ConocoPhillips Alaska, Inc. ("CPAI") requested authorization from the Alaska Oil and Gas Conservation Commission ("Commission") to expand the affected area to inject fluids for the purposes of enhanced oil recovery from the Alpine Oil Pool.
2. Notice of opportunity for public hearing was published in the Anchorage Daily News on July 30, 2004.
3. The Commission did not receive a protest or a request for a public hearing.

**FINDINGS:**

1. Commission regulation 20 AAC 25.460 provides authority to issue an order governing underground injection of fluids on an area basis for all wells within the same field, facility site, reservoir, project, or similar area.
2. The Commission issued Disposal Injection Order No. 18 ("DIO 18") on April 19, 1999 and Area Injection Order No. 18 ("AIO 18") on January 24, 2000.
3. Area Injection Order No. 18A ("AIO 18A") dated April 18, 2000, amended AIO 18 and incorporated DIO 18 into AIO 18A to provide disposal on an area wide basis. The findings, conclusions and administrative records for AIO 18 and DIO 18 were adopted by reference and incorporated into AIO 18A.
4. The Alpine Oil Pool ("AOP") is located in the Colville River Delta area on Alaska's North Slope.
5. CPAI is the only operator of all wells within one-quarter mile of the area proposed for disposal. The State of Alaska and Kuukpik Corporation are the surface owners.
6. CPAI has applied to expand the affected area of the AOP as defined in AIO 18. The expansion area includes Sections 25 and 36 of Township 12N Range 3E, Umiat Meridian

("UM") and Sections 20, 21, 22, 23, 27, 28, 29, 30, 31, and 32 of Township 12N Range 4E, UM.

7. CPAI anticipates drilling up to six development wells (producers and injectors) to develop an additional 31 to 55 million barrels of original oil in place ("OOIP") in the expansion area of the Alpine Oil Pool. OOIP for the AOP was estimated at 650 to 750 million barrels of oil.
8. Minimum values of formation water salinity in the Colville Delta Area, determined using standard openhole wellbore geophysical methods calibrated to water samples collected from drill stem and production testing, range from 15,000 to 24,000 milligrams per liter ("mg/l") total dissolved solids ("TDS").
9. The Alpine Oil Pool is contained within the Alpine Sandstone, an Upper Jurassic-aged, informal member of the Kingak Formation. It is the stratigraphically highest sandstone within the Kingak Formation in the Colville Delta area. The interval is approximately 7,000 feet below sea level and net sand thickness ranges from 0 to 120 feet. Sand thickness in the expansion area is expected to range from 0 to 30 feet.
10. The Alpine Sandstone consists of very fine to fine-grained, moderate to well sorted, burrowed, quartzose sandstone with variable glauconite and clay content. Core porosity and permeability ranges are 15% to 23% and 1 to 160 millidarcies, respectively (CO 443 finding 8).
11. Approximately 70 to 120 vertical feet of ductile shale in the Miluveach Formation overlie the Alpine Sandstone. The vertical thickness of this shale is controlled by the Lower Cretaceous Unconformity. Core and log analyses indicate the parting pressure of the Miluveach shale is 600 to 700 pounds per square inch ("psi") greater than the Alpine Sandstone.
12. The Alpine Sandstone is underlain by a thick shale interval assigned to the Upper Kingak Formation. Petrophysical analysis indicates the parting pressure of these shales is 700 to 800 psi greater than the Alpine sandstone.
13. Bottom-hole injection pressures are expected to exceed the Alpine formation parting pressure during normal operations. Rock mechanics and fracture analysis indicate that competent confining strata above and below the Alpine Sandstone will confine injected fluids within the Alpine formation (AIO 18, Finding 10).
14. Alpine Pool crude oil gravity is 40 degree API, solution gas-oil ratio is 850 scf/stb, bubble point is 2,454 psi, and viscosity is 0.46 centipoise. Initial reservoir pressure was 3,215 psi at 7,000 feet true vertical depth subsea ("TVDs"), and average reservoir temperature is 160 degrees F.
15. Alpine crude oil properties create favorable reservoir water-oil mobility ratio that enhances areal and vertical waterflood sweep efficiency. Core flood studies showed residual oil saturation may be expected to range from 35 to 40% of the OOIP after a waterflood.
16. Estimated high residual oil saturation after waterflood provided incentive to study the feasibility of a tertiary enhanced recovery process.
17. A miscible water-alternating-gas ("MWAG") project began concurrently with initial pool production to maximize recovery and to avoid relative permeability-related reduction of productivity and injectivity that is expected after water breakthrough.

18. Fine-grid compositional reservoir simulations of the MWAG process indicate incremental recovery of 10 to 12% OOIP or approximately 100 million barrels over primary (AIO 18, Finding 15). Surveillance combined with numerical simulation suggests incremental EOR recovery of 10 to 15 % of OOIP. Ultimate recovery could approach 65% with EOR.
19. Current average reservoir pressure is about 3,020 psia at 7,000' TVDss, which is significantly above the reservoir bubble point pressure of 2,454 psi.
20. Miscible injectant ("MI") is manufactured from Alpine Pool associated gas and enriching liquids recovered from fuel gas to ensure a minimum miscibility pressure of 2900 psi. To date, MI slug volume injected is approximately 21 % of hydrocarbon pore volume at Pad CD1 and 6% at Pad CD2. Total MI slug volume injected is expected to be 25 to 30% of pattern hydrocarbon pore volume.
21. Maximum MI injection pressures attainable at the plant discharge are 4,500 psi. Maximum well-head pressures vary from 3,600 to 4,300 psi (AIO 18, Finding 25). Maximum water injection pump discharge pressure is 3,500 psi (AIO 18, Finding 26). Wellhead Injection pressure varies considerably from well to well based on local reservoir pressure, faults and fracturing within the Alpine Sandstone. Wellhead pressures for MI injection currently vary from 2,200 to 3,500 psi. Wellhead pressures for water injection currently vary from 600 to 1,800 psi.
22. Injection water sources are Beaufort Sea water and produced water from the Alpine Oil Pool.
23. Produced fluids that are not compatible with the Alpine Sandstone are disposed in Colville River Unit Well WD-2, as described in Disposal Injection Order No. 18 (AIO 18, Finding 23). Produced fluids are also disposed in CD1-19A.
24. Injection well mechanical integrity conforms to 20 AAC 25.412, and tubing-casing annulus pressures of injection wells are monitored in conformance with the requirements of 20 AAC 25.402 (d) & (e) to ensure there is no leakage and that casing pressure remains less than 70% of minimum yield strength of the casing.
25. The Commission issued Disposal Injection Order No. 18 for well WD-02. The well is currently operating as a Class I well under EPA UIC Area Permit AK-11003-A (AIO 18A, Finding 6).
26. EPA UIC Area Permit AK-11003-A Part II.A.3 prohibits the drilling of offsetting wells into or below the arresting zone (lower Kingak) within the ¼ mile radius area of review unless directed by EPA (AIO 18A, Finding 7).
27. The only wellbores penetrating the disposal interval will be those wellbores intended for disposal purposes. Since these wellbores will be fully cemented across both the injection and confining intervals, there are no past, present or planned penetrations of this interval that could provide communication channels to shallower intervals (AIO 18A, Finding 10).
28. As of July 31, 2004, 231,301 barrels of oil field waste fluids have been disposed through the CD1-19A well into the Sadlerochit Formation, and 447,950 barrels of produced water have been injected into the Alpine Sandstone at Pad CD1.
29. Current practice suggests an ongoing disposal volume of approximately 30,000 bbl/year into the Sadlerochit Formation over an anticipated thirty-year field life, depending on development drilling activity and well work.

30. CPAI disposes of oil field waste fluids that include drill cuttings and fluids, completion, workover and stimulation fluids, frac sand, produced water, crude oil, production vessel sludge/sand, natural gas liquids, rig wash and well cellar fluids, diesel/methanol used as freeze protectant, plant upset fluids, snowmelt, and any fresh or seawater necessary to enable disposal.
31. Daily disposal injection volumes into the CD1-19A well do not exceed 2,500 barrels. Currently, maximum injection pressures range from 3,450 and 3,500 psig at rates ranging from 1.2 to 3.5 barrels per minute. Perforation plugging and fill accumulation affects injection pressure. Periodic cleanout and re-perforation is necessary.
32. CPAI demonstrates the mechanical integrity of injection wells as specified in 20 AAC 25.412 prior to initiating injection operations.
33. The operator has complied with the requirements of 20 AAC 25.402 (d) & (e) to monitor tubing-casing annulus pressures of injection wells periodically during injection operations to ensure there is no leakage and that casing pressure remains less than 70% of minimum yield strength of the casing.
34. All existing wells drilled within the proposed project area have been constructed in accordance with 20 AAC 25.030. All wells abandoned in the proposed project area have been abandoned in accordance with 20 AAC 25.105 and 20 AAC 25.112 or an equivalent precursor regulation.

## **CONCLUSIONS:**

1. The application requirements of 20 AAC 25.402 have been met.
2. An amended Area Injection Order is appropriate for the expanded Alpine Oil Pool area in Sections 20, 21, 22, 23, 28, 29, 30, 31, and 32 of Township 12N, Range 4E, UM and Sections 25 and 36 of Township 12N, Range 3E, UM in accordance with 20 AAC 25.460. Section 27 of Township 12N, Range 4E, UM was included in the original affected area of AIO 18.
3. No underground sources of drinking water (“USDW’s”) exist beneath the permafrost in the Colville River Unit area.
4. Enhanced recovery and disposal injection operations are conducted in permeable strata, which reasonably can be expected to accept injected fluids at pressures less than the fracture pressure of the confining strata.
5. The proposed Alpine tertiary enhanced oil recovery project is expected to recover significantly more oil than a waterflood project.
6. Ample confining shale exists above and below the Alpine Oil Pool to assure containment of the injected fluids within the Alpine Sandstone.
7. Enhanced recovery injection fluids consist of water and miscible gas. MWAG was implemented at startup to maximize ultimate recovery.

8. Class II disposal injection is, and will continue to be, limited to produced water and oil field wastes that the Commission determines are suitable for disposal in a Class II well.
9. Class I industrial waste disposal injection is, and will continue to be, in accord with EPA UIC Area Permit AK-1I003-A.
10. No wells may be drilled into or below the arresting zone (lower Kingak) within the ¼ mile radius area of review of well WD-02 under EPA permit AK-1I003-A.
11. Well mechanical integrity is demonstrated in accordance with 20 AAC 25.412 prior to initiation of injection or disposal operations.
12. The mechanical integrity of each injection well will be tested at least every four years after an initial test. Wells used for grind and inject purposes must be tested every two years.
13. Tubing-casing annulus pressure and injection rates are monitored at least weekly for surveillance of operational conditions.
14. An amendment to Area Injection Order 18A to expand the project area will not cause waste nor jeopardize correlative rights.

**NOW, THEREFORE, IT IS ORDERED** that:

This Area Injection Order supersedes AIO 18A dated April 18, 2000, and AIO 18 dated January 24, 2000. The findings, conclusions and administrative record for AIO's 18 and 18A are adopted by reference and incorporated in this decision so far as they do not conflict with the findings of this order. The following rules, in addition to statewide requirements under 20 AAC 25, to the extent not superseded by these rules, apply to the Alpine Oil Pool within the following affected area:

**UMIAT MERIDIAN**

T11N R4E Section 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27.

T11N R5E Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 29, and 30.

T12N R3E Sections 25, 36.

T12N R4E Sections 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 and 36.

T12N R5E Sections 13, 14, 15, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 and 36.

**Rule 1 Authorized Injection Strata for Enhanced Recovery (Restated from AIO 18A)**

Within the affected area, fluids may be injected for purposes of pressure maintenance and enhanced recovery into strata that are common to and correlate with the interval between the measured depths of 6,876 and 6,976 feet in the Bergschrund No. 1 well.

**Rule 2 Authorized Injection Strata for Disposal (Restated from AIO 18A)**

Within the affected area, Class II fluids may be injected for purposes of disposal into strata that are common to and correlate with the interval between the measured depths of 8,432 and 9,540 feet in the Sohio Alaska Petroleum Company Nechelik No. 1 well.

**Rule 3 Fluid Injection Wells (Restated from AIO 18A)**

The underground injection of fluids must be through a well permitted for drilling as a service well for injection in conformance with 20 AAC 25.005 or through a well approved for conversion to a service well for injection in conformance with 20 AAC 25.280.

**Rule 4 Monitoring the Tubing-Casing Annulus Pressure Variations (Restated from AIO 18A)**

The tubing-casing annulus pressure and injection rate of each injection well must be checked at least weekly to ensure there is no leakage and that it does not exceed a pressure that will subject the casing to a hoop stress greater than 70% of the casing's minimum yield strength.

**Rule 5 Reporting the Tubing-Casing Annulus Pressure Variations (Restated from AIO 18A)**

Tubing-casing annulus pressure variations between consecutive observations need not be reported to the Commission unless well integrity failure is indicated as in Rule 7 below.

**Rule 6 Demonstration of Tubing/Casing Annulus Mechanical Integrity**

The mechanical integrity of an injection well must be demonstrated before injection begins, after a work-over affecting mechanical integrity, and at least once every 4 years while actively injecting. For slurry injection wells, the tubing/casing annulus must be tested for mechanical integrity every 2 years. The MIT surface pressure must be 1500 psi or 0.25 psi/ft multiplied by the vertical depth, whichever is greater, must show stabilizing pressure and may not change more than 10% during a 30 minute period. Any alternate means of demonstrating mechanical integrity must be approved by the Commission. The Commission must be notified at least 24 hours in advance to enable a representative to witness pressure tests.

**Rule 7 Well Integrity Failure and Confinement**

Whenever any pressure communication, leakage or lack of injection zone isolation is indicated by injection rate, operating pressure observation, test, survey, log, or other evidence, the operator shall immediately notify the Commission and submit a plan of corrective action on a Form 10-403 for Commission approval. The operator shall immediately shut in the well if continued operation would be unsafe or would threaten contamination of freshwater, or if so directed by the Commission. A monthly report of daily tubing and casing annuli pressures and injection rates must be provided to the Commission for all injection wells indicating well integrity failure or lack of injection zone isolation.

**Rule 8 Plugging and Abandonment of Injection Wells (Restated from AIO 18A)**

An injection well located within the affected area must not be plugged or abandoned unless approved by the Commission in accordance with 20 AAC 25.105.

**Rule 9 Surveillance (Modified from AIO 18A)**

For grind and inject slurry injection wells, a baseline temperature survey from surface to total depth, initial step rate test to pressure equal or exceeding maximum injection pressure and pressure falloff are required prior to sustained disposal injection. Regular fill depth tags are required at least once annually or as warranted following consultation with the Commission. Operating parameters including disposal rate, pressure, annuli pressures and volume of slurry pumped must be monitored and reported according to the requirements of 20 AAC 25.432.

For slurry injection wells, an annual performance report will be required including rate and pressure performance, surveillance logging, fill depth, survey results, and volumetric analysis of the disposal storage volume, estimate of fracture growth, if any, and updates of operational plans. Report submission must be on or before April 1, in conjunction with the Alpine Pool Annual Reservoir Report.

**Rule 10 Notification (Restated from AIO 18A)**

The operator must notify the Commission if it learns of any improper Class II injection. Additionally, notification requirements of any other State or Federal agency remain the operators' responsibility.

**Rule 11 Administrative Actions**

Unless notice and public hearing is otherwise required, the Commission may administratively waive or amend any rule stated above as long as the change does not promote waste or jeopardize correlative rights, is based on sound engineering and geoscience principles, and will not result in fluid movement outside of the authorized injection zone.

**DONE** at Anchorage, Alaska and October 7, 2004.

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John K. Norman, Chairman  
Alaska Oil and Gas Conservation Commission

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Daniel T. Seamount Jr., Commissioner  
Alaska Oil and Gas Conservation Commission

AS 31.05.080 provides that within 20 days after receipt of written notice of the entry of an order, a person affected by it may file with the Commission an application for rehearing. A request for rehearing must be received by 4:30 PM on the 23rd day following the date of the order, or next working day if a holiday or weekend, to be timely filed. The Commission shall grant or refuse the application in whole or in part within 10 days. The Commission can refuse an application by not acting on it within the 10-day period. An affected person has 30 days from the date the Commission refuses the application or mails (or otherwise distributes) an order upon rehearing, both being the final order of the Commission, to appeal the decision to Superior Court. Where a request for rehearing is denied by nonaction of the Commission, the 30-day period for appeal to Superior Court runs from the date on which the request is deemed denied (i.e., 10th day after the application for rehearing was filed).