AFS POLICY STATEMENT #12:
CONSTRUCTION AND OPERATION OF OIL AND GAS PIPELINES

A. ISSUE DEFINITION

Transportation of oil and gas in North America is a vast operation with pipelines reaching virtually to every corner of the continent. Oil and gas may be transported from the field to process plants-to storage areas-to consumers in a system covering thousands of miles. For the most part, this network involves large diameter pipes. For example, gas-transmission pipelines are made of high-strength steel, generally 12 to 48 inches in diameter, and operate at pressures of 500 to 1,500 psi (Carter et al. 1982).

With improved technology, longer oil and gas transmission pipelines become feasible. The Northern Tier Pipeline proposed to transport Alaskan oil from Port Angeles (Washington) to Clearbrook (Minnesota) would have been 1,491 miles long. In Montana alone, the pipeline would have crossed 150 streams with comparable numbers of stream crossings in Washington, Idaho, North Dakota, and Minnesota. As the scale of these interstate projects has increased, so has regulatory involvement. In March 1976, the Northern Border Pipeline Company (gas) funded a study to explore permitting requirements. The study team concluded that 72,000 permit applications would be required and that the company would need to satisfy 14 federal agencies and 409 states, counties, and townships (Carter et al. 1982) to complete the pipeline between Fort Morgan, Montana and Ventura, Iowa.

Impacts from oil and gas pipelines potentially occur during construction and during operation with the type of impact different in each. During construction, typical impacts are related to clearing the pipeline right-of-way (ROW), constructing access roads, and laying the pipeline. The extent of damage depends, for example, on use of erosion control techniques, number of stream crossings, climate, and terrain. When a pipeline crosses a stream there can be biological and engineering problems. For example, the El Paso Pipeline (gas) crossing beneath the Santa Cruz River in Arizona was designed to withstand, but was severely damaged by flooding associated with a 100-year rainfall event. This pipeline was replaced by a pipe-suspension bridge.

Impacts during pre-operational testing and operation are associated not only with spills but also with maintenance of the ROWs. Cleared ROWs can continue to be a source of sedimentation. Petroleum spilled during construction of the Trans-Alaska Pipeline was estimated to be 535,000 gallons (Olson-Elliot and Associates 1979). Five oil spills occurred in the first months of operation of the Trans-Alaska Pipeline, two of which resulted in losses of 12,000 and 15,000 barrels (Montana Department of Natural Resources and Conservation 1979). On a national average, new pipelines have an annual spill frequency from all causes of 0.0022 spills per mile (U.S. Department of Interior 1979) or about one spill for every 455 miles of pipeline.

Because of the magnitude of pipeline projects, the number of waterways involved, the high quality of fishery resources in many of these waterways, and the potential for impacts to fisheries from spills or construction activities, safeguards must be adopted to protect these important resources.

B. **IMPACTS ON HABITAT**

Channel Alterations
Fishery habitat may be adversely affected by sedimentation from pipeline construction. Sedimentation

can occur from (1) trenching to lay pipeline beneath the stream channel, (2) runoff at construction sites, (3) erosion resulting from construction of culverts, roads, bridges, or fords, and (4) hydrostatic testing. Additionally, silt or sand deposition can fill interstices in gravel and reduce water flow through substrate. Equipment operating in the stream can compact substrate, create sediment, and eliminate spawning habitat.

Streambank alterations where pipelines parallel or cross the stream channel can result in increased water velocity, increased erosion upstream (degradation), deposition of sediment downstream (aggradation), shortened stream length, and migrating stream channel. Additionally, vegetation removed from streambanks can change temperature regimes, and blasting can adversely alter stream habitat.

Accidental Spills
Oil spilled during pre-operational testing and operation causes short- and long-term impacts to fish spawning habitat and invertebrate attachment sites. In addition to spills from the pipeline, oil or oil products can leak from construction equipment, broken hydraulic or fuel lines, ruptured storage tanks, overturned equipment, fuel hauling trucks, defective fuel bladders, and improperly disposed of waste oil containers.

Petroleum spilled directly into the aquatic environment immediately begins to undergo physical and chemical modifications. Changes include formation and dispersion of slicks on the water surface, evaporation of volatile components, dissolution of soluble components into the water beneath the slick, emulsification of fine petroleum particles into the water column by turbulent mixing, adsorption of petroleum onto particles and organisms, and photochemical modifications (Malins 1977).

Fish Passage
Temporary dams, diversions, or flumes constructed at pipeline stream crossings impede fish passage. Long-term blockage has resulted from inadequately sized drainage structures (resulting in excessive water velocities) or from gravels accumulated from poorly stabilized stream crossings.

Ancillary Development
Pipelines may stimulate development creating additional demands on aquatic resources and on water supplies. Refineries may be built or expanded and industries which consume oil or gas products may develop. For example, two coal gasification plants that would connect to the Northern Border Pipeline already have been proposed in northeastern Montana (Montana Department of Natural Resources and Conservation 1980). In northern Canada, a pipeline may result in construction of a new highway.

Construction of oil and gas pipelines and spin-off development may reduce the aesthetic quality of streams. Riprap, vegetation removed from ROWs and disturbed banks at trenched crossings, reduces aesthetic quality. Cleared ROWs and access roads adjacent to streams interrupt natural vegetation, provide increased vehicular access to streams, and increase need for bank stabilization structures. Bridges, pump stations, delivery facilities, and electric lines further reduce aesthetics of the fishing experience if within view of streams.

C. EFFECTS ON BIOTA

oil
Oil interferes with vital functions of many aquatic organisms. Free oil and emulsions can cover epithelial surfaces of aquatic animals and interfere with respiration. Sublethal effects of petroleum

are largely unquantified; however, many aquatic organisms are known to display adverse responses to petroleum components at levels 100-1,000 times lower than acutely toxic concentrations (i.e., in the parts-per-billion range), In plants, both respiration and photosynthesis can be inhibited. Oily substances can coat and destroy benthic organisms. Even very low oil concentrations can taint fish flesh.

Other Toxic Materials
Fish and other aquatic organisms can be killed by compounds used during pipeline construction and testing. Hydraulic fluid, rust, and bacteriacides used during construction and cleaning may be washed into streams. Antifreeze, alcohol, or heated water added to the pipe to prevent freezing also can reach natural waters and adversely impact aquatic resources. Aquatic organisms can be impacted by depressed oxygen levels caused by decomposition of oil or organic matter (from spills). Reoxygenation by aquatic plants (McKee 1956) also can be retarded.

Silt
Increased sediment in lakes or streams reduces light penetration and decreases primary production. Heavy loads of silt can cause direct mortality of aquatic plants, macroinvertebrates, and fish (Rulifson 1979). Silt can fill gravel interstices, reduce water flow through the gravel, cause declines in benthic production, and increase mortality of fish eggs or larvae. Heavy sediment loads on stream and lake bottoms can prevent successful reproduction of fishes and result in unstable and unsuitable substrates for periphyton, aquatic macroinvertebrates, and macrophytes.

Blasting
Shock waves from blasting in or near a stream can kill or injure fish. Pressures of 4,050 psi killed northern pike where dynamite explosives were used. Charges of several pounds or more killed fish 200 to 400 feet away; fifty pound charges killed fish up to 1,000 feet away (Bell 1973; Wright 1982).

D. **NEEDED ACTIONS**

Planning
Prior to pipeline construction, less damaging, alternative modes of oil and gas transportation should be explored. State natural resource agencies should be involved in the preliminary pipeline planning process to prevent violations of water quality and habitat protection laws and to minimize impact of pipeline construction and operation on aquatic resources. Several states have established committees to ensure state regulations are met, and construction and maintenance are environmentally compatible. Such committees are an effective safeguard against poor planning. If a pipeline crosses state borders, an interstate coordinating committee should be established. The interstate coordinating committee could ensure uniformity of environmental regulations and possibly lessen the regulatory burden of the pipeline company. Coordinating committees and the pipeline company should establish generic siting and safeguard criteria to ensure minimal adverse impact on habitat and biota during pipeline construction and operation. For example, only specified equipment should be allowed on the streambed, spawning habitats should be avoided during construction, and service roads should be limited to specified grades and widths. All construction activities, especially erosion control, should be based on the best available technology. The coordinating committees should also develop mitigation strategies for companies to implement, (i.e., dealing with loss of wetlands or stream habitat). If, for example, stream improvement structures are prescribed, they could be installed during the construction period. Companies and the coordinating committee should conduct joint audits of degree of compliance with the siting and construction criteria. Accurate records of compliance should be maintained.

The coordinating committee and pipeline company also should develop an oil spill contingency plan.

This plan should describe company plans for containment, clean-up, and mitigation of oil spills and detail how the company maintains cleanup readiness. Further, the plan should describe measures to prevent spills and to monitor for leaks. Approved construction plans should be posted at the construction site and periodic review of construction activities should be made.

Education

During construction of the Alaska pipeline, problems resulted because some workers were uninformed about the hazards and consequences of spills and were inadequately trained to implement clean-up procedures. As a result, spills often were not reported or cleaned up. State natural resource agencies should provide information to pipeline company personnel, contractors, and the public concerning regulatory requirements, the environmental consequences of spills, and how to prevent and react to spills. For example, an educational series in a local newspaper on hazards and methods of dealing with spills may help promote more timely and effective response. Training and certification should be mandatory with certified employees assigned to each active construction site.

Enforcement

Strict federal regulations, including mandatory reporting requirements, presently govern discharge of oil to natural waters; however, enforcement is not always vigorous. A surveillance team which includes an aquatic biologist should be formed by each state to monitor compliance with state and federal laws during construction. The surveillance team should also monitor compliance with agreements reached between the state and the pipeline company such as oil spill contingency plans. *Strict enforcement* of laws and agreements which provide authority to stop construction or operation and to assess large fines, would help minimize habitat damage.

The pipeline company should be encouraged to fund or conduct research to improve construction techniques and develop monitoring devices such as improved directional drilling methods and oil spill detection instruments, and to improve techniques of erosion control, habitat restoration, enhancement of productivity at stream crossings, and restoration of wetland areas.

E. **CONCLUSION**

Construction and operation of pipelines can cause significant damage to aquatic habitats and fishery resources; however, these impacts can be substantially reduced with proper planning, education, and regulation. Society members involved with pipeline projects should seek to ensure that a good habitat protection program is established well in advance of construction initiation. The Society should continue to examine the adequacy of existing laws dealing with oil and gas pipelines and work to update and amend legislation so as to ensure protection of aquatic resources. Finally, the Society should consider forming a committee to draft an information manual on "best management practices for oil and gas pipeline construction and operation," and a directory of AFS members with expertise to assist oil and gas pipeline committees.