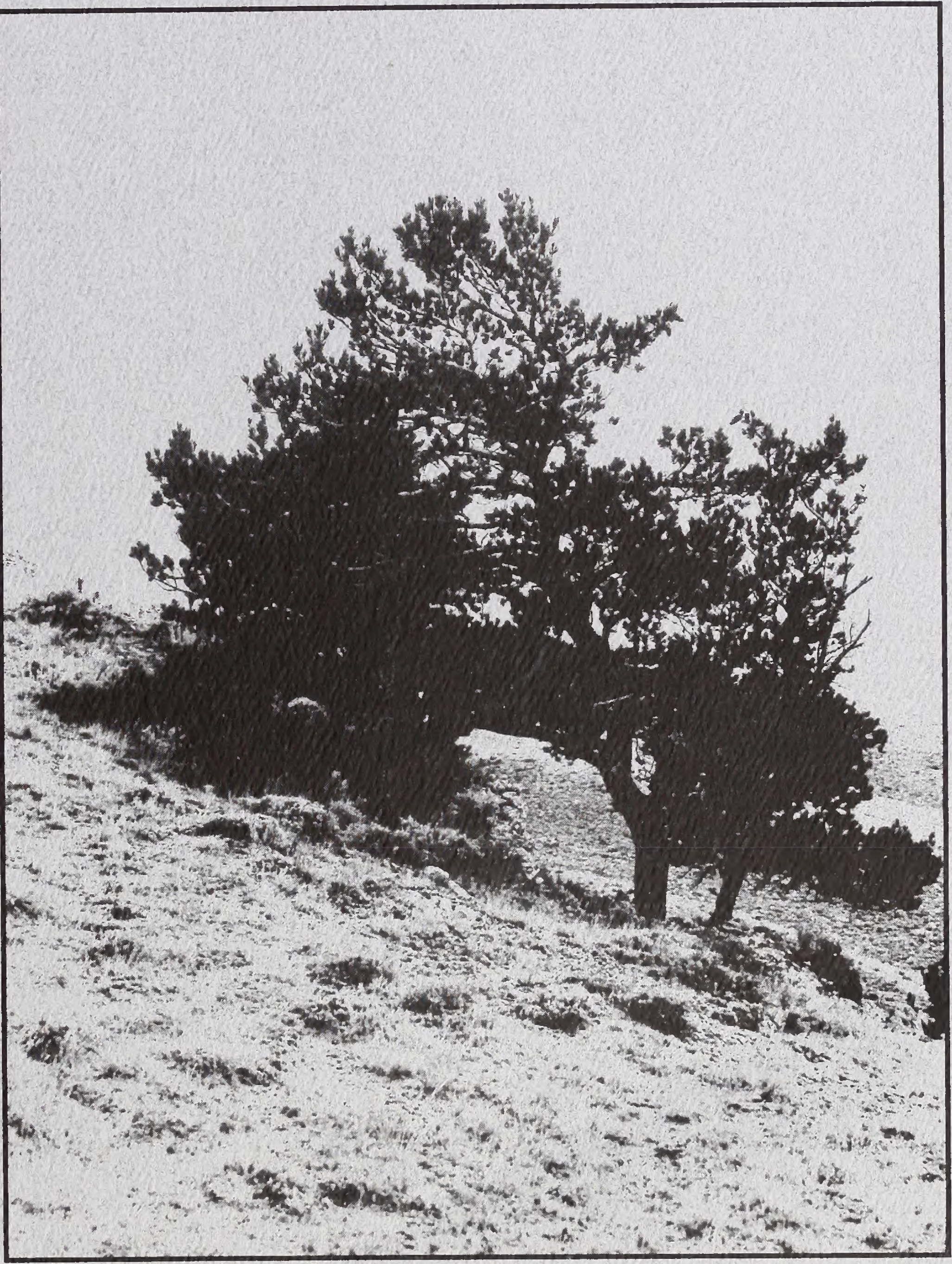
U.S. Department of the Interior
Bureau of Land Management
Worland District Office

State of Montana
Department of Environmental Quality
Energy Division

August 1995

Express Crude Oil Pipeline Draft Environmental Impact Statement



In Reply Refer To:

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(930TEnright)
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AUG 08 1995

Dear Reader:

This Draft Environmental Impact Statement (DEIS) is prepared pursuant to 40 CFR 1500 - 1508 on the proposed Express Pipeline Project and is submitted for your review and comment. The DEIS analyzes the potential impacts of a 24 inch crude oil pipeline. In the United States, the pipeline will run a total of 515 miles from Wild Horse on the Canadian border to Casper, Wyoming. Along this route, the pipeline would cross approximately 97 miles of public lands administered by the Bureau of Land Management (BLM), or the Bureau of Reclamation. The BLM must decide whether or not to issue a right-of-way for the project across these public lands. The State of Montana, Department of Environmental Quality (DEQ) is the co-lead agency with the BLM for this DEIS, in compliance with the Montana Environmental Policy Act, and the Montana Major Facility Siting Act.

If you wish to comment on the DEIS, we request that you make your comments as specific as possible. Comments will be more helpful if they include suggested changes, sources, or methodologies. Comments that contain only opinions or preferences will not receive a formal response in the Final Environmental Impact Statement (FEIS); however, they will be considered and included as part of the BLM decisionmaking process. The public comment period for this DEIS will be 60 days. Comments must be received by October 16, 1995, to be included in the FEIS. Please send written comments to either the Bureau of Land Management, Worland District Office, Attention: Don Ogaard, Project Manager, P. O. Box 119, Worland, Wyoming 82401, or the Montana Department of Environmental Quality, Attention: Art Compton, P. O. Box 202301, Helena, MT 59620.

The BLM's preferred alternative in this DEIS is Alternative 3, Proposed Action as Modified by the Wildlife Timing Limitations Alternative. We are expressing no preference at this time regarding the two route variation alternatives, Bridger Trail and South-Central Montana. These alternatives would involve substantial areas of private lands and the BLM is requesting input from the affected landowners through this DEIS. The DEQ is expressing no preference for alternatives at this time. Since much of the Montana portion crosses private lands, input from affected landowners is requested through the DEIS.

Copies of this DEIS are available for public review at the BLM District and Resource Area Offices in Havre, Lewistown, Billings, Cody, Worland, Lander, and Casper; the Montana DEQ Office in Helena; and county and city libraries along the proposed route.

Sincerely,

Mark A. Simonich
Director
Department of Environmental Quality

Alan R. Pierson
Wyoming State Director
Bureau of Land Management

EXPRESS CRUDE OIL PIPELINE PROJECT
ENVIRONMENTAL IMPACT STATEMENT

(X) DRAFT ( ) FINAL

Lead Agencies:	Department of Interior Bureau of Land Management	State of Montana Department of Environmental Quality
Cooperating Agencies:	Department of Interior Bureau of Reclamation	U.S. Army Corps of Engineers

Counties Directly Affected:

Montana: Hill, Chouteau, Fergus, Judith Basin, Wheatland, Golden Valley, Stillwater, and Carbon

Wyoming: Bighorn, Washakie, Hot Springs, Freemont, and Natrona

Environmental Impact Statement contact: Correspondence on this draft environmental impact statement should be directed to:

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Date draft environmental impact statement filed with United States Environmental Protection Agency: August 18, 1995.

Date by which comments on this draft environmental impact statement must be received to be considered in the final environmental impact statement: October 17, 1995.

ABSTRACT

Express Pipeline Inc. (Express) proposes to construct, maintain, and operate a 24-inch crude oil pipeline from the U.S.(Montana)/Canada border near Wild Horse to Casper, Wyoming. The project (the Proposed Action) would include the pipeline, five pump stations, numerous valves, and a meter station. Initially, the pipeline would be capable of transporting 172,000 barrels per day of Canadian crude oil to Casper, Wyoming. Construction is scheduled from July through October, 1996, with operations beginning by late October, 1996.

This draft environmental impact statement analyzes the environmental effects of the Express Pipeline, plus the No Action Alternative, and a Modified Action Alternative involving timing restrictions for construction across rivers and streams, construction techniques across rivers, and construction near raptor nests, key fisheries spawning habitat, and big game winter range. The BLM's preferred alternative is the Modified Action Alternative. The MDEQ is expressing no preference at present.

The Manager responsible for preparing the draft environmental impact statement is Darrell Barnes, BLM Worland District Manager.

Executive Summary

Introduction

Express Pipeline, Inc. (Express), an affiliate of Alberta Energy Company Ltd., and TransCanada Pipelines Limited, proposes to construct, operate, and maintain a 24-inch pipeline from Wild Horse (located on the border between Montana and Canada) to Casper, Wyoming (Figure S-1). Express Pipeline Ltd., another affiliate of Alberta Energy Company Ltd., and TransCanada Pipeline Limited proposes to construct, operate and maintain a 24-inch pipeline from Hardisty, Alberta to Wild Horse. These pipelines would interconnect at Wild Horse. Together, these pipelines would initially transport 172,000 barrels per day (BPD) of crude oil from the production fields in Alberta, Canada to refineries in Wyoming, Colorado, Utah, Kansas, Oklahoma, Illinois, Indiana, Ohio, Kentucky, and Tennessee via the existing pipelines downstream of Casper. With additional pump stations, the capacity could ultimately increase to 280,000 BPD.

The pipeline would parallel other pipelines for almost its entire 515-mile length. Through most of Montana (305 miles) and for the first 120 miles in Wyoming, the pipeline would be placed immediately adjacent to the certified route for the Altamont natural gas pipeline. At Lost Cabin, Wyoming, the pipeline would deviate from Altamont's route and parallel other existing pipelines to its terminus in Casper.

Purpose of and Need for the Proposed Project

The primary purpose of the proposed pipeline is to address the requirements of refiners in the U.S., particularly in the Rocky Mountain region and the Midwest Region, and the producers of Western Canada simultaneously. The Express Pipeline would provide new sources of Canadian crude to Casper, Wyoming. Casper is an established crude oil transportation hub in the Rocky Mountain region. Historically, crude has been gathered in smaller pipeline upstream of Casper for transportation to refineries in the Rocky Mountain region or for shipment east to the Midwest. In conjunction with other pipeline, the Platte Pipeline accesses southern Wyoming, Colorado and the Midwest. Similarly, Frontier Pipeline, in conjunction with two other pipeline, provides access to refineries in Salt Lake City, Utah. These pipeline delivery networks are presently underutilized and would have capacity available to transport the volumes projected by Express.

Since 1985, the production of crude oil in the Rocky Mountain region has dropped from 628,000 BPD to about 424,000 BPD (32.5 percent). By 2015, production is projected to drop to about 201,000 BPD. Thus, by 2015 production of crude oil in this region is projected to decrease almost 70 percent from the 1985 level. Because this region has no alternative crude supplies

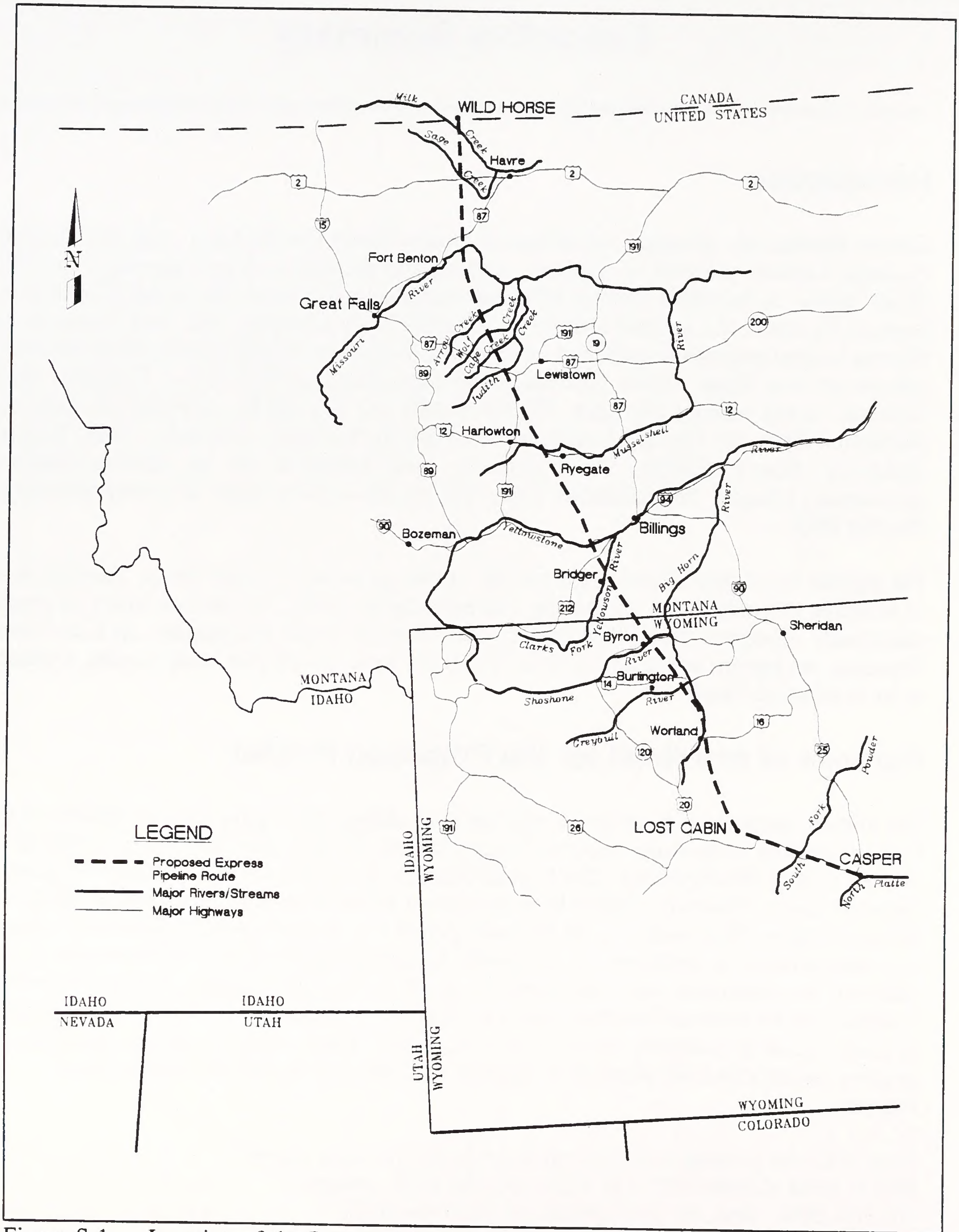

Figure S-1 Location of the Proposed Project available, Canadian crude oil via the Express Pipeline has the opportunity to satisfy the market. Demand for refined petroleum in the Rocky Mountain Region is similar now (430,000 BPD) to what it was in 1985 (432,000 BPD). In the future, demand is expected to fluctuate, but remain around 420,000 to 430,000 BPD. By 2015, demand for refined petroleum is expected to be about 427,000 BPD. Thus, the refineries in the Rocky Mountain Region need to locate supplies of crude oil elsewhere if they are to meet the region's demand for refined petroleum.

The 15 Rocky Mountain refineries have a total crude oil capacity of 503,000 BPD. The capacity of each indidividual refinery is less than 54,000 BPD. The Billings area refines mostly sour and heavy sour crude, two-thirds of which are supplied from Canada.

Two portions of the Midwest have also been considered potential markets for Canadian crude via the Express Pipeline. This region includes the states of Kentucky, and Tennessee, and the southern parts of Illinois, Indiana and Ohio. The ten refineries within this area have a total crude capacity of 1,130,000 BPD. In 1994, crude runs consisted of 1,020,000 BPD. Over two-thirds of the crude supply comes from the United States. Another Midwest region includes Kansas and Oklahoma 11 refineries having a capacity of 689,900 BPD. Since 1985, the region has shifted from a crude surplus position to a net deficit which has been satisfied by increased transfers from the West Texas region. However, transfers from West Texas are expected to decline further. As the U.S. production continues to decline, Midwest imports must increase to continue to meet the demand.

Canadian crude delivered via the Express Pipeline through the Casper Hub could be an important new supply for these regions. Production of crude in Western Canada is projected to continue at a high rate through at least 2005. In 1990, total production was 1.66 million BPD. In 1994, total production rose to 1.89 million BPD and is forecast to rise to 2.13 million BPD by 1997. Production is then projected to steadily decrease to about 1.64 million BPD by 2005. Although production of crude in Western Canada is comparatively high, domestic demand and the capacity of the area's refineries is considerably lower. Demand for crude in Western Canada is about 458,000 BPD and is expected to grow to about 478,000 BPD in 2005. The combined capacity of refineries in Western Canada to process crude will be about 487,000 BPD by 1995. Thus, between 1995 and 2005, between 1.2 and 1.4 million BPD of crude will be available for export from Western Canada.

Decisions To Be Made

Two decisions will be made based on the analysis documented in this EIS, one by the BLM and the other by the State of Montana. The BLM Worland District Manager will make the BLM decision on Express' proposal. This decision will involve one of three outcomes. First, he/she could approve Express' application for a Right-of-Way Grant as it was submitted by Express. Second, he/she could approve the Right-of-Way Grant with specific conditions of approval and mitigation measures. Third, he/she could deny the Right-of-Way Grant. If the District Manager selects an action alternative in the Record of Decision, implementation of the activities specifically identified in that alternative would begin in 1996.

The Montana Board of Environmental Review will make certain decisions based on the analysis of this EIS. The Board may only approve the alternative that minimizes the project's environmental effects when compared to the nature and economics of various alternatives. However, the Board will only make the decision on the Montana portion of the proposed project. While the two agencies will make independent decisions, the decision process will be closely coordinated between these primary lead agencies and other cooperating agencies such as the Bureau of Reclamation and the Corps of Engineers.

Alternatives Considered In Detail

Three alternatives were analyzed for this document. They include a No Action (Alternative 1), the project as originally proposed by Express (Alternative 2), and an alternative with modifications to the proposed action (Alternative 3). The modifications to the proposed action were developed in response to concerns identified during scoping. The following sections describe each of these alternatives in detail.

Alternative 1 - No Action Alternative

Under this alternative, Express would not be authorized to construct a 24-inch pipeline on public lands to transport crude oil between Wild Horse, Alberta and Casper, Wyoming. The BLM, BOR, and State of Montana would not issue the right-of-way grants or permits for the project. No physical or biological environmental impacts would occur under the No Action Alternative. However, economic effects could occur if the Express Pipeline would not be built.

If the Express Pipeline is not built, various actions may occur as refineries attempt to acquire crude oil or respond in other ways to declining crude supplies. The market responses without the Express Pipeline may include some combination of the following actions:

Accessing Alternative Crude Supplies via Other Transportation Routes

In response to declining Rocky Mountain crude production, several pipeline have announced plans for crude supply projects that would move Canadian oil into the Rocky Mountain region. Projects that may import Canadian Crude include the Cenex system, the Amoco/Conoco project on the Rangeland-Glacier system, and capacity expansion on the Wascana-Texaco-Butte system. The Cenex pipeline is under construction, although it is not known with certainty that the project will be fully permitted and reach completion on schedule. However, the pipe has been acquired and the project is beyond the "proposal" stage of development. The Amoco/Conoco and Wascana-Texaco-Butte projects are under consideration and are not scheduled for construction or seeking permits, but this activity could occur within the next 5 years.

Cenex has plans to construct a new 16-inch, 65,000 BPD line from its terminal near Cut Bank to its refinery at Laurel, Montana. The pipeline capacity could be expanded to 100,000 BPD with more pumping capacity. Once completed by the end of 1995, the facility probably would increase Canadian heavy crude imports into Billings, displacing Big Horn Basin crude volumes that currently move north into Billings, and shifting some Rangeland-Glacier crude onto the Cenex system. The volume of Canadian imports is limited by Billings area refinery capacity to handle heavy crude, the Big Horn Basin crude production volumes and Big Horn production export volumes to the Midwest. In conjunction with the Amoco/Conoco project described below, this project could open significant pipeline capacity for imports of Canadian light sweet crude to markets south of Billings.

Amoco and Conoco are considering a partnership to construct a 75-mile, 12-inch crude oil pipeline from Billings to Elk Basin, Wyoming. As part of this project, Amoco would acquire part ownership in Conoco's Glacier system from Cut Bank to Billings; and Conoco would acquire part ownership in Amoco's system from Elk Basin to Guernsey. This system could use unused capacity on Conoco's existing Glacier system (more will become available with the Cenex pipeline construction, mentioned above) to move light sweet Canadian crude through Casper and Guernsey for destinations in Utah and Colorado. The capacity of the Amoco-Conoco pipeline segment would be between 40,000 and 60,000 BPD. This pipeline segment would allow space vacated by Cenex on the Glacier pipeline to be used for crude transport to Casper and Guernsey.

Capacity on this existing route from Regina to Casper/Guernsey, could be expanded at relatively low cost. From its current 42,000 BPD capacity, the system could be expanded to 55,000 BPD by adding pumping capacity at a single station, and could be expanded to 75,000 BPD by adding an additional pumping station. However, limiting factors include Texaco pipeline capacity, which is currently at 34,000 BPD, expandable to 45,000 BPD with pumping upgrades and tankage limitations at the Regina end of the Wascana pipeline, which create scheduling problems and effectively reduce the system's capacity. The effective potential capacity increase on this system is about 10,000 BPD, enough to match incremental declines in Rocky Mountain production of light sweet crude.

Together, these projects have potential total incremental capacity to move 50,000 to 85,000 BPD of Canadian crude (or more with upgrades of the Cenex pipeline), enough to satisfy Rocky Mountain crude supply declines through the year 2002 with no Express Pipeline project, no change in refinery operations, and no change in the refined product pipeline network.

The Express Pipeline's other primary market is the Midwest. This market would be accessed by Express via Amoco or Platte pipeline connections at Casper. Faced with declining Rocky Mountain crude oil production, Midwestern refineries have several supply alternatives to Express. These include several on-going and announced pipeline projects that would add crude transport capacity from the Gulf Coast to Midwest markets. These include:

1. A crude oil pipeline reversed by Mobil from Ringgold, Oklahoma, to Corsicana, Texas. Mobile is currently reversing a major crude pipeline segment from Corsicana to

Beaumont, Texas. This will increase access of foreign waterborne crude to Midwestern markets.

2. The Seaway pipeline project which includes new pipe and the conversion of a gas pipeline to move offshore foreign crude from Freeport, Texas, to Cushing, Oklahoma. Pipe for the Seaway project has been ordered.

3. A similar project has been studied by Trunkline Gas to convert a major gas pipeline segment to transport crude oil from Lake Charles, Louisiana, to the Patoka, Illinois, pipeline hub. This project already has refineries representing several hundred thousand BPD of refining capacity as equity partners.

Additionally, Interprovincial Pipe Line might have significant excess delivery capacity to the upper Midwest should the reversal of its Sarnia-to-Ontario segment occur. That reversal would retract Interprovincial Pipe Line shipments to eastern Canada, opening a large fraction of Interprovincial Pipe Line's capacity to shipments to Midwest destinations. This reversal is expected in the short term due to competitive pressures from low cost seaborne crude oil imported via the Canadian east coast. This could increase Canadian light crude oil volumes available to Midwestern markets at a lower transportation cost to refineries than either the Express-Platte or Express-Amoco routes.

Closure of Refining Capacity or Reducing Crude Runs

Several Rocky Mountain refineries are candidates for closure based on lack of environmental upgrade investments, the type of crude they utilize (crude slates), corporate commitment and market conditions. Based on crude slates and distillate hydro treater plans, the closure candidates in the Express market area are Amoco-Salt Lake City, Phillips-Woods Cross and Total-Denver. Total, Frontier, and Conoco refineries in the Front Range face additional market pressure from the new Diamond Shamrock product pipeline. These refineries use between 25,000 to 50,000 BPD of crude each. A refinery closure would offset Rocky Mountain crude production declines. In the short term, a closure would possibly permit increased crude exports from the Rocky Mountain region to Midwestern states via the Platte and Amoco pipeline. A refinery closure would not create construction costs unless new product pipeline construction is required to meet existing product demand.

Acquiring Additional Refined Product Through Import Pipelines

Product pipeline could be built so that less crude is needed to be refined. As noted above, the incremental Rocky Mountain petroleum supply could be refined products or crude oil, where historically it's been crude oil from within region. Several product pipeline projects are expected that could change the historical equilibrium. In any case, more product imports could reduce the need for incremental crude oil supplies via Express. These projects are described briefly below.

The proposed 30,000 BPD Olympic Pipeline from Puget Sound refineries to Pasco, Washington is currently in the permitting stage. The target date for this project is summer, 1998. With this pipeline, Puget Sound product would be shipped across the Cascade Range to eastern Washington rather than up the Columbia River on barges. This pipeline would probably offset Salt Lake City product exports, which currently run on the order of 5,000 BPD. Additionally, the Chevron product pipeline segment from Pasco to Boise might be reversed in conjunction with the Olympic project, further displacing Salt Lake City exports to eastern Washington and western Idaho. In the short term, this would reduce Salt Lake City crude runs and the need for additional crude oil supplies. Over the long term, the growing Salt Lake City product market would absorb the retracted volumes.

Explorer Pipeline is expanding from Houston to Greenville (north central Texas) and increasing the capacity to transport product from Gulf Coast refineries into the Midcontinent and Midwestern market areas. This would tend to increase the availability of Midcontinent product supply to move into the Rocky Mountain market via Chase Pipeline. Chase has debottlenecked its pipeline which effectively added 25,000 BPD of capacity on the El Dorado to Denver segment. In addition to this pipeline expansion, Farmland is increasing the capacity of its refinery in Coffeyville, Kansas, from 65,000 BPD to 125,000 BPD by 1996.

The Diamond Shamrock Pipeline Segment from McKee, Texas to Colorado Springs, Colorado with Planned Expansion to Denver, Colorado is expected to be completed in fall, 1995. In the short term, Diamond Shamrock import supply into the Rocky Mountain market could be limited to product volumes retracted from the Dallas market (EAI 1995). The gasoline retraction volume level is approximately 12,000 to 14,000 BPD. This source will likely place competitive pressure on Colorado Front Range prices, reduce refinery margins, and might eventually accelerate refinery closures.

The interregional product pipeline currently being built in the Colorado Front Range area would have the most impact on the Express pipeline market. Taken together, they comprise about 30,000 to 35,000 BPD of excess product pipeline capacity into the Colorado Front Range area, where product demand is currently about 85,000 BPD. It is likely that incremental product demand in that area will be met with incremental product rather than crude oil.

Retraction of Refined Products from Export Pipelines so Less Crude is Needed

With product demand growth and refinery closures, refined product pipeline exports out of the Rocky Mountain region have been retracted. This has been occurring on the Chevron pipeline from Boise to Pasco, the Cheyenne pipeline from Cheyenne to North Platte, and the Wyco pipeline from Casper to Rapid City. Salt Lake City and Colorado Front Range area refiners are faced with direct competition from low cost refined product sources outside of the region. Movement of low cost imports via the proposed Olympic pipeline from Puget Sound to Pasco into the export market for Salt Lake City refineries could force retraction of Salt Lake City exports. Ultimately, Salt Lake City refiners could retract exports from Idaho, Washington and Nevada. Such retractions would lead to reduced crude runs, and possible refinery closures, thus decreasing the demand for Rocky Mountain crude oil supplies. Competitive pressures from product imports could exacerbate the problems of the refineries mentioned above and force refinery closures. Proposed product pipeline projects by Chase and Diamond Shamrock could force closure of refineries in the Colorado Front Range area. Product volumes from closed Colorado Front Range refineries could be made up via Chase, Phillips and Diamond Shamrock product pipeline. These retractions would delay the need for more crude oil delivery capacity via Express.

Action Alternatives

The two action alternatives, Alternatives 2 and 3, considered in detail have many features in common. Overall, they involve the construction, operation, and maintenance of a pipeline and ancillary facilities between Wild Horse and Casper. To minimize repetition among the descriptions of these alternatives, features common to all action alternatives are described first. The specific descriptions of the alternatives focus on differences among the alternatives).

Pipeline and Ancillary Facilities

The pipeline system would be 515 miles and include, five pump stations, a meter station, communication system, appurtenances, pig launchers and receivers, test leads, mainline sectionalizing valves and check valves. The pipeline would be 24 inches in diameter, operate at a maximum pressure of 1220 psig, and buried throughout its entire length.

The pump stations would be distributed along the length of the pipeline, initially three in Montana and two in Wyoming. The proposed pump stations would be located at Eagle Buttes, MT, Mile Post (MP) 81; Straw, MT, MP 157; Edgar, MT, MP 266; Greybull, WY, MP 354; and Kirby Creek, WY MP 413. All the pump stations would be equipped with variable-speed electric, motor-driven pumps to minimize noise and eliminate air emissions. Power for the pump stations would be provided by the Montana Power Corporation in Montana and the Pacific Power Company in Wyoming. The initial five stations would enable the pipeline system to pump a maximum of 172,000 barrels per day (BPD).

As part of the project, a communications system would be developed, constructed, and controlled from a central control facility in Sherwood Park, Alberta. This system would be developed as part of the overall pipeline system control. Communications, supervisory control and data acquisition (SCADA) would be accomplished through a microwave, satellite or land-based communications system. A satellite-based communications system will be evaluated. The system also would be augmented by local VHF radio systems interfacing with the primary system. The communications system would provide full control over the pipeline's operation, including certain valves, pump stations, and metering station.

Sectionalizing valves would be located with a maximum spacing of 25 miles, at upstream locations of all perennial rivers and stream, and in accordance with DOT regulations. Other valves would be installed at environmentally-sensitive locations and at locations otherwise determined to be appropriate by agencies. Additionally, block valves would be installed in locations appropriate for terrain features and in areas where activities pose a risk to external damage to the pipeline. Additional valve placement may be necessary to mitigate potential spills in sensitive areas. Depending upon actual location, it may be necessary to construct permanent roads for access to the sectionalizing valves.

Timing of Construction

Express proposes to begin construction of the pipeline in early July 1996. Construction of the pump stations should begin in April 1996. Construction is scheduled to be completed by October, 1996, and the pipeline should be commissioned and operating by the end of October 1996. Construction would occur using five mainline construction spreads each employing approximately 400 people of which 21 percent would be locally hired. Another 30 people would be needed to construct each pump station.

Construction

The process of constructing the pipeline would include five primary phases, which are preparation of the right-of-way for construction, installation of the pipeline, restoration of the right-of-way, testing of the pipeline, and commissioning of the pipeline. Installation of the pipeline would involve excavating a trench, stringing, bending, and welding the pipe, lowering in the pipe in the trench, and backfilling the trench. In addition, some sections of the pipeline would be installed using conventional and directional boring. The Missouri River crossing would be constructed using directional drilling techniques. All other river and stream crossings would use the trenching technique. Each construction phase is described in detail in Chapter 2 of the EIS.

Permanent and Temporary Access Roads

Primary access for construction crews would be public roads and the right-of-way. Temporary access roads may be required in certain areas to minimize travel time between supply points or in areas where natural environmental features, such as a number of stream crossings or steep slopes, make extensive travel along the right-of-way impractical. Permanent access roads would be required to access the pump stations and possibly at the locations of selected sectionalizing valves. The locations of permanent and temporary access roads would be determined during the detailed design phase of the project.

Operation, Maintenance, and Safety

Express would operate and maintain the pipeline in accordance with standard procedures designed to ensure the integrity of the pipeline system. The pipeline and associated facilities would be designed for a minimum operating life of 25 years. However, under the proposed design, the system could physically continue to operate safely for much longer.

Operation

Express would operate the pipeline in a batched mode to transport various types of crude oil. The sizes of the segregated crude batches would vary from 50,000 to 140,000 barrels of oil per batch. Express would operate the pipeline remotely from a central operations and control center located in Sherwood Park, near Edmonton, Alberta. Personnel stationed at the center would continuously monitor and control the flow of crude oil through the pipeline, monitor and control the operation of all pump stations and other critical facilities, and monitor for leaks from the pipeline. In case of emergency, personnel at the control center can remotely shut down pump stations and dispatch personnel to determine any necessary action.

Maintenance

Maintenance activities would include inspecting project facilities periodically, repairing or replacing equipment, and remediating problems with the right-of-way or project facilities. At a minimum, inspections would include patrolling the right-of-way weekly by aircraft, surveying the pipeline's cathodic protection annually, and conducting an internal inspection of the pipeline periodically. In addition, all valves and valve actuators would be inspected semi-annually, operated, and lubricated.

Safety

In compliance with Part 195, Express would develop a written operation and maintenance plan for the pipeline. The plan would be designed to monitor and maintain the operational integrity and reliability of the system to thus ensure a high degree of safety. Periodic aerial inspections, annual cathodic protection surveys and internal pipeline inspections would be conducted to monitor for undetected leaks, corrosion, potential effects from any nearby construction or excavation activities, and any other factors that may threaten the pipeline's integrity and pose a threat to public safety.

In addition, Express would develop an emergency response and contingency plan for operating the pipeline system. This plan would be developed to include and inform local fire, police and disaster services departments as to procedures necessary in the event of a pipeline emergency. The written plan would comply with all federal requirements and provide information such as:

- classification of events that require response;
- effective response to various types of emergencies, including oil spills, explosions, fires and natural disasters;

- communication and coordination with authorities and public officials during emergencies;
- technical data;
- personnel availability in response to emergencies;
- emergency equipment and supply sources;
- evacuation procedures; and
- emergency shutdown procedures.

Alternative 3 - Proposed Action with Modifications

This alternative was developed in response to issues raised during the scoping and the agencies' review of Express' proposal and consists of variations to the proposed action. Because these variations were individually too small to be considered separate alternatives, they were combined into one alternative. The variations comprising this alternative include minor deviations to the proposed route; different methods of construction such as boring under the Yellowstone River rather than trenching; timing restrictions to lessen potential impacts to wildlife, especially active raptor nests, key brown trout spawning habitat and big game winter range; crossing all perennial streams at the time of low flow, and applying casing pipe over the main pipe at all perennial river crossings.

Alternatives Considered But Not Given Detailed Study

Several potential alternatives were considered and dropped from detailed study for various reasons. These alternatives are listed below and the reasons they were excluded from further consideration are described.

Alternative Routes Considered

As part of the evaluation of the Express proposal, alternative route locations investigated for the Altamont pipeline project were reviewed. Three alternative entry points from Canada to the United States were considered for the Express proposal. These locations were identified during the Altamont pipeline project review process. A point of entry could occur at one of the following three locations: Monchy, located about 120 miles east of Wild Horse; Spring Lakes, located about 65 miles east of Wild Horse; or the area of Spring Lakes, located about 120 miles west of Wild Horse. The agencies have reconfirmed the earlier conclusion that the Altamont route provides an environmentally acceptable location for a pipeline. It was determined these routes would add additional length and cost without any environmental or engineering benefits.

Trenching the Missouri River Alternative

Trenching of the Missouri River was eliminated for the following reason. To comply with Montana's floodplain development regulations, the pipeline would have to be buried into an alluvial river bed. Such a trench could have substantial short-term effects on water quality and fisheries due to the greatly increased sedimentation from the construction process. Because of these anticipated impacts in a designated Wild and Scenic River with habitat for the pallid sturgeon, a fish listed under the Endangered Species Act, this alternative was dropped from further consideration.

Aerial Crossing of Perennial Streams and Rivers

Aerial pipeline crossings of waterbodies involves constructing large towers on each side of the river and multiple in stream pier sites on wide rivers and then suspending the pipeline high across the river The pipeline would be supported by a system of steel cables attached to the towers. This construction alternative was excluded from detailed consideration because of the visual impacts and security considerations. The towers and suspended pipeline would be a significant visual impact for the lifetime of the project. In contrast, visual impacts resulting from trenching across a stream or boring underneath would be short term after reclamation is achieved. More importantly, the suspended pipeline would be more susceptible to accidental damage or possible sabotage. As a result, the probability of an oil spill may be higher for a suspended pipeline than one buried under the scour depth of a stream or river.

All-Public-Lands Alternative

Under this alternative, the pipeline would be constructed across public land only. This alternative was excluded from detailed consideration because restricting the pipeline solely to public land is not feasible. Federal, state and other public lands do not exist in contiguous blocks of sufficient size and location to form a corridor for a pipeline. Nowhere between Canada and Casper does a corridor comprised of only public lands exist.

Simultaneous–Construction Alternative

Under this alternative, Express and Altamont would install their pipeline simultaneously along the same corridor. The two projects would have different scheduling requirements. Altamont does not presently have a definite construction schedule while construction of the proposed Express facilities is scheduled to take place during summer to fall of 1996 with linefill expected to take place by October 1996. The Altamont project is a 30-inch natural gas line while the

Express project is a 24-inch crude oil pipeline. It would be difficult to maintain a simultaneous schedule in both time and space because of the different engineering requirements. The Altamont project would require deeper and wider trenches, and therefore the use of slightly different construction equipment. Another factor would be the availability of specialized equipment and personnel. Both projects individually would be among the largest pipeline projects occurring in the United States at the time. If both projects would occur simultaneously, problems may be encountered with the availability of both the required specialized pipeline construction equipment and personnel. A final factor would be the width of disturbance. If Express and Altamont would construct simultaneously, the disturbance would be 190 feet, 100 feet for Altamont and 90 feet for Express. Regardless of who would construct first, a portion of the total right-of-way would overlap. This overlap could range from 25 to 55 feet depending on the construction configuration and thus decreasing the total disturbance to 165 or 135 feet. The simultaneous construction would result in an increased disturbance of 15 to 40 percent. Over the approximate 435 miles where the Express line would parallel the Altamont route, this would be a significant disturbance increase.

System Design Alternatives

Express evaluated the economics of using 16, 20, 24, and 30-inch pipe diameters for the project. The 24-inch pipe size was chosen because it maximized the project's internal rate of return (IRR) given two conditions: 1) that the average toll would be $1.35 U.S. dollars from Hardisty, Alberta to Casper, Wyoming, and 2) that the chosen pipe size would allow uncontaminated batching of crude shipments at expected throughputs. The IRRs of the other pipe size configurations were all lower for the 24-inch pipe, and the 30-inch pipe size had problems satisfying the second condition. The IRR of a project is the discount rate that equates the present value of revenues from the project with the capital invested in the project. The decision criterion is to accept a project if its IRR is greater than or equal to the firm's cost of capital, or reject the project if the IRR falls below. Following the assumptions in the Express model, the 24-inch pipe is likely the optimal pipe size.

Unless Express is successful in acquiring a high level of Midwestern destination volumes, a throughput of 140,000 BPD implies that Express would have to capture most of the volume of crude currently imported into the Rocky Mountain region on existing pipeline. Should the anticipated volume capture not occur, it is likely Express would have to restructure its proposed toll. A reduced toll at the forecast volume would produce a less favorable IRR.

Abandonment with Removal of the Pipeline Alternative

Express would remove the pipeline at the end of the project's useful life rather than abandoning the project with the pipeline left in the ground. This alternative was excluded from detailed consideration primarily because it would not be economically feasible. The costs of removing the pipeline from the ground, disposing of the pipeline, and restoring the right-of-way again would increase the overall cost of the project beyond the upper threshold for economic feasibility. Removal of the pipeline would cause avoidable impacts to the environment. Before being abandoned in-place, the pipeline would be thoroughly cleaned. Above-ground facilities would be removed upon abandonment of the pipeline and the land would be reclaimed to the original surface land use. Thus, the abandoned pipeline would not adversely affect the environment or pose a safety risk or hazard to people. Removing the pipeline would adversely affect resources present along the right-of-way. Because removing the pipeline would not provide any advantages to offset the disadvantages of the impacts and economics that would occur with removal, this alternative was dropped from further consideration.

Comparison of Alternatives

Table S-1 presents a comparison of the three alternatives considered in this EIS.

Table S-1
Comparison of Alternatives

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Geology	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline would not cross any fault known to be active during Holocene times. A landslide area would be encountered at Kirby Creek, MP 417. No liquefaction or seismic risks areas would be encountered.	Same as proposed action.
Soils	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	63% of soils would have or fair or better rehabilitation potential, 5% poor to fair, and 32% poor.	Same as proposed action.
Hydrology	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline would cross 43 perennial rivers or streams (7 are major, >100 feet wide), 98 intermittent or ephemeral streams, and 331 unnamed drainages. Short-term sedimentation would occur at river and stream crossings during and shortly after construction. Withdrawal and discharge of hydrostatic test water would not exceed 10% of instantaneous flow in the river or stream.	Rivers and streams would be crossed during low flow from July 15 to October 1. Lower flow and velocity would decrease sedimentation from construction. Yellowstone River would be directionally drilled. Cobbled riverbed could result in collapse of drill shaft resulting in a failed effort.
Air Quality	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations. If refineries would close due to alack of crude oil supply, local air quality would improve.	Minor short-term construction dust and vehicle and equipment gaseous emissions. VOC evaporative emissions from each pump station 66 lbs/yr.	Same as proposed action.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Noise	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Short-term construction noise. Pump station noise max of 30 dBA L_{dn} at closest residence is below general background noise of 35 dBA L_{dn}.	Same as proposed action.
Vegetation	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline would disturb 5,618 acres of vegetation (rangeland 2,848 acres, cropland 2,664 acres, wetland 37 acres, and riparian 69 acres). Cropland disturbance would result in loss of one growing season. Rangeland would be restores in 1-3 years except on 32% of lands with poor rehabilitation potential. Committed mitigation would result in no long-term loss of wetland and riparian vegetation.	Same as proposed action.
Terrestrial Wildlife	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Pipeline construction would disturb 413 acres of winter range (164 mule deer, 236 pronghorn, and 13 white-tailed deer). Construction schedule (July-October) would eliminate impacts to big game in winter ranges. However, recovery of shrub vegetation in the winter ranges would take at least five years. Pipeline construction would avoid by ½ miles 16 sage grouse leks from MP 395 to 427 in Wyoming.	No construction would be permitted in winter ranges from November 15 to April 30 to eliminate impacts to wintering big game species.
Raptors		93 raptor nests have been identified within ½ mile of right-of-way. Construction activity from July and early August would impact certain species' chicks that haven't fledged.	Entire route would be re-surveyed for active raptor nests in Spring 1996. Pipeline placemen would be realigned to maintain nests of TES species, and work plan would be modified to avoid active nests of other species until the chicks have fledged.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Fisheries	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Increased sedimentation would impact fisheries for 1-2 weeks construction period at major river crossings (>100 ft. wide), and 2-6 days for major streams (10-100 ft. wide). Sedimentation would decrease 24-48 hours after construction is complete. Blasting may result in fish mortality within 200 ft. of construction. Brown trout spawning habitat would be impacted by construction sedimentation after October 1. Oil spill could damage or destroy aquatic species.	To reduce impacts to brown trout spawning habitat, stream crossing would be completed at nine rivers before October 1.
TES Species	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	25 prairie dog colonies are large enough to be potential black-footed ferret habitat. Route would be re-surveyed in 1996 for prairie dog colonies and black-footed ferrets in appropriate habitat. Raptor chicks may be impacted if construction occurs nearby or nests destroyed.	Entire route would be re-surveyed for active raptor nests in Spring 1996. Pipeline placement would be realigned to maintain nests of TES species and the work plan would be modified to avoid active nests until the chicks have fledged.
Land Use	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline construction would temporarily effect 5,618 acres on the right-of-way. An additional 20 acres would be used for pump stations, metering station and valves for the lifetime of the project. The permanent right-of-way would be 3,121 acres. Agricultural and rangeland land uses could resume after reclamation, but no facilities could be constructed over the permanent right-of-way for the lifetime of the project.	Pipeline would be re-routed to avoid irrigated farmland and a steep slope near an irrigation ditch (MP 253). The slope would make boring difficult and the irrigation ditch would have to be trenched during peak irrigation time.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Recreation	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Minor short-term impacts on fishing would occur on major rivers and streams because construction would last one to two weeks.	Pipeline would be realigned at the Bridger Trail (MP 425) in the area of annual celebrations of pioneer migrations. The route would be moved to an area where the integrity of the trail has been compromised.
Visuals	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Long-term visual impacts would occur over 32% of the route where rehabilitation potential is poor. The pipeline would alter views along the Missouri, Yellowstone, Clarks Fork of the Yellowstone, and Greybull Rivers; U.S. Highways 212 and 310 which are primary routes to Yellowstone national Park; and the Bridger Trail.	Pipeline would be realigned at the Bridger Trail (MP 425) in the area of annual celebrations of pioneer migrations. The route would be moved to an area where the visual integrity of the trail has been compromised.
Transportation	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Minor, temporary impacts during the morning and evening hours when construction are arriving and departing work site.	Same as proposed action.
Socioeconomics	If the Express pipeline is not built, other proposed and announced pipeline projects (Cenex, Amoco/Conoco, Wascana) could make up the crude oil deficit until 2002. The Cenex line is planned for late 1995, while the Amoco and Wascana lines could be built in the next five years. Also, refineries in Utah and Colorado could close or reduce output. Also, additional refined petroleum products could be imported into the Rocky Mountain region. Finally, refined product could be extracted from export pipeline systems.	Pipeline construction would provide about 500 short-term jobs for local workers. Demands for temporary housing would increase occupancy rates to above 95% in some locations. Pipeline operation would result in $5 million annual ad valorem taxes for Montana and $1 million for Wyoming. Express pipeline should not effect local exploration and production since Wyoming and Montana production declining about 7% annually.	Same as proposed action.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Cultural Resources	Existing resources would continue to experience same levels of impacts due to weathering and low levels of traffic. Opportunity to discover new cultural resources may be lost.	Pedestrian Class III surveys have yielded 337 cultural sites or site segments. 191 are prehistoric, 120 are historic, and 26 are prehistoric/historic remains. The Cultural Resources Programmatic Agreement would determine NRHP eligibility and mitigation to avoid or excavate.	Same as proposed action.
Paleontological Resources	Existing resources would continue to experience same levels of impacts due to weathering and low levels of traffic. Opportunity to discover new paleontological cultural resources may be lost.	18 locations yielding reptile, mammal and bivalve fragments considered important, significant or critical are identified along the pipeline route.	Same as proposed action.
Pipeline Safety and Reliability	No impacts from the project. Effects similar to Express project could occur from other proposed crude oil pipeline projects at different times and locations.	Four spills of less than 50 barrels and two spills over 50 barrels may occur during the lifetime of the project. Although the probability of a spill is very low, impacts to water, fish, vegetation and wildlife would be significant if a spill occurred.	Same as proposed action.

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Chapter 1
Purpose and Need

Express Pipeline, Inc. (Express), an affiliate of Alberta Energy Company Ltd., and TransCanada PipeLines Limited, proposes to construct, operate, and maintain a 24-inch pipeline from Wild Horse (located on the border between Montana and Canada) to Casper, Wyoming (**Figure 1**). Express Pipeline Ltd., another affiliate of Alberta Energy Company Ltd., and TransCanada PipeLines Limited proposes to construct, operate and maintain a 24-inch pipeline from Hardisty, Alberta to Wild Horse. These pipelines would interconnect at Wild Horse. Together, these pipelines would transport crude oil from the production fields in Alberta, Canada to refineries in Wyoming, Colorado, Utah, Kansas, Oklahoma, Illinois, Indiana, Ohio, Kentucky, and Tennessee via the existing pipelines downstream of Casper. Initially, the pipeline would be capable of transporting 172,000 barrels of crude oil per day (BPD) between Hardisty and Casper. With additional pump stations, the capacity could ultimately increase to 280,000 BPD.

The pipeline would parallel other pipelines for almost its entire 515-mile length. Through most of Montana (305 miles) and for the first 120 miles in Wyoming, the pipeline would be placed immediately adjacent to the proposed route for the Altamont Gas Transmission Company (Altamont) natural gas pipeline. This route was certificated by the Federal Energy Regulatory Commission in 1991 (Altamont Gas Transmission Company, Preliminary Determination on Nonenvironmental Issues, 54 FERC ¶ 61,028 (1991); Order Issuing Certificates, and Denying Rehearing, in Part, 56 FERC ¶ 61,199 (1991); Order on Rehearing, 69 FERC ¶ 61,034 (1994). At Lost Cabin, Wyoming (**Figure 1**), the pipeline would deviate from Altamont's route and parallel other existing pipelines to its terminus in Casper. The pipeline would deviate from other pipelines route only where physical conditions, archaeological considerations, or environmental considerations prevent placement of the line immediately adjacent to the other pipeline routes.

Although most of the route proposed by Express involves private lands, it also crosses public lands primarily involving federal and state ownership. The Bureau of Land Management (BLM) and Bureau of Reclamation (BOR) administer the federal lands crossed by the route. State lands are administered by various state agencies in Montana and Wyoming. The narrow strip of land comprising the U.S.-Canadian border is administered by the International Boundary Commission.

Purpose of and Need for the Proposed Project

Nationwide, the demand for and consumption of petroleum in the U.S. has exceeded production for more than 20 years (**Figure 2**). In recent years, this gap has been widening as the demand

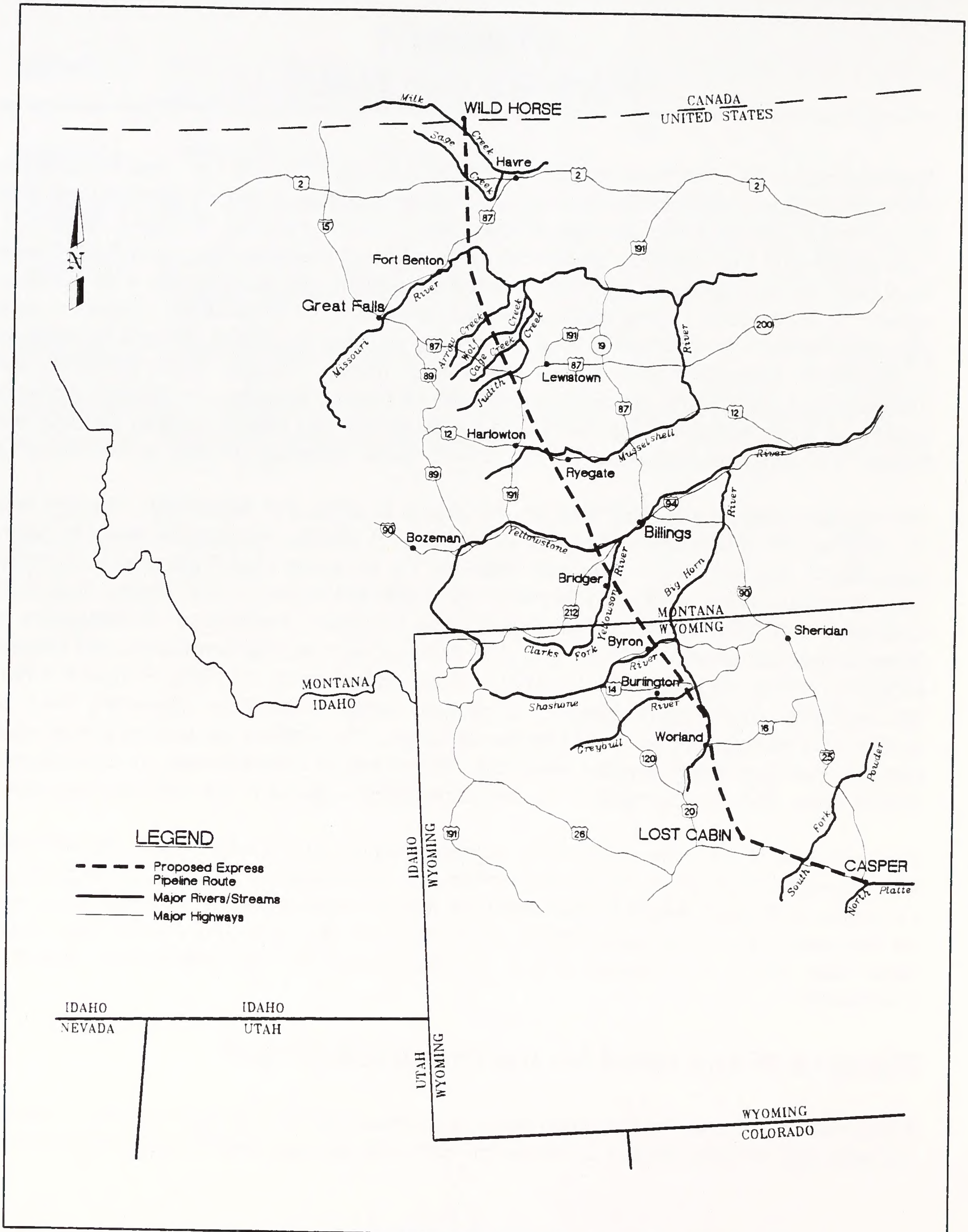


Figure 1 Location of the Proposed Project

for crude oil increased while domestic production declined. Projections indicate the gap between consumption and production will likely continue to widen into the 21st century (**Figure 2**).

Historically, the U.S. has imported crude oil from other countries to fill the gap between the consumption and production of oil in the U.S. Crude oil production in the United States was 6,600,000 BPD in 1994. Production has declined at an average annual rate of three percent, or 225,000 BPD, per year for the past ten years. Because production of crude oil in the U.S. has been declining and is expected to continue to decline, the percentage of the U.S. consumption of oil supplied by imports is projected to increase (**Figure 3**). Thus, if the U.S. is to continue to meet its demand for crude oil reliably, it needs to locate additional, dependable sources of crude oil.

In addition to locating new sources of crude oil, the resulting oil imported from these sources must be appropriate for refiners to process. With available equipment, most refineries can only process "sweet" crude oil, not "sour" crude oil. The amount of sulfur determines whether crude oil is "sweet" or "sour". Low sulfur crude oil is referred to as sweet, while crude oil having a higher sulfur content is sour. The percentage of sulfur defining "sweetness" varies from region to region. Unless the refiners can locate primarily sources of sweet crude oil, they will have to make large capital investments in their refineries to handle sour crude.

The Rocky Mountain Petroleum Administation Defense District (PADD) IV Region (consisting of Montana, Wyoming, Colorado, Utah, Idaho, and New Mexico) has historically been relatively self-sufficient for crude oil supply. Moreover, PADD IV has traditionlly supplied significant quantities of sweet, light and heavy sour crude oils to the Midwest. Since 1985, the production of crude oil in this region has dropped from 628,000 BPD to about 424,000 BPD (32.5 percent). By 2015, production is expected to drop to about 201,000 BPD. Thus, by 2015 production of crude oil in this region is projected to decrease almost 70 percent from the 1985 level. Crude oil production in PADD IV has declined 6.5 percent per year since 1991 and is projected to continue to decline by approximately 7.5 percent over the next ten years. This decline has virtually eliminated the region's crude oil surplus position. Because this region has no alternative crude supplies available, Canadian crude oil via the Express Pipeline has the opportunity to satisfy the market requirements.

Demand for refined petroleum in the Rocky Mountain Region is similar now (430,000 BPD) to what it was in 1985 (432,000 BPD). In the future, demand is expected to fluctuate, but remain around 420,000 to 430,000 BPD. By 2015, demand for refined petroleum is expected to be about 427,000 BPD.

A comparison of production and demand in the Rocky Mountain Region shows production will probably not keep pace with demand. Although the region's production exceeded demand by 45 percent in 1985, it is projected to account for only 53 percent of the region's demand in 2015. Thus, the refineries in the Rocky Mountain Region need to locate supplies of crude oil elsewhere if they are to meet the region's demand for refined petroleum.

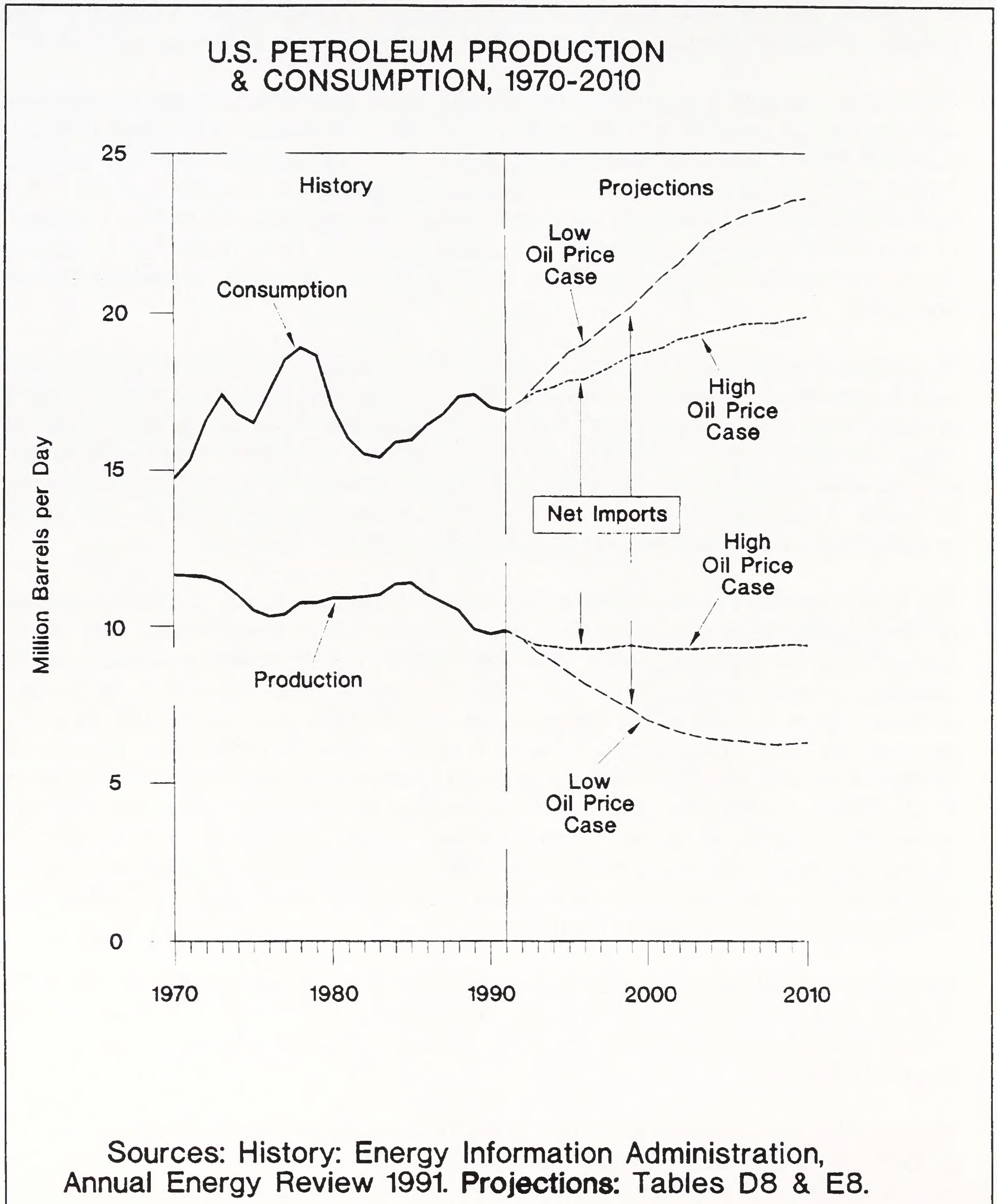


Figure 2 U.S. Petroleum Production and Consumption, 1970–2010

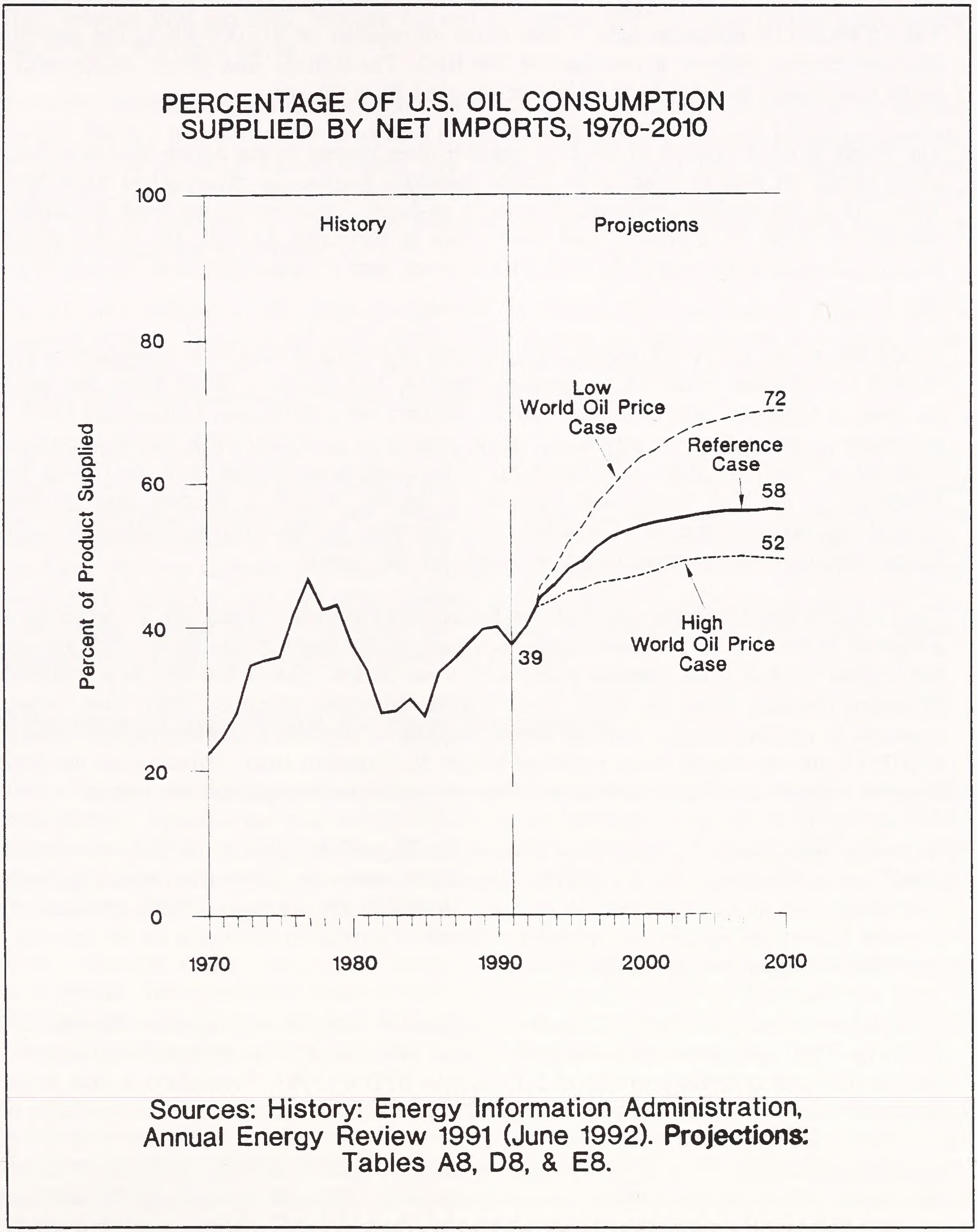


Figure 3 Percentage of U.S. Oil Consumption Supplied By Net Imports, 1970–2010

The 15 PADD IV refineries have a total crude oil capacity of 503,000 BPD. The capacity of each indidividual refinery is less than 54,000 BPD. The Billings area refines mostly sour and heavy sour crude, two-thirds of which are supplied from Canada.

The trends in other regions of the U.S. parallel those present in the Rocky Mountain Region. These trends, as well as those in the Rocky Mountain Region, are presented in more detail in Appendix A for readers interested in a more in-depth discussion of the need for additional imports of crude oil in general, and sweet crude in particular. Overall, the Rocky Mountain Region and much of the rest of the U.S. have a strong need to locate additional sources of crude oil.

In addition to the PADD IV region, two portions of PADD II have been considered potential markets for Canadian crude via the Express Pipeline. The PADD II Wood River area includes the states of Kentucky, and Tennessee, and the southern parts of Illinois, Indiana and Ohio. The ten refineries within this area have a total crude capacity of 1,130,000 BPD. In 1994, crude runs consisted of 1,020,000 BPD. Over two-thirds of the crude supply comes from the United States. However, as the U.S. production continues to decline, PADD II imports must increase to continue to meet the demand. Canadian crude delivered via the Express Pipeline through the Casper Hub could be an important new supply for this region.

The PADD II Mid-Continent area includes Kansas and Oklahoma. There are 11 refineries with a capacity of 689,900 BPD. These refineries process mainly sweet crude. Since 1985, the region has shifted from a crude surplus position to a net deficit. The deficit has been satisfied by increased transfers from the West Texas region. However, transfers from West Texas are expected to decline further, leaving excess demand in the Mid-Continent region. Similar to PADD IV and the Wood River region of PADD II, Canadian crude delivered via the Express Pipeline through the Casper Hub could be an important new supply for this region.

In contrast with production in the Rocky Mountain Region and most of the U.S., production of crude oil in Western Canada (Alberta, British Columbia, Saskatchewan, Manitoba, and the Northwest Territories) has been increasing. However, the supply of crude produced from Western Canada has significantly exceeded forecasts of production developed by the industry and governmental agencies (Appendix A).

Production of crude in Western Canada is projected to continue at a high rate through at least 2005. In 1990, total production was 1.66 million BPD. In 1994, total production rose to 1.89 million BPD and is forecast to rise to 2.13 million BPD by 1997. Production is then projected to steadily decrease to about 1.64 million BPD by 2005.

Although production of crude in Western Canada is comparatively high, domestic demand and the capacity of the area's refineries is considerably lower. Demand for crude in Western Canada is about 458,000 BPD and is expected to grow to about 478,000 BPD in 2005. The combined capacity of refineries in Western Canada to process crude will be about 487,000 BPD by 1995.

Thus, between 1995 and 2005, between 1.2 and 1.4 million BPD of crude will be available for export from Western Canada.

Presently, Western Canada cannot export all of its surplus production of crude to the desired markets due to a lack of capacity in existing pipelines. Although four primary pipelines currently transport crude oil out of Western Canada (see Appendix A, Section 1.4), they cannot transport all available crude oil. In addition, Natural Gas Liquids and refined products also compete for space in these pipelines. Producers in Western Canada need additional pipeline capacity to transport production to markets.

The primary purpose of the proposed pipeline (in conjunction with Express Pipeline Ltd.'s pipeline between Hardisty and Wild Horse) is to address the requirements of refiners in the U.S., particularly in the PADD IV Rocky Mountain Region and the PADD II/Wood River Region, and the producers of Western Canada simultaneously.

The Express Pipeline would provide new sources of Canadian crude to Casper, Wyoming. Casper is an established crude oil transportation hub in the PADD IV region. Historically, crude has been gathered in smaller pipelines upstream of Casper for transportation to refineries in the Rocky Mountain region or for shipment east to PADD II. In conjunction with other pipelines, the Platte Pipeline accesses southern Wyoming, Colorado and PADD II. Similarly, Frontier Pipeline, in conjunction with two other pipelines, provides access to refineries in Salt Lake City, Utah. These pipeline delivery networks are presently underutilized and would have capacity available to transport the volumes projected by Express.

Purpose of and Need for this Document

Before Express can construct the pipeline, it must obtain numerous federal, state, county, and local permits. Because the route crosses federal lands administered by the BLM and the BOR, Express must obtain a Right-of-Way Grant from these agencies. As part of the process for granting the permits, these agencies must consider Express' proposal under the National Environmental Policy Act of 1969 (NEPA).

NEPA requires federal agencies to assess a project's effects on the quality of the human environment. This assessment must be interdisciplinary and consider all resources that may be affected. The agency must disclose the assessment to the public. This Environmental Impact Statement (EIS) serves as the mechanism for satisfying those requirements.

In addition to the permitting process for the portion of the pipeline on federal lands, the Montana Board of Environmental Review must approve the Montana portion of the pipeline project under the Montana Major Facility Siting Act (MFSA) and the Montana Environmental Policy Act (MEPA). MEPA requires state agencies to assess a project's effects on the quality of the human environment in Montana. The Montana Department of Environmental Quality (MDEQ) is the lead state agency responsible for evaluating compliance with the MFSA and MEPA. Because

MEPA's requirements are similar to NEPA's, this EIS will also serve to meet MDEQ's obligations under MEPA.

The goal of this EIS is to provide sufficient information to make an informed decision about Express' proposal. However, it is not a decision document. It is a document disclosing the likely environmental consequences of implementing the proposed action or one of the alternatives to that action. The decision will be documented in a Record of Decision signed by the responsible officials for the BLM. The Montana Board of Environmental Review will issue a Certificate of Environmental Compatibility and Public Need for the Montana portion of the pipeline.

Regulations implementing NEPA (40 CFR Part 1500) encourage agencies to either tier or incorporate by reference their NEPA analyses to previous analyses to eliminate repetitive discussions of the same issues and to focus on specific issues of the proposal. The proposed pipeline would follow the routes of two other pipelines for which EIS's were previously issued by federal agencies. Accordingly, the PGT/PG&E and Altamont Natural Gas Pipeline Projects Final EIS (FERC 1991) and the Amoco Carbon Dioxide Projects Final EIS (BLM 1989) are incorporated by reference into this EIS.

This document describes the likely effects of implementing or not implementing the proposed pipeline between Wild Horse and Casper. A similar environmental analysis has been filed in accordance with the Canadian Environmental Assessment Act for approval of the pipeline in Canada from Hardisty to Wild Horse. This document is structured to provide an understanding of the environmental analysis process used to evaluate the proposal. Chapter 2 describes the project alternatives and the process that was used to develop them. Chapter 3 describes the environment that potentially would be affected by the alternatives. Chapter 4 outlines the environmental consequences of each alternative. The people who prepared this document are identified in Chapter 5. Finally, the agencies, organizations, and persons to which the Draft EIS was mailed are listed in Chapter 6.

Decisions To Be Made

Two decisions will be made based on the analysis documented in this EIS, one by the BLM and the other by the State of Montana. The BLM Worland District Manager will make the BLM decision on Express' proposal. This decision will involve one of three outcomes. First, he/she could approve Express' application for a Right-of-Way Grant as it was submitted by Express. Second, he/she could approve the Right-of-Way Grant with specific conditions of approval and mitigation measures. Third, he/she could deny the Right-of-Way Grant. If the District Manager selects an action alternative in the Record of Decision, implementation of the activities specifically identified in that alternative would begin in 1996.

The Montana Board of Environmental Review will make certain decisions based on the analysis of this EIS. The Board may only approve the alternative that minimizes the project's environmental effects when compared to the nature and economics of various alternatives.

However, the Board will only make the decision on the Montana portion of the proposed project. While the two agencies will make independent decisions, the decision process will be closely coordinated between these primary lead agencies and other cooperating agencies such as the Bureau of Reclamation and the Corps of Engineers.

Post-EIS Procedures

If the proposed Express Pipeline project or alternatives is approved, other requirements must be satisfied before construction would begin. The BLM Record of Decision and the Montana Board of Environmental Review Certificate of Environmental Compatability and Public Need would include mitigation measures that Express must incorporate for the project. Express would include these measures in its Final Plan of Development (POD) for the construction, maintenance and operation of the pipeline. The POD would be developed for the selected alternative. The POD would include the following plans: Engineering, Operation and Maintenance, Reclamation, Hazardous Material Handling, and Spill Prevention Containment and Control. Reclamation procedures to be performed on private lands would also be negotiated with the respective landowner.

In Montana, on-site inspections would be done for all river and stream crossings. These inspections would be conducted with the MDEQ, the Montana Department of Fish, Wildlife and Parks (MDFWP), Conservation District representatives, county and/or state floodplain coordinators, the landowner, and Express Pipeline personnel. During this on-site inspection, the timing of the crossing, method of crossing, and site-specific mitigating measures will be determined. No construction shall begin until this inspection is completed and Express Pipeline is notified of the results in writing.

The Cultural Resources Phase III Reports for the entire pipeline route would be evaluated by the BLM, the MDEQ and the Montana and Wyoming State Historic Preservation Offices (SHPO). If any of the sites located along the pipeline right-of-way would be determined eligible for listing on the National Register of Historic Places, then mitigation (avoidance or excavation) plans would be developed by Express and approved by BLM, MDEQ and the SHPOs.

Field biological surveys would be completed by Express for two key resources, active raptor nests and prairie dog colonies which may provide the necessary habitat for black-footed ferrets. These surveys would be performed in the spring of 1996. If active raptor nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests of threatened, endangered or sensitive species. The work plan would be modified to avoid the active nests of other species until chicks have fledged. Those prairie dog colonies with sufficient acreage or configuration to support habitat for black-footed ferrets would be individually surveyed for the presence of black-footed ferrets. If black-footed ferrets are found during these surveys, mitigation to deviate around the black-footed ferret location would be included in the POD.

Upon BLM and MDEQ approval of the pre-construction plans, Express must obtain the required permits from the appropriate federal, state and county agencies. Table 1 summarizes the permits, approval and coordination requirements of the proposed Express pipeline. Once all plans have been approved and all permits have been obtained, the BLM and MDEQ would issue the formal Notice to Proceed with pipeline construction. During construction, environmental inspectors would be retained to ensure that construction and reclamation procedures are carried out according to the approved Record of Decision and the POD. Additionally, the agencies (BLM, MDEQ, Corps of Engineers) would perform periodic inspections.

TABLE 1
PERMIT, APPROVAL, AND CONSULTATION REQUIREMENTS FOR EXPRESS PIPELINE PROJECT

Agency	Permit/Authority	Agency Action
CANADIAN GOVERNMENT		
International Boundary Commission	Boundary Commission permission	Grant permission for pipeline and related facilities to cross the Canada-U.S. border.
U.S. GOVERNMENT		
Advisory Council on Historic Preservation	Section 106, National Historic Preservation Act (NHPA)	Provide consultation under Section 106 for all project features that may potentially affect cultural resources that are either eligible for listing or listed in the National Register of Historic Places (NRHP).
U.S. Army Corps of Engineers	Section 40-4 (Clean Water Act) individual permits	Consider issuance of Section 404 individual permits for the placement of dredge or fill material in a water of the United States. This permit is applicable to any physical feature or activity that results in the placement of fill or dredge material in navigable waters.
	Section 404 (Clean Water Act) Nationwide permits	Confirm the applicability of Section 404 nationwide permits for the placement of dredge or fill material in a water of the United States. This permit could apply to any physical feature or activity that results in the placement of fill or dredge material in navigable waters.
	Section 10 permit (Rivers and Harbors Act of 1899)	Consider issuance of Section 10 permits for pipeline crossing of navigable waters.
U.S. Bureau of Land Management	Rights-of-way grant and use permit under Section 28 (Mineral Leasing Act)	Grant rights-of-way and issue temporary use permits under Section 28 of the Mineral Leasing Act for the portions of the project that would encroach on BLM lands.
	Temporary use permit	Renew temporary use permit for temporary activities in a construction right-of-way. The project was issued a temporary use permit in 1985. The renewal would be valid for 3 years. The state director of BLM is the authorized project officer and would issue the renewal.
	Amend the U.S. Department of the Interior right-of-way grant	Consider issuance of a federal right-of-way grant for permanent pipeline right-of-way requirements on BLM lands.
	Notice to proceed	Following issuance of the right-of-way grant, the project applicant must prepare site-specific impact analyses and must recommend mitigation measures as necessary (i.e., plans and programs). Once BLM approves the plans and programs, it will issue a notice to proceed with all project development activities.
	Antiquities and cultural resources use permit	Consider issuance of antiquities and cultural resources use permit to excavate or remove cultural resources on federal lands under FLPMA and ARPA, as necessary during site preparation activities.
	Consultation	Approve detailed Construction, Operation, Rehabilitation, and Environmental Protection Plan.
U.S. Bureau of Reclamation	Perpetual license for canal and electric transmission line crossing	Grant special land use licenses for the pipeline and access road crossing of canals, electric transmission lines, and BOR lands.

TABLE 1 (Continued)

Agency	Permit/Authority	Agency Action
	Easement for irrigation district crossing	Grant special land use license for the pipeline crossing of the Hermisson Irrigation District in the Pacific Northwest region in Idaho.
U.S. Department of Defense and U.S. Air Force	Review authority	Review construction plans to ensure that trenching would not disturb buried cables connecting minuteman missile silos in northern Montana.
U.S. Department of Energy Western Area Power Administration	Encroachment permits	Consider issuance of permits for pipeline and access road crossing of federally funded highways.
U.S. Department of Transportation, Federal Highway Administration	Permit	Consider issuance of permits to purchase, store, and use explosives for site preparation during pipeline construction.
Environmental Protection Agency	Section 309 (per Clean air Act)	Ensure the environmental impact statement and the project comply with Section 309 of the Clean Air Act with regard to pipeline construction and operation activities.
Federal Communications Commission	License for fixed microwave stations and service	Grant a license to operate industrial radio service for fixed microwave stations and service.
U.S. Fish and Wildlife Service	Section 7, Endangered Species Act (ESA)	Provide biological opinion on species of wildlife and plants that are federally listed. This act would apply to all project features that may affect federally listed species or their habitats.
MONTANA		
Department of Environmental Quality - Board of Environmental Review	Montana Major Facility Siting Act	Review project application, conduct reviews of project impacts, approve route, and coordinate other permit activities as noted below.
Air Quality Division	Air Quality Permit	Consider issuance of air quality construction and operation permits, including PSD permits, where required for project facilities that would emit air pollutants in certain quantities.
Water Quality Division	Montana Water Quality Act, 3A authorization, stormwater discharge	Consider issuance of a 3A authorization with development conditions designed to maintain water quality standards during construction activities that would affect stream water quality. A 3A authorization is required only if the 310 stream crossing permit denies a turbidity exemption.
	Section 401 certification, Clean Water Act	Consider issuance of Clean Water Act, Section 401 certification for all activities that may result in discharge to navigable waters.
	Montana Pollution Discharge Elimination System (MPDES) permit (authority delegated by EPA from the National Pollution Discharge Elimination System (NPDES)	Grant an MPDES permit for hydrostatic testing wastewater discharge.
Solid Waste Division	Solid waste management	Review solid waste from construction for proper debris disposal requirements[1].

TABLE 1 (Continued)

Agency	Permit/Authority	Agency Action
Reclamation Division	Open-cut permit	Grant permit to excavate 10,000 cubic yards or more total aggregate from one or more pits regardless of surface ownership[1].
	Aggregate and rock mining permit	Grant permit for the excavation of select fill on school trust lands if the source is outside of the right-of-way easement[1].
Montana Department of Highways	Encroachment permits	Grant state highway encroachment permits for pipeline and access roads that may encroach on state highway rights-of-way[1].
Montana Department of Natural Resources and Conservation	Floodplain development permit (Floodplain and Floodway Management Act, Title 76, Chapter 5 of the Montana Code)	Grant a permit to construct in the 100-year floodplain[1].
	Easement grant	Grant right-of-way easement for crossing state lands and state waters.
	Land use license	Grant license for temporary use of state lands and state waters (may be required in addition to right-of-way easement).
Montana Office of Historic Preservation	Consultation under Section 106, NHPA, Montana Antiquities Act	Consult with project applicants and BLM and sate agencies regarding impacts on cultural resources that are either listed or eligible for listing on the NRHP.
Montana boards of county commissioners for Hill, Chouteau, Fergus County, Judith Basin, Upper and Lower Musselshell, Stillwater, and Carbon Counties	Easement grants and road-crossing permits	Consider issuance of right-of-way easement grants and road-crossing permits for county property and roadways.
Hill County, Bid Sandy, Chouteau, Fergus County, Judith Basin, Upper and Lower Musselshell, Stillwater, and Carbon conservation Districts	Natural Streambed and Land Preservation Act	Consider issuance of 310 permits for stream crossings and identify turbidity exemptions from the 3A authorizations for pipeline and maintenance road development that may affect stream corridors[1].
	Surface water turbidity exemption	Grant a short-term exemption (part of the 310 permit for stream crossing) from surface water turbidity standards during construction. If a short-term turbidity exemption is not granted, a 3A authorization is required to ensure maintenance of water quality.
Chouteau County Planning Department		Consider issuance of a development permit for all project features.
WYOMING		
Wyoming Department of Environmental Quality	Permit	Consider issuance of a permit for the creation of a sediment pond for erosion control.
Air Quality Division	Air quality permits	Consider issuance of air quality construction and operation permits, including PSD permits where required for project facilities that would emit air pollutants in certain quantities.
Water Quality Division	NPDES permit, authorized by federal Clean Water Act	Consider issuance of a NPDES permit for point source discharge.
Wyoming Highway Department	Encroachment permit	Consider issuance of a license for encroachment on state highways.

TABLE 1 (Continued)

Agency	Permit/Authority	Agency Action
Wyoming Office of Historic Preservation	Section 106 NHPA consultation	Consult with project applicants and FERC regarding impacts on cultural resources that are either listed or eligible for listing in the NRHP.
Wyoming State Land and Farm Loan Office	Right-of-way grant and temporary use permits	Consider issuance of a grant of right-of-way across state lands. Consider issuance of temporary use permits for project activities located on state lands outside the pipeline right-of-way.
Public Service Commission	Administration role in the development process	Oversee engineering, construction, and safety matters.
Wyoming State Engineer's Office	Oversized and overweight load permit	Consider issuance of permits for transport of oversized and overweight loads (consisting of construction materials) on public roadways.
	Groundwater appropriation permit	Consider issuance of a permit to appropriate groundwater.
	Surface water appropriation permit	Consider issuance of a license for encroachment on state highways.
Wyoming Waste Management Agency	Landfill permit	Consider issuance of a landfill permit for solid waste disposal.
Wyoming county commissions for Big Horn, Washakie, Hot Springs, Fremont, and Natrona Counties	Road crossing permits	Consider issuance of a permit for pipeline and access road crossing.
	Development permits	Consider issuance of a permit for project development.
	Oil and gas transmission line permits (as required)	Consider issuance of permits for project development.
	Floodplain permits	Consider issuance of permits for encroachment upon 100-year floodplains.
Hot Springs County Planning Department	Development permit	Consider issuance of a development permit for all project features.
Fremont County Planning Department	Oil and gas location permit	Consider issuance of an oil and gas location permit for project.
Natrona County Planning Department	Utility corridor permit	Consider issuance of a utility corridor permit for the project.
Conservation Districts	Floodplain permits	Consider issuance of floodplain permits for construction or development activities in 100-year floodplain.

[1] Agency included under Major Facility Siting Act.

Chapter 2
Alternatives

This chapter covers four primary topics. First, it describes the process used to develop the alternatives considered in the analysis. Second, it identifies each alternative dropped from detailed consideration and briefly describes the reasoning for the exclusion. Third, it describes the alternatives analyzed in detail. The specific features of these alternatives are fully described. Finally, it summarily presents, in comparative form, the environmental impacts of the alternatives analyzed in detail.

The Process Used to Develop Alternatives

The process of developing alternatives to Express' proposal involved four steps. First, the BLM and the MDEQ conducted project scoping to identify the significant issues of concern. This scoping involved both agency and public aspects. It also considered environmental and project-design elements.

The second step consisted of formulating alternatives to the proposal. To be considered further, each potential alternative had to fulfill two requirements. It had to meet the purpose of and need for the project. It also had to address specifically one or more of the significant issues of concern identified during scoping.

The third step involved screening the potential alternatives for feasibility. This screening focused on technical, environmental, and economic feasibility. Technical considerations included the feasibility of various construction methods. Environmental considerations included the potential for significant impacts and the feasibility of successfully mitigating the impacts of the alternatives. Economic considerations included potential costs and benefits of implementing the alternatives.

Finally, unsuitable alternatives were dropped from detailed consideration. If an alternative did not pass the technical, environmental, and economic screening for feasibility, it was not considered any further in the analysis.

Scoping

To fully disclose and describe the proposed Express Pipeline project, public scoping meetings were held at the following locations:

- Billings, Montana, Sheraton Billings Hotel on October 4, 1993;

- Lewistown, Montana, Lewistown BLM District Office on October 5, 1993;

- Havre, Montana, Northern Montana College on October 6, 1993;

- Worland, Wyoming, Worland BLM District Office on October 7, 1993; and

- Casper, Wyoming, Hilton Inn on October 8, 1993.

At each meeting in Montana, the BLM and MDEQ personnel discussed the project and the NEPA, MEPA and MFSA policies and procedures as they applied to the proposed Express pipeline project. Express then described the proposed pipeline and presented detailed maps and aerial photographs of the proposed route. Finally, BLM, MDEQ and Express representatives conducted a question and answer session. Similar meetings were held in Wyoming, but the MDEQ did not participate because the Wyoming portion of the project is not within MDEQ jurisdiction.

In addition to the public meetings, approximately 450 scoping information packages were mailed to potentially-affected interests. The package described the project and asked for comments or concerns. Recipients of the scoping information package included federal, state, and local governments and agencies; businesses; environmental groups; and interested individuals on mailing lists maintained by federal and state agencies.

Oral responses at the scoping meetings, 59 written comments, and a review of the regulations, defined a variety of issues relevant to the proposed action. These issues were reviewed to determine if they:

- might involve a detectable effect to the human environment,

- might be highly controversial, or

- fell within the scope of this site-specific EIS.

Issues that met one or more of the above criteria determined the scope or focus of this EIS. The primary issues used to define the scope of this EIS are briefly described below and specifically addressed in Chapters 3 and 4 (Affected Environment and Environmental Consequences).

Soils

How would the proposed project affect soil resources?

Concern was expressed that construction of the pipeline could increase erosion and affect the productivity of soils along the right-of-way. The primary agents through which this effect may be realized include an increase in the compaction of soils, the displacement of soils, and the potential for mass wasting in some areas. This also may lead to an increase in sedimentation in nearby streams. A decrease in the productivity of the soils along the right-of-way may lead to a decrease in production of vegetation along the right-of-way.

Hydrology

Would the proposed action affect the quality of water in streams crossed by the right-of-way or located nearby?

Concern was expressed that the proposed project could increase sedimentation in streams directly and indirectly. Construction of the pipeline through a stream could increase sedimentation in the stream directly during installation. Also, disturbance of soils in nearby upland areas could contribute to sedimentation in streams indirectly through erosion. An increase in sedimentation could adversely affect a stream's quality of water, habitat for fish, and beneficial uses.

In addition to sedimentation, concern was expressed about the effects of crude oil entering streams from an accidental rupture of the pipeline. A spill could adversely affect the receiving stream over the short and, possibly, the long-term. A spill would affect the stream's quality of water, habitat for fish, and beneficial uses.

Air Quality

Would the proposed project affect the quality of air in the project area?

Typically, the construction of a pipeline and its ancillary facilities, such as proposed by Express, can affect the quality of air in two ways. First, construction activities increase the amount of particulates (primarily dust) in the area. Second, construction vehicles would emit pollutants, such as carbon monoxide. Depending upon the amount of particulates and gaseous pollutants released by the project, the quality of air could be degraded locally over the short term. After construction is complete, operational effects to air quality could result from leaking valves and flanges, especially at the pump stations.

Noise

Would noise generated by the proposed project adversely affect the project area and its immediate environs?

Typically, pipeline projects generate noise in two ways. First, construction of the pipeline is a short-term source of noise. Second, pump stations are a source of long-term noise. Of the two sources, pump stations are of greater concern to most people because they are a long-term source of noise.

Vegetation

How would the proposed project affect vegetation along the right-of-way?

Concern was expressed about the potential effects of the proposed project on vegetation in general, and sensitive resources, such as wetlands and riparian areas in particular. Wetlands are specifically of concern because they serve an important role in maintaining the quality of water by acting as a filter that catches sediment or other impurities in surface water. Also, concerns were expressed about the potential to fully reclaim and revegetate disturbed areas and control the invasion of weeds.

Terrestrial Wildlife

How would the proposed project affect wildlife and its habitats?

The proposed right-of-way provides habitats for a variety of species of wildlife, including antelope, deer, raptors, waterfowl, upland game birds, and nongame species. Concern was expressed about synchronizing construction with the seasonal needs and uses of the right-of-way by wildlife, minimizing disturbance to sensitive or crucial habitats, minimizing secondary impacts of large work forces, and revegetating the right-of-way with plants suitable for wildlife.

Aquatic Life

How would the proposed project affect fish and other aquatic life?

Concern was expressed about the direct and indirect effects of construction on aquatic habitats crossed by the project and the potential effects of an accidental spill of crude oil into aquatic habitats. Construction through streams and adjoining upland areas could degrade aquatic habitats by increasing sedimentation of the stream, and impeding movement of fish across the construction area. A release of oil into a stream could result in fish mortality and the degradation of aquatic habitats.

Threatened, Endangered, or Sensitive Species

Would the proposed project affect threatened, endangered, or sensitive species or their habitats?

Several threatened, endangered, or sensitive wildlife and plant species occur or may occur along the proposed right-of-way for the project. Listed species that may occur along the proposed right-of-way include the bald eagle, peregrine falcon, black-footed ferret, and whooping crane. Additional listed species may occur in rivers downstream of crossings. Also, a variety of sensitive species may occur along the proposed right-of-way.

Land Use

How would the proposed project affect existing and future uses of the land within and adjoining the proposed right-of-way?

Concerns were expressed about how the proposed pipeline would influence uses of the land within and adjoining the right-of-way. These concerns focused on how the project could adversely affect prime farmland, irrigation systems, and general use of the land within and along the right-of-way. Restrictions that may affect the future use of the right-of-way are also of concern.

Recreation

How would the proposed project affect recreation along and near the proposed right-of-way?

The proposed project could affect recreation along and near the proposed right-of-way in several ways. First, construction could result in short-term effects to the recreational experience of recreationists using adjacent properties during construction. Also, the construction of stream crossings could affect people fishing or recreating downstream of the crossings. Finally, an accidental spill of oil could adversely affect recreation over the short term, particularly if it occurred in a stream or river.

Visual Resources

How would the proposed project affect the visual quality of the project area?

The installation of the pipeline could change the visual appearance of the proposed right-of-way, particularly in sensitive areas, such as at the crossings of rivers, riparian areas, and highly-visible slopes. Also, the BLM inventories and manages land under its jurisdiction according to the Visual Resource Management (VRM) System. Concerns exist that the proposed project may affect some of the classifications the BLM has made under the VRM system.

Socio-economics

How would the project affect the local economies and social structure?

Concerns were expressed about the economic effects of the proposed project on the oil industry in Montana and Wyoming and the municipalities through which the pipeline will pass. Some respondents were concerned about the effects imports of crude oil from Canada would have on the production of oil in Montana and Wyoming. Others were concerned about the potential benefits expenditures on the project and taxes paid by Express would have at the Federal, State, County, and local levels.

Concerns were also expressed about potential effects of the project on the local social structure. For example, is housing adequate to handle the crews that would be constructing the project? How will the project affect users of transportation facilities (e.g. roads and railroads) crossed by the project? Some concern was also expressed about the potential for increases in societal problems, such as increases in trash, vandalism, and crime, particularly during construction.

Cultural Resources

How would the proposed project affect cultural resources present along the proposed right-of-way?

Concern has been expressed that the proposed project could affect cultural resources along the right-of-way. Construction of the pipeline and ancillary facilities could damage cultural resources present in the areas that would be disturbed. The project could also affect the Native American traditional or spiritual resources crossed by the pipeline.

Pipeline Safety

How safe is the pipeline and what procedures would Express follow to ensure the project is operated safely?

Concern has been expressed about the potential for an accidental rupture of the pipeline and associated spill of oil. This concern is particularly focused on the potential for spills to affect surface water and ground water. Personnel from resource management agencies as well as the public were concerned about the procedures Express would use to safely operate the pipeline and respond to an accidental rupture and spill of oil.

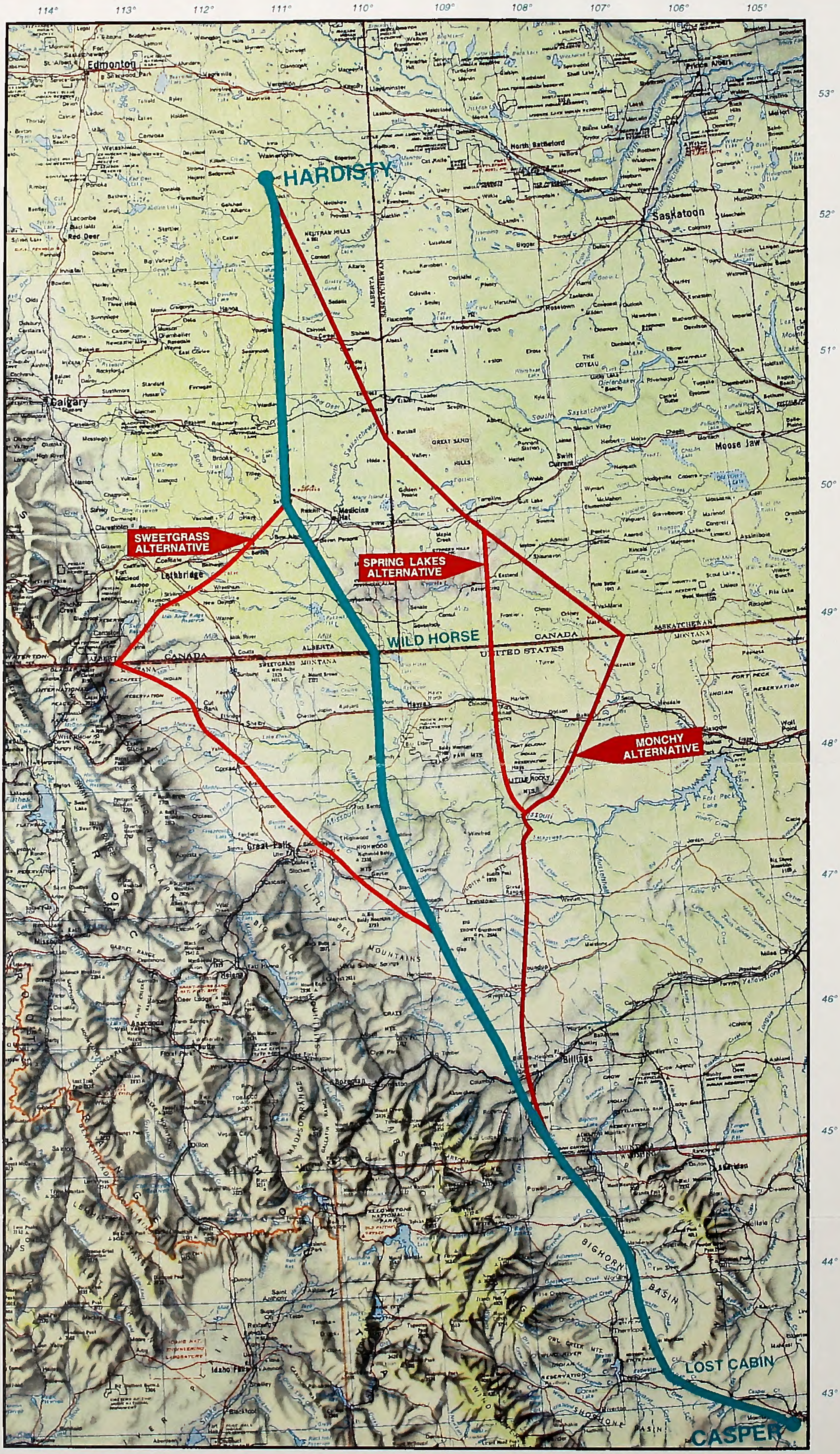
Alternatives Considered But Not Given Detailed Study

Several potential alternatives were considered and dropped from detailed study for various reasons. These alternatives are listed below and the reasons they were excluded from further consideration are described.

Alternative Routes Considered

As part of the evaluation of the Express proposal, alternative route locations investigated for the Altamont pipeline project were reviewed. Three alternative entry points from Canada to the United States (see Figure 4) were considered for the Express proposal. These locations were identified during the Altamont pipeline project review process based on information submitted to the Federal Energy Regulatory Commission (Altamont 1991). A point of entry could occur at one of the following three locations: Monchy, located about 120 miles east of Wild Horse; Spring Lakes, located about 65 miles east of Wild Horse; or the area of Spring Lakes, located about 120 miles west of Wild Horse.

Upon review of the environmental documentation completed for the Altamont project, the agencies have reconfirmed the earlier conclusion that the Altamont route provides an environmentally acceptable location for a pipeline. In considering routes connecting Hardisty and one of the three alternative points of U.S. entry, rejoining the proposed Express route in Montana, and then continuing on to Casper would add additional length and cost without any



SCALE: 0 50 100 150 200 250 MILES

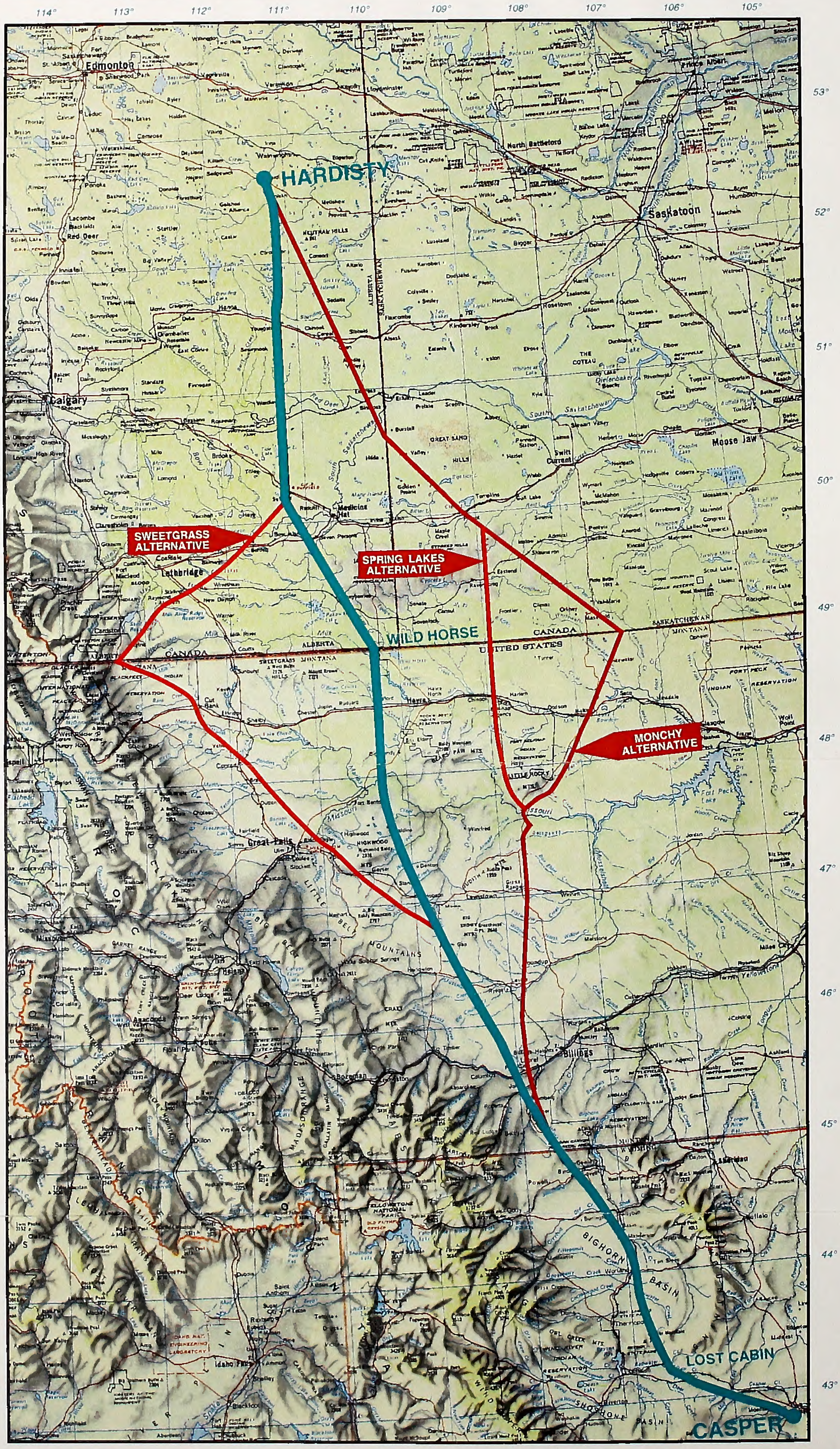
LEGEND

PROPOSED PIPELINE ROUTE — ALTERNATIVE ROUTES

Express Pipeline

PROPOSED AND PRELIMINARY ALTERNATIVE EXPRESS ROUTES

DATE: JUNE 1995 FIGURE 4



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LEGEND

PROPOSED PIPELINE ROUTE

ALTERNATIVE ROUTES

Express Pipeline

PROPOSED AND PRELIMINARY ALTERNATIVE EXPRESS ROUTES

DATE: JUNE 1995 | FIGURE 4

environmental or engineering benefits. The proposed Express route is the most direct between Hardisty and Casper while considering a variety of environmental and engineering factors. For these reasons, routing alternatives for Express' proposal were not considered in detail except for localized areas along the route as proposed by Express in recognition of the differing engineering requirements for crude oil pipelines compared to natural gas pipelines.

Trenching the Missouri River Alternative

The two methods considered by Express and the MDEQ for crossing the Missouri River were open cut trenching and directional drilling. Trenching of the Missouri was eliminated for the following reason. To comply with Montana's floodplain development regulations, the pipeline would have to be buried into an alluvial river bed. Open-cutting a ditch in alluvial material may require a wide ditch because of the sagging of the side walls of the trench. Such a trench could have substantial short-term effects on water quality and fisheries due to the greatly increased sedimentation from the construction process. Because of these anticipated impacts in a designated Wild and Scenic River with habitat for the pallid sturgeon, a fish listed under the Endangered Species Act, this alternative was dropped from further consideration.

Aerial Crossing of Perennial Streams and Rivers

Aerial pipeline crossings of waterbodies involves constructing large towers on each side of the river and multiple instream pier sites on wide rivers and then suspending the pipeline high across the river. Construction of the towers on the sides of the streams involves a large excavation area to accomodate concrete support bases. Areas excavated for the towers may fill with water and would need to be continuously pumped. Instream pier supports would also involve a fairly large excavation in the stream for the support base. The pipe would then be floated across the stream and lifted into place. The pipeline would be supported by a system of steel cables attached to the towers.

This construction alternative was excluded from detailed consideration because of the visual impacts and security considerations. The towers and suspended pipeline would be a significant visual impact for the lifetime of the project. In contrast, visual impacts resulting from trenching across a stream or boring underneath would be short term after reclamation is achieved. More importantly, the suspended pipeline would be more suseptible to accidental damage or possible sabotage. As a result, the probability of an oil spill may be higher for a suspended pipeline than one buried under the scour depth of a stream or river.

All-Public-Lands Alternative

Under this alternative, the pipeline would be constructed across public land only. Thus, the pipeline would not cross any private land. This alternative was developed in response to comments received during project scoping.

This alternative was excluded from detailed consideration because restricting the pipeline solely to public land is not feasible. Reviews of maps showing the ownership of land in Montana and Wyoming indicated ownership was patchy. Federal, state and other public lands do not exist in contiguous blocks of sufficient size and location to form a corridor for a pipeline. Nowhere between Canada and Casper does a corridor comprised of only public lands exist. Thus, this alternative was dropped from further consideration.

Simultaneous–Construction Alternative

Under this alternative, Express and Altamont would install their pipelines simultaneously along the same corridor. Thus, both projects would be constructed at the same time and the 435-mile portion of the shared corridor would be disturbed only once instead of twice.

This alternative was excluded from detailed consideration because of the following considerations. First, the two projects would have different scheduling requirements. Altamont does not presently have a definite construction schedule. Construction of the proposed Express facilities is scheduled to take place during summer to fall of 1996 with linefill expected to take place by October 1996.

Although both proposed projects are pipelines, the Altamont project is a 30-inch natural gas line while the Express project is a 24-inch crude oil pipeline. It would be difficult to maintain a simultaneous schedule in both time and space because of the different engineering requirements. The Altamont project would require deeper and wider trenches, and therefore the use of slightly different construction equipment.

Another factor would be the availability of specialized equipment and personnel. Both projects individually would be among the largest pipeline projects occurring in the United States at the time. If both projects would occur simultaneously, problems may be encountered with the availability of both the required specialized pipeline construction equipment and personnel.

A final factor would be the width of disturbance. If Express and Altamont would construct simultaneously, the disturbance would be 190 feet, 100 feet for Altamont and 90 feet for Express. Regardless of who would construct first, a portion of the total right-of-way would overlap. This overlap could range from 25 to 55 feet depending on the construction configuration and thus decreasing the total disturbance to 165 or 135 feet. The simultaneous construction would result in an increased disturbance of 15 to 40 percent. Over the approximate 435 miles where the Express line would parallel the Altamont route, this would be a significant disturbance increase. For these reasons, the simultaneous construction alternative was dropped from further consideration.

System Design Alternatives

Express evaluated the economics of using 16, 20, 24, and 30-inch pipe diameters for the project. The 24-inch pipe size was chosen because it maximized the project's internal rate of return (IRR) given two conditions: 1) that the average toll would be $1.35 U.S. dollars from Hardisty, Alberta to Casper, Wyoming, and 2) that the chosen pipe size would allow uncontaminated batching of crude shipments at expected throughputs. The toll level was set to be lower than tolls on the Wascana-Texaco-Butte and Rangeland-Glacier systems. The IRRs of the other pipe size configurations were all lower for the 24-inch pipe, and the 30-inch pipe size had problems satisfying the second condition.

The IRR of a project is the discount rate that equates the present value of revenues from the project with the capital invested in the project. The decision criterion is to accept a project if its IRR is greater than or equal to the firm's cost of capital, or reject the project if the IRR falls below that level. Following the assumptions in the Express model, the 24-inch pipe is probably optimal.

The IRR for any project is highly dependent on the assumed revenues. For a pipeline, revenues in turn depend on assumed tolls and crude oil throughput. The market situation for Express requires a fixed toll, in order to capture transport volumes from competing pipelines, and volumes in excess of 140,000 BPD for the first 20 years. In light of the foregoing analysis of alternatives to Express, it is possible that Express Midwest destination volumes not will materialize on a consistent basis given the outlook for increased pipeline capacity into the Midwestern crude market. Consequently, Express might have to depend entirely on Rocky Mountain refinery markets for its base level throughput.

It is projected that after 1995, total base imports from Canada into the Rocky Mountain region will be 125,000 BPD (EAI Appendix M). Moreover, it is probable that pipelines in existence (Wascana-Texaco-Butte), in construction (Cenex), or that have recently been announced (Amoco-Conoco), could provide adequate crude replacement capacity though the year 2002 (EAI Appendix M).

Unless Express is successful in acquiring a high level of Midwestern destination volumes, a throughput of 140,000 BPD implies that Express would have to capture most of the volume of crude currently imported into the Rocky Mountain region on existing pipelines. Should the anticipated volume capture not occur, Express would probably have to restructure its proposed toll. A reduced toll at the forecast volume would produce a less favorable IRR.

Thus, the analysis which serves as the basis for choosing the 24-inch pipe size appears optimistic due to the assumed pipeline throughput. Moreover, the IRR modelling exercise highlights the risk involved with this project, because it reveals how dependent the project is on capturing crude oil volumes from existing pipelines.

While the Express Pipeline might be able to generate its anticipated throughput, there also is a reasonable likelihood that it might not. As mentioned before, the public benefits of a project usually exceed private benefits, so the private feasibility of a project will usually ensure positive net benefits to society. In this case, Express appears ready to make a dynamic play into a highly competitive market. It might or might not find the customers it needs to make the project successful. However, if Express pipeline construction begins and is not completed, environmental resources might be put at risk. In this case, agencies could ensure that society does not bear project costs by indemnifying against unforeseen environmental costs. These measures will be developed as a result of the environmental review process that the project is currently undergoing.

Abandonment with Removal of the Pipeline Alternative

Under this alternative, Express would remove the pipeline at the end of the project's useful life rather than abandoning the project with the pipeline left in the ground. This alternative was developed in response to comments received during project scoping.

This alternative was excluded from detailed consideration primarily because it would not be economically feasible. The costs of removing the pipeline from the ground, disposing of the pipeline, and restoring the right-of-way again would increase the overall cost of the project beyond the upper threshold for economic feasibility.

In addition to the economic considerations, the removal of the pipeline would cause avoidable impacts to the environment. Before being abandoned in-place, the pipeline would be thoroughly cleaned. Above-ground facilities would be removed upon abandonment of the pipeline and the land would be reclaimed to the original surface land use. Thus, the abandoned pipeline would not adversely affect the environment or pose a safety risk or hazard to people. Removing the pipeline would adversely affect resources present along the right-of-way, such as water quality, soils, wildlife, and vegetation. Because removing the pipeline would not provide any advantages to offset the disadvantages of the impacts and economics that would occur with removal, this alternative was dropped from further consideration.

Economic Analysis of System Alternatives to Express

Introduction

This analysis was performed to assist the Montana Board of Environmental Review in evaluating the Alberta Energy Corporation's proposed crude oil pipeline across Montana. The MDEQ did the analysis pursuant to its responsibilities under Montana's Major Facility Siting Act (MFSA). For the Board to approve the project, it must first determine that it would minimize environmental impacts, considering the state of available technology and the nature and economics of the various alternatives (Sec. 75-20-301,(2), MCA). Alberta Energy is not a "utility" as defined by MFSA, so the Board is not required to establish "need" for the project.

To assist in its analysis, MDEQ enlisted a consulting firm, Energy Analysts International, Inc. (EAI). EAI prepared a report, released August 1, 1995, entitled Evaluation of AEC Express Pipeline. The report identifies possible market responses should the Express Pipeline not be built. The MDEQ analysis draws heavily from the EAI report. The Executive Summary of that report is located in Appendix M.

Basis of This Analysis

The relative merits of the proposed project and the No Action Alternative are measured by comparing the benefits of the proposed action (which will be lost if the project is not built) to the costs of the project (which will be avoided if the project is not built). Usually, if the benefits of a project exceed its cost, then the project is superior to the No Action Alternative. Here, however, the situation is not as simple because of the competitive nature of the crude oil and refined products supply markets. It is difficult to measure precisely what the magnitude of the benefits or costs would be for these market responses.

Distribution of Project Benefits and Costs

Project benefits and costs have private and social components. Private benefits include revenues gained by the pipeline owners from selling pipeline services to the pipeline owners, and whatever revenues are gained by Canadian oil producers who might not have had a market for their products if the pipeline did not exist. Social benefits are the sum of all benefits gained as a result of the project.

Project costs also have private and social components. Private costs include pipeline construction and operating costs, while social costs include all private costs and damages (costs) borne by the environment or society that are not lessened during project construction or pipeline operation.

Project Risk and Public Resources

When social benefits of a project likely exceed the private benefits, then the private feasibility of a project will likely ensure net benefits to society unless some project costs are borne by society. The agencies can ensure that society does not bear project costs for a project owner by instituting environmentally sound construction standards and indemnifying itself against unforeseen environmental costs with reclamation bonds and performance guarantees. If the agencies make sure a project sponsor covers all environmental costs, then no costs are likely to be borne by society.

Express Pipeline

The proposed Express pipeline is a 24-inch, 785-mile crude oil pipeline connecting Hardisty, Alberta, Canada to Casper, Wyoming. The U.S. - Canada border crossing would be at Wild Horse. The pipeline length in Montana would be 305 miles while 210 miles would cross

Wyoming. The pipeline would have 9 pump stations and an initial capacity of 172,000 barrels per day (BPD). Express estimates capital costs to be $395 million and the proposed tariff from Hardisty to Casper would be an average of $1.35 (U.S.) dollars per barrel. Express estimates an initial throughput of 142,000 BPD in 1996 increasing to 280,000 BPD over the course of eight years.

Target markets for the Express pipeline are refineries in the southern Rocky Mountain region (Wyoming, Utah, Colorado) and in the Midwest (Illinois, Indiana, Ohio, Michigan and Kentucky). To access Midwestern refineries, the Express pipeline would transfer shipments to Platte or Amoco pipelines at Casper. To access Utah refineries, Express shipments would be transferred to Frontier or Amoco pipelines at Casper. One of the primary driving forces for construction of the Express pipeline is the decline of U.S. crude production. In the Rockies, Canada is the only source of crude supply for the refineries besides production within the region. Midwestern refineries have access to U.S. production in the Permian Basin of West Texas, Midcontinent, Gulf Coast, Gulf Coast offshore, waterborne foreign crudes landed in the Gulf Coast, Canadian crude shipped via Interprovincial Pipe Line across Canada, and locally produced crudes.

Supply for the Express pipeline would be from Bow River, Husky, Gibson, and Chauvin pipelines at Hardisty, Alberta. Interprovincial Pipe Line also moves through Hardisty.

Petroleum Industry Setting and Basis for Alternatives

Following the low world crude oil prices of the 1980s, oil drilling declined in the Rocky Mountain region and oil production consequently declined. EAI forecasts crude oil production declines in the Rockies of roughly 10,000 to 15,000 BPD (average annual decline presented on a per-day basis) over the next ten years, or a decline rate of between 4 and 4.4 percent per year. Following a steep Rocky Mountain production decline in the years 1993 and 1994, Express projected a 7.2 percent per annum decline in Rocky Mountain oil production over the next decade. The pipeline is designed with the intent of replacing that supply with crude oil from Canada. Energy Analysts International believes that the 1994 decline in crude production (-9.8 percent) is not likely to be sustained and was caused by unusually low world oil prices. As an example of the abnormally high rate of decline, Energy Analysts International cites figures that show for the first third of 1995, Rocky Mountain production increased over 1994 levels.

The Express pipeline project's primary target refineries lie inside the Rocky Mountain region and target refineries in the U.S. Midwest. Most target refineries in the Rockies are designed to process primarily light sweet crude, which has experienced steep production declines as overall Rocky Mountain crude oil production falls. Canada has ample oil production to supply these refineries with replacement light sweet crude if sufficient and economical pipeline capacity exists. Express would serve nearly all target refineries through connections to existing pipelines at a pipeline hub at Casper rather than directly to any refining centers (it could deliver to Billings area refineries, but these are already adequately served by proprietary pipelines).

Few crude oil pipelines serve the Rocky Mountain region. The crude oil pipeline network serving the region is shown in Figure B-1 in Appendix M, page B-15. In general, some of these pipelines, such as the Frontier and Butte pipelines, move Rocky Mountain crude oil from producing areas within the region to refining centers. Others, such as the Platte and Amoco pipelines, move surplus crude out of the region to Midwestern markets. As Rocky Mountain crude oil production declines, the incremental crude to replace it will likely come from Canada, since no infrastructure currently exists that can economically transport oil to the Rockies from other sources. Canadian oil currently moves into the Rocky Mountain region via the Rangeland-Milk River-Glacier pipelines, mostly to Billings area refineries, or to markets south of Billings via the Wascana-Texaco-Butte pipelines.

The refined product network serving the Rocky Mountain region spans Colorado, Idaho, Montana, Utah, Wyoming and eastern Washington. The locations of the Rocky Mountain refining centers and the associated refined product pipeline network are shown in Figure B-5 in Appendix M, page B-19. This network is composed of twelve major local refineries and ten major product pipelines. Four minor refineries serve localized areas. Compared to the Gulf Coast, Midwest, and Midcontinent, the Rocky Mountain pipeline network is relatively simple. Two major markets dominate this network: Salt Lake City and the Colorado Front Range.

The Rocky Mountain supply region is significantly different than other regions because it is rather isolated. Most refined product exchange with other regions occurs as imports from Borger, Texas and El Dorado, Kansas to Denver, Colorado. Major volumes of product move from Texas Panhandle refineries via the Diamond Shamrock and Phillips pipelines and from Midcontinent/Gulf Coast refiners via the Chase pipeline. These import products affect the Colorado Front Range market but do not physically travel further into the Rockies. Important product pipelines within the Rocky Mountain region include Wyco, Continental, Sinclair, Pioneer, Chevron, and Yellowstone pipelines. Product exports from the Rocky Mountain region to the east occur via the Cenex, Wyco, and Cheyenne pipelines, and to the west (eastern Washington) via the Yellowstone (from Billings) and Chevron (from the Salt Lake City area) pipelines.

Rocky Mountain refining capacity is distributed among Colorado, Montana, Utah, and Wyoming. Rocky Mountain refineries are all accessible via pipeline to Canadian crude supplies and are thus potential Express markets. The Montana refineries currently use a large amount of Canadian crude, but are already well served by proprietary pipelines. South of Montana, there is about 372 thousand barrels per day (MBPD) of refining capacity. Based on estimates from crude slates by Energy Analysts International, about 288 MBPD of this capacity requires sweet crude with the balance being sour and asphaltic crude capacity. All of the refineries in Salt Lake City are sweet crude refineries. Colorado's refining capacity is less than half that of the other states in the region, even though the state consumes more products than any other state in the region. With a limited capacity for imports, the Rocky Mountain region represents a more captive market for refiners than the Midcontinent. The major competition for refined product markets is generated by the Texas Panhandle refineries (Phillips and Diamond Shamrock) and those refineries that supply the Chase pipeline. These imports delivered to Denver compete directly with Denver's refineries and refineries in Wyoming and Montana for Colorado's Front Range markets.

Scope of the Alternatives Compared to Express

Energy Analysts International concludes that declining Rocky Mountain crude oil production, coupled with increasing regional refined product demand, is creating conditions that call for some kind of action from the petroleum industry. This action could take the form of increased pipeline delivery capacity, refinery closures, reduced refinery crude runs and retraction of petroleum product exports from the region, increased refined product imports into the region, or some combination of these.

Most of the market responses predicted to address this situation that would affect the Rocky Mountain region are phased, incremental adjustments to the system and are discussed below. In contrast, Express proposes a large scale, long term change to the system. In the past, most Rocky Mountain crude oil pipeline alternatives have been sized to meet regional needs. In the short term, the Express pipeline would greatly exceed the capacity necessary to replenish diminishing Rocky Mountain crude oil supplies, and would need to move significant volumes of crude to the Midwest in order to survive. However, Express does not plan to rely on the capture of significant Rocky Mountain region crude oil transport volumes from existing pipelines, with the exception of Trans Mountain pipeline which serves the west coast.

It is difficult to make direct comparisons between the alternatives and Express because their scopes, timing, goals and approaches are different. The path the petroleum industry follows will probably alter the composition of the Rocky Mountain region's product and crude oil pipelines and refineries. With Express, the changes would occur more quickly than with the market responses discussed under the No Action Alternative. The choices directing the individual players during these changes will be driven by competitive forces. The resulting configuration will be the least cost combination that supplies the region with petroleum products at the lowest price. Because the market is so dynamic, it is difficult to predict the composition of this least cost combination.

In the final analysis, the price of petroleum products will be the driving force shaping the Rocky Mountain petroleum industry. Existing Rocky Mountain petroleum pipelines (many mostly depreciated) can adjust tolls downward to compete with Express. Rocky Mountain oil producers, especially those taking premiums over posted prices for delivery to the Salt Lake City market, can give up premiums to retain markets when faced with the certainty of more Canadian imports. Moreover, the certification of the Express project could spur action from the sponsors of other projects that could be alternatives to Express. Until now pipelines have met crude oil demand with incremental adjustments. A project on the scale of Express could force them to make significant investments to ensure the continued productivity of their assets.

Alternatives Considered In Detail

Three alternatives were analyzed for this document. They include a No Action (Alternative 1), the project as originally proposed by Express (Alternative 2), and an alternative with modifications to the proposed action (Alternative 3). The modifications to the proposed action were developed in response to concerns identified during scoping. The following sections describe each of these alternatives in detail.

Alternative 1 - No Action Alternative

Under this alternative, Express would not be authorized to construct a 24-inch pipeline on public lands to transport crude oil between Wild Horse, Alberta and Casper, Wyoming. The BLM, BOR, and State of Montana would not issue the right-of-way grants or permits for the project. No physical or biological environmental impacts would occur under the No Action Alternative. However, economic effects could occur if the Express Pipeline would not be built.

Should the Express Pipeline not be built, various actions may occur as refineries attempt to acquire crude oil or as the petroleum industry responds in other ways to declining crude supplies. Because the demand for crude oil is derived ultimately from consumers' demand for refined petroleum products, refined product pipelines are also discussed here. Refiners can respond to declining Rocky Mountain crude oil supplies by reducing product exports out of their primary markets and by reducing production to match the reduced oil supply, or by shutting down refinery operations altogether. In summary, the market responses without the Express Pipeline may include some combination of the following actions:

1. Accessing alternative crude oil supplies via other transportation routes (such as expansions or new pipelines);

2. Closure of refining capacity or reducing crude oil runs;

3. Accessing additional refined product through import pipelines such that less crude oil is needed to be refined;

4. Retraction of refined products from export pipelines such that less crude oil is needed.

Accessing Alternative Crude Oil Supplies via Other Transportation Routes

As previously stated, one of Express Pipeline's primary market is the Rocky Mountain region. In response to declining Rocky Mountain crude production, several pipelines have announced plans for crude supply projects that would move Canadian oil into the Rocky Mountain region. These include projects on the Cenex system, the Amoco/Conoco project on the Rangeland-Glacier system, and capacity expansion on the Wascana-Texaco-Butte system.

Cenex Project

Cenex has plans to construct a new 16-inch, 65,000 BPD line from its terminal near Cut Bank to its refinery at Laurel, Montana. The pipeline capacity could be expanded to 100,000 BPD with more pumping capacity. This project is under way (pipe has been purchased). Currently the subject of an Environmental Assessment in Montana, the project has not yet acquired all of its permits. It is not subject to MFSA. Cenex plans to have the facility completed and in operation by the end of 1995. Once completed, the facility probably will increase Canadian heavy crude imports into Billings, displacing Big Horn Basin crude volumes that currently move north into Billings, and shifting some Rangeland-Glacier crude onto the Cenex system. The volume of Canadian imports is limited by Billings area refinery capacity to handle heavy crude, the Big Horn Basin crude production volumes and Big Horn production export volumes to the Midwest. In conjunction with the Amoco/Conoco project described below, this project could open significant pipeline capacity for imports of Canadian light sweet crude to markets south of Billings.

Amoco/Conoco Project

Amoco and Conoco are considering a partnership to construct a 75-mile, 12-inch crude oil pipeline from Billings to Elk Basin, Wyoming. As part of this project, Amoco would acquire part ownership in Conoco's Glacier system from Cut Bank to Billings, and Conoco would acquire part ownership in Amoco's system from Elk Basin to Guernsey. This system could use unused capacity on Conoco's existing Glacier system (more will become available with the Cenex pipeline construction, mentioned above) to move light sweet Canadian crude through Casper and Guernsey for destinations in Utah and Colorado. The capacity of the Amoco-Conoco pipeline segment would be between 40,000 and 60,000 BPD. This pipeline segment would allow space vacated by Cenex on the Glacier pipeline to be used for crude transport to Casper and Guernsey.

Wascana-Texaco-Butte Capacity Upgrades

Capacity on this existing route from Regina to Casper/Guernsey, could be expanded at relatively low cost. From its current 42,000 BPD capacity, the system could be expanded to 55,000 BPD by adding pumping capacity at a single station, and could be expanded to 75,000 BPD by adding an additional pumping station. However, limiting factors include Texaco pipeline capacity, which is currently at 34,000 BPD, expandable to 45,000 BPD with pumping upgrades and tankage limitations at the Regina end of the Wascana pipeline, which create scheduling problems and effectively reduce the system's capacity. The effective potential capacity increase on this system is about 10,000 BPD, enough to match incremental declines in Rocky Mountain production of light sweet crude.

Midwest Region Pipelines

The Express Pipeline's other primary market is the Midwest. This market would be accessed by Express via Amoco or Platte pipeline connections at Casper. Faced with declining Rocky Mountain crude oil production, Midwestern refineries have several supply alternatives to Express. These include several on-going and announced pipeline projects that would add crude transport capacity from the Gulf Coast to Midwest markets. These include:

1. A crude oil pipeline reversed by Mobil from Ringgold, Oklahoma, to Corsicana, Texas. Mobile is currently reversing a major crude pipeline segment from Corsicana to Beaumont, Texas. This will increase access of foreign waterborne crude to Midwestern markets.

2. The Seaway pipeline project which includes new pipe and the conversion of a gas pipeline to move offshore foreign crude from Freeport, Texas, to Cushing, Oklahoma. Pipe for the Seaway project has been ordered.

3. A similar project has been studied by Trunkline Gas to convert a major gas pipeline segment to transport crude oil from Lake Charles, Louisiana, to the Patoka, Illinois, pipeline hub. This project already has refineries representing several hundred thousand BPD of refining capacity as equity partners (Frank Hunter, EAI, personal communication, August 1995).

Capacity and Cost of Other Potential Pipeline Projects

Together, the three Rocky Mountain region projects have potential total incremental capacity to move 50,000 to 85,000 BPD of Canadian crude (or more with upgrades of the Cenex pipeline), enough to satisfy Rocky Mountain crude supply declines through the year 2002 with no Express Pipeline project, no change in refinery operations, and no change in the refined product pipeline network.

Project costs are evaluated only for actions that involve new pipelines. As noted, the Cenex pipeline is anticipating construction, although it has not yet acquired all of its permits. The Express pipeline project is the most expensive of the new pipeline alternatives; Express pipeline capital cost is $395 million. The Amoco-Conoco alternative is estimated to cost 30 million dollars for 75-miles of 12-inch pipe. The cost for expanding the Wascana-Texaco corridor is not known. However, Wascana can by expanded to 77,000 BPD by adding a pumping station and additional pumping capability to an existing pump station. The Texaco system from Poplar to Baker can be expanded to 42,000 to 45,000 BPD with limited investment. Beyond that capacity level the system would have to be looped (EAI 1995). The entire Texaco segment is approximately 137-miles long and assuming a looping cost of $400,000 per mile, the total capital cost would be roughly $55 million.

As noted, the Cenex pipeline is under construction, although it is not known with certainty that the project will be fully permitted and reach completion on schedule. However, the pipe has been acquired and the project is beyond the "proposal" stage of development. The Amoco/Conoco and Wascana-Texaco-Butte projects are under consideration and are not scheduled for construction or seeking permits, but this activity could occur within the next 5 years (EAI 1995). The certification of the Express project might force the sponsors of the latter two projects into action to protect their assets.

The Midwest region pipeline projects have either been completed, are under construction, or are far along in the development stage. Pipeline conversions and reversals do not involve new pipe construction and thus cost significantly less than new pipelines. These pipelines reduce incentives for Midwestern refiners to acquire Canadian crude through the Express-Platte route. Given the outlook for increased pipeline capacity into the Midwestern crude market, it is possible that Express's predicted Midwestern destination volumes will not materialize on a consistent basis. The Express project may have to depend on Rocky Mountain refinery markets for its base level throughput.

Additionally, Interprovincial Pipe Line might have significant excess delivery capacity to the upper Midwest should the reversal of its Sarnia-to-Ontario segment occur. The reversal would retract Interprovincial Pipe Line shipments to eastern Canada, opening a large fraction of Interprovincial Pipe Line's capacity to shipments to Midwest destinations. This reversal is expected in the short term due to competitive pressures from low cost seaborne crude oil imported via the Canadian east coast. This could increase Canadian light crude oil volumes available to Midwestern markets at a lower transportation cost to refineries than either the Express-Platte or Express-Amoco routes.

Regardless of the Sarnia-to-Ontario reversal, Express pipeline would be in direct competition with Interprovincial Pipe Line to provide Canadian crude oil to the Midwestern market. Platte Pipeline is considering conversion to natural gas service or selling the line to a company that would do the conversion. If the Platte Pipeline system is not available to Express this would force Express Midwest destination shipments to move on the Amoco pipeline. Amoco only delivers to the Midcontinent and to Chicago, and no longer delivers crude to the Wood River/Sugar Creek area, which houses large refineries. This would limit Express's Midwestern market access if Amoco pipeline is the only long haul transportation route remaining from the Rocky Mountain to the Midwest. Moreover, the Interprovincial Pipe Line tariff to Chicago is 154 cents per barrel versus 229 cents per barrel on Express-Amoco. Amoco (or Platte) would have to agree to a more favorable joint tariff to support the Express transport route to the Midwest.

Closure of Refining Capacity or Reducing Crude Runs

Several Rocky Mountain refineries are candidates for closure based on lack of environmental upgrade investments, the types of crude oil they utilize (crude slates), corporate commitment and market conditions. Based on crude slates and distillate hydro treater plans, the closure candidates in the Express market area are Amoco-Salt Lake City, Phillips-Woods Cross and Total-Denver. Total, Frontier, and Conoco refineries in the Front Range face additional market pressure from the new Diamond Shamrock product pipeline.

These refineries use between 25,000 to 50,000 BPD of crude each. A refinery closure would offset Rocky Mountain crude production declines, putting off the need for Express delivery capacity for 1 - 4 years each. In the short term, a closure would possibly permit increased crude exports from the Rocky Mountain region to Midwestern states. A refinery closure would not create construction costs unless new product pipeline construction is required to meet existing product demand.

Acquiring Additional Refined Product Through Import Pipelines so Less crude Oil is Needed

Product pipelines could be built so that less crude is needed to be refined. As noted above, the incremental Rocky Mountain petroleum supply could be refined products or crude oil, where historically it's been crude oil from within region. Several product pipeline projects are expected that could change the historical equilibrium. The interregional product pipelines currently being built in the Colorado Front Range area would have the most impact on the Express pipeline market. Taken together, they comprise about 30,000 to 35,000 BPD of excess product pipeline capacity into the Colorado Front Range area, where product demand is currently about 85,000 BPD. It is likely that incremental product demand in that area will be met with incremental product rather than crude oil. In any case, more product imports could reduce the need for incremental crude oil supplies via Express. These projects are described briefly below:

Proposed 30,000 BPD Olympic Pipeline from Puget Sound refineries to Pasco, Washington

This project is currently in the permitting stage. The target date for this project is summer, 1998 (EAI 1995). With this pipeline, Puget Sound product would be shipped across the Cascade Range to eastern Washington rather than up the Columbia River on barges. It would have cost and environmental safety advantages over the current route. The decision to construct this product pipeline project is being driven by cost and environmental factors and would not be affected by the construction of the Express pipeline. Yet as noted previously, this pipeline would probably offset Salt Lake City product exports, which currently run on the order of 5,000 BPD. Additionally, the Chevron product pipeline segment from Pasco to Boise might be reversed in conjunction with the Olympic project, further displacing Salt Lake City exports to eastern Washington and western Idaho. In the short term, this would reduce Salt Lake City crude runs and the need for additional crude oil supplies. Over the long term, the growing Salt Lake City product market would absorb the retracted volumes.

Upgrades of the Explorer Pipeline

Explorer Pipeline is expanding from Houston to Greenville (north central Texas) and increasing the capacity to transport product from Gulf Coast refineries into the Midcontinent and Midwestern market areas. This would tend to increase the availability of Midcontinent product supply to move into the Rocky Mountain market via Chase Pipeline. Chase has debottlenecked its pipeline which effectively added 25,000 BPD of capacity on the El Dorado to Denver segment. In addition to this pipeline expansion, Farmland is increasing the capacity of its refinery in Coffeyville, Kansas, from 65,000 BPD to 125,000 BPD by 1996.

New Diamond Shamrock Pipeline

This pipeline segment from Mckee, Texas to Colorado Springs, Colorado, and with a planned expansion to Denver, Colorado, is expected to be completed in fall, 1995. In the short term, Diamond Shamrock import supply into the Rocky Mountain market could be limited to product volumes retracted from the Dallas market (EAI 1995). The gasoline retraction volume level is approximately 12,000 to 14,000 BPD. This source will likely place competitive pressure on Colorado Front Range prices, reduce refinery margins, and might eventually accelerate refinery closures.

Retraction of Refined Products from Export Pipelines so Less Crude is Needed

With product demand growth and refinery closures, refined product pipeline exports out of the Rocky Mountain region have been retracted. This has been occurring on the Chevron pipeline from Boise to Pasco, the Cheyenne pipeline from Cheyenne to North Platte, and the Wyco pipeline from Casper to Rapid City. Salt Lake City and Colorado Front Range area refiners are faced with direct competition from low cost refined product sources outside of the region. Movement of low cost imports via the proposed Olympic pipeline from Puget Sound to Pasco into the export market for Salt Lake City refineries could force retraction of Salt Lake City exports. Ultimately, Salt Lake City refiners could retract exports from Idaho, Washington and Nevada. Such retractions would lead to reduced crude runs, and possible refinery closures, thus decreasing the demand for Rocky Mountain crude oil supplies. Competitive pressures from product imports could exacerbate the problems of the refineries mentioned above and force refinery closures. Proposed product pipeline projects by Chase and Diamond Shamrock could force closure of refineries in the Colorado Front Range area. Product volumes from closed Colorado Front Range refineries could be made up via Chase, Phillips and Diamond Shamrock product pipelines. These retractions would delay the need for more crude oil delivery capacity via Express.

Action Alternatives

The two action alternatives, Alternatives 2 and 3, considered in detail have many features in common. Overall, they involve the construction, operation, and maintenance of a pipeline and ancillary facilities between Wild Horse and Casper. To minimize repetition among the descriptions of these alternatives, features common to all action alternatives are described first. The specific descriptions of the alternatives focus on differences among the alternatives.

Features Common to the Action Alternatives

Under the action alternatives, Express would construct, operate, and maintain a 24-inch pipeline between Wild Horse and Casper. This pipeline and its ancillary facilities would transport crude oil from Canada to Casper. At Casper, the oil would be transported to refineries throughout the U.S. through the existing system of pipelines.

The action alternatives have many features in common. They include the pipeline and ancillary facilities; timing of construction; methods of construction, operation, and maintenance; and committed mitigation measures. All these features are described in the following sections.

Pipeline and Ancillary Facilities

The pipeline system that would be constructed under both action alternatives includes the 515-mile long pipeline, five pump stations, a meter station, communication system, appurtenances, pig launchers and receivers, test leads, mainline sectionalizing valves and check valves. The pipeline would be 24 inches in diameter, operate at a maximum pressure of 1220 psig, and buried throughout its entire length.

The pump stations would be distributed along the length of the pipeline, initially three in Montana and two in Wyoming (Figure 5). The site-specific locations of the pump stations are shown on Maps 1-7 in Appendix J. The proposed pump stations would be located as follows:

Pump Station Number	Pump Station Name	Milepost
5	Eagle Buttes MT	81
6	Straw MT	157
7	Edgar MT	266
8	Greybull WY	354
9	Kirby Creek WY	413

The initial five stations would enable the pipeline system to pump a maximum of 172,000 barrels per day (BPD). The need for additional pump stations is influenced by the level of customer subscription for capacity and thus overall throughput of the proposed pipeline. The initial configuration of the five pump stations is based on an initial pipeline capacity of 172,000 BPD. Hydraulic studies completed to date indicate that three additional pump stations (two in Montana, one in Wyoming) would be required to achieve a capacity of up to 200,000 BPD. An additional three pump stations (two more in Montana, one more in Wyoming) would be required to reach a capacity of 280,000 BPD.

The stations would be two to three acres in size and located as close as possible to existing access roads and power lines. All the pump stations would be equipped with variable-speed electric, motor-driven pumps to minimize noise and eliminate air emissions. Commercially-obtained electric power would be used at all pump stations. Express is currently negotiating the scope and extent of such construction with local power authorities. Where these power lines would occur on BLM land, the BLM, in conjunction with the appropriate state and local authorities, would issue the right-of-way. On other locations, the appropriate state and local authorities would issue the right-of-way. The pump stations would be fenced and remotely operated from a central control facility in Sherwood Park, Alberta (near Edmonton).

Power for the pump stations would be provided by the Montana Power Corporation in Montana and the Pacific Power Company in Wyoming. The electric utility service and design for the pump stations would be as follows:

1. The Eagle Buttes Pump Station would likely be fed at 115 kilovolts (kV) from a new transmissions line approximately 27 miles long. The transmission cable would be a 795 AAC (Aluminum with Aluminum Conductor).

2. The Straw Pump Station would be fed at 100 kV from a new transmission line approximately two miles long. The transmission cable would be a 336 ACSR (Aluminum Conductor Steel Reinforced).

3. The Edgar Pump Station would be fed at 100 kV from a new transmission line approximately 1.5 miles long. This transmission cable would also be a 336 ACSR.

4. The Greybull Pump Station would be fed at Distribution Voltage (115 kV) from a new transmission line approximately two miles long. The transmission cable would be a 795 AAC.

5. The Kirby Creek Pump Station would be fed at 115 kV from a new transmission line approximately 23.5 miles long. The transmission cable would be a 795 ACSR.

Both Montana Power and Pacific Power incorporate raptor safety considerations into their standard design for all electricity transmission lines because of the phase-to-phase and phase-to-ground clearances in their standard design.

As part of the project, a communications system would be developed, constructed, and controlled from a central control facility in Sherwood Park, Alberta. This system would be developed as part of the overall pipeline system control. Communications, supervisory control and data acquisition (SCADA) would be accomplished through a microwave, satellite or land-based communications system. A satellite-based communications system will be evaluated. The system also would be augmented by local VHF radio systems interfacing with the primary system. The communications system would provide full control over the pipeline's operation, including certain valves, pump stations, and metering station.

Sectionalizing valves would be located with a maximum spacing of 25 miles and in accordance with DOT regulations. Other valves would be installed at environmentally-sensitive locations and at locations otherwise determined to be appropriate by agencies. The valves would typically be above ground at a height of no more than four feet. Summarizing the more salient points with respect to spacing and using the more stringent sections of the code where applicable, the valves should be installed as follows:

1. at scraper trap facilities,

2. on lines entering or exiting tank farms and facilities,

3. at suction and discharge of pump stations to allow isolation of the facility,

LEGEND

PIPELINE ROUTE

EXPRESS PIPELINE (CANADA)

PUMP STATION

METER STATION

Express Pipeline Inc.

FACILITIES MAP

DATE: JUNE 1995 | FIGURE 5

5. at each lateral take-off,

6. at each side of water crossings which are more than 100 feet wide at the high water mark,

7. at locations to limit hazard and accidental discharge, and

8. where maintenance and isolation requirement is necessary.

Additionally, block valves would be installed in locations appropriate for terrain features and in areas where activities pose a risk to external damage to the pipeline. Additional valve placement may be necessary to mitigate potential spills in sensitive areas. Depending upon actual location, it may be necessary to construct permanent roads for access to the sectionalizing valves.

Timing of Construction

Express proposes to begin construction of the pipeline in early July 1996. Construction of the pump stations should begin in April 1996. Construction is scheduled to be completed by October, 1996, and the pipeline should be commissioned and operating by the end of October 1996. Construction would occur using five mainline spreads as shown in Table 1. Pipeline contractors would rely on existing local accommodations for construction personnel. No construction camps are presently contemplated. Final scheduling would consider sensitivities of important species of fish and wildlife and potential land use conflicts.

The proposed construction schedule is shown on Figure 5A. This schedule is representative of all five construction spreads, and the crew size for each individual construction component represents the peak manpower for each individual crew. On each spread, approximately 30 workers would begin clearing and grading the right-of-way. About one week later, trench excavation would begin using about another 30 workers. Within another week, an additional 35 workers would join the workforce to string and bend the pipe. At this point in the middle of July, about 135 workers would be working along the construction spread. Within the next two weeks, the remaining 270 workers, the entire workforce on each spread, would be on the job. Clearing, grading and fabrication would be complete by mid-September and thus reducing the workforce by 80. Construction would be complete by the first week in October. Then, the remaining workforce would consist of 50 workers and 40 maintenance and supervision personnel to conduct testing and begin reclamation. Although not shown on Figure 5A, pump station construction would begin in April 1996 and be complete by mid-October 1996. The construction crew for each pump station would require a peak manpower of 30 workers. The detailed scheduling of activities at specific locations to avoid certain construction windows would be performed during the detailed design phase of the project, and would be identified on the Construction Alignment Sheets, the Environmental Worksheets, and the detailed river crossing drawings.

Table 1 Summary of Construction Spreads for the Action Alternatives

Contract No.	Construction Contract Location	Pipeline Spread	Spread Length (Miles)	Average Production (Ft/Day)	Work Days	Down Days	Spread[1] Size
1	Wild Horse, AB to Denton, MT	1	125	10,640	62	9	410
2	Denton, MT to Rapelje, MT	2	100	9,120	58	9	405
3	Rapelje, MT To MT/WY Border	3	80	7,600	56	9	405
4	MT/WY Border to Black Mtn. Road, WY	4	105	9,120	61	9	410
5	Black Mtn. Road, WY to Casper, WY	5	105	9,120	61	9	410
Total			515				2,040

Note:

1. Spread size shown includes pipeline contractors' personnel only. Approximately 35-40 additional Express personnel will be required on each spread for project management, field engineering, construction and environmental inspection, cultural resources, land services, surveys, radiographic inspection, etc.

FIGURE 5A

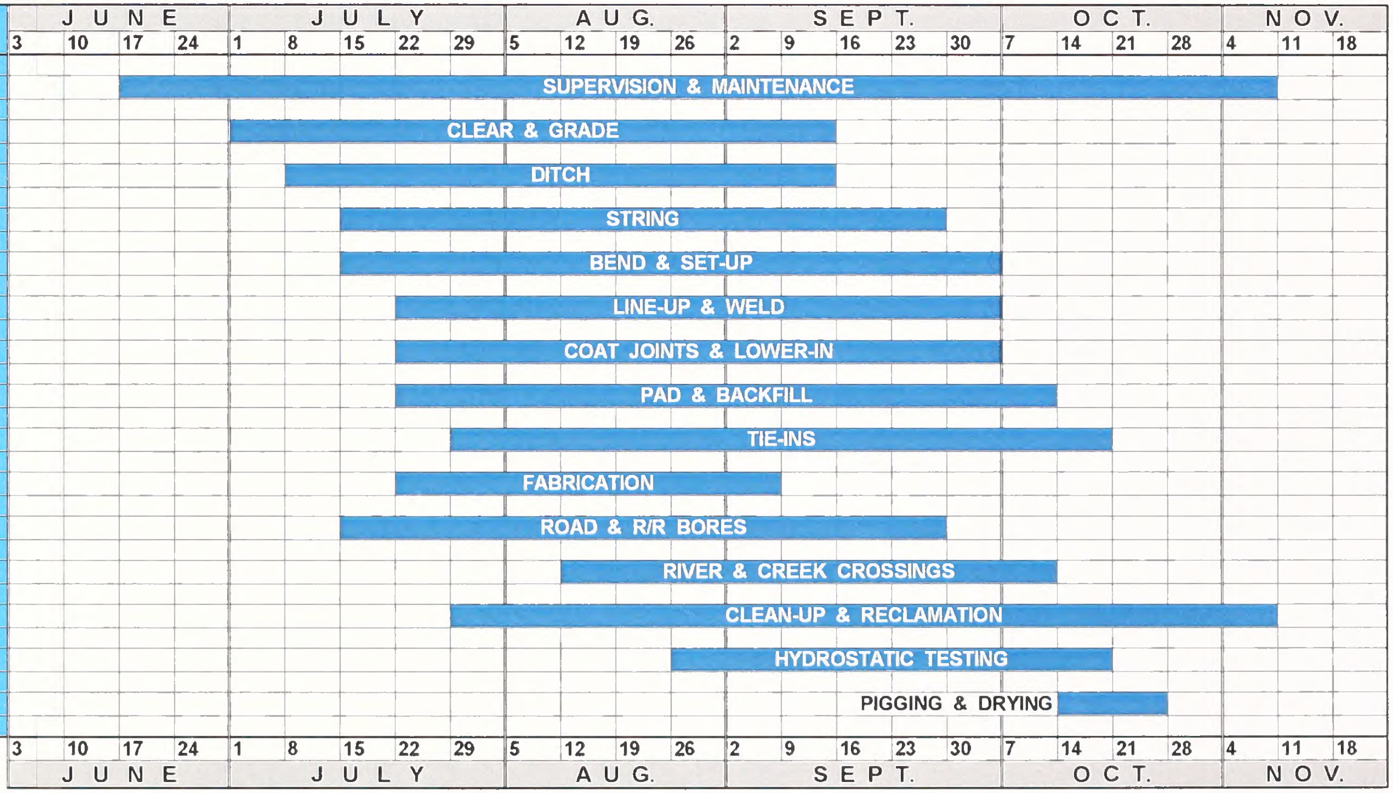
EXPRESS PIPELINE PROJECT

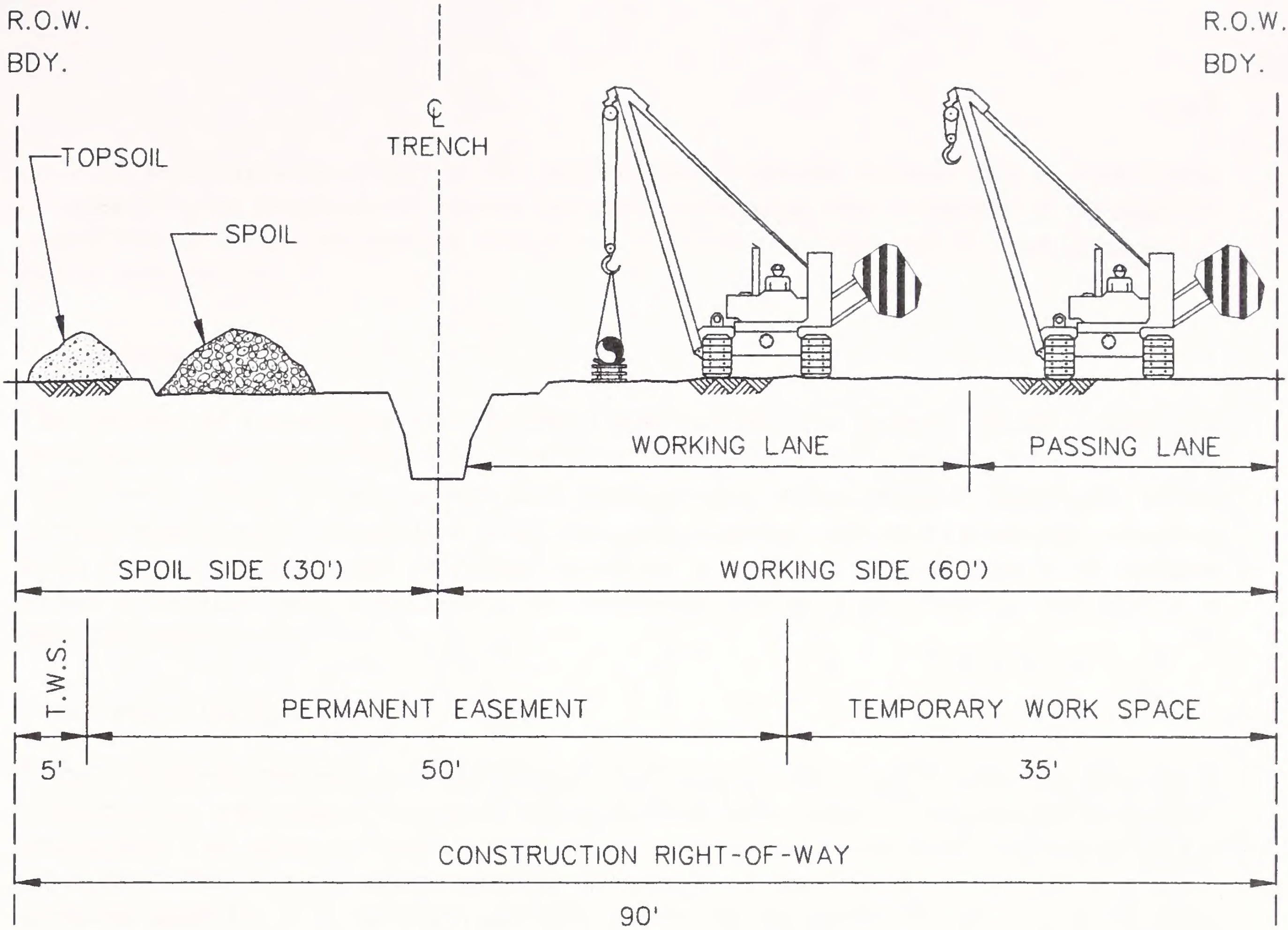
JULY 1995

PROPOSED CONSTRUCTION SCHEDULE

5 MAINLINE SPREADS (Montana & Wyoming)

CONSTRUCTION ACTIVITY	CREW SIZE	START DATE	END DATE
1. SUPERVISION & MAINTENANCE	40	17-Jun	10-Nov
2. CLEAR & GRADE	30	1-Jul	15-Sep
3. DITCH	30	8-Jul	15-Sep
4. STRING	20	15-Jul	29-Sep
5. BEND & SET-UP	15	15-Jul	4-Oct
6. LINE-UP & WELD	75	20-Jul	5-Oct
7. COAT JOINTS & LOWER-IN	25	22-Jul	6-Oct
8. PAD & BACKFILL	20	22-Jul	8-Oct
9. TIE-INS	25	29-Jul	20-Oct
10. FABRICATION	20	22-Jul	8-Sep
11. ROAD & R/R BORES	20	15-Jul	29-Sep
12. RIVER & CREEK CROSSINGS	20	12-Aug	13-Oct
13. CLEAN-UP & RECLAMATION	30	29-Jul	10-Nov
14. HYDROSTATIC TESTING	20	26-Aug	20-Oct
15. PIGGING & DRYING	15	14-Oct	27-Oct
TOTAL PER SPREAD	405		





PROFILE

N.T.S.

NOTES:

1. Right-of-way will typically be 90 feet wide consisting of 50 feet of permanent easement and 40 feet of temporary work space. Additional temporary work space will be necessary at major road, rail and river crossings and at other strategic locations, as required. Certain situations may require a narrower width.

2. This drawing reflects "Trench and Spoil Side" topsoil stripping procedure.

Express Pipeline Inc.

PIPELINE RIGHT-OF-WA

DATE: JULY 1995 | FIGURE 6

At most locations, construction of the pipeline would typically involve four to eight weeks between the initial disturbance of the land and final re-contouring and restoration of the right-of-way. Construction can be expected to advance at an overall average rate of approximately 1.5 to 2.0 miles per day.

Construction

The process of constructing the pipeline would include five primary phases, which are preparation of the right-of-way for construction, installation of the pipeline, restoration of the right-of-way, testing of the pipeline, and commissioning of the pipeline. Installation of the pipeline would involve excavating a trench, stringing, bending, and welding the pipe, lowering in the pipe in the trench, and backfilling the trench. In addition, some sections of the pipeline would be installed using conventional and directional boring. Each phase of construction is described below.

Preparation of the Right-of-Way

In most locations, preparation of the 90-foot wide right-of-way would involve the removal of obstacles (e.g., trees, large rocks, brush and logs) from the permanent easement and temporary construction work space and partially leveling and smoothing abrupt changes in contours along the right-of-way. The permanent easement and temporary work space would have to provide sufficient space for all construction activities and for the temporary storage of spoil (material excavated from the trench) and salvaged topsoil (Figure 6). Fences cut along the right-of-way would be braced on each side of the right-of-way in order to keep the stretch in the fences. Temporary gates would be located at each fence line crossed.

Where the clearing of trees would be necessary, the removal would involve specific steps. First, the right-of-way's boundaries would be suitably flagged to identify trees located outside the right-of-way. Then, trees present along the margins of the right-of-way that are of particularly high value would be fenced off to protect them from damage. After the boundaries and trees are staked, marked or protected, experienced wood cutters would remove the trees slated for removal. Merchantable timber would be salvaged as directed by the property owner. All remaining slash, stumps and other debris cleared from the right-of-way would be disposed of in conformance with special provisions applying to the tract of land involved and all applicable laws, rules and regulations.

After the right-of-way and temporary work space are cleared of trees, top soil would be stripped, the ditch line would be grubbed, and the areas would be graded, as necessary, to create a flat surface for the safe operation of heavy equipment and vehicles. Minimal grading would be required where the terrain is flat or where the right-of-way parallels the fall line of a slope. On excessively steep slopes that would otherwise require an extensive cut, grading will be reduced by using detour access roads for rubber-tired traffic around the slope. Where sidehills are unavoidable, two-toning would be used to reduce the amount of grading necessary. Two-toning involves making two small cuts rather than one large cut so that the working side is higher than the spoil side.

In cultivated and improved areas, topsoil would be handled separately from subsoils or spoil, unless directed differently by the landowner. Topsoil would be stripped over the trench and spoil areas only. Conventional bulldozers and graders would be used to remove topsoil from the trench and areas where the subsequently-removed spoil would be piled. Topsoil would be stored separately from spoil (Figure 6). Where grade cuts result in additional spoil, the spoil may be stored on either side of the construction area. In such cases, the topsoil typically would be stripped from the entire area so subsoil is not stored on topsoil. Topsoil would not be moved more than necessary to minimize handling and would be piled to minimize increases in its water content. No drains and ditches would be blocked by topsoil or subsoil storage piles.

Where the right-of-way passes through environmentally sensitive areas, additional procedures would be followed to reduce impacts. To minimize wind-generated erosion and facilitate restoration of the right-of-way, the roots of existing vegetation would be retained in place as much as possible through the use of brush beaters or similar equipment. This and other techniques to minimize erosion and sedimentation are discussed further in the Reclamation and Revegetation Plan, included as ? to this EIS.

Installation of the Pipe

Over most of the right-of-way, the pipe would be installed using standard trenching and backfilling techniques. Unless existing uses of the land or permits dictate a greater depth, the trench would generally be 36 inches wide and of sufficient depth to provide a cover of 36 inches over the top of the installed pipe. In areas with solid rock, a minimum of 24 inches of cover would be provided. Also, access ways across the ditch would be provided and spaced at convenient intervals to allow landowners, livestock, and wildlife to cross the construction area. Generally, there would be no more than 24 miles of open ditch per construction spread at any given time.

The method used to excavate the trench for the pipe would vary with local conditions. In areas with deep soils, the trench would be excavated with a ditching machine. Hydraulic backhoes would be used where ground conditions are not suitable for ditching machines and wherever a deeper or wider than normal ditch is required, such as at tie-ins. In areas of loose rock, bulldozers equipped with a single shank ripper would precede the backhoes. Solid rock would be drilled and blasted in a controlled manner. Following the blasting, the trench would be excavated using backhoes.

Explosives used in blasting would be used according to all applicable state and federal permits and authorizations, as well as local ordinances. Controlled blasting would be required near power lines, telephone lines, existing pipeline facilities, structures, and buildings to preclude damage by fly-rock, air blast, or vibrations. Fly-rock would be controlled by matting (e.g.

fabricated mats and overburden in-situ and sand-pad matting) as well as through blast design and adequate collaring.

In areas where extensive rock is encountered, the time required for trench construction would increase. To maintain efficiency, longer lengths of the trench would be opened before the pipe is strung, welded, and lowered-in. As a result, in the few areas where extensive consolidated rock would be encountered, the trench may be open for longer periods and the completion of construction activities at a given point would be extended accordingly. During this period, special precautions would be taken to ensure public safety and control erosion.

Underground utility lines crossed by the pipeline would be identified and flagged during the preconstruction phase. Trenching operations near all such utility lines would proceed only after each line's exact location has been determined by hand excavation.

Standard practices would be employed to minimize and control erosion during trenching operations and other construction activities. In any areas where a high ground water table is encountered and de-watering is necessary, water would be discharged in a manner that would minimize sedimentation and prevent off-site erosion and scouring of adjacent waterways. Generally, discharge to the ground is permitted if there is adequate vegetation along the right-of-way to effectively function as a filter medium. In environmentally sensitive areas (e.g. adjacent to streams) where vegetation may be inadequate to function as a filter, bale filters or other appropriate measures would be used to limit siltation. Measures would also be taken to minimize free flow of water into the trench and from the trench into any body of water. Water crossings would be undertaken as described subsequently in this chapter. Additional measures to control erosion and sedimentation are described in the Preliminary Rehabilitation Plan (?).

The stringing operation would involve trucking pipe from designated storage areas or directly from rail cars to the work site and placing them into position along the right-of-way in preparation for bending, lining-up and welding. The location of pipe storage areas and rail sidings would be determined during the detailed design phase of the project. Individual joints of pipe would be strung along the right-of-way, parallel to the centerline of the trench and arranged so they are easily accessible to construction personnel. At stream and road crossings, sufficient pipe would be stockpiled at staging areas near each crossing. Stringing activities would be coordinated with the advance of the trenching and pipe laying crews to minimize the length of time that a specific tract of land is occupied by the various construction crews. Temporary gaps would be maintained coincident with the access ways across the trench to allow landowners, livestock, and wildlife to cross the right-of-way.

In general, pipe would be delivered to the construction area in straight joints and bent on-site to conform to minor changes in the pipeline's alignment and natural ground contours. Bends made in the field would be made by track-mounted, hydraulic pipe-bending machines. Although most bends would be accomplished on-site, prefabricated bends may be required in some areas.

After the pipe has been bent, it would be lined up and welded in conformance with Federal DOT Regulations 49 CFR Part 195, Subpart D, "Construction" and the latest edition of API Standard 1104. The pipe joints would be welded together and placed on skidsupports as a continuous pipeline along the trench. During the welding operation, each weld would be visually inspected by a qualified inspector. Radiographic inspection of the welds would be performed in order to meet or exceed DOT regulations.

Presently, Express expects that pipe delivered to the construction area would be protected with an external coating of fusion bond epoxy (14 mil minimum) or an extruded polyethylene coating. After the welds are inspected and before the pipe is lowered into the trench with sideboom tractors, the welded joints would be coated and any defects or scratches that penetrate the pipe's external coating would be repaired.

Additional inspections would be performed to ensure that:

- The trench is of adequate depth to achieve the minimum cover required over the pipe;
- The bottom of the trench is free of rocks, tree limbs, tree roots, other debris, and water;
- The pipe is properly placed on the bottom of the trench;
- All bends conform to the alignment or contour of the trench; and,
- The external coating on the pipe is not damaged.

If the bottom of the trench is in rock, a sand or soil padding would be placed in the bottom before the pipeline is lowered into the trench. Any soil used for padding would not be dug up from onsite or nearby sources. Rather, the soil would be brought in from off-site sources. Padding may consist of sand bags or foam pillows.

After the pipe is lowered into the trench, inspected, and approved, the trench would be backfilled using a bulldozer, rotary auger backfiller or other suitable machine. In general, backfill would consist of the material originally excavated from the trench. In some cases, material from other areas may be used as backfill. For example, rock would not be backfilled directly onto the pipe unless first crushed on site to prevent damaging the pipe. Where such materials are encountered, earth or sand may be hauled in and deposited around the pipe to form a cushion or pad. No topsoil would be used for such padding. Instead, a man-made protective shield known as " Rockshield" may be wrapped around the coating of the pipe. In areas where topsoil has been segregated, the backfilling operation would involve the replacement of subsoil in the trench, followed by the replacement of topsoil over the subsoil layer. Any excess excavated materials or materials unsuitable for backfill would be disposed of in accordance with applicable regulations and landowner requirements.

During backfilling, construction procedures would be implemented to minimize erosion, restore the natural contour of the ground, and allow normal surface drainage. On cultivated and improved lands where the topsoil is conserved, the subsoil and topsoil would be returned to match the soil horizons on either side of the trench. Trench backfill would be compacted. Excess backfill material would be bermed over the ditch centerline to permit natural settling. Appropriate steps would be taken, such as installing water diversions, with the berming so water would not be channeled along the berm. To prevent erosion along the trench in sloping terrain, burlap-type sacks filled with sand or foam-type or bentonite breakers would be placed within and across the trench. Where the trench intersects streams, wetlands, or ground water and where site conditions might result in drainage from the intersected body of water, the trench would be sealed with impervious materials, such as sack breakers or clay. Sub-drains would be installed if the trench intercepts any springs.

Special Installation Techniques

The methods of installation described above apply to most of the terrain Express would encounter during construction. However, special techniques would be applied to some portions of the right-of-way. These areas include crossings of streams (particularly rivers), roads, railroads, utilities, and canals. Typical methods of construction for these areas are described below.

Stream and River Crossings

All but one crossing of streams and rivers would be constructed using the open-cut method where the trench would be excavated by tracked backhoes moving through the bed of the flowing stream. At the crossing of the Missouri River, the pipeline would be installed using directional drilling techniques instead of trenching and backfilling. The MDEQ has proposed that directional drilling will be the first option used to install this crossing. Directional drilling is discussed later in this chapter.

Handling of the material excavated from the trench would vary with local conditions. If possible, all material excavated from the trench would be temporarily stockpiled out of the water. On larger rivers however, all the material excavated from the trench could not be stockpiled out of the water. At these crossings, the material would be stockpiled on the downstream side of the trench. Gaps would be left in the stockpiles through which the water could flow.

The timing and duration of construction in streams and rivers is important to resource management agencies. To the extent possible, crossings of streams and rivers would be constructed when streamflow is low or non-existent. Also, the segment of pipeline to be placed in the stream or river would be assembled before the trench is excavated to facilitate quick installation once the trench is open. In general, actual work in the stream or river should take no more than one or two days. However, the time during which the trench would be open could be longer if blasting of rock in the stream bed is required. At all perennial rivers and major streams, the pipeline would be buried with a minimum depth of cover of five feet. The perennial streams are listed in Tables 8 and 12 in Chapter 3, and the scour depth calculations for most of these major stream are listed in Tables 11 and 15 in Chapter 3. Depending on the individual river crossings, the depth of burial may be deeper to a depth of twice the calculated scour depth.

In general, streams crossed by the Express pipeline are alluvial bed streams and no difficulties would be expected in the excavation of these crossings. Exceptions would be small streams in the uplands north of the Yellowstone River and the potential for bedrock at the planned excavation depth beneath several of the major river crossings including the Yellowstone River, the Judith river, the Shoshone River, and the Greybull River. Several of the small streams encountered crossings the uplands north of the Yellowstone River and south of the Musselshell River flow on sandstone bedrock. These sandstones tend to be weathered and friable on the surface, and become harder and more competent with depth. Although some difficulty in excavation would be anticipated considering the depth of the excavation required and the nature of the rock, it is anticipated that the use of a large track hoe with a rock bucket would preclude the need for blasting. If the trench could not be excavated with a track hoe and rock bucket, a hydraulic hammer may prove to be the most economic method of completing the trench.

In Montana, installation of the pipeline, culverts, bridges, or other structures, or other instream structures in or beneath perennial streams and other streams with known populations of fish species of special concern would be done following on-site inspections with the MDEQ, the MDFWP, Conservation District representatives, county and/or state floodplain coordinators, the landowner, Express Pipeline personnel and BLM and Corps of Engineers personnel if applicable. During this on-site inspection, the timing of the crossing, method of crossing, depth of burial, and site-specific mitigating measures will be determined. No construction shall begin until this inspection is completed and Express Pipeline is notified of the results in writing.

In addition to the procedures described above, several other procedures would be followed at all crossings of streams or rivers. These procedures are:

- Confining work to allotted right-of-way and temporary work space; (note that additional temporary work space would be required at most crossings);
- Staging areas will be located a minimum of 100 feet from watercourse crossings;
- Maintaining unexcavated areas known as “hard plugs” at the banks until just prior to installing the pipe across the watercourse;
- Minimizing disturbance of approach slopes and banks;
- Obtaining proper authorization, where appropriate, prior to in-stream work;
- Maintaining existing streamflow at all times;

- Minimizing duration of in-stream work by having the necessary equipment and materials for pipe installation on-site and assembled prior to trenching (i.e. the watercourse section of pipe would usually be welded, coated, weighted and tested prior to commencement of ditching);

- Re-establishing bottom contours;

- Providing passage for fish during spawning migrations if construction is permitted to proceed during such times; and,

- Restoring and stabilizing banks of the watercourses to approximate preconstruction condition.

Although all the procedures previously identified would apply to all crossings of streams and rivers, additional procedures may be used at crossings of streams or rivers that are particularly sensitive environmentally. Crossings that may be considered sensitive to pipeline construction include those where:

- water intakes are present downstream of the crossing;

- habitat for threatened or endangered species is present at or downstream of the crossing;

- special-concern habitats (e.g. wetlands or fish spawning areas) are present at or downstream of the crossing;

- fish migrate through the crossing area;

- the crossing or downstream area has high recreational value;

- the crossing and its immediate environs have high-quality visual qualities; or

- the watercourse is navigated by recreational boat traffic.

Preconstruction studies would assess the environmental sensitivity of each crossing and recommend the preferred method of installation, timing of construction, and appropriate mitigation in consultation with appropriate regulatory authorities.

Crossings for vehicles would be installed at most watercourses if approved by permitting agencies. However, if the crossing is too large, construction traffic would use existing bridges and new or existing access trails on either side of the crossing. In general, vehicle crossings would consist of temporary bridges, swamp mats, or culverts and ramps constructed of clean fill. Construction vehicles would not ford flowing streams unless approval is obtained from the appropriate authorities as described previously concerning the approval process concerning water crossings. Upon completion of construction, the vehicle crossings would be removed and the beds and banks of the stream restored to approximate preconstruction condition.

Directional Drilling

This technique, which was developed in the early 1970s, is similar to conventional horizontal boring in that it involves boring a hole under the target object and pulling the pipeline through the hole. However, it differs from conventional boring in two key ways. First, directional boring doesn't require that the drilling head commence the bore hole at an elevation below the target object as is required for conventional boring. The drill path enters the substrata near the ground's natural surface. Second, because the direction of the drill bit can be controlled as it advances into the ground, it can be installed in an arc under the structure with the start and finish points near ground level. Thus, the resulting bore is not horizontal.

Directional boring is a multiple-step process. First, a small-diameter pilot hole is drilled along the designed path. This hole is commonly drilled using a rig designed to drill at an angle from 8 to 18 degrees from the horizontal. A bentonite drilling mud system pumps mud through the drill pipe to power the drill bit and remove bit cuttings from the hole. The drilling mud would be hauled away by truck and disposed of at an approved location. The drill path is designed for the depth and length of the crossing and the diameter of the pipe to be installed. The drill path is monitored electronically and the drilling system is adjusted to steer the drill bit along the required path.

After the pilot hole is completed, it is enlarged to the required diameter by reaming. As with the pilot hole, the mud system is maintained to remove material cut during the reaming. The final diameter of the hole is larger than the diameter of the pipeline that is to be installed through the bore.

In the final step, the pipeline, which was assembled on the ground surface, is pulled through the bore hole, hydrostatically tested, and welded into the adjoining sections of the pipeline. The section of pipeline pulled through the bore is usually treated with additional coatings to protect it from being mechanically abraded while being pulled through the hole.

In general, directionally-drilled crossings are limited to specialized situations. Limitations on use of this technique include costs that may be up to ten times higher than conventional trenching and backfilling methods and an increase in construction time. Also, some subsurface conditions, such as unconsolidated soils or large, cobble conditions, prohibit the use of directional boring.

The size of equipment used for directional drilling is similar to normal tracked equipment used during pipeline construction. The proposed entry workspace would be approximately 1,250 feet from the west bank of the Missouri River. The proposed exit workspace would be about 350 feet from the east bank. Both locations would require about three acres; however, the banks would probably not be disturbed. Water lines would be temporarily laid on the surface during drilling and hydrostatic testing.

Directional drilling should take two to three weeks to complete. However, site preparation would take about a week and demobilization would take about two weeks after drilling is complete. Noise levels of the equipment would be above the general background levels, especially since the drilling would occur 24 hours per day.

Crossings of Highways, Railroads and Utilities

Specific construction techniques for each road crossed along the route would be negotiated with the agency having jurisdiction such as the Department of Transportation, State of Montana and Wyoming Highway Departments, and county planning commissioners in the 13 counties crossed by the pipeline. Highways, developed roads and railroads would be crossed primarily by conventional boring. This type of boring involves digging a large bell hole on both sides of the crossing and auguring a horizontal hole under the ground without damaging the road or rail bed. A section of pipe is then inserted and connected to the pipeline on each side of the crossing. Where required by the road crossing permitting agency, a casing or sleeve would be inserted and a complete section of pipeline placed within. Additional temporary work space will be required at each bored crossing to accommodate the deep bell hole and greater volume of spoil.

Where ground conditions prevent boring and where permitted by authorities having jurisdiction, highways or roads will be open-cut in stages to maintain traffic flow. Most undeveloped roads will be open-cut. During construction, every reasonable effort would be made to eliminate delays or public inconvenience at such crossings and to otherwise avoid restriction of normal traffic flow. At these crossings, appropriate safety procedures would be implemented to prevent injuries to workers and to the public. Flagmen or devices to notify the public of construction, such as traffic controls, night flashers and markers, would be used as deemed necessary by the construction supervisor, safety engineer and authorities having jurisdiction. Cross-over locations would be provided along open trenches, cuts, mounds, and strung pipe to permit passage by people and animals.

In general, underground utilities would be crossed by boring underneath or by carefully exposing the pipeline or cable by hand. Where electrical transmission line and pipeline rights-of-way are intersected, restoration programs would conform to the owner's requirements.

Permanent and Temporary Access Roads

Primary access for construction crews would be public roads and the right-of-way. Temporary access roads may be required in certain areas to minimize travel time between supply points or in areas where natural environmental features, such as a number of stream crossings or steep slopes, make extensive travel along the right-of-way impractical. However, where roads exist close to the pipeline right-of-way, for example in Carbon County, Wyoming, these roads would be used instead of constructing new roads.These temporary access roads would be located and constructed in accordance with the needs of the individual pipeline spreads, landowner requirements, and applicable regulatory authorities. These roads would not be permanently maintained and would not be open for public use. Upon completion of the construction phase, the temporary access roads would be removed and restored in a manner similar to that described for the right-of-way and to the reasonable satisfaction of the landowner. The road grade would be re-contoured and fences would be replaced.

Permanent access roads would be required to access the pump stations and possibly at the locations of selected sectionalizing valves. The locations of permanent and temporary access roads would be determined during the detailed design phase of the project. Anywhere permanent access roads are needed, measures would be taken to prevent off-road vehicular use by the public. Where permanent access roads are constructed on BLM lands, Express would construct and maintain the roads according to BLM standards. Also, the use of flat-bladed roads would be avoided on BLM lands where the road would be used for more than 30 days. Dust control measures, as mandated by the appropriate agencies (BLM, MDEQ, Wyoming Department of Environmental Quality) would be implemented where these temporary roads would be near main roads and farmlands. Methods such as gating and signing would be used to prevent vehicular use by the public.

Crossings of Irrigation Canals

Irrigation canals would be crossed by boring underneath or by open cutting, depending on site-specific conditions. If feasible, the crossing would be constructed when there is no water running in the canal. If boring is technically unfeasible, the canal would be trenched during the dry season with the bed and banks re-compacted and restored to preconstruction condition as soon as possible.

Crossings of Drainage Tile Fields

The pipeline may cross agricultural areas with drainage tile systems. However, the number of these crossings encountered by the pipeline would be few. During construction, temporary measures would be used to ensure that drainage systems continue to function effectively. Any drain tiles damaged, cut or removed during the pipeline construction process would be repaired or replaced.

Wetlands

Given the arid climate in Montana and Wyoming, there are relatively few permanent wetlands crossed by the route. Most of the wetlands are linear features associated with streams. Construction would generally be timed to coincide with the dry period when water tables are low and the ability of wetlands to withstand moving equipment is the highest. Special methods may be used to install the pipe in wetlands. All construction methods implemented would be in accordance with Section 404 permits issued by the Corps of Engineers. For example, trenching may proceed across wetlands with the aid of swamp mats and low bearing pressure equipment. Construction of temporary access roads with geotextiles and fill is currently not envisioned. Hard plugs would be retained to prevent migration of water along the ditch and ditch breakers installed as required to prevent permanent draining of wetlands. The requirement for pipe weighting would be evaluated on a site specific basis and, if required, would be implemented using saddle weights, bolt-on weights, continuous concrete coating or screw anchors. The pipe would either be carried in or pulled into the trench and the trench backfilled as soon as possible in a manner which does not permanently obstruct water flow. Original drainage patterns would be restored. Additional procedures for use in wetland areas are described in ?.

Restoration of the Right-of-Way

After the completion of backfilling, all disturbed areas (including the permanent easement, temporary work space, temporary access roads and stockpile sites) would be restored to their original grades. Any excessively-steep cuts which would be unstable if left in place would be graded back to an acceptable slope. In these areas of excessively steep cuts, gabions (wire cages containing rock) could be used to stabilize the walls. Any remaining trash, brush, or debris would be disposed of in an appropriate manner. Finally, signs would be installed along the right-of-way (at crossings of roads, railroads, navigable waterways, and other locations as necessary) to clearly mark the pipeline's location.

After final grading is completed, the right-of-way would be protected from wind and water erosion and revegetated as described in ?. Revegetation would be accomplished in a manner compatible with preconstruction vegetation patterns. The restoration and revegetation of the construction area would be completed to the approval of the landowner, the surface management agency, or other jurisdictional authority. On cultivated or improved lands, measures would be taken to relieve compaction (if necessary) and remove surface rocks by picking to leave the ground surface in a condition satisfactory to landowners.

Stream and river beds would be returned to their preconstruction contours and banks would be stabilized as appropriate with rip-rap, sand bags, erosion control fabric, or log cribwalls. Where necessary at sensitive stream crossings, specific plans for revegetating the stream banks and approach slopes would be developed in consultation with the appropriate agencies and landowners.

After the final cleanup, the appropriate surface management agency and the landowners would be contacted to determine their satisfaction with the restoration of the right-of-way and temporary work space. Thereafter, periodic aerial and ground inspections of the right-of-way would be conducted and further restoration and revegetation measures would be implemented if necessary.

Testing of the Pipeline

Once installed, the pipeline would be hydrostatically tested in accordance with the Federal Safety Standards of the Office of Pipeline Safety (49 CFR Part 195). Hydrostatic testing involves filling the completed pipeline with water and pressurizing the pipeline for a specific time. Testing would be conducted in segments. The length of each test section would depend on local topography. The hydrostatic test would be performed in sequence, where necessary, by transferring the water from one test section of pipeline to another.

Table 2 identifies the preliminary hydrostatic test sections including lengths, associated water volume required, proposed source of water and discharge locations. Detailed hydrostatic testing plans and procedures would be finalized following the completion of the pipeline centerline profile. After the completion of a satisfactory test, the hydrostatic test water would ultimately be discharged in an approved manner.

The intake and discharge of water for testing would be in accordance with all applicable state water regulations and federal and/or state discharge requirements. Express would obtain Temporary Water Use Permits from the appropriate Montana Department of Resources and Conservation Water Resource Field Offices. Test water would only be obtained from appropriate and approved sources. If test water is withdrawn from a lake or flowing stream, the withdrawal would be in accordance with the regulations of the appropriate federal, state, or local authorities. The water intake would be screened to prevent entrainment of fish. If possible, the test water would be used for successive hydrostatic test sections. Where this practice would not be possible, the water would be discharged into streams or on upland vegetated areas at a rate or in a manner that would minimize erosion. Methods to reduce erosion would include the use of energy dissipation devices, regulation of the discharge velocity, and regulation of the discharge areas. No discharge of water would be made without the appropriate discharge permits. If the test water is discharged into a dry waterway (i.e., an intermittent stream), the discharge rate would not be greater than the permit levels.

At the present time it is not anticipated that any chemicals will be added to the test water. However, depending upon the ambient temperature, the test water may be heated and circulated to prevent freezing during testing. A methanol wash may be utilized following dewatering operations. If used, the methanol would be recovered and reused for further drying runs or disposed of in an approved manner at suitable disposal sites in compliance with those authorities having jurisdiction. The locations of the final tie-ins would be cleaned up and restored following hydrostatic testing.

Commissioning of the Pipeline

After all hydrostatic testing is completed and the test water has been discharged, the pipeline would undergo final preparation and filling with crude oil. Each segment of pipeline would be completely dried using a construction pig, sphere, or other acceptable method. An internal inspection devise would be run through the entire pipe to check for defects. Once this final drying operation is completed, the pipeline would be filled with crude oil.

Table 2 Preliminary Hydrostatic Test Segments

Spread No.	Test Section Number	Starting Milepost	Ending Milepost	Length (miles)	Volume of Test Water (cubic feet)	Water Source and Discharge Location
One	1	0.0	8.4	8.4	132,600	Milk River[1]
	2	8.4	38.6	30.2	476,900	Faulkners Coulee
	3	38.6	68.8	30.2	476,900	Missouri River[1]
	4	68.8	91.8	23.0	363,200	Mud Spring Coulee
	5	91.8	114.7	22.9	361,600	Arrow Creek Bench
	6	114.7	125.0	10.3	162,600	Iowa Bench
	Total			125.0	1,973,800	
Two	1	125.0	145.3	20.3	320,500	Judith River[1]
	2	145.3	171.9	26.6	420,000	Roberts Creek
	3	171.9	198.5	26.6	420,000	Mud Creek
	4	198.5	225.0	26.5	418,500	Middle Creek
	Total			100.0	1,579,000	
Three	1	225.0	241.0	16.0	252,600	Antelope Point
	2	241.0	257.0	16.0	252,600	Yellowstone River[1]
	3	257.0	281.0	24.0	379,000	Bluewater Creek
	4	281.0	305.0	24.0	379,000	Montana/Wyoming Border
	Total			80.0	1,263,200	
Four	1	305.0	319.7	14.7	232,100	Shoshone River[1]
	2	319.7	346.6	26.9	424,800	Greybull Comp. Station
	3	346.6	374.4	27.8	439,000	Bighorn River[1]
	4	374.4	394.5	20.1	317,400	Little Sand Draw
	5	394.5	408.0	13.5	213,200	Kirby Creek
	Total			103.0	1,626,500	
Five	1	408.0	416.0	8.0	126,300	Olsen Draw
	2	416.0	419.5	3.5	55,200	Hall Butte
	3	419.5	429.5	10.0	157,900	Bridger Creek
	4	429.5	440.0	10.5	165,800	Badwater Creek[1]
	5	440.0	460.0	20.0	315,800	E-K Creek
	6	460.0	484.0	24.0	379,000	Middle Fork Casper Creek[1]
	7	484.0	510.0	26.0	410,000	Casper Meter Station
	Total			102.0	1,610,600	

Note:
1. Proposed water source.

Operation, Maintenance, and Safety

Express would operate and maintain the pipeline in accordance with standard procedures designed to ensure the integrity of the pipeline system. The pipeline and associated facilities would be designed for a minimum operating life of 25 years. However, under the proposed design, the system could physically continue to operate safely for much longer.

Operation

Express would operate the pipeline in a batched mode to transport various types of crude oil. Thus, crude oil would flow through the pipeline continuously in segregated batches moving through the pipeline in series. The sizes of the segregated crude batches would vary from 50,000 to 140,000 barrels of oil per batch.

Express would operate the pipeline remotely from a central operations and control center located in Sherwood Park, near Edmonton, Alberta. Personnel stationed at the center would continuously monitor and control the flow of crude oil through the pipeline, monitor and control the operation of all pump stations and other critical facilities, and monitor for leaks from the pipeline. In case of emergency, personnel at the control center can remotely shut down pump stations and dispatch personnel to determine any necessary action.

Maintenance

Maintenance activities would include inspecting project facilities periodically, repairing or replacing equipment, remediating problems with the right-of-way or project facilities. Schedule for inspections would be established in the detailed operation plan Express would prepare before the pipeline is operational. At a minimum, inspections would include patrolling the right-of-way weekly by aircraft, surveying the pipeline's cathodic protection annually, and conducting an internal inspection of the pipeline periodically. In addition, all valves and valve actuators would be inspected semi-annually, operated, and lubricated. All instrumentation and safety devices would be inspected and calibrated in accordance with applicable standards.

Remediation would involve fixing problems with the right-of-way and equipment. Damage to the right-of-way, such as erosion of the soil, would be repaired. Field personnel would maintain the pipeline, right-of-way, and associated facilities and assist with local operation, as required. Maintenance activities and field operations would be coordinated from facilities at district offices located strategically along the pipeline route.

Safety

Standards for safety in the engineering, construction, and operation of a pipeline designed to transport crude oil are set in the DOT Minimum Federal Safety Standards, 49 CFR, Part 195. These regulations define a variety of measures, including minimum pipe wall thickness, location of valves, and the minimum depth at which the pipeline must be buried. In addition, the regulations specify welding procedures, welder qualifications, inspection and weld testing (including frequency of non-destructive testing of welds), and the requirements for leak and strength testing and cathodic protection. The system proposed under the action alternatives would meet or exceed these safety standards.

Also in compliance with Part 195, Express would develop a written operation and maintenance plan for the pipeline. The plan would be designed to monitor and maintain the operational integrity and reliability of the system to thus ensure a high degree of safety. Periodic aerial inspections, annual cathodic protection surveys and internal pipeline inspections would be conducted to monitor for undetected leaks, corrosion, potential effects from any nearby construction or excavation activities, and any other factors that may threaten the pipeline's integrity and pose a threat to public safety.

A cathodic protection system provides a negative voltage to the pipeline. This inhibits external corrosion at any locations with minor damage to the external pipe coating. The negative charge on the pipe attracts positive ions in the soil to flow to the pipe. Since corrosion is caused by the loss of positive ions to the soil, this cathodic protection system essentially keeps refreshing the pipe with positive ions, and thus inhibits corrosion.

In addition, Express would develop an emergency response and contingency plan for operating the pipeline system. This plan would be developed to include and inform local fire, police and disaster services departments as to procedures necessary in the event of a pipeline emergency. The written plan would comply with all federal requirements and provide information such as:

- classification of events that require response;
- effective response to various types of emergencies, including oil spills, explosions, fires and natural disasters;
- communication and coordination with authorities and public officials during emergencies;
- technical data;
- personnel availability in response to emergencies;
- emergency equipment and supply sources;
- evacuation procedures; and
- emergency shutdown procedures.

In the unlikely event of an incident involving the release of oil, Express would implement the requirements set forth in 49 CFR Part 195.

Committed Mitigation

The Council on Environmental Quality defines mitigation as measures that avoid an impact, minimize the degree of an impact, rectify an impact, reduce an impact over time, or compensate for an impact (40 CFR, Section 1508.20). As part of its proposal, Express has committed to a variety of mitigation measures designed to avoid impacts and minimize unavoidable impacts. These measures consist of a variety of procedures and range from general measures to specific procedures directed toward specific resources or activities. The mitigation measures to which Express has committed as part of its proposal have been incorporated into the Preliminary Rehabilitation Plan (?).

Alternative 2 - Proposed Action

This alternative was the proposal that Express submitted to the BLM, BOR, and State of Montana for approval. It was specifically developed to meet the purpose of and need for the project. Also, this alternative was used in the internal and public scoping process to identify issues that the other alternatives were designed to address. Between Wild Horse and Lost Cabin, Wyoming, Express would install most of its pipeline parallel to Altamont pipeline route selected during the NEPA process for that project (FERC 1991). The Express pipeline would generally be within 150 feet of Altamont's route. At Lost Cabin, Wyoming, the proposed pipeline route departs from Altamont's route and proceeds southeast toward Casper. From Lost Cabin, the pipeline would parallel routes for existing or proposed pipelines and an electrical transmission line to the southern terminus in Casper. These pipelines belong to Amoco and the Platte Pipeline Company. The transmission line belongs to the Western Area Power Authority. The general pipeline route is shown on Figure 1 in Chapter 1 and the specific route is shown on Maps 1 through 7 in Appendix J. The realignments where the proposed Express route deviates from the approved Altamont route are addressed in the following paragraphs.

Lonesome Lake Realignment

The original routing for the Express pipeline followed a half-section line in northern Montana from MP 49 to MP 52 from north to south. A minor route adjustment was required to avoid a concentration of historic sites. In conjunction with Altamont, Express shifted the route approximately 3,000 feet west to avoid the sites.

Arrow Creek Breaks Realignment

In the Arrow Creek Breaks area in central Montana, approximately MP 112, Altamont's route ascends 700 feet along a narrow, two-track vehicle trail located in an unnamed drainage that flows north into Arrow Creek. This route would not permit the installation of more than one large-diameter pipeline because of physical constraints. These constraints include considerable relief, a restricted amount of work space, and requirements for specialized measures to stabilize slopes and control erosion.

Routing studies conducted for Express located an acceptable route through the Arrow Creek Breaks about 0.5 mile east of Altamont's route. The Express route was developed after consideration of the construction difficulties encountered in paralleling the Altamont route along the drainage bottom. Thus, from about Milepost 112.0, the proposed route swings east and follows a stable ridge along an existing two-track vehicle trail to the top of Arrow Creek Bench. The road was originally located in the early 1900s and the integrity is still intact. The immediate sideslopes are stable and show no evidence of recent instability. At Milepost 114.2, Express' route rejoins Altamont's route.

The pioneer road that the pipeline would parallel in the Arrow Breaks is a portion of the Benton and Billings Stagecoach Road. The trail was used as-is and was not constructed by grading or building up of a road grade. From the Class III cultural pedestrian surveys, the road is recommended as eligible for the National Register of Historic Places because the site has integrity of setting, location and feeling. Additionally, the site is stable from a geotechnical viewpoint. Thus, it has maintained its integrity. Adverse effects to the road would be mitigated as recommended and approved in the Historic Properties Treatment Plan. Research would further document the establishment, use, and local significance to the economic and social development of the general region of this historic travel route and the dynamics of its eventual abandonment.

Hauck Coulee Realignment

The Express pipeline in the vicinity of Hauck Coulee, MP 147 in central Montana, follows a route previously evaluated by Altamont. The Altamont route was moved approximately 400 feet west to parallel a dam that was installed along a north-south section line. Because there is room for only one pipeline here, the Express route was located back to the east of the original Altamont route.

Historic Well Site Realignment

An historic well site, approximately MP 239 in southern Montana, would have been dissected by the original Altamont route. To avoid a cultural resource and as a safety measure because of the potential for buried facilities, the Altamont route was realigned approximately 150 feet east of the well site. The Express route was realigned to 150 feet west of the site.

North Fork Valley Creek Realignment

The proposed crossing of the creek, approximately MP 244 in southern Montana, would minimize the number of trees and riparian vegetation that would be affected by the Altamont pipeline construction. Aligning the Express pipeline adjacent to Altamont's would impact the trees and riparian vegetation that the Altamont route seeks to avoid. Therefore, the Express route was moved approximately 250 feet west to avoid routing along the creek bottom for 500 feet, eliminate the removal of several trees, and reduce the amount of riparian vegetation affected.

U.S. Route 16 Realignment

Altamont's proposed crossing of U.S. Route 16 east of Worland, Wyoming (approximately MP 376) is close to and east of some commercial buildings situated along the highway. The Express route was realigned approximately 500 feet west to avoid congestion.

Nowater Creek Realignment

In Wyoming, Altamont's route descends steep badlands terrain north of Nowater Creek. Along this descent, the route closely follows an existing Williston Basin pipeline. The combination of terrain and close proximity of two pipelines constrict the work space too much to allow installation of Express' pipeline in the same area.

Again, routing studies located an acceptable route around the restricted work area. At about Milepost 399, Express' route diverges to the east from Altamont's route. This route follows steep, but constructable terrain, crosses Nowater Creek about 500 feet east of Altamont's crossing, and rejoins Altamont's route at about Milepost 399.5.

Kirby Creek Oil Field Realignment

Both the Altamont and Express routes parallel Kirby Creek on the east side through the Kirby Creek oil field in northern Wyoming. Altamont was routed up a narrow ridge south of MP 407 while the Express route was realigned approximately 500 feet west for this 3/4 mile stretch.

Hall Butte Realignment

The route for the Altamont pipeline is located between Hall Butte and a dugout in the vicinity of MP 418 in northern Wyoming. The Express pipeline was routed approximately 250 feet west to avoid visual impacts from transversing the edge of the butte.

Alternative 3 - Proposed Action with Modifications

This alternative was developed in response to issues raised during the scoping and the agencies' review of Express' proposal and consists of variations to the proposed action. Because these variations were individually too small to be considered separate alternatives, they were combined into one alternative. The variations comprising this alternative include minor deviations to the proposed route; different methods of construction, especially across perennial rivers; timing restrictions to lessen potential impacts to wildlife; crossing all perennial streams at the time of low flow, and applying concrete casing at all perennial river crossing. The following sections describe these variations included in this alternative.

Boring the Yellowstone River Alternative

Under this alternative construction method, Express would construct the pipeline essentially as described under the action alternatives. However, the pipeline would be bored under the Yellowstone River. This alternative drilling method was developed in response to a MDFWP wildlife biologist's concerns about effects to the fisheries in the Yellowstone resulting from conventional open cut methods.

Bridger Trail Alternative

This alternative was developed to respond to concerns about adverse effects of the project on the Bridger Trail. The proposed route for Express' project would deviate from the proposed route at approximately MP 425 just south of the Hot Springs–Fremont county line. The route would turn east for about one and one-half miles before turning south and paralleling two pipelines for about two and one-half miles. The pipeline would then again join the proposed route at approximately MP 427. The pipeline would cross the Bridger Trail on privately-owned land in Fremont County at approximately MP 425.5.

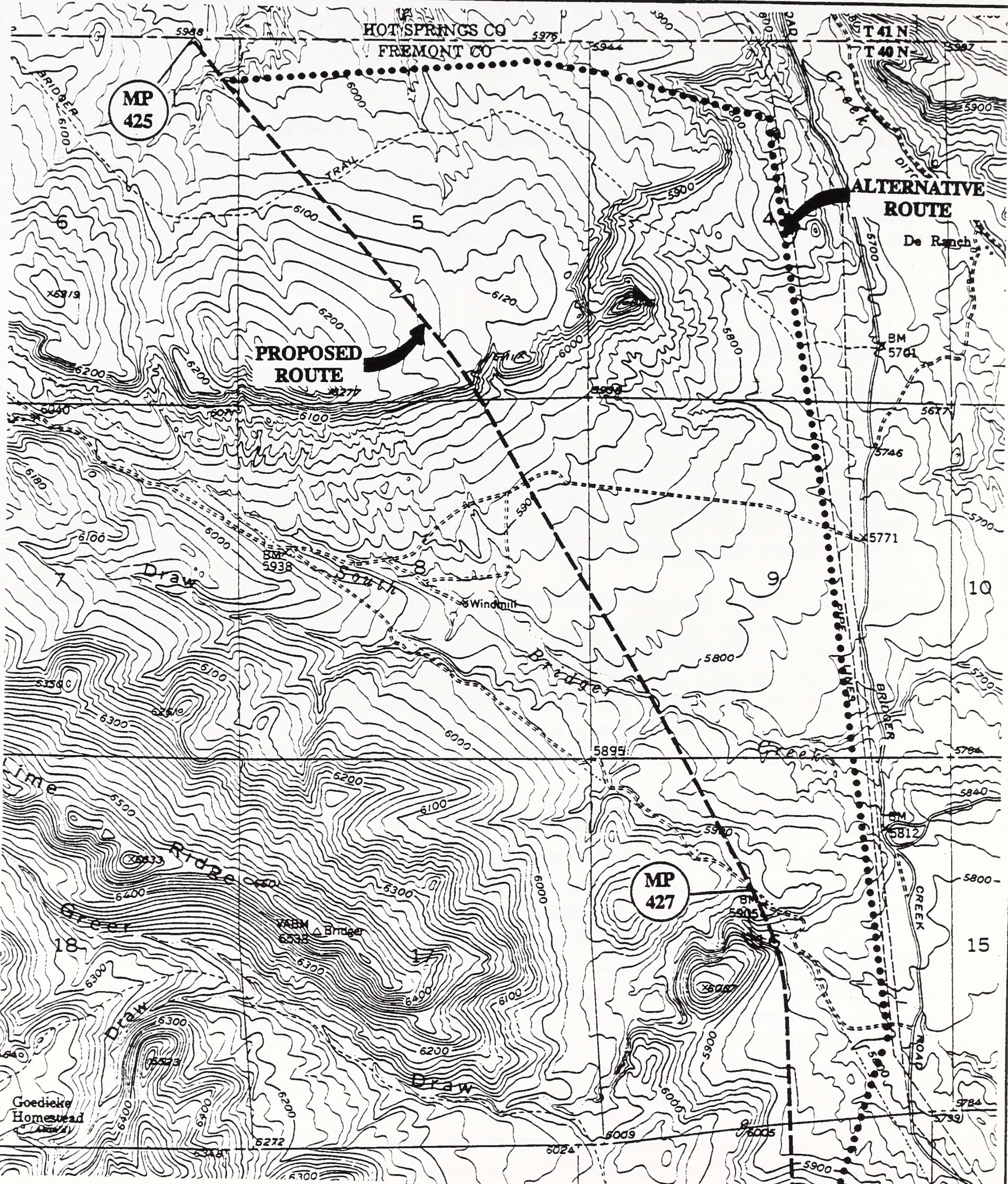
The BLM's Lander Resource Area is concerned about the visual impacts the crossing would have on recreational use of the trail. Every year, rides are conducted along this trail as re-enactment of the original migrations to the northwest. Concerns have been expressed that the disturbance associated with the pipeline's approach and crossing of the trail would adversely affect the experience of people participating in these re-enactments. The deviation from the route of the proposed action alternative is shown on Figure 7. Other than this deviation, this alternative is identical to the proposed action.

South–Central Montana Alternative

This alternative was developed to respond to specific, alternative routing proposed by a respondent during the public scoping. Another reason is that the terrain is too steep north of the Big Ditch irrigation canal for conventional horizontal techniques to be used. The proposed change in routing would occur in Stillwater County, Montana. The single difference between this variation and the proposed action's route is that the pipeline would be routed around property in Section 25 of Township 2 South, Range 22 East. The deviation from the route of the proposed action alternative is shown on Figure 7A. Other than this deviation, this variation is identical to the proposed action.

Wildlife Timing Limitations Alternative

This alternative was developed to respond to concerns raised by the Wyoming Game and Fish Department (WGFD) and the MFWPD. The agencies are concerned that construction of the pipeline be synchronized with seasonal wildlife needs. In particular, the WGFD would prefer to see no construction in crucial big game winter ranges between 15 November and 30 April.



BRIDGER TRAIL
ALTERNATIVE ALIGNMENT

Scale: 1" = 2000' | Date: 6/95 | Figure 7

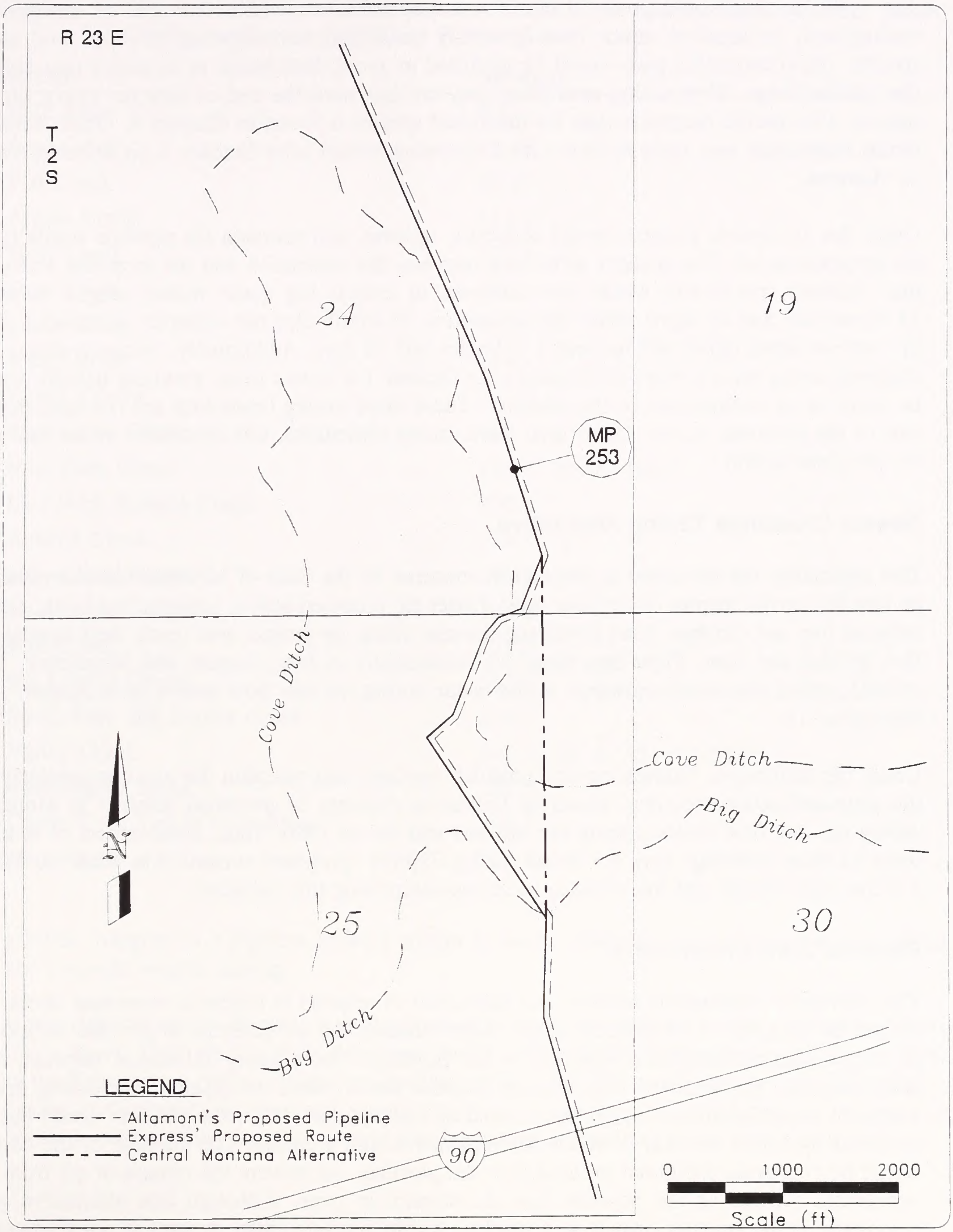


Figure 7A Location of the South-central Montana Alternative Alignment

The agencies also would prefer that no construction occurs within 0.5 mile of threatened, endangered, or sensitive raptor nests generally between 1 February and 31 July. For other species, the construction plan would be modified to avoid disturbance to an active nest before the chicks fledge. This timing restriction may not last until the end of July for every raptor species. The specific restriction date for individual species is found in Chapter 4. Other wildlife timing restrictions may apply to brown trout spawning habitat after October 1 on selected rivers in Montana.

Under this alternative, Express would construct, operate, and maintain the pipeline similarly to the proposed action. The primary difference between this alternative and the proposed action is that Express specifically would not construct in crucial big game winter ranges between 15 November and 30 April under this alternative. It would also not construct within 0.5 mile of a known active raptor nest between 1 February and 31 July. Additionally, Express would not construct across certain rivers in Montana after October 1 if brown trout spawning habitat would be found at or downstream of the crossing. These three timing limitations are not specifically part of the proposed action. Other than these timing limitations, this alternative is the same as the proposed action.

Stream Crossings Timing Alternative

This alternative was developed to respond to concerns by the State of Montana that the pipeline be installed across streams during low flow. Under the proposed action, construction could occur between July and October. Most rivers and streams within the project area reach their maximum flow in May and June. Flow then drops off substantially in July, August, and September. The MDEQ prefers that stream crossings would occur during the low flow period from August 1 to November 15.

Under this alternative, Express would construct, operate, and maintain the pipeline similarly to the proposed action. Express would be limited to crossing 22 perennial streams in Montana during the low flow period during the summer and fall of 1996. Thus, construction of at least some of these crossings may not occur during Express' proposed construction window. Table 3 shows the streams and the crossing locations comprising this variation.

Pipeline Casing Alternative

This alternative construction method was developed to respond to concerns expressed about the long-term integrity of the pipeline under major streams and the potential to provide additional protection against accidental ruptures of the pipeline. The primary difference between this alternative and the proposed action is that Express would install the pipeline in a casing under the major perennial streams and rivers crossed by the pipeline. Thus, the pipeline would not be installed by itself. Instead, it would be contained within a casing. The purpose of the casing would be to provide additional protection to the pipeline and prevent the release of oil from an accidental rupture of the pipeline into the stream or river. Although this alternative was considered in the analysis, installing a pipeline within a casing under streams is not a common

Table 3 Streams in Montana That Express Would Cross During the Low Flow Period During the Summer and Early Fall 1996

Stream	Milepost
Milk River	8.2
Sage Creek	32.8
Flat Creek	95.8
Arrow Creek	111.2
Wolf Creek	122.4
Sage Creek	132.3
Louse Creek	138.7
Judith River	144.1
Hauck Coulee	147.8
Big Coulee Creek	153.1
Ross Fork Creek	153.7, 163.6, 164.5
East Fork Roberts Creek	170.8
Roberts Creek	179.3
Musselshell River	194.1
Mud Creek	197.6
Fish Creek	202.6
Big Coulee Creek	212.6
South Fork Big Coulee Creek	214.2
Valley Creek	247.3, 247.5, 251.3, 251.8
Yellowstone River	255.5
Clarks Fork Yellowstone River	266.3
Sage Creek	287.4

practice. Integrity of a pipeline under a stream is most commonly maintained via a deep burial and concrete weight coating.

Under this alternative, Express specifically would install the pipeline within a casing under six major rivers. They are the Milk, Missouri, Judith, Musselshell, Yellowstone, and Clarks Fork of the Yellowstone rivers. Under the proposed action, the pipe would not be installed within a casing at the perennial river and stream crossings. Other than the installation of the pipeline within a casing under these six rivers, this alternative is identical to the proposed action.

Comparison of Alternatives

Summary of Impacts

Table 4 compares the impacts of the three alternatives described above. The effects on all the resources that would potentially experience impacts from one or more of the alternatives are summarized.

Table 4
Comparison of Alternatives

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Geology	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline would not cross any fault known to be active during Holocene times. A landslide area would be encountered at Kirby Creek, MP 417. No liquefaction or seismic risks areas would be encountered.	Same as proposed action.
Soils	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	63% of soils would have or fair or better rehabilitation potential, 5% poor to fair, and 32% poor.	Same as proposed action.
Hydrology	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline would cross 43 perennial rivers or streams (7 are major, >100 feet wide), 98 intermittent or ephemeral streams, and 331 unnamed drainages. Short-term sedimentation would occur at river and stream crossings during and shortly after construction. Withdrawal and discharge of hydrostatic test water would not exceed 10% of instantaneous flow in the river or stream.	Rivers and streams would be crossed during low flow from July 15 to October 1. Lower flow and velocity would decrease sedimentation from construction. Yellowstone River would be directionally drilled. Cobbled riverbed could result in collapse of drill shaft resulting in a failed effort.
Air Quality	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations. If refineries would close due to alack of crude oil supply, local air quality would improve.	Minor short-term construction dust and vehicle and equipment gaseous emissions. VOC evaporative emissions from each pump station 66 lbs/yr.	Same as proposed action.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Noise	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Short-term construction noise. Pump station noise max of 30 dBA L_{dn} at closest residence is below general background noise of 35 dBA L_{dn}.	Same as proposed action.
Vegetation	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline would disturb 5,618 acres of vegetation (rangeland 2,848 acres, cropland 2,664 acres, wetland 37 acres, and riparian 69 acres). Cropland disturbance would result in loss of one growing season. Rangeland would be restores in 1-3 years except on 32% of lands with poor rehabilitation potential. Committed mitigation would result in no long-term loss of wetland and riparian vegetation.	Same as proposed action.
Terrestrial Wildlife	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Pipeline construction would disturb 413 acres of winter range (164 mule deer, 236 pronghorn, and 13 white-tailed deer). Construction schedule (July-October) would eliminate impacts to big game in winter ranges. However, recovery of shrub vegetation in the winter ranges would take at least five years. Pipeline construction would avoid by ½ miles 16 sage grouse leks from MP 395 to 427 in Wyoming.	No construction would be permitted in winter ranges from November 15 to April 30 to eliminate impacts to wintering big game species.
Raptors		93 raptor nests have been identified within ½ mile of right-of-way. Construction activity from July and early August would impact certain species' chicks that haven't fledged.	Entire route would be re-surveyed for active raptor nests in Spring 1996. Pipeline placemen would be realigned to maintain nests of TES species, and work plan would be modified to avoid active nests of other species until the chicks have fledged.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Fisheries	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Increased sedimentation would impact fisheries for 1-2 weeks construction period at major river crossings (>100 ft. wide), and 2-6 days for major streams (10-100 ft. wide). Sedimentation would decrease 24-48 hours after construction is complete. Blasting may result in fish mortality within 200 ft. of construction. Brown trout spawning habitat would be impacted by construction sedimentation after October 1. Oil spill could damage or destroy aquatic species.	To reduce impacts to brown trout spawning habitat, stream crossing would be completed at nine rivers before October 1.
TES Species	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	25 prairie dog colonies are large enough to be potential black-footed ferret habitat. Route would be re-surveyed in 1996 for prairie dog colonies and black-footed ferrets in appropriate habitat. Raptor chicks may be impacted if construction occurs nearby or nests destroyed.	Entire route would be re-surveyed for active raptor nests in Spring 1996. Pipeline placement would be realigned to maintain nests of TES species and the work plan would be modified to avoid active nests until the chicks have fledged.
Land Use	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	The pipeline construction would temporarily effect 5,618 acres on the right-of-way. An additional 20 acres would be used for pump stations, metering station and valves for the lifetime of the project. The permanent right-of-way would be 3,121 acres. Agricultural and rangeland land uses could resume after reclamation, but no facilities could be constructed over the permanent right-of-way for the lifetime of the project.	Pipeline would be re-routed to avoid irrigated farmland and a steep slope near an irrigation ditch (MP 253). The slope would make boring difficult and the irrigation ditch would have to be trenched during peak irrigation time.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Recreation	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Minor short-term impacts on fishing would occur on major rivers and streams because construction would last one to two weeks.	Pipeline would be realigned at the Bridger Trail (MP 425) in the area of annual celebrations of pioneer migrations. The route would be moved to an area where the integrity of the trail has been compromised.
Visuals	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Long-term visual impacts would occur over 32% of the route where rehabilitation potential is poor. The pipeline would alter views along the Missouri, Yellowstone, Clarks Fork of the Yellowstone, and Greybull Rivers; U.S. Highways 212 and 310 which are primary routes to Yellowstone national Park; and the Bridger Trail.	Pipeline would be realigned at the Bridger Trail (MP 425) in the area of annual celebrations of pioneer migrations. The route would be moved to an area where the visual integrity of the trail has been compromised.
Transportation	No impacts from the project. Effects similar to Express project could occur from other proposed pipeline projects at different times and locations.	Minor, temporary impacts during the morning and evening hours when construction are arriving and departing work site.	Same as proposed action.
Socioeconomics	If the Express pipeline is not built, other proposed and announced pipeline projects (Cenex, Amoco/Conoco, Wascana) could make up the crude oil deficit until 2002. The Cenex line is planned for late 1995, while the Amoco and Wascana lines could be built in the next five years. Also, refineries in Utah and Colorado could close or reduce output. Also, additional refined petroleum products could be imported into the Rocky Mountain region. Finally, refined product could be extracted from export pipeline systems.	Pipeline construction would provide about 500 short-term jobs for local workers. Demands for temporary housing would increase occupancy rates to above 95% in some locations. Pipeline operation would result in $5 million annual ad valorem taxes for Montana and $1 million for Wyoming. Express pipeline should not effect local exploration and production since Wyoming and Montana production declining about 7% annually.	Same as proposed action.

Resource	Alternative 1 - No Action	Alternative 2 - Proposed Action	Alternative 3 - Modified Action
Cultural Resources	Existing resources would continue to experience same levels of impacts due to weathering and low levels of traffic. Opportunity to discover new cultural resources may be lost.	Pedestrian Class III surveys have yielded 337 cultural sites or site segments. 191 are prehistoric, 120 are historic, and 26 are prehistoric/historic remains. The Cultural Resources Programmatic Agreement would determine NRHP eligibility and mitigation to avoid or excavate.	Same as proposed action.
Paleontological Resources	Existing resources would continue to experience same levels of impacts due to weathering and low levels of traffic. Opportunity to discover new paleontological cultural resources may be lost.	18 locations yielding reptile, mammal and bivalve fragments considered important, significant or critical are identified along the pipeline route.	Same as proposed action.
Pipeline Safety and Reliability	No impacts from the project. Effects similar to Express project could occur from other proposed crude oil pipeline projects at different times and locations.	Four spills of less than 50 barrels and two spills over 50 barrels may occur during the lifetime of the project. Although the probability of a spill is very low, impacts to water, fish, vegetation and wildlife would be significant if a spill occurred.	Same as proposed action.

Chapter 3
Affected Environment

This chapter describes the affected environment for the action and no action alternatives. The affected environment is the portion of the existing environment that could be impacted by the project. In general, it consists of physical, biological, social, and economic components.

Data used to describe the affected environment were obtained from a variety of sources. For all but the last 35 miles of the proposed route, data collected for the natural gas and CO_2 pipelines proposed by Altamont and Amoco, respectively, were used to describe the portions of the affected environment common to these projects. These data included information from the literature, files from resource management agencies, and field studies. Data for the 35-mile segment ending at the southern terminus of the project in Casper were obtained from a review of literature, information from resource management agencies, field reconnaissances, and aerial photography.

The descriptions of the physical, biological, social, and economic environments that follow involve a variety of elements. The physical environment consists of geology, soils, hydrology, air quality, and noise. The biological environment includes vegetation; wildlife; fisheries; and threatened, endangered, or sensitive species. Finally, the social and economic environment consists of sections on land use, recreation, visual resources, socioeconomics, and cultural resources.

Geology

Over its entire length, the pipeline route would cross three physiographic provinces. They are the Great Plains, Middle Rocky Mountains, and Wyoming Basin provinces. From the Canadian border to near the crossing of the Clark's Fork of the Yellowstone River (about MP 268), the pipeline would cross two sections of the Great Plains Province. The first section, the glaciated Missouri Plateau, occurs between MP 0 and about MP 97. This segment consists of flat to hummocky glacial till and local patches of outwash gravels and lake sand, silt, and clay overlying mostly Cretaceous shale (Ross 1965). Pre- and post-glacial streams and rivers have incised wide, shallow valleys into the plateau.

Between MP 97 and MP 268, the route crosses the unglaciated Missouri Plateau section of the Great Plains Province. This section is characterized as unglaciated old plateaus, terrace lands, and local badlands. In general, the route crosses broad, gravel-mantled, late Tertiary stream terraces that bevel the bedrock. Within this section of the province, bedrock is weak, erodible shale and siltstone of Cretaceous age (Vine 1956, Vine and Johnson 1954, Zimmerman 1966, Reeves 1929).

From the Clark's Fork of the Yellowstone River to the Copper Mountain area in Wyoming (about MP 432), the pipeline would cross the Middle Rocky Mountain Province. In general, this province consists of complex mountains (mainly anticlinal ranges) and intermontane basins (DeBruin and Johnson 1970). The pipeline would cross terrain that is relatively gentle, except for a few ravines, escarpments, badlands, and steep highland sections in the Copper Mountain area. Bedrock is mostly sedimentary with extensive stretches of shale and mudstone of the Cretaceous and Tertiary Periods.

Between MP 432 and its southern terminus, the pipeline would cross the Wyoming Basin Province. In general, this province consists of elevated plains in various stages of erosion and isolated low mountains (DeBruin and Johnson 1970). Within this province, the pipeline route would cross drab to colored mudstone, siltstone, and sandstone of Eocene age with outcrops of Paleocene and Upper Cretaceous age formations. Beds in the Wyoming Basin generally dip gently to the northeast and contain local folding and faulting.

Geological Hazards

Potential geological hazards present along the pipeline route include landslides, areas of seismicity, zones of liquefaction, and rough terrain. Each of these hazards are discussed below.

Landslides

Six landslides of Quaternary age (last two million years) have been identified along the pipeline route (Case 1986b, Case et al. 1984). Table 5 describes these six landslides. In general, landslides are limited along the route because of the dry climate and lack of steep, undercut slopes in incompetent rock, such as shale and mudstone.

Areas of Seismicity

The pipeline route does not cross any major seismic areas in either Montana or Wyoming (Reagor et al. 1985a, Case 1986a). It is located more than 100 miles from the Yellowstone seismic region. It also is several miles east of the Intermountain Seismic Belt, a zone of major earthquakes and regional extension.

Few earthquakes have occurred near the pipeline route. In Montana, seven small earthquakes occurred within 25 miles of the route (Reagor et al. 1985a, see also Qamar and Stickney 1983). The highest recorded intensity for these earthquakes was III on the Modified Mercalli scale. Since 1985, no earthquakes above the Richter Scale 4.0 have occurred within 100 miles of the proposed pipeline (MBMG 1995). A Richter Scale 4.0 earthquake is roughly equivalent to a Modified Mercalli scale of III to V.

Table 5 Summary of Known Landslides Along the Proposed Express Pipeline Route

Mile-post	Location	Description of Slope Intensity
Montana		
74.6-74.8	South side of the Sag	Hummocks suggest old, completely stabilized and vegetated slumps in Cretaceous shale and mudstone on lower half of bluffs; slumps are probably Late Pleistocene in age. Upper third of slope is underlain by glacial till. Care is needed to avoid reactivating slumps, but no major shift in right-of-way is indicated. Also in this vicinity on steep shale slopes are small, surficial earth flows a few inches thick, on grassy slopes overlying shallow black Colorado (Cretaceous age) shale.
112.9-115.0	Arrow Creek	To the west of the Express route, along the Altamont route, active and inactive slumps and complex slump-earth flows in dark gray marine shale of Colorado Group (Early Cretaceous age); some are shallow, some deep. Based on aerial photo interpretation, slopes mostly have continuous ground vegetation, but there is little rounding of head scarps and other ground breaks, suggesting some movement within the past one hundred to several thousand years. A few areas are active with fresh ground breaks which suggest very shallow slumps, mainly from Milepost 114.2-115.0. Adjacent gulches along the Arrow Creek Badlands have similar unstable ground.
		The Express route stays east and north of slumps by ascending slopes at north end of Arrow Creek Breaks and then following a stable ridge. Ground reconaissance indicated minor soil creep and ersosion on steepest areas; however, no soil slumps or evidence of slope instability was noted along the Express route.
133.7-134.9	Sage Creek	South approach slope has old, stabilized slumps in incompetent Cretaceous shale. They pose no serious problem to pipeline construction.
Wyoming		
416.2-416.4	West Kirby Creek	Inactive slump on valley sideslope below (east of) bench and right-of-way. No threat to pipeline construction.
417.0-417.1	West Kirby Creek	Small inactive slump on right-of-way where creek has undercut stream terrace. During detailed design phase, a possible minor adjustment of right-of-way westward on terrace, away from stream, will be considered.
417.8-418.1	West Kirby Creek	Active and inactive slump-earth flow complex in Mowry Shale (Early Cretaceous age) on steep slope where right-of-way exits southeast from the valley to reach a high pediment bench. Based on aerial photo interpretation and site views, the slope is well vegetated but has local fresh ground breaks, and there is little rounding of headscarps and hummocky terrain., suggesting ongoing movement over the past one hundred to several thousand years. During the detailed design phase of project, a reroute around the slide area will be considered. To the northeast is a good route up a sloping bench; to the southwest is a stabilized slope which was possibly active during the Late Pleistocene, but certainly not within the past several thousand years.

In Wyoming, 21 earthquakes occurred within 25 miles of the pipeline route. Of this total, eight occurred in the Copper Mountain area. The rest of these earthquakes were located south of the Copper Mountain area. Three of the 21 earthquakes had an intensity of V on the Modified

Mercalli scale and two had an intensity of IV. Since 1985, no earthquakes above the Richter Scale 4.0 have occurred in Wyoming within 100 miles of the proposed pipeline (MBMG 1995).

The proposed pipeline route crosses two thrust faults south of the Missouri River crossing at MP 70.0 and 70.8. These faults are the result of folding due to horizontal compression (Reeves 1925). The dip of the faults is steep, 60 to 70 degrees. The faults are several miles long with the downthrown side at the north for the fault at MP 70.0 and on the south for the fault on MP 70.8. The geology in the area consists of the Cretaceous Eagle Sandstone Formation forming the surface underlain by the Cretaceous Colorado Shale Formation. Recent glacial till and Halocene surficial deposits overlay the surface and the bedrock formations are visible only on the drainages. Both faults are visible as dark Colorado Shale faulted against the younger Eagle Sandstone. The faulting does not extend into the recent glacial and surficial deposits. Reeves (1925) reports that the faulting affects the Late Cretaceous-Early Tertiary Lance Formation. There is no evidence of post-Lance faulting (Nebel 1995).

Several small faults exist in the Arrow Creek area near MP 112 (Reeves 1928). Two north to northeast trending faults occur about one mile west of the pipeline route. The faults affect the Cretaceous Colorado Shale Formation that forms the surface in this area. There is no evidence suggesting recent fault movement and, based on visual review (Nebel 1995), the faults do not extend east into the area of the pipeline route.

The pipeline route also crosses the Lake Basin Fault Zone between MP 215.0 and MP 219.2. The Lake Basin Fault Zone is a long (approximately 60 miles), narrow (approximately 6 to 8 miles) belt of shearing along the southern flanks of the Big Coulee-Hailstone Dome and Broadview Dome. The fault zone trends northwest-southeast and consists of a series of parallel to en-echelon, normal faults. The faults trend from N 12 degrees to N 35 degrees and dip from 10 degrees to 80 degrees southeast predominantly (Hancock 1918). The stratigraphic units displaced range from the Upper Cretaceous Colorado Shale Formation to the Upper Cretaceous-Early Tertiary Lance Formation.

No displacement of post-Lance Formations have been mapped in the Lake Basin Fault Zone. Field observations (Nebel 1995) in the vicinity of the pipeline route have not indicated that there has been post-Lance movement of the faults in that region. The pipeline route crosses the fault zone in an area of thin Tertiary and Quaternary sediments. No fresh fault scarps are visible.

The pipeline route also crosses the Fromberg Fault Zone at MP 268.0. The Fromberg Fault Zone is one of a series of longitudinal faults in an area extending from the Wyoming state line to north of Fromberg, Montana (Kappen et al. 1922). Where the pipeline route crosses the Fromberg Fault Zone, there are two parallel faults separated by a graben ranging from one-half to one and one-half miles wide with a maximum displacement of 400 feet (BGS 1954). The geology at this location consists of deep Quaternary Colluvial deposits over the Cretaceous Telegraph Creek Formation. Field observations (Nebel 1995) indicate that there is no evidence of the fault trace on the surface. The trace of the fault is evident on the bedrock slopes north of the pipeline route where the Telegraph Creek Formation is faulted against younger Cretaceous formations. The fault reportedly affects the Late Cretaceous-early Tertiary Lance Formation south and west of Fromberg, Montana. There is no evidence of post-Lance movement along the fault zone. No fresh fault scarps are visible and the trace of the fault is apparent only by subtle stratigraphic changes.

The pipeline route crosses two fault systems in Wyoming. The Cedar Ridge/Dry Fork and the Stagner Creek fault systems separate the Wind River Basin from the Copper Mountains. The pipeline route crosses these systems near MP 432. At the point of crossing, the Cedar Ridge/Dry Fork fault shows no evidence of Quaternary movement. However, field evidence indicates the Stagner Creek Fault system has moved during the Late Pleistocene. The Stagner Creek Fault system may have recurrence intervals of surface displacement on the order of 8,000 to 20,000 years (Geomatrix 1988a as cited in Case 1988).

Liquefaction

The potential for liquefaction occurring along the pipeline route is very low in Montana and low in Wyoming. No areas prone to liquefaction were identified in Montana. However, in Wyoming, areas prone to liquefaction occur at Badwater Creek (about MP 440). An evaluation of the area indicated the presence of a high water table and sandy soils. Thus, there is a potential for liquefaction along the floodplain where abundant sandy deposits are interbedded with overbank silt and pebbly channel gravels. Although the potential for liquefaction exists at Badwater Creek, the presence of non-sandy materials reduces the likelihood of liquefaction occurring at this location.

Rough Terrain

Rough terrain includes badlands, steep slopes, and ravines. As shown on Table 6 , most of the areas of rough terrain occur in Wyoming. Most of the rough terrain crossed by the pipeline route consists of badlands in Wyoming.

Soils

The development of soil is a function of a variety of factors, including climate, parent material, topography, vegetation, and organisms present in the soil. Soils along the pipeline route in Montana and Wyoming are strongly affected by parent material and slope. The arid climate, which ranges from very hot to very cool, directly affects and reduces vegetative cover and activity of soil organisms.

Characteristics of soils pertinent to construction of pipelines and the potential for rehabilitation of disturbances are slope, depth to bedrock, depth of topsoil, texture, depth to water table, electrical conductivity (EC), and sodium adsorption ratio (SAR). Characteristics of lesser importance to construction, but important to the potential for rehabilitation include permeability, drainage, and susceptibility to erosion by wind and water. Appendix C describes the methods used to identify restrictive features of soils crossed by the pipeline route as well as the characteristics of each soil unit crossed by the pipeline route by county.

Description of Soils Present Along the Pipeline Route

In Montana, the pipeline route crosses a variety of soil associations (**Figure 8**). To facilitate their discussion, these associations have been grouped into three regions. Region one consists of soils formed in glacial till. Region two is comprised primarily of badlands. Region three includes soils formed in a variety of sedimentary bedrock materials (claystones, siltstones, sandstones).

Region one (MP 0.0 to about MP 96.6) consists of deep, relatively gently sloping, well-drained, fine loamy to clayey textured soils. Most of this area is used for dryland farming and has a fair to good rehabilitation potential. Depth of topsoil generally ranges from 6 to 12 inches. Restrictive features include high ECs and SARs. Other constraints that normally occur near stream crossings include slope, high water table and flooding.

Region two is comparatively short (about MP 96.6 to MP 115.0) and consists of badland uplands and slopes and alluvial lowlands. The badlands are a mixture of steep slopes, rock outcrops, and shallow soils. Soil textures are predominantly clay loams. Restrictive features include slope, shallow soil and rock outcrops. Depth of topsoil ranges from two to 12 inches. The rehabilitation potential of badland uplands is poor to fair.

The alluvial lowlands of region two consist of deep, nearly level, silty clay loam to sandy loam soils. Restrictive features include a high water table and high ECs in a few locations. Depths of suitable topsoil range from 9 to 12 inches. The rehabilitation potential of badland lowlands is fair to good.

Region three (approximately MP 115.0 to MP 305.0) consists of shallow to deep, undulating to steep, well-drained, clay loams, silt loams, loams, sandy loams, and loamy sands. Restrictive features include steep slopes, shallow soils and bedrock (sandstone, siltstone and shale) in the uplands and high ECs, SARs, heavy clays, high water tables, and flooding in the lowlands. Depth of topsoil ranges from 4 to 12 inches. The rehabilitation potential for most of the region is fair to good.

In Wyoming, the pipeline route crosses a variety of general soil associations (shown in **Figure 9**). As with the discussion of Montana soils, the general soil associations crossed by the pipeline route in Wyoming are grouped into three regions to facilitate their discussion. Region one includes soils of intermountain basins and foothills. Soils of mountains and mountain valley are included in the second region. The third region includes soils of the Eastern Wyoming Plains.

Table 6 Summary of Rough Terrain Crossed by the Proposed Express Pipeline Route

Milepost	Location	Description
Montana		
95.8-114.0	Flat Creek to Arrow Creek	Soft clayey ground, bentonitic, very soft when wet; local frost heaving and saline seeps. Frost heaving should not be a problem for the more deeply-buried pipeline.
198.2-220.0	Hills south of Musselshell River	Hilly with sandstone hogbacks (MP 199.4-201.5); local rough ground.
255.6-256.7	Bluffs south of Yellowstone River	Gullies, steep slope.
276.4-282.6	Bluewater Creek	Hilly, dissected terrain with local badlands and headwaters ravines; local side-hilling; possible detailed design work.
Wyoming		
314.319.0	Slopes north of Lovell	Incipient badlands developed in sparsely vegetated Cretaceous shale and mudstone; local gullying.
328.8-332.0; 333.3-333.5; 335.0-336.4	South of Lovell	Badlands and incipient badlands in gray, bentonitic Cretaceous shale; local saline crusts and seeps; local accelerated soil creep affecting upper 2-3 feet of ground. Soil creep and frost heave should not be a problem to the more-deeply buried pipeline.
344.4-345.3	North of Greybull	Badlands in Willwood (Paleocene age) Formation, in shale and mudstone.
347.7-345.3	Northwest of Greybull	Local and incipient badlands.
351.1-351.6; 353.2-353.3	West of Greybull	Badlands at steep valley side slopes, on west-dipping (25-degrees) Cretaceous mudstone and sandstone; local saline crusts.
353.5-358.6	West of Greybull	Local and incipient badlands.
361.0-361.2	South of Greybull	South approach to Elk Creek is steep, 100-feet high, badlands and gully; possible detailed design work.
363.0-363.2	South of Greybull	Badlands.
364.9-368.6	South of Greybull	Local incipient badlands in Willwood Formation.
380.8-382.6	Northeast of Worland	Incipient badlands in bentonitic shale.
385.7-386.8	Southeast of Worland	Badlands in Willwood Formation.
390.1-390.9	Southeast of Worland	Badlands gulches incised into Banjo Flat.
392.4-392.9; 394.1-394.8; 397.8-398.0	Southeast of Worland	Badlands; some sandstone.
398.7-399.7	Southeast of Worland	Badlands, steep slopes and gulches on approaches to Nowater Creek. Rehabilitation difficult. Detailed design phase might consider local rerouting.
405.3-406.8	Southeast of Worland	Incipient badlands in gray Cretaceous shale; several incised gullies in bench north to Milepost 403.0
411.2-412.3	East of Thermopolis	Incipient badlands in Cretaceous shale and siltstone.
416.4-416.7	Flank of Copper Mountain	Steep, long slope dropping down from bench to West Kirby Creek, across shale and sandstone.
421.5	Flank of Copper Mountain	Incised gulch at bottom of valley.

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10 0 10 20 30 40 MILES

SCALE

SOURCE: USDA 1978

SHEET 1 OF 2

Express Pipeline

SOIL ASSOCIATIONS - MONTANA

DATE: JUNE 1995

FIGURE 8

LEGEND

ARIDIC/USTIC-FRIGID:

Ap — ENTISOLS-ARIDISOLS-INCEPTISOLS-MOLLISOLS: NEARLY LEVEL TO STRONGLY SLOPING SOILS ON LOW TERRACES, FANS AND FLOOD PLAINS

- Ap1 Torrifluvents
- Ap2 Camborthids-Torrifluvents-Torriorthents
- Ap3 Camborthids-Natrargids-Torrifluvents
- Ap4 Ustochrepts-Ustifluvents-Argiborolls
- Ap5 Ustifluvents-Haploborolls-Argiborolls
- Ap6 Haploborolls
- Ap7 Haploborolls-Argiborolls-Ustifluvents

USTIC-FRIGID:

Gb — MOLLISOLS: NEARLY LEVEL TO STEEP SOILS ON FANS, BENCHES, AND TERRACES

- Gb1 Argiborolls-Haploborolls
- Gb2 Argiborolls-Lithic Haploborolls-Haploborolls
- Gb3 Argiborolls-Ferroborsifs-Haplaquolls
- Gb4 Argiborolls
- Gb5 Argiborolls-Calciborolls
- Gb6 Calciborolls

Gf — MOLLISOLS: MODERATELY SLOPING TO STEEP SOILS ON FOOTHILLS

- Gf1 Argiborolls-Lithic Argiborolls
- Gf2 Argiborolls-Haploborolls
- Gf3 Calciborolls-Haploborolls
- Gf4 Haploborolls-Ustorthents
- Gf5 Haploborolls-Lithic Haploborolls

ARIDIC-FRIGID:

Kb — ARIDISOLS-MOLLISOLS: NEARLY LEVEL TO MODERATELY STEEP SOILS ON FANS, BENCHES, AND TERRACES

- Kb1 Calciorthids-Torriorthents
- Kb2 Calciorthids-Haplargids-Argiborolls
- Kb3 Calciorthids-Argiborolls-Camborthids
- Kb4 Calciorthids

USTIC-FRIGID:

Nh — ENTISOLS-INCEPTISOLS-MOLLISOLS: STRONGLY SLOPING TO STEEP SOILS ON SEDIMENTARY BEDROCK PLAINS AND HILLS

- Nh1 Haploborolls-Calciborolls-Argiborolls
- Nh2 Ustochrepts-Ustorthents-Haploborolls
- Nh3 Ustorthents-Lithic Haploborolls-Argiborolls
- Nh4 Ustorthents-Ustochrepts
- Nh5 Ustochrepts-Ustorthents
- Nh6 Ustorthents-Haploborolls

Np — MOLLISOLS-ENTISOLS: NEARLY LEVEL TO STRONGLY SLOPING SOILS ON SEDIMENTARY BEDROCK PLAINS

- Np1 Argiborolls-Ustorthents
- Np2 Argiborolls-Lithic Argiborolls
- Np3 Ustorthents-Haploborolls-Natriborolls
- Np4 Calciborolls-Haploborolls
- Np5 Ustorthents-Argiborolls
- Np6 Haploborolls-Ustochrepts-Ustorthents

Og — MOLLISOLS-ENTISOLS: UNDULATING TO STRONGLY ROLLING SOILS ON GLACIAL TILL PLAINS

- Og1 Argiborolls-Haploborolls (loamy)3/
- Og2 Argiborolls-Haploborolls (clayey)4/
- Og3 Argiborolls-Ustorthents (thin solum)5/
- Og4 Argiborolls-Ustorthents (thick solum)6/

ARIDIC-FRIGID:

Ph — ENTISOLS-MOLLISOLS: STRONGLY SLOPING TO STEEP SOILS ON DISSECTED SEDIMENTARY BEDROCK PLAINS AND HILLS

- Ph1 Torriorthents (shallow)-Argiborolls-Camborthids
- Ph2 Torriorthents (shallow)-Lithic Torriorthents-Torrifluvents

Pp — MOLLISOLS-ARIDISOLS: NEARLY LEVEL TO STRONGLY SLOPING SOILS ON SEDIMENTARY BEDROCK PLAINS

- Pp1 Argiborolls-Haploborolls-Lithic Argiborolls
- Pp2 Argiborolls-Haplargids-Lithic Torriorthents

Sg — MOLLISOLS-ARIDISOLS: NEARLY LEVEL TO HILLY SOILS ON GLACIAL TILL PLAINS

- Sg1 Argiborolls-Haploborolls
- Sg2 Argiborolls-Paleargids-Natrargids
- Sg3 Argiborolls-Torriorthents-Natrargids

St — MOLLISOLS: NEARLY LEVEL TO MODERATELY STEEP SOILS ON GLACIAL OUTWASH TERRACES AND STREAM TERRACES

- St Argiborolls-Haploborolls

Tb — ARIDISOLS-MOLLISOLS: NEARLY LEVEL TO STEEP SOILS ON FANS, BENCHES, AND TERRACES

- Tb1 Haplargids-Haploborolls-Argiborolls
- Tb2 Natrargids-Haplargids
- Tb3 Camborthids

Th — ENTISOLS-ARIDISOLS: STRONGLY SLOPING TO STEEP SOILS ON DISSECTED SEDIMENTARY BEDROCK PLAINS AND HILLS

- Th1 Torriorthents-Camborthids
- Th2 Torriorthents (shallow)-Camborthids-Torriorthents
- Th3 Torriorthents (shallow)-Torriorthents-Camborthids
- Th4 Torriorthents-Torriorthents (shallow)-Camborthids
- Th5 Torriorthents-Lithic Torriorthents-Camborthids
- Th6 Torriorthents-Natrargids

Tp — ARIDISOLS-ENTISOLS: NEARLY LEVEL TO MODERATELY STEEP SOILS ON SEDIMENTARY BEDROCK PLAINS

- Tp1 Camborthids-Haploborolls-Argiborolls
- Tp2 Camborthids-Torriorthents (shallow)
- Tp3 Camborthids
- Tp4 Camborthids-Torriorthents
- Tp5 Haplargids-Camborthids-Natrargids

ARIDIC/USTIC/AQUIC-FRIGID:

Vh — ENTISOLS-ARIDISOLS: PREDOMINANTLY CLAYEY, STRONGLY SLOPING TO STEEP SOILS ON DISSECTED SHALE PLAINS

- Vh1 Torriorthents (shallow)-Camborthids-Natrargids
- Vh2 Ustorthents-Ustorthents (shallow)-Haploborolls
- Vh3 Torriorthents (shallow)-Torriorthents

X — BADLAND-ENTISOLS: STEEP AND VERY STEEP SOILS ON HIGHLY DISSECTED RIVER BREAKS

- X Badlands-Torriorthents

PROPOSED ROUTE

SOURCE: USDA 1978

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Express Pipeline

SOIL ASSOCIATIONS - MONTANA

DATE: JUNE 1995

FIGURE 8

Region one (about MP 304.8 to MP 417) is dominated by soils that are generally shallow to deep, well-drained, undulating to steep, clay loams, loams, and sandy loams located in residual sedimentary soils of the uplands. The alluvial lowlands are more gently-sloped and consist of clay loams, silty loams, and sandy loams. Restrictive features include steep slopes, shallow soil and bedrock (sandstone, siltstone and shales) in the uplands, and high ECs, SARs, flooding, and high water tables along drainage bottoms. Depth of topsoil ranges from 2 to 6 inches. The rehabilitation potential is poor to fair in the uplands and fair to good in the lowlands.

Region two (MP 417 to 460) is dominated by soils that are generally moderately deep to deep, undulating to steep, well-drained, sandy clay loams, loams, sandy loams, and loamy sands. Restrictive features include shallow soil, bedrock (sandstone, siltstone and shales), and steep slopes. Depth of suitable topsoil ranges from 4 to 6 inches. The rehabilitation potential for the majority of the region is poor to fair.

Region three (MP 460 to 515) is dominated by soils that are generally shallow to very deep, rolling to steep, well drained, clays, silty clays, and loams. Soils along the alluvial lowlands are generally very deep, level to greatly sloping, fine loamy, loamy, coarse loamy, and sandy. Restrictive features include steep slopes, shallow depths to bedrock (sandstone, siltstone and shales) in the uplands and high ECs, SARs, flooding, and high water tables along drainage bottoms. The rehabilitation potential for the majority of the region is fair to good.

Rehabilitation Potential

Overall, most of the pipeline route crosses soils with rehabilitation potential of fair or better. The rehabilitation potential along 73 percent of the route in Montana, 49 percent in Wyoming, and 64 percent overall is rated fair or better (Table 7). Approximately 23 percent of the route in Montana, 45 percent in Wyoming, and 32 percent overall is rated poor. Salinity, sodium, steep slopes, unsuitable texture, and shallow depth to bedrock are the primary characteristics leading to the poor potential for rehabilitation.

Hydrology

Surface Water

In Montana, the pipeline would cross 28 perennial, 36 intermittent and 18 ephemeral rivers and streams, as well as 313 various named and unnamed drainages, irrigation canals and ditches. All of these watercourses crossed by the pipeline route are identified in Table 8. State water use and fishery classifications are also provided in the table, as are species of fish reported. Unless otherwise noted, tributaries to classified drainages have the same classification as the mainstream. Locations of named perennial streams and all irrigation canals and ditches are shown on Maps 1-4.

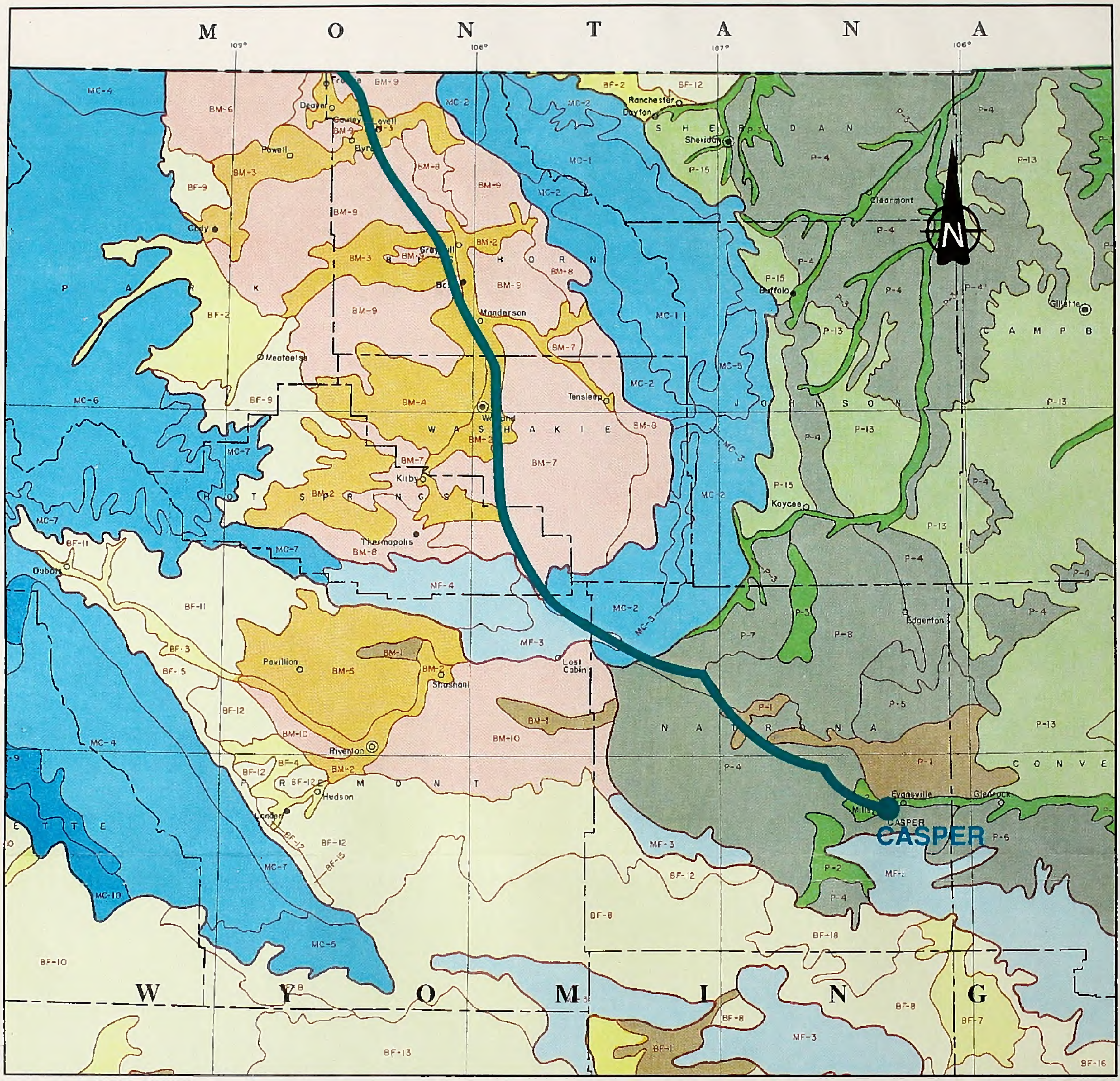
Table 7 Summary of Rehabilitation Potentials for Soils Crossed by the Express Pipeline Route

	Montana		Wyoming		Total	
Rehabilitation Potential	Overall Length (miles)	Portion of Route (percent)	Overall Length (miles)	Portion of Route (percent)	Overall Length (miles)	Portion of Route (percent)
Good	104.3	34	48.0	23	152.3	30
Fair-Good	65.8	21	29.3	14	95.1	18
Fair	55.3	18	23.3	11	78.6	15
Poor-Fair	11.2	4	12.7	6	23.9	5
Poor	72.2	23	94.9	46	167.1	32
Total	308.8	100	206.2	100	515.0	100

Perennial and intermittent streams in Montana support a variety of uses, including irrigation, wildlife/livestock watering, domestic water supply (for ranches and farms), and recreation (angling, hunting). The only designated public water supply watersheds crossed are the Musselshell River and Yellowstone River. The crossings are approximately 10 miles upstream of the water intakes.

Flows of streams that would be crossed by the pipeline vary among streams and seasonally (Table 9). A variety of factors are responsible for this variation. In general, mountain-fed rivers, like the Missouri and Yellowstone, gradually reach peak flows in the months of May, June, and July and have lower, steady flows occurring between August and February. In contrast, streams rising from the Great Plains or Great Basin regions, tend to rapidly reach peak flows during spring runoff in March and April with flows sharply falling off thereafter. Some of the major streams crossed by the route periodically flood during spring runoff and during ice blockages in winter. Finally, many of the smaller streams crossed by the route are free-flowing, and are not restricted by flood control impoundments, levees, or other structures.

In Montana, the pipeline would cross ten streams with designated 100-year floodplains. All rivers and streams with designated or estimated 100-year floodplains crossed by the proposed pipeline route are listed in Table 10. The sites of the proposed crossings for the largest of these streams have been evaluated for scouring associated with a 100-year flood. The methods and data used to calculate scour depths are included in Appendix G. The evaluation indicated a 100-year flood would scour relatively limited amounts of streambed for five of the seven major streams (Table 11). However, such an event in the Milk River or Arrow Creek would substantially scour their streambeds. Evaluations of potential lateral scouring in all streams indicate a 100-year flood would scour a substantial portion of the stream banks outside the active channel (Table 11). The scour depths of the remaining perennial streams and rivers that would be crossed by the Express pipeline are currently being calculated using the procedures described in Appendix G.



M - Soils of the Mountains and Mountain Valleys

MC - Dark and light colored soils of the high mountains that are usually moist, have an AAP (1) of 45-100 cm. (18-40 In.), and a MSST (2) of less than 15°C. (59°F.).

Soils formed from residual materials:

- MC-1 Cryoboralfs-Cryoborolls association
- MC-2 Cryoborolls-Cryoboralfs association
- MC-3 Cryoborolls association
- MC-4 Rock Outcrop-Cryoboralfs-Cryoborolls association
- MC-5 Cryoborolls-Rock Outcrop association
- MC-6 Cryochrepts-Cryumbrepts association
- MC-7 Cryoboralfs-Cryoborolls-Rock Outcrop association
- MC-8 Cryoborolls-Cryorthents association

Soils formed from transported materials:

- MC-9 Cryoboralfs, stony-Cryoborolls, stony association
- MC-10 Cryoborolls-Cryaquents association
- MC-11 Cryoborolls-Cryaquolls association

MF - Dominantly dark colored soils of the mountains and mountain valleys that are usually moist in some parts during the summer, have an AAP of 35-60 cm. (14-24 in.), a MAST (3) of less than 8°C. (47°F.), and a MSST of more than 15°C. (59°F.).

Soils formed from residual materials:

- MF-1 Eutroboralfs-Haploborolls association
- MF-2 Argiborolls-Haploborolls association
- MF-3 Haploborolls-Argiborolls-Rock Outcrop association
- MF-4 Haploborolls, shallow association

MX - Dominantly dark colored soils of the mountains and mountain valleys that are usually dry during the summer and have an AAP of 35-55 cm. (14-22 In.), a MAST of less than 8°C. (47°F.), and a MSST of more than 15°C. (59°F.).

Soils formed from residual materials:

- MX-1 Calcixerolls-Calciorthids association
- MX-2 Haploxerolls association
- MX-3 Argixerolls association

B - Soils of the Intermountain Basins and Foothills

BF - Dominantly light colored soils of basins, terraces, and fans which are usually dry or may be moist in some parts during the summer, have an AAP of 20-35 cm. (8-14 in.), a MAST of less than 8°C. (47°F.), and a MSST of more than 15°C. (59°F.).

Soils formed from transported materials:

- BM-1 Torripsamments-Torriorthents association
- BM-2 Torrifluvents-Haplargids association
- BM-3 Haplargids-Torrifluvents association
- BM-4 Haplargids-Calciorthids association
- BM-5 Torriorthents-Haplargids-Torrifluvents association

Soils formed from residual materials:

- BM-6 Torriorthents association
- BM-7 Torriorthents-Haplargids-Rock Outcrop association
- BM-8 Torriorthents, red association
- BM-9 Torriorthents, fine association
- BM-10 Haplargids-Torriorthents association

BX - Dominantly light colored soils of basins, terraces, and fans which are usually dry, have an AAP of 20-35 cm. (8-14 In.), a MAST of less than 8°C. (47°F.), and a MSST of more than 15°C. (59°F.).

Soils formed from transported materials:

- BX-1 Calciorthids-Ustifluvents association

Soils formed from residual materials:

- BX-2 Calciorthids-Torriorthents association

P - Soils of the Eastern Wyoming Plains

Dark and light colored soils on upland plains, terraces, and fans which are usually moist in some parts during the summer, have an AAP of 30-40 cm. (12-16 In.), a MAST of 8°- 15°C. (47°- 59°F.), and a MSST of more than 15°C. (59°F.).

Soils formed from transported materials:

- P-1 Torripsamments association
- P-2 Torrifluvents-Haplargids association
- P-3 Torrifluvents-Haplargids-Torriorthents association

Soils formed from residual materials on steep uplands:

- P-4 Torriorthents, shallow association
- P-5 Torriorthents-Haplargids association
- P-6 Torriorthents-Torriorthents, shallow association
- P-7 Torriorthents-Torriorthents, shallow-Rock Outcrop association
- P-8 Torriorthents association
- P-9 Argiustolls, shallow association

Soils on nearly level to rolling upland plains, terraces, and fans:

- P-10 Torriorthents, fine, acid association
- P-11 Torriorthents-Argiustolls association
- P-12 Torriorthents-Argiustolls-Haplustolls association
- P-13 Haplargids-Paleargids-Torriorthents association
- P-14 Haplargids-Torriorthents association
- P-15 Torriorthents-Haplargids-Camborthids association
- P-16 Argiustolls-Haplustolls association
- P-17 Haplustolls-Argiustolls-Torripsamments association
- P-18 Haplustolls-Argiustolls-Torriorthents association
- P-19 Haplargids association
- P-20 Argiustolls-Haplustolls-Torriorthents association
- P-21 Torriorthents, fine-Torrifluvents association

(1) AAP = Average Annual Precipitation
(2) MSST = Mean Summer Soil Temperature
(3) MAST = Mean Annual Soil Temperature

10 0 10 20 30 40 MILES

SCALE 1 : 1,500,00

SOURCE: UNIVERSITY OF WYOMING 1978

Express Pipeline

SOIL ASSOCIATIONS - WYOMING

DATE: JUNE 1995 | FIGURE 9

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
MILK RIVER ABOVE FRESNO RESERVOIR SUB-BASIN								
Spring Coulee	0.70	SE SEC 2 T37N R11E			B-3			E
Unnamed	2.2	NW SEC 14 t37N R11E						
Unnamed	3.4	W ½ SEC 23 T37N R11E						
Unnamed	3.6	SE SEC 23 T37N R11E						
Unnamed	7.0	NE SEC 11 T36N R11E						
Milk River	8.23	NE SEC 14 T36N R11E	170	70	B-3	IV	LC(A),LS(A)WCK(A) NR(A),LD(C)BS(C),N P(U)WM(U),FC(U)F M(U),W(U)RT(R),LW (R) YP(R),B(R) BM(R),ES(R)SC(R),S(R) ID(R),MC(R)	P
Unnamed	9.5	W SEC 24 T36N R11E						
Unnamed	10.0	SW SEC 24 T36N R11E						
Unnamed	11.5	NW SEC 36 T36 R11E						
North Branch Seven Mile Coulee	12.2	NW SEC 1 T35N R11E						
South Branch Seven Mile Coulee	12.6	W SEC 1 T35N R11E						
Unnamed Pond	14.5	W SEC 13 T35N R11E						
Ninemile Coulee	14.90	SW SEC 13 T35N R11E	0	15	B-3			E
Archie Coulee	17.0	SW SEC 25 T35N R11E						
Unnamed Tributary Archie Coulee	17.2	NW SEC 36 T35N R11						
Unnamed	17.8	SW SEC 36 T35N R11E						
Unnamed	18.5	NW SEC 1 T34N R11E						
Unnamed	19.9	SW SEC 12 T34 R11E						
Spring Coulee	21.00	SW SEC 13 T34N R11E			B-3			E
Dry Lake Coulee	23.72	SW SEC 36 T34N R11E			B-3			E
Unnamed	24.8	SW SEC 1 T33N R11E						
Unnamed	25.1	NW SEC 12 T35N R11E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
SAGE CREEK SUB-BASIN								
Sage Creek	32.84	SE SEC 13 T32N R11E	0	16	B-3	IV	SM(C),LC(C)FM(C) WCK(C) BS(C),ID(C)	E
Unnamed Tributary Faulkners Coulee	37.2	NW SEC 12 T31N R11E						
Faulkners Coulee	37.59	W SEC 12 T31N R11E			B-3			E
Unnamed Tributary Halfway Coulee	40.7	SE SEC 25 T31N R11E						
Halfway Coulee	42.00	SE SEC 36 T31N R11E			B-3			I
BIG SANDY CREEK SUB-BASIN								
Unnamed Triburary Twelve Mile Coulee	50.3	NE SEC 13 T30N R11E						
Twelve mile Coulee	50.79	SE SEC 13 T30N R11	0	20	B-3			I
Unnamed Triburary Twelve mile Coulee	51.4	NE SEC 24 T30N R11E						
Unnamed Triburary	58.9	SW SEC 30 T28N R11E						
Unnamed Triburary	59.3	NE SEC 36 T28 R11E						
MISSOURI RIVER FROM MARIAS RIVER TO BULLWHACKER SUB-BASIN								
Coal Banks Coulee	65.09	SE SEC 25 T27N R11E	0	35	B-3			E
Unnamed Triburary Missouri River	66.5	NE SEC 1 T26N R11E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Missouri River	68.34	SE SEC 7 T26N R12E	700	18	B-3	1	CC(C),B(C) P(C),CP(C) G(C),FD(C) M(C),SM(C) LD(C),FC(C)ES(C),F M(C)RC(C),LS(C)WC K(C) SB(C),SR(C) SC(C),S(C) SS(C),YP(U) NP(U),BC(U)BB(U), W(U) MW(U) MC(U),ID(R)PS(R)	P
Arm of Jackson Coulee	71.11	SE SEC 20 T26N R12E	0	13				
Unnamed Tributary to Jackson Coulee	71.7	NE SEC 29 T26N R12E						
Unnamed	72.5	NE SEC 32 T26N R12E						
The Sag	73.60	NE SEC 5 T25N R12E			B-3			1
Unnamed	73.8	E ½ SEC 5 T25N R12E						
Unnamed	77.8	NW SEC 29 T25N R12E						
Unnamed	80.3	SW SEC 4 T24N R12E						
Unnamed Saline Drainage	82.88		0	20				
Crow Coulee	82.70	NW SEC 21 T24N R12E			B-3			1
Unnamed Saline Drainage	87.85	NE SEC 16 T23N R12E	0	270				
ARROW CREEK SUB-BASIN								
Unnamed Pond	83.4	NW SEC 28 T24N R12						
Unnamed Pond	86.8	SW SEC 9 T23N R12E						
Unnamed Tributary Dammel Reservoir	88.5	NE SEC 21 T23N R12E						
Flat Creek	95.77	NW SEC 27 T22N R12E	0	85	C-3			1
Unnamed	95.9	NW SEC 27 T22N R12E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed	96.1	NW SEC 27 T22N R12E						
Unnamed	96.5	SW SEC 27 T22N R12E						
Phantom Coulee	97.53	NW SEC 3 T21N R12E			C-3			1
Unnamed	98.4	SW SEC 3 T21N R12E						
Saline Wetland in Flat Creek	99.71	NW SEC 15 T21N R12E	0	4600				
Saline Wetland in Flat Creek	100.64	NE SEC 21 T21N R12E	0	400				
Unnamed Drainage	101.20	SE SEC 21 T21N R12E	0	3				
Unnamed	101.7	NW SEC 28 T21N R12E						
Unnamed	102.5	SE SEC 28 T21N R12E						
Unnamed	102.7	SE SEC 28 T21N R12E						
Unnamed	103.4	SE SEC 33 T21N R12E						
Unnamed	104.5	SE SEC 3 T20N R12E						
Unnamed	104.8	SE SEC 3 T20 R12E						
Unnamed Drainage	105.35	NW SEC 11 T20N R12E						
Unnamed Drainage	105.52	NW SEC 11 T20N R12E						
Unnamed Drainage	107.00	NE SEC 13 T20N R12E						
Unnamed Drainage	107.60	SW SEC 18 T20N R13E						
Unnamed Drainage	108.30	SE SEC 19 T20N R13E	0	20				
Unnamed Drainage	109.54	NE SEC 29 T20N R13E						
Unnamed	110.2	SE SEC 29 T20N R13E						
Unnamed	110.4	SW SEC 29 T20N R13E						
Arrow Creek	111.15	NE SEC 33 T20N R13E	40	172	C-3			1
Unnamed Tributary to Arrow Creek	111.45	NE SEC 33 T20N R13E	3	0				
Unnamed Tributary to Arrow Creek	111.92	NW SEC 34 T20N R13E	2	7				
Unnamed Tributary to Arrow Creek	112.10	SE SEC 34 T20N R13E	6	0				
Coffee Creek	116.63	SW SEC 23 T19N R13E	6	59	C-3			1

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Coffee Creek	117.46	SE SEC 26 T19N R13E	8	4				
Unnamed Tributary Coffee Creek	118.6	SW SEC 36 T19N R13E						
JUDITH RIVER SUB-BASIN								
Unnamed Tributary Coffee Creek	119.7	SE SEC 1 T18N R13E						
Unnamed Tributary Wolf Creek	122	SW SEC 18 T18N R14E						
Unnamed Tributary Wolf Creek	122.2	NW SEC 19 T18 R14E						
Wolf Creek	122.40	NW SEC 19 T18N R14E	15	3	C-3		RT(A),M(C)	1
Coyote Creek	123.08	S ½ SEC 19 T18N R14E	20	230	C-3			1
Unnamed Tributary Coyote Creek	123.6	SE SEC 30 T18N R14E						
Pacer Coulee	124.91	SE SEC 31 T18N R14E	3	38	C-3			E
Unnamed	126.3	NW SEC 8 T17N R14E						
Unnamed	126.4	NW SEC 8 17N R14E						
Unnamed Coulee	126.92	SW SEC 8 T17N R14E	0	95				
Unnamed	128.4	NE SEC 20 T17N R143						
Unnamed	128.5	NE SEC 20 T17N R14E						
Unnamed	129.1	SW SEC 21 T17N R14E						
Dry Wolf Creek	129.38	SW SEC 21 T17N R14E	148	2	C-3			1
Unnamed	129.7	NW SEC 28 T17N R14E						
Unnamed	130.1	SE SEC 28 T17N R14E						
Unnamed	130.2	SE SEC 28 T17N R14E						
Unnamed	130.9	NE SEC 33 T17N R14E						
Unnamed	131.2	SW SEC 34 T17N R14E						
Unnamed	131.8	NE SEC 3 T16N R14E						
Sage Creek	132.30	SE SEC 3 T16N R14E	13	7	C-3		BKT(C)	P
Unnamed	133.8	NW SEC 14 T16N R14E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Tributary Squaw Coulee	134.6	SW SEC 14 T16N R14E						
Squaw Coulee	134.68	SW SEC 14 T16N R14E	3	14	C-3			E
Indian Creek	135.78	SW SEC 24 T16N R14E	0	80	C-3			E
Unnamed Drainage	137.10	NE SEC 36 T16N R14E	0	98				
Louse Creek	138.75	NW SEC 6 T15N R15E	10	22	B-1		BKT(A) LD(A),MC(A)LS(C)	P
Unnamed Drainage	141.23	SE SEC 17 T15N R15E	0	55				
Unnamed Drainage	142.72	NW SEC 28 T15N R15E	0	30				
Unnamed Canal	143.58	SW SEC 28 T15N R15E	5	0				
Unnamed Drainage	143.62	NE SEC 33 T15N R15E	5	285				
Unnamed Drainage	143.67	NW SEC 33 T15N R15E	0	10				
Unnamed Drainage	143.77	NW SEC 33 T15N R15E	0	29				
Seep/Drainage	143.95	NW SEC 33 T15N R15E	0	350				
Judith River	144.12	NW SEC 33 T15N R15E	75	30	B-1	IV	LD(C),LS(C)MS(C),MC(C)RT(U) BRT(U) WCK(U)	P
Unnamed	146.4	SW SEC 8 T14N R15E						
Unnamed Drainage	146.80	NW SEC 15 T14N R15E	3	25				
Pond	147.2	NW SEC 15 T14N R15E						
Hauck Coulee	147.87	NW SEC 22 T14N R15E	4	6	B-1			P
Unnamed Ross Fork Creek	149.5	SE SEC 27 T14N R15E						
Unnamed	151.1	NW SEC 2 T13N R15E						
Unnamed	151.8	SW SEC 2 T13N R15E						
Unnamed	152.3	NW SEC 11 T13N R15E						
Unnamed Tributary Big Coulee Creek	153.0	NE SEC 14 T13N R15E						
Big Coulee Creek	153.10	NE SEC 14 T13N R15E	7	35	B-1		LD(C),NR(P) NX(P)	P
Ross Fork Creek	153.72	SE SEC 15 T13N R15E	22	10	B-1		WCK(A) MC(A),LD(C)MS(C), FM(U)LS(U),CH(R)	P

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
East Buffalo Creek	155.90	SW SEC 25 T13N R15E	9	20	B-1			P
Unnamed	156.5	NW SEC 36 T13N R15E						
Unnamed	156.6	SW SEC 36 T13N R15E						
Unnamed	156.9	SW SEC 36 T13N R15E						
Unnamed	157.1	NE SEC 1 T12N R15E						
Unnamed	157.3	NW SEC 6 T12N R16E						
Dry Creek	157.75	SW SEC 6 T12N R16E	0	15	B-1			P
Unnamed Drainage	158.28	NW SEC 7 T12N R16E						
Unnamed Drainage	158.96	SW SEC 7 T12N R15E						
Unnamed Drainage	159.94	SW SEC 18 T12N R16E						
Unnamed	160.1	NW SEC 19 T12N R16E						
Unnamed	160.9	SW SEC 19 T12N R16E						
Unnamed Drainage	161.32	NE SEC 30 T12N R16E	0	8	B-1			I/E
Unnamed	161.7	SW SEC 30 T12N R16E						
Meadow Creek	162.77	SW SEC 31 T12N R16E	0	116	B-1			P
Unnamed	162.9	SW SEC 31 T12N R16E						
Ross Fork Creek	163.64	SE SEC 6 T11N R16E	13		B-1			P
Ross Fork Creek	163.7	SE SEC 6 T11N R16E						
Unnamed Tributary Ross Fork	163.8-9	SE SEC 6 T11N R16E						
Unnamed Tributary Ross Fork	164.1	NE SEC 7 T11N R16E						
Abandoned Ross Fork Meander Bend	164.39	NE SEC 7 T11N R16E	0	150				
Ross Fork Creek	164.50	NE SEC 7 T11N R16E	60	90	B-1			P
Unnamed Drainage	164.95	SW SEC 8 T11N R16E	6	6				
Unnamed Drainage	165.69	SW SEC 17 T11N R16E	4	32				
MUSSELSHELL RIVER SUB-BASIN								
Unnamed Drainage	167.2	NE SEC 29 T11N R16E						
Unnamed	168.6	NE SEC 32 T11N R16E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
East Fork Creek	170.88	NE SEC 8 T10N R16E	0	159	B-1			P
Unnamed	171.3	NE SEC 17 T10N R16E						
Unnamed Drainage	172.25	NW SEC 21 T10N R16E	0	125				
Unnamed Drainage	172.39	NW SEC 21 T10N R16E						
Unnamed	173.4	NW SEC 28 T10N R16E						
Tributary to East Fork Roberts Creek	173.58	NW SEC 28 T10N R16E	0	20				
Unnamed	174.8	NE SEC 33 T10N R16E						
Unnamed	174.9	SE SEC 33 T10N R16E						
Unnamed	176.9	SW SEC 10 T9N R16E						
Unnamed	177.0	SW SEC 10 9R R16E						
Unnamed	177.1	SW SEC 10 T9N R16E						
Unnamed	178.0	SW SEC 15 T9N R16E						
Unnamed Drainage	178.41	SE SEC 15 T9N R16E	0	162				
Roberts Creek	179.29	SE SEC 22 T9N R16E	60	37	B-1			I
Unnamed	182	NE SEC 2 T8N R16E						
Alkali Creek	182.56	SE SEC 2 T8N R16E	0	117	B-1			I
Unnamed Drainage	185.00	SW SEC 18 T8N R17E						
Unnamed Drainage	185.19	NW SEC 19 T8N R17E						
Unnamed Drainage	185.47	SE SEC 19 T8N R17E						
Unnamed Drainage	185.61	SW SEC 19 T8N R17E						
Unnamed Drainage	185.80	SW SEC 19 T8N R17E						
Unnamed Drainage	185.86	SW SEC 19 T8N R17E						
Unnamed Drainage	186.00	SW SEC 19 T8N R17E						
Unnamed Drainage	186.13	SW SEC 19 T8N R17E						
Unnamed Drainage	186.20	SW SEC 19 T8N R17E						
Unnamed Drainage	186.50	NW SEC 29 T8N R17E						
Unnamed Drainage	186.65	NW SEC 29 T8N R17E						
Unnamed Drainage	186.70	NW SEC 29 T8N R17E						
Unnamed Drainage	187.3	SE SEC 29 T8N R17						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Drainage	187.61	SE SEC 29 T8N R17E	0	4				
Unnamed Drainage	187.92	NW SEC 33 T8N R17E						
Unnamed Drainage	188.03	NW SEC 33 T8N R17E						
Unnamed Drainage	188.79	SE SEC 33 T8N R17E						
Unnamed Drainage	188.88	SE SEC 33 T8N R17E	0	5				
Unnamed Drainage	189.62	NW SEC 3 T7N R17E						
Unnamed Drainage	189.70	NW SEC 3 T7N R17E						
Unnamed Drainage	189.82	SW SEC T7N R17E						
Unnamed Drainage	189.86	SW SEC 3 T7N R17E						
Unnamed Drainage	189.91	SW SEC 3 T7N R17E						
Unnamed Drainage	189.99	SW SEC 3 T7N R17E						
Unnamed Drainage	190.02	SE SEC 3 T7N R17E						
Unnamed Drainage	190.06	SE SEC 3 T7N R17E						
Unnamed Drainage	190.17	SE SEC 3 T7N R17E						
Unnamed Drainage	190.61	NE SEC 10 T7N R17E	0	9				
Unnamed Drainage	190.83	NE SEC 10 T7N R17E						
Unnamed Drainage	191.42	SW SEC 11 T7N R17E	0	365				
Unnamed Drainage	191.53	SE SEC 11 T7N R17E						
Unnamed Drainage	191.8	NE SEC 14 T7N R17E						
Deadman's Basin Canal	192.62	SW SEC 13 T7N R17E	5	13	B-1			I
Unnamed Drainage	192.80	SW SEC 13 T7N R17E	3	3				
Unnamed Drainage	193.2	NE SEC 24 T7N R17E						
Highway 12 Ditch (N. Side)	193.84	SE SEC 24 T7N R17E	0					
Musselshell River	194.09	NE SEC 25 T7N R17E	60	142	B-2	III	LD(A),FC(A)WM(C), LS(C)WCK(C) MS(C),RT(U)BRT(U) CP(U),FM(U)SR(U),S C(U)MW(U),NR(P)	P
Unnamed Ditch	194.72	SE SEC 25 T7N R17E	8	56				
Unnamed Drainage	195.7	SE SEC 31 T7N R17E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Drainage	196.28	NE SEC 6 T7N R17E	0	10				
Mud Creek	197.60	SE SEC 6 T7N R17E	10	325	C-3			I
Unnamed Drainage	200.76	NE SEC 21 T7N R17E						
Unnamed Drainage	201.18	NW SEC 22 T7N R17E	0	5				
Unnamed Drainage	201.25	NW SEC 22 T6N R18E						
Unnamed Drainage	201.33	NW SEC 22 T6N R18E						
Fish Creek	202.57	NW SEC 26 T6N R18E	14	11	C-3		NR(P),M(P)	P
Unnamed Drainage	203.43	SW SEC 26 T6N R18E						
Unnamed Drainage	203.90	NW SEC 35 T6N R18E						
Unnamed Drainage	206.1	SW SEC 11 T5N R18E						
Unnamed Drainage	206.3	SW SEC 11 T5N R18E						
Unnamed Drainage	206.59	NE SEC 14 T5N R13E	0	8				
Unnamed Drainage	206.99	NE SEC 14 T5N R13E	0	0				
Rock Creek	207.37	SW SEC 14 T5N R13E	0	0	C-3			I
Unnamed Drainage	209.91	NE SEC 35 T5N R13E	3	21				
Tributary to Van Winkle Creek	211.23	NE SEC 1 T6N R13E	0	7				
Van Winkle Creek	211.52	SE SEC 1 T4N R13E	0	132	C-3			I
Unnamed Trib. N Fork Big Coulee Creek	212.3	NE SEC 12 T4N R12E						
North Fork Big Coulee Creek	212.57	SE SEC 12 T4N R13E	0	0	C-3			I
Unnamed Trib. S. Fork Big Coulee Creek	213.3	NW SEC 18 T4N R19E						
Unnamed Trib. S. Fork Big Coulee Creek	213.5	NW SEC 18 T4N R19E						
Unnamed Trib. S. Fork Big Coulee Creek	213.9	SW SEC 18 T4N R19E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Trib. S. Fork Big Coulee Creek	214.1	NW SEC 19 T4N R19E						
Unnamed Trib. S. Fork Big Coulee Creek	214.2	NW SEC 19 T4N R19E						
South Fork Big Coulee Creek	214.22	NW SEC 19 T4N R19E	8	36	C-3			1
Unnamed Trib. S. Fork Big Coulee Creek	214.7	SE SEC 19 T4N R19E						
Tributary to South Fork Big Coulee Creek	214.80	SE SEC 19 T4N R19E	0	21				
Unnamed Trib. S. Fork Big Coulee Creek	215.6	SE SEC 30 T4N R19E						
Unnamed Drainage	215.84	SE SEC 30 T4N R19E	0	0				
Tributary to South Fork Big Coulee Creek	216.49	NW SEC 32 T4N R19E	0	17				
Unnamed Drainage	216.87	SW SEC 32 T4N R19E	0	0				
Unnamed Drainage	216.96	SW SEC 32 T4N R19E						
Unnamed Drainage	217.09	SW SEC 32 T4N R19E	0	0				
Unnamed Drainage	217.13	SE SEC 32 T4N R19E	0	0				
YELLOWSTONE RIVER FROM CLARKS FORK TO BIG HORN RIVER SUB-BASIN								
Unnamed Drainage	217.5	NE SEC 5 T3N R19E						
Unnamed Drainage	219.32	NW SEC 16 T3N R19E	0	322				
Unnamed Drainage	219.65	SW SEC 16 T3N R19E	0	4				
Sixshooter Creek	220.05	SE SEC 16 T3N R19E	0	27	B-2			1
Unnamed Drainage	220.1	NE SEC 21 T3N R19E						
Unnamed Drainage	220.2	NE SEC 21 T3N R19E						
Unnamed Drainage	220.25	NE SEC 21 T3N R19E						
Unnamed Drainage	220.3	NE SEC 21 T3N R19E						
Unnamed Drainage	220.95	SW SEC 22 T3N R19E	0	0				

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Middle Creek	223.75	SW SEC 36 T3N R19E	2	21	B-2			I
Cedar Creek	225.52	SW SEC 6 T2N R20E	0	11	B-2			I
Unnamed Drainage	226.45	NW SEC 8 T2N R20E						
Gurney Creek	227.56	NE SEC 17 T2N R20E	0	1356	B-2			I
Unnamed Drainage	229.55	NE SEC 22 T2N R20E	0	18				
Unnamed Drainage	229.9	SW SEC 22 T2N R20E						
Unnamed Drainage	230.42	SE SEC 22 T2N R20E	0	18				
Struck Creek	233.21	NE SEC 1 T1N R20E	0	128	B-2		M(P)	I
Struck Creek	233.30	NE SEC 1 T1N R20E	0	117				
Toll Creek	233.95	SW SEC 6 T1N R21E	0	66	B-2		M(P)	I
Greenwood Creek	234.49	SE SEC 6 T1N R21E	2	6	B-2			I
Unnamed Drainage	236.13	NE SEC 17 T1N R21E	0	4				
Unnamed Drainage	236.24	NE SEC 17 T1N R21E	0	40				
Unnamed Drainage	237	SW SEC 16 T1N R21E						
Unnamed Drainage	237.70	NE SEC 21 T1N R21E	0	18				
Unnamed Drainage	238.72	SE SEC 22 T1N R21E	3	0				
YELLOWSTONE RIVER FROM BRIDGER CREEK TO VALLEY CREEK SUB-BASIN								
Unnamed Drainage	239.0	NE SEC 27 T1N R21E						
Unnamed Drainage	239.7	SW SEC 26 T1N R21E						
Unnamed Drainage	240.8	SE SEC 35 T1N R21E						
Unnamed Drainage	242.1	NW SEC 8 T1S R22E						
Unnamed Drainage	242.2	NW SEC 8 T1S R22E						
North Fork Valley Creek	243.87	NW SEC 17 T1S R22E	2	3	B-1			I
Unnamed Drainage	243.9	NW SEC 17 T1S R22E						
Unnamed Drainage	244.5	SE SEC 17 T1S R22E						
Unnamed Drainage	246.1	SW SEC 21 T1S R22E						
North Fork Valley Creek	246.42	NW SEC 27 T1S R22E	3	5	B-1			I

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Sawmill Gulch	246.77	NW SEC 27 T1S R22E	32	0				
Valley Creek	247.30	SE SEC 27 T1S R22E	0	25	B-1		BRT(P)	P
Valley Creek	247.48	SE SEC 27 T1S R22E	16	0	B-1			P
Unnamed Trib. Valley Creek	248.2	NE SEC 34 T1S R22E						
Unnamed Trib. Valley Creek	248.5	SW SEC 35 T1S R22E						
Unnamed Trib. Valley Creek	249.3	NW SEC 2 T2S R22E						
Unnamed Trib. Valley Creek	249.6	SE SEC 2 T2S R22E						
Valley Creek	251.34	NW SEC 13 T2S R22E	7	75	B-1			P
Valley Creek	251.78	SW SEC 13 T2S R22E	0	15				
Cove Ditch	253.10	NE SEC 25 T2S R22E	19	0	B-1			1
Big Ditch	253.70	SE SEC 25 T2W R22E	30	0	B-1			1
Italian Ditch	254.75	SE SEC 36 T2S R22E	10	15	B-1			1
Old Mill Ditch	254.94	SE SEC 36 T2S R22E	10	150	B-1			1
Yellowstone River	255.53	NW SEC 6 T3S R23E	700	50	B-1	II	G(A),LS(A) WCK(A) RT(C),BRT(C)B(C),S R(C) MW(C) CC(U),CP(U)SC(U),S(U)	P
Yellowstone River	255.53	NW SEC 6 T3S R23E						
Bellion Creek	255.68	NW SEC 6 T3S R23E	8	7				
Unnamed Drainage	257.2	SE SEC 7 T3S R22E						
Unnamed Drainage	258.33	SW SEC 17 T3S R23E	0	10				
Farewell Creek	260.13	NE SEC 29 T3S R23E	0	14	B-1			E
Unnamed Drainage	260.57	SW SEC 28 T3S R23E	0	0				
Unnamed Ditch	262.47	NW SEC 3 T4S R23E	2	2				
Unnamed Drainage	262.51	NW SEC 3 T4S R23E	1	6				

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
CLARK'S FORK YELLOWSTONE RIVER SUB-BASIN								
Free Silver Ditch	262.80	NW SEC 3 T4S R23E	2	2	B-1			I
Smith Dutch	262.80	NW SEC 3 T4S R23E	7	4	B-1			I
Rock Creek	263.26	SW SEC 3 T4S R23E	75	640	B-1	IV	LD(A) BRT(C) MS(U),RT(R)BRT(R)	P
Clawson Ditch	264.06	SE SEC 3 T4S R23E	2	2	B-1			I
Unnamed Drainage	264.88	NE SEC 15 T4S R23E	2	2				
Clark's Fork Yellowstone R.	266.33	NE SEC 23 T4S R23E	150	20	B-2	III	G(A),LS(A) B(C),MS(C) SC(C),MW(C)WM(U) LC(U),SR(U)BRT(R), CP(R)S(R)	P
Clark's Fork Meander Channel	266.45	NE SEC 23 T4S R23E	14	3				P,I,E
Five Mile Creek	266.86	NW SEC 23 T4S R23E	4	0	B-1			P
Edgar Canal	266.89	SE SEC 24 T4S R23E	1	0	B-1			I
Unnamed Drainage	268.10	NW SEC 30 T4S R23E						
Unnamed Drainage	268.23	NW SEC 30T4S R23E						
Unnamed Drainage	269.35	NE SEC 31T4S R23E						
Unnamed Drainage	269.41	NE SEC 31T4S R23E						
Unnamed Drainage	269.47	NE SEC 31T4S R23E						
Unnamed Drainage	269.75	SW SEC 32 T4S R23E						
Unnamed Drainage	269.80	SW SEC 32T4S R23E						
Unnamed Drainage	269.90	SW SEC 32 T4S R23E						
Unnamed Drainage	270.13	SW SEC 32T4S R23E						
Unnamed Drainage	270.75	SE SEC 5 T5S R24E						
Unnamed Drainage	270.86	SE SEC 5 T5S R24E						
Unnamed Drainage	271.25	SE SEC 5 T5S R24E						
Unnamed Drainage	271.39	NE SEC 8 T5S R24E						
Unnamed Drainage	271.49	NE SEC 8 T5S R24E						
Unnamed Drainage	271.68	NW SEC 9 T5S R24E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Drainage	271.83	NW SEC 9 T5S R24E						
Unnamed Drainage	272.10	SW SEC 9 T5S R24E						
Unnamed Drainage	272.18	SW SEC 9 T5S R24E						
Unnamed Drainage	272.5	NE SEC 16 T5S R24E						
Unnamed Drainage	272.71	NE SEC 16 T5S R24E						
Unnamed Drainage	272.84	NW SEC 16 T5S R24E						
Unnamed Drainage	273.12	SE SEC 16 T5S R24E						
Unnamed Drainage	273.24	SE SEC 16 T5S R24E						
Unnamed Drainage	273.37	SE SEC 16 T5S R24E						
Unnamed Drainage	273.90	NE SEC 22 T5S R24E						
Unnamed Drainage	273.97	NE SEC 16 T5S R24E						
Unnamed Drainage	274.43	SE SEC 22 T5S R24E						
Unnamed Drainage	274.56	NW SEC 27 T5S R24E	5	0	B-1			P
Unnamed Drainage	275.40	SE SEC 27 T5S R24E	3	0				
Unnamed Drainage	276.24	SE SEC 34 T5S R24E						
Unnamed Drainage	276.43	SE SEC 34 T5S R24E						
Unnamed Drainage	276.47	SE SEC 34 T5S R24E						
Unnamed Drainage	276.79	NW SEC 1 T6S R24E						
Unnamed Drainage	276.87	NW SEC 1 T6S R24E						
North Fork Bluewater Creek	278.17	NW SEC 12 T6S R24E			B-1			E
Unnamed Drainage	278.26	SW SEC 12 T6S R24E						
Unnamed Drainage	278.34	SW SEC 12 T6S R24E						
Unnamed Drainage	278.93	NW SEC 13 T6S R24E						
Unnamed Drainage	279.05	NW SEC 13 T6S R24E						
Unnamed Drainage	279.70	SW SEC 13 T6S R24E						
Bluewater Creek	279.70	SW SEC 13 T6S R24E	6	0	B-1			E
Unnamed Drainage	280.03	NW SEC 24 T6S R24E						
Bluewater Creek	280.4	SW SEC 24 T6S R24E						
Unnamed Drainage	280.9	NW SEC 25 T6S R24E						

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Drainage	281.50	SW SEC 25 T6S R24E	7	0				
Unnamed Drainage	281.83	SW SEC 25 T6S R24E						
Unnamed Drainage	281.95	NW SEC 26 T6S R24E						
Unnamed Drainage	282.20	NW SEC 36T6S R24E	5	0				
Unnamed Drainage	282.3	NW SEC 36 T6S R24E						
Unnamed Drainage	282.50	SE SEC 36 T6S R24E						
Unnamed Drainage	282.80	SE SEC 36 T6S R24E	5	0				
Unnamed Drainage	283.39	SE SEC 1 T7S R25E						
Unnamed Drainage	284.5	NW SEC 7 T7S R25E						
Unnamed Ditch	285.1	NW SEC 18 T7S R25E						
Unnamed Drainage	286.3	NE SEC 19 T7S R25E						
Unnamed Drainage	286.9	SW SEC 20 T7S R25E						
SAGE CREEK SUB-BASIN								
Sage Creek	287.41	SW SEC 20 T7S R25E	5	0				E
Unnamed Drainage	287.6	NW SEC 29 T7S R25E						
Unnamed Drainage	287.7	NW SEC 29 T7S R25E						
Unnamed Drainage	288.9	SE SEC 32 T7S R25E						
Unnamed Drainage	289.1	SE SEC 32 T7S R25E						
Unnamed Drainage	289.4	NE SEC 5 T8S R25E						
Water Canyon Creek	291.07	SW SEC 9 T8S R25E	4	0				
Inferno Canyon	293.46	NE SEC 28 T8S R25E						E
Unnamed Drainage	294.75	NW SEC 34 T8S R25E						
Unnamed Drainage	294.86	NW SEC 34 T8S R25E						
King Canyon	295.23	SW SEC 34 T8S R25E	0	1280				E
Unnamed Drainage	295.27							
Piney Creek	296.42	SE SEC 3 T9S R25E	4	70			WC(P)	P
Unnamed Drainage	296.9	NE SEC 11 T9S R25E						
Cottonwood Creek	297.71	NW SEC 14 T9S R25E	5	0				E
Unnamed Drainage	298.38	SW SEC 14 T9S R25E	2	0				

Table 8 Perennial, Intermittent and Ephemeral Drainages Crossed by the Express Pipeline Route in Montana

WATER BODY	MILEPOST	LOCATION	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS	STATE FISHERY CLASS[1]	FISH SPECIES[1]	FLOW CLASS[2]
Unnamed Drainage	298.9	NE SEC 23 T9S R25E						
Unnamed Drainage	299.7	SE SEC 23 T9S R25E						
Unnamed Drainage	299.8	SE SEC 23 T9S R25E						
Bear Canyon Creek	300.33	NW SEC 25 T9S R25E	2	0				E
Unnamed Drainage	300.5	NW SEC 25 T9S R25E						
Unnamed Drainage	300.9	SE SEC 25 T9S R25E						
Unnamed Drainage	301.0	SE SEC 25 T9S R25E						
Unnamed Drainage	301.05	SE SEC 25 T9S R25E						
Unnamed Drainage	301.3	NE SEC 36 T9S R25E						
Unnamed Drainage	301.82	NW SEC 31 T9S R26E						
Unnamed Drainage	302.07	SW SEC 31 T9S R26E						
Unnamed Drainage	302.28	SE SEC 31 T9S R26E						
Unnamed Drainage	302.5	SE SEC 31 T9S R26E						
Unnamed Drainage	302.65	SE SEC 31 T9S R26E						
Unnamed Drainage	302.66							

Notes:

[1] Montana Water Classification (MDHES 1988a).

B-1: Waters classified B-1 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

B-2: Waters classified B-2 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

B-3: Waters classified B-3 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

C-3: Waters classified C-3 are suitable for bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply.

Degradation that will impact established beneficial uses will not be allowed.

Note: The Montana water use classification ranges from A-closed to C-3 (Class A waters are the highest quality). There are no Class A waters crossed by the Express Pipeline.

[2] In Montana, Class I streams provide exceptional habitat for outstanding populations of species of high interest. Class II streams provide moderate habitat for highly valued species and exceptional habitat for less highly valued species. Class III streams provide substantial habitat for highly valued species and moderate habitat for less valued species. Class IV streams have moderate fishing resources (Montana Department of Fish, Wildlife and Parks, 1980).

[3] Fish Species Codes: Sources: Montana Department of Fish, Wildlife and Parks, 1995.

RT: Rainbow trout	BKT: Brook trout	BRT: Brown trout	WC: westslope cutthroat	LW: Lake whitefish
YP: Yellow perch	NP: Northern pike	CC: Channel catfish	B: Burbot	P: Paddlefish
CC: Common carp	G: Goldeye	M: Minnow -unclassified		SM:Silvery minnow
LD: Longnose dace	BM: Brassy minnow	WM: Western silvery plains minnow		FC: Flathead chub
LC: Lake chub	ES: Emerald shiner	CH: Creek chub	FM: Flathead minnow	RC: River carpsucker
LS: Longnose sucker	WCK: White sucker	BC: Blue sucker	BB: Bigmouth buffalo	SM: Smallmouth buffalo
SR: Shorthead redhorse		MS: Mountain sucker	SC: Stonecat	BS: Brook stickleback
S: Sauger	W: Walleye	ID: Iowa darter	MW: Mountain whitefish	PS: Pallid sturgeon
MC: Mottled sculpin	NR: Northern redbelly dace		NX: Northern redbelly dace x fine scale dace	

The following is a MDFWP classification of relative abundance of fish species in individual stream:

(A) = Abundant
(C) = Common
(U) = Uncommon
(R) = Rare
(P) = Present

[4] Stream width includes open water, stream channels with or without flowing water and mud flats based on field surveys in summer and fall 1991.

[5] Wetland width includes total wetlands on both sides of the stream based on field surveys in summer and fall 1991. Therefore,stream width plus wetlands width indicates stream width at normal high water mark.

[6] E = Ephemeral   E/I = Ephemeral/Intermittent   I = Intermittent   P= Perennial

Table 9 Mean Monthly Flows in Selected Streams Crossed by the Express Pipeline Route In Montana

Station	Period of Record	Mean Monthly Flows (cubic feet per second)											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept
Milk R. at eastern crossing of International Boundary	CY 1994	131	-	-	-	-	1366	317	807	805	606	536	437
	CY 1984	13	-	-	-	-	283	306	284	596	568	532	40
	CY 1988	5	-	-	-	-	227	704	594	629	494	187	13
Sage Creek near Whitlash	WY 1988	1	1	1	<1	1	1	1	1	<1	<1	<1	<1
Missouri R. at Virgelle	1935-1994	6,200	6,399	6,295	6,249	6,539	7,310	8,754	13,700	18,080	9,749	6,115	5,811
Judith R. near Utica	1937-1986	13	9	6	3	3	3	20	204	297	91	28	18
Ross Fork Creek near Hobson	1937-1986	1	2	3	2	8	69	56	30	27	5	2	1
Musselshell R.at Harlowtown	1935-1994	75	79	68	59	65	115	181	419	510	159	74	64
Yellowstone R. at Billings	1929-1994	4,029	3,574	2,791	2,472	2,642	3,042	4,160	12,620	24,970	13,530	5,183	4,093
	WY 1984	6,280	5,163	3,194	3,834	3,577	3,316	4,082	13,330	23,740	17,710	6,580	4,880
	WY 1988	2,755	2,690	2,168	1,854	1,972	2,171	3,066	14,180	15,400	3,526	1,728	1,837
Rock Creek at Rockvale	WY 1988	201	151	108	95	153	106	124	754	113	9	14	26
Clarks Fork of Yellowstone R. near Silesia	WY 1984	860	635	400	515	400	376	458	1,811	3,618	2,554	834	603
Clarks Fork of Yellowstone R. at Edgar	WY 1988	360	416	342	329	333	305	506	2,258	2,684	290	50	156
Louse Creek1 (MP 138)		0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.5	3.2	0.8	0.5	0.4
Wolf Creek1 (MP 122)		6.3	5.8	5.0	4.3	4.6	4.0	5.4	7.9	53.0	13.9	9.4	7.8

Source: (USGS 1994)

WY = Water Year; CY = Calendar Year; 1994 and 1984 = Wetter Years 1988 = Drier Year
- No data.
1 Monthly average flow developed with a lag-one Markov stream flow simulation model (MDEQ 1991).

Table 10 Recorded and Estimated 100-year Floodplains Crossed by the Express Pipeline Route in Montana[1]

Stream	Milepost	Width of 100-yr. Floodplain (miles)
Milk River (R)	8.2	0.4
Ninemile Coulee Creek (R)	14.9	<0.1
Sage Creek (R)	32.8	0.1
Faulkners Coulee	38.0	0.1
Twelve Mile Coulee	50.8	<0.1
Coulee (No Name)	54.4	<0.1
Coal Banks Coulee	65.1	<0.1
Missouri River	68.3	0.6
The Sag	74.2	0.1
Flat Creek	95.8	0.1
Arrow Creek	111.1	0.3
Coulee (No Name)	117.5	<0.1
Pacer Coulee	124.9	<0.1
Coulee (No Name)	126.9	<0.1
Dry Wolf Creek	129.3	<0.1
Squaw Coulee	134.7	<0.1
Louse Creek	138.8	<0.1
Coulee (No Name)	144.8	<0.1
Judith River	144.1	0.2
Hauck Coulee	147.9	0.1
Big Coulee	153.1-154.4	<0.1
East Buffalo Creek	155.9	0.1
Tributary to Ross Fork Creek	157.6	0.5
Dry Creek	157.8	0.2
Ross Fork Creek	163.6	0.2
Ross Fork Creek	164.4	0.2
Ross Fork Creek	164.5	0.2
E. Fork Roberts Creek	170.7	<0.1
Roberts Creek	179.3	<0.1
Musselshell River	194.1	0.4
Fish Creek	202.5	0.4
N. Fork Big Coulee Creek	212.6	<0.1
Middle Creek	223.8	0.2
Cedar Creek	225.5	<0.1
Gurney Creek	227.6	0.2
Struck Creek	233.2	0.2
Cottonwood Creek (R)	251.3	0.2
Valley Creek (R)	251.8	<0.1
Yellowstone River (R)	255.4	0.5
Yellowstone River (R)	255.5	0.2
Rock Creek (R)	263.3	0.1
Clark's Fork of the Yellowstone (R)	266.3	0.2
Sage Creek (R)	287.4	<0.1

Note:

1. Floodplains according to National Flood Insurance Program Maps, FEMA, 1981-1988 are denoted by the letter (R) following the name of the stream. Floodplains of the remaining streams were estimated from visual analysis of topographic mapping, interpretation of stereo aerial photographs at a scale of 1:24,000 and selected field inspections. All channels were studied for the existence of depositional features. Where a channel appeared erosional rather than depositional, no floodplain was acknowledged. Depositional features include meandering stream patterns adjacent to alluvial surfaces as well as recent terraces associated with larger streams and rivers.

Table 11 Summary of Scour Information for Streams Crossed by the Express Pipeline Route in Montana

				ESTIMATED EXTENT OF LATERAL SCOUR			
STREAMS	D_{50} BED MATERIAL (mm)	100-YR FLOOD (cfs)	EST. DEPTH OF BED SCOUR[1] (feet)	DISTANCE BEYOND LEFT BANK (feet)	ACTIVE CHANNEL WIDTH (feet)	DISTANCE BEYOND RIGHT BANK (feet)	TOTAL LENGTH OF DEEP BURIAL (feet)
Milk River	0.2	13,900	22	700	500	300	1,500
Arrow Creek	1.5	5,890	8	700	20	2,080	2,800
Judith River	53	5,190	4	10	40	170	220
Musselshell River	41	9,000	3	200	60	240	500
Yellowstone River	127	66,900	4	50	1,100	0	1,150
Rock Creek	42	8,270	5	330	90	580	1,000
Clarks Fork Yellowstone River	68	16,810	3	100	200	500	800

[1]These depths reflect scour in the alluvial material. The maximum potential scour depth in bedrock per crossing is estimated to be one foot. Additional depth of burial to account for degradation is allowed for some crossings.

[2] D_{50} refers to the median size of the bed material. The median size means that 50 percent of the materials are smaller than the indicated value and 50 percent are larger.

[3] Further geotechnical studies are in progress at the Milk River crossing to establish the actual nature and depth of the scour depth.

Note: Further field studies are also in progress to determine actual nature and depth of all perennial streams and rivers to be crossed by Express pipeline.

In terms of the quality of water, streams in eastern Montana are naturally more turbid and of poorer quality than those in western Montana. The primary reason for this difference is streams in the eastern prairie region of Montana drain croplands and badlands. These areas contribute sediment and dissolved solids to runoff (Montana Board of Oil and Gas Conservation 1989). Natural erosion, road construction, urban development, agricultural practices, and heavy grazing of livestock contribute sediment to the streams. Flows returning from irrigated fields carry nutrients, pesticides, and sediment from the fields into surface waters.

There are 33 towns within 15 miles of the proposed Express Pipeline stream crossings. The evaluation of towns within 15 miles of a proposed linear facility is a requiremnet of the Montana Major Facility Siting Act, ARM 36.7.2535. Of these, only Ryegate and Laurel in Montana receive their drinking water from surface waters crossed by the proposed pipeline. Ryegate draws its water from an infiltration gallery adjacent to the Musselshell River and Laurel draws water from a raw water intake located on the north bank of the Yellowstone River. Both water intake locations are about 10 miles downstream of the pipeline water crossings.

The factors influencing the quality of water in the streams that would be crossed by the pipeline are often exacerbated during extended periods of low flow. During years of low precipitation and runoff, diversions for irrigation severely dewater some streams and rivers. These reductions in flow may lead to elevated stream temperatures, decreased dissolved oxygen levels, reduced aquatic habitat, and decreased fish and aquatic invertebrate populations.

In Wyoming, the pipeline would cross 55 named perennial, intermittent, and ephemeral rivers and streams, as well as 41 named and unnamed drainages, irrigation canals and ditches. The watercourses crossed by the pipeline route are identified in Table 12. State water use and fishery classifications are also provided in the table, as are species of fish reported. Unless otherwise noted, tributaries to classified drainages have the same classification as the mainstream. Locations of named perennial streams and all irrigation canals and ditches are shown on the Pipeline Route Maps 5-7.

As in Montana, perennial streams in Wyoming support a variety of uses. However, the pipeline would cross only one watershed designated as a public supply. The town of Lovell obtains water for municipal and industrial use from the Shoshone River. The pipeline would cross this river beside an existing pipeline approximately 0.3 mile upstream (west of) the town of Lovell at about MP 319.5.

Flows of streams that would be crossed by the pipeline vary among streams and seasonally (Table 13). A variety of factors are responsible for this variation. In general, mountain-fed rivers gradually reach peak flows in the months of May, June, and July and have lower, steady flows occurring between August and February. In contrast, streams rising from the Great Plains or Great Basin regions, tend to rapidly reach peak flows during spring runoff in March and April with flows sharply falling off thereafter. Some of the major streams crossed by the route periodically flood during spring runoff and from ice blockages during break-up of ice during spring. Finally, many of the smaller streams crossed by the route are free-flowing, and are not restricted by flood control impoundments, levees, or other structures.

Table 12 Perennial, Intermittent, and Ephemeral Drainages Crossed By The Express Pipeline Route in Wyoming

WATERBODY	MILEPOST	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS[1]	STATE FISHERY CLASS[2]	FISH SPECIES[3]	FLOW CLASS[6]
SHOSHONE RIVER SUB-BASIN							
Sidon Canal	318.5	10	8	IV			P,I,E
Unnamed Drainage	317.0	0	10				7
Unnamed Drainage	317.2	0	55				7
Peterson Creek	318.0	8	4	II			E
Unnamed Drainage	318.7	2	4				7
Sage Creek	319.3	25	6				7
Shoshone River	319.4	125	275	II	III	T,W,S,L,NG	P
Hunt Godfrey Canal	318.7	15	8				I
Globe Canal	320.8						I
Irrigation Lateral	321.6						I
Irrigation Lateral	322.9						I
Elk-Lovell Canal	323.9			IV			I
Little Dry Creek	325.5	5	0	IV			E
BIGHORN RIVER FROM GREYBULL TO BIG HORN RES.							
Sand Draw	326.6	6	0	IV			E
Sand Draw	328.5	80	0	IV			E
Unnamed Drainage	333.6	150	0				E
Lovell Draw	335.4	20	0				E
Little Dry Creek	344.6	5	0				E
Agrarian Ditch	347.0						I
DRY CREEK SUB-BASIN							
Dry Creek	347.7	26	20	II	IV	T,NG	P
GREYBULL RIVER SUB-BASIN							
Greybull River	352.2	90	665	II	IV	T,W,S,L,NG	P
BIGHORN RIVER FROM HEADWATERS TO GREYBULL							
Antelope Creek	358.4	5	0	II			E
Elk Creek	361.9	2	0	III	IV	T,NG	I
Dobie Creek	366.1	4	0	II			I
Unnamed Drainage	366.1			II			E
Alamo Creek	367.4	4	0	II			I
Big Horn Canal	372.5	0	5	IV			I
Fivemile Creek	372.8	5	10	III			I
Sixmile Creek	373.8	1	115	III			P
Big Horn River	374.3	200	400	II	IV	T,W,S,L,CC, NG	p
Fritz Canal	374.6	7	20	IV			I
Lower Hanover Canal	377.2			IV			I
Upper Hanover Canal	379.9			IV			P,I,E
Slick Creek	385.8	40	0	IV			I

Table 12 Perennial, Intermittent, and Ephemeral Drainages Crossed By The Express Pipeline Route in Wyoming

WATERBODY	MILEPOST	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS[1]	STATE FISHERY CLASS[2]	FISH SPECIES[3]	FLOW CLASS[6]
Unnamed Drainage	386.3	30	0	IV			E
Highland Hanover Canal	387.0	20	0				I
Little Slick Creek	387.8	3	0	IV			I
East Fork Nowater Creek	392.1	20	0	IV	V	T, NG	I
Little Sand Draw	395.8	50	0	IV			I
Nowater Creek	398.4	3	9	IV			P
Unnamed Drainage	403.8	100	0				
Unnamed Spring/Drainage	406.4	0	70				
Unnamed Drainage	406.9	12	0				
Lake Creek	407.0	6	0	II			P
Kirby Creek	408.8	4	7	IV	V	T,NG	I
Unnamed Drainage	410.0	50	0				
West Kirby Creek	416.1	5	225	II	IV	T,NG	P
<u>BADWATER CREEK SUB-BASIN</u>							
West Bridger Creek	422.6	12	14	II	IV	T,NG	P
South Bridger Creek	426.4	4	0	II			P
Greer Draw	427.1	0	0	II			I
Bridger Creek	433.7	14	10	II			P
Davis Draw	435.0	0	0	II			I
Cottonwood Creek	435.8	3	0	II			I
Badwater Creek	438.7	15	5	II			P
South Fork	440.1						
South Fork	440.2			II			I
Sand Creek	442.1			IV			I
South Fork Sand Creek	446.3						
Unnamed Drainage	448.3			IV			I
Unnamed Drainage	448.5						
Unnamed Drainage	451.0						
Red Creek Tributary	453.4			III			I
Red Creek Tributary	453.7						
Red Creek	454.4						
Alkali Creek Tributary	456.9			IV			I
Alkali Creek Tributary	457.8						
Unnamed Drainage	459.3						
E-K Creek	459.9						
Alkali Creek	460.9						
Alkali Creek Tributary	461.1						
Keg Spring Draw	471.4	0	115	III			I
<u>SOUTH FORK POWDER RIVER SUB-BASIN</u>							
South Fork Powder River	477.5	5	45	IV			P

Table 12 Perennial, Intermittent, and Ephemeral Drainages Crossed By The Express Pipeline Route in Wyoming

WATERBODY	MILEPOST	CHANNEL WIDTH[4] (FT)	WETLAND WIDTH[5] (FT)	STATE WATER USE CLASS[1]	STATE FISHERY CLASS[2]	FISH SPECIES[3]	FLOW CLASS[6]
Wyatt Draw	478.5	7	45	IV			I
CASPER CREEK SUB-BASIN							
Middle Fork Casper Creek	485.2			III			P
Smith Canyon Draw	486.0			III			P
Middle Fork Casper Creek Tributary	486.7						
Middle Fork Casper Creek Tributary	487.7						
Canyon Draw	489.6						
Selby Draw	491.4			III			I
Selby Draw	491.9			III			I
Tie Bridge Gulch	493.0			IV			I
Unnamed Drainage	494.3						
South Fork Casper Creek	496.9	6	4	IV			P
South Fork Casper Creek	497.0	6	4				
Casper Canal	498.0	20	0				
Casper Canal Underdrain	498.3	0	10				
Tudor Draw	499.5	0	0				
Johnson Lateral Canal	501.3	20	4	IV			I
Twelvemile Draw (Upper)	502.2	2	0	UV			I
Unnamed Drainage	505.0	6	2				
Twelvemile Draw (Lower)	505.8	6	2				
Unnamed Drainage	506.2	0	600				
Unnamed Drainage	506.4	0	10				
Siphon Johnson Lateral	508.0	15	4				
Sixmile Draw	509.3	6	8	IV			

Notes:

[1] Wyoming Water Classification (WDEQ 1989)

Class II: Those surface waters, other than those classified Class I, which are determined by the Wyoming Game and Fish Department to be presently supporting game fish or have the hydrologic and natural water quality potential to support game fish.

Class III: Those surface waters, which are determined by the Wyoming Game and Fish Department to be presently supporting nongame fish only or have the hydrologic and natural water quality potential to support nongame fish only or include nursery areas or food sources for nongame fish only.

Class IV: Those surface waters, other than those classified as Class I, which are determined by the Wyoming Game and Fish Department to not have the hydrologic or natural water quality to support fish.

Note: There are not Class I waters crossed by the Express Pipeline.

[2] In Wyoming, Class I streams indicate a premium trout water of national importance. Class III streams are important trout waters. Class IV streams are low production trout waters. No Class I or II streams are crossed.

[3] Fish Species Cods:
W = Walleye L = Ling

S = Sauger T = Trout
CC = Channel Catfish NG = Native Non-Game Species

[4] Stream width includes open water, stream channels with or without flowing water and mud flats.

[5] Wetland width includes total wetlands on both sides of the stream. Therefore, stream width indicates width during late summar and fall, while wetlands column includes stream width at normal high water mark.

Source: Wyoming Game and Fish Department, 1987.

[6] E= Ephemeral E/I = Ephemeral/Intermittent I = Intermittent P =Perennial

Table 13 Mean Monthly Flows in Selected Wyoming Streams Crossed by the Express Pipeline Route

Station	Period of Record	Mean Monthly Flows (cubic feet per second)											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept
Shoshone R. near Lovell	1967-1993	775	718	663	600	610	633	688	804	1,913	1,83 7	759	776
Bighorn River at Basin	1984-1993	1,486	1,479	1,312	1,200	1,250	1,356	1,280	2,292	3,782	1,70 8	982	1,262
Greybull River at Meeteetse, WY	1931-1971	152	104	78	64	63	77	145	558	1,241	798	473	229
East Fork Nowater Creek near Colter	WY 1984	<1	<1	<1	0	0	64	6	2	6	<1	<1	8
	WY 1988	0	1	<1	<1	1	1	1	22	6	<1	0	<1
Rock Creek above Rock Creek Reservoir	WY 1984	3	2	2	2	2	2	2	44	28	8	4	4
	WY 1988	2	2	2	1	1	1	7	29	10	3	1	1

Source: (USGS 1993)

WY = Water Year; WY 1984 = Wet Year; WY 1988 = Drier Year

In Wyoming, the pipeline would cross five streams with designated 100-year floodplains. All streams that would be crossed are listed in Table 14 with the width of their designated or estimated 100-year floodplains. The sites of the proposed crossings for the largest of these streams have been evaluated for scouring associated with a 100-year flood. The evaluation indicated a 100-year flood would scour relatively limited amounts of streambed (Table 14). Scouring would be less than the depths identified for streams in Montana. However, the evaluation indicated a 100-year flood would scour a substantial portion of the stream banks outside the active channel for all three streams (Table 15).

The quality of surface water varies with location along a specific stream. The quality of water at the headwaters of perennial streams is generally good. However, quality deteriorates downstream. Watersheds along the Wyoming portion of the pipeline route consist primarily of rangelands and occasional badlands. Comparatively high erosion in these areas increases the salinity and concentration of sediment in the streams. Point and nonpoint sources of pollution also contribute to the deterioration of water quality. Finally, water deficits, due to losses to evapotranspiration and sublimation occur in many areas (BLM 1986a), further increasing the concentration of sediment and salinity of the streams. The water quality in ephemeral drainages mirrors that in downstream perennial streams for similar reasons.

Salinity and sedimentation in the streams that would be crossed by the pipeline route are of primary concern. Salinity restricts the use of water for agricultural, municipal, industrial, and recreational purposes. Sediment transports nutrients and pesticides, which can degrade fisheries, increase the cost of municipal treatment, and damage crop and irrigation facilities (BLM 1988a).

Ground Water

The quantity and quality of ground water in the Great Plains region of Montana and Wyoming vary considerably depending on geology, topography, and patterns of precipitation. Where ground water is available and of good quality, it is used for domestic, municipal, industrial, irrigation, and livestock water supplies.

Ground water in the vicinity of the proposed pipeline occurs in both unconsolidated deposits and consolidated bedrock aquifers. Quaternary unconsolidated deposits include glacial deposits, alluvium, colluvium, and terrace gravels. Typically, depths to ground water range from 20 to 60 feet and dissolved solids are generally less than 2,200 mg/L (USGS 1985).

In Montana, glacial deposits occur north of Flat Creek (approximately MP 96.6). Although they are typically less than 50 feet thick, they can be thicker than 100 feet in some areas. Alluvial and terrace deposits are usually less than 30 feet thick along most drainages, but can reach thicknesses of 200 feet along some of the major rivers. Colluvial deposits are rarely thicker than 15 feet (Noble et al. 1982).

Alluvium is the most heavily used aquifer in the Great Plains area of Montana, primarily because it is accessible at shallow depths, typically has high yields, and is close to farmland. Dissolved solids

Table 14 Recorded and Estimated 100-year Floodplains Crossed by the Express Pipeline Route in Wyoming[1]

STREAM	MILEPOST	WIDTH OF 100-YR. FLOODPLAIN (miles)
Shoshone River	319.4	0.5
Dry Creek (R)	347.7	0.2
Greybull River (R)	352.2	0.2
Antelope Creek (R)	358.4	0.1
Elk Creek (R)	361.9	0.2
Dobie Creek (R)	365.1	<0.1
Sixmile Creek	373.7	0.05
Big Horn River	374.3	0.3
Nowater Creek	399.4	0.08
West Kirby Creek	416.1	0.15
West Bridger Creek	422.7	0.04
South Bridger Creek	426.4	0.19
Bridger Creek	433.7	0.04
Badwater Creek	439.7	0.2
South Fork Powder River	477.5	0.23
Middle Fork Casper Creek	485.2	0.23
South Fork Casper Creek	497.9	0.15

range from 300 to 2,500 mg/L. Yields and water quality vary considerably in glacial deposits, with those that have been reworked by running water yielding more and better quality water (Noble et al. 1982).

Bedrock aquifers in the vicinity of the pipeline route in Montana include the Judith River Formation, the Eagle Formation, the Kootenai Formation, and the Madison Group. Depths to ground water range from 100 to 3,000 feet and dissolved solid concentrations are usually less than 2,300 mg/L (USGS 1985). The Judith River Aquifer consists of sandstone, siltstone, and silty shale. It varies in thickness and yields from wells range up to about 100 gpm. Flowing wells occur along portions of the Missouri River and Musselshell River drainages. The quality of water varies considerably, often

Table 15 Summary of Scour Information for Streams Crossed by the Express Pipeline Route in Wyoming

				ESTIMATED EXTENT OF LATERAL SCOUR			
STREAMS	D_{50} BED MATE-RIAL (mm)	100-YR FLOOD (cfs)	EST. DEPTH OF BED SCOUR[1] (feet)	DISTANCE BEYOND LEFT BANK (feet)	ACTIVE CHANNEL WIDTH (feet)	DISTANCE BEYOND RIGHT BANK (feet)	TOTAL LENGTH OF DEEP BURIAL (feet)
Shoshone River	82	21,000	5	600	120	380	1,100
Greybull River	35	21,100	5	200	220	880	1,300
Big Horn River	74	20,600	3	450	160	340	950

Note:
1. These depths reflect scour in the alluvial material. The maximum potential depth per crossing is estimated to be one foot. Additional depth of burial to account for degradation is allowed for some crossings.

reflecting differences in lithology (Noble et al. 1982). The Eagle Aquifer is the most heavily used aquifer in the western portion of the Great Plains region of Montana. The formation is predominantly sandstone and yields relatively good quality water (Noble et al. 1982). The Kootenai Aquifer consists of sandstone, shale, and freshwater limestone. The basal sandstone is the primary aquifer, with yields of up to 300 gpm of variable quality water (Noble et al. 1982). The Madison Group is an extensive limestone (and dolomitized limestone) unit that shows a great degree of variability in yield (20 to more than 1,000 gpm) and quality (500 to 15,000 mg/L dissolved solids) (Noble et al. 1982). Although there is considerable potential for development in this aquifer, it remains largely untapped at present.

There are six towns in Montana within one mile of the proposed pipeline route that receive their drinking water from shallow wells (less than 100 feet deep) within the unconsolidated aquifers. These towns, along with the respective depths of their wells, are Buffalo (11–97 feet), Garneil (10–40 feet), Shawmut (15–80 feet), Park City (10–80 feet), Rockvale (10–66 feet) and Edgar (10–98 feet). With the exception of a few school districts, all six towns are on private well systems.

In Wyoming, occurrence of ground water is controlled primarily by climate, geology, and topography. Recharge to shallow ground water occurs via seepage, infiltration, and percolation from runoff, precipitation, and streamflow. The quality of water ranges from poor to excellent (BLM 1988b).

Ground water is derived from unconsolidated floodplain deposits and terrace deposits and bedrock aquifers. The unconsolidated deposits vary considerably in permeability, depending on grain size and sorting. The fine-grained deposits yield only small quantities of water (2 to 8 gpm) at depths of 10 to 100 feet. This water is generally marginal for human consumption but suitable for use by livestock and wildlife. The coarse-grained deposits typically yield about 15 to 70 gpm and the water is generally suitable for municipal, irrigation, livestock, wildlife, and most industrial uses (BLM 1978).

Bedrock aquifers in the vicinity of the pipeline route in Wyoming include the Willwood, Fort Union, Lance, Mesaverde, Tensleep, Madison, Wasatch, and Green River formations. The Willwood, Fort Union, Lance, and Mesaverde are Tertiary and Upper Cretaceous formations that consist of interbedded shale, mudstone, marl, sandstone, and conglomerate lenses. Discontinuous sandstone beds are the primary zones producing water. Water from these units is commonly used for livestock and wildlife and is generally suitable for human use (BLM 1978). The Tensleep and Madison are Paleozoic formations that consist of massive dolomite and limestone sequences. Permeability in these units is high and yields range from 200 to more than 1,000 gpm. Water quality is generally good and is satisfactory for human consumption, irrigation, livestock, wildlife, and some industries (BLM 1978). The sandstone and conglomerate members of the Wasatch Formation yield small to moderate amounts of water that commonly contain 500 to 1,000 mg/L of dissolved solids. The Green River Formation yields fair to poor quality water at considerable depths (BLM 1988b).

In Wyoming, Lovell is the only town within one mile of the proposed pipeline route that has a shallow well (less than 25 feet) in the unconsolidated alluvium. Lovell has five wells for miscellaneous use and numerous other shallow domestic wells. However, the main source of water for Lovell is the Shoshone Municipal pipeline, which transports water from the Buffalo Bill Reservoir west of Cody, Wyoming.

Air Quality

General Climate

Within Montana, the climate along the route is continental with cold winters, hot summers, and high evapotranspiration rates. Most precipitation falls as spring and summer rains. Summer storms are often short duration, high intensity "cloud bursts" accompanied by strong winds. High intensity summer storms have high erosion potential on soils where vegetation has been removed. Distribution of precipitation is irregular during the summer due to the local nature of many convection storms. Winters are extremely cold with desiccating winds. Snow accumulation is irregular but may reach depths of two to three feet following blizzards. The frost-free growing season averages 120 to 130 days over most of the route. Typically, soil freezes around November 20 and thaws by mid April. Average annual precipitation is about 14 inches for the route, except the portion from Bridger (approximately MP 280) to the Wyoming border. This route segment lies in the rain shadow of the Beartooth Mountain range and, as a result, only receives from 6 to 10 inches of precipitation per year.

The climate of the project area within Wyoming is semi-arid with precipitation ranging from about 6 inches per year in the cool desert of the Bighorn River valley to about 11–15 inches per year in the plains portion of the Platte River Resource Area (BLM 1985). The mid-continental climate is characterized by large annual and daily temperature ranges, low relative humidity, and irregular rainfall patterns. Recorded annual temperature extremes at Basin, Wyoming, were -50°F to 114°F. The average annual growing season at lower elevations along the Bighorn River is 160 days, decreasing to an average 125 days in the Platte River Resource Area. Soils typically freeze to shallow depths (6–12 inches) by early December and thaw by mid-March at the lower elevations in the Bighorn River valley.

Because much of the route in Wyoming is bordered by mountain ranges, much moisture is removed from approaching air masses. A "rain shadow" creates desert and semi-desert conditions along much of the route. Evapotranspiration rates are high due to low relative humidity, high winds, and a high frequency of days with sunshine. Most precipitation falls as rain in spring. Summer thunderstorms may cause flash flooding, which contributes to erosion and other damages.

Air Quality

The quality of air along the route in Montana is good due to frequent winds, relatively gentle terrain, and the lack of major pollution sources. Unlike mountainous regions of the state where temperature inversions often trap airborne pollutants, inversions in the study area are infrequent. Dust from unpaved roads and fallow cropfields is common. During autumn, smoke is generated by burning of wheat stubble, a farming practice employed to reduce the potential for plant disease and insects. In the Yellowstone River valley, air quality is reduced during some periods due to emissions from petroleum refineries located in Laurel and Billings. These facilities emit vaporous hydrocarbons and sulfur compounds into the air.

Under the Federal Clean Air Act, Prevention of Significant Deterioration (PSD) requirements set limits for increases in ambient pollution levels. The pipeline route in Montana has a PSD II classification. A Class II designation allows for slight to moderate deterioration of air quality. The route in Montana does not cross any Class I areas, which are pristine areas where any deterioration of air quality is considered a significant change.

Air quality in Wyoming is good with few industrial sources and low levels of motor vehicle traffic in most areas. Oil fields are the most common industrial sources of air emissions. Persistent, strong winds, generally from the southwest through the northwest, contribute to good air quality by dispersing pollutants; however, they also degrade visibility by increasing airborne dust. Air quality in the project area is generally good with ambient concentrations of regulated pollutants well below both Wyoming and National Ambient Air Quality Standards (NAAQS) (BLM 1988). Air contaminants in the project area include suspended particulates, hydrogen sulfide, sulfur oxides, nitrogen oxides, and hydrocarbons. The proposed pipeline route is considered Class II under Wyoming Prevention of Significant Deterioration (PSD) regulations.

Noise

At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day, throughout the week and seasonally. This variation is caused in part by differences in output level from noise sources, changing weather conditions and the effects of seasonal vegetative cover. Two measures commonly used to relate the time-varying quality of environmental noise to its known effect on people are the equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}). The $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the $L_{eq(24)}$ with a 10-dBA weighting applied to night time sound levels between the hours of 10:00 PM and 7:00 AM to account for people's greater sensitivity to sound during the night.

Most of the lands crossed in Montana are rural, with few noise receptors. Most rural locations can be expected to have ambient noise levels of 35 to 40 dBA L_{dn}. The route passes near some low-density residential development in the vicinity of Park City, Rockvale, Edgar and the unincorporated town of Garneill. Typical sources of noise along the route include agricultural activities (vehicles and farming equipment), motor vehicles, trains, aircraft, petroleum drilling and extraction activities, wildlife, and wind.

Most of the route in Wyoming is rural with few noise receptors. Near Lovell and Worland, some residences are approached by the route. Noise sources in Wyoming are similar to those in Montana, except that there is more mining and oil and gas drilling and production in the Wyoming segment of the route. As in Montana, there are frequent low-level military flights over much of the state.

Vegetation

Vegetation communities present along the pipeline route through Montana and Wyoming are predominantly grasslands and shrublands, typical of the Northern Great Plains and Great Basins **(Figure 10)**. Cold winters, hot summers, limited precipitation, high rates of evapotranspiration, and local site factors are the primary factors influencing the composition and structure of the vegetation communities. Tree cover is extremely limited and is concentrated primarily in riparian areas.

The following sections describe the general vegetation types crossed by the pipeline route. The distribution of these types along the pipeline route is shown on Maps 1-7. Noxious species also are discussed. Sensitive plants are discussed in the Threatened, Endangered, or Sensitive Species section of this document.

Upland Vegetation Communities

Mixed Grass Prairie

The rolling terrain of north-central Montana is vegetated by native grasslands with tracts of dryland cropfields interspersed on level and gently sloping areas. Three mixed grass prairie subtypes can be distinguished: grama-needlegrass-wheatgrass, wheatgrass-needlegrass-shrubsteppe, and foothills prairie.

The Grama-Needlegrass-Wheatgrass subtype extends from the Canadian border to the uplands north of the Yellowstone River. Much of this prairie has been cultivated and the remainder is used for rangeland. Dominant species of plants include blue grama, needle-and-thread, western wheatgrass, Sandberg's bluegrass, junegrass, fringed sage, broom snakeweed, hairy golden aster, and blazing star.

The wheatgrass-needlegrass-shrubsteppe is intermediate between prairie and shrub vegetation. Big sagebrush and winterfat occur as an overstory to western wheatgrass and needle-and-thread in this subtype. In Wyoming, the Copper (Bridger) Mountains are primarily vegetated by this community. Big sagebrush, western wheatgrass, needle-and-thread, fringed sage, winterfat, and numerous forbs provide productive grazing and wildlife habitat on upland sites. Along drainages and in swales, silver sagebrush, rose, snowberry, and Great Basin wildrye form a dense understory, with narrow-leaved cottonwood also providing canopy cover on the wettest sites.

The foothills prairie grassland is dominated by bluebunch wheatgrass, needle-and-thread and western wheatgrass. A distinguishing feature of this plant community is the mixture of plains and mountain species, with shrub and tree-covered drainage bottoms descending into this grassland community type.

LEGEND

NEEDLELEAF FORESTS

12	Douglas fir forest	*(Pseudotsuga)*
16	Eastern ponderosa forest	*(Pinus)*

SHRUB

40	Saltbush-greasewood	*(Atriplex-Sarcobatus)*

BROADLEAF FORESTS

98	Northern floodplain forest	*(Populus-Salix-Ulmus)*

SHRUB AND GRASSLANDS COMBINATIONS

55	Sagebrush steppe	*(Artemisia-Agropyron)*
56	Wheatgrass-needlegrass shrubsteppe	*(Agropyron-Stipa-Artemisia)*

GRASSLANDS

63	Foothills prairie	*(Agropyron-Festuca-Stipa)*
64	Grama-needlegrass-wheatgrass	*(Bouteloua-Stipa-Agropyron)*

PROPOSED ROUTE

MILES: 50 0 50 100 150 200 250

SCALE

SOURCE: KUCHLER 1985

Express Pipeline

VEGETATION TYPES

DATE: JUNE 1995 FIGURE 10

Eastern Ponderosa Pine Forest

Open ponderosa pine forest is limited along the pipeline route, occurring in small stands south of the Musselshell River, in the broken, eroded terrain adjacent to the Yellowstone River, and in the upper Bluewater Creek drainage. Within this community, ponderosa pine and Rocky Mountain juniper form a sparse overstory. Common understory plants include bluebunch wheatgrass, western wheatgrass, needle-and-thread, sideoats grama, skunkbush sumac, snowberry, and numerous forbs.

Saltbush-Greasewood

This community is composed of many Great Basin plants including several species of saltbush and sagebrush, greasewood, and rabbitbrush as well as grasses and forbs typical of the Great Plains flora. Vegetative cover is very sparse with scattered low shrubs growing where active erosion has not created gullies and rills. The topography where this community occurs is generally undulating and hilly with heavy soils that are often alkali clays. Infiltration of precipitation is retarded due to heavy clays, causing high amounts of sediment laden runoff to flow to ephemeral and perennial drainages.

In Montana, this community extends from near Bridger to the Wyoming border in the arid (6 to 10 inches of annual precipitation) valley between the Pryor and Beartooth mountain ranges. This is the northern-most extension of the Great Basin flora in Montana and several plant species present are considered sensitive in the state because of limited geographic distribution.

In Wyoming, this community occurs from the Montana border into the Big Horn Basin. The eroded, rolling, buff, red, and gray colored hills in the broad valley bottom often have more than 70 percent of the soil surface exposed on undisturbed sites. Scattered saltbush, greasewood, sagebrush, rabbitbrush, and deep-rooted forbs provide the sparse canopy cover.

Sagebrush Steppe

After departing from the Bridger Mountains, the remainder of the pipeline route in Wyoming primarily traverses this low shrub/grassland. Big sagebrush and black sagebrush are the dominant shrubs; however, saltbush and other Great Basin plants are also important components, along with a diversity of forbs and grasses. On sandy sites, yucca, needle-and-thread, and dryland sedge species co-dominate with sagebrush. On poorly drained sites and along drainages, greasewood, inland saltgrass, and Great Basin wildrye are the dominant plants.

Agricultural Lands

Dryland farming and irrigated cropland have replaced much of what were once primarily mixed grass prairie, saltbush-greasewood, and sagebrush steppe communities. The distribution of agricultural lands is shown on Maps 1-7.

Table 16 Summary of Wetlands and Riparian Areas Crossed by the Express Pipeline Route

State	Wetland Type	Non-Wetland Riparian (linear feet)	Wetland WUS[1] (linear feet)	Non-Wetland WUS[1] (linear feet)	Total Jurisdictional Wetland (linear feet)
Montana	Ditch	0	288	96	384
	Pond	0	14	100	114
	Sandstone	0	0	32	32
	Deciduous Shrub/Wet Meadow Complex	1,754	5,427	331	5,758
	Riparian Cottonwood Forest	3,059	1,145	1,787	2,932
	Saline/Sodic Shrubland	470	70	170	240
	Saline/Sodic Wet Meadow	2,285	7,665	19	7,684
	Total	7,568	14,609	2,535	17,144
Wyoming					
	Deciduous Shrub/Wet Meadow Complex	787	868	313	1,181
	Disturbed	0	0	150	150
	Disturbed/ Wet Meadow Complex	0	5	0	5
	Grassland	80	0	0	0
	Not Inventoried (Private)	-	-	-	-
	Riparian Cottonwood Forest	2,950	950	240	1,190
	Saline/Sodic Shrubland	6,840	17	124	141
	Saline/Sodic Shrubland/Wet Meadow Complex	3,655	15	29	44
	Saline/Sodic Wet Meadow	5,600	987	105	1,092
	Unknown	4,265	-	-	-
	Unvegetated	800	0	89	89
	Wet Meadow	780	616	53	669
	Xerophytic Shrub	0	0	287	287
	Total	25,757	3,458	1,390	4,848

[1] WUS = Waters of the U.S. defined as open waters, mud flats, riffle and pool complexes, vegetated shallows, and other aquatic habitat.

Wetlands and Riparian Areas

Wetlands and riparian areas tend to be extremely important ecologically, particularly in arid regions. Wetlands and riparian areas are considered important because of their beneficial functions, including recharging ground water, controlling floods, improving water quality via control of sediment and removal of excess nutrients, providing wildlife habitats, and providing aesthetic or scenic values. Recognizing the importance of wetlands and riparian areas, Express routed its proposed pipeline to avoid wetlands and riparian areas, to the extent possible.

Several general types of wetlands and riparian areas were identified and delineated using interpretation of aerial photography and field reconnaissance (Table 16). Each type is discussed below. In addition, Appendix E identifies, for each wetland and riparian area crossed by the pipeline route, the location (by milepost), type, width, and classification as waters of the U.S. (primarily stream channels or mud flats that are not dominated by hydrophytic vegetation).

Riparian Cottonwood Forest

These open to closed-canopy forests grow on soils with ground water within the rooting zones of most woody species; however, the upper several feet of alluvial silts, sands, and gravels are well drained and are not saturated during the growing season. Well-developed overstories of plains cottonwood with understories of various shrubs, grasses, and forbs dominate the floodplains of the major rivers crossed by the pipeline route. The pipeline route would cross about 12 acres of riparian cottonwood forest.

In Montana, vegetation along major rivers and streams typically has a forest overstory dominated by plains cottonwood and boxelder with understories of willow, rose, snowberry, and other species adapted to higher moisture regimes. "Gallery" forests, with several tiers in the canopy, have developed along the floodplains of major rivers, such as the Missouri, Musselshell, Yellowstone, and Clark's Fork of the Yellowstone rivers. A gallery forest exists along the west bank of the Missouri, extending approximately 500 feet along the proposed right-of-way. Due to heavy grazing and trampling by livestock, most riparian areas have a large proportion of exotic grasses, including Kentucky bluegrass, smooth brome, and redtop. Many riparian areas have been cleared and converted to irrigated and subirrigated hay meadows and cropfields.

In Wyoming, the floodplains of the Bighorn and Shoshone rivers are forested by mature plains cottonwood, Russian olive, tamarisk, narrow-leaved cottonwood, willow, chokecherry, and other deciduous shrubs. Smaller drainages typically have narrow-leaved cottonwood, greasewood, saltgrass, and other species tolerant of relatively high levels of salinity. Cattail, rushes, sedges, and other obligate wetland species grow on the wettest areas of the riparian zones.

Deciduous Shrub/Wet Meadow Complex

Small perennial streams, not subject to frequent, high intensity flooding are vegetated by deciduous shrubs, such as snowberry, rose, chokecherry, buffaloberry and willow, or by herbaceous streamside species. Scattered cottonwoods may be present, but they usually do not have a density of more than 2 to 3 trees per acre. Understories consist of both native and exotic species adapted to moist soils. Stream margins, having adjacent surface water or ground water within several inches of the soil's surface for most of the growing season, support stands of rushes, sedges, or grasses adapted to an aquatic environment.

Saline/Sodic Shrubland

On flood terraces with high levels of sodium or alkali and shallow ground water, stands of greasewood, western wheatgrass, and saltgrass form a distinct community in arid regions.

Saline/Sodic Wet Meadows

Saline, alkali wet meadows grow in poorly drained areas where ground water is within 1 to 2 feet of the soil's surface during the growing season. Dominant species include foxtail, saltgrass, western wheatgrass, curly dock, and saltwort with numerous weeds such as kochia, buffalo burr, wild licorice, and annual sunflower. During dry years, many of these areas are managed as hay meadows or pastures, which has led to the proliferation of non-native grasses and forbs.

Ephemeral Wetlands

In the glaciated region of Montana, small undrained depressions become ephemeral wetlands only during years with high precipitation. Currently, these areas on the route do not have surface water or support vegetation indicative of a moist climatic cycle. Unglaciated areas have undrained depressions caused by wind erosion (i.e., deflation basins). These low areas periodically collect surface runoff and may have high ground water levels during wet years, although none currently reflect this condition.

Noxious Weeds

Noxious weeds are usually exotic species of plants that proliferate and reduce the value of land for agriculture, forestry, livestock, wildlife, or other beneficial uses. Twenty-seven species of plants designated as noxious weeds in Montana and Wyoming occur or potentially occur along the pipeline route (Table 17). Noxious weeds occur along 63 segments of the pipeline route (Table 18). Noxious weeds, including Canada thistle, leafy spurge, Russian knapweed, spotted knapweed, field bindweed, and whitetop occur along approximately 30 miles of the route in Montana. Whitetop, spotted knapweed, Canada thistle, Russian knapweed, leafy spurge, and quackgrass infest about 2 miles of the route in Wyoming. These species colonize areas where the natural vegetation has been disturbed by farming, grazing, transportation corridors, and other land use practices.

Although it is not designated a noxious weed in Wyoming, halogeton infests much of the Big Horn Basin. The proposed pipeline route crosses approximately 77 miles of halogeton in Big Horn, Washakie and Hot Springs counties.

Control of noxious weeds is an important concern in both Montana and Wyoming. The Montana County Noxious Weed Management Act and the Wyoming Weed and Pest Control Act of 1973 govern the control and spread of plants designated as noxious weeds in the two states. The laws specify that noxious weeds must be prevented from becoming established and must be eradicated when possible.

In addition to the state law, the Montana Legislature requires that each county establish a county weed management plan. County weed management plans require identification of noxious weeds and implementation of control measures where noxious weeds occur. Control measures can include mechanical, chemical, or biological treatment as well as selective grazing by domestic animals. Control measures selected depend on the severity of infestation and other factors.

Terrestrial Wildlife

The discussions that follow focus on species that occur or may occur in the project area and are considered important by resource management agencies. These species include big game, upland game birds, waterfowl, raptors, and small mammals. The wildlife resource crossed by the pipeline route is typical of the Northern Great Plains and Great Basin. Coyote, mule deer, white-tail deer, pronghorn antelope, deer mouse, red-tailed hawk, mourning dove, raven, and magpie occur throughout the route. In contrast, species such as sage grouse, sharp-tailed grouse, and pronghorn show specific preferences for habitats. Threatened, endangered, and sensitive species are discussed in the Threatened, Endangered, and Sensitive Species section later in this chapter.

In general, mule deer occur in all the major habitat types crossed by the proposed route at some time during the year. Although the pipeline route would cross different ranges for mule deer, winter ranges and crucial ranges are of primary concern to resource management agencies in Montana and Wyoming. No migration routes or parturition areas have been identified along the route.

Within Montana, the proposed pipeline would cross mule deer winter range as mapped by the MDFW&P at four locations (Maps 1-5). These locations include the Milk River (approximately MP 7-9), Sage Creek (approximately MP 32-35), Missouri River (approximately MP 67-75) and southeast of Arrow Creek (approximately MP 110-113).

Within Wyoming, the proposed pipeline would cross mule deer crucial winter year-long (CWYL) range at five locations (Maps 6-7 and Appendix E). These locations include the East Fork of Nowater Creek (approximately MP 391), Kirby Creek (approximately MP 408.5), the south and east slopes of the Bridger Mountains (Copper Mountain) (approximately MP 410-420), the south slopes of Lysite Mountain and Cedar Ridge (approximately MP 428-432), and immediately east of Lost Cabin (MP 439).

Table 17 Noxious Weeds in Montana and Wyoming

Common Name	Scientific Name	Montana Category[1] 1	2	3	Wyoming
Canada thistle	*Cirsium arvense*	•			•
Dalmation toadflax	*Linaria dalmatica*	•			•
Diffuse knapweed	*Centaurea diffusa*	•			•
Field bindweed	*Convolvulus arvensis*	•			•
Leafy spurge	*Euphorbia esula*	•			•
Russian knapweed	*Centaurea repens*	•			•
Spotted knapweed	*Centaurea maculosa*	•			•
St. Johnswort	*Hypericum perforatum*	•			
Whitetop (hoary cress)	*Cardaria draba* and *Cardaria pubescens*	•			•
Dyers woad	*Isatis tinctoria*		•		•
Lythrum	*Lythrum virgatum*		•		
Purple loosetrife	*Lythrum salicaria*		•		
Sulfur (erect) cinquefoil	*Potentilla recta*		•		
Common crupina	*Crupina vulgaris*			•	
Rush skeleton weed	*Chondrilla juncea*			•	
Yellow starthistle	*Centaurea solstitialis*			•	
Perennial sowthistle	*Sonchus arvensis*				•
Quackgrass	*Agropyron repens*				•
Perennial pepperweed (Giant whitetop)	*Lepidium latifolium*				•
Ox-eye daisy	*chrysanthemum leucanthemum*				•
Skeletonleaf bursage	*Ambrosia tomentosa*				•
Yellow toadflax	*Linaria vulgaris*				•
Scotch thistle	*Onopordum acanthium*				•
Musk thistle	*Carduus nutans*				•
Common burdock	*Arctium minus*				•
Plumeless thistle	*Carduus acanthoides*				•
Houndstongue	*Cynoglossum officinale*				•

Note:

1. Category 1 noxious weeds are weeds that are currently established and generally widespread in many counties of the state. These weeds are capable of rapid spread and render land unfit or greatly limit beneficial uses. Management criteria include awareness and education, containment and suppression of existing infestations, and prevention of new infestations.

   Category 2 noxious weeds have recently been introduced into the state or are rapidly spreading from their current infestation sites. These weeds are capable of rapid spread and invasion of lands, rendering lands unfit for beneficial uses. Management criteria include awareness and education, monitoring and containment of known infestations, and eradication where possible.

   Category 3 noxious weeds have not been detected in the state or may be found in only small, scattered, localized infestations. These weeds are known pests in nearby states and are capable of rapid spread and render land unfit for beneficial uses. Management criteria include awareness and education, early detection, and immediate action to eradicate infestations.

Sources: Montana County Noxious Weed Management Act 1985 ARM 4.5.201-204 (amended 1991); Wyoming Weed and Pest Control Act of 1973, Title 11, Chapter 5 and the Wyoming Seed Law (WS11-12-104).

Table 18 Known Locations of Noxious Weeds Crossed by the Express Pipeline Route

Montana

County	Milepost Location	Species[2]
Hill	30.00-33.00	EUES
Choteau	68.17-68.18	CIAR
	68.33-68.42	EUES
Fergus	111.10-111.80	CIAR
	117.50-117.51	CIAR
Judith Basin	122.35-122.36	CIAR
	123.10-123.11	CIAR
	132.30-132.33	CIAR
	133.00-140.00	CADR/COAR
	134.70-134.74	CIAR
	137.10-137.14	CIAR
	139.00-146.00	CADR/EUES
	141.20-141.22	EUES
	142.70-142.71	EUES
	143.70-143.75	EUES
	146.00-155.00	CADR/CEMA/EUES
	153.10-153.11	CIAR
	153.70-153.71	CIAR
	155.90-155.91	CIAR
	157.80-157.81	CIAR
	161.30-161.31	EUES
	162.80-168.82	CIAR/EUES
	164.50-164.52	CIAR/EUES
	165.70-165.75	EUES
Wheatland	192.80-192.81	CIAR
	193.81-193.82	CIAR
	194.70-194.81	CIAR
	195.00-196.00	CEMA
Golden Valley	211.30-211.60	CIAR
Stillwater	214.20-214.21	CIAR
	223.75-223.76	CIAR
	227.40-227-66	CIAR
	229.50-229.51	CIAR

Montana

County	Milepost Location	Species[2]
Stillwater (Contd.)	233.90-233.91	CIAR
	251.78-251.79	CIAR
	255.23-255.46	CIAR/EUES
Carbon	255.59-255.68	EUES
	258.31-258.33	CIAR
	262.55-262.56	CIAR
	262.80-262.81	CIAR
	263.20-263.35	CEMA/CIAR
	266.34-266.45	CIAR
	266.86-266.89	CADR/EUES
	268.00-269.00	CIAR
	278.00-283.00	EUES
	294.85-294.87	CEMA/CERE/CIAR
	296.37-296.43	CIAR

Wyoming

County	Milepost Location	Species[2]
Big Horn	306.51-306.52	CADR/CERE
	318.69-318.70	CIAR
	319.22-319.86	AGRE/CIAR
	347.42-347.73	AGRE/CADR/CIAR
	352.18-352.35	AGRE/CADR/CIAR
	372.78-372.88	AGRE/CIAR
Washakie	373.78-373.80	CIAR
	374.29-374.57	AGRE/CEMA/CIAR
	399.41-399.42	AGRE
	404.29-404.30	AGRE
Hot Springs	407.02-407.08	AGRE/CIAR
	408.77-408.80	CIAR
	409.99-410.00	CIAR
	416.04-416.06	CIAR
	416.68-416.69	CIAR
Fremont	422.64-422.65	CIAR
	431.70	CACP/CERP
	433.24-433.90	CACP/CERP/CIAV
	433.60-434.00	CERE
	438.80-439.74	CERE
Natrona	506.41	CIAV

Notes:

1. Mileposts taken from orthophoto worksheets for Montana (sheets 1-52) and Wyoming (sheets 1-21); and 1993 orthophoto worksheets for Wyoming (sheets 22-36).
2. Sources include observations made while conducting pedestrian survey of route and communications with county weed control personnel. EUES = *Euphorbia esula*, CIAR = *Cirsium arvense*, CIAV = *Cirsium arvense*, CACP = *Cardiria chalpensis*, CADR = *Cardaria draba*, COAR = *Convolvulus arvensis*, CEMA = *Centaurea maculosa*, AGRE = *Agropyron repens*, CERE = *Centaurea repens*, CERP = *Centaurea repens*

Pronghorn occur in the mid-grass prairie, but are not as numerous as in areas with greater amounts of sagebrush. Sagebrush is the pronghorn's primary winter food, whereas forbs are important during other seasons. During harsh winters, pronghorn move to areas with exposed sagebrush and lesser amounts of snow. Although the proposed route does not cross any identified migration routes for pronghorn, it does cross near (within 0.25 to 0.5 miles) parturition areas for pronghorn from about MP 353 to MP 355 (Appendix E).

Winter range for pronghorn that is of concern to MDFW&P and WGFD exists along the proposed route. Within Montana, pronghorn winter range is crossed by the pipeline route near Arrow Creek (approximately MP 103-113), Stanford (approximately MP 129-141), and north of Judith Gap (approximately MP 158-167). Within Wyoming, pronghorn CWYL range exists along the Kirby Creek route crossing (MP 408.5), Bridger Creek crossing (MP 425), the south slope of Lysite Mountain (MP 430-436), at the Sand Creek crossing (MP 436), and the southeastern slope of Cedar Ridge (MP 441.0 - 445). In addition, CWYL range exists from the townsite of Powder River east to Natrona (MP 479- 491).

There is no defined winter range for other ungulates (elk, moose, mountain goat, mountain sheep) along the route. However, winter ranges for white-tailed deer are assumed to follow riparian forests along streams and rivers. Concentrations of white-tailed and mule deer are noted in the broad valleys surrounding streams and rivers. In addition, the route does not cross any defined migration routes of any big game species.

Several species of raptors inhabit the proposed pipeline route as seasonal or year-round residents. Typical species include the bald eagle, golden eagle, Swainson's hawk, ferruginous hawk, red-tailed hawk, northern harrier, prairie falcon, American kestrel, great horned owl, and burrowing owl. Raptors are expected to occur through out the pipeline route in habitats including riparian woodlands, grasslands, and agricultural areas.

During the spring of 1992, raptor nests in the Montana portion of the route were surveyed. Locations of active nests within 0.5 mile of the route are shown on Maps 1-7. Results of the surveys indicate that a total of 33 active nests occurred along the pipeline. These nests included 12 Swainson's hawk, five red-tailed hawk, five ferruginous hawk, five American kestrel, four golden eagle and two great horned owl. Although goshawks were not observed in the survey, they are known to exist in ponderosa pine forests at mid elevations in central Montana. In addition, there were many inactive nests along the route. Species such as owls, northern harrier, and American kestrel are undoubtedly more common than was documented.

Within Wyoming, raptor nesting sites within 0.5 mile of the route have been identified by the WGFD, BLM and Altamont (Appendix E and Maps 1-7). An estimated 19 raptor nests have been identified within the Platte River Resource Area (BLM 1993). An additional 60 raptor nests have been identified as occurring within at least 0.5 mile of the proposed route in Wyoming.

In both Montana and Wyoming, several species of upland game birds occur or potentially occur along the route. They include the sage grouse, sharp-tailed grouse, mourning dove, ring-necked pheasant, gray partridge, chuker and wild turkey. However, the sharp-tailed grouse has not been documented to occur along the route within Wyoming.

Within Montana, native grasslands and the shrub coulees that dissect these grasslands are critical to sharp-tailed grouse for food and shelter in the winter. Sharptails return each spring to the same sites (i.e., leks) where courtship and breeding take place. Leks are usually located in native grasslands. Nests are typically placed in dense stands of grasses or shrubs within one mile of a lek.

In contrast, the proposed route passes through sagebrush/grassland areas that have high concentrations of sage grouse. Thus, a variety of leks, nesting habitat, and winter habitat is crossed by the route. Sage grouse return each spring to the same sites (i.e., leks) where courtship and breeding take place.

Within Montana, the presence of only one sharp-tailed grouse lek (MP 77.5) and one sage grouse lek (MP 276) has been documented within 0.5 mile of the route. No winter concentration areas for either species have been documented. The larger and better nesting habitats for both species are shown on Maps 1-4.

Unpublished data from the WGFD and BLM and field surveys conducted for Altamont's project (Altamont 1991) indicate sage grouse leks are present from the Wyoming-Montana border south to Bridger Creek, about MP 433.7 (Maps 5-6). From Bridger Creek south to the pipeline's terminus in Casper, the number of sage grouse lek decreases to just a few (WGFD, BLM 1993). Within Wyoming, the pipeline would pass through or within 0.5 mile of approximately 16 leks (Appendix E).

Although white-tailed prairie dog colonies occur near the southern end of the Montana portion of the route (MNHD 1993), they are not crossed by the pipeline. In Wyoming however, white-tailed prairie dog colonies are present throughout the region crossed by the proposed pipeline route (Appendix E). Prairie dog colonies are important because they are potential habitat for the endangered black-footed ferret. Maps and field surveys indicate prairie dog colonies are present from south of Basin (approximately MP 362) to the Lost Cabin Corner (MP 440) (Maps 5-6). In addition, the BLM has identified prairie dog colonies south and northeast of the proposed route (Maps 5-7). A total of 33 prairie dog colonies was estimated to occur within 0.5 mile of the proposed right-of-way for the Express pipeline.

A variety of waterfowl occur along the proposed route. Common species include the mallard, American coot, redhead, common merganser, green-winged teal, shoveler, and gadwall. However, many more species may be present during the seasonal migrations.

Waterfowl breeding habitat in the vicinity of the route includes the Hailstone National Wildlife Refuge (approximately MP 220) and Halfbreed Lake National Wildlife Refuge (approximately MP 230). Neither of these refuges is crossed by the route. However, there are proposed plans to convert Bureau of Reclamation lands near Lonesome Lake (approximately MP 51) to waterfowl habitat. These plans were finalized in a 1994 EIS. At present, BOR land crossed by the proposed route is rangeland.

Waterfowl resources of particular concern to the various resource management agencies include nesting colonies. However, aerial and ground surveys conducted during 1991 and 1992 failed to locate any nesting colonies of white pelicans, great blue herons, double-crested cormorants, gulls, or terns along the route (Appendix E).

Wildlife Habitat Types

A variety of wildlife habitat types would be crossed by the proposed pipeline. Because the types identified along the route vary between Montana and Wyoming, the discussion of habitat types is split by state.

Montana Habitat Types

Grama-Needlegrass-Wheatgrass

The prairie grasslands and interspersed dryland grainfields provide habitat for sharp-tailed grouse, gray partridge, horned lark, prairie falcon, long-billed curlew, common nighthawk, upland sandpiper and meadowlark. Where relatively moist coulees or riparian areas occur within the upland habitats, ring-necked pheasant and mule deer are common. Brushy coulees and riparian areas provide forage, security and escape cover for mule deer and white-tailed deer which feed in agricultural areas.

Eastern Ponderosa Pine Forest

Species typical of the Eastern Ponderosa Pine Forest include wild turkey, porcupine, red-tailed hawk, common nighthawk, least chipmunk and mule deer. The relatively open forests and associated rugged terrain provide excellent winter and year-round habitat for mule deer. The proximity of the forested areas to croplands and hay meadows along the Yellowstone River allows mule deer, white-tailed deer and wild turkey to utilize agricultural lands for feeding and forested areas for escape, security cover and rearing of young.

Foothills Prairie

The fauna of the Foothills Prairie is similar to that of the grama-needlegrass-wheatgrass community. The higher elevations of this vegetation type, adjacent to the Pryor and Beartooth Mountain ranges, are winter range for elk and mule deer, but this range does not extend down to the pipeline route.

Saltbush-Greasewood

Pronghorn, mule deer, white-tailed prairie dog, grasshopper mouse, deer mouse, kangaroo rat, desert cottontail, raptors and other birds utilize the saltbrush-greasewood habitat type. However, the relatively sparse vegetative cover does not produce sufficient amounts of forage to support large wildlife populations. Typically, pronghorn and mule deer feed in this habitat, but also depend on interspersed sagebrush, Utah juniper and mountain mahogany for sufficient cover and browse on a year-round basis.

Riparian

Riparian areas have the greatest diversity of breeding birds of any habitat along the pipeline route. Many passerine species as well as raptors, waterfowl and shorebirds nest along the major rivers and streams. Sandhill cranes nest and feed in riparian areas, wet meadows and pastures. White-tailed deer, although widely distributed, often attain their highest population densities where riparian areas are interspersed with agricultural lands.

Wetlands

Wetlands associated with the pipeline route attract migrating and breeding waterfowl. During spring and fall migrations, snow geese, Canada geese, tundra swans, shorebirds and ducks rest and feed near the pipeline route. Mallard, pintail, teal, gadwall, widgeon and Canada geese may nest in wetlands along the route.

Wyoming Habitat Types

Sagebrush-Shrubland

In the northern portion of the Express route through Wyoming (MP 307-385), the route crosses saltbush, rabbitbrush and sagebrush-grassland habitats interspersed with riparian areas composed of willows, buffaloberry, Russian olive and cottonwood. Agricultural lands constitute significant portions of this area and provide additional important summer and winter range for a variety of wildlife species. Rivers (Shoshone, Greybull and Big Horn) along this portion of the route provide significant raptor habitat and nesting habitat for upland game bird species.

Sagebrush-Greasewood

The middle portion of the proposed route (MP 385-420) passes through habitat consisting of big sagebrush, silver sage, greasewood, saltbush and juniper. The drainages along this portion of the route (Copper and Lysite Mountains) provide important wintering sites for wildlife.

Badland

From the Copper Mountain area (MP 420-460), the route heads southeast into desert badlands vegetative types with juniper-covered slopes containing true mountain mahogany. Sagebrush flats and meadows adjacent to the badlands are utilized by mule deer and antelope.

Sagebrush-Shortgrass Prairie

The eastern portion of the pipeline route (MP 460-510) is predominantly sagebrush-shortgrass prairie with some ponderosa pine on rocky knolls north of Powder River. Hells Half Acre (MP 474) is immediately south of the proposed route. This site is a deeply eroded area consisting of badlands, towers, spires and caverns.

Agricultural

Near Casper, farming and livestock grazing are the dominant land uses. This area provides marginal big game habitat.

Riparian

Riparian areas provide habitat for sandhill cranes, whooping cranes, great blue herons, and other waterfowl. Areas along the Bighorn, Shoshone, and Greybull rivers provide habitat for great blue heron rookeries identified during field investigations conducted by Altamont in 1991 and 1992 (Maps 5-7) and by WGFD personnel (Appendix E).

Aquatic Life

The rivers and streams in northern and central Montana are prairie streams with broad floodplains, relatively low current velocities and high turbidity. Common game fish adapted to these warm and cool-water environments include channel catfish and sauger. Streams originating in the foothills of mountain ranges, particularly in the central and southern portions of the Montana section of the route, are cool to cold-water streams capable of supporting trout.

The rivers and streams known to support fish and the type of fishery in the vicinity of the pipeline crossing are shown on Maps 1-4. The types of fish found in perennial streams and rivers are listed previously in Table 9 in this chapter.

Montana has classified rivers and streams based on the capability of the stream to produce habitat for relatively rare species, or important habitat for fish of special recreational and aesthetic value. Class I streams provide exceptional habitat for outstanding populations of species of high interest. Class II streams provide moderate habitat for highly valued species and exceptional habitat for less highly valued species. Class III streams provide substantial habitat for highly valued species and moderate habitat for less valued species. Class IV streams have moderate fishing resources.

Along the pipeline route, MDFWP classifies the Missouri River as Class I habitat, whereas the Musselshell River, Clarks Fork Yellowstone River, and South Fork Bluewater Creek are all Class III streams. The Milk River, Sage Creek, Judith River, and Rock Creek are all Class IV streams. The pipeline would cross only one Class II stream, the Yellowstone River.

Although the MDFWP is in the process of re-evaluating classifications of streams throughout the state, none of these classifications have changed (Jaffe 1993). All other perennial, intermittent, and ephemeral streams crossed by the route may not support recreational populations of game fish, although non-game species may be present. MDFW&P has sampled some of the streams that would be crossed by the pipeline. The results of these efforts are summarized in the following paragraphs.

Sage Coulee, from above to several miles downstream from MP 33, was found to be ephemeral in 1978. Fish habitat was considered static, and was limited by inadequate pools, inadequate riffles, flooding, anchor ice and scouring ice. The only fish caught in this reach was a non-game species, the longnose dace. This stream reach was not considered important to the local human community, and had no special fishing regulations.

Missouri River, from above to several miles downstream from MP 69 (approximate crossing location), was surveyed by MDFWP in 1990 and 1991; reports were submitted to Altamont Gas Transmission Company and MDNRC. In brief summary, the surveys did not document any pallid sturgeon (a Federally listed endangered species) in the vicinity of the pipeline crossing, although potential spawning habitat was available. Paddlefish spawn between the Virgelle Ferry and Boggs Island, 1-2 miles upstream from the proposed crossing, and there is potential spawning habitat at and downstream from the crossing. Other species that could occur in this river segment include shovelnose sturgeon, blue sucker, walleye, sauger, channel catfish, smallmouth buffalo and bigmouth buffalo.

Wolf Creek at approximately MP 123 is intermittent. It becomes perennial as it is joined by downstream tributaries such as Coyote Creek and Dry Wolf Creek. In 1978 MDFW&P sampled Wolf Creek about 13 miles downstream from the pipeline crossing, and found that it supported abundant rainbow trout. Recreational fishing pressure was low (estimated to be 12 angler days per year). The habitat trend was static; physical factors that limit trout production were identified as sediment and turbidity from a highly erosive drainage.

Louse Creek (the pipeline crosses Louse Creek at approximately MP 140) was surveyed by MDFW&P for its entire length in 1985. Fish habitat was considered static; physical limiting factors were livestock trampling of banks and vegetation. The stream was not considered important to the local human community and recreational fishing pressure was only 185 anglers per year (MDFWP Montana Statewide Angling Pressure 1989, 1991 and 1993). Brook trout were considered abundant.

Judith River is crossed by the pipeline at approximately MP 145. From 0.5 upstream to 2.0 miles downstream, it may be characterized at low flow as a small, coldwater perennial stream that varies from 3-4 inches deep in shallow riffles, to 5-6 feet deep in holes. It ranges from 12-30 feet wide and the cobble/gravel bottom is often covered with fine sediment which limits trout production. Livestock grazing and irrigation withdrawals and returns have affected streambank stability and instream cover.

Ross Fork Creek, crossed by the pipeline at approximately Mps 153.7, 163.6 and 164.5, was sampled about two miles downstream from the pipeline crossing in 1985. Habitat trend was considered to be deteriorating, as a function of domestic livestock pollution, irrigation turbidity and sediment, excess siltation, bedload movement and lack of streambank cover. Although Ross Fork Creek is considered a trout stream, the only species caught in this reach was longnose dace.

Musselshell River, crossed by the pipeline at approximately MP 196, is a perennial stream that at low flows is 2-4 inches deep in riffles and 5-6 feet deep in holes. The boulder/cobble bottom is often covered with thick sediment. Streambank vegetation consists of mature riparian forest and stands of willows, and streambank stability is generally good. Dewatering resulting from irrigation is common in this reach. The fishery in this vicinity is transitional from a coldwater trout stream to a cool-water sauger and channel catfish fishery.

During 1991, the MDFWP conducted a study in the area of the proposed Altamont pipeline crossing to determine the presence of the northern redbelly X finescale dace hybrid in the Musselshell river and its tributaries (MDFWP 1991). The northern redbelly X finescale dace hybrid are a unique species in that nearly all specimens collected are female, they are usually found in the presence of only one parent species, and they are apparently a product of clonal or parthenogenetic reproduction. Northern redbelly dace are fairly common in Montana, but finescale dace had never been collected in the state. Due to the uniqueness of this hybrid species and its limited distribution in Montana, it was designated as a Species of Special Concern in 1985.

Fish samples were collected at 26 different sites in the Musselshell drainage in 1991. Northern redbelly X finescale dace were positively identified in one sample collected in the South Fork of Big Coulee Creek (T4N, R19E, S18). A second sample collected in Big Coulee Creek (T4N, 19E, S5) contained one specimen exhibiting some characteristics of the hybrid, but could not be positively identified. Northern redbelly dace were collected at five sites: two in the Big Coulee Creek, one in the South Fork of Big Coulee Creek where the hybrids were found, one in Fish Creek, and one in the Musselshell River at Shawmut. The presence of this parent species in the vicinity of hybrids indicates the potential of collecting hybrids at any of these sites with more intense sampling.

Yellowstone River up and downstream from the pipeline crossing (approximately MP 258) is transitional between cold-water and cool-water habitat. Trout are present but are near their thermal tolerance limit. Cool-water species such as ling, walleye and sauger are the most sought-after game species.

Rock Creek up and downstream from the pipeline crossing (approximately MP 265) is a perennial cold-water stream flowing over boulder/cobble substrate, bounded on either bank by deciduous forest and irrigated crop and hay fields. MDFW&P sampled Rock Creek several miles upstream from the pipeline crossing in 1977 and found it to be a moderately valued trout stream. The habitat trend was static; limiting factors included channel and bank alterations for agricultural uses, irrigation-caused turbidity, sediment and summer dewatering, excess siltation and livestock trampling along banks.

Clarks Fork Yellowstone River, a cold-water trout stream crossed by the pipeline at approximately MP 268, was sampled by MDFW&P in 1977 about five miles downstream from the crossing. The habitat trend was static. Limiting factors were irrigation caused turbidity and sediment, excess siltation and lack of spawning areas.

Bluewater Creek is dry at the pipeline crossing of the North Fork (approximately MP 280), mainstem (approximately MP 282) and South Fork (approximately MP 285). At these headwater crossings, the ephemeral drainages dissect open rangeland and small conifer stands. Perennial flows apparently begin 2-3 miles downstream, near the confluence of the forks. MDFW&P sampled the perennial portion in 1977 and found that the habitat trend was static. Limiting factors were identified as excess siltation, channel and banks altered for agricultural purposes, irrigation-caused turbidity and sediment, high summer water temperatures and over-population of rough fish.

Within Wyoming the proposed pipeline crosses the Bighorn River Drainage Basin (WGFD Fisheries Management Area 20 and 22), the Powder River Drainage System (WGFD Fisheries Management Area 55) and the North Platte River Drainage System (WGFD Fisheries Management Area 55).

Stream classifications in Wyoming are cataloged by two state agencies according to specific criteria. The Wyoming Department of Environmental Quality (WDEQ) classifies streams according to the water quality standards (WDEQ, 1989). A rating system identifies surface waters. This system reflects chemical quality with regard to health and safety and may or may not support specific species of fish. WDEQ identifies four classes of water quality, with Class I identified as waters having no further water quality degradation by point source discharge; to Class IV waters identifying waters too poor to have hydrologic or natural water quality to support fish.

In comparison, WGFD's system of classifying waters relates more to fish habitat which supports specific species of fish. WGFD identifies five classes (Class I-V) which rate fishery quality of streams. Class I identifies premium trout waters and fisheries of national importance, while Class V streams are identified as very low production waters, usually incapable of supporting trout fisheries. Most of the streams on the route are Class IV (low production trout waters). Within the scope of this project, the proposed pipeline crosses one WGFD Class II river, the Shoshone river.

Major river crossings include the Bighorn, Shoshone and Greybull rivers. These rivers have both cold-water and cool-water fisheries. With the exception of the Shoshone River, these rivers are generally considered low production trout waters, incapable of sustaining fishing pressure. They do however, have good fishing for ling, sauger and channel catfish. Native non-game species include longnose dace, flathead chub, mountain sucker, fathead minnow, white sucker and plains killifish. The Shoshone River has been identified as an “important trout water with fisheries of regional importance” (WGFD 1991).

The WGFD maintains a database of all game and non-game species of fish by streams in a given management area. Currently, the only two species of fish on Wyoming's list of species of special concern are the sturgeon chub and silvery minnow. Both are identified as rare. Specific information on these species for the management areas crossed by the pipeline route is deficient because the fish inventory for special status designation is currently outdated by about 15 years. A more complete survey is currently being conducted by the WGFD and the University of Wyoming. Publication of the results is expected in 1995 or 1996 (WGFD 1993). WGFD personnel have indicated that no significant fisheries occur in the Powder River Drainage and the North Platte River Drainage (Dufek 1993; McMillan 1993).

The smaller tributaries include Nowater Creek, Kirby Creek, Badwater Creek, Alkali Creek, Bridger Creek, Red Creek, Sand Creek, the South Fork of the Powder River and the Middle and South Fork of Casper Creek. In addition, many intermittent and ephemeral drainages are crossed by the route. All drainages are listed in Table 13. Seasonal low flows and irrigation use affect all water bodies. The Casper Canal is the only water structure crossed in the eastern portion of the proposed route (MP 505).

Threatened, Endangered, and Sensitive Species

A variety of species identified as threatened, endangered, or sensitive occur or potentially occur along the proposed route for the Express Pipeline. Specifically for Express' proposal, the FWS has determined that seven species listed as threatened or endangered or proposed for listing occur or potentially occur along the proposed route.

Vegetation

Sensitive Species of Plants

Although the FWS did not identify any species of plants listed as threatened or endangered present along the proposed route for the pipeline (Harms 1993, Davis 1993), the Montana Natural Heritage Program (MNHP) has identified several species of sensitive plants that could be affected by the project. Appendix E lists records of occurrence for species of sensitive plants identified by the MNHP within three miles on each side of the proposed Express route. All but one of the listed species occur in Carbon County, Montana.

The proposed route from the Montana-Wyoming state line to the Lost Cabin area was inventoried for sensitive plant species during May, 1990. Of the 10 species listed by MNHP in Appendix E, six were recorded within 0.5 mile of the route. However, no sensitive plant species were encountered on the right-of-way. The segment of the route from Lost Cabin to Casper was inventoried during June 1995 (Mountain West 1995), targeting the species listed by the Wyoming Natural Heritage Program. No sensitive plants were observed on or immediately adjacent to the proposed pipeline right-of-way. Disturbance to any sensitive plant species that may occur along this segment would be avoided or minimized using minor route realignments or construction and reclamation techniques designed to ensure minimal impact or sensitive plant reestablishment.

Rabbit buckwheat is the only species of sensitive plant occurring along the route that also has a federal status. This buckwheat is listed as a Category 2 candidate, but has been proposed as Category 3C (more widespread and abundant than previously known). Rabbit buckwheat is present along the proposed route intermittently from approximately MP 280 to about MP 299. Specific locations include MP 280-280.1, 290-292 and 298.6-299. Lesica and Achuff (1992) located 40 populations of this species in southern Carbon County and found the species to have a wide ecological amplitude occurring on a variety of habitats throughout the area.

Five sensitive plant species, geyer milkvetch, obscure evening-primrose, miner's candle, spiny hopsage, and desert dandelion, were recorded within 0.5 mile of the route but were not encountered during the surveys for sensitive plants conducted along the proposed right-of-way. These species are generally found on sandy, stony or limestone substrates.

One additional species of sensitive plant, *Townsendia spathulata*, was encountered during the surveys for sensitive plants. It is rated S3/G3 by the MNHP (1993b). This species was not included in the 1993 MNHP data base search but was recorded at two locations during the surveys. It was found within 0.2 mile of the proposed route on a limestone outcrop. It was also observed in a grassland community on a dry rocky ridge about one mile west of the route. *Townsendia spathulata* was not found on the right-of-way although suitable habitat is present. Lesica and Achuff (1992) recorded 28 populations in southern Carbon County, all east of the proposed route. They describe the species as very widespread in the area and recommended that it not be given special status on BLM's Miles City District.

The Wyoming Natural Heritage Program (1989) listed two known sensitive plants within one mile of the proposed route. In addition, eight sensitive species potentially occur along the route (Culwell 1993). Appendix E provides the status of each species.

Sensitive Communities of Plants

The MNHP identified three potentially sensitive communities or stands of plants located within three miles of the proposed route (MNHP 1993a). These communities include the Utah juniper/bluebunch wheatgrass community, birdsfoot sage, Xeric Dwarf Shrub Series, and a near-pristine stand dominated by bluebunch wheatgrass and prairie junegrass.

The MNHP has listed the Utah juniper/bluebunch wheatgrass community type as S3/G3. Utah juniper-dominated woodland communities are present in Montana only on the south and west flanks of the Pryor Mountains. Utah juniper communities in the area have been described by Kratz (1988), South (1974) and Knight et al. (1987). Utah juniper is more common in northwestern Wyoming on the foothills of the Owl Creek Mountains and the western foothills of the Big Horn Mountains (Wight and Fisser 1968). This type does not occur on the proposed route and would not be affected by the project. Utah juniper is found within 0.25 mile of the route south of Bowler Flats on the west flank of the Pryor Mountains.

Although the birdsfoot sage, Xeric Dwarf Shrub Series is unranked by the MNHP it has been identified as a potentially sensitive group of community types. Birdsfoot sage community types are apparently of limited distribution in Montana, found only in the Great Basin Physiographic Region in southern Carbon and Big Horn counties (Kratz 1988; Knight et al. 1987; Morris et al. 1976) and in extreme southwestern Beaverhead County near Bannock Pass (Mueggler and Stewart 1980). A birdsfoot sage/bluebunch wheatgrass community type was encountered during the 1991 field survey from south of King Canyon (approximately MP 295.5) to the state line. Birdsfoot sage dominated communities were abundant from the state line south through the Big Horn Basin in Wyoming. Birdsfoot sage also occurred with Gardner saltbush and Basin big sagebrush from about MP 295.5 south to the Montana/Wyoming border. Because the route parallels an existing pipeline and road through this area and since birdsfoot sage communities are common in the area, anticipated impacts would be low.

A near-pristine stand dominated by bluebunch wheatgrass and prairie junegrass was found on Miller Butte in Stillwater County about three miles north-northeast of Park City and about 1.5 miles east of the proposed route. The butte is inaccessible to livestock, and would not be affected by the Express pipeline project.

No sensitive communities of plants are known to occur along the pipeline route in Wyoming. No sensitive plant communities were identified by the Wyoming Natural Heritage Program (1989) or BLM for the segment of the route from the Montana-Wyoming state line to the Lost Cabin area. Also, no sensitive plant communities were recorded along this segment during field investigations in 1990 and 1991 for the portion of the proposed pipeline route from the U.S-Canadian border to Lost Cabin, Wyoming. the inventory along the segment from Lost Cabin to Casper was completed in June, 1995 (Mountain West 1995), and no sensitive plant communities were observed along this segment.

Wildlife and Aquatic Life

Seven federally-listed threatened or endangered wildlife species, occur along the Express route. These species include the bald eagle, peregrine falcon, whooping crane, piping plover, least tern, black-footed ferret, and pallid sturgeon (Harms 1993, Davis 1993). In addition to the federally-listed species, one Category One species, the mountain plover, potentially occurs along the route. A mountain plover was observed near MP 494 in Wyoming ((Mountain West 1995) and was acting like it had a nest nearby. Although this candidate species has no protection under the Endangered Species Act, it was evaluated because it could be listed as either threatened or endangered before construction of the pipeline would be completed.

Bald Eagle

Bald eagles migrate through and overwinter along the proposed route in both Montana and Wyoming. Eagles may be present along rivers or reservoirs near the proposed route that have open water from late October through early May. The distribution of bald eagles varies from year to year, depending on the severity of the winter and the availability of food. Within Montana, wintering bald eagles may occur along the Milk River (approximately MP 8), Missouri River (MP 69), Musselshell River (MP 196), Yellowstone River (MP 258), and the Rock Creek/Clark's Fork of the Yellowstone River area (approximately MP 265 to 268). Within Wyoming, eagles winter along the Greybull River (approximately MP 353) (BLM 1988a), Bighorn River (approximately MP 374), and Nowater Creek (approximately MP 399) (BLM 1986b).

Also within Wyoming, the Pole Mountain Area west of Casper (approximately MP 482-485) has been identified as a significant bald eagle roost site. Bald eagle winter roost sites are also present in the Pine Mountain area within the Platte River Resource Area (BLM 1993), immediately south of the proposed route (approximately MP 482-489). A total of six bald eagle roost sites were identified near the proposed ROW. Appendix E identifies specific roost sites existing within 0.5 mile of the proposed pipeline corridor.

The nesting population of bald eagles in Montana has increased dramatically during the 1980's. As a result, breeding territories are present along some of the rivers crossed by the pipeline route. Preliminary 1995 surveys indicated two bald eagle nests are located two to three miles west of the proposed Missouri River crossing. The MNHP indicates that although there are active nests along the Yellowstone River, none are within two miles of the proposed pipeline crossing. However, there is an active territory (birds residing in the area but not nesting) within 2-3 miles of the route on the Clark's Fork of the Yellowstone River. Also, an inactive nest occurs within the Clark's Fork several miles west of the route near Bridger (approximately MP 283). No other known nests or territories are known to occur along the proposed route within Montana.

Although bald eagles may be present along any major river or stream crossed by the route in Wyoming, no breeding territories are known to occur along the route. No nests have been documented along the route. The closest suspected nesting site is on the South Fork of the Shoshone River (BLM 1988a), many miles west of the proposed route.

Peregrine Falcon

Peregrine falcons are migrants and winter residents in Montana and occur in appropriate habitat along the entire route throughout Wyoming. Peregrines typically occur along river systems or reservoirs where an adequate food supply, primarily waterfowl and other birds, is available. Roost sites are generally cliffs, bluffs or large rock outcrops.

Nesting by peregrine falcons in both Montana and Wyoming is limited and it is being supplemented by reintroduction programs. There are no known eyries along the pipeline route. The nearest known potential reintroduction site in Montana is about four miles east of the pipeline route. Although reintroduction is planned at certain sites within Wyoming, none of these sites are along the proposed pipeline route (Oakleaf 1993).

Whooping Crane

Whooping cranes are usually associated with large wetlands or rivers with adjoining agricultural fields. Whooping cranes migrate seasonally through Montana and Wyoming but do not nest in either state. In Montana, sightings have been recorded irregularly in the eastern two-thirds of the state and near Red Rocks Lakes in southwest Montana. In Wyoming, sightings of whooping cranes have been restricted to seasonal documentation near the western and eastern borders of the state (WGFD 1993). The proposed route does not cross any site that has produced regular observations of this species.

Piping Plover

Piping plovers are generally associated with relatively unvegetated river channels and exposed sandbars that they utilize for nesting. Piping plovers also will use nonriparian or nonriverine habitats, including lake beaches, unvegetated flats near alkaline or salt lakes, man-made habitats, and dredge fill areas (Dinsmore 1983). The presence of piping plovers along the proposed route in either Montana or Wyoming has not been documented (Skaar 1985, Oakleaf 1982).

Least Tern

Least terns are associated with broad expanses of unvegetated river channel, sparsely vegetated sandbars, suitable levels of water, and adequate supply of small fish for food. As with the piping plover, the presence of least terns along the proposed route in either Montana or Wyoming has not been documented (Skaar 1985, Oakleaf 1982).

Black-footed Ferret

Black-footed ferrets are typically associated with prairie dog colonies. Within Montana, the pipeline route was surveyed for prairie dog colonies of sufficient size to meet the FWS' criteria as black-footed ferret habitat. Only two black-tailed prairie dog colonies (approximately MP 218 and MP 279) and one white-tailed prairie dog colony (approximately MP 297) meet these criteria.

Within Wyoming, prairie dog colonies are known to occur along some portions of the route. Appendix E and Maps 5-7 show the locations of known prairie dog colonies. However, some of these locations have not been field checked since 1985 or 1986 (BLM, 1993).

Pallid Sturgeon

Although the ecology of the pallid sturgeon is not well documented, pallid sturgeons are thought to require large, turbid, free-flowing rivers with rocky or sandy streambeds. The pallid sturgeon inhabits areas of swifter water than does the shovelnose sturgeon, a related, but smaller species, common in the Missouri River. Observations that the pallid and shovelnose sturgeon hybridize suggests that both species may spawn in the same or similar habitats.

The pallid sturgeon is thought to occur in the Missouri River downstream from Fort Benton, near the Express route. However, surveys conducted by the MDFWP during 1990 and 1991 failed to document the presence of the pallid sturgeon in the area where the pipeline would cross the river.

Mountain Plover

The Mountain plover is currently considered a Category One species, but it does not appear likely that it will be listed as either a threatened or endangered species in the near future. Mountain plovers are migratory birds that utilize high, dry, shortgrass prairies. Breeding by the plover in the general project area has been documented (Skaar 1985, Oakleaf et al. 1982). Therefore, the mountain plover may occur in grassland prairie regions along the proposed route. These grassland prairies are depicted as Vegetation Type MG on Maps 1 through 7 in Appendix J.

Wildlife Species of Special Concern

The Montana Natural Heritage Program has established a list of animal species of special concern (Reichel 1995). A computer search of the Natural Heritage Program database was accomplished for a five-mile buffer on each side of the Express pipeline route. Only five of the special concern species had been identified within the ten-mile wide buffer. A western hognose snake was documented approximately four miles west of the route near MP 220. Also, a milk snake was documented about five miles west of the route near MP 266. A mountain plover was observed three miles east of the route near MP 171. Finally, numerous white-tailed prairie dog colonies are found within ½ to three miles of the route from MP 297 to MP 300.

Land Use

Ownership

Overall, most of the land that would be crossed by the pipeline is privately owned (Table 19). In Montana, private land accounts for more than 80 percent of the land that the pipeline would cross. However, in Wyoming, ownership is almost evenly divided between private and public lands. The distribution of ownership along the route is shown on route maps in the map pocket.

As shown on Table 19, the pattern of ownership for public lands located along the pipeline route varies substantially between Montana and Wyoming. In Montana, almost 80 percent of the public lands that the pipeline would cross are administered by the State. The State of Montana would issue the easement permits for the 41 miles of state lands listed in Table 20. Federally-administered lands consist of scattered BLM and BOR parcels at the Milk River (approximately MP 8.3), Lonesome Lake (approximately MP 51.2), Missouri River (approximately MP 69.0), Arrow Creek (about MP 113.0-115.0) and through northern Carbon County (about MP 285.0-305.0). In Wyoming, almost 86 percent of the public lands that the pipeline would cross are administered by the BLM and BOR. The State administers only 14 percent of public lands crossed by the pipeline route. In neither state does the pipeline route cross an Indian Reservation or land administered by the FWS or USDA Forest Service.

Near Wild Horse, the pipeline route crosses the U.S.–Canadian border. This border consists of a narrow strip of land administered by the International Boundary Commission.

Patterns of Use

The pipeline would cross eight counties in Montana and five counties in Wyoming (**Figure 11**). The route generally traverses a rural landscape with low population densities and few developed areas. It also avoids incorporated settlements. Land use along the route is predominantly rangeland and dryland cultivation with a small amount of irrigated acreage (route maps in map pocket).

Each of the 13 County Planning Offices or county commissioners were contacted in July 1995 to determine if pipeline siting or construction was regulated by county zoning ordinances or if any special county-issued pipeline permits would be required for the Express pipeline. In Montana, none of the eight counties have zoning regulations for the areas of the proposed pipeline right-of-way. Zoning regulations within the Montana counties were primarily administered through local municipalities. None of the eight Montana counties required permits because construction and operation of the pipeline is administered by the State of Montana.

In Wyoming, most of the counties contacted have no zoning regulations for the pipeline right-of-way, and do not require any special permits for pipeline construction and operation. Natrona County would require a conditional use permit for a utility station. The unincorporated areas around Casper are zoned for a variety of uses including agricultural, commercial, industrial and residential. However, zoning ordinances would not affect the pipeline right-of-way. While Hot Springs County does not currently have a permitting policy, a new policy will be implemented by summer 1996. This new policy will require an approximate $100 fee for some uses. The officials contacted were:

T. Best, Washakie County Planner
T. Curren, Natrona County Planning Director
M. Fahley, Carbon County Planning Director
J. Harwood, Big Horn County, Chairman, Land Planning Board
J. Johnson, Chouteau County Clerk and Recorder
A. Kelly, Judith Basin County Clerk and Recorder
A. Mattheis, Golden Valley County Clerk and recorder
D. Miller, Wheatland County Commissioner
J. Skaggs, Hot Springs County Planner
J. Parkins, Stillwater County Clerk and Recorder
C. Vincent, Hill County Planner
B. Water, Fergus County Administrative Assistant
W. Zgurich, Fremont County Planning Department Secretaty.

Hill and Chouteau Counties, Montana

Upon entering the United States west of the Port of Wild Horse, the pipeline route would cross through Hill and Chouteau counties. Land use in these two counties is predominantly dryland wheat farming with some grazing. In addition, the route would cross the Laredo gas field between about MP 35.0 and 50.0. In Chouteau County, the pipeline would cross about 0.3 mile of prime farmland.

Fergus and Judith Basin Counties, Montana

The pipeline route would enter Fergus County in the breaks at Arrow Creek (administered by the BLM). From these breaks south, the pipeline would cross lands primarily used for dryland farming. The principal crops grown on these lands are wheat and barley. In addition, limited portions of the route are used as rangeland.

TABLE 19
LAND OWNERSHIP ALONG THE EXPRESS PIPELINE ROUTE

COUNTY	Ownership (miles) BLM	BOR	STATE	PRIVATE	TOTAL
MONTANA					
Hill	–	1.0	11.0	36.5	48.5
Chouteau	1.0	2.0	12.0	48.7	63.7
Fergus	2.0	–	4.0	15.8	21.8
Judith Basin	–	–	2.0	32.4	34.4
Wheatland	–	–	6.0	31.5	37.5
Golden Valley	–	–	–	8.6	8.6
Stillwater	–	–	4.0	38.8	42.8
Carbon	5.0	–	2.0	40.7	47.7
TOTAL	8.0	3.0	41.0	253.0	305.0
%	3%	1%	13%	83%	100%
WYOMING					
Big Horn	33.0	8.0	4.0	23.1	68.1
Washakie	17.0	1.0	–	14.0	32.0
Hot Springs	2.0	–	4.0	13.9	19.9
Fremont	9.2	–	2.0	8.6	19.8
Natrona	15.4	–	4.1	46.0	65.5
TOTAL	76.6	9.0	14.1	105.6	205.3
%	37%	4%	7%	52%	100%
TOTAL	84.6	12.0	55.1	358.6	510.3
% MT & WY	17%	2%	11%	70%	100%

Source: Title Searches

Table 20
MONTANA STATE LANDS CROSSED BY THE EXPRESS PIPELINE ROUTE

County	Township, Range	Description	Land Use
Hill	T36N, R11E	Sec. 2: Lot 1	Rangeland
	T36N, R11E	Sec. 36: W2W2	Agriculture/non-irrigated
	T35N, R11E	Sec. 1: W2SW	Agriculture/non-irrigated
	T35N, R11E	Sec. 14: E2SE	Agriculture/non-irrigated, rangeland
	T35N, R11E	Sec. 36: W2W2	Agriculture/non-irrigated
	T34N, R11E	Sec. 36: W2W2	Agriculture/non-irrigated
	T33N, R11E	Sec. 1: Lot 4, SWNW	Agriculture/non-irrigated
	T33N, R11E	Sec. 12: W2SW	Agriculture/non-irrigated
	T33N, R11E	Sec. 36: W2W2	Agriculture/non-irrigated
	T32N, R11E	Sec. 13: W2NE	Rangeland
	T32N, R11E	Sec. 13: E2SW	Rangeland
	T32N, R11E	Sec. 36: W2E2	Agriculture/non-irrigated
	T31N, R11E	Sec. 13: W2E2	Rangeland, agriculture/non-irrigated
	T31N, R11E	Sec. 36: W2E2	Agriculture/non-irrigated
	T30N, R11E	Sec. 36: W2SE	Agriculture/non-irrigated
Chouteau	T26N, R12E	Sec. 7: S2SW	Missouri R. bottom
	T28N, R12E	Sec. 19: Lots 1&2	Agriculture/non-irrigated
	T28N, R11E	Sec. 36: E2E2	Agriculture/non-irrigated
	T27N, R11E	Sec. 36: E2NE	Rangeland
	T26N, R12E	Sec. 32: E2SE	Rangeland
	T25N, R12E	Sec. 5: NWSE	Rangeland
	T25N, R12E	Sec. 32: SESW, SWSE	Agriculture/non-irrigated
	T24N, R12E	Sec. 4: Lot 4, W2SW	Agriculture/non-irrigated
	T23N, R12E	Sec. 33: W2SE	Rangeland
	T21N, R12E	Sec. 16: E2SE	Agriculture/non-irrigated

County	Township, Range	Description	Land Use
Chouteau	T21N, R12E	Sec. 33: N2NE, SENE	Rangeland, agriculture/non-irrigated
	T21N, R12E	Sec. 34: SWSW	Rangeland
	T20N, R12E	Sec. 3: W2NE, N2SE, SESE	Rangeland
	T20N, R12E	Sec. 11: NWNW	Rangeland
	T20N, R12E	Sec. 13: SESE	Agriculture/non-irrigated
	T20N, R13E	Sec. 29: S2NE	Rangeland
	T20N, R13E	Sec. 28: N2SW, NWSE	Rangeland
Fergus	T20N, R13E	Sec. 34: NW lying south & east of Arrow Crk.	Rangeland
	T19N, R13E	Sec. 36: W2	Agriculture/non-irrigated
	T18N, R13E	Sec. 12: 100' strip in NWSE	Agriculture/non-irrigated
Judith Basin	T15N, R15E	Sec. 17: N2, N2S2	Agriculture/non-irrigated
	T15N, R15E	Sec. 17: 150' strip in NW	Agriculture/non-irrigated
	T14N, R15E	Sec. 22: SWSE	Agriculture/non-irrigated
	T11N, R16E	Sec. 20: W2, W2NE	Rangeland
Wheatland	T10N, R16E	Sec. 16: SWNW, W2SW	Rangeland
	T7N, R17E	Sec. 11: SWNW, N2SW, SESW, SWSE	Rangeland
	T7N, R17E	Sec. 14: NE	Rangeland
	T7N, R17E	Sec. 36: NENE	Rangeland
	T6N, R18E	Sec. 16: SW, SWSE, SWNW	Rangeland
	T6N, R18E	Sec. 22: NWNW, S2NW, NESW, NWSE, S2SE	Rangeland, agriculture/non-irrigated
Golden Valley	None		
Stillwater	T3N, R19E	Sec. 16: all	Rangeland
	T3N, R19E	Sec. 36: W2, SE	Rangeland
	T2N, R20E	Sec. 16: SWNW	Agriculture/non-irrigated

County	Township, Range	Description	Land Use
Stillwater	T2N, R20E	Sec. 36: all	Agriculture/non-irrigated, rangeland
	T1N, R21E	Sec. 16: NW, S2	Agriculture/non-irrigated,
	T1N, R21E	Sec. 36: SW	Rangeland
	T1S, R22E	Sec. 16: W2SW	Rangeland
	T3S, R23E	Sec. 6: NWNW	Yellowstone R. bottom
Carbon	T5S, R24E	Sec. 16: E2W2, E2	Rangeland
	T6S, R24E	Sec. 36: E2W2, W2E2	Rangeland
	T8S, R25E	Sec. 16: W2, W2E2	Rangeland
	T9S, R25E	Sec. 36: NWNE, E2NE	Rangeland

Wheatland and Golden Valley Counties, Montana

The proposed pipeline route runs southeast through Wheatland and Golden Valley counties. In northern Wheatland County at about MP 170, the pipeline would pass a mile east of Judith Gap which has about 30 houses and a sawmill. From Judith Gap to Shawmut, the route would cross open, dryland cultivation and rangeland. South of Shawmut (approximately MP 194), the route would cross dryland and irrigated cropland and rangeland. About 1.4 miles of prime farmland also would be crossed in Wheatland County.

Stillwater and Carbon Counties, Montana

Within these two counties, the pipeline would cross primarily lands used for rangeland and farming. The farming land includes dryland (in Stillwater County only), irrigated cropland, and prime farmland. Most of the prime farmland crossed by the route occurs in these two counties.

From the northern boundary of Stillwater County to near Park City, the route would cross land used for dryland farming and rangeland. West of Park City, the route would cross some irrigated croplands and scattered suburban residential tracts. South of Park City, the pipeline would cross irrigation diversions and cropland. The remainder of the route to Wyoming is predominantly rangeland with minor amounts of dryland cultivation although several fields irrigated by center pivots are skirted to the east near Sage Creek (approximately MP 297).

In addition to the above uses, the pipeline would cross the site of an irrigation and recreation reservoir site proposed for the southern part of Stillwater County along Valley Creek (approximately MP 250.0-255.0). However, the federal funding needed to construct the project is not available. Thus, officials of Stillwater County indicate the possibility that the project would ever be constructed is extremely remote (Altamont 1989).

Express Pipeline Inc.

COUNTY MAP

DATE: JUNE 1995

FIGURE 12

Big Horn County, Wyoming

Big Horn County is the northernmost Wyoming county along the proposed route. Land use is predominantly open rangeland. However, irrigated farmland would be crossed in the Shoshone River valley west of Lovell (approximately MP 319). Principal crops are sugar beets, beans, corn and malting barley.

Lovell is the closest community to the pipeline route (approximately 0.5 mile to the east). About five miles north of Lovell, the route parallels an existing pipeline which passes 500 feet east of the Lovell-Cowley-Byron airport (approximately MP 314). Immediately west of Lovell are some large-lot suburban developments and the Western Sugar factory. Several gravel pits south of town are excavated by state and private operators.

The BLM's Cody Resource Management Plan (BLM 1988) delineates right-of-way avoidance areas north of the Shoshone River (historic Sidon Canal), at the Shoshone River (Special Recreation Management Area [SRMA]), and along State Highway 310 (raptor nesting and sage grouse dancing areas). These designations however, do not preclude pipeline locations because there already is an existing pipeline along the proposed route.

Washakie and Hot Springs Counties, Wyoming

Within these counties, the pipeline would cross private irrigated cropland, settled farmland, and rangeland. Crops include malt barley, sugar beets, beans, corn, and hay. There are a few isolated ranch buildings on private lands close to the route and two small irrigation impoundments are present on intermittent drainages of Kirby Creek (approximately MP 409.5).

The BLM has designated the Bighorn River as a Special Recreation Management Area. However, much of the land adjacent to the river is privately owned. Depending on its final alignment, the route may also cross BLM's Bighorn River Habitat Management tracts near Worland.

South from Worland, the route crosses rolling grazing lands and eroded badlands administered by the BLM. The BLM has designated much of this area as "sensitive watershed". Management of this area emphasizes the reduction of soil erosion and sediment yield on 391,000 acres along the East Fork of Nowater Creek and Kirby Creek.

Fremont County, Wyoming

Fremont County is the second largest county in Wyoming. However, the pipeline would cross only the northeast corner of the county. The portion of the county the pipeline would cross involves private, State, and BLM ownership which falls within BLM's Rawlins District, managed by the Lander Resource Area.

Natrona County, Wyoming

According to the Natrona County Land Use Plan of 1978, approximately 87 percent of the County is used for agriculture. Most of this agricultural land is used for grazing. Land in the remainder of the County is used for forests, urban development, water, and other uses.

The Natrona County Land Use Plan designates a corridor along the Lost Cabin-Arminto Road for placement of major rights-of-way. Rights-of-way needed to transport products out of the area must parallel county roads. A similar corridor has also been designated along U.S. Highway 20/26 to accommodate major rights-of-way.

Prime Farmland

Prime farmlands are one of our most important natural resources for providing the nation's short- and long-term needs for food and fiber. Prime farmlands produce the highest yields with minimal investments of energy and economic resources. When managed properly, prime farmlands can be farmed continuously without harming them.

Like many other natural resources, prime farmlands are limited. Because of the importance of prime farmlands, their limited occurrence, and the ongoing conversion of farmland to other uses, federal, state, and local governments encourage the identification and wise use of prime farmlands. They also encourage the conservation of prime farmlands.

Although the soil surveys for counties in Montana are in various stages of completion, identification of prime farmlands is complete. The pipeline route would cross about 7.9 miles of prime and important farmlands in Montana. Important farmlands are farmlands that would qualify as prime farmlands if the farmer irrigated them.

Similar to Montana, the soil surveys for counties in Wyoming are in various stages of completion, but identification of prime farmlands is complete. The USDA Soil Conservation Service (SCS) had determined that no prime farmlands occur along or near the pipeline route (Derr 1993). Thus, the route crosses no prime farmlands in Wyoming.

Hazardous Waste Sites

Two lists maintained by the EPA contain potential or known hazardous waste sites. They are the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) and Resource Conservation and Recovery Act (RCRA). Site inspection reports were obtained from EPA for sites close to the route and reviewed to confirm the exact location and nature of the listing. Based on this review, there are no known or potential hazardous waste sites within one mile of the proposed route in Montana or Wyoming.

The closest site on either of the lists is the Ohio Oil Company's Lovell Refinery. This inactive refinery is about 1.5 miles west of the route at about MP 319.0. This property has undergone a series of site investigations by the EPA and may have been the cause of contamination of nearby land, ground water, and surface water with petroleum by-products. If remedial action is taken at this site, it probably would be localized (on site) and directed at removal of the source of contamination.

Recreation

The pipeline was routed to avoid designated recreational sites. These sites include state and national recreation areas; designated federal wilderness areas and primitive areas; wilderness study areas; state, county and local parks; access sites for fishing; and state and national wildlife refuges and ranges. Although the route does cross the Upper Missouri National Wild and Scenic River, it does so in a corridor specifically designated by the BLM for utilities within a section of river designated as "Recreational". Additionally, a portion of the Judith River presently under study as a possible Wild and Scenic River (Altamont 1989) is well south of the crossing site.

Public and private lands along the proposed pipeline route support a variety of dispersed recreational activities, such as hunting and fishing. Dispersed recreational activities on public lands are most likely to occur on BLM lands and in the Pryor Mountain range (U.S. Forest Service) east of the route in Carbon County.

Publicly owned recreation sites within five miles of the proposed route in Montana are exclusively water-related. These include (north to south) Fresno Lake (approximately MP 15.0); Coalbanks Landing State Recreation Area (approximately MP 67.0); the Upper Missouri National Wild and Scenic River (approximately MP 69.0); Deadman's Basin Reservoir (approximately MP 195.0); Hailstone, Halfbreed Lake and Big Lake wildlife refuges (approximately MP 220.0-240.0); Buffalo Mirage and Homestead Isle fishing access sites on the Yellowstone River; and the Bluewater Springs, a trout hatchery on Bluewater Creek. Fishing pressure on Bluewater Creek occurs primarily downstream of the hatchery. All of these sites provide some combination of activities including fishing, swimming, camping, water-skiing and waterfowl hunting or observance. Coalbanks Landing is a popular putting-in location for float trips down the Missouri River. It is located about one mile downstream of the pipeline crossing.

Average angler (MDFWP Montana Statewide Angling Pressure, 1989, 1991 and 1993) use from 1989 to 1993 use on perennial rivers and streams crossed by the pipeline and public recreational waterbodies are as follows:

- Milk River (Fresno Dam to Canada) — (221 angler days)
- Fresno Lake — (9,920 angler days)
- Missouri River (Blaine/Chouteau County Line to Marias River) — (3,011 angler days)

- Sage Creek (27 angler days)
- Louse Creek (185 angler days)
- Judith River (Plum Creek to headwaters) (1,818 angler days)
- Ross Fork Creek (68 angler days)
- Musselshell River (Lavina to headwaters) (3,010 angler days)
- Deadmans Basin Reservoir (5,240 angler days)
- Valley Creek (20 angler days)
- Yellowstone River (Clarks Fork to Stillwater River, includes Buffalo Mirage and Homestead Isle) (11,346 angler days)
- Rock Creek (Mouth to West Fork) (13,959 angler days)
- Clarks Fork Yellowstone (Mouth to Bridger) (2,354 angler days)

Angler day = one person fishing one body of water for any length of time on one day

Dispersed hunting, fishing, camping, and other kinds of outdoor recreation occur along BLM and BOR lands on the Wyoming portion of the proposed route. In northern Wyoming, public lands are heavily used for outdoor recreation. Because this area is a major corridor for tourists traveling to Yellowstone National Park, sightseeing is particularly important on or near highways leading to the Park. Near Lovell, use of off-road motorcycles and all-terrain-vehicles is popular. Near Worland, the route is near the former Pits Motorcycle Area, where 125 acres were designated for motorcycle use prior to recent closure by BLM. The Pine Mountain and Goldeneye RMU in Natrona County is managed primarily for extensive and dispersed recreational use with minimal regulatory constraints. Off-road vehicles are restricted to designated roads.

Water-based recreation in the portion of Wyoming crossed by the pipeline route includes fishing, trapping, waterfowl hunting, and boating. Some important fishing streams flow into the area from the west slope of the Bighorn Mountains. In addition, the Shoshone, Greybull, and Bighorn rivers offer fishing, hunting, and boating. Portions of the Shoshone and Bighorn rivers have been designated as special recreation management areas by the BLM. Thus, the BLM intensively manages public lands along these rivers for recreational use. Additionally, the BLM has implemented Recreation Area Management Plans (RAMPs) in the Platte River Resource Area in Natrona county. The Goldeneye Wildlife and Recreation Area, one of the RAMP sites, is located north of the proposed pipeline route.

Visual Resources

Overview

The pipeline route in northern and central Montana can be described as predominantly level terrain with broad, gently rolling low hills characteristic of the Great Plains province. Occasionally, where streams or drainageways are present, erosion has carved steep breaks into the round plain. The natural vegetation consists primarily of wheatgrasses, with occasional stands of willow or cottonwood in the wetland or riparian areas. Agriculture dominates most of the viewshed in the province and results in large, expansive quilt patterns in all directions. The agricultural practices create displays of contrasting colors made up of deep greens, browns and white against the naturally dark terrain.

The visual character of the route in southern Montana, from the Yellowstone River to the Wyoming border, changes dramatically due to scattered, open pine forest on the sandstone rims above the Yellowstone River; the abrupt rise of the nearby Beartooth Mountain Range; and the geological formations, colors and vegetation associated with the Chugwater sandstone; and other formations west of the Pryor Mountains. This visual character reflects the influence of the Northern Rocky Mountain province.

The pipeline route would generally traverse a rural landscape through Montana. Background views of the proposed pipeline route are of broad, generally flat horizons that are open and unrestricted. Middleground views are mixed with large expanses of semiarid grasslands and quilted farmlands. Foreground views illustrate lush greenscapes in the river and wetland areas and gentle low geographic formations in the grassland areas.

The visual character of the route in northern and central Wyoming is dominated by badlands, flat plains and isolated drainages, with the Bighorn Mountain Range in the background. Brown, tan, gray, and white earthtones create a landscape of pastel colors amidst sparse vegetative cover.

The pipeline route crosses a generally arid, open, rolling rangeland in Wyoming. Background views are similar to those described for Montana. Broad, open expanses dominate the view. Middleground views are of low, rolling hills and flat rangelands. Foreground views are of an arid landscape with sagebrush as the dominant vegetation.

Visually-Sensitive Resources

Only lands administered by the BLM and crossed by the pipeline route are actively managed for visual resources. The BOR, Montana, and Wyoming have no system for managing visual resources. Also, no visual management system exists for private lands.

The BLM recognizes that scenic values and visual quality are important public resources and manages activities on federal lands to protect visual resources. As part of the process, the BLM inventories and manages lands it administers using its Visual Resource Management (VRM) system. The VRM system evaluates several parameters to determine the appropriate VRM class for a particular parcel of land. There are five VRM classes, each of which combines an evaluation of visual quality, visual sensitivity, and viewing distances. Each of these classes also describes the different degrees of modification allowed in the basic elements of the landscape. Areas designated as VRM Class I or II are considered scenic or visually sensitive.

The pipeline route would cross eight areas with high or visually-sensitive scenic qualities (Table 21). The BLM has designated all these areas as VRM Class II areas. As a result, the BLM manages these areas to retain the existing character of the landscape. Thus, any changes must be low and not attract the attention of the casual observer.

Lands administered by the BLM that would be crossed by the pipeline are less visually sensitive. They have been assigned ratings of VRM Class III or IV. Although lands administered by the Platte River Resource Area have not been formally designated using the VRM system, they would most likely be rated VRM Class III or IV (BLM 1993).

Transportation

Transportation facilities present along the pipeline route include interstate highways, U.S. highways, state highways, local roads, and railroads. In Montana, the pipeline would cross Interstate Highway 90; U.S. Highways 2, 87, 191, 12, 212, and 310; and State Highways 80, 81, 200, and 306. U.S. Highways 212 and 310 are of particular concern because they are two of the primary recreational travel routes to Yellowstone and Grand Teton National Parks. In addition, the pipeline would cross several railroads, including Burlington Northern's main east-west line (about MP 30). About 30 trains use this line daily, including Amtrak trains. The crossings of major transportation facilities are shown on the seven route maps (in map pocket).

In Wyoming, the pipeline would also cross a variety of transportation facilities. Among the roadways that the pipeline would cross are U.S. Highways 14, Alternate 14, 310, 16, 20, and 26 and State Highways 310, 30, and 789. In addition, the pipeline would cross several railroads, including tracks of Burlington Northern and Chicago-Burlington-Quincy. The pipeline also would pass within 500 feet of the east margin of the Lovell-Cowley-Byron airport.

TABLE 21
VISUALLY SENSITIVE RESOURCES ALONG THE EXPRESS PIPELINE ROUTE

	Location	Milepost	Visual Resource Management Class	Relationship to Pipeline	Comments
MONTANA					
69.0	Missouri River	Missouri River	II	Crosses	Recreational National Wild and Scenic River: BLM-designated utility corridor; BLM and state management area: Lewis and Clark Trail.
257.4	Yellowstone River	Yellowstone River	II	Crosses	Lewis and Clark Trail
264.6	US 212 viewshed	US 212	II	Intersects	Primary recreation travel route
266.9	US 310 viewshed	US 310	II	Intersects	Primary recreation travel route
268.1	Clarks Fork Yellowstone River	Clarks Fork Yellowstone River	II	Crosses	Lewis and Clark Trail
WYOMING					
352.2	Greybull River	Local road	II	Crosses	BLM management area
423.9	West Bridger Creek	Local road	II	Crosses	BLM management area
425.4	Old Bridger Trail Road	Old Bridger Trail Road	II	Intersects	On private land

Socioeconomics

The social and economic character of Montana and Wyoming has been shaped by a history of reliance on natural resources, such as agriculture, logging, mining, oil and gas, hydroelectricity, and tourism. The earliest white inhabitants were first attracted by furs and then by gold. Boom towns sprung up in mining districts and rapidly faded as the gold and silver played out. Coal, oil and natural gas have been important sources of revenue since the early 1900's and remain so today. More than 50 percent of the Rocky Mountain region's crude oil comes from Wyoming. Deposits of bentonite, uranium, trona, phosphate, limestone, sulfur and other minerals are mined in both Montana and Wyoming.

The history of natural resource development is significant in interpreting the social and economic evolution of the two states. Both positive and negative impacts, due to the use of renewable and non-renewable natural resources, and construction of associated transportation networks and other facilities, have been documented. Pipeline construction is not an alien activity in many communities, particularly in Wyoming, where the development of petroleum has been going on for decades. The proposed pipeline route is near the first oil well in Wyoming drilled in 1884 near Lander (MP 489.0).

Population and Housing

Montana

The socioeconomic milieu of the pipeline route in Montana is typical of western agricultural regions. Most of Montana's rural population are farmers and ranchers who have lived on the land for several generations. Despite the mineral wealth of the state, Montana is second only to Texas in cultivated acreage. The pipeline route traverses a fertile triangle, bounded by Great Falls, Cut Bank and Havre, that produces about 40 percent of Montana's wheat crop.

The proposed route crosses eight counties in Montana (**Figure 11**). These counties are predominantly rural with dispersed population and few cities. In 1990, the population density of Montana was 5.5 people/square mile (Bureau of the Census 1990). Hill County had the largest density of people (6.1 people/square mile), whereas Golden Valley County had the lowest density (0.8 people/square mile). Population centers near the pipeline route include Havre, Fort Benton, Harlowton, Lewistown, Billings, Laurel, and Red Lodge.

Although Montana's population increased 1.6 percent between 1980 and 1990, from 786,690 in 1980 to 799,065 (Bureau of the Census 1991), population in the counties crossed by the pipeline decreased. Judith Basin County showed the largest decrease in population between 1980 and 1990 (13.8 percent), followed by Golden Valley (11.1 percent), Chouteau (10.5 percent), Fergus (7.6 percent), Wheatland (4.8 percent), Stillwater (1.9 percent) and Hill (1.8 percent). Hill County had the highest population in the study area with 17,654 people in 1990, while Golden Valley County had the lowest population (912 people).

Workers generally prefer to reside close to their employment to reduce commuting distance, provided that adequate housing and services are available. Monitoring studies have shown that construction workers may be willing to commute 50 to 75 miles to the project site, but operational workers rarely commute over 60 miles (Leholm et al. 1975). Construction workers also tend to leave their families in their established residences, and return home on their days off and after project completion.

On the Montana segment of the route, total temporary housing consists of an estimated 6,297 motel/ hotel units, and 7,251 private campground/mobile home spaces, within 60 road miles of the pipeline route (Table 22). Spread 1 (Wild Horse to Denton) has an estimated 4,445 motel/hotel units and spaces in private/public campgrounds and mobile home parks; Spread 2 (Denton to Rapelje) has a total of 1,514 temporary units; and Spread 3 (Rapelje to Wyoming Border) has 7,589 units. In addition to motels and campgrounds, there are rental units (apartments, homes and mobile homes). Rental units probably are more plentiful in the larger cities such as Havre, Lewistown, Billings and Laurel.

Occupancy rates for temporary housing were estimated through telephone interviews with managers of motels/hotels, mobile home parks and campgrounds. Most motel managers reported an occupancy rate of 80 to 90 percent during the high season and 40 to 50 percent during the off season (Table 23). Mobile home park managers typically did not report having a high or off season, rather, they have experienced a 70 to 90 percent occupancy rate year-round. Many campground owners reported that they are open only during the summer months and close after Labor Day. During the summer months, occupancy rates for campgrounds were between 70 and 99 percent.

The high season for most motels was reported to be June through August, with a busy peak during the hunting season in October and November. Motels in the community of Red Lodge experience high seasons during summer and again during the winter skiing season. Mobile home parks in northern Montana were nearly 100 percent occupied during the grain harvest season in August and September.

Community services such as ambulance service and fire protection are usually provided by volunteer organizations in the small rural towns and unincorporated cities of Montana. The larger cities offer hospital care, local law enforcement protection, physician services, and other amenities, such as restaurants, retail outlets, and inside recreation.

Wyoming

The arid, intermountain region traversed by the route in Wyoming is similar to Montana with its sparse population and remote urban areas. Cattle ranching, irrigated farming, mining, and the petroleum industry provide most of the employment and income. Greybull, Worland, and Riverton are agricultural hubs, while Casper is dominated by oil and gas development.

TABLE 22
ESTIMATED TEMPORARY HOUSING ALONG THE EXPRESS PIPELINE ROUTE - MONTANA WITHIN 10 MILES OF COMMUNITY

Community and Public Spaces	1990 Population	Motel/Hotel Units	Trailer & Tent Private	Road Miles From the Route
Spread 1: (MP 0-125)				
Havre	10,201	381	545	21
Rudyard	U	0	0	15
Hingham	181	0	0	9
Chester	942	38	15	35
Big Sandy	740	8	20	3
Loma	U	4	0	27
Fort Benton	1,660	22	45	38
Great Falls	55,097	1,803	1,549	60
Hilger	U	0	9	41
Denton	350	4	2	10
Total Spread 1		**2,260**	**2,185**	
Spread 2: (MP 125-225)				
Stanford	529	12	42	19
Hobson	226	0	18	4
Lewistown	6,051	314	363	26
Moore	211	6	17	6
Judith Gap	133	0	2	1
Harlowton	1,049	75	19	8
White Sulphur Springs	963	53	120	62
Martinsdale	U	18	35	33
Roundup	1,808	52	84	58
Big Timber	1,557	74	210	56

TABLE 22 (Continued)

Community and Public Spaces	1990 Population	Motel/Hotel Units	Trailer & Tent Private	Road Miles From the Route
Total Spread 2		**604**	**910**	
Spread 3: (MP 225-305)				
Reed Point	U	0	23	34
Billings	81,151	2,949	3,378	25
Laurel	5,686	102	291	9
Columbus	1,573	48	91	16
Park City	U	8	24	1
Silesia	U	0	22	2
Joliet	522	4	30	4
Fromberg	370	0	9	10
Absarokee	U	4	28	32
Roberts	U	0	18	19
Bridger	692	8	32	10
Belfry	U	0	0	36
Red Lodge	1,958	310	210	48
Total Spread 3		**3,433**	**4,156**	
Montana Total		**6,297**	**7,251**	

Notes:
1) U = Unincorporated city; population estimate not available.
2) NA = Not available.

Sources:
1) Montana Department of Health and Environmental Sciences, Food and Consumer Safety Bureau, Helena, Montana. October 1993.
2) American Automobile Association, Tour Book. 1993 Edition.
3) American Automobile Association, Camp Book. 1993 Edition.
4) Montana Department of Commerce, Promotion Division, Helena, Montana.
5) U.S. Bureau of the Census, 1990 Census of Population for Governmental Units, Montana, 1991.

TABLE 23
OCCUPANCY RATES - MONTANA TEMPORARY HOUSING UNITS ALONG THE EXPRESS PIPELINE ROUTE

Spread	Type of Housing	No. Contacted	No. Units/ Spaces with High/Off Season	Percent Occupancy During High Season	Percent Occupancy During Off Season	No. Units/Spaces Without High/Off Season	Percent Occupancy Without High/Off Season
1	Motel	34	1,179	82%	50%	287	72%
	Mobile Home Parks	12	78	98%	73%	519	91%
	Campgrounds	4	155	99%	5%	0	NA
2	Motel	23	540	78%	45%	44	78%
	Mobile Home Parks	7	0	NA	NA	311	71%
	Campgrounds	5	200	72%	24%	0	NA
3	Motel	37	1,761	86%	49%	30	65%
	Mobile Home Parks	13	0	NA	NA	644	69%
	Campgrounds	4	295	80%	28%	32	40%

Source: Telephone interviews were conducted with owners of motels, hotels, mobile home parks, and campgrounds in October and November, 1989.

The proposed pipeline route crosses five counties in Wyoming (Big Horn, Fremont, Hot Springs, Washakie and Natrona). In 1990, the U.S. Bureau of the Census reported 4.7 persons per square mile in the state. Of counties crossed by the pipeline route, Natrona had the highest density of people (11.5 people/square mile), whereas Hot Springs County had the lowest density (2.4 people/square mile). Major population centers (population in excess of 5,000) near the route include Worland, Powell and Casper.

Wyoming's population decreased by 3.5 percent from 469,557 in 1980 to 453,588 in 1990 (Bureau of the Census 1991). Of the five counties within the Wyoming study area, none experienced a population increase in the ten-year period. Hot Springs County had the largest population decrease (18.7 percent), followed by Fremont County (15.8 percent), Natrona County (14.8 percent), Washakie County (13.2 percent)and Big Horn County (13.0 percent). Natrona County was the most populated county in the study area with 61,226 people in 1990, while Hot Springs County had the lowest population with 4,809 persons.

Temporary housing (motels and campgrounds) along the Wyoming segment of the route appears to be less plentiful than the Montana segment; however, this may be attributable to the lack of comprehensive data sources for mobile home courts in Wyoming (Table 24). There is an estimated total of 3,224 motel/hotel rooms, and 1,725 private and public campground spaces within 60 road miles of the pipeline route. Spread 4 (Montana border to Black Mountain Road) has 1,721 motel/ hotel units and campground spaces; Spread 5 (Black Mountain Road to Casper) has 3,228 temporary spaces.

Similar to Montana, the highest occupancy rates for temporary housing occur during the summer months from Memorial Day through Labor Day (Table 25). The hunting season was not specifically reported to be a high use season for temporary housing although it appears that during some fall periods (e.g., One-Shot Antelope Hunt in the Lander area) hunters occupy considerable numbers of motels and campgrounds. Some motel managers indicated that they either close their motel or operate with fewer number of motel units available during the winter months.

Many campgrounds were closed during the housing survey, thus few owners were able to be contacted to discuss occupancy rates. Some of the campground owners who were contacted reported closing their facilities during the winter (November through April).

As in Montana, community services are limited in the small rural areas of Wyoming. Larger population centers offer a wider range and diversity of community services.

Employment and Income

Montana

Montana ranked second in the nation in 1991 for acreage of land in farms and ranches. In 1991, Montana ranked third in the nation for wheat production, and thirteenth for the livestock industry (cattle and calves) (Montana Department of Agriculture 1992).

TABLE 24
ESTIMATED TEMPORARY HOUSING ALONG THE EXPRESS PIPELINE ROUTE - WYOMING WITHIN 10 MILES OF COMMUNITY

Community	1990 Population	Motel/Hotel Units	Trailer & Tent Private & Public Spaces	Road Miles From the Route (Estimated)
Spread 4: (MP 305-420)				
Lovell	2,131	70	191	0. 3
Powell	5,292	140	25	23
Greybull	1,789	103	87	4
Shell	U	4	52	14
Basin	1,180	9	0	2
Worland	5,742	162	65	2
Ten Sleep	311	40	252	26
Meeteetse	368	19	0	49
Thermopolis	3,247	238	264	22
Total Spread 4		**785**	**936**	
Spread 5: (MP 420-512)				
Shoshone	497	29	196	30
Riverton	9,202	473	60	54
Bar Nunn	835	0	0	10
Mills	1,574	0	92	10
Evansville	1,403	0	0	10
Casper	46,742	1,937	441	10
Powder River	U	0	40	10
Total Spread 5		**2,439**	**789**	

TABLE 24 (Continued)

Community	1990 Population	Motel/Hotel Units	Trailer & Tent Private & Public Spaces	Road Miles From the Route (Estimated)
Wyoming Total				
		3,224	**1,725**	

Notes: 1) The list may not include privately-operated mobile home courts.
2) U = Unincorporated city; population estimate not available.

Sources: 1) American Automobile Association, Tour Book. 1993 Edition.
2) American Automobile Association, Camp Book. 1993 Edition.
3) Wyoming Travel Commission, Cheyenne, Wyoming.
4) U.S. Bureau of the Census, 1990 Census of Population and Housing, Summary Population and Housing Characteristics, Wyoming, 1991.

There are few large businesses in the state. Of the 25,028 business establishments in Montana in 1990, approximately 60 percent employed less than five people, 19.6 percent employed between five and nine persons, 11.3 percent employed 10 to 19 people, 6.2 percent employed between 20 and 49 persons and 2.6 percent employed 50 or more (Bureau of the Census 1992). Only four business establishments, both in the services sector, employed 1,000 or more people. The services sector represented the largest percent (29.7 percent) of all industry groups in Montana, while the mining industry accounted for the smallest percent (1.1 percent), closely followed by agricultural services, forestry and fisheries sector (1.4 percent).

The civilian labor force was 412,000 in 1992 (Montana Department of Labor and Industry 1993). In 1992, the unemployment rate was 6.7 percent. Among the eight counties in the study area, Golden Valley County had the highest unemployment rate in 1992 (13.0 percent), and Chouteau County had the lowest rate (3.4 percent).

Data from the Montana Department of Labor and Industry, Job Service Division, indicate that workers with general skills necessary for pipeline construction are available in some Montana communities within 60 miles of the pipeline route. Most of the available job seekers are general construction workers and operating engineers (Table 26). The local labor force has few available workers with specialized skills for pipeline work (e.g., pipeline supervisors and pipefitters).

Per capita personal income in Montana increased from $14,154 in 1989 to $15,680 in 1991, a 10.8 percent increase in the three-year period (Bureau of the Census 1993). In 1991, Fergus County had the lowest per capita personal income ($13,762) of the eight counties in the study area, whereas Chouteau County had the highest per capita personal income ($20,035).

TABLE 25
OCCUPANCY RATES - WYOMING TEMPORARY HOUSING UNITS ALONG THE EXPRESS PIPELINE ROUTE

Spread	Type of Housing	No. Contacted	No. Units/Spaces with High/Off Season	Percent Occupancy During High Season	Percent Occupancy During Off Season	No. Units/ Spaces Without High/Off Season	Percent Occupancy Without High/Off Season
4	Motel	39	838	79%	41%	34	50%
	Mobile Home Parks	10	0	NA	NA	207	46%
	Campgrounds	9	327	73%	29%	NA	NA
5	Motel	44	1,764	86%	46%	169	62%
	Mobile Home Parks	20	0	NA	NA	2,653	60%
	Campgrounds	6	154	41%	20%	61	<10%

Source: Telephone interviews were conducted with owners of motels, hotels, mobile home parks, and campgrounds in October and November, 1989.

TABLE 26
NUMBER OF APPLICANTS REGISTERED IN SELECTED JOB CATEGORIES - MONTANA JOB SERVICE OFFICES ALONG THE EXPRESS PIPELINE ROUTE (September 1993)

Job Category (DOT Code)	Havre	Great Falls	Lewistown	Billings
Welding-Machine Operator, Arc (810.382-010)	0	0	0	1
Welder, Arc (810.384-014)	0	0	0	17
Welding Supervisor (819.131-014)	0	0	0	2
Weld Inspector I (819.281-018)	2	0	0	1
Weld Inspector II (819.687-010)	0	1	0	0
Welder Helper (819.687-014)	1	0	0	9
Corrosion-Control Fitter (820.361-010)	0	0	1	0
Supervisor, Reclamation (850.133-010)	0	0	0	0
Supervisor, Labor Gang (850.137-014)	0	0	0	0
Inspector of Dredging (850.387-010)	0	0	0	0
Grade Checker (850.467-010)	1	0	0	0
Horizontal-Earth-Boring-Machine Operator (850.662-010)	0	0	0	0
Rock-Drill Operator II (850.662-014)	0	0	0	0
Dredge Operator (850.663-010)	0	0	0	0
Elevating-Grader Operator (850.663-014)	0	0	0	0

TABLE 26 (Continued)

Job Category (DOT Code)	Havre	Great Falls	Lewistown	Billings
Bulldozer Operator I (850.683-010)	0	0	0	0
Ditcher Operator (850.683-014)	0	0	0	0
Dragline Operator (850.683-018)	0	0	0	0
Mucking-Machine Operator (850.683-026)	0	0	0	0
Power-Shovel Operator (850.683-030)	1	2	0	0
Rock-Drill Operator I (850.683-034)	0	0	0	0
Scraper Operator I (850.683-038)	0	0	1	0
Horizontal-Earth-Boring-Machine-Operator Helper (850.684-014)	0	0	0	0
Supervisor, Grading (859.137-010)	0	0	0	0
Blaster (859.261-010)	0	0	0	0
Operating Engineer (859.683-010)	22	25	15	87
Blaster Helper (859.687-010)	0	0	0	0
Supervisor-Pipelines (862.131-022)	0	0	0	0
Pipefitter (862.381-018)	0	0	0	0
Pipe-Wrapping-Machine Operator (862.682-014)	0	0	0	0
Clearing Supervisor (869.133-010)	0	0	0	0
Surveyor Helper (869.567-010)	5	2	4	7

Job Category (DOT Code)	Havre	Great Falls	Lewistown	Billings
Construction Worker I (869.664-014)	29	39	14	4
Construction Worker II (869.687-026)	80	56	7	95
Pipeliner (899.684-026)	0	0	0	0

Note: Data are based upon the Dictionary of Occupational Titles (DOT) general classification groups. Applicants may be registered under more than one job category and in more than one Job Service Office.

Source: Montana Department of Labor and Industry, Job Service Division, Helena, Montana, September 1993, Unpublished data.

TABLE 27
NUMBER OF APPLICANTS REGISTERED IN SELECTED JOB CATEGORIES - WYOMING JOB SERVICE OFFICES ALONG THE EXPRESS PIPELINE ROUTE
(July 1 through September 30, 1993)

Job Category (DOT Code)	Worland	Riverton	Casper
Welding-Machine Operator, Arc (810.382-010)	0	0	1
Welder, Arc (810.384-014)	5	12	53
Welding Supervisor (819.131-014)	0	0	3
Weld Inspector I (819.281-018)	0	0	0
Weld Inspector II (819.687-010)	0	0	2
Welder Helper (819.687-014)	15	14	79
Corrosion-Control Fitter (820.361-010)	0	0	0
Supervisor, Reclamation (850.133-010)	0	0	0
Supervisor, Labor Gang (850.137-014)	0	0	13
Inspector of Dredging (850.387-010)	0	0	0
Grade Checker (850.467-010)	0	1	1
Horizontal-Earth-Boring-Machine Operator (850.662-010)	0	0	0
Rock-Drill Operator II (850.662-014)	0	0	0
Dredge Operator (850.663-010)	0	0	1
Elevating-Grader Operator (850.663-014)	0	0	0

TABLE 27 (Continued)

Job Category (DOT Code)	Worland	Riverton	Casper
Bulldozer Operator I (850.683-010)	8	24	16
Ditcher Operator (850.683-014)	0	0	0
Dragline Operator (850.683-018)	0	1	0
Mucking-Machine Operator (850.683-026)	0	0	1
Power-Shovel Operator (850.683-030)	20	2	39
Rock-Drill Operator I (850.683-034)	0	0	0
Scraper Operator I (850.683-038)	7	0	13
Horizontal-Earth-Boring-Machine-Operator Helper (850.684-014)	0	0	1
Supervisor, Grading (859.137-010)	0	0	0
Blaster (859.261-010)	0	3	1
Operating Engineer (859.683-010)	31	159	146
Blaster Helper (859.687-010)	0	0	0
Supervisor-Pipelines (862.131-022)	1	0	0
Pipefitter (862.281-018)	4	7	15
Pipe-Wrapping-Machine Operator (862.682-014)	0	0	0
Clearing Supervisor (869.133-010)	1	0	0
Surveyor Helper (869.567-010)	3	4	19

Job Category (DOT Code)	Worland	Riverton	Casper
Construction Worker I (869.664-014)	110	60	287
Construction Worker II (869.687-026)	67	650	404
Pipeliner (899.684-026)	1	0	3

Note: Data are based upon the Dictionary of Occupational Titles (DOT) general classification groups. Applicants may be registered under more than one job category and in more than one Job Service Office.

Source: Wyoming Employment Security Commission, Research and Analysis Section, Casper, Wyoming, October 1993, Unpublished data.

Wyoming

There were 14,630 business establishments in Wyoming in 1990. Approximately 59 percent of the establishments employed less than five people, 20.6 percent employed five to nine workers, 10.9 percent employed 10 to 19 persons, 6.4 percent employed 20 to 49 people and 2.8 percent employed 50 or more people (Bureau of the Census 1992). Four establishments employed between 500 and 999 people (two in the mining sector and two in the services sector) while one business establishment in the mining industry employed 1,000 or more workers. The services sector accounted for the largest percent (29.8 percent) of all industry groups in Wyoming, while the agricultural services, forestry and fisheries sector represented the smallest percent (1.2 percent).

Agriculture ranks among the top three industries in Wyoming, providing cash receipts of nearly $870 million in 1991, a 26 percent increase from 1987. Wyoming ranked 37th in the nation in 1991 for cash receipts from agriculture. Major crop-producing areas are the irrigated lands in the Bighorn River basin. Hay, sugarbeets and barley are the leading cash crops. In 1991, Wyoming ranked 6th nationally in sugarbeet production, 7th in barley production and 9th for dry bean production (Wyoming Department of Agriculture et al. 1993).

The Wyoming labor force was 240,000 in 1992 (Kaminski, pers. comm. 1993). The annual average unemployment rate for the state was 5.6 percent in 1992. Hot Springs County had the lowest unemployment rate (4.9 percent) of the five-county study area, whereas Natrona County had the highest rate (7.4 percent).

The occupational groups listed in Table 27 are applicants registered at the three Job Service Offices in Wyoming which are within 60 miles of the pipeline route. As indicated in the Table, most of the available work force within 60 miles of the pipeline route is composed of construction workers and operating engineers.

Per capita personal income in Wyoming increased 11.0 percent between 1989 and 1991 from $15,096 to $16,968 (U.S. Bureau of the Census 1993). In 1991, Natrona County had the highest per capita personal income $18,461 in the five-county study area, while Fremont County had the lowest per capita personal income ($13,339).

Cultural and Paleontology Resources

A Class III cultural resource inventory has been completed for the entire pipeline route, except for a few segments between Powder River and Casper, Wyoming where landowners did not allow access. A Class I file search was completed for those segments not inventoried. Most of the proposed pipeline route was intensively pedestrian inventoried for cultural and paleontology resources for the Altamont and Amoco CO_2 pipeline projects (PIC 1988, Newberry et. al. 1989, Altamont 1995a,b). Native Americans were consulted in conjunction with the inventory and subsequent evaluations of properties found along the route. The results of these surveys are described in the following sections.

Paleontology

Between the Canadian border and the Montana-Wyoming border, three paleontological localities considered important, significant, or critical were identified during pedestrian surveys. All are located in Hill County near Fresno Reservoir and are associated with the Judith River Formation. One locality is north of the lake and contains small vertebrate bone fragments, turtle shell, and plant remains. The other two localities, both south of the reservoir, contain dinosaur (hadrasaur and carnosaur) and non-dinosaur-related remains (e.g. turtle shell, fish scales, crocodile teeth, reptilian phalanges). All are on lands administered by the BOR.

The Wyoming portion of the proposed Express Pipeline route traverses stratigraphic units ranging from the Mesozoic through Cenozoic in age (Williamson, pers. comm. 1995). Twenty-three of these units are known to contain fossils of scientific importance: the Triassic Red Peak and Crow Mountain/Popo Agie Formation; the Jurassic Nugget Sandstone and Morrison Formation; the Cretaceous Cloverly, Cody Shale, Mesa Verde, Meeteetse, Lewis Shale, and Lance Formations; the Tertiary Fort Union, Indian Meadows, Wind river, Wasatch, Green river, Aycross, Bridger, Wagonbed, Tatman, White River, Arikaree, and South Pass Formations; and undivided Quaternary Alluvius.

A total of 15 paleontological localities considered important, significant or critical were identified during pedestrian surveys along the 205-mile segment between the Montana-Wyoming border and Casper, Wyoming. One locality is within the Paleocene (Torrejonian-Tiffanian?) Fort Union Formation and yields reptile and bivalve fragments. Eleven localities are in the Eocene (Wasatchian) Willwood Formation and yield reptile and mammal remains. These localities are within the 120-mile segment of the proposed pipeline route between the Montana-Wyoming border and Lost Cabin. The remaining three localities are within the Eocene (Wasatchian-Bridgerian) Wind River formation in the 55-mile segment between Lost

Cabin and Casper, and yield fish, reptile and mammal remains. At least one of these localities corresponds to a published fossil vertebrate locality of critical importance. This locality not only yielded a diverse assemblage of fish, reptiles and mammals, but also is considered important for defining and characterizing the Wasatchian-Bridgerian land-mammal "age" boundary, an important biostratigraphic and biochronologic marker for correlation of continental deposits of western North America.

Cultural Resources

The intensive pedestrian surveys of the route between the Canadian border and Casper, Wyoming identified a total of 337 cultural resource sites or site segments. One hundred eighteen were in Montana and 219 were in Wyoming.

Of the 118 sites recorded in Montana, 59 sites date to the prehistoric era and 59 to the historic era. The prehistoric sites include 31 tipi ring sites, 16 cultural material scatters, nine sites containing stone features other than tipi rings, two lithic scatters, and one site containing a possible Medicine Wheel, in addition to numerous tipi rings and other stone features. All of the prehistoric sites have been evaluated for their scientific potential and information value (criterion d of 36 CFR 60.4) by examination of subsurface deposits (testing) and their surface attributes. Twenty-two of the 59 sites (37 percent) have been recommended to the National Register of Historic Places (NRHP). The prehistoric sites recommended as eligible to the NRHP include 14 tipi ring sites, five cultural material scatters, one lithic scatter, one other stone feature site, and the site containing the possible Medicine Wheel and other stone features (Altamont 1993).

There are 11 prehistoric properties entirely or partially on state land. They are in Hill, Chouteau, and Wheatland counties, Montana. These include two cultural material scatters, one other stone feature site, and five tipi ring sites recommended as ineligible to the NRHP. Also found on the proposed route on state land in Montana are two tipi ring sites (24HL948 and 24CH781) and one cultural material scatter (24HL946), all of which have been recommended as eligible to the NRHP.

The 59 historic sites include 31 agricultural sites, 13 railroad related sites, eight pioneer roads, five modern roads, one oil and gas site, and one site that contains both an agricultural component and a pioneer road. Thirty-nine percent (23 of 59) of the historic sites have been evaluated as eligible to the NRHP. Eligible historic sites include eight properties associated with historic railroads, 14 agricultural sites, one modern road, three pioneer roads, and one site that contains both an agricultural component and a pioneer road.

There are four historic properties located entirely or partially on state land in Montana. All are located in Chouteau County. They include pioneer road segments (24CH773 and 24CH796) that have been recommended as ineligible to the NRHP and railroad related sites 24CH942 and 24CH943 that have been recommended as eligible to the NRHP.

Of the 219 cultural sites or site segments identified along the route in Wyoming, 132 are prehistoric, 61 sites are historic, and 26 sites have prehistoric and historic remains (Smith 1995). The prehistoric sites include open camps, flaked stone artifact scatters, stone circles, cairns, heat-altered rock scatters, and lithic procurement areas. Historic sites consist of canals, trash scatters, dumps, a feedlot, a cabin, railroad grades, and trails or roads. Canals include the Big Horn, Hunt-Godfreg, Glove, Elk-Lovell, Sidon, Fritz, Handover, and Casper. The recorded railroad segments include the Chicago and Northwestern and the Chicago, Burlington and Quincy. Among the recorded trails or roads are the Bridger Trail, Okie Post Office to Casper Road, the Casper to Lost Cabin Road, and the Okie trail. Twenty prehistoric sites, 33 historic sites or site segments, and 11 sites with prehistoric and historic components have been recommended as eligible for the NRHP.

Native American Consultation

Cultural representatives of various tribes were consulted in conjunction with the inventories and evaluation of properties found along the proposed route in Montana and Wyoming. Tribes involved in the consultation process included the Blackfeet, Northern Arapaho, Crow, Eastern Shoshone, Assiniboine, Gros Ventre, Northern Cheyenne, and Chippewa-Cree tribes. Tribes were consulted prior to the surveys and during the surveys, testing, and evaluation. Members of the Blackfeet, Northern Cheyenne, and Eastern Shoshone tribes made site visits. The Northern Arapaho, Crow, and Northern Cheyenne chose to review site forms and video tapes of the sites.

In Montana, two sites on the proposed pipeline route have been recommended as Traditional Cultural Properties. Site 24HL795 contains features, a possible Medicine Wheel and a possible burial cairn, that are culturally recognizable symbols of traditional Blackfeet spiritual heritage. Site 24CH787, a large complex ring site near Lonesome Lake, is associated with significant themes in Gros Ventre, Blackfoot and Chippewa-Cree tribal history. Further it is associated with Bull Lodge, a famous Gros Ventre medicine man, warrior and chief. Neither of the Traditional Cultural Properties is on state lands.

Prior to the surveys in Wyoming, both the Eastern Shoshone and the Northern Arapaho identified the Lost Cabin area as being potentially sensitive due to the presence of burials and rock art sites (Altamont 1992a). During the survey of the route north of Lost Cabin, only one locality was identified by Native American consultants as having traditional cultural value. Site 48BH1707 contains a single cairn that, according to the consultants, has important spiritual associations. This site was not recommended as eligible to the NRHP as Traditional Cultural Property because the tribal consultants feel it is inappropriate to provide the information necessary to support such a recommendation.

The eastern portion of the route from where it joins the right-of-way for the previously proposed Amoco CO_2 pipeline to its terminus in Casper contains five stone feature sites (Deaver 1995). Four of the five have been examined in the field by the Eastern Shoshone and via video tape by the Northern Arapaho. The Northern Arapaho have expressed no cultural concerns about these sites. The Eastern Shoshone have expressed generalized concerns about 48NA157. Site 48NA157 will not be recommended as eligible to the National Register as Traditional Cultural Property because the tribal consultants feel it is inappropriate to provide the necessary information to support such a recommendation. The fifth site, 48FR3658, is a stone feature site containing both historic and prehistoric features. It was recorded in the last week of May, 1995. Consultation is ongoing. It is unlikely that the site will cause concern among the tribal consultants because all of the stone features are outside of the proposed right-of-way.

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Chapter 4
Environmental Consequences

INTRODUCTION

This chapter analyzes the environmental impact of the proposed Express Pipeline on the physical, biological, and socioeconomic resources. Where quantifiable, significance criteria for each resource are established as thresholds to determine if the proposed Express Pipeline and alternatives would have a significant impact. Where significant impacts are determined, mitigation measures are recommended to reduce the level of impact.

Since there are no major variations to the proposed pipeline route, impacts generally are the same for both of the action alternatives. Differences in alternatives are the result of minor route variations, timing restrictions for wildlife, and construction technique issues at river crossings. To avoid repetition, impacts which are common to all the action alternatives are grouped together in the analysis. When an alternative would result in different impacts for a particular resource, the alternative is analyzed separately.

GEOLOGY

Potential geologic hazards associated with construction of the Express Pipeline project would be caused by slope instability, active or potentially active faults, earthquakes, and liquefaction. In addition, construction could potentially affect mineral development operations.

Criteria for Determining Significant Impacts

Geologic hazards and impacts were considered significant if implementation of the Express Pipeline project would subject people, structures, or other resources to geologic hazards; or cause substantial damage to, eliminate, or otherwise render mineral resources unusable. The occurrences of the following geologic hazards along the proposed pipeline route were considered significant:

- active landslides, ancient landslides, avalanches, or other features indicative of unstable slopes;

- faults crossed by the alignment or faults within five miles of the alignment that are known to be active historically or are thought to have been active in the Holocene epoch with the capability of ground displacement;

- faults that are known to be active within 10 miles of aboveground facilities that have the capability to cause strong vibratory ground motion;

- soils prone to liquefaction as a result of seismic activity;

- active or proposed mineral or energy development that would be directly affected and disrupted due to pipeline construction or operation.

Impacts that are related to unstable slopes include several types of landslides or avalanches. Landslides occur as a result of natural or man-made stresses on naturally weakened earth materials. A major landslide could dislodge or severely damage the pipeline or ancillary facilities, or even rupture the pipeline.

Impacts related to active faults that are either crossed by, or are within 10 miles of the pipeline alignment include fault displacement and earthquake-induced strong vibratory ground motion. Although it is difficult to quantify the probability of surface fault rupture, it is generally accepted that the more recently a fault has moved, the more likely it is to move again in any given period of time. Surface fault rupture in an area that is crossed by the pipeline could result in offset of the fault blocks, which could, in turn, rupture an unprotected pipeline. Earthquake-induced strong vibratory ground motion is capable of damaging an unprotected pipeline directly.

Impacts related to soils that are prone to liquefaction include ground failure which could result in damage to the pipeline and/or its ancillary facilities. Soil liquefaction occurs as a result of earthquake-induced strong ground shaking of water-saturated alluvial or lacustrine surface deposits. The liquefaction potential of otherwise susceptible deposits is very low where groundwater depth exceeds 50 feet.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to geological resources, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Slope Stability

The potential for landslides or other forms of mass movement to affect the pipeline is low along most of Express proposed route. Six areas on or along the proposed right-of-way have been identified as being potentially unstable (see Table 6). Several of these areas (the Sag, Sage Creek, and one location at West Kirby Creek) are stabilized or would pose no risk to the pipeline. However, the presence of active slides in the vicinity of Arrow Creek (MPs 112.9-

115.0), and West Kirby Creek (MPs 417.0-417.1 and MPs 417.8-418.1), shown on Table 28, would be a significant hazard for the pipeline. Express would incorporate the additional mitigation measures, listed in the Recommended Mitigation Section in this chapter, in their Plan of Development to reduce these impacts to less than significant.

Table 28 Landslide Areas Along The Express Pipeline Route

Milepost	Location
111.0 - 115.0	Gullied terrain due south of Arrow Creek, Fergus County Montana
417.0 - 417.1	West and south of West Kirby Creek, Hot Springs County, Wyoming
417.8 - 418.1	West and south of West Kirby Creek, Hot Springs County, Wyoming

Express has proposed a different route through the Arrow Breaks than the one certified for the Altamont pipeline. A different route is needed because of the land slide potential and that two pipelines could not be built in the narrow space. An initial study was conducted in 1992 to determine an alternative route. The report of "Geologic Evaluation of Unstable Slopes Along the Altamont Pipeline Route in the Upper arrow Creek Area, Montana" completed by Dan Nebel in August, 1992 is included as Appendix H of this document. The Express Pipeline route through the Arrow Creek breaks was established after a field and office evaluation of the Altamont route in this area. The field evaluation was conducted by Dan Nebel, Engineering Geologist, Bryan Singleton, Pipeline Engineer, and Lyal Singleton, Pipeline Construction Specialist, on September 8, 1993. The office evaluation was conducted after the field visit by interpretation of stereo aerial photography and geologic and topographic data.

The Altamont route follows the bottom of the drainage and leaves the drainage by following a stable ridge. The Altamont route along the drainage bottom is located between an actively eroding stream with vertical banks and steep hillsides. In the drainage bottom, there is room for only one pipeline, provided specific mitigation measures are employed. Encroachment closer to the stream is not possible without the potential for exposure due to stream action. To locate an additional pipeline in the drainage bottom would require either boring or direction drilling of several drainage crossings. Other drainages would require stabilization and structural control after construction.

Therefore, the Express route was developed after consideration of construction difficulties encountered in paralleling the Altamont route along the drainage bottom. The proposed Express route leaves the drainage bottom at approximately MP 112 at the mouth of the Arrow Creek side drainage of concern and follows a stable ridge to the top of the drainage (see Map 2). The original road from the Arrow Creek Bench to the south to the valley of Arrow Creek follows this route. The road was originally located in the early 1900s and the integrity is still intact. Furthermore, the road is unaffected by landslides. The immediate side slopes are stable and show no evidence of recent instability. Following this route allows the Express pipeline to avoid slope instability and stream erosion hazards associated with locating the line parallel to the Altamont pipeline in the drainage bottom.

Surface Faulting

The proposed route would not cross any fault zones known to be active historically or thought to be active during Holocene times, although one fault that may have had late-Quaternary activity would lie within five miles of the pipeline near Lost Cabin at MP 430. Preliminary reconnaissance at this Cedar Ridge/Dry Fork fault system suggests no evidence of offset since Quaternary times. However, the possibility of more recent activity at the Stagner Creek Fault System during the Late Pleistocene period cannot be precluded. Passing within five miles of active or potentially active surface faults would be a significant hazard. Rupture of crossed faults may cause displacement that could cause the pipeline to fail. This impact would be significant in the event of an earthquake which may rupture the pipeline and result in an oil spill. Express should incorporate mitigation measures, listed in the Recommended Mitigation Section in this chapter, in their Plan of Development to reduce this impact to less than significant.

Ground Shaking

The Express project lies entirely within Seismic Risk Zone 1. In spite of the presence of fault systems and moderate seismicity in and near the areas that would be crossed by the proposed route, ground shaking is not expected to pose a significant hazard for the pipeline and associated facilities.

Liquefaction

The proposed pipeline route would not cross any potentially liquefiable sediments. Although the Milk River is in a "quickened" state due to the silty streambed and bank, the seismic risk is too low to include the conditions that would lead to liquefaction.

SOILS

Impacts on soils from pipeline construction could result in the potential for increased water and wind erosion, and reduced soil productivity as a result of soil compaction, damage to soil structure, and mixing of topsoil and subsoil.

Criteria for Determining Significant Impact

Impacts to soils were considered significant if increased erosion rates or reductions in soil productivity would prevent successful rehabilitation and the eventual reestablishment of vegetative cover.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to soils, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Erosion Impacts Common to All Action Alternatives

Implementation of the proposed Express Pipeline project would result in minor, short-term impacts to soils over most of the route. Surface disturbance associated with construction would remove the protective vegetation for soils along the pipeline Right-of-way. It would also cause disruption and compaction of the soil surface. As a result, more soil would be exposed to erosional forces than at present. The most critical period for soil erosion is after initial site clearing and grading and before the reestablishment of vegetation. Water erosion primarily occurs in loose or exposed soils on steep slopes, and increases with the length and gradient of the slope. Express has proposed specific mitigation measures to minimize the erosion potential. They are listed in Section 7.0 of the Preliminary Rehabilitation Plan, Appendix B, and summarized in this section. These measures would be applied to slopes five percent or greater and would be kept in force until vegetated cover is reestablished.

Reclamation Impacts Common to All Action Alternatives

Additional impacts would be most significant for those soils having a poor or poor to fair potential for successful reclamation. If the soil is determined to have a reclamation potential of fair to good, impacts would be insignificant because these soils would support adequate revegetation. Factors leading to soils having a poor or fair to poor reclamation potential are:

- high electrical conductivity (greater than 8 mmhos/cm)
- high sodium adsorption rate (greater than 8)
- steep slopes (greater than 15 percent)
- high clay content (greater than 40 percent)
- high sand content (greater than 85 percent)
- surface covered with stones (greater than 75 percent coverage)
- soil depth (less than 20 inches to bedrock)

Within Montana, the MDEQ has established criteria to determine the success of reclamation of soils and vegetation. One year after reseeding, vegetation coverage must be at least 30 percent of the vegetation cover on undisturbed lands immediately adjacent to the construction right-of-way. Five years after reseeding, vegetation coverage must be at least 90 percent of the vegetation cover on undisturbed lands immediately adjacent to the construction right-of-way. In the event that these reclamation objectives would not be attained in the prescribed time periods, Express would continue reclamation.

The average width of the construction Right-of-way is 90 feet over the 515-mile proposed pipeline route. Approximately 5,564 acres would be temporarily disturbed by the pipeline construction. Over the total length of the pipeline, 63 percent of the disturbed soils have a reclamation potential of fair or greater, 5 percent is poor to fair, and the remaining 32 percent is poor. Of the soils with a poor rehabilitation potential, 57 percent occur in Wyoming, and the remaining 43 percent occur along the proposed route in Montana. Appendix C lists the reclamation potential of each unit along the proposed route. Appendix C also lists the features which restrict the rehabilitation potential of each individual segment. Express' proposed mitigation, listed in Section 8.0 of the Preliminary Rehabilitation Plan, Appendix B, and summarized below, would minimize the impacts on these soils.

Erosion Control Mitigation

Express has proposed mitigation measures that would minimize the erosional effects to soils. These measures would comply with the Wyoming State Statute for Stormwater Discharge Control Program and applicable Montana statutes. Steep, erodible slopes would not be cleared unless construction is scheduled to begin immediately following clearing. Additionally, erodible slopes which do not require grading would be hand cleared. Graded materials would be bermed where possible to reduce surface water flows across graded areas. Environmental inspectors, contracted by Express to ensure compliance with all mitigation required by agencies, would be continuously on the job to insure these construction techniques are carried out for erodible steep slopes.

Drainage control structures would be used to: 1) transport surface runoff across the right-of-way with minimal erosion; 2) direct surface drainage away from the right-of-way; and 3) provide downgradient control of runoff and sediment from all disturbed areas. These structures include drainage channels (ditches) and water bars (berms and cross ditches).

Drainage channels or ditches would be used on a limited basis to provide drainage along the right-of-way and along the toe of cutslopes, and to direct surface runoff across or away from disturbances onto undisturbed ground. Channels would be constructed during grading operations.

Water bars (diversion berms) would be used to direct intercepted runoff away from disturbed areas. Typical spacing intervals would be as follows:

Slope Gradient (%)	Typical Spacing (ft)
5 - 15	150
16 - 30	100
greater than 30	75

Actual spacing interval would be subject to adjustment in the field as required and berm angles would be surveyed to ensure proper slope (3-5 degrees). Gaps in the diversion berms would be left at all obvious drainages.

Reclamation Mitigation

Sites requiring special construction or rehabilitation procedures include saline, sodic, saline/sodic, shallow, extremely sandy and extremely clayey soils; soils shallow to groundwater; steep slopes; and possibly some acid soils. Each of these areas would require special soil handling techniques as well as intensive monitoring and maintenance to ensure erosion and sediment control and reestablishment of vegetation patterns similar to adjacent undisturbed areas. For all soils with restrictive features leading to a less than fair reclamation potential, Express would strip and salvage the topsoil using the same methods as proposed for cultivated and improved soils. Topsoil would be salvaged using the trench and spoil area stripping method to depths recommended in Table C-3-1, listed in Appendix B, the Preliminary Rehabilitation Plan. In addition to salvaging topsoil, further mitigation is proposed to minimize the impact of other restrictive features.

Saline Soils

Severe saline soils have electrical conductivities in excess of 8 milli-mohs per centimeter. These soils nearly always occur over a fluctuating high water table. The high water table prevents salts from moving deeper into the soil profile. Special handling techniques include:

- No amendments (fertilizer) would be applied during topsoil replacement because soil amendments only compound the salt problem.

- Seedbed and seed would be applied with species adapted to saline conditions (Mix No. 8, listed in Appendix B).

Sodic Soils

Sodic soils have sodium adsorption ratios in excess of 12. Sodium is adsorbed onto clay particles causing clays to lose tilth, become slick when wet and form "panspots" when dry. Water does not infiltrate, but runs off during wet weather. Special handling techniques include:

- Seedbed and seed would be applied with species adapted to sodic conditions (Mix No. 8, listed in Appendix B)

Saline/Sodic Soils

These are soils that have both salt and sodium problems. Special handling techniques are the same as for saline soils.

Steep Slopes

These are soils that occur on slopes greater than 15 percent. Special handling techniques include:

- Erosion control techniques listed in Appendix B, Preliminary Rehabilitation Plan, Section 7.0, would be employed.

- Topsoil would be replaced, leaving the seedbed rough. .

- Seed would be applied using Mix No. 4, listed in Appendix B.

- Mulch or erosion control matting would be used to protect the seed and seedbed from wind and water erosion.

Textural Extremities (Sandy or Clayey Soils)

Special handling techniques would be used to include:

<u>Clayey soils</u>

- Reduce compaction in clayey subsoil by ripping and discing. Generally, the maximum depth of ripping would be one foot because the construction equipment proposed by Express would cause minimal soil compaction.

- After topsoil replacement, seedbed would be prepared to reduce compaction and seed with the mixture adapted to clayey soils (Mix No. 3, listed in Appendix B).

<u>Sandy soils</u>

- The seedbed would be prepared, seeded with Mix No. 1, listed in the Preliminary Reclamation Plan, Appendix B, and protected by using snow fence, straw bales or increased mulch rates. These three measures would help to reduce water erosional forces until the revegetation would be established.

Shallow Groundwater

Soils exhibiting shallow ground water tables are sensitive because deep rutting, compaction and soil horizon mixing may occur in wet, highly organic soils. Special handling techniques would include:

- Possibly schedule construction in these areas until late summer when groundwater is deeper.
- Use equipment with wide, low pressure tracks or tires to reduce compaction.
- If the seedbed is moist and consists of fine soil particles (silts and clays), deep tillage and discing may be required.
- Seed would be applied with Mix No. 5, listed in Appendix B.

Acid Soils

No acid soils were identified in the review of existing soil survey information summarized on Table C-3-1 in Appendix B. If acid soils are encountered, special handling techniques would include:

- Bury acid subsoil, replace topsoil, prepare seedbed and seed.
- Replace topsoil, lime at the rate of 5 tons of calcium carbonate ($CaCO_3$) per acre .
- Prepare seedbed and seed with species adapted to acid conditions.

HYDROLOGY

Potential impact on water resources would result from construction and operation of the Express Pipeline, as well as from increased access along the right-of-way following construction. Temporary, short-term, and long-term impacts have been defined as impacts that last up to one year, one to three years, and over three years, respectively, following the end of construction. Impacts were judged as significant based on criteria discussed below.

Criteria for Determining Significant Impacts

Adverse surface water and groundwater quality impacts were considered significant if they would result in either the short- or long-term violation of state or federal agency numerical water quality standards or narrative water quality objectives. Water quality objectives are not numerical standards but are general goals of an agency as stated in the agency's water quality control plans or resource management plans.

Adverse impacts of stream or river crossings were considered significant if the crossing would alter channelbed armoring resulting in short- or long-term bed erosion on streams of high erosion potential; or result in long-term sedimentation that would affect public water supplies, aquatic life, or the operation of irrigation water control structures, gates, and valves.

Adverse impacts of construction or operation of the pipeline were considered significant if they would modify the quantity of streamflow. Such impacts include water withdrawals and instream construction to the extent that current streamflows would be substantially changed. Stream withdrawals required for hydrostatic testing that would constitute ten percent or more of the streamflow during the withdrawal period were considered to have a potentially significant impact on downstream beneficial uses. If a water withdrawal would adversely affect the use of a water right, it could constitute a significant impact to downstream water use.

Adverse impacts on shallow groundwater were considered significant if pipeline construction or operation would alter flow or reduce the flow of groundwater to wetland areas, or degrade groundwater uses for municipal and industrial purposes. Impacts on groundwater springs were considered significant if pipeline construction would sever or restrict the natural hydraulic flow of water to the spring.

Adverse impacts within floodplains that would be crossed by the pipeline projects were considered significant if aboveground facilities would be located within the 100-year floodplain.

Permitting for the construction of stream crossings differs between Montana and Wyoming. In Montana, the construction of stream crossings is regulated by four permitting or easement programs. The U.S. Army Corps of Engineers requires a "404" permit for the crossings of all waterways and wetlands and a "Section 10" permit for crossing of navigable streams. The crossing of the Yellowstone and Missouri Rivers would require an easement from the State board of Land Commissioners. Finally, a Short term Exemption from Surface Water Quality Standards must be obtained. This 3A authorization would be obtained from the MDEQ. In Wyoming, only the U.S. Corps of Engineers "404" permitting process applies.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to hydrological resources, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Construction Impacts Common to All Action Alternatives

Stream and River Crossings

Potential impact on surface waters could occur due to pipeline construction and hydrostatic testing. The rivers and streams that the Express Pipeline would cross in Montana and Wyoming are listed in Tables 8 and 12 respectively in Chapter 2. Construction techniques that could cause impact include clearing and grading of stream banks, in-stream trenching, trench dewatering, backfilling, and blasting. Potential impact includes increased turbidity, sedimentation, decreased dissolved oxygen concentrations, stream warming, releases of chemical and nutrient pollutants from sediments, and introduction of chemical contaminants such as fuels and lubricants.

Sedimentation and Turbidity

In-stream construction would temporarily increase sedimentation and turbidity in the vicinity of the proposed crossing. The extent of sedimentation and turbidity would depend on stream discharge velocity, turbulence, streambank composition, and sediment particle size. Faster flows or smaller particles (e.g. clay or silt) would result in material traveling farther downstream. In addition to the temporary increase in sediment loading due to instream construction, longer-term sediment loading could result from erosion of cleared streambanks and rights-of-way until they are revegetated.

Clearing and grading of banks, and land construction of the pipeline would result in compaction of the soil, resulting in increased surface runoff of water into streams and other surface water bodies. This increased runoff could cause erosion of streambanks and an increase in turbidity and sedimentation in recipient water bodies. Because the length of streambank segment that would be cleared for pipeline installation would be relatively narrow (from 90 feet for minor streams to 140 feet for major rivers - stream width shown on Tables 8 and 12 in Chapter 3) and would be revegetated, the impact from increased runoff would be short-term until revegetation is complete. In Montana, the MDEQ would make a site-specific determination to assure that headwall erosion was not initiated or aggravated by bank clearing.

Turbidity and sedimentation increases could cause slight chemical changes in overall stream water quality. Increased turbidity reduces light penetration and, thus, photosynthetic production of oxygen. Organic and inorganic materials in the sediments can, when resuspended, cause an increase in oxygen demand, resulting in a decrease in dissolved oxygen. This impact would be expected to be minimal in trout streams, which have colder temperatures and have gravelly, rubble stream bottoms and high levels of dissolved oxygen. However, during spawning periods or periods of low flows, reduction of dissolved oxygen could have significant impact on fish populations. Again, the more susceptible fish species (trout) inhabit faster-flowing streams, where this would not be a problem. Since the construction periods would be from two days to possibly two weeks for major streams and the stream crossings would occur before most spawning periods, these impacts would be very short term.

Vegetation Clearing

Clearing vegetation from streambanks at proposed crossings could result in a decrease of vegetative cover and an increase in insolation of the water body. It is unlikely there would be any impact on water temperature or primary production from vegetation clearing at most proposed stream crossings, because the crossing would be oriented perpendicular to the stream. The length of a streambank segment cleared for pipeline installation would be relatively narrow, usually only 90 to 140 feet, and minimal compared to the overall length of most of the streams and rivers along the route.

Floodplains

For streams and rivers in Montana having designated floodplains (see Table 11 in Chapter 3), Express would be required to place the pipeline a maximum of five feet below the maximum calculated scour depth, for the 100-year flood of the stream or river. The maximum depth of scour would be determined from any of the accepted hydraulic engineering methods, but the final calculated depth would be subject to approval by the MDEQ.

Calculated scour depths are shown on Table 12 in Chapter 3. Estimated depths of bed scour are three to eight feet for most of the designated floodplains. The estimated depth at the Milk River is 22 feet due to a bed material of fine grain poorly graded sand with silt (median size of 0.2 mm). There is no evidence of bedrock in the Milk River valley, and no well or bridge data is available to estimate the depth of the alluvial material. Express plans a drilling program at the Milk River to determine the nature of the soil profile and further establish the potential scour.

Groundwater

The Express project would cross many groundwater aquifers that may be affected by pipeline construction and operation activities. In general, the potential for impacts on shallow aquifers is much greater than for impacts on deeper aquifers. Most groundwater systems that supply municipal uses are deep aquifers. Potential impacts on groundwater resources include groundwater contamination, temporary overdrafting of aquifers for hydrostatic testing, and alteration of subsurface flow patterns.

Shallow aquifers could experience minor impact from changes in overland water flow and recharge caused by clearing and grading of the proposed right-of-way. Enhanced water infiltration provided by a well-vegetated cover could be temporarily lost until successful revegetation has occurred. Near-surface soil compaction caused by heavy construction vehicles could also reduce the soil's ability to absorb water. This minor impact would not be expected to significantly affect groundwater resources.

In order to protect groundwater resources, which are vital for public and private supply systems, Express shall submit a groundwater monitoring plan prior to commencing construction that would identify community and private supply wells and springs located within 100 feet of the proposed pipeline. The plan would be required to document preconstruction and post-construction well- and spring-water quality and yields and would be of adequate detail to determine with relative certainty whether the pipeline construction activities had been responsible for any adverse impact on any groundwater user. In the unlikely event that groundwater supply systems are affected by the Express' activities, Express would provide for an emergency potable water source and for the necessary repairs, replacement, and/or relocation of the affected facilities to restore the supply system to its former capacity. The groundwater monitoring plan should provide protocols for determining how compensation would be provided to homeowners in the event damage does occur as a result of pipeline construction, including measures that would be taken if it were not technically possible to restore a well to its original capacity and not possible to install a new well.

Hydrostatic Testing

Pipeline integrity is verified by hydrostatic testing, which is conducted by pumping water into the installed pipe and checking for losses in pressure resulting from leakage. Large quantities of water are needed for testing. Express' 24-inch line would take approximately 1.25 million gallons for a 10-mile section. Diversion of such volumes from streams and rivers could adversely affect downstream users and aquatic organisms, primarily fish populations, if the diversion would constitute a large percentage of the source's total flow. Impact could include temporary disruption of surface-water supplies, loss of habitat, warming of water, depletion of dissolved oxygen levels, and interruption of spawning, depending on time of withdrawal and current downstream uses. However, the sources of water for testing generally contain large volumes, and withdrawal would be conducted at a rate that would minimize downstream impact. Additionally, Express has indicated that test waters would be reused from one test section to the next, when technically feasible, to limit water withdrawals. Discharge waters from testing may contain small amounts of oil residues left from the pipe bending and some welding residues.

Express would prepare detailed site-specific hydrostatic testing plans and procedures in their Plan of Development (POD) for the project. This POD would be submitted to the BLM and DNRC for final approval before construction would begin. Express has proposed that water withdrawal rates from approved sources would not exceed 10 percent of instantaneous flows. Water rights would be purchased from downstream or upstream users. If the 10 percent flow would affect a water right, then Express would propose to either lessen the withdrawal to an acceptable rate or obtain the water from other sources.

Withdrawals could be as high as an estimated 7 cfs and could affect the designated beneficial uses on many of these streams, especially if withdrawals were made in a dry or critically dry year. Proposed stream withdrawals that would constitute 10 percent or more of the monthly streamflow during the designated withdrawal period are considered to be a potentially significant impact on downstream beneficial uses.

Express proposes to withdraw water from the Milk, Missouri, Judith, and Yellowstone Rivers for hydrostatic testing in construction spreads one through three. Express would obtain temporary water use permits from the appropriate Water Resource Field Offices for these withdrawals. There would be no impact to the waters of the Missouri and Yellowstone since mean flows in the proposed construction period range exceed 1,800 cfs. Flows are considerably less in the Milk and Judith Rivers. Mean flow in the Milk reduces drastically from 532 cfs in August to 13 cfs in October (data is not available for November and December). Mean flows are similar in the Judith River, decreasing from 28 cfs in August to 6 cfs in December. Withdrawals of water from the Milk and Judith Rivers could have an impact if construction occurs during a dry year. Express would monitor flows from these streams and would withdraw water at a rate not greater than ten percent of the flow.

Withdrawal of water for construction spread four from the Shoshone and Bighorn Rivers in Wyoming would not have an impact since flows are at least 350 cfs in the Shoshone and 1,350 in the Bighorn. Mean flows in the Badwater and Middle Fork Creeks are unknown. Therefore, withdrawals from these creeks for testing in construction spread five could have an impact in a dry year.

If a suitable stream is not available for discharge of the test water, Express proposes to discharge the test water into upland vegetation areas. Express proposes to construct temporary above-ground dewatering lines to permit the disposal of test water into the upland vegetation areas using energy absorbing diffusers. The purpose of the dewatering lines would be to pump the test water from the pipe to a previously agreed upon discharge location. Energy absorbing diffusers would be used to regulate the flow and velocity of the discharge water to prevent erosion, scour and damage to vegetation. Suitable discharge locations would be determined that would permit test water to both evaporate and soak into the surrounding soil. Any disposal would be carried out in accordance with governing permits and/or landowner requirements.

Potential impacts that could result from discharge of hydrostatic test waters into streams and upland vegetated areas would be generally limited to erosion of soils and subsequent temporary degradation of water quality from increased turbidity and sedimentation. If the velocity of discharge water would be too high, erosion of the banks and bottom could result in a temporary release of sediment. A longer term impact could result from continued erosion of the discharge area after the proposed pipeline was in operation, if the discharge area were not properly stabilized.

Express would minimize these impacts by the use of energy dissipator devices, regulation of the discharge velocity, and regulation of the discharge location. In addition, Express would notify state water quality and fishery management agencies of the intent to use specific water resources prior to testing activities and obtain a National Pollutant Discharge Elimination System (NPDES) and other state-issued withdrawal and discharge permits. If surface waters are not available, recycled water from previously tested loops or trucked-in water from approved sources may be required.

Stream Crossings Timing Alternative

The State of Montana would require that the pipeline be installed across streams during low flow. Under the proposed action, construction could occur between July and October. Most rivers and streams within the project area reach their maximum flow in May and June. Flow then drops off substantially in July, August, and September. The MDEQ prefers that stream crossings would occur during the low flow period from August 1 to November 15.

Under this alternative, Express would construct, operate, and maintain the pipeline similarly to the proposed action. Express would be limited to crossing 22 perennial streams (shown in Table 8 in Chapter 3) in Montana during the low flow period during the summer and fall of 1996. Impacts from sedimentation would be reduced under this alternative because the volume of water would be less and the velocity would be slower. These flow conditions would produce less mechanical action of the water over the trench and reduce the amount and transport of sediment downstream.

In Montana, installation of the pipeline, culverts, bridges, or other structures, or other instream structures in or beneath perennial streams and other streams with known populations of fish species of special concern would be done following on-site inspections with the MDEQ, the MDFWP, Conservation District representatives, county and/or state floodplain coordinators, the landowner, and Express Pipeline personnel. During this on-site inspection, the timing of the crossing, method of crossing, and site-specific mitigating measures would be determined. No construction shall begin until this inspection is completed and Express Pipeline is notified of the results in writing.

Boring the Yellowstone River Alternative

This construction alternative considers the option of directionally drilling the Yellowstone River rather than open-cut trenching. Altamont conducted a study in 1992 to determine the feasibility of directionally drilling the Yellowstone. Because the Express pipeline would be installed adjacent to the Altamont pipeline, this study also can be applied to the proposed Express crossing. Results of the study, which is included as Appendix I of this document, are summarized below.

The cost to directionally drill would be significantly more than that for open-cut trenching. The cost for drilling, independently verified, was estimated as $5.8 million compared to $1.2 million for trenching. Construction risks involved with directional drilling are significant and experience has shown that the costs tend to increase for questionable, drillable crossings after drilling begins and problems are encountered. The risks involve with directional drilling include breaking drill bits when large cobbles are encountered, and collapse of the drilling shaft in the riverbed of course gravel overburden. Conversely, the construction risk associated with trenching are minimal.

A comparison with a similar project shows the problems that may be encountered with directionally drilling the Yellowstone. A 30-inch pipeline was installed across the Niagara River in November, 1991. The Niagara is 1,800 feet wide, 50 feet deep, and has a massive flow draining from Lake Erie. There are some similarities between the directional drilling conditions at the Niagara and the Yellowstone. The Niagara was a 30-inch pipeline, the crossing was approximately 3,000 feet, and in Queenstone shale bedrock with an average compressive strength of 3,000 to 4,000 psi. The Yellowstone crossing would be 24-inch pipeline, approximately 3,000 feet in length, and in Colorado shale bedrock with a compressive strength of 2,000 to 3,000 psi. The major difference between the two crossings was the much less flow and depth of water in the Yellowstone. Because of the depth of the Niagara, the open-cut trenching was not a viable option.

On the Niagara crossing, much experimentation occurred as several types of downhole drilling assemblies did not perform to expectations. Reamer cutter cones and bearings had to be constantly changed out as drilling operations progressed, even though the rock was considered to be very drillable before the project started. A reamer failed downhole and parts broke loose. Hundreds of thousands of dollars were spent retrieving the parts before drilling could continue. There were several times over the course of the job when the success of the crossing was in question. Enough new directional drilling knowledge and technology were not developed or proven on the Niagara River crossing to ensure the successful drilling of the Yellowstone River. The Niagara crossing took three months to complete.

The associated risk would necessitate that Express develop contingency schedules and plans because of the possibility of a failure or a prolonged installation period. In contrast, the time of open-cut trenching the Yellowstone can be scheduled and projected more accurately based on past experience. Perhaps more important, there would be no risk of failure associated with open cutting the Yellowstone River.

While directionally drilling the Yellowstone is not considered completely infeasible, the study concluded that open cut trenching could be used with very little impact for the following reasons:

- the riverbed is too cobbled which could potentially result in a collapse of the drill shaft using directional drilling;

- low flow (1,728 in August 1988, a dry year to 6,580 cfs in August 1984, a wet Year) in the construction period compared to over 23,000 cfs in July 1984;

- the substrate contains very few fines, which would result in very little increased sediments; and

- DNRC personnel witnessed the Montana Power Company pipeline river crossing at the Yellowstone, and very little visible sedimentation was noticed (Compton, pers. comm. 1995).

Operations Impacts Common to All Action Alternatives

During normal pipeline operation, there would be no impact to water quality. Any potential impacts to water resources would occur as a result oil spills. Potential impact to surface water quality would occur in the highly unlikely case of a leak or rupture of the pipeline near any rivers or streams. Impacts to groundwater could occur in the event of a major spill over an area where the water table is relatively high. The probability of an oil spill is analyzed in the Pipeline Safety and Reliability section later in this chapter. Based on historical liquids pipeline safety and performance records, one spill of over 50 barrels of crude oil may occur in the lifetime of the Express Pipeline. This impact would be significant. To minimize the potential impacts as a result of a pipeline rupture, Express would develop a Spill Prevention, Containment and Control Plan (SPCCP) before construction would begin.

Surface Water

An oil spill in or near major rivers or streams would have a significant impact to water quality. The degree of impact would be the greatest during low flow periods. Oil spilled into the rivers and streams would be more concentrated in a smaller area downstream from the location of the spill. Water would be contaminated from the hydrocarbon content and result in significant effects to fish, riparian vegetation, and terrestrial wildlife whose habitat would be adjacent to water. If a spill would occur during periods of high flow, the contamination would spread to greater distances, but the concentration of hydrocarbons in the water would be less at any given downstream location.

Impacts resulting from an oil spill would be lessened by Express' measures contained in the SPCCP, which would be developed and approved before construction would begin. The measures which would be included in the SPCCP are discussed in the Hazardous Materials section later in this chapter. The SPCCP would contain measures to lessen the probability of a significant spill, and to rapidly respond to a spill to begin clean-up and remediation actions. Measures to be included in the SPCCP are listed in the Pipeline Safety and Reliability section later in this chapter. Additionally, the potential impacts to wildlife, fish, and vegetation are discussed in the respective sections of this chapter.

Groundwater

In the event of an oil spill over an area with a relatively high water table, hydrocarbons could seep into the groundwater. Contamination could occur over a small area if clean-up and remediation actions did not rapidly occur. Impacts to the groundwater could be minimized by a rapid determination of the volume of oil spilled, depth of seepage, direction of the groundwater flow, and subsequent remediation action to clean the contaminated groundwater and soil. These specific identification, clean-up, and remediation measures would be included in Express' SPCCP, which would be completed and approved before construction would begin.

AIR QUALITY

Emissions resulting from the Express Pipeline would be caused from construction activities and operation of the electric pump stations.

Criteria for Determining Significant Impacts

Emissions from the construction and operation of the Express Pipeline would be significant if they were in excess of permitted ambient air levels as regulated by the States of Montana and Wyoming. Particularly, volatile organic compounds (VOC) emissions would be significant if they exceeded 25 tons per year from evaporation of spilled crude oil at pump stations or valves.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to air quality, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

If other alternative pipelines could not supply a sufficient amount of crude oil to the Rocky Mountain region, some refineries in Wyoming, Colorado or Utah may be forced to close. A resultant small improvement in the local air quality in the vicinity of these refineries would occur.

Impacts Common to All Action Alternatives

Construction of the Express Pipeline would cause temporary reductions in local ambient air quality as a result of fugitive dust and emissions generated by construction equipment. The extent of dust generation would depend on the level of construction activity and the soil composition and moisture content. Construction is anticipated to proceed at an average of 1.5 to 2.0 miles per day. As a result, dust and equipment emissions would be generated in short time and length segments as the construction proceeds down the pipeline route. Therefore, the construction impacts to the local ambient air quality would be very short term at any one location.

There would be no direct ambient air emissions from the electric motors at each of the five pump stations and the shutoff valves along the route. However, fugitive VOC emissions would be attributable to the evaporation of leaked crude oil from valves, flanges, and pump seals. Normally, control of these fugitive VOC emissions involves minimizing leaks and spills through equipment changes, procedure changes, and monitoring housekeeping, and maintenance procedures.

VOC emissions would result from the evaporation of light ends from crude oil leaks at flange sets, valve stem seals, and pump seals. There would also be emissions from sump tank vents. For a fully-powered (i.e., three pumps per station) pump station with trap facilities, the quantity of potential leakage sources are as follows:

- 50 large bore (greater than 16 inches) flange sets
- 12 large bore valve stem seals
- 6 mainline pump seals
- 40 small bore (less than 4 inches) valve stem seals
- 20 small bore valve stem seals, and
- 1 sump tank vent with an approximate 4 inch diameter.

Based on Appendix E, Table E-1, of American Petroleum Institute Publication 4322, Fugitive Hydrocarbon Emissions from Petroleum Production operations, July 1980, the total VOC emissions for each pump station would be 0.182 pounds per day, or 66.4 pounds per year. These annual emissions would be well below the 25 tons per year limit that the States of Montana and Wyoming Air Quality Divisions consider significant enough to require an air emissions permit. Emissions from valves along the pipeline route would be much less than the total VOC emissions per station noted above. Accordingly, the proposed project and alternatives would have no impact on air quality.

NOISE

Discussions of noise do not focus on pure tones. Commonly heard sounds have complex frequency and pressure characteristics. Accordingly, sound measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, A-Weighted correction factors are employed. The filter de-emphasizes the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good correlation to a human's subjective reaction to instantaneous noise.

A continuous noise source is described using the L_{dn} noise scale. The L_{dn} is the average 24-hour average day-night noise obtained after adding 10 dBA between the hours of 10:00 PM and 7:00 AM. Averaging over the 24-hour period for a continuous noise source, 6.3 dBA is added to the source noise. The extra 6.3 dBA accounts for the generally lower background noise during the nighttime hours which may cause noise to be more noticeable to the human ear.

The following discussion sets a basis of familiarity with known and common noise levels. A quiet whisper at five feet is 20 dBA; a rural area is approximately 30-35 dBA; a residential area at night is 40 dBA; a residential area during the day is 55 dBA; a large and busy department store is 60 dBA; a construction site is 80-85 dBA; and a jet takeoff at 200 feet is 120 dBA.

Criteria for Determining Significant Impacts

Project noise would be a significant impact if it violated any existing state laws, or if it was significantly above the existing ambient background noise levels.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to air quality, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

The proposed action would produce short term impacts on the local noise environment both during the construction phase of the Express Pipeline. Pipeline construction would proceed at rates from several hundred feet up to two miles per day. Construction activities would occur progressively down the right-of-way, with the open trench phase of the construction in rural areas lasting approximately two to three months. Construction equipment would be operated on a random, as needed basis during this period. Although individuals in the immediate vicinity of the work could experience temporary annoyance, the duration of the impact on the noise environment at any specific location would be less than one week. Nighttime noise levels normally would be unaffected, since most construction would be limited to daylight hours. When construction would be complete, these noise impacts would cease.

During the operational phase of the Express Pipeline, the impact on the noise environment would be limited to the vicinity of the electric pump stations. Initially, two electric motors and pumps would be installed to drive the pumps. At the fifth station, three motors would be installed. The electric motors would be enclosed in buildings at each site. Potentially, three pumps could be installed at the other stations in the future.

The source noise of each electric motor is 85 decibels (dBA), measured ten feet from the motors. The noise effect of co-located noise sources is not arithmetically additive, but rather is a logarithmic addition. Accordingly, the noise source level of two identical motors operating simultaneously would be 88 dBA, and the noise level of three would be 90 dBA.

To assess the impact of the electric pump stations, the noise levels were calculated at various distances using the Inverse Square Law of Noise Propagation (Ortholano, 1984). Briefly, this formulation states that noise decreases by approximately 6 dBA with every doubling of the distance from the source. This methodology is an accurate assessment of noise propagation and is represented as:

$$L2 = L1 - 20 \log (R2/R1)$$

where:

L2 = noise level at a selected distance R2 from the source
L1 = noise level measured at a distance R1 from the source.
L_{dn} = L2 + 6.3

The closest residence to any of the proposed pump stations is 3,000 feet from the proposed pump station number 7 near Edgar MT at MP 266. Noise levels at this residence would be 40 dBA L_{dn} if three motors were installed, and 38 dBA L_{dn} if there were only two motors. These levels assume no noise attenuation as a result of the buildings housing the motors. These buildings would probably decrease noise levels by 10 dBA. As a result, the noise at the nearest residence would be about 30 dBA L_{dn}. All other residences are at least 4,000 feet from the proposed pump stations, and noise levels would be below 30 dBA L_{dn}. Since the general noise levels are 35-40 dBA along the proposed Express Pipeline route, noise from the pump stations would barely be noticeable above the ambient background levels. Therefore, there would be no noise impacts resulting from the proposed Express Pipeline operation or alternatives.

VEGETATION

Potential impact on vegetation resources would result from construction and operation of the Express Pipeline, as well as from increased access along the right-of-way following construction. Construction-associated impacts include the removal of vegetation during construction, which would be offset by the potential to successfully revegetate the disturbed areas after construction is complete. Operational impacts could occur due to vegetation management practices along the right-of-way, from periodic surveys of the pipeline, and from the operation of the electric pump stations. In addition, removing vegetation along the right-of-way may increase vehicle access along the right-of-way and increase disturbance of vegetation that occur along the the right-of-way.

Criteria for Determining Significant Impacts

Impacts on general vegetation types (excluding special native plant communities) were considered significant if a substantial portion of a vegetation type within a local region would be disturbed and regeneration would not restore the vegetation to its pre-project plant and wildlife habitat value during the life of the project. Defining "substantial" in a general case is impossible; the determination of what is substantial was based on literature reviews and professional judgment for each vegetation type.

Impacts were also considered significant if they would substantially alter portions of biological communities that are especially diverse, regionally uncommon, or of special concern to federal or state agencies. These communities include riparian communities, wetlands, and communities of special concern listed by BLM. The BLM's and MDEQ's determination of substantial impacts was based on literature reviews, discussions with local experts, field surveys, and professional judgment.

Three federal laws direct weed control on federal lands: the Carlson-Foley Act of 1968, the federal Noxious Weed Act of 1974, and the Conservation Reserve Program Act (Farm Bill) of 1990, Section 15. BLM supports a policy of controlling noxious weeds on BLM land. In addition, Montana and Wyoming have state and local weed control laws (see discussions for each state in Chapter III). Construction activities that would lead to the expanded range of existing weed species or the introduction of new weed species were considered significant impacts.

Method of Analysis

Vegetation. Estimates of total area to be removed of each vegetation type were calculated as the linear extent of vegetation that would be crossed, multiplied by the construction right-of-way width. The construction right-of-way width would be 90 feet, except at major river crossings. It was assumed that all vegetation in the construction right-of-way would be removed for the purpose of analysis. However, in many locations, it would be possible to leave the root systems in place using mechanical brush beaters or other techniques.

Wetlands and Riparian Habitat. Impact areas for wetland and riparian vegetation were estimated as the linear extent that would be crossed, multiplied by the construction right-of-way width. The same right-of-way width assumptions were made as described above under "Vegetation," except at major river crossings. The Missouri River would be directionally drilled and would require no clearing of riparian vegetation. It would, however, require extra workspace away from the banks on both sides of the river to accommodate the drilling equipment.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to air vegetation, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

General Vegetation

In Montana, eastern ponderosa pine forest, grama needlegrass-wheatgrass association, foothills prairie, and saltbush-greasewood shrub would be removed for the project. Approximately 2,416 acres of cropland would be disturbed by the project in Montana. In Wyoming, construction of the proposed project would require removal of mixed-coniferous forest, sagebrush-steppe, wheatgrass-needlegrass shrub-steppe, and saltbrush-greasewood shrub, and disturbance of approximately 248 acres of cropland. These vegetation types are widespread and abundant in Montana and Wyoming; therefore, impacts would be minor and short-term until revegetation is complete.

The primary impact on vegetation during construction and routine maintenance of the proposed project would be the temporary and permanent alteration of vegetative cover. Impact on non-forest vegetation should be relatively short-term in most areas, although some areas with poor reclamation potential exist (see the Soils section earlier in this chapter). Non-forested wetlands should return to preconstruction condition in one or two growing seasons. Construction through agricultural land, in most cases, would result in the loss of only one growing season. Abandoned agricultural land in early successional stages would also revert back to preconstruction conditions in a relatively short time (one to three growing seasons).

Noxious Weeds

Noxious weeds spread rapidly, outcompete most native species, and often become established on disturbed sites. Construction of the Express Pipeline project has the potential to transport, establish, or expand populations of noxious weeds. Montana and Wyoming have laws which state that it is unlawful to allow noxious weeds to propagate or go to seed. Without a stringent plan to mitigate the establishment and/or transportation of noxious weeds, this would be a significant impact.

Express's committed mitigation plan would reduce the impact of noxious weeds. The complete plan is listed in Appendix B, Preliminary Rehabilitation Plan. The main points of the mitigation plan are summarized below.

Contractors would be required to have equipment arrive at the sites in a clean condition, free of weeds, and readily available for inspection by the environmental inspector. During and following construction of the pipeline, areas disturbed on the Right-of-way or along access roads would be monitored by construction and reclamation contractors, under the supervision of an environmental inspector, for the presence of noxious weed infestations. Treating initial invasions of noxious weeds before they would become established and produce seeds would be the highest priority in noxious weed management. Specific weed control measures would be implemented for segments of the right-of-way where noxious weeds are detected. Specifically, the BLM

Lewistown Resource Area has requested that scraping be conducted when the right-of-way is cleared in the Arrow Creek area near MP 112. Herbicides would be used to selectively kill broadleaf species. These herbicides generally would not kill grasses if applied at rates recommended in Appendix B.

After early detection and control of potential noxious weeds, rapid revegetation would be a high priority in rehabilitation to reduce the potential for noxious weed invasions. Drill seeding would help ensure prompt regrowth of desirable plant species to reduce the potential for proliferation of noxious weeds. Drill seeding is effective in promoting vigorous strands of grasses which can effectively compete with noxious weeds for growing space, nutrients, and soil moisture.

Wetlands

Construction of the project would cross approximately 30.2 acres of wetland and 15.6 acres of riparian vegetation in Montana (Table 17). Of the wetlands encountered along the route, 89.5 percent would be deciduous shrub or saline/sodic wet meadows. The largest areas of saline/sodic wet meadows that would be disturbed are 8.2 acres in the Flat Creek floodplain (MP 96-99). Construction of the project would impact approximately 7.1 acres of wetland and 53.2 acres of riparian vegetation in Wyoming. Impact on riparian vegetation would be long term.

Construction of the project would require removal of riparian shrub and forest vegetation. In Wyoming, the largest patches of riparian forest would be removed along the Shoshone, Greybull, and Bighorn Rivers. In Montana, the most extensive areas of riparian forest that would be removed occur at the Yellowstone River (4.5 acres) and Clarks Fork of the Yellowstone River (1.9 acres). Although impact on portions of this riparian shrub and forest would be long-term, Express' proposed mitigation measures listed below would prevent these impacts from being significant.

The primary impact on wetlands as a result of the construction and operation of the pipeline would be the temporary and potential long-term alteration of wetland vegetation. Additional impact could include temporary changes to wetland hydrology, water quality, aesthetic values, and the quality of wildlife habitat. Pipeline construction would not significantly alter any wetlands since wetlands would not be filled or drained. Therefore, no wetland "loss" would occur. Express would utilize wetlands construction procedures that would ensure that impact on wetland areas would be of a short-term nature, and that long-term impact would be restricted to the alteration of vegetation on the right-of-way.

Several additional effects could result from the clearing of the right-of-way through wetlands. Soil compaction and rutting may result from the temporary stockpiling of soil and the movement of heavy machinery. Surface drainage patterns and hydrology may be temporarily altered, and there would be increased potential for the trench to act as a drainage channel. Increased siltation and turbidity may result from trenching activities. Trenching could remove an impervious soil layer and consequently drain a perched water table. This would result in drying soil conditions which could slow the reestablishment of wetland vegetation. Erosion and flood control capabilities of affected wetlands could be altered.

The clearing of wetland vegetation could result in the temporary loss and alteration of wildlife habitat. A temporary displacement of wildlife or loss of some individuals could also result from construction activities. Impact on the aesthetic or recreational value of wetlands would be relatively short-term where the proposed pipeline would pass through wetlands dominated by herbaceous vegetation. The impact may last longer in soils associated with saline wetlands having a poor or poor-to-fair rehabilitation potential. Aesthetic effects would also occur during the period of construction to initial revegetation.

The Express Pipeline would be constructed under the Nationwide Section 404 Permit Program. In the event that individual Section 404 Permits are required for specific stream crossings, a Section 404(b)(1) guidelines analysis would be conducted by the Corps of Engineers (COE) to ensure that the discharge of dredged and fill materials would be minimized and that all practical construction alternatives have been identified and utilized to reduce impact on wetland resources. The COE has indicated that Yellowstone River crossing would require an individual 404(b)(1) analysis. A draft of the 404(b)(1) Evaluation for the Yellowstone River crossing and the Missouri River crossing, if directional drilling techniques fail, is included as Appendix K to this document. These guidelines require that dredged or fill materials would not result in violations of state water quality or toxic effluent standards; nor jeopardize the existence of species listed as endangered or threatened under the Endangered Species Act of 1973; nor cause significant degradation to waters of the United States (as demonstrated by chemical testing); nor result in significantly adverse individual or cumulative effects on human health or welfare, aquatic life or wildlife dependent on aquatic ecosystems, or on recreation, aesthetic, and economic values. As a result of the COE analysis, additional conditions could be imposed on the applicants in the proposed crossings of wetlands.

Wetlands Mitigation Measures

The pipeline has been routed to avoid wetland/riparian areas to the maximum extent practicable. Where these areas could not be avoided or crossed by following an existing right-of-way, the pipeline has been routed in a manner that minimizes disturbance to wetland/riparian areas.

The width of construction right-of-way will be reduced to less than 75 feet unless site conditions require additional width. Areas where additional construction width is necessary will be detailed on site-specific plans and submitted to appropriate agencies for approval prior to construction.

Vegetation will be cut off at ground level leaving existing root systems intact, and any larger woody vegetation will be removed from the wetland for disposal.

Pulling of tree stumps and grading activities will be limited to directly over the trench. Stumps or root systems will not be removed from the rest of the right-of-way in wetlands, unless in the judgment of the Environmental Inspector, safety-related construction constraints require removal of tree stumps from under the workpad. Where tree stumps are removed from under the workpad area, Express will specifically identify the areas where the pulling of tree stumps is required and will develop and implement a detailed plan to actively reestablish native woody vegetation in these areas. This plan will be submitted to appropriate agencies prior to construction.

The top one foot of topsoil will be segregated from the area disturbed by trenching, except in areas with standing water or saturated soils.

To the extent possible, construction equipment operating in wetlands will be limited to that needed to dig trench, install pipe, backfill trench and restore the right-of-way.

Dirt, rockfill, tree stumps or brush riprap will not be used to stabilize the right-of-way. In some areas, brush may be used as a filter window for sediment control. The sites will be specified in the final POD.

Wide-track or balloon-tire construction equipment will be used, or normal equipment will be operated off of timber pads, prefabricated equipment pads, or geotextile fabric overlain with gravel fill, if standing water or saturated soils are present.

Trees located outside the right-of-way will not be cut to obtain timber for equipment pads, and no more than two layers of timber or equipment pads will be utilized to stabilize the right-of-way.

All timber pads, prefabricated equipment pads and geotextile fabric overlain with gravel fill will be removed upon completion of construction.

The pipeline will be assembled in upland area and the "push-pull" or "float" technique will be used to place pipe in the trench whenever water and other site conditions allow.

It is currently anticipated that three wetland/riparian crossing methods will be used depending on site conditions and construction scheduling. The methods are:

Method 1: This method will be employed where the soil is dry and firm enough at the time of construction to support heavy equipment, generally during late summer and early fall when the water table is low.

Method 2: This procedure will be instituted when soil moisture at the time of construction is sufficient to prevent effective use of standard upland construction procedures. The general sequence for standard construction will still apply, but some steps will be modified to reduce construction impacts to wetland/riparian areas.

Method 3: This method will address procedures applicable to push/pull construction where water is sufficient to float the pipeline in the trench.

Specific procedures for each method (including any variations from the general mitigation measures listed previously) and the locations where each method would be used will be prepared during final design.

TERRESTRIAL WILDLIFE

Potential impact on the wildlife resource would result from construction and operation of the proposed Express Pipeline, as well as from increased access along the right-of-way following construction. Construction-associated impacts include the removal of habitat and disturbance of wildlife during construction, and the potential mortality of wildlife from construction. Operational impacts on wildlife may occur due to habitat disturbance along the right-of-way, the presence of new structures in important habitat areas, routine maintenance activities along the pipeline, and from the operation of the pump stations. In addition, vehicle access along the right-of-way may increase disturbance to wildlife within the right-of-way.

Criteria for Determining Significant Impact

Impacts on wildlife were considered significant if any of the following criteria were met:

- direct mortality of threatened and endangered species;
- permanent loss of existing or potential habitat;
- temporary loss of habitat that may result in increased mortality or lowered reproductive success; or
- avoidance by wildlife of biologically important habitat for substantial periods that may increase mortality or cause lowered reproductive success.

Resource recovery time was considered in the determination of significant impacts. Wildlife resources require temporary, short, or long periods to recover from adverse impacts. Impacts were considered temporary if wildlife would recover from impacts during or immediately after construction. If wildlife would recover from impacts within three years after construction, impacts were considered short-term. If recovery from impacts would not occur within three years after construction, impacts were considered long-term. Permanent impacts, from which the resource would never recover, were considered long-term impacts.

Impacts were also considered significant if they would substantially alter portions of biological communities that are especially diverse, regionally uncommon, or of special concern to federal or state agencies. These communities include riparian communities, wetlands, and communities of special concern listed by BLM. The BLM's and MDEQ's determination of substantial impacts was based on literature reviews, discussions with local experts, field surveys, and professional judgment.

Impacts on wildlife species, due to construction and operation of the proposed project, would largely result from temporary and permanent alteration of habitats. The impact on individuals would include disturbance, displacement, and direct mortality. During construction, the more mobile species would be temporarily displaced from the right-of-way and surrounding areas. Wildlife displaced from the construction right-of-way should return to adjacent, undisturbed habitats soon after construction is completed. Less mobile species, primarily small mammals, reptiles, amphibians, and nesting birds located in the proposed right-of-way would be more directly affected by pipeline construction. Regardless of mobility, some individuals would suffer loss of cover, nesting, and foraging habitat. However, through vegetation reclamation measures, habitats would be returned to preconstruction conditions over the long-term.

After construction, the most significant impact on wildlife would result from the long-term or permanent alteration of vegetative cover types. The cover types most altered by the proposed construction and maintenance would include riparian areas and wetlands vegetated with woody cover. The wildlife species that would be most directly affected by the clearing of riparian areas would be those interior species that require large tracts of unfragmented habitat to ensure breeding and nesting success. However, through vegetation reclamation measures, habitats would be returned to preconstruction conditions over the long-term.

Nonforested habitats that would be affected by construction and operation of the proposed project include nonforested wetlands, agricultural land, and mixed grass prairie. Impact on these habitat types, and associated wildlife species, would be relatively minor and short-term. However, shrub community regrowth would likely take up to five years. While the overall impact would be minor, the effects on deer and upland game habitat would be long-term until regrowth is complete.

Express would use techniques for construction through nonforested wetlands that would allow emergent wetlands vegetation to recover within one or two growing seasons following construction. The construction techniques and mitigation measures to reduce the impacts on wetlands are described in Appendix B, the Preliminary Rehabilitation Plan.

Agricultural, mixed grass prairie and shrub-scrub habitats on the right-of-way would also recover within one or two growing seasons following pipeline construction. The temporary alterations to these habitats would generally not be expected to have significant impact on wildlife species over the long-term.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to wildlife, although at different locations and timeframes and different species, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Big Game Species

The Express project would disturb vegetation on approximately 87 acres of mule deer winter range within Montana. Within Wyoming, the project would disturb approximately 77 acres of winter range, all of which is designated Crucial Year Round Winter Range. Crucial Year Round Winter Range is defined as an area where a population or portion of a population uses the suitable habitat sites within this range in substantial numbers only during the winter. The dates vary, but the commonly defined period is December 1 to April 30. Surface disturbance is not permitted from November 1 through April 30 for identified antelope and mule deer crucial winter range.

Disturbance of these ranges is unlikely to cause any perceivable adverse effects to mule deer. The disturbance would be short term because the disturbance would be reclaimed and seeded upon completion of construction. In areas where winter range vegetation would be removed, a seed mix that includes forbs and shrubs would be used in addition to the native grasses. Furthermore, construction through these ranges would occur during the summer and early fall, rather than the more critical winter period.

Because the construction is planned from July to October, direct mortality or disturbance would not occur on mule deer winter ranges . If the construction would occur between November and April, construction activities may disturb mule deer, resulting in avoidance of areas, but the disturbance would be temporary. Therefore, these impacts would be significant in the short-term only if construction occurred during the winter.

Construction of the pipeline in early summer could disturb mule deer during fawning. This impact is not expected to be significant because the disturbance would be temporary based on the following considerations. First, no known fawning areas have been identified along the route. Second, the proposed project would be constructed between July and October, after the fawning season.

Because of the proposed construction schedule, the proposed Express pipeline would minimally disturb approximately 169 acres of pronghorn antelope winter range within Montana. In Wyoming the project would minimally disturb approximately 67 acres, all of which is designated Crucial Year Round Winter Range. The impacts to the pronghorn antelope would be similar to those described previously for mule deer winter range.

Construction of the pipeline is not expected to adversely affect any pronghorn antelope parturition areas. The route does not cross thrcugh parturition areas. The closest parturition area is within 0.25 to 0.5 miles between MP 353 and 355. Moreover, construction would occur between July and October, a period past the time when pronghorn antelope are giving birth.

Construction activities would impact approximately 13 acres of winter range for white-tailed deer. The effects of these activities are similar to those described previously for mule deer range. Therefore, these impacts are not expected to be significant over the long-term.

Sage Grouse

During the breeding, nesting, and rearing season, proposed project activities could disturb sage grouse nesting habitat. These impacts are not significant because sage grouse are not abundant along the pipeline route (Fanner, personal communication 1993).

The proposed right-of-way for the pipeline may cross five sage grouse leks in Wyoming. These leks are near MPs 401, 417, 426, 428 and 432 (see Appendix E and Map 6 in Appendix J). Furthermore, 11 other leks were identified within ½ mile of the proposed route between MPs 395 and 427. Disturbance of these leks could cause the birds to abandon the sites. Unless suitable alternative sites for these leks exist, these breeding populations may disappear. To minimize adversely affecting the five leks, Express would route the pipeline around these leks.

In Montana, the proposed project would disturb approximately 412 acres of potential sage grouse habitat. However, only one sage grouse lek has been identified within 0.5 miles of the right-of-way at approximately MP 275. These impacts are not significant because the impacts would be temporary and the amount of habitat disturbed would be small in relation to the amount of habitat available. In addition, the project would be constructed outside of the breeding season. Therefore, impacts would not be substantial in the long-term.

In Wyoming, approximately 61 acres of sage grouse breeding and nesting habitat would be disturbed by construction. Although the potential habitat for sage grouse is considerably less in Montana, 16 leks have been identified within 0.5 miles of the right-of-way. WGFD and BLM policy prohibits disturbance of leks between March 15 and May 31. Removal of vegetation would result in a loss of cover and forage. These impacts are not significant because the loss of habitat would not be long-term and the amount of habitat lost would be minimal compared to available habitat. Also, the project would be constructed from July through October, outside of the breeding season.

In Montana the proposed project would disturb approximately 666 acres of potential habitat for sharp-tailed grouse. The effects of construction would be similar to those described previously for sage grouse. Therefore, the impacts would not be significant over the long-term.

Raptor Nests

Express has surveyed the proposed route for raptor nests. A total of 93 nests were identified (33 in Montana and 60 in Wyoming) within 0.5 miles of the proposed pipeline route. Of the 60 nests in Wyoming, five are on the proposed right-of-way. Construction activities within the prime nesting period (February 1 through July 31) would have an impact to raptor breeding and nestling activities, and possibly result in either the raptors avoiding these nests or an increased fledgling mortality rate. However, by the planned construction in July, the raptors would have a lot of time invested in their young and are less apt to abandon their nests. Some of the chicks would have fledged by July. Because the planned construction period is July through October, the construction activities during July could have an impact on raptors in the early stages of construction during July.

The entire pipeline route would be re-surveyed for raptor nests in spring of 1996. If active raptor nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests of threatened, endanger or sensitive species. The work plan would be modified to avoid the active nests of other species until chicks have fledged. The average dates of fledging of all species is shown on Table 29.

Table 29
Average Raptor Species Fledging Dates in Montana and Wyoming.

Species	Category	Montana Average Fledging Dates	Wyoming Average Fledging Dates
Bald eagle	Endangered	June 15 - August 15	June 26 - July 6
Peregrine falcon	Endangered	July 15-30	June 1-26
Ferruginous hawk	C2	July 1-15	June 4 - July 2
Northern goshawk	C2	Unknown Estimated July 1-15	August 11-27
Burrowing owl	C2	90% by August 5	July 3-10
Golden eagle	None	June 20 - July 15	June 7-21
Red-tailed hawk	None	July 1-15	May 16 - July 1
Swainson's hawk	None	August 1-15	July 16-26
Northern harrier	None	July 1-15	June 17-26
Prairie falcon	None	July 1-20	July 2-15
Great horned owl	None	May 1-15	March 31 - June 17
American kestrel	None	June 20-July 7	June 28 - July 28

Waterfowl

In Montana, waterfowl in riparian areas and wetlands would be disturbed during construction, resulting in avoidance of these areas. The impact is not significant because no important waterfowl nesting areas have been identified within the pipeline route. Only small, local groups of waterfowl may be potentially affected during the construction period. Therefore, the impacts to waterfowl are expected to be short-term.

In Wyoming, the proposed pipeline route would not cross any waterfowl refuges. Waterfowl that are present in riparian areas and wetlands would be disturbed during construction. This is not significant due to the lack of important nesting habitat in this area. Only small, local groups of waterfowl would be potentially affected during the construction period.

Operational Impacts

In addition to construction impacts, the potential for oil spills does exist after the pipeline is completed. In the event of a pipeline rupture there is a potential for terrestrial wildlife species to come in contact with oil products. Although the potential for this to occur is minor, there have been reports of oil contamination on terrestrial wildlife species.

In March 1980, a crude oil pipeline ruptured near Glenrock, Wyoming releasing approximately 8552 barrels of crude oil into the North Platte River (Long n.d.). Containment of the spill was achieved in approximately twelve days. However, in this time period 355 birds and 33 mammals were either found dead or died during rehabilitation. However, 883 individuals were observed oiled and alive, but were not captured for rehabilitation (Long n.d.).

Species impacted included furbearers, small mammals, songbirds, raptors, shorebirds, and ducks. Overall, it was observed that the spill had little long-term impacts on nonfish-eating or nonraptorial birds. In addition, Canada goose production was not significant between oiled and nonoiled stretches of the river. Also, general bird observations did not show any differences 4 to 16 months after the spill. Small mammal populations within riparian zones exhibited no differences before or after the spill. However, there was a decrease in muskrat populations in the area of the spill. Raptors did not show any significant difference in densities between the two sections of the river after the spill (Long, no date).

The 1980 study indicated that while the impacts were significant in the short-term, the system was resilient and recovered quickly after the spill was contained and cleaned-up (Long 1980). The short-term impacts to mammals was significant within the spill area. However, in general the oil spill did not have a long-term impact on the wildlife resource. Therefore, a potential spill from the Express pipeline may result in a short-term impact, but the long-term impacts are not expected to be significant if the spill is contained quickly.

Wildlife Timing Restriction Alternative

This alternative was developed in response to concerns of the Wyoming Fish and Game Department. The Express project would disturb 87 acres of mule deer winter range within Montana. Within Wyoming, the project would disturb approximately 77 acres of winter range, all of which is designated Crucial Year Round Winter Range. While this acreage represents a small portion of the winter ranges, construction during the winter would impact mule deer and pronghorn antelope habitat and forage during their most vulnerable time of year. However, construction is planned for July to October. If construction is delayed, the WGFD would prefer to see no construction in these winter range areas from November 15 to April 30. A prohibition of construction during this period could impact the Express construction schedule. Express may either have to employ special crews, or divert construction workers and equipment from scheduled construction spreads, to lay the pipeline in the winter range areas before November 15. However, this alternative would ensure that there would be no impact to the wintering mule deer.

The survey for raptor nests along the proposed route found a total of 93 nests (33 in Montana and 60 in Wyoming) within 0.5 miles of the proposed pipeline route. Construction activities within the prime nesting period (February 1 through July 31) would have an impact to raptor breeding and nesting activities, and possibly result in either the raptors avoiding these nests or an increased fledgling mortality rate. Because construction is planned to begin in July, there could be an impact to raptors under this alternative. The entire pipeline route would be re-surveyed for raptor nests in spring of 1996. If active raptor nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests of threatened, endanger or sensitive species. The work plan would be modified to avoid the active nests of other species until chicks have fledged. The average dates of fledging of all species is shown on Table 29.

FISHERIES

Potential impact on fish habitat and populations ranges from physical or chemical changes in water quality to degradation and loss of physical habitat. Impacts were judged to be significant based on the criteria discussed below. Three categories of impact duration were considered: temporary, short term, and long term. Temporary impacts occur only during the construction period (e.g., turbidity from in-channel excavation). Short-term impacts last from the time construction ceases to three years following construction (e.g., loss of vegetation in the construction right-of-way). Long-term impacts last longer than three years following construction (e.g., permanent loss of riparian vegetation along the width of the operational right-of-way).

Criteria for Determining Significant Impacts

Adverse impacts on individuals of game fish species were considered significant if any of the following criteria were met:

- direct mortality;
- long-term loss of existing habitat;

- temporary or short-term loss of habitat that may result in increased mortality or lowered reproductive success; or

- avoidance by fish of biologically important habitat for substantial periods of time, which may increase mortality or lower reproductive success.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to wildlife, although at different locations and timeframes and different species, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Impact on fishery resources, such as sedimentation and turbidity, disturbance during spawning periods, acoustic shock, loss of stream cover, introduction of water pollutants, or entrainment of fish, could result from construction activities. Federal, state, and local land management agencies may require the applicants to follow more stringent procedures and to prepare site-specific stream- and river-crossing plans. No activities that violate existing state or federal water permitting standards would be allowed.

Sediment and Turbidity

Increased sedimentation and turbidity from construction would have the greatest potential to adversely affect fishery resources. Construction across major rivers (100 feet wide or greater) would typically last one to two weeks, major stream (10 to 100 feet wide, average depth greater than two feet) construction would last about two to six days depending on whether blasting would be required, and minor stream (width less than 10 feet, average depth less than two feet) construction would be complete in one to two days. The width of each perennial river and stream crossed by the pipeline is listed in Tables 8 and 12 in Chapter 3. Express' river and stream construction techniques and mitigation measures (Appendix B) would reduce the quantity of sediments being deposited in to the rivers and streams. The construction times described above reflect the total time from equipment set-up to backfilling the trench and clean-up. The actual time "in the water" would be less in most circumstances.

Increased turbidity from construction activities would typically cease within 24 hours after construction is complete. In low flow rivers and streams, downstream sedimentation would be slightly elevated until the high flows of the next spring. Therefore, these impacts would be temporary in nature.

Disturbance During Spawning Periods

If the stream crossing area contains spawning habitat, instream construction would directly disturb the substrate for a maximum width of 90 feet, except at major crossings where this width could increase to a maximum of 140 feet. Spawning areas directly downstream of these proposed crossing sites could receive increased fines in the substrate. Much of these fines would be washed away during subsequent high flows unless drought conditions exist. Therefore, impacts to spawning habitats could be short term and could have an impact on one season's spawning success.

Spawning habitat for brown trout is known to exist in the following Montana rivers and streams: Judith River, Ross Fork, Musselshell River, Valley Creek, Yellowstone River, Rock Creek, the North and South Fork of Bluewater Creek, and the Clarks Fork of the Yellowstone River. The prime brown trout spawning period is during October. Brown trout deposit their eggs in active redds, hollows in cobbles on the river bed. A large increase in sediment could fill these hollows and decrease the spawning areas. Activities during the period of October through December could cover and suffocate the newly laid eggs. This could be an impact on the reproductive rate since the brown trout eggs do not hatch until spring. However, there would be no impact if construction would be completed before October 1.

During the process to determine the proper stream crossing techniques, the nine rivers and streams listed as having potential habitat for brown trout spawning would be surveyed. Particularly, the proposed crossing and downsteam areas would be surveyed for active redds. If active redds are located at the crossing or just downstream, the personnel involved in the process (described in Chapter 2) would probably recommend either a different crossing or to construct before October. The application of these mitigation measures would significantly reduce the potential impact on brown trout spawning habitat.

Implementation of the project at the Bighorn River crossing in Wyoming would result in suspension and deposition of fine sediments during the period of construction. This could have a potential short-term impact on critical channel catfish and sauger spawning habitat downstream of the crossing. The WGFD is planning to introduce young, or fry, shovel-nosed sturgeon into the Bighorn, Greybull, and Norwood Rivers, and Shell Creek starting in the spring of 1996 (WFGB 1995). The introduction is planned to be complete by mid-July, 1996. Generally, these fry immediately begin to drift downstream. All of the fry are expected to be downstream of the Greybull River by mid-July. Express' proposed crossing of the Greybull, Bighorn and Nowater Rivers may affect the shovel-nose sturgeon fry if construction is conducted before July 15. In all likelihood, construction would occur after July 15 because the flow in these rivers decreases substantially by August.

Some stream crossings such as the Yellowstone River, the Judith River, the Shoshone River, and the Greybull River, may require blasting of bedrock, which, due to acoustic shock, could be harmful to fish that are in the immediate vicinity of the explosion. The degree of blasting impact on fish would depend on the type of explosive, blasting technique, fish species, and timing.

Teleki and Chamberlain (1978) conducted experiments on the survival of various species following detonation of charges placed in bedrock or mud of a lake bottom. These experiments revealed that laterally compressed fish species (e.g., pumpkinseed, crappies) were most sensitive to blast-related acoustic shock, while those with more rounded body forms (e.g., rainbow trout, white sucker) were least affected.

Based on several assumptions, the distance to which fish would suffer mortalities in the stream from underwater detonation can be estimated. Robbins (1988) described techniques and quantity of blasting material used for a major gas pipeline crossing on the Susquehanna River in Pennsylvania. Assuming similar techniques would be utilized by Express for major stream crossings allows an estimate of distances to which fish mortality would occur. Based on Robbins' described methods, a double row of drill holes, with the holes spaced five feet apart, and 60 pounds of explosive placed in each hole could be used. This method would use 2,400 pounds of explosive per 100 feet of excavation. Most streams that would be crossed are much less than 100 feet wide, so an assumed 50-foot-wide crossing would be detonated at one time, which equals 1,200 pounds of explosive detonated. Based on the data presented by Teleki and Chamberlain (1978), the most sensitive laterally compressed fish (e.g., crappie) would suffer 95 percent mortality within 213 feet of the detonation, and 10 percent mortality within 472 feet of detonation. The least sensitive rounded fish (e.g., rainbow trout) would suffer 95 percent mortality within 174 feet of the blast, dropping rapidly to 10 percent mortality at 194 feet.

Laterally compressed fish species in the Yellowstone River (see Table 8, Chapter 2) which would most likely be affected by blasting are goldeye, burbot and mountain whitefish. All the other abundant and common varieties are of the rounded body form. All abundant and common species within the Judith River are of the rounded body form. In the Shoshone River in Wyoming (see Table 12 in Chapter 2), only the burbot is of a laterally compressed body form. Likewise, the burbot is the only variety of laterally compressed fish in the Greybull River. Although a 95 percent mortality rate would be assumed within 200 feet of blasting for the laterally compressed fish and within 170 feet for rounded body form aquatic life, the impact would be significantly reduced by using much smaller detonations to scare the fish away from the blast site.

Cover Loss

Some instream and shoreline cover would be altered or lost at the proposed stream crossings. Streambank vegetation, instream logs, rocks, and undercut banks provide important cover for fish. Fish that normally reside in these areas could be displaced. However, since the right-of-way temporary work space cleared would typically be 140 feet or less, these impacts would be less than significant considering the length of these streams.

Interruption of Fish Migrations

Some fish, such as trout, migrate during spawning runs and could be briefly interrupted during installation of pipelines across water bodies. Most fish migrate over several days or weeks in small streams. Consequently, migration would only be briefly interrupted, since installation across streams less than 100 feet wide would take one to six days, and is scheduled to occur during nonmigrating periods. Accordingly, this very short-term impact would cease after the stream crossing is complete.

Fish Entrainment

Entrainment of larger fish species would not likely occur from water withdrawal for hydrostatic testing, since intakes would be screened. The quantity of water for hydrostatic testing would not significantly reduce instream flow (see Hydrology Section) because water withdrawal and discharge rates would not exceed ten percent of the actual stream flow.

Toxic Materials Spills

Contamination by an oil spill (DNRC 1979) would be a major potential impact of the proposed pipeline. Although the potential for an oil spill reaching a river or stream is very low, as explained later in this chapter, the impacts associated with a spill would be great, depending on the size of the spill and the flow of the stream. During the construction phase, spills could result from:

- oil leaks from construction machinery;
- overturned equipment;
- refueling or servicing operations; and
- fuel line leaks.

Direct spills into streams could be toxic to fish, depending on the quantity of spill and concentration. To reduce the potential for surface-water contamination, Express would store fuel and other potentially toxic materials away from streams (at least 100 feet), minimizing the chance of direct stream spills. Also, construction vehicles and equipment would not be refueled within 100 feet of water.

The impact on fisheries (DNRC 1979) could occur during the operational phase by a leak of the pipeline at or near a water crossing. A later section in this chapter describes the probability of such a spill. Crude oil could harm fish by:

- interfering with respiration by acting on the body and gill surfaces;
- coating and destroying periphton, plankton and macroinvertebrates;
- interfering with spawning habitat;

- deoxygenating water through increased microbial activity;
- interfering with photosynthesis and preventing re-oxygenation by coating the water surface; and
- acting as a toxic material for aquatic organisms.

The impact on aquatic organisms would depend on the physical and chemical properties of the water and the speed and effectiveness of the subsequent response and cleanup. When the water volume is not sufficient or the flow is not fast enough to dilute the oil concentration, an oil spill has the greatest potential for long-term impacts. Accordingly, the impacts of a spill during the low flow season (late summer through winter) would be greater than in the high flow periods of spring and early summer.

The progression and fate of oil in mountain streams is difficult to assess. It depends on the location of containment basins, volume and rate of a potential spill, streamflow, stream gradient, type of stream bottom, and the effectiveness of the cleanup.

Information on crude oil toxicity indicates the fraction that produces the most direct toxicity to fish also dissipates most rapidly by evaporation or other natural degradation processes. Although this indicates that long-term impacts probably would not occur, little can be done to prevent temporary toxic effects. More rapid degradation of crude oil would occur in warmer water. While faster flowing streams would show faster degradation because of the more turbulent flow, the oil would spread farther downstream. The agitation in the higher gradient stream would result in stream bottoms becoming more contaminated. Large rocks on stream bottoms may become coated with oil, but would be scoured through turbulence during high flow. Fine sediments or organic material may mix with oil and form a long lasting mat.

In summary, in the event of a potential oil spill, recovery rates of affected fish depends on the volume and rate of spill, the volume and flow of the water to dilute the oil concentration, several other streambed characteristics, and the speed and effectiveness of the cleanup. To reduce these potential impacts to fish from an oil spill, Express would implement the SPCCP, which would be developed and approved before construction would begin. The SPCCP would contain measures to lessen the probability of a significant spill, and to immediately respond to a spill to begin clean-up and remediation actions. Specific measures to be included in the SPCCP are listed in the Pipeline Safety and Reliability section later in this chapter.

Timing Restriction Alternative

As a part of the river and stream crossings evaluations, the MDFWP has indicated that they would require that river and stream crossings to be completed between July 15 and October 1 for the following Montana rivers and streams: Judith River, Ross Fork, Musselshell River, Valley Creek, Yellowstone River, Rock Creek, the North and South Fork of Bluewater Creek, and the Clarks Fork of the Yellowstone River.

This timing restriction would be placed on the crossings to protect the spawning periods of the brown trout. If an operational need existed to construct after October 1, the DFWP would survey each stream to determine if an extension could be made for construction activities. In particular, the MDFWP would look for active redds, hollows in rocks where eggs would be deposited. The survey would include the proposed crossing location and a distance downstream. The downstream area would also be important since increased sedimentation from the crossing construction could fill the redds and decrease potential spawning locations. If there is no evidence of active redds, the DFWP could grant time extensions to complete the crossings at particular locations.

Implementation of the project at the Bighorn River crossing (MP 374.2) would result in suspension and deposition of fine sediments during the period of construction. This could have a potential short-term impact on critical channel catfish and sauger spawning habitat downstream of the crossing. To reduce the impact to channel catfish and sauger downstream of the Bighorn River crossing in Wyoming to a less-than-significant level, it is recommended that construction across the Bighorn River also be restricted to the period from July 15 to October 1.

Threatened, Endangered and Sensitive Species

To comply with Section 7 requirements, the BLM has consulted with the appropriate USFWS offices regarding the presence of federally listed or proposed species in the project area. The USFWS has indicated that seven federally-listed wildlife species and one Category One species potentially occurs along the proposed pipeline route (Harms 1993 and Davis 1993). In addition the BLM has indicated numerous sensitive species potentially occurring along the proposed route. These species are listed in Appendix D. However, they are not analyzed as a part of this report.

The BLM will prepare a Biological Assessment (BA) to determine if the project would affect these federally-listed or proposed threatened or endangered species. The BA process will also be utilized by the BLM to develop site-specific mitigation recommendations to minimize or eliminate impacts on federally-listed or proposed species. Based on the determinations reached in the BA, the BLM will enter into formal consultation with the appropriate regional office of the USFWS, and will secure a Biological Opinion for the Express project prior to the commencement of any construction activities. Information developed in the BA will be included in the FEIS.

Criteria for Determining Significant Impacts

Impacts on federally-listed or proposed species, and BLM-designated sensitive species, were considered significant if any of the following criteria were met:

- direct mortality;
- permanent loss of existing or potential habitat;
- temporary loss of habitat that may result in increased mortality or lowered reproductive success; or
- avoidance by wildlife of biologically important habitat for substantial periods that may increase mortality or cause lowered reproductive success.

The potential for adverse impacts on federally-listed threatened, endangered and category one species was based on known ranges and habitat requirements of species as identified in Chapter 3, and the results of field surveys conducted for the proposed pipeline.

Field surveys of habitats likely to be inhabited by wildlife and plant species along the Express route to Lost Cabin, Wyoming were conducted in summer and fall 1989, spring and summer 1990, and spring and summer 1992. Additional surveys were conducted in summer 1993 and spring 1995 for the portion of the Express route from Lost Cabin to Casper. Known locations of threatened, endangered, candidate, and sensitive and species on or near the pipeline route were also surveyed. The information from these surveys is incorporated in the following impact assessment.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts to threatened, endangered, and sensitive species, although at different locations and timeframes and for different species, would be similar to the effects of the Express pipeline described in this section.

Impacts to Threatened, Endangered and Category One Wildlife Species Common to All Action Alternatives

Black-Footed Ferret

Black-footed ferrets have been released in Montana and Wyoming at locations far distant from the proposed pipeline route (Westech 1995). Potential habitat for black-footed ferrets includes black-tailed prairie dog colonies larger than 80 acres, white-tailed prairie dog colonies larger than 200 acres, and complexes of colonies (FWS, 1989). A complex consists of two or more neighboring prairie dog towns less than seven kilometers apart.

Aerial and ground searches for potential black-footed ferret habitat (i.e. black-tailed and white-tailed prairie dog colonies) along the proposed route were conducted during 1990 and 1992.

White-tailed prairie dog range was surveyed during the period, March 20 - April 9, 1990. This part of the route (approximately 325 miles) is almost all within Wyoming, largely on public land administered by BLM, and is known to contain white-tailed prairie dog colonies. Ground surveys were conducted only on days with favorable weather. Only active prairie dog colonies were mapped on USGS 7-1/2 minute topographic maps. Colonies were considered active if prairie dogs were observed during either the air or ground surveys or if fresh prairie dog scat was present around burrow openings.

Prior to the aerial survey, locations of known prairie dog colonies from BLM management documents were mapped. An attempt was made to verify the locations of these colonies during the flight. In addition, all observed prairie dog colonies on or near (¼ to ½-mile of the centerline) of the route were mapped. After the survey, additional colony locations were added to the maps from overlays maintained by the BLM Lander Resource Area Office, and from other published sources (BLM, 1982; BLM, 1985; BLM, 1988a; BLM, 1988b; Hayden-Wing Associates, 1990).

In white-tailed prairie dog range (Milepost 295-515), surveys were conducted from the ground, airplane, and helicopters. Twenty white-tailed prairie dog colonies or complexes were located and mapped within or adjacent to the search corridor. As expected, no black-tailed prairie dogs were found. In Wyoming, black-tailed prairie dogs occur in the eastern counties and are known in only one location west of the Big Horn Mountains.

Five sites proved to be areas where badgers had been digging and one other was not located during ground survey. At some sites, the acreage estimate made during aerial survey was changed when the prairie dog colony was mapped from the ground.

Black-tailed prairie dog colonies along the proposed route (Milepost 0-295) were surveyed by plane. Only five distinct prairie dog colonies were identified. All observed black-tailed prairie dog colonies on or within 0.5 miles of the proposed route were mapped on USGS 7-1/2 minute topographic maps.

Of the five colonies, two were intersected by the proposed route and two were in close proximity. Of these, three are greater than 80 acres and would have to be searched for black-footed ferrets under USFWS guidelines. It is possible that a colony complex, as defined by USFWS guidelines, is present in the vicinity of the first two colonies, and possibly the fifth. Further surveys would need to be conducted prior to black-footed ferret surveys.

In summary, a search for black-tailed prairie dog colonies along the proposed route in Montana (MP 0-295) and white-tailed prairie dog colonies in southern Montana and Wyoming (MP 295-430) in March and April, 1990, and then from MP 430-510 in 1993, yielded five black-tailed prairie dog colonies and 20 white-tailed prairie dog colonies/complexes. Of these, three black-tailed prairie dog colonies and two white-tailed prairie dog colonies/complexes were large enough to warrant searches for black-footed ferrets under USFWS guidelines. It should be noted, however, that if the seven kilometer search radius described in USFWS guidelines is employed, the proposed route may cross several more white-tailed prairie dog complexes than were identified during this survey.

Construction impacts to black-footed ferrets would be mitigated using one of two methods. Depending on the size and location of the prairie dog colony, it may be possible to slightly alter the pipeline route to avoid colonies or complexes that would otherwise have to be surveyed for black-footed ferrets. Where this method is impractical, surveys for black-footed ferrets would be conducted during the year prior to construction (fall 1995 and winter 1996), following USFWS guidelines. If a ferret is found, Express would notify the appropriate authorities and the pipeline route would be altered to avoid the colony or complex containing the ferret.

Implementation of the proposed mitigation measures would ensure that construction and operation of the Express Pipeline would not affect the black-footed ferret.

Bald Eagle

Within Montana the proposed project would not affect nesting bald eagles due to the lack of nests within the vicinity of the pipeline (Montana NHP, McMaster, personal communication). In addition, no active nests were observed in a recent survey of the proposed route (Westec, 1990).

The proposed pipeline route also would not cross bald eagle nesting habitat in Wyoming (Starkey personal communication). In addition, no active bald eagle nests were observed during surveys of the proposed route.

Historic nesting sites in Montana are present approximately three miles east of the proposed route on Clarks Fork of the Yellowstone River. Active nests exist along the Yellowstone River, but they are more than three miles from the proposed route, and along the Missouri River two to three miles west of the proposed crossing.

Use of the Clarks Fork of the Yellowstone River by nonbreeding, summer resident bald eagles is increasing, and there is an active territory, but nesting has not been observed. Potential nesting habitat occurs where the proposed route crosses the Yellowstone River, and bald eagles may nest there in the near future (Flath, personal communication).

Bald eagles both migrate through, and winter in Montana. Peak spring migration occurs in March, and peak fall migration occurs in November (BLM, 1986). Construction activities probably would not affect migrating bald eagles, since construction would probably take place between July and October.

The distribution of wintering eagles varies from year to year depending on the severity of the winter and the availability of food. Within Montana eagles winter along the Milk, Missouri, Musselshell, Yellowstone, and the Clarks Fork of the Yellowstone Rivers. Wintering bald eagles may be present near any open water along any large rivers and streams that may be crossed by the proposed pipeline route. Because the proposed construction is from July to October, the project should not affect wintering bald eagles.

Bald eagles occur as migrants and may winter in Wyoming, along the Greybull, Bighorn, and Green Rivers, and Nowater Creek. Eagles may occur along any large river or stream that would be crossed by the pipeline.

Although no bald eagles currently are known to nest or roost along Express' proposed route, potential and historic nesting and roosting habitat do exist. The primary mitigation for potential impacts to nesting bald eagles would be timing constraints during the nesting season. Express has proposed not to construct in big game winter range from November 15-April 30, when bald eagles may be present, or to construct in known big game parturition areas from May 1-June 30.

The entire pipeline route would be re-surveyed for all types of raptor nests, including bald eagle nests, in spring of 1996. If active bald eagle nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests There would be no construction within 0.5 miles of active bald eagle nests from February 1 to August 15 to allow for nesting and rearing.

To ensure that the Express Project does not affect winter roosting bald eagles, Express would implement the following additional mitigation measures. Express would survey its approved route for bald eagle winter roosting habitat in the year prior to construction. Express would not construct near identified roosting trees between the period of November 1-March 31. In addition, Express shall restrict its construction right-of-way through bald eagle winter roosting habitat to a maximum of 75-feet in width, and shall align its pipeline in a manner that minimizes the clearing of roost trees to the maximum extent practicable. Because the construction is planned for July through October, the Express pipeline would not cause any impact to bald eagle roosting sites.

Implementation of mitigation measures would ensure that construction and operation of the Express Project would not affect the bald eagle.

Peregrine Falcon

The proposed project would have no impact on nesting peregrine falcons because none occur along the proposed route within Montana (McMaster, personal communication). There is a historic peregrine falcon eyrie approximately six miles east of the proposed route, but no known existing or historical peregrine falcon eyries occur within five miles of the proposed pipeline route. In addition, no peregrine falcons or eyries were observed during 1990 surveys of the proposed pipeline route (Westech, 1990).

Potential nesting habitat does exist along the proposed route near the Yellowstone River in Montana. This habitat is located west of the proposed crossing, and extends for approximately 0.5 mile. A peregrine falcon was observed near the area in April 1988 (Flath, personal communication). However, this site may not be suitable habitat because several sources of human disturbance occur within sight of area, including occupied homes, a highway, and a railroad. An additional potential peregrine falcon use area occurs near Lonesome Lake.

Migrating peregrine falcons could be present along any of the major river systems that would be crossed by the proposed pipeline route. Construction activities would not affect peregrine falcons during spring migration because falcons migrate in March and April (Ritter, personal communication), prior to the time planned for construction. Construction activities in late summer or fall may overlap with the peregrine falcon's autumn migration. However, these highly mobile birds could easily avoid areas of pipeline construction, and this short-term avoidance would not disrupt migration. Additionally, no known historical or active peregrine falcon eyries occur within five miles of the proposed pipeline right-of-way within Wyoming.

As indicated above, although no peregrine falcons currently are known to nest along Express' proposed route, potential and historic nesting habitat does exist. If an active or potentially active peregrine nest site is found during construction, activity would be halted and the situation would be evaluated in conjunction with federal and state agencies. Activity would not resume without the agencies' approval. The primary result of this consultation probably would be timing constraints during the nesting season.

The entire pipeline route would be re-surveyed for all types of raptor nests, including peregrine falcon nests, in spring of 1996. If active peregrine falcon nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests. There would be no construction within 0.5 miles of active peregrine falcon eagle nests from February 1 to July 31 to allow for nesting and rearing. Implementation of mitigation measures would ensure that construction and operation of the Express Project would not affect the peregrine falcon.

Whooping Crane

The whooping crane does not nest in Wyoming but is a spring and fall migrant and a summer resident (McMaster, personal communication). The proposed pipeline route is not within the known summer range of the whooping crane and does not enter heavily used migration corridors. No whooping cranes are known to occur within Montana in close proximity to the proposed pipeline route.

Construction activities should not affect whooping cranes during spring migration because they pass through Wyoming between April 1 and May 15 (Ritter, personal communication) and construction is scheduled to begin in July. Fall migration occurs between August 21 and September 24 (Ritter, personal communication). Construction activities that take place during late summer could disturb migrating cranes that stop along the proposed pipeline route.

Express would have a qualified environmental inspector present on all construction spreads that are operating in Wyoming during the whooping crane migration seasons (spring migration - April 1 to May 15; fall migration - August 21 to September 24), who shall survey the pipeline route for the occurrence of whooping crane within ¼ mile of the route each morning prior to the start of construction activities. In the event that whooping cranes are sighted within ¼ mile of any construction activities, construction activities shall not commence in that location until the whooping cranes have left the area.

Implementation of proposed mitigation would ensure that construction and operation of the proposed Express Project would not affect the whooping crane.

Pallid sturgeon

The pallid sturgeon is not expected to be impacted by the proposed project. This is based on the fact that the only known occurrence of the sturgeon along the proposed pipeline route is in the Missouri river. However, surveys in 1990 and 1991 did not document the presence of this species in the area of the proposed route crossing. Also, because the Missouri River would be directionally drilled, aquatic resources in the Missouri River would not be affected. If the directional drilling technique would fail, the surveys would be re-accomplished before construction to determine the presence of the pallid sturgeon near the proposed crossing.

Piping plover

The piping plover is not expected to be impacted by the proposed project. This is based on the following considerations. The piping plover has not been documented to occur within the general project area. Construction activities in July could affect chicks before they fledge. The entire pipeline route would be re-surveyed for all types of raptor nests, including piping plover nesting sites, in spring of 1996. If active piping plover nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests. There would be no construction within 0.5 miles of active piping plover nests from February 1 to August 31 to allow for nesting and rearing. Implementation of mitigation measures would ensure that construction and operation of the Express Project would not affect the piping plover.

Least tern

The least tern is not expected to be adversely impacted by the proposed project. This conclusion is based on the following considerations. No least terns have been documented to occur within the general project area. Construction activities in July could affect chicks before fledgling. The entire pipeline route would be re-surveyed for all types of raptor nests, including least tern nesting sites, in spring of 1996. If active least tern nests are documented, the pipeline placement would be slightly realigned to maintain the integrity of the nests. There would be no construction within 0.5 miles of active piping plover nests from February 1 to August 12 to allow for nesting and rearing. Implementation of mitigation measures would ensure that construction and operation of the Express Project would not affect the least tern.

Mountain Plover

Approximately 280 acres of potential nesting habitat for mountain plovers would be crossed by the pipeline route in Montana. The proposed project may result in direct mortality of nesting mountain plovers, a temporary loss of habitat, or avoidance of nesting areas. These impacts are not significant because few mountain plovers may potentially be affected by the project. Moderate densities of mountain plovers nest in Phillips, Blaine, Valley, and Golden Valley Counties, Montana (Knowles, n.d.). The pipeline route would cross only Golden Valley County. A breeding population is known to exist in Golden Valley, south of the Snowy Mountains east of the pipeline route.

Construction activities within Wyoming may also result in direct mortality of nesting mountain plovers, a temporary loss of habitat, or avoidance of nesting areas. Mountain plover young generally fledge by the end of July. Construction activities in July could affect chicks before fledgling. The entire pipeline route would be re-surveyed for all types of raptor nests, including mountain plover nesting sites, in spring of 1996. If active mountain plover nesting sites are documented, the pipeline placement would be slightly realigned or the work plan would be modified to maintain the integrity of the nests. The impacts would not be significant because few mountain plovers would be affected by the project, the majority of the construction would be beyond the breeding season, and active breeding nests would not be removed. Densities of nesting mountain plovers average below 40 birds per square mile, and only 40 acres of potential nesting habitat would be disturbed. Thus, potential impacts to plovers would be minor.

Special-Status Plant Species

No threatened or endangered plant species were indicated for either the Montana or Wyoming portion of the project area, however, one candidate species is listed (Harms 1993 and Davis 1993). Ten sensitive plant species were indicated to potentially occur within the proposed project area. Appendix E lists these species and their locations.

Wild buckwheat is a federal-candidate species throughout its range. No impacts on these species would result from the project.

Surveys completed in 1990 indicated that no listed species occurred on the proposed route. However, one sensitive species not listed by MNHP, *Townsendia spathulata*, was found within 0.2 miles of the proposed route, but not on the proposed right-of-way. Because this species appears to occur in the vicinity in significant numbers and is not on the right-of-way, it is not expected to be impacted by the proposed project.

Although impacts on substantial portions of populations of these plants would be significant, this is not expected to occur. However, to minimize any potentially significant impacts, Express would survey its proposed route for the occurrence of sensitive plants in Montana and Wyoming and realign its route to minimize disturbance of these species to the maximum extent practicable.

Sensitive Plant Communities

Three sensitive plant communities were identified by the MNHP as potentially occurring along the proposed route. No sensitive plant communities were identified in Wyoming (Culwell 1993).

None of the identified communities would be impacted by the proposed project. The Utah juniper/bluebunch wheatgrass community type occurs the closest to the proposed route. However, it is approximately 0.25 miles off the route. Therefore, it would not be impacted.

One community type, the birdsfoot sage, xeric dwarf shrub series is not ranked as a sensitive community type, however, it may potentially be listed. This community type was found along the proposed route for approximately 0.5 miles. Although the route would cross this area it is not expected to impact the community. This is based on the following consideration. The route follows a existing pipeline route and a road, therefore, the habitat has been previously disturbed and any new impacts would be minimal.

LAND USE

Impact on land use along the pipeline routes would result from the clearing of the entire construction right-of-way for the installation of the pipelines and from the maintenance of a permanent right-of-way. The construction right-of-way would be 90 feet wide consisting of a combination of a temporary and a permanent right-of-way. In many cases, the vegetation on the temporary right-of-way would be brush beat, thereby preserving the root systems along the temporary right-of-way. The temporary right-of-way is work space that would be returned to the landowner following construction and allowed to return to its previous use and condition. After construction, the width of the permanent right-of-way would be 50 feet centered on the pipeline. The permanent right-of-way would be restored to its pre-construction condition in a generally grassy condition (although most agricultural practices would be allowed) and no trees, large shrubs, or structures, except roads, would be permitted.

Agricultural lands affected by the project include cropland, pasture, and rangeland. Impact on agriculture areas during construction would include the loss of standing crops, loss of crop productivity, loss of topsoil, soil compaction, and damage to drainage tiles. During operation of the pipeline, cropland and pastures would be allowed to revert to their previous use. Land used for pipeline construction would take row crops out of production for up to one growing season; hay fields and pastures would take approximately two years to return to previous production levels. Express would compensate the owner for any crop damage caused during routine pipeline maintenance.

Pipeline construction near residential areas would result in temporary construction impact which could include:

- inconvenience from noise and dust generated by construction equipment and personnel, and from trenching of roads or driveways;

- ground disturbance and the removal of trees, landscaping, and other plantings;

- potential damage to existing septic systems or wells due to trenching or blasting; and

- the removal of any aboveground structures, such as sheds, from within the construction right-of-way.

Long-term impact associated with pipeline operation includes the land easement encumbrance for the permanent right-of-way and its restrictions. The easement encumbrance would prohibit certain types of continued residential use such as the construction of any aboveground structures (e.g., house additions, garages, patios, pools). Additionally, the necessary inspection and maintenance activities are often considered a minor nuisance. The construction and operation of the Express pipeline would not require the removal of any homes.

The easement, usually negotiated with the landowner, is the instrument used to convey right-of-way to the pipeline company. The easement gives the company the right to operate and maintain the pipeline and the permanent right-of-way and, in return, compensates the landowner for the use of the land. The easement negotiations between the pipeline company and the landowner would include compensation for loss of use during construction, loss of nonrenewable or other resources, and the restoration of unavoidable damage to property during construction.

If an easement cannot be negotiated with the landowner, Express may use the right of eminent domain granted to them under the Montana and Wyoming state law. Express would still be required to compensate the landowner for the right-of-way, as well as for any damages incurred during construction; however, the level of compensation would be determined by the court according to state laws. State laws set out procedures for the use of eminent domain. Generally, the pipeline company would file in either state or federal court for the right to use land by eminent domain. The level of compensation determined as a result of condemnation proceedings could be the different than the amount of money offered during earlier negotiations with the company.

Criteria for Determining Significant Impacts

Adverse impacts on land uses were considered to be significant if the project implementation would:

- conflict with existing land use designations,
- conflict with the plans, policies, or regulations established by the governmental entities of the directly affected jurisdictions, or
- conflict with urban industrial use, or with the development of any urban project that had received either tentative or final approval from the jurisdiction in which it is located.

Impacts that continue to exist one year after construction of the proposed facilities were considered to be long-term.

General Impacts

Construction of the Express Pipeline would require a temporary disturbance of approximately 5,564 acres. When operations would begin, the Express project would require approximately 3,090 acres of permanent right-of-way. Above ground facilities, consisting of five pump stations, one metering station, permanent access roads, and mainline block valves at least every 25 miles, would add approximately 50 acres to the project's requirements. Locations for the proposed pump and metering station are shown on the Maps 1 through 7.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Land use impacts, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Above Ground Facilities

The siting of above ground facilities would require permanent removal of .1 acres of agricultural land per mainline valve in 30-40 locations and upstream of major stream crossings, approximately 2-3 acres each in the five locations for the electric pumping stations, and approximately 2 acres for the metering station. All of the pump stations would be placed on agricultural or range land resulting in a long-term loss of 10-15 acres of these types of land.

Neither construction nor operation of the pump stations would interfere with any transportation networks. Valve location would involve considerations of placing the 0.1 acre site at the edge of agricultural fields whenever possible. When compared to county or state totals of land in agricultural production, these impacts on agricultural uses would be minor.

Urban Resources

Pipeline construction would not occur through major concentrations of rural or suburban development. Where construction would occur near development, it would be beyond existing buildings and never within 50 feet of a residence. The primary long-term land use constraint would be the prohibition of new structures or earthworks on the permanent easement during the life of the project. The impact on urban resources in limiting location of development would be minor because the route is predominantly aligned through rangeland and farmland, future development of which could accommodate the presence of the permanent easement.

Plans and Policies

No applicable zoning requirements along the pipeline route preclude pipeline routing. The right-of-way through Montana would be granted under the Major Facilities Siting Act, as administered by the MDEQ. Only Natrona and White Springs counties in Wyoming have a type of permit system for siting a pipeline facility. The Express pipeline project would comply with these permitting requirements.

The route would traverse various parcels of BLM-administered land and would need to comply with management plans for the appropriate jurisdiction. The Missouri River crossing would be in an approved utility corridor across the BLM-administered Wild and Scenic River. The portion of the pipeline proposed in BLM lands administered by the Platte River Resource Area is within the pipeline corridor designated in the Platte River Resource Area Resource Management Plan. These lands are in Hot Springs, Fremont, and Natrona Counties of Wyoming.

The pipeline route would cross the Shoshone and Bighorn Rivers, in BLM-designated Special Resource Management Areas, that provide water-based recreational opportunities. The project would also cross the Green River approximately 0.8 mile northwest of the Seedskadee NWR. A temporary impact would be realized from noise and the obstacle that would be produced by the pipeline during construction. Impacts would be less than significant because of their short duration and minor interference with the use of the recreational facilities.

Mineral Uses

The pipeline route would cross the Laredo Gas Fields in Hill County, Montana. Impacts on this land use would be less than significant because placement of the pipeline would not reduce production.

Airports

The pipeline route would pass within 500 feet of the Lovell-Cowley-Byron airport in Big Horn County, and would also cross a private airstrip on the Fuller Ranch in Fremont County. Placement and operation of the pipeline would not affect airstrip operations.

South-Central Montana Alternative

Under this alternative the pipeline would be re-routed in Section 25 of Township 2 South, Range 22 East in Stillwater County, Montana to avoid crossing irrigated farmland (see Figure 7 in Chapter 2). Express proposed to deviate from the Altamont right-of-way in this area to avoid the steep slope just north of an irrigation ditch. Express has proposed to bore under all irrigation ditches to reduce the potential of interrupting flow. Under this alternative, they would have to trench cut the ditch since it would be impossible to establish a staging area due to the steep slope. A trench cut would have a short-term impact, one to two days, on the flow of irrigation water.

August is the peak month for drawing irrigation water for croplands in Montana. However, since the construction is planned from July to October, there is a good possibility that the trench cut would be completed either before or after the peak month for drawing irrigation water. If construction is completed at this time, the minor short-term impact to the flow would be eliminated.

RECREATION

Criteria for Determining Significant Impacts

Impacts to recreation are considered significant if recreational sites would be permanently displaced. Additional impacts would occur if long-term disturbances would occur to recreation.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Recreational impacts, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

The pipeline would not cross any state- or county-designated parks or recreation areas. Construction of the pipeline would have a short-term effect on areas in recreation use and would be limited to the time of construction. Since most of the recreational activity that would be disturbed by the pipeline is of a dispersed nature (such as hiking or hunting), disturbance from the pipeline would be minor. Some recreational activities would be diverted during construction, but would resume once construction ended. Because of the short duration of construction at any one location, these impacts would be short-term and minor. Once construction is complete at any particular location, the minor impacts would cease to exist.

For river crossings that are constructed by the open trench technique, there would be a short-term impact on recreation. Construction across major rivers (100 feet wide or greater) would typically last one to two weeks, major stream (10 to 100 feet wide, average depth greater than two feet) construction would last about two to six days depending on whether blasting would be required, and minor stream (width less than 10 feet, average depth less than two feet) construction would be complete in one to two days. The width of each perennial river and stream crossed by the pipeline is listed in Tables 8 and 12 in Chapter 3. Although the river channel would not be completely blocked at any time, the instream activity would require boaters to avoid equipment and spoil piles. Also, if any instream blasting is necessary, river travel at the crossing site would be temporarily halted. The water downstream would be muddied as a result of the instream activity, temporarily reducing the quality of the fishery. The actual instream work would normally be completed in less than two weeks at major river crossings.

Publicly owned recreation sites within five miles of the proposed route in Montana are exclusively water-related. Because Fresno Lake (approximately MP 15.0) is ½ mile west of the route, impacts would be minor and consist of short-term construction noise. The Coalbanks Landing State Recreation Area (approximately MP 67.0), a popular putting-in location for float trips down the Missouri River would not be affected because the Missouri River would be directionally drilled. If directional drilling would fail at the proposed crossing, trench cutting would muddy the water at this location for about a week. Deadman's Basin Reservoir (approximately MP 195.0) is about five miles east of the route and recreational use would not be affected. The pipeline route extends ½ mile west of the Hailstone, Halfbreed Lake and Big Lake wildlife refuges (approximately MP 220.0-240.0). Buffalo Mirage and Homestead Isle are fishing access sites on the Yellowstone River. Sedimentation resulting from the Yellowstone River crossing may affect fishing for less than a week.

Pipeline construction would affect moderate to heavy water-related recreational use of the Musselshell, Yellowstone, and Clarks Fork of the Yellowstone River, Rock Creek and the Shoshone and Bighorn rivers. These recreation resources would undergo temporary impacts because of noise and the obstacle produced by the pipeline during construction, as well as muddied waters for a short time afterward. These impacts would be minor because they would be temporary and because they would interfere only minimally with the use of the recreational facilities. Because the turbidity would clear within 24 hours at the crossing site, these short-term impacts would be less than significant to recreational land use.

Recreational fishing impacts would be minimal on these rivers and streams because pipeline construction on these rivers would only last from one to two weeks. Temporary increased sedimentation may affect downstream fishing opportunities for about an extra week. However, no effects would occur upstream from the pipeline crossing.

Bridger Road Alternative

Under this alternative, the pipeline would be routed around a crossing of the historic Bridger Trail near MP 430. The alternative route would be visible during annual celebrations of pioneer migrations along the Bridger Trail in an area where the integrity of the trail setting has been compromised. Therefore, potential recreational impacts during the annual event would be eliminated.

VISUAL RESOURCES

The Express pipeline route would cause construction-related visual impacts. Visual impacts would be caused by vegetation removal, earthwork and grading scars, staging and laydown areas, heavy equipment tracks, trenching, blasting, rock formation alteration or removal, temporary support machinery and tool storage, and related waste materials and tailings.

The degree of impacts from vegetation clearing would depend on the type of vegetation that would be affected. In annual grasslands and agricultural croplands, restoration of the vegetation may occur within three growing seasons, which would limit the visual impact to a short time. Where the pipeline would cross shrub vegetation, the visual impact may persist for many years. In forested areas and areas with low revegetation potential, visual impacts could persist for up to 30 years or longer. Landform and vegetation changes would introduce contrasts in visual scale; spatial characteristics; and form, line, color, and texture.

Where needed, the right-of-way would be periodically cleared of vegetation that is hazardous to ongoing pipeline operation. This periodic clearing of the right-of-way would create the greatest visual impacts in the small forested areas of the proposed route. In nonforested areas, the pipeline would not be noticeable to the casual observer once vegetation was restored to its original condition.

New pump stations, meter stations, valves, and pipeline markers would be permanent introductions to the landscape. The siting of above ground facilities would require 0.1 acres per valve in 30-40 locations and upstream of major stream crossings, approximately 2-3 acres each in the five locations for the electric pumping stations, and approximately 2 acres for the metering station. All of the pump stations would be placed on agricultural or range land. Valve location would involve considerations of placing the 0.1 acre site at the edge of agricultural fields whenever possible. Pipeline markers, consisting of a four-foot signed post, would be placed every 1,000 feet along the right-of-way.

Access roads leading to facilities would be constructed and kept clear of vegetation. At new pump station facilities, electrical power lines would increase manipulation of the landscape character. New structures on the landscape would affect spatial characteristics and form, line, color, and texture.

Criteria for Determining Significant Impacts

Visual impacts were evaluated for thresholds of context and intensity. The context includes the visual character of the site, its rehabilitation potential, and the jurisdictional context of the affected area. The project setting or existing features of the project site are sometimes subject to federal, state, or local laws and regulations, such as the Wild and Scenic Rivers Act.

Intensity includes both sensitivity and duration. Sensitivity is evaluated in terms of viewer sensitivity and proximity to resources, such as park lands, Wild and Scenic Rivers, or historic or cultural resources. The duration of impacts is divided into permanent, long-term, and short-term. Permanent impacts are those changes to the visual resource that involve aboveground structures or areas where vegetation would not recover for the life of the project. Long-term impacts are those changes to the visual resource that would take longer than three years to blend with the surrounding native environment. Short-term impacts are those changes to the visual resource where the native vegetation would recover to its original condition, concealing the pipeline scar, within three years after construction.

Significant visual impacts were determined according to the identified visual management objectives, whether the area had been modified previously, the duration of the impact, and the degree of visibility. Most high and moderate visual impacts were determined to be significant; all low visual impacts were determined to be less than significant.

New structures, such as pump stations, mainline valves, and signs, would become a part of the landscape on the proposed routes. Overhead powerlines may connect to each station. Mainline valves typically consist of a vertical loop of the pipeline that extends approximately four feet out of the ground with the valve at the top of the loop. Express proposes to bury all mainline valves such that only the blowdowns and valve operators would be above ground level. Chainlink fence would surround each valve. All aboveground structures would affect the character of their existing landscape. These structures would create permanent visual impacts. These impacts would be significant. Measures to minimize the visual impacts of above-ground structures should be included in Express' Plan of Development. These measures are described in the Mitigation section in this chapter.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Visual impacts, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Visually sensitive resources along the proposed Express Pipeline route are shown in Table 21. The following is a discussion of the impacts of the proposed project on these visual resources.

Missouri River

Since directional drilling techniques would be used to cross the Missouri River (MP 69), long-term visual impacts would be less than significant. However, the short-term construction-related visual impacts would be significant to recreational users, mainly boaters, of the river. Recreation impacts with respect to use of the river are not anticipated, but access to the river would be restricted when and where directional drilling is taking place. These short-term impacts would last for the construction period. Generally, the rehabilitation potential around the Missouri River is fair to good. A small segment of the southern banks of the Missouri is rated as poor vegetation rehabilitation potential because of steep slopes and shallow soil. Accordingly, the visual impact would last longer until this small segment of land is reclaimed. To reduce this potential visual impact along the Missouri, Express would implement the mitigation listed in the Reclamation Mitigation section in this chapter for their Plan of Development.

Yellowstone River

This segment of the pipeline route would have a moderate visual impact where the pipeline would cross the Yellowstone River (MP 257.4). The impacts on riparian forest vegetation on the riverbanks would be long-term. The pipeline route would scar the shores and banks of the river. Manipulation of these contours would affect the visual character of the river. These impacts would be significant. To reduce impacts to less-than-significant levels, Express should implement mitigation measures, listed in the Mitigation section of this chapter, in their Plan of Development

To the north of the Yellowstone River, the vegetative rehabilitation potential is good. To the south, the rehabilitation potential is rated poor on agricultural land. A visual impact would occur until the next year's crops are grown.

U.S. Highways 212 and 310

These segments of the pipeline route would have a moderate visual impact where the pipeline would intersect U.S. Highway 212 (MP 264.6) and U.S. Highway 310 (MP 266.9) respectively. Both of these highways are primary recreation travel routes to Yellowstone National Park in Wyoming. The visual impact resulting from right-of-way clearing of vegetation would be long term. Vegetation clearing would affect landscapes of high visual sensitivity, as modifications to the landscape in the highway viewsheds would be noticeable and would attract the attention of travelers. The pipeline scar would be intermittently visible from each highway on the surrounding terrain of rolling hills, and would be evident primarily on slopes facing the highways. These impacts would be significant. The rehabilitation potential for these lands is generally fair to good, except the potential is rated poor to the north in mixed grass prairie vegetation. Therefore, the visual impact of viewsheds to the north would last longer than those to the south. To reduce this potential visual impact, Express should implement the mitigation listed in the Reclamation Mitigation section in this chapter for their Plan of development.

Clarks Fork of the Yellowstone

This segment of the proposed pipeline route would have a moderate visual impact where the pipeline would cross the Clarks Fork of the Yellowstone River (MP 268.1). The impacts on riparian forest vegetation on the eastern riverbanks would be long-term. The pipeline construction would create a scar on the eastern banks of the river. Manipulation of the contours would affect the visual character of the river. These impacts would be significant. To reduce impacts, MDEQ recommends that Express should restore the riverbank earthforms and replant the trees uprooted for the river crossing. These measures would be implemented in the Plan of development. The vegetation rehabilitation potential in this area is good. Therefore, visual impacts should not be as significant or long-term as those to the north.

Greybull River

This segment of the proposed pipeline route would have a moderate visual impact where the pipeline would cross the Greybull River (MP 352.2). The impacts on riparian forest vegetation on the riverbanks would be long-term. The pipeline construction would create a scar on the banks of the river. Manipulation of the contours would affect the visual character of the river. These impacts would be significant. The vegetation rehabilitation in this area is poor which would result in a longer time to reclaim the vegetation. To reduce impacts, Express should implement in their Plan of Development the mitigation measures listed in the Mitigation Section in this chapter.

Old Bridger Trail Road

The proposed crossing of West Bridger Creek (MP 423.9) and Old Bridger Trail Road (MP 425.4) at these locations would have a moderate visual impact. The impacts on vegetation are long-term because the climate is dry and some steep terrain would be crossed by the proposed route. Most of this segment would be located in isolated areas and open rangeland not visible to travelers. However, a reenactment of original pioneer migration is celebrated annually on the Old Bridger Trail. Therefore, there may be a visual impact on this annual event until reclamation efforts are complete. Vegetative rehabilitation potential is this area is rated poor, which would result in a longer time to reclaim the vegetation. To reduce impacts, Express should implement in their Plan of Development the mitigation measures listed in the Mitigation Section in this chapter.

Bridger Road Alternative

Under this alternative, the pipeline would be routed around a crossing of the historic Bridger Trail near MP 430. The alternative route would be visible during annual celebrations of pioneer migrations along the Bridger Trail in an area where the integrity of the trail setting has been compromised. Therefore, potential visual impacts during the annual event would be eliminated. Impacts to other visual resources would be the same as all other action alternatives.

TRANSPORTATION

Construction would have temporary, short-term impacts on existing transportation systems, including the increased use of roadways to transport construction materials and crews to the work areas, and the open-cut crossing of county and local roads by pipeline construction. Railroad and state and federal highway crossings would be bored and therefore would not be affected. No operational impacts on transportation would be associated with the proposed projects.

Criteria for Determining Significant Impacts

Adverse impacts on existing roadways used to haul construction material and transport workers were considered significant if they would result in an increase in traffic that is substantial in relation to the existing traffic load of the road system. Proposed recommended practices prepared by the Institute of Transportation Engineers indicate that a complete traffic impact analysis should be prepared whenever a proposed project would generate 100 or more additional peak-hour trips in the peak direction. Trucks are larger than passenger vehicles and have longer starting and stopping periods at intersections. One truck, therefore, adds more congestion than one passenger vehicle. Based on passenger car equivalents for non-signaled intersections, one truck is counted as the equivalent of two passenger vehicles. An increase of 50 trucks, 100 passenger vehicles, or an equivalent combination of vehicles per hour during the peak hour was used as the threshold for determining significance of impacts. An increase in traffic volumes greater than this threshold was considered a significant impact.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Transportation impacts, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Heavy Vehicles on Rural Roadways

Construction of the pipeline would result in increased vehicle traffic on roads between the railheads and the work site, primarily attributable to transportation of construction crews and materials to the sites. Although these impacts would be temporary, vehicle and equipment weights may well exceed the design capabilities of rural roads and bridges. Short term damage to the rural roads, such as rutting, may result, especially during wet weather. These impacts would last until the roads would be regraded.

Express would use existing road crossings to access the rights-of-way. The right-of-way itself would be used to access the job site. Where construction of new access roads would be required to facilitate the delivery of construction materials and workers to the jobsite, additional impact to environmental resources (including possible entry into previously unroaded/inaccessible areas) would occur. Express's Traffic Management mitigation (Appendix B) would reduce these potential impacts.

Construction Material Transportation

Approximately four to six trucks per hour during the peak hour would be required to supply the construction spreads with pipe, considerably less than the threshold of 50 trucks per hour. This would be a less-than-significant impact.

Construction Crew Transportation

Several hundred vehicles would be added to local traffic loads if each worker used a personal vehicle to travel to the work site. On each construction spread, the maximum number of workers would be 405 people. However, these workers would be spread out over at least 25 miles of each spread. For economic and traffic considerations, most of the workers would probably car-pool with two to three workers in a vehicle. Thus, the typical construction worker traffic would be about 150-200 vehicles. Because of the generally rural setting of the pipeline route, the morning and evening arrival and departure from the work site would create a "mini rush hour". However, pipeline construction workers typically begin work as early as possible each day. Consequently, workers commuting from motels to the work site are expected to precede much of the typical 7 to 9 A.M. and 4 to 6 P.M. traffic increases. Further, by its very nature a construction spread disperses workers along its length. This would tend to reduce the impact on traffic at any one location. If construction worker commuting coincides with local roadway peak traffic hours, it is possible that the threshold of significance could be exceeded. However, given the rural environment and the "moving" job site down the pipeline route, this potential impact would be minor and short term at any one location.

State and Federal Highway Crossings

All state and federal highways would be crossed by boring and would not be affected. Express would need to obtain from the appropriate state highway departments, utility crossing permits for each federal and state highway crossed. Construction of the pipeline would not result in the disruption of transportation on state and federal highways.

County and Local Road Crossings

The open-cut method of road crossing would be used where permitted. Federal land management agencies and local jurisdictions, such as county and city governments, have the authority to determine whether the road crossing would be open-cut or bored. The applicant would need to obtain a right-of-way encroachment permit from the proper agency for each road crossing. If the road is bored, no disruption of normal transportation flow would occur.

An open-cut road crossing would generally require approximately one day or less to complete, during which time the operation would minimally interrupt the normal transportation flow. This interruption would not be significant, as traffic flows would be maintained through the use of on-site detours.

Railroad Crossings

All railroad crossings would be bored. Construction of the pipeline would not result in the disruption of railroad transportation.

SOCIOECONOMICS

Socioeconomic impacts would result from the temporary increase in population associated with pipeline construction. Temporary impacts from population increases are estimated to last between one and three months in the counties that would be crossed by the proposed pipelines. In a small number of cases, minor temporary impacts may last as long as seven months; however, it is unlikely that entire construction crews would be located within one county for more than three months.

Socioeconomic impacts to the petroleum industry was raised as an issue during the public scoping process. The respondent believed the import of Canadian crude oil via the proposed Express Pipeline could hinder the exploration for future petroleum resources and cause a continuation of declining crude oil production levels in Wyoming and Montana.

The construction of the proposed projects would result in some beneficial economic impact on the area crossed by the projects. The hiring of local workers, contractor purchases of materials and supplies, and spending of nonlocal workers would result in a short-term increase in local personal income. The project would have a long-term beneficial effect on local property tax revenues. Express has estimated that its proposed pipeline would generate approximately $6 million annually in ad valorem taxes, $5 million in Montana and $1 million in Wyoming. The amounts of annual ad valorem taxes that would be received by each county crossed by the pipeline would be directly proportional to the length of pipeline installed in each county. Figure 11 shows the counties that would be traversed by the pipeline.

Construction impacts also include the temporary and permanent removal of agricultural land and forestland from production. It is estimated that temporary impacts on agricultural production would occur over the period needed to return disturbed areas to production. In most cases, it is estimated that pipeline construction would preclude agricultural production on disturbed land for one growing season.

All socioeconomic impacts would be generated by construction of the proposed pipeline. No additional socioeconomic impacts related to operation of the pipeline are expected.

Criteria for Determining Significant Impacts

Adverse impacts were considered significant if the following criteria were met:

- Population. The total population of the counties that would be crossed by a construction spread would increase by 10 percent or more.

- Housing. The project-related demand would cause the vacancy rate for temporary housing to fall to less than 5 percent.

- Public Services. The estimated demand for public services from the project-related population would exceed the existing capacities of affected public services.

- Agricultural Land Resources. The construction of the proposed project would result in the temporary or permanent loss of one percent or more of the agricultural land in a county or a loss of one percent or more of the acreage planted to a county's most valuable corp.

- Forest Resources. The proposed project would result in the permanent conversion of timberland that would cumulatively cause at least a one percent decrease in the volume of commercial timber produced in a state.

Assumptions and Limitations of Analysis

Population Increase and Associated Impacts

Because of the complex nature of the Express Pipeline project, certain assumptions were required to assist in the identification of significant socioeconomic impacts. Population impacts were analyzed by treating the group of counties crossed by each construction spread as a single unit, adding the individual county statistics together. Data on population, housing, public services, employment, and income levels reported by federal and state agencies are typically available on a county-by-county basis. Counties that would not be directly affected by pipeline construction were not included in the analysis. Excluding these counties may, in some cases, overstate the impacts of the project on individual counties.

The analysis of temporary housing supplies was limited to examining housing stocks that were quantifiable. Other housing stocks, such as rooms in private homes and boarding houses, were not quantifiable and were therefore not included in the analysis. The occupancy rates for Montana temporary housing units along the Express Pipeline route are shown in Table 23 of the Socioeconomics section. It can be expected that during peak seasons, the combined demand for temporary housing from tourists, recreationists, and construction personnel would at times exceed the supply. While this would benefit the proprietors of the local motels and RV camps, it could result in the displacement of some tourists or recreationists and could detract from the quality of the recreational experience. The opportunity for this conflict in a specific area, however, would exist for only one summer season.

Agricultural Resource Impacts

All agricultural impacts were identified on a county-by-county basis because data are published on a county-by-county basis by the U.S. Department of Commerce, as well as by state agricultural departments. This method allowed for a consistent comparison between impacts on each county that would be crossed by the pipeline projects.

The analysis of the potential impacts on agricultural production used a worst-case approach. Data on the actual crop types grown in the permanent and temporary rights-of-way are not available; therefore, general assumptions of crop types were made by examining the agricultural land use designations within each county. Agricultural land use designations include rangeland, pasture, dry cropland, broadcast irrigation, row crops, vineyards, and orchards. The total acreage of the most valuable crop in each county was then compared with the total acreage of the agricultural land use designation in which that crop could be grown.

Forest Resources

Losses to timber production were analyzed on a state-by-state basis because of available data. Additionally, it is not uncommon for timber to be transported great distances to centralized processing facilities. These processing facilities may be located in counties that would not be crossed by the proposed pipelines.

No Action Alternative

Under the no action alternative, no beneficial economic impact on the area crossed by the projects would be attained. No short-term increases in local personal income would be realized from the hiring of local workers, contractor purchases of materials and supplies, or spending of nonlocal workers. The project would not generate long-term beneficial effects on local property tax revenues. This would result in an estimated loss of approximately $6 million annually in ad valorem taxes, $5 million in Montana and $1 million in Wyoming.

Impacts Common to All Action Alternatives

Population

Construction of the Express Pipeline project would temporarily increase the population of areas the pipeline would cross. Increases in temporary population levels would occur as workers with the specialized skills needed for pipeline construction, who are not readily available from local pools, move into the area. These increases would exist only during the four-month construction period.

The peak manpower for each construction spread is shown on Figure 5A in Chapter 2 and is estimated at just over 400 people. The comparison, by occupation, of the workers that would be used to construct the pipeline is shown on Table 30. Express would attempt to maximize local hiring when possible, but the proportion of skilled trade workers that would be hired locally would likely be only 21 percent. This is because pipeline construction requires specialized workers not often found in counties where little oil and gas or pipeline construction regularly occurs. Also, the contractors selected to install the pipeline would likely be based outside the project area, and would likely bring in a significant portion of their own skilled workforce experienced in pipeline construction.

Table 30
Express Pipeline Workforce

Occupation	Approximate Allocation of Work force	Approximate Workers Hired from Construction Area
Supervisory	40 (10%)	4 (10%)
United Association	80 (20%)	12 (15%)
Operating Engineers	80 (20%)	16 (20%)
Teamsters	80 (20%)	16 (20%)
Laborers	120 (30%)	36 (30%)
Total	**400 (100%)**	**84 (21%)**

Express plans to maintain three field offices along the route, although the locations have not yet been determined. A total of no more than 30 employees would be permanently placed for the operation of these offices. Impacts due to increases in permanent population levels would be less than significant because so few workers would be needed to operate the completed pipeline.

The temporary increases in population would be based on approximately 79 percent of the total number of construction workers and management personnel Express Pipeline has estimated would be needed for each construction spread. Additionally, it was assumed that 15 percent of the nonlocal workers would be accompanied by their families, and that each family would have three members.

Construction of the Express Pipeline project would proceed at a rate of approximately 1.5 miles per day. It was assumed that all construction workers and management personnel for a construction spread would be located within the same area. As the project progresses, the construction personnel working on different phases of the project would gradually disperse through the area covered by each spread.

Total population for each construction spread includes the counties that would be crossed by the spread. In cases where a construction spread would start or end in the middle of a county, the total population of the county was allocated.

The estimated increases in population within the counties crossed by each pipeline spread are all well below the 10 percent threshold of significance. The temporary population increases, based on 1990 census figures, for each construction spread would be as follows:

Spread 1 (Wild Horse to Denton, Montana): The existing population of Hill County (17,985), Chouteau County (6,092), and Fergus county (13,076) is 37,163. The temporary population increase caused by 355 (79 percent nonlocal) Express workers would be 0.9 percent.

Spread 2 (Denton to Rapelje, Montana): The existing population of Fergus County (13,076), Judith Basin county (2,646), Wheatland County (2,359), Golden Valley County (1,026), and Stillwater County (5,598) is 24,705. The temporary population increase caused by 355 Express workers would be 1.4 percent.

Spread 3 (Rapelje to Montana/Wyoming border): The existing population of Stillwater County (5,598) and carbon County (8,099) is 13,697.The temporary population increase caused by 355 Express workers would be 2.6 percent.

Spread 4 (Montana/Wyoming border to Black Mountain Road, Wyoming): The existing population of Big Horn County (10,525), Washakie County (8,388), and Hot Springs County (4,809) is 23,722. The temporary population increase caused by 355 Express workers would be 1.5 percent.

Spread 5 (Black Mountain road to Casper): The existing population of Hot Springs County (4,809), Fremont County (33,662), and Natrona County (61,226) is 99,697. The temporary population increase caused by 355 Express workers would be 0.3 percent.

Housing

Construction of the Express Pipeline project would increase the demand for local housing. The increase in demand for housing would correspond to the number of nonlocal workers hired for each construction spread. It was assumed that nonlocal workers would choose temporary housing instead of renting apartments or houses. Temporary housing analyzed was limited to campsites, RV sites, and motel/hotel units. Local workers are not expected to move from their current residences.

Demand for housing was calculated by assuming that single construction workers would not share housing units and that workers with facilities would share a single unit. It was also assumed that workers have no preference over campsites, RV sites, or motel/hotel units. The supply of housing units was calculated based on the occupancy rate, and for each construction spread by totaling the estimated number of units in the counties that would be crossed by a respective spread.

The demand for temporary housing and the supply of available housing units were calculated for the project both during the "high season" from Memorial Day to Labor Day, and the "low season" after Labor Day. During the high season, the greatest impact on the temporary housing market would be expected along Spread 1 (Table 31) which would create an estimated vacancy rate of 1.7, a significant impact which exceeds the minimum desirable 5 percent vacancy rate. Also, temporary housing vacancy rates in Spreads 2 and 4 would drop to 2.2 and 3.7 percent respectively. Insignificant impacts would be expected along Spreads 3 and 5 where projected vacancy rates would be 12.2 and 14 percent respectively.

Motels and campgrounds generally stay open through October. Therefore, it is assumed that all the campgrounds and motel unit would be available through the projected construction period through October. Vacancy rates drop to 45 to 64 percent after Labor Day with the Express workers, the Express project would not be a significant impact on temporary housing after Labor Day. Actually, positive benefits would be realized by the temporary housing owners as occupancy rates would be considerably above normal for September and October.

To reduce the temporary housing impacts to less than significant in Spreads 1,2 and 4, the Express workers may have double up in units in July and August. After Labor Day, temporary housing would be abundant for all workers.

Table 31
Projected Temporary Housing Demands Along Express Pipeline Route

		Occupancy Rate			Occupancy Rate		Resulting Vacancy Rate with 355 Express Workers Added	
Spread	Motel Units	High Season	Low Season	Campground Units	High Season	Low Season	High Season	Low Season
1	2260	82%	50%	2185	99%	5%	1.7%	64.2%
2	604	78%	45%	910	72%	24%	2.2%	44.2%
3	3433	86%	49%	4156	80%	28%	12.2%	57.8%
4	785	79%	41%	936	73%	29%	3.7%	45.0%
5	2439	86%	46%	789	41%	20%	14.0%	49.4%

Public Service

The temporary increase in population associated with the construction of the Express Pipeline project may adversely affect certain public services (e.g., medical, water and sewer facilities, waste disposal). The degree of impact would vary from community to community depending upon the number of nonlocal workers (and any accompanying family members) that temporarily reside in each community, how long they stay, and the size of the community. Although these factors are too variable to accurately predict the severity of the impact, the effects would be short-term and are therefore not expected to be significant. Express Pipeline would help ameliorate increased demand for public services by working with affected communities or counties to anticipate and meet increased demands whenever possible.

Agricultural Land Resources

Project implementation would cause the short-term (usually one year) loss of agricultural production from lands that would be crossed by the pipeline as annual crops are cleared from the pipeline right-of-way prior to construction. The total of the rangeland and agricultural land use along the proposed Express Pipeline route is shown in Tables 32 and 33 by county in Montana and Wyoming respectively. It is assumed that all land temporarily cleared for the right-of-way would be returned to preconstruction levels of production. Measures necessary to ensure that disturbed soils are returned to preconstruction levels of productivity are in Soils section of this chapter.

TABLE 32
LAND USE ALONG THE RIGHTS-OF-WAY FOR THE EXPRESS ROUTE THROUGH MONTANA

County	Rangeland			Dryland Cultivated			Mechanically Irrigated Cropland			Flood Irrigated	
	Miles	Perm. ROW (acres)	Const. ROW (acres)	Miles	Perm. ROW (acres)	Const. ROW (acres)	Miles	Perm. ROW (acres)	Const. ROW (acres)	Miles	Perm. ROW (acres)
MONTANA											
Hill	2.8	17.0	30.5	45.5	275.8	496.4	0.0	0.0	0.0	0.0	0.0
Chouteau	8.1	49.1	88.4	49.2	298.2	536.8	0.0	0.0	0.0	0.3	1.8
Fergus	4.8	29.1	52.4	18.1	109.7	197.5	0.0	0.0	0.0	0.0	0.0
Judith Basin	3.3	20.0	36.0	22.6	137.0	246.6	0.6	3.6	6.5	1.0	6.1
Wheatland	20.8	126.1	226.9	14.6	88.5	159.3	0.4	2.4	4.4	1.0	6.1
Golden Valley	8.5	51.5	92.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stillwater	17.4	105.5	189.8	21.5	130.3	234.6	0.0	0.0	0.0	0.5	3.0
Carbon	38.1	230.9	415.7	0.0	0.0	0.0	6.6	40.0	72.0	0.5	3.0
TOTAL	103.8	629.2	1132.5	171.5	1039.5	1871.2	7.6	46.1	82.9	3.3	20.0

Notes: Acres of right-of-way affected by the project are based on Express using a 90-foot-wide construction right-of-way and permanently maintaining a 50-foot-wide right-of-way. Road and railroad crossings are included in the above land uses.

Perm. ROW = Permanent right-of-way Const. ROW = Construction right-of-way

TABLE 33

LAND USE ALONG THE RIGHTS-OF-WAY FOR THE EXPRESS ROUTE THROUGH WYOMING

County	Rangeland Miles	Rangeland Perm. ROW (acres)	Rangeland Const. ROW (acres)	Dryland Cultivated Miles	Dryland Cultivated Perm. ROW (acres)	Dryland Cultivated Const. ROW (acres)	Mechanically Irrigated Cropland Miles	Mechanically Irrigated Cropland Perm. ROW (acres)	Mechanically Irrigated Cropland Const. ROW (acres)	Flood Irrigated Miles	Flood Irrigated Perm. ROW (acres)
WYOMING											
Big Horn	61.0	369.7	665.5	1.3	7.9	14.2	0.0	0.0	0.0	0.0	0.0
Washakie	24.6	149.1	268.4	0.0	0.0	0.0	1.2	7.3	13.1	0.0	0.0
Hot Springs	17.6	106.7	192.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fremont	19.9	120.6	217.1	0.0	0.0	0.0	0.8	4.8	8.7	0.0	0.0
Natrona	59.4	360.0	648.0	2.9	17.6	31.6	0.0	0.0	0.0	0.0	0.0
TOTAL	182.5	1106.1	1991.0	4.2	25.5	45.8	2.0	12.1	21.8	0.0	0.0

Notes: Acres of right-of-way affected by the project are based on Express using a 90-foot-wide construction right-of-way and permanently m railroad crossings are included in the above land uses.

Perm. ROW = Permanent right-of-way Const. ROW = Construction right-of-way

To compute the loss of livestock production from rangeland along the route, the total number of acres categorized as rangeland in each county was divided by the production value for livestock in that county. This figure was then multiplied by the number of acres that would be temporarily taken out of production by pipeline construction. Factors such as the purchase cost of the livestock to the landowner and the productivity of affected rangeland were not considered. The resulting value is the potential value of production that would be lost during construction.

Of the counties along the pipeline route, none would lose more than 1 percent of their total agricultural land during pipeline construction. No county would lose more than 1 percent of its acreage planted to its most important crop, which is the threshold established in the significance criteria.

Forest Resources

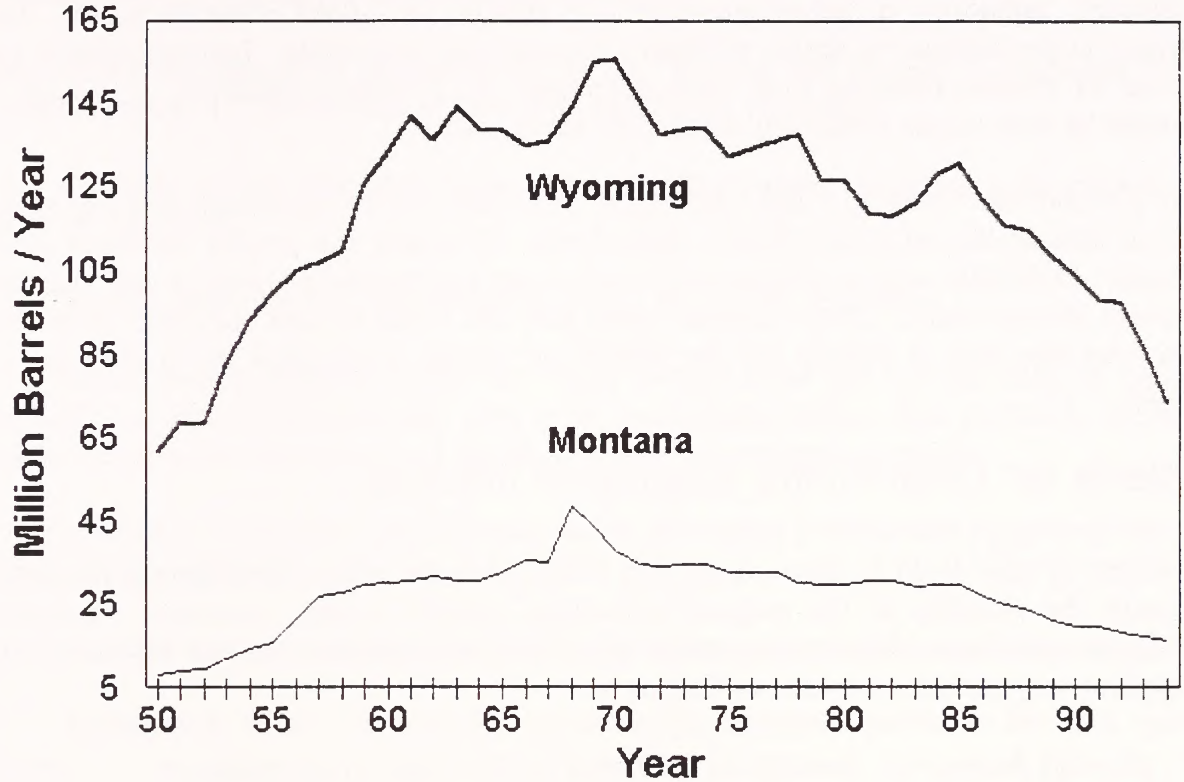
Construction of the Express Pipeline project would result in no impact on commercial forestland.

Local Oil Exploration and Production

Crude oil production in Wyoming and Montana, shown on Figure 13, shows a steady increase from 1950 to around 1970. Wyoming production increased from about 60 million barrels per year (MMBY) in 1950 to a peak production of 157 MMBY in 1970. Production then began an unsteady decline. The oil embargo years of the mid 70s and early 80s resulted in significant oil price increases and corresponding production increases during these periods. However, by 1985, production started a steady decline, dropping from 131 MMBY in 1985 to 78 MMBY production in 1994. In Montana, the trend has been similar. Production increased from about 8 MMBY in 1950 to a peak of 48 MMBY in 1968. By 1994, production had decreased to 16 MMBY.

Two factors account for the decrease in Wyoming and Montana oil production. First, many of the wells were developed in the 1950s and 1960s and are approaching their end of economic production levels. Second, the price of oil has decreased from peak 1980s prices of over $30 per barrel to present day values of about $18-20 per barrel. At this present value of oil, major exploration for new sources of oil is not economically viable.

Oil prices are projected to remain fairly steady at near $20 per barrel until 2000, and then slowly rise to $27 per barrel by 2010 (DOE 1994). Overall production rates within PADD IV (the Rocky Mountain Region) are projected to decrease from 1993 levels of 439,000 barrels per day (BPD) to 301,000 BPD by 2000, and then to 190,000 BPD by 2010. Without a significant increase in oil prices which would probably launch to a major exploration effort, it can be assumed that Wyoming and Montana crude production will continue to decline. Therefore, it can be reasonably concluded that the import of Canadian crude oil via the proposed Express Pipeline should not directly affect oil production in Wyoming and Montana.



Sources: Bureau of Mines (1950-1969), Wyoming Department of Revenue and Taxation (1970-1988), Wyoming Oil and Gas Commission (1989-1993), US Energy Information Agency

Figure 13 Wyoming and Montana Oil Production 1950-1994

CULTURAL RESOURCES

Construction and operation of the proposed Express Pipeline could affect historic, archeological, architectural and/or traditional cultural properties on or eligible for inclusion on the NRHP. Project impacts could include the physical disturbance during construction of archeological sites located within the proposed project right-of-ways; the demolition, removal or alteration of historically or architecturally significant structures; and the introduction of visual elements (pump or meter stations); right-of-way cuts through sensitive areas) that could alter the settings, integrity of location, or feeling associated with historic properties or historically sensitive areas. Mitigative measures would include rerouting the project right-of-way to avoid historic properties; data recovery (scientific excavation of archeological sites, photographic and architectural recording of standing structures); and/or use of buffer zone or vegetative screens, or other landscaping techniques that would reduce or eliminate adverse visual effects.

The potential effects of the project may be either direct or indirect. Direct effects or impacts result from the destruction of historic properties or impairment of the values that make them significant. Bulldozing an archeological site is an example of a direct effect or impact. Indirect impacts on the character or setting of these resources may also occur. Indirect impacts may be caused by erosion resulting from slope regrading, or increased vandalism or looting, made possible by new access roads into previously remote areas.

It is possible that landscapes and historically or architecturally significant standing structures located outside the proposed project right-of-way but within the project viewshed would be affected. Potentially adverse effects could result from the creation of right-of-way cuts through sensitive historic areas. These changes could alter the visual context associated with standing structures that may be eligible for the NRHP, or historic areas listed in, or eligible for, the NRHP.

Criteria for Determining Significant Impacts

A project is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Within the context of the proposed projects, adverse effects on historic properties may include, but are not limited to:

- physical destruction, damage, or alteration of all or part of the property;
- isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the NRHP; or
- introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.

In accordance with the ACHP procedures for implementing Section 106 of the NHPA, the BLM, in consultation with the ACHP, SHPOs, and the appropriate State and Federal agencies has developed a Programmatic Agreement (PA) to address adverse effects that may occur to historic properties as a result of the project. The PA addresses the procedures to be followed to evaluate cultural resources for the NRHP eligibility, assess project effects on historic properties, and develop mitigation measures to address these effects. The PA is included as Appendix L to the EIS and summarized in the following paragraphs.

The BLM has the responsibility to ensure that Class III pedestrian surveys are completed for the entire route which has not been previously inventoried. The BLM will also ensure that consultations with Native Americans are completed. After the surveys and reports have been completed for the entire route, ancillary facilities, and access roads, BLM will distribute the information to the parties of the PA for evaluation. At this point, an evaluation will be made to determine which resources are eligible for the NRHP and the effects of the project on any cultural resources considered to be historic properties.

Based on the conclusions of the parties of the PA, Express will prepare a Treatment Plan for Historic Properties. The Treatment Plan will include the following:

1. List of all historic properties to be affected by the project, including a description of the nature of the effects;

2. Detailed description of treatments proposed for NRHP resources;

3. Archaeological Research Design for NRHP resources that will explain research questions, data needed to explore the questions, sites to be investigated further, data collection methods to explore the research questions, and justification for the research questions;

4. Description of the areas and rationale where controlled construction procedures would be used to protect resources;

5. Listing of and rationale for the properties for which no further treatment is proposed; and

6. Explanation of the methods for involving the interested public in the data recovery process.

The BLM and the interested parties of the PA will review the PA. Upon final approval, the PA will be incorporated into the Construction and Use Plan required for the project right-of-way grant.

The American Indian Religious Freedom Act of 1978 requires the consideration of effects on traditional religious and cultural values and practices. The implementing regulations for the NHPA (36 CFR 800) emphasize the consideration of the concerns of interested parties, such as Native American groups, in the evaluation of cultural resources. Significant impacts would occur if areas with contemporary or sacred values to the Native American community or other interested parties would be directly or indirectly affected by project-related activities.

No Action Alternative

Under the no action alternative, there would be no change in the current level of effects on cultural resources. Existing resources would continue to experience similar levels of impacts from weather and low levels of traffic as they have experienced in recent years. However, the opportunity to discover new resources as the result of extensive surveys and construction activities would not be available.

Cultural Impacts Common to All Action Alternatives

In order to ensure that federal agency responsibilities under Section 106 of the NHPA, and the implementing regulations, are met, the procedures described in the PA would be followed. Notices to Proceed will not be provided by the appropriate land managers until the actions required under the PA have been completed.

Eligibility for listing in the NRHP, for most of the resources identified within the project area (described in Chapter 3) by the background search and pedestrian Class III surveys has not been formally determined by the agencies. However, the destruction, damage, or alteration of all or part of these sites could be significant impacts because the resources have not been formally determined to be ineligible for listing in the NRHP. The BLM, SHPOs and other appropriate agencies would review and approve an Express workplan before construction would commence.

Mitigation for eligible sites may include avoidance, data recovery, the use of buffer zones or vegetative screening, or boring when ground conditions permit. Boring or directional drilling may be especially useful in the case of linear features such as trails. Express is prepared to cross trails listed on or eligible for the NRHP by boring, if ground conditions permit. Data recovery plans would be implemented in consultation with the SHPOs, the ACHP, and the appropriate federal agencies.

Paleontology Impacts Common to All Action Alternatives

Paleontologic resource impacts could occur from construction of either the pipeline or the pump stations, as well as from increased public access to these areas. The evaluation of impacts on paleontologic resources is based on a preliminary review of published scientific literature and information available at institutions serving as repositories for paleontologic resources (e.g., American Museum of Natural History). An inventory also was completed.

Direct physical modifications of paleontologic resources may occur during project construction through ground-disturbing activities, such as trenching. Indirect impacts during construction may result from erosion caused by slope regrading or the unauthorized collection of fossils by project personnel. In addition, maintenance of cleared pipeline rights-of-way and operation of constructed facilities (e.g., pump stations) may result in further direct or indirect physical alterations of paleontologic resources. Increased public access to previously undisturbed areas may result from the construction of service roads and maintenance of cleared pipeline corridors. Unregulated access may create direct and indirect adverse impacts on paleontologic resources.

Paleontologic resources with significant values that lie solely in the scientific data contained in the deposit may be excavated under a data recovery plan developed in consultation with qualified paleontologists and appropriate federal agency officials (e.g., FS and BLM). Completion and approval of a data recovery plan would result in a less-than-significant impact on resources of this type.

No published records exist of paleontologic sites within the Area for Potential Effects (APE) in Montana. The proposed pipeline would, however, intersect or pass within 0.5 mile of two geologic formations considered to have a high potential for containing fossil remains.

The Judith River and Hell Creek Formations, dating to the Cretaceous Period, would be crossed by the pipeline in Hill, Chouteau, Judith Basin, Wheatland, and Carbon Counties. These rock units are particularly prevalent in the Judith River Basin and Musselshell River areas between MP 145 and MP 195. Important fossil reptilian and mammalian assemblages are known to occur in these formations. Of special concern within these formations are the isolated dinosaur skeletal remains found in bank deposits, the articulated skeletal remains encountered in channel sand deposits, and the microvertebrate faunal resources found in association with freshwater clam beds.

The second resource of interest in Montana is the Paleocene-age sediment found in Carbon County. Important fossil mammalian resources are known from these sediments.

Although there are no published references to particular paleontologic resources within the APE in Wyoming, the project would intersect or pass within 0.5 mile of eight geologic formations considered to have high potential for containing important fossil remains.

Significant fossil reptilian and mammalian faunal assemblages are known to occur in the early Cretaceous rocks in Big Horn County (near MP 301-375). The Willwood Formation, of Wasatchian age, encountered in Big Horn and Washakie Counties is known to contain significant mammalian assemblages. In Hot Springs County, fossil mammalian remains are noted within the Aycross Formation.

HAZARDOUS MATERIALS

The following is a list of potentially hazardous materials that probably would be used by Express and its contractors during the construction of the pipeline:

- gasoline, diesel fuel, oil, grease, lubricants, antifreeze, battery acid;
- oxygen, acetylene, propane, nitrogen;
- fusion bond epoxy coating, resin, liquid epoxy coating;
- paints, base coats, thinners; and
- explosives and detonators.

To reduce the potential impacts resulting from the use or spill of hazardous materials, Express would develop a Hazardous Materials Management Plan. The following is a description of the items that would be addressed in the Hazardous Materials Plan.

Refueling of vehicles and storage of fuel, oil, or other fluids near surface waters or wetlands would create a potential for contamination if a spill were to occur. Construction equipment could potentially leak fluids into water bodies during construction. Staging areas will be located at least 50 feet away from the wetland/riparian edge, where topographic conditions permit. The size of the staging area will be limited to the minimum needed to construct the wetland crossing. Hazardous materials, chemicals, fuels and lubricating oils will not be stored within 100 feet of the wetland/riparian boundary. Construction equipment will be refueled at least 100 feet from the wetland/riparian boundary. All maintenance of construction equipment will be performed at least 100 feet from the wetland/riparian boundary. Any spills that do occur during refueling or maintenance will be promptly cleaned up.

Waste materials such as pipe coating, spent welding rods, containers, cans, used engine oil and other detritus from pipeline activities will be collected daily and disposed of at approved landfills and waste disposal sites.

Continuous efforts will be made to prevent and control range and forest fires. All muffler systems will have spark arrestors to reduce noise pollution and the risk of fire.

Express will also employ environmental inspectors to ensure that appropriate techniques to minimize environmental impacts are implemented. There will be at least one environmental inspector assigned to each construction spread. It will be the responsibility of each environmental inspector to bring to the immediate attention of the construction supervisor and Express, any activity which may cause negative environmental impact. Daily meetings will be held between the environmental inspector(s) and the Express construction representative to discuss the environmental implications of the construction, compliance and possible impacts of the day's activities. A daily written report will be made by the environmental inspector.

The environmental inspector will also act as the liaison between the construction supervisor and environmental surveillance officers employed by regulatory agencies. Should a situation arise in which there is a clear contravention of environmental specifications and in which the delay necessary for proper communications could result in unnecessary environmental impact, the environmental inspector will take immediate action to have the specific task discontinued until appropriate Express personnel have been informed. Although expected to be infrequent, these situations will be handled according to the individual circumstances demanded by each particular problem. Contingencies for such events will be worked out during preconstruction meetings.

PIPELINE SAFETY AND RELIABILITY

An evaluation of the potential impacts of a failure in the Express Pipeline can be assessed by analyzing the following parameters:

1) Developing a risk assessment of an Express Pipeline failure based on historic frequency of pipeline spills;

2) Analyzing the safety factors which Express would employ in construction and operation of the pipeline; and

3) Evaluating the adequacy of Express' measures to respond to a potential spill.

Since an absolute prediction cannot be made whether the Express Pipeline would experience a leak or rupture during its lifetime, impacts discussed in this section are considered potential impacts.

No Action Alternative

The proposed Express Pipeline would not be constructed under this alternative. However, other pipelines may be built to supply the projected crude oil deficit in the Rocky Mountain region. Impacts resulting from crude oil spills, although at different locations and timeframes, would be similar to the effects of the Express pipeline described in this section.

Impacts Common to All Action Alternatives

Risk Assessment

The Office of Pipeline Safety (OPS) of the U.S. Department of Transportation requires operators to report failures that result in fatalities, injuries that require hospitalization, or property or product loss in excess of $5,000 for liquid pipelines (Transportation Research Board, 1988). Between 1971 and 1986, 3,753 failures in liquid pipelines were reported. Because the property loss threshold for reporting remained constant during this period despite a near trebling in prices, an annual increase in the number of reported failures might be expected simply because the real value of reporting threshold for property and product losses declined. However, as shown on Figure 14, the main distinguishable trend is a decline in failures from between 250 and 300 per year in the early 1970s to a yearly average of fewer than 200 during the 1980s. This decline coincides with improvements in corrosion control technology and with the introduction of stricter federal regulations for liquids pipelines.

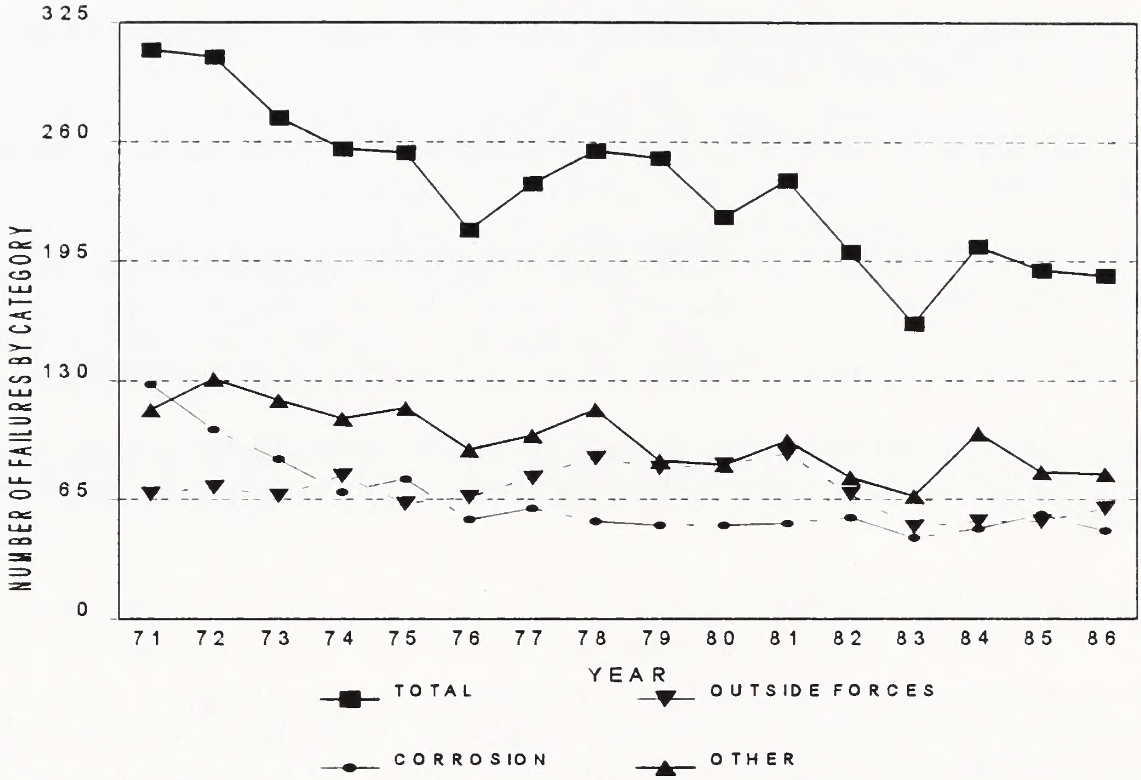


Figure 14 Liquid Pipeline Failures, 1971-1986

The OPS requires operators to specify in their reports the reason for a pipeline failure as outside force damage, corrosion, defective material or construction, or "other". The primary cause for pipeline failures is damage from outside forces, which from 1971 to 1986 accounted for 30 percent of liquids pipeline failures. Corrosion is the second leading cause of pipeline failures, accounting for 28 percent of the failures. However, corrosion has become less of a problem as corrosion control methods, pipeline materials, and maintenance have improved. Construction and material defects, equipment failures, incorrect operation, and unidentified causes were responsible for the remaining 42 percent of failures reported. Approximately one-half of these failures are classified as "other" in reports to OPS. Therefore, only 21 percent of liquid pipeline failures are the result of defective materials, equipment, and incorrect procedures. From this extensive past history of liquid pipeline spills, it can be assumed that projected spills would be caused by external forces, i.e., damaging the pipe through incorrect excavation practices 51 percent of the time, corrosion 28 percent, and defective materials or incorrect procedures 21 percent.

The U.S. Environmental Protection Agency (EPA, 1982) reports the average spill rate for pipelines as 0.0005 spills per mile-year for lines larger than a 14-inch diameter. Furthermore, 70 percent of the spills were 50 barrels or less. The distribution of the remaining 30 percent of the spills is shown on Table 34.

Table 34
Crude Oil Pipeline Spill Size Distribution

Past 1971-1975		Predicted for Express Pipeline (over 515-mile length)	
Spill Size (barrels)	% of Total Number	Spill Risk Factor (spills/mile-year)	Number of Spills within 25 years
50	70	.000350	4.4
50 - 100	8	.000040	.5
101 - 500	13	.000065	.8
501 - 1000	4	.000020	.25
1001 - 5000	3	.000015	.19
>5000	3	.000015	.19

Projecting these distributions to the expected spill rate for the 515-mile Express Pipeline over a 25- and 50- year lifetime, the following predictions can be made:

- Four spills of 50 barrels or less and two spills of over 50 barrels could occur in the first 25 years of the pipeline. However, 50 percent of spills are the result of corrosion, defective materials and equipment, or incorrect procedures, and the other 50 percent are the result of external forces. Because it can be assumed that the probability of incorrect excavation in and near riverbeds is very low, the probability of a spill in or near a river or stream would be reduced by half to:

  Two spills of 50 barrels or less and one spill of over 50 barrels could occur in the first 25 years of the pipeline.

- Nine spills of 50 barrels or less and four spills of over 50 barrels could occur during the second 25-year period of the pipeline. For the same reasons discussed above, the probability of a spill in or near a river or stream would be reduced by half to:

  Five spills of 50 barrels or less and two spills of over 50 barrels could occur during the second 25-year period of the pipeline.

- The projected number of major spills, i.e., greater than 500 barrels, could be considerably lower (.31 during the first 25 years, and .62 during the second 25-year period).

Express Safety Factors

Design and Construction

The proposed pipeline consists of approximately 515 miles of buried 24-inch diameter pipe, five pump stations, and a meter station. The pipeline system would be designed and constructed in accordance with the DOT regulation 49 CFR Part 195. The pipe would be externally coated with fusion bond epoxy (14 mil minimum) and cathodically protected with a combination of impressed current and sacrificial magnesium anodes.

Mainline block valves would be installed at a maximum spacing of 25 miles and at upstream locations of all major river and stream crossings. The mainline block valves would be located approximately 100 feet upstream of major river crossings, and check valves would be approximately 100 feet downstream. Likewise, the check valves would be installed approximately 100 feet downstream of the major rivers and streams. The block valves would be remotely operated. Scraper traps, to permit on-line pigging, would be installed at Pump Station #5 (MP 123), Pump Station #7 (MP 325), and the Casper Metering Station (MP 510). Cathodic protection test lead stations would be installed at two mile intervals along the pipeline.

During construction, Express would employ experienced pipeline inspection personnel to ensure that the facilities would be installed in accordance with certificate and permit conditions, code requirements, and construction specifications. Each weld would be radiographically inspected, repaired if necessary, and coated prior to lowering of the pipe into the trench. Hydrostatic testing of each section would be conducted to a minimum of 1.25 times the maximum operating pressure to ensure the integrity of the pipeline.

Operation and Monitoring

After completion of construction, the pipeline right-of-way would be patrolled by aircraft once a week. Every three years, on-line pigging would be conducted along the entire route to inspect for potential corrosion problems. These inspection measures would identify potential pipeline exposure and physical damage to the right-of-way and other activities that might constitute a safety hazard. Appropriate remedial measures would be taken immediately. The potential landslide prone areas at Arrow Creek (MP 112.0 to 115.0) and Big Kirby Creek (MP 417 to 410) would be thoroughly checked for possible land movement during the maintenance inspection.

Maintenance activities would include scheduled pipeline leak surveys. All valves would be inspected semi-annually, operated, and lubricated. The cathodic protection system would be surveyed annually to verify the effectiveness of the system. The electrical outputs of the rectifier installations would be checked. The performance of the cathodic protection system would be monitored by maintaining a record of rectifier voltage and current readings. Any significant changes in these readings, beyond that anticipated due to seasonal variation in soil conditions, would indicate that adjustments to the cathodic protection systems or minor repairs to the pipeline's facilities may be required. Readings would be taken of test leads attached to the pipe, which would be accessible at the test lead stations.

The pipeline would be remotely operated and controlled from a central control center in Sherwood Park, Alberta, Canada, using the Communications, Supervisory Control and Data Acquisition (SCADA) computer system. Personnel at the center would continuously control crude oil flow in the pipeline, monitor operating conditions at all pump stations and other critical locations, and provide leak detection monitoring for the pipeline. Every minute, the SCADA calculates the volumetric balance with line pack compensation from Hardisty to Casper. The nine pump stations (four in Canada and five in the U.S.) and the Casper meter station would be monitored remotely from the control center. If an accidental spill would occur, the loss of pressure in the pipeline system would be detected by the SCADA system. If a rupture in the line (loss of at least 50% of the crude oil at a point), the SCADA would detect this rupture within minutes. A small leak (1% of the flow at point) would take 24 hours or longer to detect. After the operator would verify the spill, first the pump stations would be shut down, and then the valves to locate the spill. If any crude oil would back-flow, the check valves would automatically detect the reversal and automatically shut down. The entire line could be shut down in 10 to 15 minutes after detection. Personnel would be immediately dispatched to the spill and the SPCCP procedures would be immediately implemented.

Express' proposed construction, operations, and maintenance plans should ensure that all precautions would be taken to reduce the probability that a major oil spill (over 500 barrels) would occur. The final and completed safety plans would be included in the Final Design Review and Plan of Operations which would be submitted to the regulatory agencies before construction would begin.

Spill Response Measures

Although the likelihood of a major oil spill in excess of 50 barrels is small, Express would be required to submit a SPCCP to the BLM, the MDEQ, fire departments and county agencies in all 13 counties that the pipeline would cross before construction of the pipeline. Express has reasonably addressed the measures necessary to reduce the probability of an oil spill. However, the following measures, as proposed by Express in the project description, need to be fully expanded into an emergency plan in the event of a spill:

Emergency Shutdown Procedures

Classification of Events that Require Response

Effective Response to Spills, Explosions, Fires, and Natural Disasters

Rapid Communication and Coordination with Federal, State, and Local Authorities

Technical data to include safety information and methodologies to be used to contain and clean-up spills;

Personnel Required and readiness status to respond to emergencies;

Emergency Equipment and Supply Sources

Evacuation Procedures

Training for Emergency Personnel

Periodic Review and Update of the Plan

The SPCCP needs to list the personnel involved (along with current addresses and telephone numbers), the type of equipment needed and the location and availability, notification of and coordination with local, state and federal authorities, type and frequency of training for emergency responses, and the procedures to ensure that the SPCP will be reviewed and updated at least annually.

Pipeline Casing Alternative

Under this construction alternative, Express would be required to install a casing pipe around pipeline crossing major perennial rivers (shown on Tables 8 and 12 in Chapter 3). This procedure would be implemented to decrease the external corrosion potential of the pipe, and thus decrease the probability of a crude oil spill in a major river.

As background information, it is important to note that pipelines have been historically installed inside casing pipe underneath railroads and highways. This practice was done as a result of previous concerns regarding point loads and not as a measure to contain spills. Concern in the industry caused by the carrier pipe and the casing pipe, i.e. "Shorting", or bending and increased corrosion to the carrier pipe, has been problematic. Operating history and subsequent industry experience has shown that properly installed river crossings by either open-cut trenching or boring techniques has minimized the potential of spills.

As a further matter of clarification, crossings that contain pipe encased in concrete coating should not be confused with "cased" crossings. River crossings, when properly installed, tend to be the most secure segments on a pipeline project for the following reasons:

1) Heavywall pipe, i.e., greater pipe wall thickness than the standard mainline carrier pipe, is generally installed at major river and stream crossings;

2) The river crossing pipe is concrete coated to provide negative buoyancy and protect the pipe during installation, backfilling and system operation;

3) Major crossings are welded up on the banks, welds are radiographed, joints are coated, the entire section is hydrostatically tested before and after installation and backfilling; and

4) The crossing pipe is installed at a depth that exceeds the calculated scour depths. This depth of burial further protects the pipeline from natural or human damage.

When concrete casing is installed, the pipe is initially covered with wrapping. With time, the wrapping begins to disintegrate, and a space is then left between the pipeline and casing pipe. This space can become a cavern for air and moisture. Over time, more external pipeline corrosion may occur as a result of an increase of air and moisture on the external surface of the pipe. As a result, this alternative may actually increase the probability of an oil spill at or near a river or stream.

RECOMMENDED MITIGATION

Several mitigation measures would be implemented by Express in the final Plan of Development before construction begins. These measures are recommended in addition to Express' committed mitigation in order to reduce potential impacts identified in the impact analysis.

Acoustic Shock to Fish

Effects of riverbed explosions would be mitigated by several factors. Teleki and Chamberlain (1978) suggest that active construction in the stream area would scare most fish out of the area prior to detonation. Detonation could be done in such a manner (e.g., utilizing delayed detonation, air bubble curtains) as to reduce the total acoustic shockwave intensity to the greatest extent possible, based on site-specific conditions. Additionally, prior to each detonation in rivers (greater than 100 feet wide), a disturbance such as a scare blast could be used to scare fish out of the area. Although some difficulty in excavation in riverbeds is anticipated, it is expected that in most cases the use of a large track hoe with a rock bucket would preclude the need for explosives. If the trench cannot be excavated with a hoe and rock bucket, a hydraulic hammer may prove the most economic method of completing the trench in a riverbed.

In the worst case scenario described above, laterally compressed fish could be affected as far away as 490 feet from the detonation, and rounded fish as far away as 197 feet. These effects would be temporary and could result in some fish mortality. Most fish would be scared away from the immediate area during initial drilling, there would be a reduction in shockwave intensity by blasting delays, and only a small portion of each river would be impacted.

Slope Stability

Express would implement the following measures to mitigate hazards posed by potentially unstable slopes:

- divert water seeps and concentrated surface runoff by using standard erosion and sediment control measures;
- install ditch plugs at slope crests and significant breaks in slope;
- install subsurface drains;
- avoid undercutting landslide toes with the trench or with sidecuts on the construction side of the right-of-way.
- stabilize landslides that are directly crossed by the pipeline, either by dewatering or buttressing at the toe or within the slide mass;
- monitor by aerial patrols and site visits all active landslides crossed by the pipeline; and
- monitor and regularly maintain all structures installed to stabilize landslides.

Surface Faulting

To protect its pipeline from displacement-induced damage near the Cedar Ridge/Dry Fork fault, approximately five miles from Lost Cabin (MP 430), Express would conduct detailed geological/geotechnical studies during the detailed design phase. If evidence of Holocene surface displacement is found, Express would implement "appropriate design measures," including placing the pipe in a V-shaped trench across the fault zones. Depending upon the particulars of the fault, this approach can be effective to accommodate movement at the fault while limiting shear and compressive strains on the pipeline.

Vegetation

In areas where winter range vegetation would be removed, a seed mix that includes forbs and shrubs would be used in addition to the native grasses.

Visual Impacts

To minimize the visual impacts at the eight locations identified in this EIS, Express would implement the measures described below in the Plan of Development.

Minimize Clearing

An onsite inspector would monitor clearing. Clearing would be minimized as much as possible at stream and road crossings. Trees would be left as close to the downhill side of the pipeline as possible. Landings and turnouts would be located on exposed slopes or on crests of ridges if topographic conditions permit.

Clearing in forested lands should not leave abrupt, straight lines. Clearing could create curvilinear boundaries instead of straight lines, and minimize scarring of the landscape. Grading would be done to minimize erosion and to conform to the natural topography. The right-of-way would be cleared by scalping vegetation rather than scraping and grading, wherever possible.

Minimize the Area Affected by Road Crossings

Staging areas and temporary work space would be located at least 50 feet from the roadside if trees exist at the crossing. A screen of trees could be left in place at these road crossings.

Minimize Stream Crossing Impact

Staging areas and additional temporary work space would be located 100 feet from the streambank or beyond the riparian vegetation zone, whichever is nearer to the streambank. However, at no time are the staging areas to be located closer than 50 feet to the streambank. Stream, river, and other water shorelines would be restored to their original condition and contour. Boulders would be returned to their original locations and set to the original soil line.

Reduce Surface Contrast

Surfaced soil material would be replaced with the same color material where existing soil surfaced and backfill colors contrast. The original surface material may be stockpiled and re-spread.

Restore Earthforms

All disturbed land would be restored to the original contours. An inspection would occur between one and two years after construction completion to document all areas where settling and other defects have occurred. The contours would then be restored within one year of inspection. Cut and blasted slopes would be rounded at the top to blend the cut and provide a transition. Boulders that have been displaced and stored to one side of the right-of-way would be redistributed over the area in a random manner. No rows or boundaries of newly placed boulders would remain.

Retain Rock Outcroppings

To avoid disturbance, the pipeline route would be rerouted around rock outcropping. Rock outcroppings that cannot be avoided could be documented and replaced. Outcroppings would be reconstructed to as close to their original condition as possible. Rocks would be set to their original soil line.

Above Ground Facilities

All semipermanent and permanent facilities would be located, designed, and painted to blend with the natural surroundings. It is desirable that as many facilities as possible be painted a uniform, non-contrasting color. Semipermanent and permanent structures are those facilities that are onsite more than 90 days after completion of the project. The color at each site would be chosen from the BLM 10 Standard Environment Color System. BLM selection criteria for colors would be followed.

If technically feasible, electrical lines could be buried. Otherwise power lines would be located at the base of slopes to provide a background of topography or natural cover. Materials used to construct towers or poles would harmonize with the natural surroundings. Where natural wood poles are appropriate, the color range would be limited to present a unified series of poles. Choice of conductor material would be carefully considered to avoid a strong silhouette and to provide blending of the conductors into their setting. When lines are adjacent to roads, guyed towers could be avoided to limit the visual impact.

Environmentally Sensitive Areas

In addition to the five visually sensitive areas in Montana listed on Table 21 of Chapter 3, the MDEQ would recommend the same visual mitigation measures for environmentally sensitive areas in Montana. Particularly, two of these areas would be the Lewis and Clark Trail at the Missouri River crossing (MP 69) and the Old Fort Benton Stage Coach Trail near the Arrow Creek Breaks (MP 112). These measures would be in addition to Express' committed mitigation listed in Appendix B, Preliminary Rehabilitation Plan.

Safety for River Crossing Construction

To protect boaters and fishermen during instream construction on major river crossings, Express would install appropriate warning signs upstream and print a notice of the upcoming river crossing schedule in a local newspaper for general distribution. This would be referenced in the site-specific plans required for all major river crossings by the States of Montana and Wyoming.

CUMULATIVE IMPACTS

As defined in the Council of Environmental Quality Guidelines, Section 15355: "Cumulative impacts refer to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental effects.... Cumulative impacts can result from individually minor, but collectively significant, projects taking place over a period of time. Cumulative impacts are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions".

The Express route would be within the FERC-Certificated Altamont natural gas pipeline corridor, with a few minor route variations, from the Canadian border for 425 miles to Lost Cabin, Wyoming. It would then follow the route of the previously proposed Amoco CO_2 pipeline from Lost Cabin to Hell's Half Acre (MP 435-475). Finally, the pipeline would generally parallel the existing Platte Pipeline Company crude oil pipeline to the terminus at Casper, Wyoming. Impacts from the Express Pipeline would have cumulative effects with the planned Altamont and Amoco pipelines for 475 miles, and the existing Platte pipeline for the remaining 35 miles.

Cenex Inc. (Cenex) plans to construct a 16-inch crude oil pipeline in late August, 1995. The pipeline will extend from the Cenex Santa Maria terminal north of Cut Bank, Montana to Laurel, Montana. This pipeline will deliver sour crude oil to the Laural and Billings refineries. The right-of-way for construction will be 75 feet wide. The Cenex pipeline will be constructed within three miles of the Express route from about 15 miles north of Judith Gap to 15 miles northwest of Laurel. The Cenex and Express lines would cross three times. The first crossing would be at Roberts Creek (Express MP 179). Subsequent other crossings would be five miles north of Shawmut (Express MP 194) and the South Fork of Big Coulee Creek (Express MP 214). Impacts from the Express Pipeline may be cumulative with the Cenex Pipeline over a distance of approximately 100 miles.

The Express Pipeline construction is planned from July to October 1996. The Cenex Pipeline is scheduled to begin construction in late August 1995. The Altamont natural gas pipeline was certified for construction by FERC in 1991. For the sake of the cumulative analysis, it is assumed the Altamont Pipeline will be built in 1997, one year after the Express Pipeline, and the Cenex line will be built on schedule, one year ahead of the Express Pipeline. The EIS to approve the Amoco CO_2 was completed in 1989. While no action has been taken by Amoco to begin the permitting process, the application has not been withdrawn. Therefore, the assumption for this cumulative analysis is that the Amoco pipeline will be constructed in 1998, two years after the Express project. The Platte Pipeline has been in service for over 40 years. Accordingly, it is assumed that reclamation is complete, and the Express project would not cumulatively add to any effects of the Platte Pipeline.

Many of the impacts identified for the Express Pipeline would be short-term effects related to construction. Most of these impacts, (e.g., turbidity and sedimentation in rivers, construction related dust and noise, effects on boating, hunting, fishing, etc.) would last at most two to three weeks at any one location. After construction is complete, these impacts would cease. Since construction of the three pipelines is assumed to all be separated by a year, these temporary construction related effects would not have a cumulative effect.

The rest of this section describes the cumulative effects of the Express Pipeline project by the resource areas analyzed in this chapter.

Geology

The only significant geological hazard identified for the Express Pipeline was potential landslides hazards in two areas, Arrow Creek in Montana and West Kirby Creek in Wyoming. As a result of intensive geotechnical studies, Express aligned their route such that it would not parallel the Altamont route through these two locations. With the separation of these routes, no significant cumulative impacts to geological resources would occur.

Soils and Vegetation

The Altamont Pipeline would impact approximately 5,150 acres of soils and vegetation in addition to the 4,635 acres disturbed by the Express Pipeline along the similar portions of the two pipelines. The Cenex would impact approximately 909 acres of soil and vegetation along the 100 miles where construction would be within three miles of Express and Altamont. Additionally, the Amoco pipeline would disturb an additional 436 acres where the two pipelines would be constructed along adjacent right-of-ways. Approximately 34 percent of the two routes have soils with a poor reclamation potential. Since the generally rangeland vegetation removed for construction is very widespread and abundant in both Montana and Wyoming, there would be no significant cumulative impact. However, a short-term cumulative impact to vegetation resources would occur where the reclamation potential is poor.

Hydrology

Impacts to rivers and streams would generally be temporary for all pipeline projects during the construction phases. However, increased turbidity and sedimentation would only last two to three weeks at any given river or stream, and would cease within 24 hours after construction. Since the projects would each be a year apart, no cumulative impacts to hydrology are expected.

Air Quality and Noise

Construction noise and air quality impacts would cumulatively not be significant since construction would occur at yearly intervals. In the operational phase, the Express pipeline would not add to the cumulative impact to air quality since the Altamont and Amoco emissions would be nitrous oxides, and the Express emissions would be small amounts of volatile organic compounds. Cumulative impacts to air quality may occur if a Cenex pump station is constructed adjacent to an Express pump station. An Express pump station would emit less than 100 pounds per year of volatile organic compounds. It is assumed that the Cenex emissions would be similar. Therefore, the effects would be insignificant. There would be a minor cumulative noise impact if a Cenex pump station would be adjacent to an Express pump station. Because the Altamont and Express compressor and pump stations would be well separated, there would be no cumulative noise impact.

Terrestrial Wildlife

Impacts during the construction phase would scatter most small wildlife species during the construction at any given location for a few weeks. Most of the species would return shortly. Cumulative impacts may be significant, especially along the co-aligned Cenex portion of the route, because species could be displaced for three years in a row. This impact would not be significant along the Express-Amoco route, since the construction would be two years apart.

Cumulative impacts to game species would be significant if construction would occur three consecutive years during the winter; however, winter construction is not expected for any of the pipeline projects.

Aquatic Wildlife

Cumulative impacts to fisheries could be significant along the Express-Altamont route if river crossings would be conducted during spawning periods (October 1 through March 1). Increased sedimentation may damage spawning habitat by filling hollows in the river bed. If the Cenex, Express and Altamont projects all occurred during key spawning times in consecutive years, three spawning seasons could be significantly impacted.

Threatened, Endangered, and Sensitive Species

The Express project would cause no impacts to threatened, endangered, or sensitive species. Since the other two pipelines would parallel Express, no significant cumulative impacts would be expected.

Land Use

The only permanent above-ground facilities would be pump and compressor stations and above ground valve assemblies for the four pipeline projects. The small acreage of these facilities (one to three acres for each above ground facility) would be insignificant.

Aesthetically, the cumulative effect of adjacent construction of the Cenex, Express and Altamont pipelines would be significant to the individual land owners. The major impact would be the construction of the Express and Altamont pipelines because, in most cases, the rights-of-way are adjacent for the 435-mile length through Montana and Wyoming. Along these two rights-of-way, agricultural activities would be interrupted for two consecutive seasons. Also, the annoyance factor of construction (increased traffic, dust and noise) for two consecutive periods would occur. The cumulative effects of the Cenex construction would be much less because, in most cases, the Cenex construction would be one to three miles from the Express and Altamont rights-of-way. However, the traffic annoyance factor would probably still occur.

Recreation

Recreation resources would only be effected in the short term during construction of the three pipelines. Since construction activities would be a year apart for all projects, there would be no significant cumulative impact on recreation.

Visuals

Cumulative impacts to visual resources along the Express-Altamont would be significant at the locations identified in this analysis. Impacts at the Yellowstone River and the Clarks Fork of the Yellowstone River would be long-term as a result of the clearing of riparian forest along the banks for an adjacent right-of-way of 145 feet. Impacts along U.S. Highways 212 and 310 would be significant, but for a shorter time, because the entire disturbed width would be double in width and remain until regrowth of vegetation. This would be an cumulative impact to the vistas encountered along primary routes to Yellowstone National Park. Cumulative visual impacts resulting from the Cenex project would only occur at those locations where the routes intersect or would be within ½ mile of the Express and Altamont rights-of-way.

Transportation

There would be no significant cumulative impacts to transportation resources because the construction of the four pipelines would nor occur simultaneously.

Socioeconomics

The Altamont and Amoco pipelines, and to a certain extent the Cenex pipeline, would slightly increase job opportunities during the construction phases. Additionally, the cumulative tax revenues would almost triple with the completion of the Cenex, Altamont and Amoco pipelines.

A stress would be placed on temporary housing availability for the two consecutive years of Express and Altamont construction. Because the Altamont construction crews would be roughly the size of Express, vacancy rates are projected to drop below five percent in construction spreads 1, 2 and 4. This may impact tourism and recreational opportunities. On the other hand, the increased occupancy would have positive economic benefits to the motel and campground owners. Construction of the Cenex pipeline would only affect Express spreads 2, 3 and 4. Therefore, a cumulative housing shortage associated with the Cenex and Express projects would only affect Spreads 2 and 4.

Cultural Resources

The Express and Altamont and the Express and Amoco pipelines would be constructed along essentially adjoining right-of-ways. The Cenex line would parallel the Express and Altamont pipelines for approximately 100 miles. Each of the four pipeline construction projects would undergo extensive cultural resource pedestrian surveys, follow-up determination of NRHP eligibility, and extensive mitigation measures to protect eligible resources. Additionally, an environmental inspector would be on-hand for all four projects to ensure evaluation and mitigation for an uncovered resources. Considering the extensive surveys, evaluations and clearances that would be performed before construction, the probability of destroying valuable cultural resources is small. In fact, the possibility exists to discover buried resources heretofore unknown. Accordingly, the cumulative effect of the four pipelines may very well be beneficial to survey and perhaps discover cultural and paleontological resources.

Pipeline Safety

The Express Pipeline would not add to the cumulative effect of potential oil spills with Altamont and Amoco pipelines because both are gas pipelines and would have no safety cumulative effect with the Express pipeline. Potential impacts from gas leaks would be much less significant than for an oil spill.

The cumulative probability an oil spill occurring from either the Cenex or the Express Pipelines would be doubled in and near rivers and streams over the anticipated lifetime of both projects. The Cenex and Express pipelines would both cross 16 perennial rivers and streams. However, the crossings of five of these rivers and streams (Missouri River, Arrow Creek, Dry Wolf Creek, Sage Creek, and Louse Creek) would be from five to 50 miles separated. The remaining 11 rivers and stream (Judith river, Hauck Coulee, Big Coulee Creek, Ross Fork Creek, East Buffalo Creek, Dry Creek, Ross Fork Creek, Musselshell river, Mud Creek and Fish Creek) crossings would be separated by three miles or less. Based on the analysis presented earlier in this chapter, the combined probability of an oil spill from both the Cenex and Express pipelines in or near the same rivers or streams would be:

> Four spills of 50 barrels or less and two spills of over 50 barrels could occur in the first 25 years of the pipeline.
>
> Ten spills of 50 barrels or less and four spills of over 50 barrels could occur during the second 25-year period of the pipeline.
>
> The projected number of major spills, i.e., greater than 500 barrels, could be considerably lower (.62 during the first 25 years, and 1.24 during the second 25-year period).

Although the likelihood of spills is small, the impacts to water, aquatic resources, waterfowl, and vegetation described in this chapter would be significant if a spill would occur.

Unavoidable Adverse Impacts

Construction of the Express Pipeline would result in some direct and indirect unavoidable impacts. Vegetation would be removed along the right-of-way for construction. The short-term adverse impacts to wildlife forage and visual impacts on rangeland could not be avoided. However, these impacts would be reduced gradually as the revegetation process continues. However, in some areas where the reclamation potential is poor on rangeland due to terrain and soil conditions, the visual "scar" of the pipeline construction route may remain for years.

Irreversible and Irretrievable Commitment of Resources

The Express pipeline construction would result in an irreversible and irretrievable commitment of resources from direct consumption of fossil fuels for construction, materials used during construction, the manufacture of new equipment that cannot be recycled at the end of the project's useful lifetime, and the energy required for the production of materials used in the new equipment. However, the relatively small scale of the project would result in an adverse but not significant impact due to this consumption of resources.

Future development along the 515-mile Express right-of-way would need to consider the placement and depth of the pipeline. Construction of the pipeline would not result in an irreversible and irretrievable commitment of resources because the land would be restored to its original condition at the end of the project's useful lifetime. The land along the right-of-way would then be available for any desired beneficial use.

The construction and operation of the Express pipeline would not result in the loss of any animal or plant species. However, it would involve the loss of some animals and plants. Biological habitat may be affected for the lifetime of the project, but the habitat would revert after the useful lifetime of the project.

If cultural or paleontological resources are discovered during construction and cannot be avoided, recovery of these resources would ensure no irreversible and irretrievable loss of these valuable resources.

Chapter 5
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Lisa Welch	Transportation, Visual Resources, and Recreational Resources	BS, Geology 4 years of experience

Chapter 6
List of Agencies, Organizations, and Persons to Whom the DEIS Was Sent

The following agencies, organizations, companies, and individuals received copies of the DEIS.

Federal Agencies

ACHP-Western Division of Project Review
BLM, Billings Resource Area
BLM, Casper District Office
BLM, Cody Resource Area
BLM, Grass Creek Resource Area
BLM. Havre Resource Area
BLM, Judith Resource Area
BLM, Lander Resource Area
BLM, Lewistown District Office
BLM, Miles City District Office
BLM, Montana State Office
BLM, Platte River Resource Area
BLM, Washakie Resource Area
BLM, Worland District Office
BLM, Wyoming State Office
Bonneville Power Administration, Montana District Office
Bureau of Reclamation, Montana Projects Office
Bureau of Reclamation, North Platte Projects Office
Bureau of Reclamation, Regional Office
Congressman Thomas' Office
Congressman Thomas' Office
Congressman Thomas' Office
Congressman Williams' Office
Department of Energy
Environmental Protection Agency, Region VIII
Farmers Home Administration
HQ ACC/Deputy
Senator Baucus' Office
Senator Burns' Office
Senator Simpson's Office
Senator Wallop's Office
USDA Soil Conservation Service
U.S. Fish and Wildlife Service
USDA Forest Service, Custer National Forest
USDA ASCS
USDI Bureau of Mines
Western Area Power Administration

State Agencies

Montana Department of State Lands
Montana Department of Fish, Wildlife and Parks
Montana State Historic Preservation Officer
Wyoming State Historic Preservation Officer
State of Wyoming DEQ/LQD
Wyoming Department of Public Lands and Farm Loans
Wyoming Conservation Commission
Wyoming Department of Agriculture
Wyoming Department Of Commerce and Cultural Resources Division Of Parks
Wyoming DEQ, Water Quality Division
Wyoming Game and Fish Department
Wyoming Governor-Planning Coordinator
Wyoming Oil and Gas Conservation Commission
Wyoming State Engineer

County and Local Agencies

Big Horn County Weed and Pest Control
Big Horn County Clerk
Big Horn County Commissioners
Big Horn County Extension Agent
Big Horn County Planner
Yellowstone County Board of Commissioners
Carbon County Board of Commissioners
Stillwater County Board of Commissioners
Golden Valley County Board of Commissioners
Wheatland County Board of Commissioners
Fergus County Board of Commissioners
Choteau County Board of Commissioners
Hill County Board of Commissioners
Campbell County Commissioners
Conservation Districts of the Yellowstone
Converse County Commissioners
Crook County Commissioners
Hot Springs County Clerk
Hot Springs County Commissioners
Hot Springs County Extension Agent
Hot Springs County Weed and Pest Control
Hot Springs Conservation District
Hot Springs County Planner
Hot Springs County Sheriff
Johnson County Commissioners
Mayor of Basin
Mayor of Cody
Mayor of Cowley
Mayor of Deaver
Mayor of Frannie
Mayor of Greybull
Mayor of Kirby
Mayor of Lovell
Mayor of Manderson
Mayor of Ten Sleep
Mayor of Thermopolis

Mayor of Worland
Nowood/Washakie Conservation District
Park County ASCS
Park County Clerk
Park County Commissioners
Park County Extension Agent
Park County Sheriff
Park County Weed and Pest Control
Shoshone Conservation District
South Big Horn Conservation District
Washakie County Weed and Pest Control
Washakie Conservation District
Washakie County Clerk
Washakie County Commissioners
Washakie County Farm Bureau
Washakie County Planner
Washakie County Sheriff

Native American Organizations

Arapaho Business Council
Association of American Indian Affairs Inc.
Assiniboine Tribal Council
Blackfeet Tribal Council
Cheyenne River Sioux Tribal Council
Crow Creek Sioux Tribal Council
Crow Tribal Administration
Devils Lake Sioux Tribal Council
Flandreau Santee Sioux Executive Commission
Shoshone Business Council

Educational

Big Horn County Library
Greybull Public Library
Hot Springs County Library
Johnson County Library
Lovell Library
Park County Library
Powell Public Library
Ten Sleep Public Library
University of Wyoming Geology Department
University of Wyoming Range Management Department
University of Wyoming Recreation and Parks Administration Department
University of Wyoming Wildlife Management Department
University of Wyoming Department of Zoology
University of Wyoming Extension Service

Companies

Altamont Gas Transmission Company
Amoco Production Company
Apache Corporation

Arco Oil and Gas Company
Atlantic Richfield Company
Basin Electric
Belle Fourche Pipeline Company
Big Wells Energy Corporation
Brent Exploration
Buffalo Creek Land Company
Burlington Northern Railroad
Carol-Holly Oil Corporation
Cenex Pipeline
Chevron USA Production Company
Conoco, Inc.
Conoco Pipeline Company
Cork Petroleum Company
Dan Brown Trucking
Douglas Budget
Environmental Strategies, Inc.
Ethnoscience
Excel Energy Corporation
Express Pipeline
Exxon Company USA
Exxon Pipeline Company
Flahive Oil and Gas
Glasier Management Ltd.
Goldmark Engineering Inc.
Grace Petroleum Corporation
Graham Royalty Ltd.
Great Northern Drilling Company Inc.
Grosch Construction Company
Hall and Hall Inc.
Hanson Oil Corporation
Heitzman Drill Site Services
Hot Springs Resources Ltd.
Hot Springs Title Company
Hydrocarbon Engineers
Intoil, Inc.
Jefferson Oil and Gas Company
JN Exploration and Production Ltd.
John W Donnell Associates Inc.
Kiska Oil Company
Koch Production Company
L B Industries
Lancaster Corporation
Luff Exploration Company
M-3 Industries
Marathon Oil Company
Marathon Pipeline Company
MC Garvin-Moberly Construction Company
MC Kenzie Petroleum Company
Medallion Production Company
Minerals Exploration Coalition
Mobil Oil Corporation
Montana Power Company
Montana Rail Link

MW Petroleum Corporation
Natural Gas Processing Company
Newman Brothers Drilling
North American Resource Company
Nowood Ranch Company
Okie Crude Company
Pacific Power and Light Company
Park County Title Insurance Agency
Petroleum Inc.
Petroleum Information Corporation
Phillips Petroleum Company
Phoenix Production Company
Plains Petroleum Op Company
R B Oil Company
Ralph Wortham Construction
Sawtooth Oil Company
Shell Oil Company
Sinclair Oil Company
Singleton Associates. Engineering Ltd.
Texaco Inc.
Trico Inc.
True Oil Company
U P Resources Company
US West Communications
Unicorn Drilling Inc.
Union Oil Company
Washakie Oil Company
Westech
Western Production Company
Williston Basin Interstate Pipeline Company
Wyo-Ben Inc.
Wyoming Production Credit Association

Organizations

American Fisheries Society
American Horse Protection Association Inc.
Associated General Contractors of Wyoming
Audubon Council of Wyoming
Billings Rod and Gun Club
Casper Sierra Club-North Platte Group
Casper-Alcova Irrigation District
Citizens Against Ruining the Environment
Clear Creek Grazing Association
Defenders of Wildlife
Ducks Unlimited
Earth First!
IAGC
IPAMS--Independent Petroleum Producers
Izaak Walton League of America
National Audubon Society
National Outdoor Leadership School
National Trappers Association Inc.

National Wildlife Federation
Natural Resources Defense Council
Northern Plains Resource Council
Powder River Basin Resource Council
Public Lands Council
Renewable Natural Resources Foundation
Sierra Club
The Audobon Society, Billings Chapter
The Nature Conservancy
The Outdoorsman
The Sierra Club, Mountain Chapter
The Wilderness Society
Tri-County Telephone Association Inc
Trout Unlimited
Wildlife Management Institute
Wildlife Society
Wildlife Society, Wyoming Chapter
Wind River Multiple Use Advocates
Wyoming Mining Association
Wyoming Stock Growers Association
Wyoming Wilderness Society
Wyoming Wool Growers Association

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Media

Associated Press
Basin Republican Rustler
Billings Gazette
Buffalo Bulletin
Casper Journal
Casper Star Tribune
Cody Enterprise
Country Journal
Gillette News-Record
Great Falls Tribune
Greybull Standard and Tribune
Havre News
Helena Independent Record
KAML-FM/KIML-FM
KASL-AM
KBBS-AM
KCWC-FM
KCWC-TV

KEMC Radio
KTBC-AM/KTBQ-FM
KGWN-TV
KLEN-FM
KLWD
KMMZ Radio
KMUS-FM
KODI/KTAG Radio
KOVE-AM/KDLY-FM
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KULR-TV
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Chapter 7
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Glossary

Affected Environment- the natural, physical, and human-related environment that is sensitive to changes due to the proposed actions; the environment under the administration of one line officer.

Alluvial- deposited by a stream.

Ambient Air Quality- the state of the atmosphere at ground-level as defined by the range of measured and/or predicted ambient concentrations of all significant pollutants for all averaging periods of interest.

Aquifer- A body of rock that is sufficiently permeable to conduct ground water and to yield economically significant quantities of water to wells and springs.

Big Game- those species of large mammals normally managed as a sport hunting resource.

Check Valve- Pipeline valve designed to automatically prevent the backflow of oil.

Class II Airshed- a geographical region which can accommodate normal well-managed industrial growth before significant air quality deterioration would be deemed to occur.

Crude Oil- petroleum in its natural state as is emerges from a well.

Community (Plant Community)- an assembly of plants living together, reflecting no particular ecological status.

Cultural Resources- Those fragile and nonrenewable remains of human activities, occupations, and endeavors as reflected in sites, buildings, structures, or objects, including works of art, architecture, and engineering. Cultural resources are commonly discussed as prehistoric and historic values, but each period represents a part of the full continuum of cultural values from the earliest to the most recent.

Dispersed Recreation- A general term referring to recreation use outside the developed recreation site; this includes activities such as scenic driving, hunting, backpacking, and recreation in primitive environments.

Endangered Species- any species which is in danger of extinction throughout all or part of it s range.

Environmental Impact Statement (EIS)- a detailed statement prepared by the responsible official in which a major Federal action which significantly affects the quality of the human environments described, alternatives to the proposed action provided, and affects analyzed.

Ephemeral Drainage- a stream or stream segment which flows only briefly in response to local precipitation (rainfall or snowmelt) and has no base flow.

Evapotranspiration- water lost from the soil, open water, and as the result of transpiration from plants.

Fault- A fracture or fracture zone along which there has been displacement of the sides relative to one another.

Fisheries Habitat- streams, lakes and reservoirs that support fish.

Floodplain- The nearly level alluvial plain that borders a stream or river and is subject to inundation during high water periods; the relatively flat area or lowland adjoining a body of standing or flowing water which has been or might be covered by floodwaters.

Forb- any herbaceous plant other than true grasses, sedges, or rushes.

Ground water- Water found beneath the land surface, in the zone of saturation below the water table.

Groundwater Basin- Underground formation with sides and bottom of relatively impervious material in which groundwater is held or retained. Aquifer or system of aquifers with well defined boundaries.

Habitat- The place where an animal or plant normally lives, often characterized by a dominant plant and codominant form, such as pinyon-juniper habitat.

Intermittent Stream- a stream which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas.

L_{dn}- The day/night average sound level, defined as the 24-hour period L_{eq} with 10 dBA added to the nighttime average level, $L_{n.}$

Liquefaction- in cohesionless soil, the transformation from a solid to a liquid state as a result of increased pore pressure and reduced effective stress.

Lithology- the physical characteristic of a rock

Modified Mercalli Scale- an arbitrary scale of earthquake intensity.

Mitigation- actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.

National Environmental Policy Act (NEPA)- 1969 legislation which encourages restoration and maintenance of environmental quality to the overall welfare of living things.

National Register of Historic Places (NRHP)- A list of significant historic and prehistoric sites and districts which provides procedural protection of these properties.

Notice of Intent (NOI)- A notice prepared by a federal lead agency to inform cooperating agencies and interested parties of the proposed project. Required by the National Environmental Policy Act.

Noxious Weed- exotic species of plants that proliferate and reduce the value of land for agriculture, forestry, livestock, wildlife,or other beneficial uses.

One-Hundred-Year-Flood- This is the flood which has a 1 percent probability of occurrence in a given year.

Overstory- that portion of a plant community that is dominant as to height; the tallest plants on a given site.

Perennial Stream- a stream which normally flows throughout the year from source to mouth.

Pig- An internal inspection tool used to detect leaks. It is launched into the pipeline and records the pipe wall thickness to determine specific locations where the pipeline show signs of weakness due to corrosion.

Prime Farmland- Land that is best suited for producing food, feed, forage, fiber and oilseed crops. The inventory of prime agricultural land is maintained by the U.S. Department of Agriculture, Soil Conservation Service.

Rare Species- A species which, although not presently threatened with extinction, is in such small numbers throughout its range that it may become endangered if its present environment worsens.

Right-of-way- The right to pass over property owned by another. The strip of land over which facilities such as roadways, railroads, pipelines, or powerlines are built.

Rill- a small intermittent water course with steep sides, less than six inches deep.

Riparian Areas or Habitat- streams, lakes, ponds, wetlands, flood plains, and their seasonal aquatic and riparian ecosystems.

Scoping- Determination of significant environmental issues and concerns related to a proposed action.

Sediment- Soil or rock particles that have been transported to stream channels or other bodies of water.

Sensitive Species- those plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations.

Soil Association-two or more soils, occurring together in a characteristic pattern in a given geographic area.

Sour Crude Oil- crude oil containing significant fractions of sulphur compounds.

Spread- The team working on a particular section of the pipeline construction. It consists of units for clearing and grading, ditching, hauling and stringing, pipe bending, line-up, welding, pipecoating, lowering and tying-in, backfilling, and cleanup and restoration.

Sublimation- The process by which a solid substance vaporizes without passing through a liquid state.

Surge Tank- Because of capacity limitations in pipeline, crude is periodically diverted into tanks and temporarily stored there until operating conditions allow for it to be re-injected into the line.

Sweet Crude Oil- crude oil that contains few or no sulphur compounds.

Threatened Species- any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Topsoil- fertile soil or soil material, usually rich in organic matter, used to top dress disturbed areas. Topsoil is better suited to supporting plants than other materials.

Turbidity- murkiness in water due to stirred-up sediment.

Understory- that portion of the plant community that grows underneath taller plants growing on the same site.

Visual Resources Management System (VRM)-the degree of acceptable visual change within a characteristic landscape. A class is based upon the physical and sociological characteristics of any given homogenous area as a management objective.

Watershed- All land and water within the confines of a drainage divide.

Wetlands- areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances, does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Appendix A

Current Market Situations in the U.S. and Canada Relative to the Proposed Express Pipeline Project

Table 1.1.1

CRUDE OIL AND EQUIVALENT REMAINING RESERVES IN CANADA AT DECEMBER 31, 1994

(Thousands of Cubic Metres)

	Remaining Established Reserves
Conventional Crude Oil	
Conventional Area	
British Columbia	17,500
Alberta	435,000
Saskatchewan	131,200
Manitoba	6,500
Ontario	1,200
Other Eastern Canada	0
Total Conventional Areas	591,400
Frontier Areas	
Mainland Territories	19,000
Mackenzie/Beaufort	54,000
Arctic Islands	0
Eastcoast Offshore	137,000
Total Frontier Areas	210,000
Total Crude Oil	801,400
Developed Synthetic Crude Oil	
Alberta	292,600
Developed Bitumen	
Alberta	158,800

(Statistics Canada - Energy Statistics Handbook - April 1995

1.0 SUPPLY AND DISPOSITION OF WESTERN CANADIAN CRUDE OIL

1.1 Crude Oil Pools and Established Reserves

Express commenced its study of the overall supply of Canadian crude oil available by examining the total established remaining reserves of Canadian crude oil and equivalent as of December 31, 1994 (see Table 1.1.1, obtained from the "Statistics Canada Energy Statistics Handbook, April, 1995"). For the purposes of this application, Express will rely on the NEB's Report entitled "Canadian Energy - Supply and Demand 1993-2000", dated July, 1994 (the "NEB Report").

1.2 Western Canadian Crude Oil Supply Forecast

Western Canadian crude oil production has grown since 1991. The NEB has recently completed supply forecasts which show a 28,600 - 31,800 m^3/d (180,000 - 200,000 BPD) increase in crude oil supply over the next three years (see the NEB Report - Current Technology Case). Over the past decade the actual production of Western Canadian crude has exceeded production forecasts developed by industry and government agencies (see Figure 1.2.1). Both conventional light and heavy crude oils have traditionally been forecast to be in decline. Nonetheless industry continued to increase actual production levels.

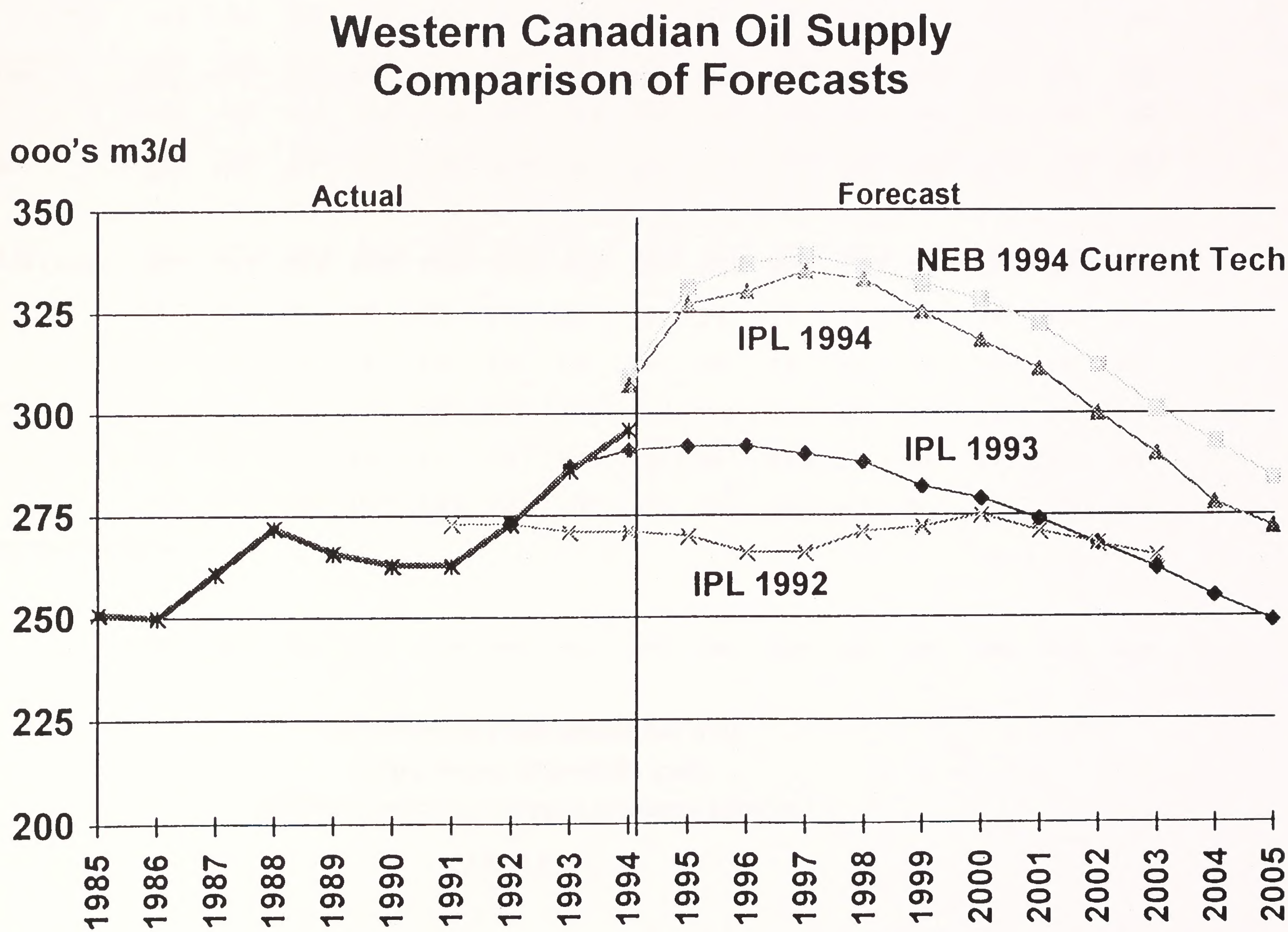
In this section of the Application supply references reflect the NEB's Current Technology Supply Case from the NEB Report (see Table 1.2.1 - Western Canada Crude Oil Production Forecast).

As a sensitivity to the NEB's Current Technology Supply Case, Table 1.2.2 shows production utilizing the NEB's High Technology Supply Case, which takes into consideration the impact of advances in technology by increasing supply and holding it stable for several additional years before beginning a decline.

In Alberta, the Alberta Energy and Utilities Board estimated that reserves of conventional crude oil decreased by 12% in 1994. However, much of this decrease was a one time reassessment of reserves, including reserves becoming available from enhanced recovery. While overall conventional crude oil reserves are projected to decline, the 1994 reassessment is seen as a one-time adjustment.

When examining the overall crude oil supply available in Western Canada, the vast reserves provided by Canada's Oil Sands must also be taken into account. Oil Sands production has approximately doubled, to about 63,564 m^3/d (400,000 BPD), in the past ten years. It is generally acknowledged that the Oil Sands have potentially recoverable deposits of about 300 billion barrels. (See: National Oil Sands Task Force Report - The Oil Sands: A New Energy Vision for Canada ((the "Task Force Report"), page 5). The advances in recovery technology have made production from oil sands increasingly economic and profitable. Another attractive feature of future oil sands development is that it can occur in smaller capacity increments as markets are developed. This reduces capital requirements and allows for incremental development over a longer period of time.

Figure 1.2.1



Western Canadian Oil Supply
Comparison of Forecasts
ooo's m3/d
Actual
Forecast
350
325
300
275
250
225
200
NEB 1994 Current Tech
IPL 1994
IPL 1993
IPL 1992
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005

Table 1.2.1

Western Canada Crude Oil Production Forecast
NEB Current Technology Case
(Thousands of Cubic Metres per day)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Conventional Light and Medium															
Alberta	114.1	114.5	116.7	119.2	124.5	122.3	118.5	114.3	109.6	104.9	99.5	94.5	89.1	84.6	80.4
B. C.	5.4	5.5	5.6	5.6	5.7	5.6	5.4	5.2	5.0	4.8	4.5	4.3	4.1	3.8	3.6
Saskatchewan	11.1	11.6	12.9	13.0	13.4	13.2	12.8	12.3	11.8	11.3	10.5	9.8	8.9	8.3	7.8
Manitoba	1.9	1.8	1.7	1.8	1.9	2.0	1.9	1.9	1.9	1.8	1.7	1.7	1.7	1.6	1.5
N. W. T.	5.2	5.1	5.1	5.3	5.3	5.3	4.8	4.1	3.6	3.1	2.6	2.3	2.0	1.7	1.4
Total Western Canada	137.7	138.5	142.0	144.9	150.8	148.4	143.4	137.8	131.9	125.9	118.8	112.6	105.8	100.0	94.7
Pentanes Plus	19.3	21.4	23.8	24.7	25.5	26.2	27.1	27.6	27.9	28.4	28.7	28.9	29.1	29.2	29.3
Synthetic Crude	35.9	37.2	38.9	41.7	43.8	44.3	45.2	45.2	45.2	48.2	54.2	54.7	55.2	56.5	57.0
Total Light	192.9	197.1	204.7	211.3	220.1	218.9	215.7	210.6	205.0	202.5	201.7	196.2	190.1	185.7	181.0

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Heavy/Bitumen															
Alberta Conventional	27.9	30.3	37.4	42.4	48.5	50.1	50.0	48.9	47.1	44.5	41.7	39.5	37.0	35.0	33.3
Sask. Conventional	22.3	24.6	28.0	32.5	37.6	39.5	39.9	39.4	38.2	36.3	34.2	32.2	30.7	29	27.5
Bitumen	19.4	19.9	21.4	22.8	24.7	28.1	33.4	37.0	41.3	44.5	44.2	44.1	43.8	42.8	42.2
Total Heavy	69.6	74.8	86.8	97.7	110.8	117.7	123.3	125.3	126.6	125.3	120.1	115.8	111.5	106.8	103.0
Total Crude Oil	262.5	271.9	291.5	309.0	330.9	336.6	339.0	335.9	331.6	327.8	321.8	312.0	301.6	292.5	284.0

Table 1.2.2

Western Canada Crude Oil Production Forecast

NEB High Technology Case

(Thousands of Cubic Metres per day)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Conventional Light and Medium															
Alberta	114.1	114.5	116.7	119.2	127.3	126.8	124.5	121.3	117.4	113.6	109.4	105	100	95.8	91.7
B. C.	5.4	5.5	5.6	5.6	5.8	5.8	5.7	5.5	5.3	5.1	4.9	4.7	4.4	4.2	4.0
Saskatchewan	11.1	11.6	12.9	13	13.7	13.7	13.4	13.1	12.6	12.2	11.5	10.9	10.1	9.5	9
Manitoba	1.9	1.8	1.7	1.8	2.0	2.0	2.0	2.0	1.9	1.9	1.8	1.8	1.7	1.6	1.5
N. W. T.	5.2	5.1	5.1	5.3	5.3	5.3	4.8	4.1	3.6	3.1	2.6	2.3	2.0	1.7	1.4
Total Western Canada	137.7	138.5	142	144.9	154.1	153.6	150.4	146	140.8	135.9	130.2	124.7	118.2	112.8	107.6
Pentanes Plus	19.3	21.4	23.8	24.7	24.5	24.5	24.7	24.5	24.2	24.2	24.3	24.6	24.8	25.5	26.0
Synthetic Crude	35.9	37.2	38.9	41.7	43.8	44.3	45.2	45.2	45.2	48.2	54.2	54.7	55.2	56.5	57.0
Total Light	192.9	197.1	204.7	211.3	222.4	222.4	220.3	215.7	210.2	208.3	208.7	204	198.2	194.8	190.6

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Heavy/Bitumen															
Alberta Conventional	27.9	30.3	37.4	42.4	49.2	51.8	52.9	52.9	51.9	50.1	48.1	46.4	44.3	42.5	40.9
Sask. Conventional	22.3	24.6	28.0	32.5	38.0	40.6	41.8	42	41.4	40.1	38.5	36.9	35.5	34.0	32.5
Bitumen	19.4	19.9	21.4	22.8	25.5	29.9	37.9	44.8	50.0	54.4	56.8	60.1	63.8	66.3	66.3
Total Heavy	69.6	74.8	86.8	97.7	112.7	122.3	132.6	139.7	143.3	144.6	143.4	143.4	143.6	142.8	139.7
Total Crude Oil	262.5	271.9	291.5	309	335.1	344.7	352.9	355.4	353.5	352.9	352.1	347.4	341.8	337.6	330.3

The National Task Force has concluded that, at crude oil prices in the range of Cdn $25.00, the Canadian Oil Sands production could reach 127,128 - 190,692 m^3/d (800,000 - 1.2 million BPD) over the next quarter century (Task Force Report, page 5).

The steady increase in Oil Sands production was also acknowledged by the NEB in its Inquiry and Licensing of Long-Term Exports of Oil Sands Production. This report states that production from the Oil Sands currently amounts to about 20% of total Canadian production of crude oil or equivalent, even though less than two percent of the recoverable Oil Sands resource is now under development (See Task Force Report, page 7).

1.3 Markets for Western Canadian Crude Oil

Currently the largest markets for Western Canadian crude oil are Western Canada, Ontario and the U.S. Midwest (PADD II). Smaller volumes of Canadian crude move to refineries in the Rocky Mountain States (PADD IV), as well as to refineries in Puget Sound, Washington (in PADD V). The Express Pipeline will significantly expand access to PADD IV and southern PADD II markets. These markets are described below.

1.3.1 Existing Markets

Western Canada

The demand for crude oil in Western Canada was 77,100 m^3/d (485,000 BPD) in 1994. This was up from 73,900 m^3/d (465,000 BPD) in 1993. The planned shutdown of Imperial Oil Ltd.'s ("Imperial") refinery in British Columbia is expected to reduce crude oil runs in 1995.

Table 1.3.1 outlines refinery capacity in Western Canada, which is estimated at 78,700 m^3/d (495,000 BPD), after the Imperial refinery closure.

Refineries in Western Canada are expected to run near capacity at approximately 74,700 m^3/d (470,000 BPD) during the forecast period.

Ontario

Ontario has the largest refining capacity in Canada. Six refineries and the Novacor Chemicals Ltd. petrochemical plant have a total crude oil capacity of 78,300 m^3/d (492,500 BPD).

Ontario processed a total of approximately 63,300 m^3/d (398,000 BPD) in 1994. Currently this market relies primarily on light sweet crude oil.

Table 1.3.1 (m3/d)
WESTERN CANADA REFINERY CRUDE CAPACITY - 1995

(Thousands of Cubic Metres per Day)

	Nameplate (1)	Effective	Effective
British Columbia			
Chevron	8.0	8.0	
Husky	1.5	1.5	
Total	9.5	9.5	
Alberta			
Husky	3.7	2.2	(2)
Imperial	28.0	28.0	
Parkland	1.0	1.0	
Petro-Canada	18.5	18.5	
Shell	10.9	11.1	(3)
Total	62.1	60.8	
Saskatchewan			
Co-Op	7.2	7.2	
Moose Jaw	2.1	0.7	(2)
Total	9.3	7.9	
North West Territories			
Imperial	0.6	0.6	
Total	81.5	78.8	

Notes:(1)Oil & Gas Journal, December 19, 1994 except as noted. Excludes refineries scheduled for closure. (2)Asphalt refineries are derated to obtain annual capacity. (3)Allows for estimated debottlenecking potential.

PADD II - Upper Midwest

The U.S. Upper Midwest region includes the States of Minnesota, Wisconsin, North Dakota and South Dakota. There are four refineries with a total crude oil capacity of 61,700 m^3/d (388,000 BPD). The crude oil blends processed by the Upper Midwest refineries includes 50-60% heavy sour with the remainder being light sour and light sweet. Total crude oil requirements in 1994 were 58,000 m^3/d (365,000 BPD).

Historically, sour crude oil has been supplied to this region by Canadian imports, although Mexican imports have become more significant in recent years. The region's light sweet crude oil requirements have been supplied from production in the Williston Basin area of North Dakota and from Canada.

PADD II - Great Lakes

There are nine refineries in Michigan and the northern parts of Illinois, Indiana and Ohio with a combined capacity of almost 187,500 m^3/d (1.18 million BPD).

The Chicago refineries represent 127,500 m^3/d (802,000 BPD) of the U.S. Great Lakes region's capacity. These refineries run a slate which is mostly heavy crude and sour crude oil. The Ohio and Michigan refineries run a slate which is mostly sweet crude oil. Total crude oil runs in 1994 were estimated at 175,000 m3/d (1,100,000 BPD), with Canadian crude oil receipts amounting to approximately 71,500 m3/d (450,000 BPD).

PADD I

United Refining's refinery at Warren, Pennsylvania is expected to continue to rely on Canadian crude oil supplies. We estimate this demand to continue at approximately 10,300 m^3/d (65,000 BPD).

Puget Sound

Washington has seven refineries on Puget Sound. Four of these, Arco, Tosco, Shell and Texaco, have a combined crude capacity of 76,300 m^3/d (480,000 BPD) and are connected to the Trans Mountain pipeline system at Ferndale and Anacortes, providing them with direct access to Canadian crude oil supplies. The Arco refinery uses mostly ANS equity crude (27° API, 1.1% sulphur) which it receives by tanker. Shell, Tosco and Texaco process considerable ANS crude as well, but much of this is purchased from other producers. Chevron, Sound Refining and U.S. Oil have specialty asphalt refineries near Tacoma which import heavier crudes. Canadian crude exports to Puget Sound refiners in 1994 were 11,200 m^3/d (70,400 BPD).

Offshore West Coast Markets

Historically, some crude oil was exported from the Trans Mountain Pipeline's Westridge terminal in Vancouver to markets in the Orient and in some cases, to the U.S. Gulf Coast. In 1994 the volumes of crude oil exported offshore were 900 m^3/d (5,800 BPD).

1.3.2 Express Pipeline Markets

PADD IV

Canadian crude oil currently has limited access to the U.S. PADD IV region. As such, the PADD IV markets accessed via the Express Pipeline will constitute new markets for Western Canadian production. Express will provide an ability to move significant incremental volumes of a wide range of crude oil types to satisfy the requirements in all areas of this region.

As shown in Table 1.3.2, the 15 PADD IV refineries have a total crude oil capacity of 79,900 m^3/d (503,000 BPD) of crude oil . The capacity of each individual refinery is less than 8,600 m^3/d (54,000 BPD). The Billings area runs are mostly sour and heavy sour crude, two-thirds of which are supplied from Canada. Except for the Billings and Cheyenne area refineries, most of the region's refiners have essentially no capacity to process sour crudes and would require large investments to do so.

PADD IV has historically been relatively self-sufficient for crude oil supply. Moreover, PADD IV has traditionally supplied significant quantities of sweet, light sour and heavy sour crude oils to the Midwest. However, crude oil production from this area has declined 6.5% per year since 1991 and is expected to decline rapidly over the next few years. This has virtually eliminated the region's crude oil surplus position.

To demonstrate that additional crude oil supplies will be needed into the PADD IV area after 1995 see Table 1.3.3 and Figure 1.3.1. As this region has no alternative crude supplies available, Canadian crude oil can be expected to satisfy market requirements via Express. PADD IV, therefore, has an opportunity to become a growing market for Canadian crude supplies.

PADD IV also provides an opportunity to enhance the market for Canadian Oil Sands production. The aforementioned Task Force Report recognized the importance of developing new markets and transportation systems as key stimulants to future Oil Sands development. The Task Force Report also acknowledges that the current access to PADD IV is limited and that expansion of pipeline capacity south from Edmonton and/or Hardisty will be necessary to attach PADD IV markets (see Task Force Report, page 31).

In PADD IV imports must increase to meet refinery demands and Canadian crude oil delivered via the Express Pipeline would be an important new supply source to this region.

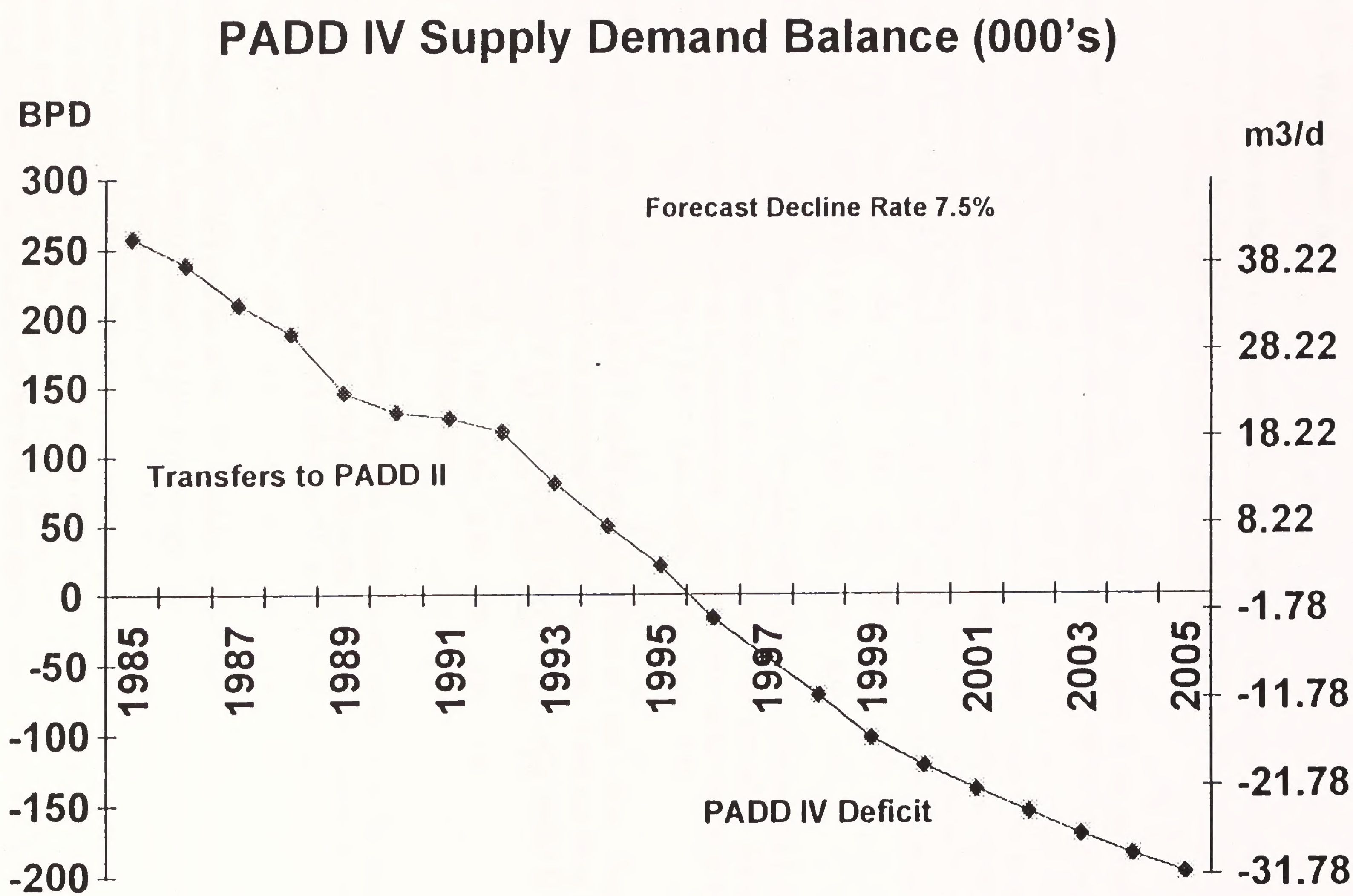
Table 1.3.2

PADD IV REFINERIES [1]

	Company	Location	Crude Capacity [2] m3/d
Colorado	Colorado Refining Co.	Commerce City	4,400
	Conoco Inc.	Denver	8,600
Montana	CENEX	Laurel	6,600
	Conoco Inc.	Billings	7,900
	Exxon Co.	Billings	7,000
	Montana Refining Co.	Great Falls	1,100
Utah	Amoco Oil Co.	Salt Lake City	7,000
	Big West Oil Co.	Salt Lake City	3,800
	Chevron U.S.A.	Salt Lake City	7,100
	Crysen Refining Inc.	Woods Cross	2,000
	Phillips 66 Co.	Woods Cross	4,000
Wyoming	Frontier Oil & Refining Co.	Cheyenne	6,500
	Little America Refining Co.	Casper	3,500
	Sinclair Oil Corp.	Sinclair	8,600
	Wyoming Refining Co.	Newcastle	1,800
	TOTAL CRUDE		80,100

Notes:(1) Source: Oil & Gas Journal, December 19, 1994. (2) As of January 1, 1995, excluding 1995 closures. (3) m3/d means Cubic Meters per calendar day.

Figure 1.3.1



PADD IV Supply Demand Balance (000's)
BPD
m3/d
300
250
200
150
100
50
0
-50
-100
-150
-200
38.22
28.22
18.22
8.22
-1.78
-11.78
-21.78
-31.78
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Forecast Decline Rate 7.5%
Transfers to PADD II
PADD IV Deficit

Table 1.3.3

Padd 4 Supply Demand

(Thousands of Cubic Metres per day)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Supply												
Sweet	55.8	52.3	48.6	45.3	42.0	38.8	35.8	32.7	30.0	27.3	24.9	22.9
Sour	4.6	4.3	4.0	3.5	3.2	2.9	2.7	2.4	2.1	1.9	1.7	1.4
Heavy	13.7	12.4	11.3	10.3	9.4	8.4	7.5	6.7	6.0	5.4	4.9	4.4
Total	74.1	69.0	63.9	59.1	54.5	50.1	45.9	41.8	38.1	34.6	31.6	28.8
Demand												
Sweet	48.9	48.0	47.4	47.8	48.1	48.5	48.8	49.1	49.3	49.6	49.9	50.1
Sour	9.4	9.2	8.1	8.1	8.3	8.3	8.3	8.4	8.4	8.4	8.4	8.6
Heavy	22.9	24.0	26.1	26.2	26.4	26.9	26.5	26.5	26.9	26.9	27.0	27.0
Struct.	7.0	6.8	6.4	6.0	5.7	5.4	5.1	4.6	4.1	3.8	3.5	3.2
Total	88.2	88.0	87.9	88.2	88.5	89.0	88.7	88.7	88.7	88.7	88.8	88.8
Deficit												
Sweet	-0.2	-2.5	-5.1	-8.6	-11.9	-15.1	-18.1	-21.0	-23.4	-26.1	-28.4	-30.4
Sour	-4.8	-4.9	-4.1	-4.6	-5.1	-5.4	-5.6	-6.0	-6.4	-6.5	-6.7	-7.2
Heavy	-9.2	-11.6	-14.8	-15.9	-17.0	-18.4	-19.1	-19.9	-20.8	-21.5	-22.1	-22.6
Total	-14.1	-19.1	-24.0	-29.1	-34.0	-38.9	-42.7	-46.9	-50.5	-54.0	-57.2	-60.1

Assumptions:

1.Structural exports are only those that cannot physically reach Padd 4 markets.

2.Current Canadian imports not included to determine absolute need for crude.

3.Includes North Dakota.

PADD II - Wood River Area

The Wood River area market includes the States of Kentucky and Tennessee and the southern parts of the States of Illinois, Indiana and Ohio . There are ten refineries in this area with a total crude oil capacity of 180,000 m^3/d (1,130,000 BPD), as shown in Table 1.3.4.

In 1994, crude runs were 162,000 m^3/d (1,020,000 BPD). Over 66% of the crude supply comes from the U.S., but as U.S. domestic production declines more imports will be required in this market. These refineries imported 54,400m^3/d (342,000 BPD) of crude oil in 1994. Of this, 8,900 m^3/d (56,000 BPD) was heavy crude. This market region is a potential market for sweet, sour and heavy Canadian crude. In 1994 the region began to receive Canadian crude via the Mobil pipeline from Chicago to Patoka. PADD II imports must increase to meet refinery demands and Canadian crude oil delivered via the Express Pipeline would be an important new supply source to this region.

PADD II - Mid-Continent

The Mid-Continent market area of PADD II includes refineries in Oklahoma and Kansas. There are 11 refineries with a total crude oil capacity of 109,600 m^3/d (689,900 BPD). These refineries currently have no practical access to Canadian crude. The crude slate of the region is mainly sweet crude oil.

Since 1985 the region has shifted from a crude surplus position to a net deficit. The deficit was satisfied by increased transfers of crude from the West Texas region. Transfers from West Texas are expected to decline further, leaving excess demand in the Mid-Continent market to be filled by imports.

1.4 Western Canadian Crude Disposition

The forecast volume of crude oil leaving Western Canada is estimated from the supply forecast described in Section 1.2 of this Application and the Western Canadian demand described in Section 1.3 hereof. This forecast of Western Canadian crude oil dispositions, excluding Express, is shown in Table 1.4.1.

The InterProvincial Pipe Line Inc's. 1993 expansion was based on total Western Canadian production reaching a level of 311,600 m^3/d (1,961,000 BPD) in 1996 and declining thereafter. The latest NEB forecast has production reaching 339,100 m^3/d (2,134,000 BPD) in 1997. An increase in available supply reaffirms the need for more pipeline capacity. The mix of crude oil types being produced is also changing with heavy crude and bitumen replacing declining light crude. This will also have a negative effect on the capability of current facilities to move all available production to market in the future. In addition to crude oil, NGL and refined products also compete for space on the crude oil pipeline systems leaving Western Canada.

Table 1.3.4

WOOD RIVER AREA REFINERIES [1] (m^3/d)

	Company	Location	Crude Capacity [2]
Illinois	Clark Oil & Refining Corp.	Hartford	9,100
	Indian Refining Co.	Lawrenceville	13,300
	Marathon Oil Co.	Robinson	26,400
	Shell Oil Co.	Wood River	42,600
Indiana	Countrymark Co-operative Inc.	Mt. Vernon	3,500
Kentucky	Ashland Petroleum Co.	Catlettsburg	33,800
	Somerset Refinery Inc.	Somerset	900
Ohio	Ashland Petroleum Co.	Canton	10,500
	BP Oil Co.	Lima	25,600
Tennessee	Mapco Petroleum Co.	Memphis	14,300
	TOTAL CRUDE		180,000

Notes:(1) Source: Oil & Gas Journal, December 19, 1994 (2) As of January 1, 1995, excluding 1995 closures. (3) m3/d means Cubic Metres per calendar day.

Table 1.4.1

Supply and Disposition of Western Canadian Crude Oil

Without Express

Current Tech

(Thousands of Cubic Metres per day)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Crude Production	309.0	330.9	336.6	338.9	335.9	332.0	328.0	321.9	311.9	301.0	292.9	284.0
Demand												
Western Canada	78.7	76.1	74.7	75.2	75.3	75.6	74.7	75.2	75.3	75.6	75.8	76.1
Eastern Canada	65.9	68.6	68.8	69.9	70.7	71.7	71.0	71.8	70.7	66.6	62.9	59.1
Exports												
Padd 1 & 2	119.5	131.9	136.0	135.9	135.2	134.1	134.8	134.0	131.7	125.7	117.0	114.6
West Coast	12.4	11.3	15.6	15.6	15.6	13.5	11.3	9.2	6.0	6.0	6.0	6.0
Padd 4	20.3	23.2	24.5	26.2	27.3	28.6	29.2	29.4	29.6	29.7	29.9	23.8
Total	296.4	307.8	318.9	320.4	320.7	318.8	315.6	314.0	307.6	297.8	285.6	279.7
Surplus/-Shortfall	12.6	23.1	17.6	18.6	15.3	13.2	12.4	7.9	4.3	3.2	7.3	4.3

High Tech

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Crude Production	309.0	330.9	344.7	352.8	355.3	353.6	352.8	352.1	347.4	341.8	337.7	332.0
Demand												
Western Canada	78.7	76.1	74.7	75.2	75.3	75.6	74.7	75.2	75.3	75.6	75.8	76.1
Eastern Canada	65.9	68.6	68.8	69.9	70.7	71.7	71.0	71.8	70.7	66.6	62.9	59.1
Exports												
Padd 1 & 2	119.5	131.9	136.0	135.9	135.2	134.1	134.8	134.0	131.7	125.7	117.0	114.6
West Coast	12.4	11.3	15.6	15.6	15.6	13.5	11.3	9.2	6.0	6.0	6.0	6.0
Padd 4	20.3	23.2	24.5	26.2	27.3	28.6	29.2	29.4	29.6	29.7	29.9	23.8
Total	296.4	307.8	318.9	320.4	320.7	318.8	315.6	314.0	307.6	297.8	285.6	279.7
Surplus/-Shortfall	12.6	23.1	25.7	32.4	34.6	34.8	37.2	38.1	39.7	44.0	52.1	52.3

1.4.1 Interprovincial Pipe Line Inc.

IPL's capacity on a sustainable basis, based on the current mix of crude oil types and products, is 221,600 m^3/d (1,395,000 BPD) ex-Kerrobert, and 233,800 m^3/d (1,471,000 BPD) ex-Cromer. From Cromer Line 2 and Line 3 carry crude oil to Superior where they connect to Lakehead lines 5 and 6 for delivery to markets in the U.S. and Eastern Canada. Line 5 takes deliveries through Lakehead's northern route to Ontario. Line 6 delivers light and heavy crude oil from Superior to Chicago and on through to Sarnia.

IPL transports refined products via Line 1 to Gretna, and NGL through Line 1 to Superior. The available capacity for crude oil is 193,700 m^3/d (1,219,000 BPD) ex-Kerrobert and 205,900 m^3/d (1,295,000 BPD) ex-Cromer.

1.4.2 Trans Mountain PIpeline Company

Trans Mountain ships both crude oil and petroleum products into British Columbia. Any surplus capacity will be available for exports. These exports can occur at Westridge or to the Puget Sound refineries in the state of Washington. The maximum capacity of the current pipeline, if no heavy crude is shipped, is 37,800 m^3/d (238,000 BPD).

Trans Mountain is currently operating at approximately 35,900 m^3/d (226,000 BPD). Exports to Puget Sound and through Westridge are currently averaging 15,200 m^3/d (96,000 BPD).

1.4.3 Rangeland Pipe Line Co./Murphy Oil Co. Ltd. (Milk River)

The Rangeland pipeline delivers into the Glacier pipeline at the U.S./Canada border. The Milk River pipeline delivers into the Cenex pipeline at the U.S./Canada border. The systems combine at Cut Bank, Montana for deliveries through the Glacier pipeline to Billings area refineries. Historical volumes for 1993 - 1994 are shown below:

Crude Oil Shipments on Rangeland/Milk River Pipelines
m^3/d (thousands BPD

	Rangeland	Milk River	Total
1993	6,300 (39.8)	7,500 (47.3)	13,800 (87.1)
1994	7,900 (49.6)	8,500 (53.5)	16,400 (103.1)

The current Milk River system has sufficient capacity to ship 9,900 m^3/d (62,000 BPD). The Rangeland pipeline has a capacity of 9,500 m^3/d (60,000 BPD). Currently, exports of crude oil on the combined Rangeland/Milk River systems are limited to approximately 17,000 m^3/d (107,000 BPD), due to capacity constraints on the Glacier pipeline.

The Bow River system is currently being expanded along with capacity additions on the Milk River and Cenex systems. The expansions will connect into the new pipeline being constructed by Cenex to serve its Laurel refinery. The capacity of the Cenex system, scheduled for completion in late 1995, will be 9,500 m^3/d (60,000 BPD).

The Montana refineries have a total crude oil requirement of approximately 22,600 m^3/d (142,000 BPD), and the Glacier/Cenex pipelines will have a capacity in excess of 26,500 m^3/d (167,000 BPD). More than 4,800 m^3/d (30,000 BPD) of Wyoming crude (mainly heavy sour) is delivered to Billings and approximately 1,^{3}50 m^3/d (8,500 BPD) of Montana crude is used by Montana refineries.

1.4.4 Wascana Pipeline Ltd.

The Wascana pipeline ships crude oil from Regina south across the U.S. border, where it connects with the Texaco Pipeline Co., which in turn delivers crude oil through the Butte Pipeline to Guernsey, Wyoming. From Guernsey, Canadian crude oil could serve refineries in Denver and Wyoming or it could be shipped to U.S. Midwest refineries on the Platte Pipe Line Company or Amoco Pipeline Company systems. Shipments on Wascana have increased from 3,200 m^3/d (20,000 BPD) in 1992 to 4,500 m^3/d (28,500 BPD) in 1993 and 5,600 m^3/d (35,200 BPD) in 1994.

1.5 Express Pipeline Delivery Forecasts

Supply and disposition of Western Canadian crude oil with the Express Pipeline included, is shown in Table 1.5.1.

Table 1.5.1
Supply and Disposition of Western Canadian Crude Oil
With Express
Current Tech

(Thousands of Cubic Metres per day)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Crude Supply	309.0	330.9	336.6	338.9	335.9	332.0	328.0	321.9	311.9	301.0	292.9	284.0
Less												
Western Canada	78.7	76.1	74.7	75.2	75.3	75.6	74.7	75.2	75.3	75.6	75.8	76.1
Available	230.3	254.8	261.9	263.8	260.6	256.3	253.3	246.8	236.6	225.3	217.1	207.8
Disposition												
Ontario - Existing Pipelines	65.9	68.6	68.8	69.9	70.7	71.7	71.0	65.9	53.1	46.1	39.9	36.2
Exports												
Padd I & II - Existing Pipelines	119.5	131.7	134.4	134.8	135.1	128.4	122.4	118.1	118.2	111.4	106.9	99.2
West Coast	12.4	11.3	13.7	12.7	7.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Padd IV - Existing Pipelines	20.3	23.2	22.2	22.2	21.8	21.5	22.1	22.2	22.4	22.6	22.7	22.9
Subtotal	218.2	234.9	239.2	239.6	235.0	227.6	221.5	212.3	199.7	186.1	175.6	164.3
Express	0.0	0.0	22.7	24.2	25.6	28.8	31.8	34.5	36.9	39.2	41.5	43.5
Surplus /-Deficit	12.2	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Express Throughput												
Light	0.0	0.0	9.5	11.0	12.4	15.6	17.8	20.5	22.9	24.5	26.7	28.8
Medium	0.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Heavy	0.0	0.0	9.2	9.2	9.2	9.2	10.0	10.0	10.0	10.8	10.8	10.8
Total	0.0	0.0	22.7	24.2	25.6	28.8	31.8	34.5	36.9	39.2	41.5	43.5

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
High Tech												
Crude Supply	309.0	330.9	344.7	352.8	355.3	353.6	352.8	352.1	347.4	341.8	337.7	332.0
Less												
Western Canada	78.7	76.1	74.7	75.2	75.3	75.6	74.7	75.2	75.3	75.6	75.8	76.1
Available	230.3	254.8	270.0	277.6	280.0	277.9	278.1	277.0	272.0	266.2	261.9	255.8
Disposition												
Ontario - Existing Pipelines	65.9	68.6	68.8	69.9	70.7	71.7	71.0	65.9	53.1	46.1	39.9	36.2
Exports												
Padd I & II - Existing Pipelines	119.5	131.7	134.4	134.8	135.1	128.4	122.4	118.1	118.2	111.4	106.9	99.2
West Coast	12.4	11.3	13.7	12.7	7.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Padd IV - Existing Pipelines	20.3	23.2	22.2	22.2	21.8	21.5	22.1	22.2	22.4	22.6	22.7	22.9
Subtotal	218.2	234.9	239.2	239.6	235.0	227.6	221.5	212.3	199.7	186.1	175.6	164.3
Express	0.0	0.0	22.7	24.2	25.6	28.8	31.8	34.5	36.9	39.2	41.5	43.5
Surplus /-Deficit	12.2	19.9	3.0	8.3	9.1	6.0	5.4	9.5	20.5	25.3	33.7	31.6
Express Throughput												
Light	0.0	0.0	9.5	11.0	12.4	15.6	17.8	20.5	22.9	24.5	26.7	28.8
Medium	0.0	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Heavy	0.0	0.0	9.2	9.2	9.2	9.2	10.0	10.0	10.0	10.8	10.8	10.8
Total	0.0	0.0	22.7	24.2	25.6	28.8	31.8	34.5	36.9	39.2	41.5	43.5

2.0 PURPOSE AND JUSTIFICATION

2.1 Introduction

The market assessment conducted by Express indicates that an opportunity exists for incremental barrels of Canadian crude oil to access new markets in PADD IV and southern PADD II. The combination of available crude oil supply and market demand provides Express with the ability to generate benefits for parties at both ends of the pipeline. The objective of the Express Pipeline is to present a viable alternative for prospective crude oil shippers to access new markets. Supply to PADD IV from traditional sources is declining. Replacement supplies are required and Express will provide Canadian producers with an ability to compete for this market. Access to the Wood River/Patoka area, south of the traditional northern PADD II market area currently accessable by Western Canadian crude oil, will also be enhanced by the Express Pipeline system.

Crude oil production in PADD IV has been declining at an average rate of 6.5 percent per year since 1991. In 1994, production from this region declined 5,600 m^3/d (35,000 BPD) or 8.5%. Crude oil refining capacity in PADD IV is 79,900 m^3/d (503,000 BPD). This region needs a significant new source of crude supply to offset experienced and projected crude declines and to meet the existing refining requirements. Canadian crude supplies are well positioned to successfully compete for this available market, provided the necessary transportation link is available. If significant new crude supply is not developed this market will likely be permanently lost to refined product imports from other regions of the U.S.

Crude oil production in the United States in 1994 was 1,050,000 m^3/d (6.6 million BPD). Production has declined at an average rate of approximately 3 percent per year or 35,800 m^3/d (225,000 BPD) per year for the past 10 years. This decline rate affects crude supply to PADD II or the Mid-Continent region of the United States and presents a further significant market opportunity for Canadian crude. PADD II refiners are taking aggressive action to promote new pipeline capacity from the Gulf Coast to facilitate increased volumes of imported off-shore crudes. Therefore, enhanced pipeline access from Canada must be made available quickly if Canadian supply is to compete for this important market.

Production of Western Canadian crude oil has grown in the past several years. Crude production from Western Canada has increased from 263,000 m^3/d (1.66 million BPD) in 1990 to 300,000 m^3/d (1.89 million BPD) in 1994. Crude supply is forecast to rise to 339,000 m^3/d (2.13 million BPD) by 1997 (NEB Report - Current Technology Case), an increase of 39,000 m^3/d (245,000 BPD). The forecast increase in production will clearly exceed current pipeline capacity. Experience has shown that when the supply of crude oil exceeds pipeline capacity to primary markets distressed selling can occur. If prolonged, distress selling may result in general price discounts across all crude oil produced in Western Canada. The current level of economic activity in the oil and gas industry in Western Canada will likely not be sustained if crude oil production is allowed to exceed pipeline capacity.

Express intends to offer market based tolls for transportation services to market participants. At the outset, this will result in Express assuming a higher level of risk compared to pipelines regulated by the NEB on a traditional cost of service basis. Additionally, the initial returns are not commensurate with the level of risk assumed. The Project Sponsors have concluded that satisfactory returns will be generated over the full life-cycle of the pipeline provided that Express is permitted to charge market based tolls over such time. This longer term view is a significant consideration in bringing forth the current project.

2.2 Purpose of the Proposed Facilities

2.2.1 Access to PADD IV Market

PADD IV is an increasingly important market area for Western Canadian crude. In 1990, 11,900 m^3/d (75,000 BPD) were exported to PADD IV and by 1994 this has increased to 19,000^3 m /d (120,000 BPD). The Billings area refiners processed 83% of this crude. In 1994, PADD IV production declined by 5,600 m^3/d (35,000 BPD) and this trend is forecast to continue at similar decline rates.

Canadian imports have been increasing and transfers out of the region to PADD II via the Platte and Amoco pipeline systems have been decreasing. Over the short-term this combination of events has been able to offset the decline rate and meet most of the refining requirements of the area. However, refined product imports have also been required to meet the growth in demand in the area and in 1992 the region became a net importer of refined products.

The PADD IV area is running out of options to meet its crude refining requirements and significant new Canadian supply is viewed by Express as the best alternative to satisfy this demand.

Current pipeline access from Canada to PADD IV cannot meet the refining requirements of the Salt Lake City area refiners, which represent approximately 30% of the PADD IV region's 79,900 m^3/d (503,000 BPD) of refining capacity. Salt Lake area refiners run a slate of ultra-sweet crudes, similar in quality to Canadian synthetic crudes. As such, this area represents an important new market opportunity to meet the forecast growth in Canadian synthetic production from Alberta's Oil Sands.

2.2.2 Connections to Existing Pipeline Infrastructure

Casper, Wyoming is an established crude oil transportation hub in the PADD IV region. Historically, crude has been gathered in smaller pipelines upstream of Casper for transportation to refineries in the Rockies or shipment east to the Wood River area. Therefore, Casper is a logical destination for the Express Pipeline. Discussions are ongoing with the owners of the Platte and Frontier pipelines for connections to their systems at Casper. In conjunction with other pipeline systems, Platte accesses southern Wyoming, Denver and Wood River refiners, while the Frontier Pipe Line accesses the Salt Lake City area refiners. These two pipeline systems are presently underutilized and have available capacity to move the volumes projected by Express. Additional volumes delivered to Casper by Express will permit the tolls on these systems to be significantly reduced.

2.2.3 Access to PADD II Market

In 1994, access to the Wood River market area in southern PADD II was opened up from Chicago via the reversal of an existing pipeline owned by Mobil. This is an important new market area for Western Canadian production, especially heavy and synthetic crudes. The Chicago and Minnesota market areas are dominated by a small number of major refiners having access to offshore crudes in competition with Canadian crude. Historically, Northern PADD II refiners have been able to extract discounts on Canadian crudes relative to their offshore alternatives since Canadian crude had no other available market. Expanding the number of purchasers for Canadian crude is important in order to maximize revenues to Western Canadian producers. Express will achieve the goal of diversifying the markets available for Canadian crude oil by providing a link to the Platte pipeline.

2.2.4 Pipeline Capacity to Primary Markets

Additional pipeline capacity is required to accomodate the increased supply of Western Canadian crude oil. Available supply has been described in detail in Section 1. As well, seasonal fluctuations, which arise from changes in summer to winter demand or required maintenance shut-downs on other pipeline systems, provide an additional source of supply. These fluctuations can be significant given that refinery turnarounds at Edmonton can coincide with hydrostatic testing and repairs (which in turn can extend to fall refinery turnarounds). These peak pumping requirements are not usually reflected in the annual forecasts of supply. Distressed selling of crude caused by directing crude into lower netback markets can result in lower crude prices for all Western Canadian production. As Western Canadian Sedimentary Basin crude slate shifts to heavier type crudes the available capacity on existing pipelines leaving this basin will be reduced.

2.2.5 Crude Type Flexibility

Express is designed to handle all the major crude types produced in Western Canada. The pipeline will operate in a batch mode. This is especially important to refiners in the Salt Lake City area who require ultra-sweet crudes, such as synthetic.

The flexibility offered in the design of the Express Pipeline is also important in that it matches crude types to the refinery slates in the above mentioned market areas.

2.2.6 Threats to Western Canadian Crude Markets

There are significant projects under consideration by various interests in the U.S. and Canada to enhance crude supply options and expand markets for refined products.

Reversal of the Sarnia to Montreal pipeline (Line 9) has been under discussion for a number of years. Reversing Line 9 would enable Ontario refiners to access offshore crude for Ontario and thereby displace Canadian crude. In the event of a Line 9 reversal, 24,000 - 48,000 m^3/d (150,000 to 300,000 BPD) of the light sweet crude market in Ontario could potentially be lost to offshore crude. In these circumstances, PADD IV will provide an attractive alternative market for displaced light sweet crude. Express will be designed with an ability to expand in the event such an occurence takes place.

If Canadian crude is not available to meet the refining requirements of PADD IV, then refined products will be imported to meet the demand. This could result in a potential market for Canadian crude being permanently lost.

Pipeline capacity from the U.S. Gulf Coast to the U.S. Mid-Continent has been expanded and additional projects to convert existing natural gas pipelines to crude oil service are under consideration. These projects have the potential to substantially increase supplies of offshore crude to the PADD II area. This represents significant new competition for Canadian crude oils in PADD II.

Express Pipeline will offer enhanced market diversity and act to at least partially offset the potential market threats described above.

2.3 Economic Justification of the Proposed Facilities

2.3.1 Toll Design

In order to determine the appropriate tolls for the project, Express examined the tolls currently charged by existing pipelines to transport Canadian crude to PADD IV and PADD II. In PADD IV, the benchmark pipeline tariff is derived from the delivery of crude by the combination of the IPL, Wascana, Texaco, and Butte pipelines to Guernsey, Wyoming. In PADD II the benchmark pipeline tariff is the delivery by the IPL, Lakehead, Mobil and Capwood pipelines to Wood River, Illinois. The current tolls on these pipeline systems are shown in Table 2.1 and Table 2.2, respectively.

A further consideration in deriving the appropriate tolls is the incremental cost of expanding existing pipelines. Based on general knowledge of these systems, Express does not view this alternative as economically attractive.

Refined products imported from other refining areas affect crude oil refining margins and product markets in both PADD IV and PADD II. Therefore, crude must be competitively priced or an incentive to build the pipeline infrastructure necessary to import products will result. The failure to provide competitively priced transportation services will create market opportunities for increased product imports. Thus, there is an effective cap on the rates that the market will bear.

In order to attract volumes to its system, Express will have to respond to the aforementioned competitive challenges and provide a viable, economic alternative. Express is of the view that over the long term, its proposal achieves this end.

Table 2.1

Competitive Transportation Tolls to Guernsey via Wascana Pipeline

	Light Crude	Medium Crude
Point of Origin	**Edmonton**	**Hardisty**
IPL ($/m3)		
Receipt Terminalling	0.348	0.348
Receipt Tankage	0.260	0.000
Delivery Terminalling	0.355	0.355
Delivery Tankage	0.000	0.260
Transmission	2.120	1.720
Loss	0.077	0.070
Total IPL	**3.160**	**2.753**
Murphy ($/m3)		
Linefill	0.310	0.310
Transmission	1.790	2.020
Loss	0.150	0.140
Total Murphy	**2.250**	**2.470**
Texaco ($US/Bbl)		
Transmission	0.480	0.570
Loss	0.020	0.020
Total Texaco	**0.500**	**0.590**
Butte ($US/Bbl)		
Transmission	0.403	0.403
Loss	0.020	0.020
Total Butte	**0.423**	**0.423**
Total $US/Bbl to Guernsey	**1.560**	**1.627**

Exchange rate 1.35 or 0.74

Current tolls in effect as of May 1, 1995

Table 2.2

Competitive Transportation Tolls to Wood River via IPL/Lakehead/Mobil

	Light Crude	Medium Crude	Heavy Crude
Point of Origin	**Edmonton**	**Hardisty**	**Hardisty**
IPL ($/m3)			
Receipt Terminalling	0.348	0.348	0.348
Receipt Tankage	0.260	0.000	0.000
Delivery Terminalling	0.000	0.000	0.000
Delivery Tankage	0.000	0.000	0.000
Transmission	3.749	3.479	3.866
Loss	0.077	0.070	0.068
Total IPL	**4.434**	**3.897**	**4.282**
Lakehead ($US/m3)			
Transmission	3.538	3.787	4.162
Loss	0.060	0.050	0.050
Total Lakehead	**3.598**	**3.837**	**4.212**
Texaco ($US/Bbl)			
Lockport Terminal	0.090	0.090	0.090
Total Texaco	**0.090**	**0.090**	**0.090**
Mobil ($US/Bbl)			
Transmission	0.474	0.701	0.738
Total Mobil	**0.474**	**0.701**	**0.738**
Shell ($US/Bbl)			
Transmission	0.100	0.100	0.100
Total Shell	**0.100**	**0.100**	**0.100**
Total $US/Bbl to Wood	**1.757**	**1.959**	**2.101**

Exchange rate 1.35 or 0.74

Current tolls in effect as of May 1, 1995

2.3.2 Risk and Return to Shareholders

The throughput forecast detailed in Section 1 and the design toll described above results in an acceptable risk and return relationship for the Project Sponsors.

2.3.3 Throughput Commitments

Express has held a significant number of meetings with prospective shippers from the refining community in PADD IV and the producing community in Western Canada. Negotiations with shippers are ongoing and Express is encouraged by the indicated support which it has received to date.

2.3.4 Benefits to the Producing Sector

As discussed above, the need for additional pipeline capacity from Western Canada is readily acknowledged. The benefits of Express Pipeline to the producing sector provide a key determinent in concluding that this project is in the public interest. The producer's benefits can be summarized as follows:

- Relieve current projected pipeline capacity constraints
- Provide competitive access to new markets, both directly and through connections to an extensive existing pipeline network
- Enable producers to capture maximum value for crude production
- Provide added diversification for Western Canadian crude production
- Reduce risk of market loss in the event that the Sarnia to Montreal pipeline is reversed
- Provide a transportation link to incremental markets that could be readily and cost effectively expanded
- Provide an impetus for further Oil Sands and heavy oil development
- Promote constructive competition between buyers of all crude streams

2.3.5 Benefits to the Refining Sector in PADD IV

In addition to the aforementioned producing sector benefits, the Express Pipeline provides value to the refining sector. The need for a new reliable crude oil supply is readily acknowledged by PADD IV refiners. Canadian crudes possess the characteristics required by this market. A compatible, competitively priced, crude slate will allow the PADD IV refiners to continue to maintain their competitive position without large expenditures to alter the existing infrastructure. The additional benefits which PADD IV refiners will realize from the Express Pipeline are as follows:

- Access to an attractive crude slate
- Access to a reliable supply basin
- Cost effective transportation
- Minimal contamination
- Non-refining pipeline operator

Access to ultra-sweet crudes for the Salt Lake City area refiners and a delivery system which will protect crude quality integrity
Effective long term competition against refined product imports

2.3.6 Benefits to the Refining Sector in PADD II

The southern PADD II refiners represent a large and attractive market for additional volumes of Western Canadian crude. The key to penetrating this market is to deliver the crude oil on a competitive basis.

At the present time, sponsors of other pipeline projects, which access crude from the Gulf Coast, are contemplating building new pipe, reversing existing pipe or converting pipe from natural gas service to crude oil service. Express is prepared to compete with these projects and thereby open up new opportunities for Canadian producers.

Padd II refiners will benefit from the enhanced competition, the diversity of supply sources and an ability to access a reliable supply area.

2.4 Detailed Description and Evaluation of Other Viable Alternatives

This section contains an examination of the alternatives to the Express Pipeline considered from a crude oil supply/demand perspective. Also set forth below is an assessment of the environmental effects associated with these alternatives, as required by section 16 of the CEAA. In Express' view, in order for an option to be considered a feasible alternative to Express it must provide similar access to the new markets for Western Canadian crude oil, which will be attached by Express.

2.4.1 Crude and Product Imports to Padd IV

PADD IV is a natural market for Canadian crude oil given its geographical proximity to the Western Canadian Sedimentary Basin. As well, declining PADD IV production and crude oil surpluses in Western Canada make it an attractive target for increased deliveries of Canadian crude oil. Additionally, Canadian crude types fit the range of crudes needed by Padd IV refiners for them to remain viable. Discussions with PADD IV refiners indicate support for the Express Pipeline, as a significant number of these parties have concluded that it is the best alternative to meet their refining needs.

Pipeline expansion from the U.S. Gulf Coast is focused on the U.S. Mid-Continent. The PADD IV market is relatively isolated and is not of sufficient size to be the primary focus for crude pipeline access from the south.

Refined product pipelines from the Midwest or Westcoast could however serve the PADDIV market. This however, will represent a lost opportunity for Canadian crude oil.

Construction of such a pipeline is not an alternative to Express, as it does not provide Western Canadian crude with access to new markets. The construction of a new pipeline wholly within the U.S. would have environmental impacts in the U.S., but obviously there would be no direct environmental impacts within Canada.

2.4.2 Existing IPL System

The current IPL system is nearing its maximum capability to move heavy crude to markets in Eastern Canada and Padd II. The supply forecast described in Section 1 demonstrates that the major growth area for Canadian crude is in heavy crude oil and bitumen. This trend will exacerbate IPL's difficulties and will result in an overall loss of system capacity as the crude oil mix becomes heavier. IPL's 1994 expansion was based on a supply forecast that has already been exceeded.

In addition to the physical capability to move crude, there is the question of market saturation and a narrowing of market diversity for Canadian producers. Access to PADD IV and the Wood River area of PADD II is not provided in a meaningful way by IPL. As such, IPL is not viewed as an alternative to Express. The markets accessed are significantly different.

Once again, the environmental impacts of expanding an existing system may be less than those associated with the construction of a new pipeline, depending on the specifics of the project. However, in order to provide a true alternative the same markets must be accessed.

2.4.3 Existing Wascana System

The Wascana pipeline currently provides transportation to PADD IV from the IPL system at Regina via connections to pipelines operated by Texaco and Butte. The Wascana system currently has a capacity of approximately 7,150 m^3/d (45,000 BPD). Therefore, this system cannot transport the volumes forecast in Section 1. Major expansions and changes to several pipelines would be required to provide an equivalent level of service and this is not viewed as economically attractive.

Express Pipeline offers a single operator between Hardisty and Casper which will be able to better serve the requirements of shippers by reducing the number of pipelines involved and the level of contamination experienced.

As discussed above in the context of IPL, this alternative may have less environmental impacts, although the magnitude of the expansions that would be required and the number of pipelines involved may actually result in more significant environmental impacts. In Express' view this is not an economically feasible alternative to Express.

2.4.4 Existing Rangeland System

The Rangeland system is unable to access all of the major crude types that can be accessed from Hardisty . The only major heavy oil accessed by Rangeland is Cold Lake blend and it has a limited appeal in the PADD IV market.

The Rangeland/Glacier/Cenex systems cannot currently take crude past Billings. The major growth areas in Padd IV are Wyoming, Denver and the Salt Lake area and Rangeland cannot access these markets. In addition, Rangeland does not offer access to Padd II because it cannot access the Platte or Amoco systems.

This is not a practical or economically feasible alternative to Express, as it does not access the same supply sources or markets.

2.4.5 Existing TMPL System

ANS and offshore crudes for the Puget Sound market. However, Trans Mountain cannot access certain Hardisty crudes which may be priced competitively with ANS.

For market and environmental reasons, shipping significant quantities of crude offshore through Trans Mountains' Westridge Terminal is not a viable option to deal with Western Canada's crude surplus. A major expansion to the Trans Mountain system could encounter significant environmental obstacles. In any event, this system does not access the same markets and is not an alternative to Express.

2.4.6 Bow River/Murphy/Cenex Systems

These systems access only medium and heavy crude from southern Alberta and Saskatchewan. Therefore, they have tremendous appeal to the Billings refiners but they do not solve the light crude supply deficiency prevalent in the balance of Padd IV. In addition they offer no access to the Padd IV market south of Billings. As above, from an environmental point of view, this is not an alternative to Express.

2.4.7 Smaller Pipe Diameter

Lower throughput, higher operating costs and resulting higher tariffs could ultimately jeopardize the long-term viability of such a pipeline. As well, such a line would also not provide adequate access to the identifiable market.

From an environmental point of view, the impacts associated with a smaller sized line may be greater, given the larger number of pump stations required.

2.4.8 Alternate Routes

Alternate routes such as starting at Edmonton or Regina and ending at Guernsey were examined. None of these routes provided the access to the different types of crudes (hub concept) offered from Hardisty. Hardisty to Casper makes the best use of existing pipelines and terminaling facilities and allows for the best matchup of Canadian supply alternatives with access to significant new markets.

These options would likely increase potential environmental impacts, as the route evaluation conducted by Express confirms that the present route is the most attractive from an environmental point of view.

Appendix B

Preliminary Rehabilitation Plan

PRELIMINARY REHABILITATION PLAN

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1.0 INTRODUCTION

This Reclamation and Revegetation Plan is designed to mitigate potential environmental effects (ARM 36.7.2543(7)(b)) and is specifically focused on controlling erosion and sedimentation as well as on revegetating disturbed areas. As routing and design are finalized, this Plan will be refined to include site-specific, detailed measures suitable for inclusion in construction contracts, specifications and on alignment sheets. The principal scope of this Plan is for areas not subject to annual cultivation. The Plan does not specifically address repair of agricultural drainage tiles as current data indicates none would be encountered within the proposed right-of-way.

1.1 OBJECTIVES

The short-term objectives of the Reclamation and Revegetation Plan are to control erosion and sedimentation and to minimize impacts on existing land uses. Long term objectives also include erosion and sedimentation control, as well as restoration of topography, water resources, soils and vegetation to complement pre-disturbance conditions (ARM 36.7.3011(9)). These objectives would be met by implementing practices developed during preconstruction negotiations with involved parties and by utilizing practices detailed in this Plan. Construction practices, scheduling and rapid construction progress would mitigate short-term impacts. Monitoring during the construction and operational phases would ensure that these objectives are met.

The following specific objectives are addressed in this Plan:

- Construct the pipeline and rehabilitate disturbed areas to a uniformly high standard along the entire length of the pipeline route, regardless of land ownership (private, state or Federal);

- Restore approximate original contours (unless otherwise recommended by a geotechnical engineer) to blend with the adjacent landscape;

- Salvage, protect and utilize the highest quality soil for revegetation;

- Provide erosion, subsidence and sediment control as required;

- Implement site-specific and comprehensive erosion control and rehabilitation procedures on wetlands/riparian areas, steep slopes, areas subject to wind erosion, soils affected by salts, extremely sandy or clayey soils, soils shallow to bedrock, badlands or breaks or other such sites identified during final routing and design;

- Reestablish and stabilize surface water features;

- Utilize adapted native species for revegetation where appropriate to reduce the visual effect of the corridor and provide a self-perpetuating cover compatible with post-construction land use;

- Discourage non-noxious weed competition and control noxious weeds;

- Discourage the unauthorized use of the right-of-way by off-road vehicles; and

- Monitor and maintain revegetation and erosion and sediment control structures and practices.

Construction supervisory personnel would be made aware of environmental concerns, pertinent laws and regulations and final rehabilitation specifications and design. Inspectors would be employed to enforce environmental protection measures in the field during construction and rehabilitation.

1.2 COORDINATION WITH PRIVATE AND PUBLIC LANDOWNERS

This Rehabilitation Plan proposes general procedures to rehabilitate disturbed areas. Specific design criteria would be finalized only after consultation and coordination with involved parties. For example, rehabilitation of agricultural land would be finalized only after discussions with the landowner. In addition to private landowners, several Federal and state agencies are involved directly or indirectly in land or resource management along the proposed route. Express would coordinate with these agencies to mitigate specific concerns through plans of development required under the right-of-way granting process. Therefore, flexibility of the rehabilitation procedures described in this Plan is necessary to allow site-specific mitigation.

1.3 GENERAL ENVIRONMENTAL CONSIDERATIONS

Several environmental protection measures pertain to pipeline construction and operation activities. These general measures include:

- All vehicular traffic associated with construction would be confined to the right-of-way or designated access roads.

- Disturbance would be limited to the minimum necessary to efficiently complete activities. For example, if a 10-foot wide temporary access road is adequate, a wider road would not be constructed.

- All supervisory construction personnel would be made aware of environmental concerns, pertinent laws and regulations and final rehabilitation specifications and design.

- Environmental inspectors would be employed to enforce environmental protection measures in the field during construction.

- No firearms would be allowed on the right-of-way by pipeline personnel, subcontractors or other personnel visiting the work site.

- Wildlife and livestock would not be harassed or fed. All workers would be informed of applicable Federal and state wildlife regulations.

- Waste materials such as pipe coating, spent welding rods, containers, cans, lunch wrappers, used engine oil and other detritus from pipeline activities would be collected daily and disposed of at approved landfills and waste disposal sites.

- Continuous efforts would be made to prevent and control range and forest fires, soil erosion and air, noise and water pollution.

- All muffler systems would have spark arrestors to reduce noise pollution and the risk of fire.

- Oil changes, refueling and lubrication of machinery and equipment would be done in a manner to prevent spills. Spills that may occur would be promptly cleaned up.

2.0 CLEARING PROCEDURES

Pipeline construction necessitates the removal of obstacles (e.g., trees, large rocks, brush and logs) from the permanent and temporary right-of-way, as well as the partial levelling and smoothing of abrupt changes in ground contours. The permanent and temporary right-of-way are needed to provide room for all construction activities and for the temporary storage of spoil (material excavated from the trench) and salvaged topsoil. To the extent possible, the temporary work space would be limited to the minimum area necessary for these activities.

Where the route passes through environmentally vulnerable areas, specific procedures would be followed to minimize impacts. To prevent wind erosion and facilitate plant restoration, the roots of existing vegetation would be left in place as much as possible through the use of brush beaters or similar equipment. Low shrubs, smaller woody debris and herbaceous plants would be salvaged with topsoil, then reapplied during rehabilitation to create organic matter and a plant material source and to decrease wind and water erosion.

In the few locations where tree clearing is required, the right-of-way boundaries would be suitably flagged and any trees along the margins deemed to be of particularly high value would be protected from damage by the use of snow fence. Experienced wood cutters would be employed to clear wooded areas. All brush, tree tops, stumps and other debris cleared from the right-of-way would be disposed of according to applicable laws, rules, regulations and special provisions applying to each tract of land. Merchantable timber would be salvaged as directed by the property owner. Small trees that have no economic value could be placed on steep slopes after seeding. This procedure would aid in erosion control.

Additional protection measures would be implemented to reduce the effects of clearing.

- In environmentally vulnerable areas, construction equipment which would minimize surface disturbance, soil compaction and loss of topsoil would be utilized. Such equipment includes low ground pressure tracks or tires, blade shoes and brush rake attachments.

- Suitable vehicle water crossing structures such as temporary bridges would be installed as required.

- Only the area between flagged right-of-way boundaries would be cleared. Trees would be felled away from watercourses and off-site vegetation to prevent damage to adjacent trees and aquatic habitat.

- Steep, erodible slopes would not be pre-cleared unless construction is scheduled to commence immediately following clearing.

- Erodible slopes which do not require grading would be hand cleared. Trees, debris or soil inadvertently deposited within the high water mark of watercourses would be removed in a manner that minimizes disturbance of the bed and banks.

- Unless the area is to be grubbed, non-merchantable timber would be cleared in a manner that breaks the tree cleanly without pulling up the roots.

- Mature crops along the right-of-way would be harvested or mulched, in accordance with landowner requests. Stubble would be retained in order to control dust and reduce soil compaction on the working side.

3.0 TOPSOIL SALVAGE AND STORAGE

Topsoil handling objectives are to salvage, store and redistribute the highest quality soils suitable for revegetation and for maintenance of surface color. Topsoil or "highest quality soils" are defined as surface soils that contain higher amounts of organic matter as well as the soil seedbank, and generally exhibit more favorable textures, fewer coarse fragments and less salts or other potentially limiting characteristics than soils located in lower horizons or in the subsoil.[1]

Soil map units, preliminary stripping depths, restrictive features, rehabilitation potential and revegetation mixes are given by milepost in Table B-3-1.

Table B-3-1 is based on information presented in Section 4.2. Topsoil stripping width, depth and storage would vary along the pipeline route depending on criteria such as: potential safety hazards, construction techniques, land use, soil characteristics, grading requirements, slope, amount of traffic expected over a particular construction segment, vegetation, landowner preference, visual sensitivity, and methods for crossing wetlands, streams, canals, roads, etc. Stripping depth, width and storage location would be specified on final construction drawings.

Surface disturbance would be minimized by adjusting the working area space and stripping widths to meet construction needs. Topsoil would be salvaged wherever the right-of-way is graded unless otherwise specified.

In cultivated and improved areas, topsoil would be stripped over the trench and spoil storage areas or as directed by the landowner. Conventional bulldozers and graders would be used to perform this operation. Topsoil would be stored separately from subsoil and subsequently replaced with a minimum of handling. Where grade cuts result in additional spoil, the spoil may be stored on either side of the construction area. In such cases, the topsoil typically would be stripped from the entire area so that subsoil is not stored on topsoil. Topsoil would not be piled in a manner that increases its water content. No drains and ditches would be blocked by topsoil or subsoil storage piles.

Topsoil stripping widths on rangeland would consist of blade width stripping, trench and spoil stripping. Topsoil stripping is not necessary where there is no viable seed source or suitable soil for salvage due to salinity and/or sodicity problems (usually indicated by the lack of vegetation), rock outcrop (shale, sandstone, or other types of rock outcrop), or steep slopes (those that pose potential safety hazards to equipment operators). In areas that consist of rock outcrops or saline and/or sodic soils, surface stabilization would require alternative methods to revegetation.

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[1]Express recognizes that the word "topsoil" may be inappropriate in some areas of Wyoming. However, for ease of understanding by pipeline contractors, this document uses the word "topsoil" throughout.

TABLE B-3-1
DOMINANT AND RESTRICTIVE SOIL MAP UNITS BY MILEPOST[1]

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
MONTANA					
0 - 0.9	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
	JOPLIN-HILLON		WE		4
	SCOBEY-KEVIN		---		2
0.9 - 1.0	GERDRUM-CREED-ABSHER	5	NA,WAE,(EC)	P	8
1.0 - 7.8	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
	JOPLIN-HILLON		WE		4
	SCOBEY-KEVIN		---		2
7.8 - 7.9	BADLAND-RO	0-4	ST,SH,WE,WAE	P	4
*7.9 - 8.2	HAVRE	8	FL,WT	G	5
8.2 - 8.3	WATER	---	WATER	---	---
*8.3 - 8.7	HAVRE	8	FL,WT	G	5
8.7 - 8.9	BADLAND-RO	0	ST,SH,WE,WAE	P	4
8.9 - 15.0	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
	JOPLIN-HILLON		WE		4
	SCOBEY-KEVIN		---		2
15.0 - 15.1	HILLON	5	ST,WAE	F	4
15.1 - 33.1	TELSTAD-JOPLIN	11	---	F-G	2
	JOPLIN-HILLON		WE		4
	TELSTAD-HILLON		---		2
	FORTBENTON-KENILWORTH		---		2
*33.1 - 33.5	HAVRE	8	FL,WT	G	5
33.5 - 38.8	TELSTAD-JOPLIN	11	---	F	2
	FORTBENTON-HILLON		WE		4
	FORTBENTON-KENILWORTH		---		2
	JOPLIN-HILLON		WE		4
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
38.8 - 39.0	CREED-GERDRUM	6	NA,WAE,(EC)	P	8
39.0 - 42.3	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
	JOPLIN-HILLON		WE		4
42.3 - 42.4	ABSHER	4	(EC),(NA)	P	2,(8)
42.4 - 44.8	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
	JOPLIN-HILLON		WE		4
44.8 - 45.5	MARVAN-VANDA	4	EC,NA,WE,C	P	3,8,
	GERDRUM-CREED-ABSHER		NA,WAE,(EC)		8
45.5 - 46.4	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)
46.4 - 46.5	CREED-GERDRUM	4	NA,WAE,EC	P	8
46.5 - 47.4	TELSTAD-JOPLIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC),(NA)		2,(8)

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
47.4 - 47.7	THOENY-ELLOAM-ABSHER	4	NA, (EC)	P	8
47.7 - 65.6	TELSTAD-JOPLIN	10	---	F-G	2
	PHILLIPS-KEVIN		---		2
	PHILLIPS-ELLOAM		(EC), (NA)		2, (8)
	ASSINIBOINE		WE		4
	KENILWORTH-FORTBENTON		---		2
	TELSTAD		---		2
	FORTBENTON-SCOBEY		WE		2
	FORTBENTON		WE		2
	VIRGELLE		WE		1
	SCOBEY-KEVIN		---		2
	DEGRAND		---		2
	CHINOOK		WE		2,4
	EVANSTON		---		2
65.6 - 65.7	CABBART	4	WE, ST, EC, WAE, SH	P	4
65.7 - 65.9	HILLON	5	WAE, ST	F	2,4
65.9 - 66.1	CABBART	4	WE, SH, ST, EC, WAE	P	4
66.1 - 67.2	TELSTAD-JOPLIN	9	---	G	2
67.2 - 67.3	CABBART-HILLON	4	WE, SH, ST, EC, WAE	P	4
67.3 - 68.2	TELSTAD-JOPLIN	9	---	G	2
68.2 - 68.6	CABBART-HILLON	4	WE, SH, ST, EC, WAE	P	4
68.6 - 68.9	YAMAC-HAVRE	10	WT, FL	G	2
68.9 - 69.1	WATER	---	WATER	---	---
69.1 - 69.3	BUSBY	12	WE	F	2,4
69.3 - 69.4	BUSBY	12	ST, WE, WAE	P	2,4
69.4 - 71.8	CHINOOK	10	WE	F-G	2,4
	DEGRAND		---		2
	ASSINIBOINE		WE		4
	TELSTAD-JOPLIN		---		2
	JOPLIN-HILLON		WE		2
71.8 - 71.9	HILLON	5	WAE, ST	F	2,4
71.9 - 72.3	TELSTAD-JOPLIN	9	---	F-G	2
	JOPLIN-HILLON		WE		2
72.3 - 72.4	HILLON	5	WAE	F	2,4
72.4 - 74.2	JOPLIN-HILLON	9	WE	G	2
	TELSTAD-JOPLIN		---		2
74.2 - 74.3	CABBART-HILLON	4	WE, SH, ST, EC, WAE	P	4
74.3 - 74.6	MARVAN	4	WE	F	3
74.6 - 75.1	NELDORE-BASCOVY	4	WE, SH, WAE, ST	P	3,4
75.1 - 75.6	MARVAN	4	WE	F	3
75.6 - 81.0	SCOBEY-KEVIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC), (NA)		2, (8)
81.0 - 81.1	NISHON	11	WT, FL	P	5

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
81.1 - 83.6	SCOBEY-KEVIN	10	---	F	2
	PHILLIPS-ELLOAM		(EC), (NA)		2, (8)
83.6 - 83.7	ABSHER	4	(EC), (NA)	P	2, (8)
83.7 - 84.0	SCOBEY-KEVIN	9	---	G	2
84.0 - 84.3	BEARPAW-VIDA	6	---	G	2
84.3 - 84.4	NISHON	11	WT, FL	P	5
84.4 - 89.5	BEARPAW-VIDA	6	---	G	2
	BEARPAW		---		2
89.5 - 89.6	NISHON-(HYDRIC)	11	WT	P	5
89.6 - 90.5	BEARPAW-VIDA	6	---	G	2
90.5 - 92.0	NISHON	11	WT, FL	P	5
92.0 - 96.5	BEARPAW-VIDA	6	---	G	2
	ZAHILL-VIDA		WAE		4
96.5 - 102.0	MARVAN-NOBE	4	WE, FL, (EC), WT	P	3, 5, (8)
102.0 - 102.8	SAGEDALE	11	WE, WAE	F	4
102.8 - 103.0	SAGEDALE	11	WE, WAE, ST	P	4
103.0 - 103.4	SAGEDALE	11	WE, WAE	F	4
103.4 - 103.7	MARVAN-NOBE	4	WE, FL, (EC), WT	P	3, 5, (8)
103.7 - 104.0	SAVAGE	12	WE	G	2
104.0 - 104.1	MARVAN-NOBE	4	WE, FL, (EC), WT	P	3, 5, (8)
104.1 - 105.7	MACAR	12	---	G	2
	TALLY		WE, WAE		4
105.7 - 106.0	SAGEDALE	11	WE, WAE	F	4
106.0 - 112.0	MACAR	11	---	G	2
	SAGEDALE-MACAR		WE, WAE		4
112.0 - 112.7	MARIAS	8	WE	F-G	3
	HAVRE		FL		5
	HARLEM		FL		5
112.7 - 115.0	NELDORE-THEBO-RO	0-4	SH, ST, WAE, WE, C	P	3, 4
115.0 - 117.4	DANVERS	10	WE	G	2
	FAIRFIED-DANVERS		WE		2
117.4 - 117.6	WINIFRED-WINDHAM	6	WE, WAE, ST	P	4
117.6 - 118.0	TAMANEEN-JUDITH	9	WE	G	2
118.0 - 118.8	WINIFRED-WINDHAM	6	WE, WAE, ST	P	4
118.8 - 120.1	TAMANEEN-JUDITH	9	WE	G	2
	WINIFRED-JUDITH		WE		2, 4
120.1 - 120.6	ELTSAC-LAWTHER	6	WE	P-F	3
	CABBA-DONEY-WAYDEN		WE, SH		2, 4
120.6 - 120.7	TYPIC USTIFLUVENTS, SALINE	4	EC, NA, WT	P	5, 8

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
120.7 - 121.0	ELTSAC-LAWTHER	6	WE	P-F	3
	CABBA-DONEY-WAYDEN		WE,SH		2,4
121.0 - 122.4	WINIFRED	9	WE	G	2
	FAIRFIELD-DANVERS		WE		2
	WINIFRED-JUDITH		WE		2,4
122.4 - 122.7	GERBER	12	---	G	2
122.7 - 123.5	DAGLUM-ADGER	6	EC,NA,WE	P	3,8
	MARCOTT		FL,WE,WT		2,5
123.5 - 123.9	JUDITH	9	WE	G	2,4
	FAIRFIELD-DANVERS		WE		2
123.9 - 124.0	DAGLUM-ADGER	4	EC,NA,WE	P	3,8
124.0 - 124.1	HAPLAQUOLLS	8	FL,WT	G	5
124.1 - 124.3	DAGLUM-ADGER	4	EC,NA,WE	P	3,8
124.3 - 124.7	WINIFRED-WINDHAM	6	WE,WAE,ST	P	4
124.7 - 125.8	TAMANEEN-JUDITH	9	WE	G	2
	FAIRFIELD-JUDELL		WE		2
125.8 - 125.9	HAPLAQUOLLS	8	FL,WT	G	5
125.9 - 126.9	TAMANEEN-JUDITH	9	WE	G	2
	FAIRFIELD-JUDELL		WE		2
	DANVERS		WE		2
126.9 - 127.1	DAGLUM-ADGER	4	EC,NA,WE	P	3,8
127.1 - 127.7	JUDITH	9	WE	G	2,4
	FAIRFIELD		WE		2
	WINIFRED		WE		2
127.7 - 127.8	HAPLAQUOLLS	8	FL,WT	G	5
127.8 - 129.2	WINIFRED-JUDITH	9	WE	G	2,4
	FAIRFIELD-JUDELL		WE		2
129.2 - 129.5	WINIFRED-WINDHAM	5	WE,WAE,ST	P	4
	WINIFRED-UTICA		WE,WAE,ST		2,4
129.5 - 130.0	DANVERS-JUDITH	6	WE	F	2
	WINIFRED		WAE,WE		2,4
130.0 - 130.2	ARVADA-LAUREL	4	WE,NA,EC	P	3,8
130.2 - 130.3	GALLATIN-RAYNESFORD	11	WT,FL	G	5
130.3 - 130.6	ARVADA-LAUREL	4	WE,NA,EC	P	3,8
130.6 - 131.1	PROMISE	3	WE,C	F	3,4
131.1 - 131.9	WINIFRED	6	WE,WAE	F	2,4
131.9 - 132.7	JUDITH	6	WE	G	2
	DANVERS		WE		2
132.7 - 133.1	ARVADA-LAUREL	4	WE,NA,EC	P	3,8
133.1 - 133.3	SAVAGE	12	WE	F-G	3,4
133.3 - 133.4	GALLATIN-RAYNESFORD	11	WT,FL	G	5

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
133.4 - 133.5	SAVAGE	12	WE	F-G	3,4
133.5 - 133.8	BECKTON-ARVADA	4	WE,NA,(EC)	P	2,8
133.8 - 134.8	WINIFRED-UTICA	4	WE,WAE,ST	P	4
134.8 - 135.2	JUDITH	6	WE	G	2
135.2 - 135.6	WINIFRED	6	WE,WAE	F	2,4
135.6 - 135.7	GALLATIN-RAYNESFORD	11	WT,FL	G	5
135.7 - 135.9	WINIFRED	6	WE,WAE	F	2,4
135.9 - 136.7	DANVERS	6	WE	G	2
	JUDITH		WE		2
	WINIFRED-JUDITH		WE		2,4
136.7 - 136.9	WINIFRED-UTICA	4	WE,WAE,ST	P	4
136.9 - 138.0	JUDITH	6	WE	F-G	2
	DANVERS		WE		2
	WINIFRED		WAE,WE		2,4
138.0 - 138.1	GALLATIN-RAYNESFORD	11	WT,FL	G	5
138.1 - 139.5	JUDITH	6	WE	G	2
	DANVERS		WE		2
139.5 - 139.9	JUDITH	4	WE	P	2
	WINIFRED-UTICA		WE,WAE,ST		4
	UTICA		WE,WAE,ST		2,4
139.9 - 142.2	DANVERS	6	WE	G	2
142.2 - 142.5	JUDITH	5	WE	P	2
	UTICA		WE,WAE,ST		2,4
142.5 - 143.7	DANVERS	6	WE	G	2
	JUDITH		WE		2
	JUDITH-UTICA		WAE,ST		4
143.7 - 143.8	GALLATIN-RAYNESFORD	11	WT,FL	G	5
143.8 - 144.6	JUDITH	6	WE	G	2
	DANVERS-JUDITH		WE		2
144.6 - 145.0	GALLATIN-RAYNESFORD	11	WT,FL	G	5
145.0 - 145.3	COBBLY ALLUVIAL	4	FL,WE,WAE,	P	1,4,5
	WINIFRED-UTICA		WE,WAE,ST		4
145.3 - 147.2	WINIFRED	6	WE,WAE	F-G	2,4
	JUDITH		WE		2
147.2 - 147.9	WINIFRED-UTICA	4	WE,WAE,ST	P	4
	PROMISE		WE,C		3,4
	PIERRE		WE,WAE,C		3,4
147.9 - 148.1	WINIFRED	6	WE,WAE	F	2,4
148.1 - 148.3	PIERRE	4	WE,WAE,C	P	3,4
	WINIFRED-UTICA		WE,WAE,ST		4
148.3 - 148.8	DANVERS-JUDITH	6	WE	G	2
148.8 - 149.0	ARVADA-LAUREL	4	WE,NA,EC	P	3,8

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
	WINIFRED-UTICA		WE,WAE,ST		4
149.0 - 150.1	DANVERS-JUDITH	6	WE	G	2
150.1 - 150.7	PROMISE	4	WE,C	P	3,4
150.7 - 151.7	DANVERS	6	WE	G	2
151.7 - 152.9	PROMISE	4	WE,C	P	3,4
152.9 - 155.1	SAVAGE	12	WE	G	3,4
	GALLATIN-RAYNESFORD		WT,FL		5
	STRAW		WE		2
155.1 - 157.6	WINDHAM	8	WAE,WE	F-G	4
	JUDITH		WE		2,4
	JUDITH-JUDELL		WE		2
	HAPLAQUOLLS		FL,WT		5
	MARCOTT		FL,WT,WE		2,5
157.6 - 157.7	STRAW	12	WE	G	2
157.7 - 157.9	HAPLAQUOLLS	8	FL,WT	G	5
157.9 - 158.3	DAGLUM-ADGER	4	WE,EC,NA	P	3,8
158.3 - 159.0	SAVAGE	12	WE	G	2
159.0 - 159.2	HAPLAQUOLLS	8	FL,WT	G	5
159.2 - 159.4	SAVAGE	12	WE	G	2
159.4 - 159.5	MARCOTT	8	FL,WE,WT	F	2,5
159.5 - 159.7	SAVAGE	12	WE	G	2
159.7 - 161.4	MARCOTT	8	FL,WE,WT	F	2,5
	HAPLAQUOLLS		FL,WT		5
161.4 - 162.1	SAVAGE	12	WE	G	2
162.1 - 162.3	HAPLAQUOLLS	8	FL,WT	G	5
162.3 - 163.8	GALLATIN	12	FL,WT	G	5
	SAVAGE		WE		3,4
163.8 - 164.7	MARCOTT	8	FL,WE,WT	F	2,5
164.7 - 165.7	SAVAGE	12	WE	G	3,4
165.7 - 166.2	HAPLAQUOLLS	8	FL,WT	G	5
	MARCOTT		FL,WE,WT		2,5
166.2 - 166.5	TYPIC USTIFLUVENTS,SALINE	4	EC,NA,WT	P	5,8
166.5 - 166.8	GERBER	12	---	G	2
166.8 - 167.0	TYPIC USTIFLUVENTS,SALINE	4	EC,NA,WT	P	5,8
167.0 - 167.2	JUDITH-JUDELL	9	WE	G	2
	WINIFRED		WE		2
167.2 - 167.6	DONEY-WINDHAM	6	WE	F	2,4
	AMOR-CABBA		WE,SH		2,4
167.6 - 167.9	DAGLUM-ADGER	4	WE,EC,NA	P	3,8

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
167.9 - 168.0	JUDITH-JUDELL	9	WE	G	2
168.0 - 168.7	AMOR-CABBA	7	WE, SH	F	2,4
	CABBA-DONEY-WAYDEN		WE, SH		2,4
168.7 - 168.9	MORTON	12	---	G	2
168.9 - 171.5	KOBAR-WAYDEN	6	WE	F-G	2,4
	ROTHIEMAY		---		2
	UTICA		WE, WAE, ST		2,4
171.5 - 172.0	ALLUVIAL, WET	4	WT, EC	P	5,8
	ABSHER		WE, (EC), (NA)		2, (8)
172.0 - 172.4	KOBAR-WAYDEN	12	WE	G	2,4
	KOBAR		WE		2
172.4 - 173.0	ALLUVIAL, WET	4	WT, EC	P	5,8
	ABSHER		WE, (EC), (NA)		2, (8)
173.0 - 173.1	RENTSAC	4	WE, SH	F	1,4
173.1 - 173.4	ABSHER	4	WE, (EC), (NA)	P	2, (8)
173.4 - 173.5	KOBAR, WET	12	WT, WE	G	2,5
173.5 - 174.1	ALLUVIAL, WET	4	WT, EC	P	5,8
174.1 - 174.5	JOPLIN-CABBA	8	WAE	G	4
	JOPLIN		---		2
174.5 - 174.9	KOBAR, WET	12	WT.WE	G	2,5
174.9 - 175.9	TWO DOT	12	---	G	2
175.9 - 178.2	MUSSELSHELL	6	---	G	2
	CRAGO		WE		2,4
	MUSSELSHELL-CRAGO		---		2
178.2 - 178.5	CRAGO-BERCAIL	5	WAE, ST	P	4
178.5 - 179.7	BERCAIL	5	---	G	2
179.7 - 179.9	MARIAS	5	WE, (EC)	F	2,4, (8)
179.9 - 180.6	KOBAR	8	WE	G	2
	MUSSELSHELL-CRAGO		---		2
180.6 - 180.7	HAVRE-MARIAS	5	WE, FL, (EC)	F	5,8
180.7 - 183.5	LEBO-MUSSELSHELL	7	WE	G	2
	BERCAIL		---		2
	CRAGO-BERCAIL		WAE		4
	CRAGO		WE		2,4
	MUSSELSHELL		---		2
183.5 - 183.7	AMESHA	10	WE	G	2
183.7 - 183.9	CRAGO	6	WE	G	2,4
183.9 - 184.5	YAMAC	11	---	G	2,4
184.5 - 184.7	BERCAIL	4	---	P	2
	BERCAIL-WAYDEN		WAE, ST		3
184.7 - 186.2	SAVAGE	12	---	G	2
	TWO DOT		---		2

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
186.2 - 189.5	WAYDEN-CRAGO	0-4	WAE,WE,ST,SH	P	4
	WAYDEN-RO		WAE,ST,SH		4
	BERCAIL		---		2
	WAYDEN		WAE,ST,SH		4
	RENTSAC-RO		WE,WAE,SH,ST		4
	RENTSAC		WE,SH		1,4
	BERCAIL-WAYDEN		WAE,ST		3
189.5 - 190.1	SHAAK	12	---	G	2
190.1 - 190.3	CRAGO-BERCAIL	5	WAE,ST	P	4
190.3 - 190.5	SHAWMUT	12	SH	G	2
190.5 - 192.7	CRAGO-BERCAIL	0-4	WAE,ST,SH	P	4
	WAYDEN-RO		WAE,ST,SH		4
	BERCAIL-WAYDEN		WAE,ST		3
	WAYDEN		WAE,ST,SH		4
192.7 - 192.9	ALLUVIAL,WET	4	WT,EC	P	5,8
192.9 - 193.0	LAMBETH	8	---	G	2
193.0 - 194.2	BERCAIL-WAYDEN	4	WAE,ST	P	3
	BERCAIL		---		2
194.2 - 195.2	KOBAR	12	WE	G	2
195.2 - 195.5	HAVRE	8	FL	G	5
195.5 - 195.6	RIVERWASH COMPLEX	4	WT,FL,(EC)	P	5,(8)
195.6 - 196.0	HAVRE	8	FL	G	5
196.0 - 196.4	MARIAS	4	WE,(EC)	P	2,(4),(8)
	MARIAS,SALINE		WE,EC		2,4,8
196.4 - 197.0	CRAGO-BERCAIL	6	WAE,ST	P	4
	SHAWMUT		SH		2
197.0 - 197.1	ABSHER	4	(EC),(NA),WE	P	2,(8)
197.1 - 197.2	MARIAS-WAYDEN	5	WAE,WE	F	4
197.2 - 197.3	ABSHER	4	(EC),(NA),WE	P	2,(8)
197.3 - 198.7	MARIAS-WAYDEN	5	WAE,WE	F	4
198.7 - 198.8	WAYDEN-RO	0-4	WAE,ST,SH	P	4
198.8 - 198.9	ALLUVIAL,WET	4	WT,EC	P	5,8
198.9 - 199.0	ABSHER	4	(EC),(NA),WE	P	2,(8)
199.0 - 199.1	RAPPELJE	12	---	G	2
199.1 - 199.3	ABSHER	4	(EC),(NA),WE	P	2,(8)
199.3 - 199.5	KOBAR	12	WE	G	2
199.5 - 199.9	RENTSAC-RO	0-4	WE,WAE,SH,ST	P	4
199.9 - 201.1	WAYDEN	4	WAE,ST,SH	P	4
201.1 - 202.9	WAYDEN-RO	0-4	WAE,ST,SH	P	4
	CABBA		WAE,ST		4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
202.9 - 203.1	BERCAIL	8	---	G	2
	SHAAK		---		2
203.1 - 203.6	CABBA	7	WAE, ST	P	4
203.6 - 204.0	RENTSAC-RO	0-4	WE, WAE, ST, SH	P	4
204.0 - 204.2	HAVRE-MARIAS	5	WE, FL, (EC)	F	5, (8)
204.2 - 206.1	RENTSAC-RO	0-4	WE, WAE, SH, ST	P	4
	BEENOM-RENTSAC		WE		2,4
	CABBART-RENTSAC		WE, WAE, EC, SH		1,4,8
206.1 - 207.3	TANNA	12	---	G	2
	YAMAC-DELPOINT		---		2
	YAMAC-DELPOINT, CALCAREOUS		WE		2
207.3 - 209.5	CABBART-YAWDIM-DELPOINT	0-4	WAE, WE, ST, SH	P	4
	CABBART-RENTSAC		WE, WAE, EC, SH		1,4,8
	RENTSAC-RO		WE, WAE, ST, SH		4
*209.5 - 210.1	DELPOINT	11	---	G	2
*210.1 - 210.3	CABBART-RENTSAC	4	WAE, WE, EC, SH	P	1,4,8
*210.3 -211.2	DELPOINT	11	---	G	2
*211.2 - 212.7	CABBART-RENTSAC	0-4	WAE, WE, EC, SH	P	1,4,8
	RENTSAC-RO		WE, WAE, ST, SH		4
*212.7 - 213.9	EVANSTON	11	---	G	2
	KOBAR		---		2
	YAMAC		---		2
*213.9 - 214.1	CABBART-RENTSAC	4	WE, WAE, EC, SH	P	1,4,8
214.1 - 215.1	LAMBETH-YAWDIM	8	---	G	2
215.1 - 215.3	RENTSAC	8	WAE, ST, SH	P	4
215.3 - 216.7	LAMBETH-YAWDIM	8	---	G	2
216.7 - 217.0	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
217.0 - 217.4	TANNA-RENTSAC	7	WE, SH	F	2,4
217.4 - 218.2	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
218.2 - 218.5	LAMBETH-YAWDIM	8	---	G	2
218.5 - 218.8	USTIFLUVENTS-USTOCHREPTS	12	WAE, WE	F	2
218.8 - 218.9	LAMBETH-YAWDIM	8	---	G	2
218.9 - 219.5	ABSHER	4	(EC), (NA), WE	P	2, (8)
219.5 - 220.0	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
220.0 - 220.9	LAMBETH-YAWDIM	9	---	G	2
	LONNA		---		2
220.9 - 221.7	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2,3
221.7 - 221.8	ABSHER	4	(EC), (NA), WE	P	2, (8)
221.8 - 222.0	TANNA-RENTSAC	7	WE, SH	F	2,4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
222.0 - 225.1	LONNA	9	---	G	2
	TANNA		WE		2
225.1 - 225.2	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2,3
225.2 - 225.5	LARDELL	4	WE,EC,WT	P	2,5,8
225.5 - 225.7	TANNA-RENTSAC	7	WE,SH	F	2,4
225.7 - 226.2	LARDELL	4	WE,EC,WT	P	2,5,8
226.2 - 227.0	TANNA-RENTSAC	7	WE,SH	F	2,4
227.0 - 227.1	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2,3
227.1 - 227.9	TANNA-RENTSAC	7	WE,SH	F	2,4
227.9 - 228.1	MCKENZIE	4	EC,NA,FL,C	P	3,5,8
228.1 - 228.9	TANNA-RENTSAC	7	WE,SH	F	2,4
228.9 - 229.2	MCKENZIE	4	EC,NA,FL,C	P	3,5,8
229.2 - 230.9	TANNA-RENTSAC	7	WE,SH	F	2,4
230.9 - 232.2	MCKENZIE	4	EC,NA,FL,C	P	3,5,8
	LARDELL		WE,EC,WT		2,5,8
232.2 - 235.3	LAMBETH-RENTSAC	7	WAE,SH	F-G	4
	YAMAC		---		2,4
	TANNA-RENTSAC		WE,SH		2,4
235.3 - 235.6	ABSHER	4	(EC),(NA),WE	P	2,(8)
235.6 - 235.8	TANNA	7	WE	G	2
235.8 - 236.1	ABSHER	4	(EC),(NA),WE	P	2,(8)
236.1 - 237.5	TANNA	7	WE	F-G	2
	TANNA-RENTSAC		WE,SH		2,4
237.5 - 237.6	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2,3
237.6 - 237.8	TANNA-RENTSAC	7	WE,SH	F	2,4
237.8 - 238.0	YAWDIM-LAMBETH-RO	0-4	WAE,WE,ST,SH	P	4
238.0 - 238.5	TANNA-RENTSAC	7	WE,SH	F	2,4
238.5 - 238.7	YAWDIM-LAMBETH-RO	0-4	WAE,WE,ST,SH	P	4
238.7 - 239.1	TANNA-RENTSAC	7	WE,SH	F	2,4
239.1 - 240.1	ABSHER	4	(EC),(NA),WE	P	2,(8)
240.1 - 240.6	YAWDIM-LAMBETH-RO	0-4	WAE,WE,ST,SH	P	4
240.6 - 242.3	TANNA-RENTSAC	7	WE,SH	F-G	2,4
	TANNA		WE		2
242.3 - 242.4	YAWDIM-LAMBETH-RO	0-4	WAE,WE,ST,SH	P	4
242.4 - 242.6	YAMAC	8	---	G	2,4
242.6 - 242.7	YAWDIM-LAMBETH-RO	4	WAE,WE,ST,SH	P	4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
242.7 - 243.3	TANNA	7	WE	G	2
243.3 - 243.4	ABSHER	4	(EC), (NA), WE	P	2, (8)
243.4 - 244.4	TANNA-RENTSAC	7	WE, SH	F-G	2, 4
	TANNA		WE		2
244.4 - 245.5	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
245.5 - 246.7	ABSHER	4	(EC), (NA), WE	P	2, (8)
246.7 - 247.6	KOBAR	12	WE	G	2
247.6 - 247.7	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
247.7 - 247.8	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2, 3
247.8 - 248.2	LAMBETH-YAWDIM	8	---	G	2
248.2 - 248.3	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2, 3
248.3 - 248.5	YAMAC	8	---	G	2, 4
248.5 - 248.9	TANNA-RENTSAC	7	WE, SH	F-G	2, 4
248.9 - 249.1	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2, 3
249.1 - 249.4	BONFRI-LAMBETH	7	---	F-G	2
	TANNA-RENTSAC		WE, SH		2, 4
249.4 - 249.5	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
249.5 - 250.2	LAMBETH-YAWDIM	7	---	F-G	2
	FLUVENTS-USTOCHREPTS-CAMBORTHIDS		WAE		2, 3
250.2 - 250.4	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
250.4 - 252.0	LAMBETH-YAWDIM	7	---	F-G	2
	FLUVENTS-USTOCHREPTS-CAMBORTHIDS		WAE		2, 3
	BONFRI-LAMBETH		---		2
252.0 - 252.2	ABSHER	4	(EC), (NA), WE	P	2, (8)
252.2 - 253.0	TANNA-RENTSAC	7	WE, SH	F-G	2, 4
	BONFRI-LAMBETH		---		2
253.0 - 253.3	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
253.3 - 253.5	ASSINIBOINE	10	WE	G	2, 4
253.5 - 253.7	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2, 3
253.7 - 254.2	ASSINIBOINE	10	WE	G	2, 4
254.2 - 254.8	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
254.8 - 254.9	FLUVENTS-USTOCHREPTS-CAMBORTHIDS	5	WAE	F	2
254.9 - 255.0	YAWDIM-LAMBETH-RO	0-4	WAE, WE, ST, SH	P	4
255.0 - 256.5	YAMAC	7	---	G	2, 4
	GLENDIVE		---		2
256.5 - 257.3	ATTEWAN	12	---	G	2
	ATTEWAN, WET		WT		2, 5
	FLUVAQUENT		WT, FL		5
	GLENDIVE, WET		WT, FL		2, 5

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
257.3 - 257.4	WATER	---	WATER	---	---
257.4 - 257.5	GLENDIVE, WET	6	WT, FL	F	2,5
257.5 - 260.8	MIDWAY-TRAVESILLA CABBA-RENTSAC MACAR-CABBA	5	WE, (EC), ST, SH SH WE	P	4, (8) 4 2
260.8 - 260.9	RO-TRAVESILLA	0-4	WAE, ST, SH	P	4
260.9 - 261.8	MACAR-CABBA MIDWAY-TRAVESILLA	5	WE WE, (EC), SH	F	2 4, (8)
261.8 - 262.0	HAVERSON-HELDT	10	---	G	2
262.0 - 264.1	MIDWAY-TRAVESILLA MACAR-CABBA	5	WE, (EC), ST, SH WE	P	4, (8) 2
264.1 - 264.8	HELDT	12	---	G	2
264.8 - 265.1	ALLUVIAL LAND	4	SH	P	5
265.1 - 266.2	FORT COLLINS VONA	12	--- WT, (EC)	F-G	2 2,5, (8)
266.2 - 267.1	TOLUCA	6	---	G	2
267.1 - 268.7	FORT COLLINS HELDT	12	--- ---	G	2 2
268.7 - 269.0	MIDWAY-TRAVESILLA	4	WE, (EC), ST, SH	P	4, (8)
269.0 - 270.0	TOLUCA	6	---	G	2
270.0 - 270.1	TORCHLIGHT	4	EC, WE, C, NA	P	3,8
270.1 - 270.7	MIDWAY-TRAVESILLA TOLUCA MACAR-CABBA	5	WE, (EC), ST, SH --- WE	P-F	4, (8) 2 2
270.7 - 274.3	TORCHLIGHT KYLE	4	EC, WE, C, NA WE, C, (EC)	P	3,8 3, (8)
274.3 - 278.7	WAYDEN-CABBA MARIAS	6	WAE, WE, ST, SH WE, (EC)	P-F	4 2, (8)
278.7 - 279.0	LAMBETH	8	---	G	2
279.0 - 279.3	WAYDEN-CABBA	6	WAE, WE, ST, SH	P	4
279.3 - 279.4	RENTSAC-RO	0-4	WE, WAE, ST, SH	P	4
279.4 - 279.9	MARTINSDALE	12	WE	G	2
279.9 - 280.0	ABAC-TWIN CREEK RO-ABAC	0-4	WAE, WE, ST WAE, WE, SH, ST	P	4 4
280.0 - 280.3	TWIN CREEK	12	WE	G	2
280.3 - 281.0	RENTSAC-RO RENTSAC CHANNERY LOAM	0-4	WE, WAE, ST, SH WE, SH	P-F	4 2,4
281.0 - 281.5	REEDER-CASTNER	8	SH	F	2,4
281.5 - 281.6	RENTSAC-RO	0-4	WE, WAE, ST, SH	P	4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
281.6 - 281.7	TWIN CREEK	12	WE	G	2
281.7 - 282.9	RENTSAC CHANNERY LOAM	0-4	WE,SH	P	2,4
	RENTSAC-RO		WE,WAE,ST,SH		4
282.9 - 283.0	MARTINSDALE	12	WE	G	2
283.0 - 283.5	RENTSAC-RO	0-4	WE,WAE,ST,SH	P	4
283.5 - 283.8	MARTINSDALE	12	WE	G	2
283.8 - 284.8	RENTSAC CHANNERY LOAM	4	WE,SH	P-F	2,4
284.8 - 285.0	WAYDEN-CABBA	6	WAE,WE,ST,SH	P	4
285.0 - 286.6	HARVEY	5	WE	G	2,4
286.6 - 287.0	LA FONDA	12	---	G	2
287.0 - 287.2	STORMITT STONY LOAM	6	WE	G	2
287.2 - 287.3	LA FONDA	12	---	G	2
287.3 - 287.9	STORMITT STONY LOAM	6	WE	G	2
287.9 - 288.7	LA FONDA	12	---	G	2
288.7 - 295.4	STORMITT STONY LOAM	6	WE	G	2
	STORMITT LOAM		WE		2
	STORMITT GRAVELLY LOAM		WE		2
295.4 - 295.8	LA FONDA	12	---	G	2
295.8 - 296.8	STORMITT LOAM	6	WE	G	2
296.8 - 296.9	HELDT, SALINE	4	EC	P	8
296.9 - 297.3	NEVILLE	5	---	F-G	2
	STORMITT LOAM		WE		2
297.3 - 297.6	HELDT, SALINE	4	EC	P	8
297.6 - 298.0	STORMITT LOAM	6	WE	G	2
298.0 - 298.4	STORMITT GRAVELLY LOAM,SALINE	6	WE,EC	P	2,8
298.4 - 298.5	HELDT, SALINE	4	EC	P	8
298.5 - 300.9	NEVILLE	5	---	F-G	2
	NIHILL		WAE,ST		4
	HARVEY		WE		2,4
	STORMITT LOAM		WE		2
	STUTZMAN		WE		3
300.9 - 302.3	LISMAS	4	WE,SH,C,EC	P	3,8
	ALLENTINE		WE,NA		2,8
302.3 - 303.2	STUTZMAN	5	WE	F-G	6
	NIHILL		WAE		4
303.2 - 303.4	ALLENTINE	4	WE,NA	P	7,8
303.4 - 304.8	NIHILL	5	WAE	F-G	4
	STUTZMAN		WE		6

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
WYOMING					
304.8 - 305.2	NIHILL	5	WAE	F-G	4
	STUTZMAN		WE		6
305.2 - 309.0	SAYLES-PERSAYO	4	WAE,WE,SH	F	6,4
	STUTZMAN		WE		7
309.0 - 309.6	LOSTWELLS, ALKALI	12	NA,EC,WE	P	8
309.6 - 318.0	SAYLES-PERSAYO	4	WAE,WE,SH	F	6,4
	BINTON-YOUNGSTON		WAE,WE		7
	STUTZMAN		WE		7
	CHIPETA-DEAVER-STUTZMAN		WAE,WE,SH		4
318.0 - 318.1	BADLAND-RO	0-4	SH,ST,WE,WAE,NA,EC	P	4,8
318.1 - 318.6	TORCHLIGHT	4	NA,EC,WE	P	7,8
	CESTNIK, WET		WT,EC		5,8
318.6 - 319.0	CHIPETA-PERSAYO-RO	0-4	WAE,WE,ST,SH	P	4
319.0 - 319.2	STUTZMAN,WET	4	WT,EC,WE	P	5,8
319.2 - 319.8	SHOSHONE-WILLWOOD	5	WT,WE	G	1,5
319.8 - 320.7	YOUNGSTON	9	WE	G	Ag
320.7 - 320.8	PREATORSON-WORLAND-WILLWOOD	4	WAE,WE,ST	P	Ag
320.8 - 321.4	SHARLAND	8	WE	G	Ag
321.4 - 321.6	GARLAND-EMBLEM	12	---	G	Ag
321.6 - 322.1	SHARLAND	8	WE	F-G	Ag
	SHARLAND,WET		WT,EC		Ag
322.1 - 322.6	GARLAND-EMBLEM	12	---	P-F	Ag
	GARLAND-EMBLEM,WET		WT,EC		Ag
322.6 - 324.1	LOSTWELL-YOUNGSTON,WET	4	WT,EC,WE	P	Ag
	GLENTON-BAROID,WET		FL,WT,EC,WE		Ag
	GLENTON		FL,WT,WE		Ag
	APRON		WE		Ag
324.1 - 324.8	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
324.8 - 325.1	WORLAND-PERSAYO	4	WAE,WE,ST,SH	P	1,4
	RAIRDENT-UFFENS		WAE		7
325.1 - 326.5	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
326.5 - 326.6	WORLAND-PERSAYO	4	WAE,WE,ST,SH	P	1,4
326.6 - 327.4	YOUNGSTON-UFFENS	6	WAE,WE	F	7
327.4 - 327.5	CHIPETA-PERSAYO-RO	0-4	WAE,WE,ST,SH	P	4
327.5 - 328.9	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
328.9 - 331.1	CHIPETA-PERSAYO-RO	0-4	WAE,WE,ST,SH	P	4
	SAYLES-PERSAYO		WAE,WE,SH,ST		6,4
331.1 - 331.3	UFFENS	5	EC	P	8
331.3 - 332.0	SAYLES-PERSAYO	0-4	WAE,WE,ST,SH	P	4,6
	CHIPETA-PERSAYO-RO		WAE,WE,ST,SH		4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
332.0 - 333.2	GREYBULL-PERSAYO	4	WAE,SH	F	4
333.2 - 333.3	YOUNGSTON-UFFENS	6	WAE,WE	F	7
333.3 - 341.8	CHIPETA-PERSAYO-RO	0-4	WAE,WE,ST,SH	P	4
	OCEANET-RO		WAE,WE,ST,SH		4
	WORLAND-PERSAYO		WAE,WE,ST,SH		1,4
	OCEANET-PERSAYO-RO		WAE,WE,ST,SH		1,4
341.8 - 342.0	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
342.0 - 344.4	WORLAND-PERSAYO	4	WAE,WE,ST,SH	P	1,4
344.4 - 345.3	CHIPETA-PERSAYO-RO	0-4	WAE,WE,ST,SH	P	4
	PREATORSON-WORLAND-WILLWOOD		WAE,WE,ST		4
345.3 - 345.6	SHARLAND,ALKALI	4	NA	P	8
345.6 - 346.0	PREATORSON-WORLAND-WILLWOOD	4	WAE,WE,ST	P	4
346.0 - 346.6	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
346.6 - 347.2	STUTZMAN	4	WE	F	Ag
347.2 - 347.3	SHARLAND,ALKALI	4	NA	P	Ag
347.3 - 347.4	PREATORSON-WORLAND-WILLWOOD	4	WAE,WE	F	4
347.4 - 347.7	GLENTON-BAROID,WET	4	FL,WT,EC,WE	P	5,8
347.7 - 347.8	PREATORSON-WORLAND-WILLWOOD	4	WAE,WE,ST	P	4
347.8 - 348.3	SHARLAND,ALKALI	4	NA	P	8
348.3 - 352.1	CHIPETA-DEAVER-STUTZMAN	0-4	WAE,WE,ST,SH	P	4
	CHIPETA-PERSAYO-RO		WAE,WE,ST,SH		4
	PREATORSON-WORLAND-WILLWOOD		WAE,WE,ST		4
352.1 - 352.3	RIVERWASH	4	SH,WT	P	5
352.3 - 353.0	WILLWOOD-GLENTON		WT,FL,WE	P	Ag
	BINTON,WET		WT,EC,NA		Ag
	LOSTWELLS-YOUNGSTON,WET		WT,EC,WE		Ag
353.0 - 353.3	BINTON-YOUNGSTON	5	WAE,WE	F	7
353.3 - 353.5	BADLAND-RO	0-4	WE,WAE,NA,EC,SH,ST	P	4,8
353.5 - 358.5	CHIPETA-DEAVER-STUTZMAN	4	WAE,WE,ST,SH	P	4
	BRIBUTTE-PERSAYO-PAVILLION		WAE,WE,ST,SH		4
	GREYBULL-PERSAYO		WAE,ST,SH		4
	PAVILLION-KINNEAR-PERSAYO		WAE,WE,ST,SH		4
	BINTON-YOUNGSTON		WAE,WE		7
358.5 - 358.7	BADLAND-RO	0-4	WE,WAE,NA,EC,SH,ST	P	4,8
358.7 - 359.2	GREYBULL-PERSAYO	4	WAE,ST,SH	P	4
	PREATORSON-WORLAND-WILLWOOD		WAE,WE,ST		4
359.2 - 360.3	SHARLAND,ALKALI	4	NA	P	8
360.3 - 361.4	PREATORSON-WORLAND-WILLWOOD	4	WAE,WE,ST	P	4
	BRIBUTTE-PERSAYO-PAVILLION		WAE,WE,ST,SH		4
361.4 - 361.8	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
361.8 - 362.1	GLENTON	4	FL,WT,WE	F	5
	BINTON-YOUNGSTON		WAE,WE		7

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
362.1 - 362.2	BADLAND-RO	0-4	WE,WAE,NA,EC,SH,ST	P	4,8
362.2 - 365.0	BRIBUTTE-PERSAYO-PAVILLION	4	WAE,WE,ST,SH	P	4
	GREYBULL-PERSAYO		WAE,ST,SH		4
	MUFF-UFFENS-PERSAYO		WAE,SH,WE,ST		4
365.0 - 365.1	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
365.1 - 367.1	BRIBUTTE-PERSAYO-PAVAILILON	4	WAE,WE,ST,SH	P	4
	GREYBULL-PERSAYO		WAE,ST,SH		4
	MUFF-UFFENS-PERSAYO		WAE,WE,ST,SH		4
367.1 - 367.2	UFFENS	5	EC	P	8
367.2 - 367.3	LOSTWELLS,ALKALI	12	NA,EC,WE	P	8
367.3 - 371.4	BRIBUTTE-PERSAYO-PAVILLION	4	WAE,WE,ST,SH	P	4
	WORLAND-PERSAYO		WAE,WE,ST,SH		1,4
	PREATORSON-WORLAND-WILLWOOD		WAE,WE,ST		4
371.4 - 371.5	RAIRDENT-UFFENS	4	WAE	F	7
371.5 - 372.4	LOSTWELLS-KINNEAR	10	WE	F	7
372.4 - 372.9	LOSTWELLS-YOUNGSTON,WET	4	WT,EC,WE	P	5,7,8
	GLENTON-BAROID,WET		FL,WT,EC,WE		
372.9 - 373.6	APRON	4	WE	G	5,8
	LOSTWELLS		WE		7
373.6 - 373.7	YOUNGSTON	9	WE	F	7
373.7 - 373.8	FLUVAQUENT	6	WT,(EC)	F	5,(6,8)
373.8 - 374.1	YOUNGSTON	9	WE	F	7
374.1 - 374.2	RIVERWASH	4	FL,WT,(EC),SS	P	5,(8)
374.2 - 374.6	BAROID-LAS ANIMAS	7	WT,FL,WE	F	5
	YOUNGSTON,MOD.WET		WT,FL,WE		5
374.6 - 379.9	YOUNGSTON	6	WE	F-G	Ag
	LOSTWELLS		WE		Ag
379.9 - 383.9	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
	GREYBULL-PERSAYO		WAE,WE,SH,ST		4
383.9 - 385.8	WORLAND	9	WE	G	Ag
	WALLSON		WE		Ag
385.8 - 386.8	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
386.8 - 390.2	WALLSON	12	WE	G	2
390.2 - 390.5	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
390.5 - 392.3	WALLSON	9	WE	F-G	2
	FRISITE-NEIBER		WE,(EC),WAE		4,(8)
	YOUNGSTON		WE		2
392.3 - 393.2	MUFF-NEIBER	7	WAE,WE	F-G	4
	FRISITE-NEIBER		WE,(EC),WAE		4,(8)
393.2 - 393.5	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
393.5 - 394.2	MUFF-NEIBER	6	WAE,WE,ST	P	4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
394.2 - 394.4	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
394.4 - 397.8	FRISITE-NEIBER	7	WE,(EC),WAE	F-G	4,(8)
	YOUNGSTON		WE		2
	LOSTWELLS		WE		2
	MUFF-NEIBER		WAE,WE		4
397.8 - 398.2	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
398.2 - 398.6	FRISITE-NEIBER	8	WE,(EC),WAE	F	4,(8)
398.6 - 399.0	PERSAYO-RO	0-4	WE,WAE,ST,SH	P	4
399.0 - 405.0	FORKWOOD-HAVERDAD	0-6	WE	P-F	2
	FORKWOOD-KISHONA		WE		2
	MUFF-NEIBER		WAE,WE,ST		4
	KISHONA-SHINGLE-RO		WAE,WE,ST,SH		4
	KISHONA-SHINGLE		WAE,(EC),WE,SH,ST		4,(8)
405.0 - 406.8	CADOMA-EPSIE	4	(EC),ST,SH,WAE,WE	P	4,(8)
406.8 - 411.0	KISHONA,ALKALI-KISHONA	4	NA,WAE,EC	P	2,8
411.0 - 413.4	SHINGLE-THEDALUND	4	WAE,WE,ST,SH	P	4
	RENOHILL-CADOMA-WORKFA		WAE,SH		2,4
413.4 - 414.7	KISHONA-THEDALUND	4	---	F	2
414.7 - 415.6	SHINGLE-THEDALUND	4	WAE,WE,ST,SH	P	4
415.6 - 416.6	RENOHILL-CADOMA-WORKFA	0-4	WAE,SH,ST	P-F	2,4
	SAMSIL-SHINGLE-RO		WAE,WE,ST,SH		1,4
416.6 - 417.9	TORRIFLUVENTS-FLUVAQUENTS	6	WT,EC,FL	P	5,8
417.9 - 424.2	BLAZON-BROWNSTO	4	WAE,WE,ST,SH	P	4
	FORELLE-PINELLI		WAE,WE		2,4
	BLAZON-DIAMONDVILLE		WAE,ST,SH		4
	RENTSAC VARIANT-CLAYBURN VARIANT		WAE,ST		4
	RENTSAC VARIANT-RENTSAC-CLAYBURN VARIANT		WAE,ST,SH		4
424.2 - 425.0	SPEARFISH-NEVILLE	5	WAE,WE,SH	F	4
	RENOHILL-CADONA-WORKFA		WAE,SH		2,4
425.0 - 425.04	THERMOPOLIS-SINKSON	3	WAE,SH,ST	P	2,4
425.04 - 425.60	SINKSON-ALMY THERMOPOLIS	4	WAE,SH,ST	F-G	2,4
425.60 - 425.95	DIAMONDVILLE-FORELLE	6	WAE,ST	G	2,4
425.95 - 426.25	SINKSON-ALMY THERMOPOLIS	4	WAE,SH,ST	F-G	2,4
426.25 - 427.00	DIAMONDVILLE-FORELLE	6	WAE,ST	G	2,4
	FORELLE-POPOSHIA	3	---		2
427.00 - 427.13	SINKSON-ALMY THERMOPOLIS	4	WAE,SH,ST	F-G	2,4
427.13 - 427.89	THERMOPOLIS-SINKSON	3	WAE,SH,ST	P	2,4
427.89 - 428.04	BLACKHALL-CARMODY	4	WE,WAE,SH,ST	P-F	1,4
428.04 - 428.19	DIAMONDVILLE-FORELLE	6	WAE,ST	G	2,4
428.19 - 428.28	BLACKHALL-CARMODY	4	WE,WAE,SH,ST	P-F	1,4
428.28 - 428.47	DIAMONDVILLE-FORELLE	6	WAE,ST	G	2,4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
428.47 - 429.91	BLACKHALL-CARMODY	4	WE, WAE, SH, ST	P-F	1,4
429.91 - 430.60	FRISITE-YOUNGSTON	4	WE	G	7
430.60 - 430.72	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,7
430.72 - 431.59	FRISITE-YOUNGSTON	4	WE	G	1
431.59 - 431.70	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
431.70 - 431.90	UFFENS-MUFF-FRISITE	6	WE	F-G	7
431.90 - 432.08	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
432.08 - 432.13	FRISITE-YOUNGSTON	4	WE	G	7
432.13 - 432.43	PERSAYO-ROCK OUTCROP BADLAND-BIRDSLEY	0-1 0-3	WE, WAE, SH, ST WAE, WE, EC, NA, SH, ST, C	P	4,6 4,6,8
432.43 - 432.87	UFFENS-MUFF-FRISITE	6	WE	F-G	2
432.87 - 433.21	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
433.21 - 433.35	YOUNGSTON-LOTSWELLS	6	---	F-G	2
433.35 - 433.45	YOUNGSTON-EFFINGTON	2-4	NA	F	3,8
433.45 - 433.61	YOUNGSTON-LOSTWELLS-APRON	3-9	WE	F-G	2,5
433.61 - 433.89	YOUNGSTON-EFFINGTON BINTON-YOUNGSTON	2-4 5	NA WAE, WE	F	5,8 4,5
433.89 - 434.80	UFFENS-MUFF-FRISITE	6	WE	F-G	7
434.80 - 434.85	APRON-LOSTWELLS	9-12	WE	G	5
434.85 - 435.04	UFFENS-MUFF-FRISITE	6	WE	F-G	7
435.04 - 435.19	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
435.19 - 435.61	UFFENS-MUFF-FRISITE EMBLEM-CLIFSAND-RAIRDENT	6 4	WE WAE, ST	F-G	7 7
435.61 - 435.68	APRON-LOSTWELLS	9-12	WE	G	5
435.68 - 436.17	UFFENS-MUFF-FRISITE	6	WE	F-G	1
436.17 - 436.25	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
436.25 - 436.32	CLIFSAND-PERSAYO	4	WE, WAE, ST, SH	P-F	4,6
436.32 - 436.51	EMBLEM-CLIFSAND-RAIRDENT	4	WAE, ST	F-G	2,4
436.51 - 436.63	CLIFSAND-PERSAYO	4	WE, WAE, ST, SH	P-F	2,4
436.63 - 436.81	EMBLEM-CLIFSAND-RAIRDENT	4	WAE, ST	F-G	2,4
436.81 - 436.89	CLIFSAND-PERSAYO	4	WE, WAE, SH, ST	P-F	2,4
436.89 - 437.02	EMBLEM-CLIFSAND-RAIRDENT	4	WAE, ST	F-G	2,4
437.02 - 437.09	CLIFSAND-PERSAYO	4	WE, WAE, SH, ST	P-F	2,4
437.09 - 437.60	EMBLEM-CLIFSAND-RAIRDENT	4	WAE, ST	F-G	2,4
437.60 - 437.65	CLIFSAND-PERSAYO	4	WE, WAE, SH, ST	P-F	2,4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
437.65 - 437.70	FRISITE-EMBLEM	8-12	WE	G	1
437.70 - 437.81	CLIFSAND-PERSAYO	4	WE, WAE, SH, ST	P-F	2,4
437.81 - 437.93	EMBLEM-CLIFSAND-RAIRDENT	4	WAE, ST	F-G	2,4
437.93 - 438.13	FRISITE-EMBLEM	8-12	WE	G	1
438.13 - 438.34	EMBLEM-CLIFSAND-RAIRDENT	4	WAE, ST	F-G	2,4
438.34 - 438.44	CLIFSAND-PERSAYO	4	WE, WAE, SH, ST	P-F	4,5
438.44 - 438.61	FRISITE-EMBLEM	8-12	WE	G	1
438.61 - 438.66	CLIFSAND-PERSAYO	4	WE, WAE, SH, ST	P-F	2,4
438.66 - 439.26	FRISITE-EMBLEM	8-12	WE	G	AG,1
439.26 - 439.30	CLIFSAND-PERSAYO	4	WE, WAE, ST, SH	P-F	2,4
439.30 - 439.49	FRISITE-EMBLEM	8-12	WE	G	1
439.49 - 439.61	YOUNGSTON-LOTSWELLS	6	---	F-G	5
439.61 - 439.68	YOUNGSTON-EFFINGTON	2-4	NA	F	3,8
439.68 - 439.91	UFFENS-MUFF-FRISITE	6	WE	F-G	6
439.91 - 440.04	WORLAND-OCEANET-PERSAYO	3	WE, SH, ST	F	2,4
440.04 - 440.21	YOUNGSTON-LOTSWELLS	6	---	F-G	2
440.21 - 440.32	CLIFSAND-PERSAYO	4	WE, WAE, ST, SH	P-F	2,4
440.32 - 440.76	YOUNGSTON-LOTSWELLS	6	---	F-G	2
440.76 - 440.80	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
440.80 - 441.00	FRISITE-EMBLEM	8-12	WE	G	1
441.00 - 441.11	YOUNGSTON-LOTSWELLS	6	---	F-G	2,5
441.11 - 441.61	FRISITE-EMBLEM	8-12	WE	G	1
441.61 - 441.64	PERSAYO-ROCK OUTCROP	0-1	WE, WAE, SH, ST	P	4,6
441.64 - 441.68	CLIFSAND-PERSAYO	4	WE, WAE, ST, SH	P-F	4,6
441.68 - 443.28	FRISITE-YOUNGSTON	4	WE	G	2,5
	APRON-LOSTWELLS	9-12	WE		2
443.28 - 445.93	APRON-WALLSON-WORLAND	3-12	WE	F-G	1,7
	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST		1,4,7
445.93 - 447.17	BADLAND	0	WAE, WE, EC, NA, SH, ST, C	P	4,6,8
	PERSAYO-GREYBULL	3	WAE, SH, ST		4,6
447.17 - 451.00	GRIFFY	12	WE, ST	G	1,4,5
	ENOS-WALLSON	12	WE, ST		1,4,5
451.00 - 451.17	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	1,4
451.17 - 452.45	GRIFFY	12	WE, ST	G	1,4,5
452.45 - 452.68	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	1,4

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
452.68 - 452.74	GRIFFY	12	WE, ST	G	1,4,5
452.74 - 452.81	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	5
452.81 - 453.54	GRIFFY	12	WE, ST	G	1,4,5
453.54 - 453.66	UFFENS, thick surface-UFFENS	6	EC, NA, WE	P-F	1,5,8
453.66 - 454.27	GRIFFY-EMBLEM	8-12	WE	G	1
454.27 - 454.78	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	1,4,5
454.78 - 454.91	GRIFFY-EMBLEM	8-12	WE	G	1
454.91 - 455.00	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	1,4
455.00 - 455.18	GRIFFY-EMBLEM GRIFFY	8-12 12	WE WE, ST	G	1 1,4
455.18 - 456.38	EFFINGTON-UFFENS	2-4	EC, NA, WE	P-F	2,8
456.38 - 456.55	GRIFFY	12	WE, ST	G	1,4
456.55 - 457.00	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	1,4,5,7
457.00 - 458.07	GRIFFY	12	WE, ST	G	2,4,5
458.07 - 458.18	OCEANET-PERSAYO	5-12	WE, WAE, SH, ST	F-G	2,4
458.18 - 459.19	GRIFFY	12	WE, ST	G	2,4
459.19 - 459.28	EFFINGTON-UFFENS	2-4	EC, NA, WE	P-F	2,5,8
459.28 - 459.80	GRIFFY	12	WE, ST	G	2,4
459.80 - 460.09	TYPIC TORRIFLUVENT EFFINGTON-UFFENS	0-12 2-4	EC, NA, WE EC, NA, WE	P-F	2,5,8 2,5,8
460.09 - 460.72	GRIFFY	12	WE, ST	G	2,4
460.72 - 461.76	UFFENS, runon-TYPIC TORRIFLUVENTS EFFINGTON-UFFENS	0-12 2-4	EC, NA, WE EC, NA, WE	P-F	1,5,8 2,5,8
461.76 - 461.93	MUDRAY-BRIBUTTE-BIRDSLEY	1-3	EC, NA, WAE, SH, C, ST	P	3,4,8
461.93 - 463.42	VONALEE-HILAND	4	WE, ST	F-G	1,4
463.42 - 464.83	HILAND sandy loam	12	WE	G	2
464.83 - 464.89	KEYNER-ABSTED-SLICKSPOTS	0-12	EC, NA, WE, C	P	3,8
464.89 - 465.36	HILAND sandy loam	12	WE	G	2
465.36 - 465.54	KEYNER-ABSTED-SLICKSPOTS	0-12	EC, NA, WE, C	P	3,8
465.54 - 466.51	HILAND sandy loam	12	WE	G	2
466.51 - 469.70	VONALEE-HILAND	4	WE, ST	F-G	1,4
469.70 - 472.45	HILAND sandy loam	12	WE	G	2,5
472.45 - 473.00	VONALEE-HILAND	4	WE, ST	F-G	1,4
473.00 - 476.64	THEEDLE-SHINGLE-KISHONA HILAND sandy loam	9-12 12	WAE, SH, ST WE	G	2,4 2

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
476.64 - 477.19	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C	P	3,8
477.19 - 477.51	FORKWOOD-ZIGWEID	12	ST	G	2,4
477.51 - 477.70	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	5,8
477.70 - 478.53	FORKWOOD-ZIGWEID	12	ST	G	2,4
	BOSLER-ALCOVA	5-12	WE		2
478.53 - 478.61	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	5,8
478.61 - 480.00	FORKWOOD-ZIGWEID	12	ST	G	2,4,5
	FORKWOOD-ULM	12	---		2,5
480.00 - 480.50	ORELLA-CADOMA-PETRIE	2-5	EC,NA,C,WAE,ST	P	3,4,8
480.50 - 480.64	FORKWOOD-ULM	12	---	G	AG
480.64 - 480.83	SILHOUTEE-PETRIE	3-5	C	F	AG
480.83 - 481.00	ULM-ABSTED	2-12	EC,NA,C	P	AG
481.00 - 481.70	SILHOUTEE-PETRIE	3-5	C	F	AG
481.70 - 482.00	BOWBAC-HILAND	12	WE	G	AG
482.00 - 482.47	SILHOUTEE-PETRIE	3-5	C	F	3
482.47 - 483.10	ZIGWEID	12	---	G	2
483.10 - 483.50	SHINGLE-THEEDLE	9-12	WE,WAE,ST,SH	F-G	2,4
483.50 - 484.55	ZIGWEID	12	---	G	2
484.55 - 485.15	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C	P	3,8
	ORELLA-CADOMA-PETRIE	2-5	EC,NA,WAE,C,ST		3,4,8
485.15 - 485.36	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	2,8
485.36 - 485.56	ARVADA-ABSTED-SLICKSPOTS	0-12	EC,NA,C	P	3,8
485.56 - 485.70	SHINGLE-THEEDLE	9-12	WE,WAE,SH,ST	F-G	2,4,5
485.70 - 485.82	BOSLER-ALCOVA	5-12	WE	G	2
485.82 - 485.92	SHINGLE-THEEDLE	9-12	WE,WAE,SH,ST	F-G	2,4
485.92 - 486.83	KEYNER-ABSTED-SLICKSPOTS	0-12	EC,NA,WE,C	P	3,8
	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C		3,8
486.83 - 487.14	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4
487.14 - 487.20	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C	P	3,8
487.20 - 487.52	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4
487.52 - 487.77	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C	P	3,8
487.77 - 487.84	SHINGLE-THEEDLE	9-12	WE,WAE,ST,SH	F-G	2,4
487.84 - 487.90	ORELLA-ROCK OUTCROP	0-2	EC,NA,SH,C,WAE,ST	P	3,4,8
487.90 - 488.15	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4
488.15 - 490.88	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C	P	3,5,8
	ORELLA-ROCK OUTCROP	0-2	EC,NA,SH,C,WAE,ST		3,4,5,8
	PETRIE-ARVADA	1-5	EC,NA,C		3,5,8

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
	ORELLA-CADOMA-PETRIE	2-5	EC,NA,WAE,C,ST		3,4,5,8
	KEYNER-ABSTED-SLICKSPOTS	0-12	EC,NA,WE,C		3,5,8
490.88 - 491.84	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4,5
491.84 - 491.94	KEYNER-ABSTED-SLICKSPOTS	0-12	EC,NA,WE,C	P	3,8
491.94 - 492.35	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4,5
492.35 - 493.07	ORELLA-CADOMA-PETRIE	2-5	EC,NA,WAE,C,ST	P	3,4,8
	PETRIE-ARVADA	1-5	EC,NA,C		3,8
493.07 - 493.20	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4
493.20 - 493.25	PETRIE-ARVADA	1-5	EC,NA,C	P	3,8
493.25 - 493.57	CUSHMAN-FORKWOOD	12	WE,ST	G	2,4,5
493.57 - 496.12	LOLITE, dry -ROCK OUTCROP	2	EC,NA,WE,SH,ST,C	P	3,4,8
	ORELLA-CADOMA-PETRIE	2-5	EC,NA,WAE,C,ST		3,4,8
496.12 - 496.23	AMODAC	7	---	G	2
496.23 - 496.73	KEYNER-ABSTED-SLICKSPOTS	0-12	EC,NA,WE,C	P	3,8
	ARVADA-runon-SLICKSPOTS	0-2	EC,NA,C		3,8
496.73 - 497.16	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	2,8
497.16 - 498.60	KEYNER-ABSTED-SLICKSPOTS	0-12	EC,NA,WE,C	P	3,5,8
	ARVADA-ABSTED-SLICKSPOTS	0-2	EC,NA,C		3,5,8
	PETRIE-ARVADA	1-5	EC,NA,C		3,5,8
498.60 - 499.12	AMODAC	7	---	G	2
499.12 - 501.93	PETRIE-ARVADA	1-5	EC,NA,C	P	3,5,8
501.93 - 502.15	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	2,8
502.15 - 502.27	ORELLA-CADOMA-PETRIE	2-5	EC,NA,WAE,C,ST	P	3,4,8
502.27 - 502.32	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	2,8
502.32 - 503.94	BLACKDRAW clay loam	1	C	P	3,5
503.94 - 504.40	AMODAC-KEYNER	7-12	WE	G	1
504.40 - 505.63	SALT FLATS	0	EC,NA,C,WT	P	3,5,8
	PETRIE-ZIGWEID, wet	5-12	EC,NA,C,WT		3,5,8
	ARVADA-runon-SLICKSPOTS	0-2	EC,NA,C		3,8
505.63 - 505.70	HAVERDAD-CLARKELEN, saline	6-12	WE,EC	F	2,8
505.70 - 506.26	ARVADA-runon-SLICKSPOTS	0-2	EC,NA,C	P	3,8
	PETRIE-ZIGWEID, wet	5-12	EC,NA,C,WT		3,5,8
506.26 - 506.68	HILAND sandy loam	12	WE	G	2
506.68 - 506.74	PETRIE-ZIGWEID, wet	5-12	EC,NA,C,WT	P	3,5,8
506.74 - 509.14	HILAND sandy loam	12	WE	G	2
	CAMBRIA-ZIGWEID	12	WE,ST		2,4
509.14 - 509.38	ARVADA-runon-SLICKSPOTS	0-2	EC,NA,C	P	3,8
509.38 - 511.61	CAMBRIA-ZIGWEID	12	WE,ST	G	2,4,5
	HILAND sandy loam	12	WE		2,5

TABLE B-3-1 (CONTINUED)

MILEPOST (MILES)	DOMINANT MAP UNITS	TOPSOIL SALVAGE DEPTH (INCHES)	RESTRICTIVE FEATURES	REHABILITATION POTENTIAL	REVEGETATION MIX
511.61 - 512.00	HILAND loamy sand, gravelly substratum	6-12	WE	F-G	1

TABLE B-3-1 (CONTINUED)

[1]DEFINITIONS AND METHODS USED FOR SOIL PARAMETERS AND SYMBOLS IN TABLE C-3-1

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TOPSOIL SALVAGE DEPTHS: Topsoil salvage depths were derived from Tables 4.2-2 to 4.2-14 in the Existing Environmental Section. Soil salvage depths range from a minimum of 4 inches (stripping equipment can not successfully strip less than 4 inches) to a maximum of 12 inches. In many areas similar soils were grouped together and soil salvage depths were averaged.

Suitable soil depths serve only as a guidelines for actual soil salvage. Because depths can vary within each map unit, operators must make site-specific adjustments to salvage the best material for each soil. This will require the services of a soil scientist for ground verification and flagging salvage depths ahead of stripping.

RESTRICTIVE FEATURES: Restrictive features are soil constraints derived from Table 4.2-1 and 4.2-2 to 4.2-14 in the Environmental Report.

DEFINITIONS OF RESTRICTIVE FEATURES:

C	=	clay
EC	=	electrical conductivity (salinity)
FL	=	flooding
NA	=	sodicity
S	=	sand
SH	=	shallow (<20")
SS	=	surface stoniness
ST	=	steep (>15%)
WAE	=	wind erosion hazard
WE	=	wind erosion hazard
WT	=	high water table
( )	=	restrictive features in parenthesis are features that are problems with depth (subsoil)

REHABILITATION POTENTIAL: Rehabilitation potential in a soil is the potential to reestablish vegetation commensurate with predisturbance cover.

G: Good - A map unit or group of map units that are located on gentle slopes and consist of deep, non-saline, non-sodic, loamy textured soils. These may exhibit wind (WE) and water (WAE) erosion hazards, high water tables (WT), or flooding (FL) but these traits are not necessarily detrimental to vegetation establishment. These are physical constraints that can be addressed with proper management.

F-G: Fair to Good - A map unit or group of map units rated either Fair or Good that are intricately mixed and difficult to separate.

F-: Fair - A map unit or group of map units that exhibit moderate categories for EC (4 to 8 mmhos/cm), NA (SAR between 4 and 8), SH (20 to 40 inches total soil), shallow topsoil depths (less than 4 inches topsoil shown on Tables 4.2-2 to 4.2-14), and extreme EC, NA, or C beneath the surface horizon.

P-F: Poor to Fair - A map unit or group of map units rated either Poor or Fair that are intricately mixed and difficult to separate.

TABLE B-3-1 (CONTINUED)

P: Poor - A map unit or group of map units that exhibit one or more extremes of the following categories:

EC	-	High electrical conductivity	>8 mmhos/cm
NA	-	High Sodium Adsorption ratio	>8
ST	-	Steep slopes	>15%
C	-	High clay content	>40%
S	-	High sand content	>85%
SS	-	Excessive surface stoniness	>75% surface covered
SH	-	Shallow soil	<20"

SEED MIXTURES (Tables 6-1 through 6-8 in Rehabilitation Plan (Attachment C)):

#1	Sandy Textured Soils
#2	Loamy - Coarse Textured Soils
#3	Very Fine - Fine Textured Soils
#4	Breaks/Steep Slope/Erosive Soils
#5	Riparian/Wetland
#6	Gardner Saltbush - Fine Textured Soils
#7	Gardner Saltbush - Loamy to Coarse Textured Soils
#8	Saline/Sodic
( )	Apply if poor subsoils are close to the soil surface

These mixtures will be used on rangeland. Agricultural land (grains, hay and tame pasture) will be returned to previous production, based on landowner requests.

* Where published and unpublished soil surveys were not available (Hill and Golden Valley counties in Montana) county soil association maps, 1:24000 topographic maps, and the same scale aerial photographs were used. Soil association maps were used to generally characterize an area and the topographic and aerial photographs were used to map specific land types or landforms. Restrictive features were also assigned to each land type by interpreting features on the topographic maps and aerial photographs.

Generally, a minimum of 4 inches and a maximum of 12 inches of topsoil would be salvaged. Topsoil would be stored separately from spoil.

Topsoil would be salvaged from all newly constructed access roads, material storage and staging areas, borrow areas and rock disposal sites and pump station sites.

Additional salvage measures to protect the topsoil resource include:

- Gaps would be left in topsoil piles where drainages, drains and ditches occur and where livestock and farm machinery crossings are located.

- Topsoil would be piled in a manner that minimizes increases in water content.

- Topsoil would not be stripped during excessively wet (soil moisture high enough to foul blades, rut deeply or conglomerate mud on tires and tracks) and/or inordinately windy (large plumes of soil particles visibly moving during stripping operations) conditions.

- Topsoil would not be used as padding in the trench, to fill sacks for trench breakers, or for any other use as a construction material.

- Where boring or punching methods are used under roads, railroads, and other areas impractical for trenching, topsoil would be stored on either side of the bellhole separate from the spoil material.

- Topsoil would be pushed away from streams, trees, dugouts, and wetlands and stored on the uphill side of the disturbance away from the spoil pile.

- Topsoil would be salvaged wherever grading is required or as otherwise specified on final construction drawings.

4.0 GRADING, TRENCHING AND SPOIL HANDLING

Following clearing and prior to trenching, the right-of-way would be graded as necessary to create a level work surface for construction equipment and vehicles. Minimal grading would be required where the terrain is flat or where the right-of-way parallels the fall line of the slope. On excessively steep slopes which would otherwise require an extensive cut, grading would be reduced by using temporary detour access roads for rubber-tired traffic around the slope. Where sidehills are unavoidable, two-toning would also assist in reducing the amount of grading. Two-toning involves making two small cuts rather than one large cut, so that the working side is higher than the spoil side. Temporary grade modification would be required at specific locations identified on Table 4.1-3 in the main text.

Trenching consists of excavating the pipeline trench and may be performed by one or more methods. In areas with deep soils, the trench would be excavated by a bucket-wheel ditching machine. Conventional mechanical backhoes would be used where ground conditions are not ideal and where deeper and wider than normal ditch is required, such as at tie-ins. Unless land use and permits dictate otherwise, the trench would be a minimum of 36 inches wide and of sufficient depth to provide a cover of 36 inches from the top of the pipe. During trenching operations along the entire length of the pipeline right-of-way, access across the trench would be provided at convenient intervals to allow landowners and animals to cross the construction area.

In areas of loose rock, the backhoes would be preceded by a large bulldozer (such as a CAT D-9L) equipped with a single steel shank ripper. In areas of solid rock, a minimum of 24 inches of cover would be provided and trenching would be performed by drilling and controlled blasting, followed by backhoe excavation (see Table 4.1-4 in main text). Explosives would be used in compliance with all applicable Federal, state and local permits, ordinances and authorizations. Controlled blasting would be required in the vicinity of powerlines, telephone lines, existing pipeline facilities, structures, or buildings to preclude damage by fly-rock, air blast, or vibrations.

In areas where extensive rock is encountered, the time required for trenching operations may increase. To maintain efficiency, longer lengths of the trench may be opened before the pipe is strung, welded and lowered-in. As a result, in the few areas of extensive consolidated rock, the trench may be open for several days and the completion of construction activities at a given point may require several weeks. During this period, special precautions would be taken to ensure public safety and erosion control.

Standard erosion control practices would be employed to minimize erosion during trenching operations and construction activities. In the few areas where a high groundwater table is encountered and dewatering is necessary, water would be pumped out of the trench and discharged in a manner that would minimize sedimentation and prevent off-site erosion and bottom scour in adjacent waterways. Generally, discharge to the ground is allowable if there is adequate vegetation along the right-of-way to effectively function as a filter medium. In environmentally vulnerable areas (e.g., adjacent to streams) where there is inadequate vegetation, bale filters or other appropriate measures would be used to limit siltation.

Primary access for construction crews would be via public roadways and the right-of-way. Temporary access roads may be required in certain areas to minimize travel time between supply points or in areas where natural environmental features, such as a number of stream crossings or steep slopes, make extensive travel along the right-of-way impractical. These access roads would be located and constructed in accordance with the needs of the individual pipeline spreads, landowner requirements and applicable regulatory authorities. These roads would not be permanently maintained and would not be open for public use. Upon completion of the construction phase, the temporary access roads would be removed and restored in a manner similar to that described for the right-of-way and to the reasonable satisfaction of the landowner. Where permanent roads are needed to access the pump stations, measures would be taken to prevent off-road vehicular use by the public.

Backfill would generally consist of the material originally excavated from the trench. In some cases, backfill material from other areas may be used. For example, rock would not be backfilled directly onto the pipe unless first crushed or screened on site to prevent damaging the pipe. Where such materials are encountered, earth or sand may be hauled in and deposited around the pipe to form a cushion or pad. No topsoil would be used for such padding. Rockshield may be used as an alternative to padding.

The overall effects of construction and operation of the Express pipeline on topography would be minor, limited primarily to temporary impacts related to construction. Impacts to topography would mainly occur during the construction phase, when existing contours would be temporarily altered. The proposed route has been selected to minimize traversing of mountainous terrain, deep valleys and steep slopes. The proposed alignment would be further refined at locations identified in Section 8.9 of this plan.

4.1 PROTECTION MEASURES FOR GRADING, TRENCHING AND BACKFILLING

General and site-specific measures would be implemented to minimize the effects of grading, trenching and backfilling; to enhance rehabilitation; and to minimize erosion and sedimentation. These measures include:

- Graded areas would be the minimum size required for construction activities.
- Disturbance of drainages would be minimized; channels would not be blocked with graded material.
- Grading would be conducted away from watercourses to reduce the risk of material entering the watercourse.

- Graded material would be bermed where possible to reduce surface water flows across the graded area.

- The time between trenching and backfilling would be minimized.

- Trenching would be delayed in areas with a high water table until water levels have dropped or until just prior to lowering-in to prevent the trench from sloughing.

- Trenching activities would be stopped short of watercourse banks to prevent any silty trench water from entering watercourses. Hard trench plugs would be left in place until the watercourse crossing is completed and the pipe ready to install. A minimum plug length of 10 feet would be used.

- Any necessary trench dewatering would be directed onto stable surfaces in a manner that does not cause soil erosion. Bales or silt fences would be used where appropriate.

- Gaps would be left in the spoil pile at drainages to accommodate surface runoff.

- Where blasting is required, fly-rock would be controlled by matting, including but not limited to fabricated mats, in-situ spoil and sand-pad matting, as well as through blast design and adequate collaring.

- The length of open trench would be minimized by backfilling immediately after lowering-in.

- Backfill would be kept free of wood, garbage and other construction debris.

- On cultivated lands, the plough layer would be kept free of rocks to prevent interference with farm implements, consistent with conditions on undisturbed portions of the field.

- Trench breakers would be installed as necessary.

- After final grading, all compacted areas would be ripped.

4.2 POST-CONSTRUCTION TOPOGRAPHY

After the completion of backfilling, all disturbed areas (including the permanent easement, temporary work space, temporary access roads and stockpile sites) would be restored to approximate original contour. In most locations, it would be possible to restore cuts completely. In some locations, however, cuts may not be completely replaced if, in the opinion of Express's geotechnical engineer, replacement would result in an unstable slope. In these cases, the cut slopes would be rounded off, the fills regraded to a stable position, and all disturbed areas seeded and protected from erosion as required and as approved by the agencies. Some of these locations would be shown on the final construction drawings, but it is anticipated that other locations would not be known until the geotechnical engineer makes a field inspection during construction. The agencies would be kept advised of the location of such areas.

Stream and river beds would be returned to their preconstruction contours and banks would be stabilized as appropriate with riprap, sand bags, erosion control fabric, or log cribwalls. Where necessary at sensitive stream crossings, specific plans for revegetating the stream banks and approach slopes would be developed in consultation with the appropriate agencies and landowners.

Trench backfill would be compacted by driving tracked or rubber-tired equipment over the trench. Since compaction would still be incomplete, a roach (or crown) would be left over the trench. It would be feathered on either side to blend the trench with adjacent areas. Roach gaps would be left at drainages to allow surface flow.

On agricultural lands, compaction would be conducted in more than one lift to reduce roach size. Roaches would not be left on irrigated lands.

Some excess spoil would remain where large bellholes are excavated, such as at road crossings where a boring machine would be used to install the crossing, or where material with a high swell factor is excavated. Where possible, small amounts of excess spoil would be feathered over the right-of-way to slightly increase the elevation of the right-of-way and then covered with replaced topsoil. Where it is not possible to blend excess spoil within the right-of-way, it would be placed in an approved off-site location in accordance with all applicable regulatory requirements, good engineering practices and landowner specifications. Topsoil would be salvaged in any disposal area for subsequent reapplication and revegetation.

5.0 TOPSOIL REPLACEMENT AND FERTILIZATION

After the trench has been backfilled, the right-of-way regraded, and any subsoil compaction of the work areas has been relieved by chisel plowing, discing or ripping, topsoil would be respread over those areas where topsoil was stripped. Topsoil would not be handled during excessively wet or inordinately windy conditions. Indications of excessively wet soils include deep rutting, build-up of mud on tires and tracks, and/or fouling of blades. Inordinately windy refers to large plumes of soil particles visibly moving during soil handling.

Redistribution depths would vary between 4 and 12 inches depending upon stripping depths. Topsoil would not be mixed with spoil material before or during replacement and only topsoil would be respread. Topsoil from unstripped areas would not be used to cover adjacent disturbances. Redistribution of stripped soils would contribute to mitigation of visual contrasts by retaining local surface soil color. Inspectors would ensure soil conservation practices are followed according to the plans and specifications outlined herein and to be detailed in final specifications.

The following methods would be implemented to promote successful rehabilitation:

- All garbage and debris would be removed from the regraded right-of-way before topsoil is replaced.
- Excess rock which was not buried or could not be blended with the natural terrain would be disposed of at an approved location.
- The length of time topsoil is stored would be minimized based on the proposed construction schedule. Normally, topsoil stripping and respreading activities would occur within a few weeks of each other.
- Topsoil redistribution would commence immediately after regrading, weather permitting. Spoil material would not be mixed with either salvaged topsoil or the adjacent unstripped topsoil.
- If it is necessary to alleviate compaction, rutting or crusting prior to seeding, the replaced topsoil would be worked with a disc, spring tooth, chisel plow or similar implement. All compacted areas would be scarified.
- Replaced topsoil would be left in a roughened condition to discourage wind and water erosion. Additional erosion control and soil stabilization may be required on steeper slopes, in or adjacent to drainages, on topsoil easily transported by wind and along pipeline segments running parallel with prevailing winds.

Previous evaluations have recommended that no fertilizer be applied along the pipeline route with the exception of excessively calcareous soils on private lands. Express would generally not use fertilizer since soil stockpiles would be short-term and because fertilizer may enhance weed growth. Exceptions to this generalization may occur in some areas; fertilizer application rates would be included in final specifications.

6.0 <u>REVEGETATION</u>

Revegetation would be undertaken on the right-of-way and any other disturbed areas to provide stabilization through erosion and sedimentation control. Express would re-establish a vegetative cover that is similar in structure and composition to pre-construction conditions and restore wildlife and livestock productivity. This plan specifically addresses species selection, seed mixtures and rates, seedbed preparation, seeding methods, mulching, interim revegetation, agricultural land and schedule. Rehabilitation of special areas is discussed in Section 8.0 of this plan.

6.1 SPECIES SELECTION

A description of existing vegetation resources is presented in Section 4.4. Selection of plant species for revegetation is based on evaluation of existing species occurrence, establishment potential, growth characteristics, soil stabilizing qualities, palatability to wildlife and livestock, commercial availability, post-construction land use objectives and landowner requests. Redistributed soil and substrate properties (texture and restrictive features such as wind and water erosion hazard, salinity, acidity, alkalinity, sodicity and drainage) have also been considered.

Seed would be obtained from within the same geographical area that is being revegetated (300 miles south and north and 500 miles east and west of the planting site). This measure would enhance revegetation success by using seed adapted to local conditions.

6.2 SEED MIXTURES AND RATES

Express proposes to use revegetation mixtures which include species present in pre-construction communities. The use of native species in non-agricultural areas has been stressed. Proposed seed mixtures are presented in Tables B-6-1 to B-6-8. The recommended seed mix by Milepost and Dominant Soil Map Unit is listed on Table B-3-1.

Seeding rates have been designed to total approximately 90-130 pure live seeds (PLS) per square foot for broadcast seeding; the drill rate would be roughly half that of the broadcast rate. Seeding rates are lower than conventional broadcast rates for similar revegetation to provide increased opportunity for natural reinvasion.

TABLE B-6-1

SANDY TEXTURED SOILS (MIX 1)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
GRASSES:			
Agropyron dasystachyum Thickspike wheatgrass	Critana	2.0	7
Agropyron trachycaulum Slender wheatgrass	Pryor	1.0	4
Agropyron spicatum Bluebunch wheatgrass	Secar	2.0	6
Oryzopsis hymenoides Indian ricegrass	Nezpar	3.0	10
Sitanion hystrix Bottlebrush squirreltail	-	2.0	9
Calamovilfa longifolia Prairie sandreed	Goshen	2.0	13
Stipa comata Needle-and-thread	-	3.0	8
	TOTAL	15.0	57

[1]Based on a drill seed rate of approximately 55-60 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

TABLE B-6-2

LOAMY-COARSE TEXTURED SOILS (MIX 2)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
Agropyron dasystachyum Thickspike wheatgrass	Critana	4.0	14
Agropyron spicatum Bluebunch wheatgrass	Secar	3.0	10
Agropyron trachycaulum Slender wheatgrass	Pryor	2.0	7
Koeleria cristata Prairie junegrass	-	0.1	5
Oryzopsis hymenoides Indian ricegrass	Nezpar	3.0	10
Poa canbyi Canby bluegrass	Canbar	0.5	10
Stipa comata Needle-and-thread	-	3.0	8
	TOTAL	15.6	64

[1]Based on a drill seed rate of approximately 60-70 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

TABLE B-6-3

VERY FINE - FINE TEXTURED SOILS (MIX 3)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
Agropyron smithii Western wheatgrass	Rosanna	4.0	10
Agropyron trachycaulum Slender wheatgrass	Pryor	2.0	7
Bouteloua gracilis Blue grama	Alamo	0.5	9
Poa sandbergii Sandberg bluegrass	-	0.6	12
Sitanion hystrix Bottlebrush squirreltail	-	2.0	9
Stipa viridula Green needlegrass	Lodorm	4.0	17
	TOTAL	13.1	64

[1]Based on a drill seed rate of approximately 60-70 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

TABLE B-6-4

BREAKS/STEEP SLOPE/ERODIBLE SOILS (MIX 4)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
Agropyron dasystachyum Thickspike wheatgrass	Critana	2.0	7
Agropyron spicatum Bluebunch wheatgrass	Secar	4.0	13
Agropyron trachycaulum Slender wheatgrass	Pryor	2.0	7
Oryzopsis hymenoides Indian ricegrass	Nezpar	4.0	13
Poa sandbergii Sandberg bluegrass	-	0.5	10
Stipa comata Needle-and-thread	-	4.0	10
	TOTAL	16.5	60

[1]Based on a drill seed rate of approximately 60 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

TABLE B-6-5

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
RIPARIAN (MIX 5A)			
Agropyron dasystachyum Thickspike wheatgrass	Critana	1.0	4
Agropyron smithii Western wheatgrass	Rosanna	5.0	12
Agropyron trachycaulum Slender wheatgrass	Pryor	1.0	3
Agrostis stolonifera Redtop	-	0.1	11
Elymus canadensis Canada wildrye	-	3.0	8
Elymus cinereus Basin wildrye	Magnar	3.0	9
Poa ampla Big bluegrass	Sherman	0.5	10
Sporobolus airoides Alkali sacaton	-	0.1	4
Stipa viridula Green needlegrass	Lodorm	1.0	4
	TOTAL	14.7	65

Species/Common Name	Preferred Variety	Percent Composition[2]
WETLAND (MIX 5B)		
Agropyron trachycaulum Slender wheatgrass	Pryor	5
Carex spp. (nebraskensis, rostrata or other locally adapted spp.)	-	30
Deschampsia cespitosa Tufted hairgrass	-	5
Distichlis stricta Inland saltgrass	-	5
Eleocharis palustris Common spike-rush	-	10
Juncus spp. (balticus or other locally adapted spp.) Rush	-	15
Scirpus (americanus or other locally adapted spp.) Bulrush	-	15
Spartina (pectinata or gracilis) Cordgrass	-	15

[1]Based on a drill seed rate of approximately 65 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.
[2]Actual seeding rates will depend on site conditions and availability of species.

TABLE B-6-6

GARDNER SALTBUSH - FINE TEXTURED SOILS (MIX 6)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
Elymus juneus Russian wildrye	-	3.0	10
Oryzopsis hymenoides Indian ricegrass	Nezpar	3.0	9
Poa sandbergii Sandberg bluegrass	-	0.5	10
Sitanion hystrix Bottlebrush squirreltail	-	2.0	8
Atriplex gardneri Gardner saltbush	-	2.0	5
	TOTAL	11.0	45

[1]Based on a drill seed rate of approximately 45 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

TABLE B-6-7

GARDNER SALTBUSH - LOAMY TO COARSE TEXTURED SOILS (MIX 7)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
Agropyron dasystachyum Thickspike wheatgrass	Critana	2.0	7
Elymus juneous Russian wildrye	-	3.5	10
Oryzopsis hymenoides Indian ricegrass	Nezpar	3.0	9
Poa sandbergii Sandberg bluegrass	-	0.2	4
Sitanion hystrix Bottlebrush squirreltail	-	1.0	4
Stipa comata Needle-and-thread	-	2.0	5
Atriplex gardneri Gardner saltbush	-	2.0	5
	TOTAL	13.7	46

[1]Based on a drill seed rate of approximately 40-50 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

TABLE B-6-8

SALINE/SODIC SOILS (MIX 8)

Species/Common Name	Preferred Variety	Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq.ft.
Agropyron smithii Western wheatgrass	Rosana	5.0	12
Elymus juneus Russian wildrye	-	3.0	7
Distichlis stricta Inland saltgrass	-	1.0	12
Elymus triticoides Creeping wildrye	Shoshoni	2.0	2
Poa ampla Big bluegrass	Sherman	0.5	10
Sporobolus airoides Alkali sacaton	-	1.0	12
	TOTAL	13.3	65

[1]Based on a drill seed rate of approximately 65 Pure Live Seeds (PLS) per square foot; rates will be doubled for broadcast seeding.

Seed mixtures may be modified based on limited species availability, poor seed quality or site differences. Seed mixtures may also be modified to protect seeded areas from grazing. In open areas where seedings cannot be otherwise protected, it may be necessary to substitute species with low palatabilities or greater resistance to grazing. If noxious weeds occur on revegetated areas, forbs may be deleted from mixtures because of their susceptibility to chemical control, if used. Modifications would be undertaken only with the concurrence of appropriate regulatory authorities.

6.3 SEEDBED PREPARATION

Seedbed preparation would be accomplished immediately after backfilling, topsoil replacement, and if needed, fertilizer application. On slopes of 33 percent or less the seedbed would be disced and harrowed to break up large clods. On slopes exceeding 33 percent, the soil surface would be left in a roughened condition to create an irregular seedbed which would provide microsites for plant germination and reduce soil movement on steeper slopes. Sites that exhibit minimal construction damage would not require revegetation. Small areas may be worked by hand and seeded as required.

6.4 SEEDING METHOD

Both broadcast and drill seeding would be used as to be specified in Part 5. Seed would be broadcast using manually operated cyclone-type bucket spreaders, mechanical seed blowers or hydroseeders. The best results would be to employ broadcast seeding when the area is slightly compacted after seeding. This allows for a better seed to soil contact. Seed would be mixed frequently to discourage settling. Where possible, broadcast seeded areas would be chained, harrowed or cultipacked to cover the seed. On steeper slopes, broadcast seeded areas would be dozer-tracked perpendicular to the slope to provide microsites for seed germination. On small or inaccessible sites, hand raking would be used to cover seed.

When hydroseeding is used, seed and mulch (not more than 1 pound of mulch for 3 gallons of water) would be sprayed in one application. Hydroseeding would be conducted to ensure seed/soil contact by directing the spray at the ground. Where hydromulching is used, a second application would spray the remainder of the cellulose fiber mulch (to achieve a total of one ton per acre) and a tackifier (at the manufacturer's recommended application rates).

Drill seeding would be employed on areas with adjacent noxious weed infestations, on areas where adverse soil properties are present and on sites prone to wind erosion. Drill row spacing would range from 6 to 14 inches. Seeding depth would reflect requirements of the specific seed mixture, but would generally be ¼ to ½ inch. A rangeland drill or comparable equipment would be used.

6.5 MULCHING

Mulches may be recommended for sites with low annual precipitation, on slopes, exceeding 6H:1V, windy sites, or where soil texture indicates high erosion potential. The BLM recommends that all BLM lands lands should be mulched. Where specified, mulch would be evenly spread over seeded areas at rates dependent on seeding method and slope. Mulch should be blown onto the site and then crimped into soil. Mulch should not be hand spread. Certified noxious weed-free straw mulch would be applied at a rate of 1.0 ton/acre minimum on relatively level surfaces and 1.0-1.5 tons/acre on steeper slopes where conventional broadcast methods are used. Mulch would be anchored into the seedbed using a mulch crimper or disc with notched coulters. Straw mulch would be applied at a rate of one ton/acre on hydroseeded areas. Hay mulch could be used from certified seed producers. A tackifier would be used on hydroseeded areas that are mulched in the fall and on areas which require prompt stabilization. Mulching aids in erosion control, soil moisture retention, temperature moderation and provides supplemental organic material.

The use of soil stabilization products such as jute netting, geotextile mats, excelsior blankets, etc., would be considered on extremely unstable sites which require more aggressive erosion control treatments.

6.6 INTERIM REVEGETATION

In order to reduce erosion and sedimentation in the short term, certain disturbances may be temporarily stabilized with an interim cover crop, soil binder, mulch or straw mats. Sites to be stabilized prior to final reclamation might include areas subject to extreme wind or water erosion that cannot be revegetated due to planting season considerations, other delays in reclamation scheduling or construction shutdowns.

Where sowing a temporary cover crop is necessary, an appropriate annual cereal grain (e.g., annual rye, oats, wheat) would be drill seeded at a rate of 15 pounds PLS per acre (rate would be doubled for broadcast seeding). Annual rye would not be seeded near fields where wheat is grown.

If immediate stabilization is required (such as on slopes greater than 3H:1V or adjacent to perennial or intermittent streams), a chemical soil binder may be applied alone or in combination with mulches; soil binders would be applied at the manufacturer's recommended rate. Other erosion control products may be used.

6.7 AGRICULTURAL LAND

Agricultural land (cropland, hayland, tame pasture) would be restored to a condition that allows a return to the previous agricultural use. Specific methods of agricultural restoration would be negotiated on a case by case basis with property owners. In general:

- Compensation for crop losses would be negotiated with property owners.

- The trench surface and construction right-of-way would be recontoured according to property owner agreements.

- Topsoil would be stored separately from subsoil and be replaced with a minimum of handling.

- Rocks would be removed from the soil surface to a density similar to that of adjacent soils.

- Disruption to major irrigation supplies would be avoided. Boring under water conveyance systems is one method that may be utilized.

- Emergency repairs would be made in case of accidental disturbance to irrigation systems.

6.8 SCHEDULE

Rehabilitation activities would be determined by construction schedules and seasonal climatic variations. Seeding and planting would be coordinated with other rehabilitation activities to occur as soon after seedbed preparation as possible. Revegetation would be conducted during locally recognized planting seasons, normally in fall (after September 15) or spring (prior to May 15) depending on weather conditions. The BLM, Cody Resource Area recommends reseeding from September 15 to April 30. The BLM, Billings Resource Area recommends resseding in their area of responsibility from September 15 to October 15 and from Aprip 1-30. These dates are general guidelines and may be altered based on seasonal climatic variations and on-site conditions. Revegetation would not occur if snow cover is in excess of two inches. Spring seedings would be conducted as early in the season as possible to maximize the use of early moisture.

7.0 DRAINAGE CONTROL STRUCTURES

Drainage control structures would be used to: 1) transport surface runoff across the right-of-way with minimal erosion; 2) direct surface drainage away from the right-of-way; and 3) provide downgradient control of runoff and sediment from all disturbed areas. These structures include drainage channels (ditches) and water bars (berms and cross ditches).

Drainage channels or ditches would be used on a limited basis to provide drainage along the right-of-way and along the toe of cutslopes, and to direct surface runoff across or away from disturbances onto natural undisturbed ground. Channels would be constructed during grading operations.

Water bars (diversion berms) would be used to direct intercepted runoff away from disturbed areas. Water bars closer together at the top of a steep slope aid in reducing water energy. Lower on the slope, the bars can be placed farther apart than the typical spacing intervals shown below:

Slope Gradient (%)	Typical Spacing (ft)
5 - 15	150
16 - 30	100
greater than 30	75

Actual spacing interval would be subject to adjustment in the field as required; berm angles would be surveyed to ensure proper slope (3-5 degrees).

Gaps in the roach would be left at all obvious drainages.

8.0 SPECIAL AREA REHABILITATION

Sites requiring special construction or rehabilitation procedures include saline, sodic, saline/sodic, shallow, extremely sandy and extremely clayey soils; soils shallow to groundwater; steep slopes; and possibly some acid soils. Each of these areas would require special soil handling techniques as well as intensive monitoring and maintenance to ensure erosion and sediment control and reestablishment of vegetation patterns similar to adjacent undisturbed areas.

8.1 SALINE SOILS

Severe saline soils exhibit electrical conductivities in excess of 8 milli-mohs per centimeter. These soils nearly always occur over a fluctuating high water table. The high water table prevents salts from moving deeper into the soil profile. Special handling techniques include:

- Salvage topsoil using the trench and spoil area stripping method to depths recommended in Table B-3-1.

- No amendments (fertilizer) are required during topsoil replacement because soil amendments only compound the salt problem.

- Prepare seedbed and seed with species adapted to saline conditions (Mix No. 8).

8.2 SODIC SOILS

Sodic soils exhibit sodium adsorption ratios in excess of 12. Sodium is adsorbed onto clay particles causing clays to lose tilth, become slick when wet and form "panspots" when dry. Water does not infiltrate, but runs off during wet weather. Special handling techniques include:

- Salvage topsoil to depths recommended in Table B-3-1 using the trench and spoil stripping method.

- If the topsoil contains sufficiently high amounts of $CaCO_3$ (lime), amend the subsoil with gypsum at the appropriate rate.

- If topsoil is also sodic, amend with 26-10-5 fertilizer at 100 pounds per acre and apply gypsum as required.

- Prepare seedbed and seed with species adapted to sodic conditions (Mix No. 8)

8.3 SALINE/SODIC SOILS

These are soils that have both salt and sodium problems. Special handling techniques are the same as for saline soils.

8.4 STEEP SLOPES

These are soils that occur on slopes greater than 15 percent. Special handling techniques include:

- Salvage topsoil to depths recommended in Table B-3-1.
- Employ erosion control techniques listed in Section 7.0.
- Replace topsoil, leaving the seedbed rough and fertilize with 26-10-5 at 100 pounds per acre.
- Seed with Mix No. 4.
- Use mulch or erosion control matting to protect the seed and seedbed from wind and water erosion.

8.5 TEXTURAL EXTREMITIES (SANDY OR CLAYEY SOILS)

Special handling techniques include:

Clayey soils

- Salvage topsoil to recommended depths listed in Table B-3-1 using trench and spoil area topsoil stripping methods.
- Reduce compaction in clayey subsoil by ripping and discing.
- After topsoil replacement, fertilize with 26-10-5 at the rate of 100 pounds per acre, then prepare seedbed to reduce compaction and seed with the mixture adapted to clayey soils (Mix No. 3).

Sandy soils

- Salvage topsoil to recommended depth listed in Table B-3-1 using the trench and spoil area stripping method.
- After replacement, the topsoil would be amended with 26-10-5 fertilizer at the rate of 200 pounds per acre.
- The seedbed may be prepared, seeded with Mix No. 1 and protected by using snow fence, straw bales or increased mulch rates.

8.6 SHALLOW GROUNDWATER

Soils exhibiting shallow ground water tables are sensitive because deep rutting, compaction and soil horizon mixing may occur in wet, highly organic soils. Special handling techniques include:

- Possibly schedule construction in these areas until late summer when groundwater is deeper.
- Use equipment with wide, low pressure tracks or tires to reduce compaction.
- Salvage topsoil to recommended depths listed in Table B-3-1.
- If the soil is highly organic (over 6 percent organic matter) fertilizer would not be required after soil redistribution. If the soil consists of less than 6 percent organic matter, fertilize with 26-10-5 at 100 pounds per acre after topsoil replacement.
- If the seedbed is moist and consists of fine soil particles (silts and clays),deep tillage and discing may be required.
- Seed with Mix No. 5.

8.7 ACID SOIL

No acid soils were identified in the review of existing soil survey information summarized on Table B-3-1. If acid soils are encountered, special handling techniques include:

- Salvage soil to depths listed in Table B-3-1 using trench and spoil area stripping.
- Bury acid subsoil, replace topsoil, prepare seedbed and seed.
- Replace topsoil, lime at the rate of 5 tons of calcium carbonate ($CaCO_3$) per acre and fertilize with 26-10-5 at the rate of 100 pounds per acre.
- Prepare seedbed and seed with species adapted to acid conditions.

8.8 STREAM CROSSINGS, WETLAND AND RIPARIAN CONSTRUCTION AND MITIGATION PROCEDURES

Measures outlined in this plan are designed to minimize adverse effects to streams, wetlands and riparian areas by:

- Expediting construction in streams and wetlands to minimize the duration of turbidity-causing activities;

- Scheduling construction, to the extent practicable, to minimize potential impacts on fish spawning;

- Limiting the amount of equipment and mainline construction activities that may occur within streams and wetlands in order to minimize disturbances to streambeds and wetland soils;

- Implementing temporary erosion and sediment control practices to minimize construction related erosion and sedimentation;

- Restoring stream channels/bottoms and wetlands to their original configuration/contours;

- Stabilizing stream banks and adjacent upland areas by establishing permanent erosion control measures and vegetative cover as soon as possible after construction; and

- Inspecting the right-of-way periodically during and after construction and performing any necessary maintenance work in a timely manner.

This section outlines general construction and mitigation techniques for stream crossings, wetlands and riparian areas; site-specific details would be presented in final specifications. Specific stream crossing rehabilitation plans would be developed during final design.

8.8.1 Stream Crossings

Universally applicable stream crossing procedures are difficult to establish because individual stream crossings are so variable (i.e., banks, substrate, flow, floodplains, vegetation, adjacent slopes). For this reason, this section presents general approaches to stream crossings that would best minimize environmental impacts. The procedures outlined below would be followed to the extent practicable and would be modified only with the approval of appropriate regulatory authorities.

8.8.1.1 General Conditions

Conditions applicable to all stream crossing methods include:

Permitting Conditions

The U.S. Army Corps of Engineers (COE), Omaha District Regulatory Branch has been notified regarding proposed construction activities and the need for Section 404 permits. The COE has indicated that individual permits would be required for crossings on the Yellowstone and Missouri Rivers; all other crossings would be covered under COE's nationwide permit program. Boring the Missouri River may preclude the necessity for a 404 permit. At a minimum, Express would comply with pertinent conditions of nationwide Section 404 permits

12 and 14 (33 CFR 330). As needed, Express would apply for state-issued stream crossing permits and obtain Section 401 water quality certification or waiver.

Staging Areas/Additional Right-of-Way

Where topographic conditions permit, staging areas and additional right-of-way would be located at least 50 feet back from the streambank. The size of the staging area would be limited to that needed for pre-fabrication of pipe segments. Hazardous materials, chemicals, fuels or lubricating oils would not be stored, nor would concrete coating activities be performed within 100 feet of streambanks or within any municipal watershed area. Construction equipment would be refueled at least 100 feet from streambanks. Where it is necessary to refuel closer than 100 feet of streambanks (barge-mounted backhoes, trench dewatering pumps), Express would utilize procedures outlined in the Spill Prevention, Containment and Control Plan which would be prepared during final design.

Spoil Pile Placement/Control

Trench spoil would be placed at least 10 feet away from streambanks at all stream crossings where practicable. The flow of spoil off the right-of-way would be prevented by using berms, silt fences or straw bales. Sediment filter devices would be emplaced above streambanks. In some areas, such as crossings where the bed material is gravel or cobbles, special procedures may not be necessary to protect spoil piles.

At major stream crossings, spoil would be stockpiled on the banks in the near shore areas where possible. However, where the river is wider than the reach of the tracked backhoe excavating the crossing, it would be necessary to stockpile some of the spoil on the downstream side of the trench in discrete piles away from areas of highest water velocity. This would leave gaps for the water to flow through.

8.8.1.2 Crossing Procedures

General Procedures

Prior to installing the pipeline across a stream, the right-of-way would be cleared and graded on both sides of the crossing. The right-of-way adjacent to the stream would be graded so that soil is pushed away from the stream rather than toward it. Culverts would be installed, if needed, during clearing. A 10-foot wide vegetation buffer would be left on each bank if more than one week is expected to pass between right-of-way clearing and the actual crossing of the stream, unless the stream crossing must be used for access to other sections of the right-of-way. This buffer strip would prevent sediment from entering the stream, reduce bank exposure and maintain shade and cover for fish. If the stream crossing occurs within one week of right-of-way clearing, the vegetation buffer would not be required. However, the contractor would preserve as much vegetation as possible along the stream banks, while still allowing for safe equipment operation. If vegetation is sparse, a filter fence, straw or hay bale barrier would be used for sediment control.

The stream crossing would generally be perpendicular to the stream flow. If possible, the crossing would be located in relatively straight sections of the stream where width, depth, bank and bottom characteristics would reduce instream construction time and the potential for channel alteration. To prevent trench water from flowing directly into the stream, ditch plugs would be placed in the trench, or an unexcavated section (hard plug) would be left in the trench on both sides of the stream.

Vehicle crossing structures (temporary bridges, swamp mats, or culverts and ramps built with clean fill or gravel) would be installed at most watercourses unless the crossing is too large, in which case construction traffic would utilize existing bridges and new or existing access trails on either side of the crossing. No perennial watercourses would be forded unless approval is obtained from the appropriate agencies. Vehicle crossings would be removed after pipeline construction and the beds and banks of the watercourse restored to approximate preconstruction condition.

Appropriate original streambed contours would be restored after construction. Dredge and spoil material would be placed to avoid or minimize impacts to public water supplies, threatened or endangered species, critical fish habitat, or movement of aquatic species. Materials toxic to fish or other aquatic life would not be discharged into watercourses. Prior to construction, the hydraulic, fuel, and lubrication systems of equipment used in water crossings would be inspected to ensure that they are free of leaks. Equipment or machinery would not be washed in streams.

In most cases a backhoe would be used to trench the streambed. The backhoe would operate either from the streambank (at narrow streams) or directly straddling the trenchline in wider streams. A dragline working from the banks would excavate the trench if the water is too deep for a backhoe. The trench would be dug to a depth that would allow for suitable cover over the pipe in the streambed as determined during detailed design. Streambeds comprised of solid rock may require blasting. If so, charges and delays would be controlled and appropriate matting would be used to minimize impacts to the surrounding area.

Pipe for each crossing would be fabricated at a staging area outside the stream and riparian zone. Sand, gravel or dirt padding would be placed around the pipe where rock is present in the streambed. Spoil removed during ditching would be used to backfill the trench, usually with a backhoe, clamshell or a dragline working off the streambank.

Alternative Crossing Procedures

Minor Streams ($\leq$ 10 feet wide and $\leq$ 2 feet average depth)
For crossings of all coldwater and warmwater fisheries, construction equipment would cross the stream on a bridge consisting of one of the following: 1) equipment pads and culvert(s); 2) clean rockfill and culvert(s); 3) flexi-float or portable bridge; or 4) existing bridge (if nearby).

For crossings of all coldwater fisheries, and warmwater fisheries considered significant by the state fish management agency, the stream would be routed across the trench using flume pipe, and the pipeline installed using "dry-ditch" techniques as follows:

- install flume after blasting, but prior to trenching;
- use sand bag/plastic dam structure;
- properly align flume pipe;
- do not remove flume during trenching, pipe-laying or backfilling activities;
- dewater trench, as required, to prevent discharge of silt-laden water into stream during construction and backfilling operations;
- remove all flumes and dams upon completion of construction.

Pending final design, Express may propose alternative dry-ditch techniques to flumes such as the dam and pump technique. Any alternative crossing procedures would be submitted to appropriate agencies for approval prior to construction.

For all other minor perennial stream crossings, instream construction would be completed within 24 hours (not including blasting).

Major Streams (> 10 feet wide or > 2 feet average depth, but ≤ 100 feet wide)

At major streams, construction equipment would usually cross on a bridge consisting of one of the following: 1) equipment pads and culvert, 2) clean rockfill and culvert, or 3) a flexi-float or portable bridge. In-stream equipment would be limited to that needed to construct the crossing; all necessary equipment and materials would be on site and ready for installation before the crossing construction begins. Appropriate authorities would be notified at least 48 hours prior to in-stream trenching or blasting. An attempt would be made to complete in-stream trenching and backfill work (not including blasting) within 48 hours with a maximum of 72 hours unless site-specific physical conditions make completion within 72 hours impossible. If bedrock is encountered, the time needed for blasting, excavation, pipe installation, and backfill may exceed 72 hours. Every attempt would be made to minimize the duration of in-stream activity.

Rivers (>100 feet wide)

Site-specific construction procedures for major river crossings would be prepared during final design and would be submitted to appropriate agencies for review and approval prior to construction.

8.8.1.3 Temporary Erosion and Sediment Control

Erosion and sediment control structures at stream crossings would be inspected daily and repaired (if needed). In Wyoming, erosion would be monitored as required by the Wyoming

State statutes under the Wyoming Storm Water Discharge Program as per the NOI/Pollution Prevention Plan for the project. The right-of-way through riparian zones would not be graded until the staging area is prepared. In-stream pipeline installation work would usually not occur until the pipe is welded, coated, weighted and tested, so the duration of in-stream work would be minimized.

Wherever practicable, sedimentation near streams would be controlled by filtering runoff through natural vegetation or filtration structures, and/or by small sediment basins.

Trenching would not be allowed to drain sloughs and other standing waterbodies unless permission has been granted by the appropriate agencies. Trenching would stop short of the watercourse and hard plugs would be installed to prevent silt-laden water from entering the stream. Since hard plugs would be retained at streambanks as long as possible (until just after the watercourse has been ditched), sediment filter devices would usually not be needed. When hard plugs are removed, soft plugs would be installed where necessary to minimize sediment in the trench from entering the watercourse. Trench plugs would be used at non-flumed minor stream, major stream and river crossings to prevent diversion of streamflow into upland portions of the trench during construction.

8.8.1.4 Bank Stabilization and Revegetation

After construction, all excess debris would be removed from the streambed and banks. In most cases, the banks and streambed would be restored to their original contours. However, if the original streambank contours are excessively steep and unstable, a more stable final contour may be specified. If used, riprap activities would comply with nationwide Section 404 permit no. 13 conditions at a minimum. The use of riprap would be limited to areas where flow conditions preempt vegetation stabilization unless otherwise specified by state permit. Riprap would extend from the stabilized streambed to the top of the streambank or to the 50-year storm level, whichever is lower. Appropriate height of riprap would be specified in Parts 5 and 6. The riprap thickness would be at least 12 inches and generally thicker at the base. Where crossings occur across a bend in the stream, the outside bend would be riprapped from the low water to the high water mark. Where practicable, native rock similar in appearance to adjacent rock would be utilized as riprap. A viable alternative method would be the use of gabions.

Topsoil would be respread over the right-of-way, up to and including the streambank; soil would not be applied to the stream channel. Prompt replacement of soil containing roots, rhizomes and seeds would enhance revegetation success. Seedbed preparation would be conducted following grading and soiling.

The use of erosion control products would vary by site; specifications would be determined during final design. Erosion control products that would be used as necessary include jute netting, biodegradable geotextiles and coconut or excelsior blankets. Selection of the appropriate product would be based on slope steepness, water velocity and soil properties. Soil amendments (lime, fertilizer) would not be applied.

Sites would be revegetated with an appropriate mixture to be specified during final design. In general, the moist conditions and soils in these areas would favor rapid revegetation. Impacts to the understory and herbaceous species would be minor and short term. If necessary, sites would be temporarily revegetated with a suitable annual species.

Mowing and other vegetation maintenance practices would not be conducted except for selective cutting of trees located within a 20-foot strip centered on the pipe. Specific procedures would be developed to prevent the invasion or spread of undesirable exotic vegetation in coordination with appropriate agencies. Sediment filter devices would be maintained at the base of all slopes located adjacent to streams until right-of-way revegetation is complete. Permanent slope breakers would be installed at the base of all slopes adjacent to streams.

8.8.1.5 Trench Dewatering

Trench dewatering would be conducted such that any silt laden water does not flow into any perennial stream or river. Alternative trench dewatering practices include: 1) discharging onto upland vegetated areas; or 2) discharging into straw bale, silt fence or other sediment filtering devices approved by the environmental inspector.

8.8.2 Wetland and Riparian Areas Crossing

Wetlands (as defined by federal delineation criteria) and riparian areas include land adjacent to intermittently and perennially flowing creeks, streams and rivers, potholes and springs/seeps, where vegetation and soils are strongly influenced by water. Techniques for wetland crossings would vary according to the type of wetland to be crossed, the length of the crossing and the level of soil saturation or standing water at the time of the crossing.

8.8.2.1 Staging Areas

Staging areas would be located at least 50 feet away from the wetland/riparian edge, where topographic conditions permit; the size would be limited to the minimum needed to construct the wetland crossing. Hazardous materials, chemicals, fuels and lubricating oils would not be stored within 100 feet of the wetland/riparian boundary. Construction equipment would be refueled at least 100 feet from the wetland/riparian boundary. Where conditions require construction equipment to be refueled within 100 feet of any wetland boundary (e.g., pontoon-mounted backhoes, trench dewatering pumps), procedures outlined in the Spill Prevention, Containment and Control Plan would be followed. Aboveground facilities would not be constructed in any federally delineated wetland except where the relocation of such facilities would prohibit compliance with DOT regulations.

8.8.2.2 Spoil Pile Placement/Control

The flow of spoil off the right-of-way would be prevented by using berms, silt fences or straw bales as necessary.

8.8.2.3 Crossing Procedures

The U.S. Army Corps of Engineers (COE), Omaha District has been notified concerning the proposed construction activities. At a minimum, Express would comply with nationwide Section 404 permit conditions (33 CFR 330). Express would apply for state-issued stream and wetland crossing permits and obtain Section 401 water quality certification or waiver.

General mitigation measures for wetland/riparian area crossings include:

- The pipeline has been routed to avoid wetland/riparian areas to the maximum extent practicable. Where these areas could not be avoided or crossed by following an existing right-of-way, the pipeline has been routed in a manner that minimizes disturbance to wetland/riparian areas.

- The width of construction right-of-way would be reduced to $\leq$ 75 feet unless site conditions require additional width. Areas where additional construction width is necessary would be detailed on site-specific plans and submitted to appropriate agencies for approval prior to construction.

- Vegetation would be cut off at ground level leaving existing root systems intact, and any larger woody vegetation would be removed from the wetland for disposal.

- Pulling of tree stumps and grading activities would be limited to directly over the trench. Stumps or root systems would not be removed from the rest of the right-of-way in wetlands, unless in the judgment of the Inspector, safety-related construction constraints require removal of tree stumps from under the workpad. Where tree stumps are removed from under the workpad area, Express would specifically identify the areas where the pulling of tree stumps is required and would develop and implement a detailed plan to actively reestablish native woody vegetation in these areas. This plan would be submitted to appropriate agencies prior to construction.

- The top one foot of topsoil would be segregated from the area disturbed by trenching, except in areas with standing water or saturated soils.

- To the extent possible, construction equipment operating in wetlands would be limited to that needed to dig trench, install pipe, backfill trench and restore the right-of-way.

- Dirt, rockfill, tree stumps or brush riprap would not be used to stabilize the right-of-way. In some areas, brush may be used as a filter windrow for sediment control. The sites would be specified in the final POD.

- Wide-track or balloon-tire construction equipment would be used, or normal equipment would be operated off of timber pads, prefabricated equipment pads, or geotextile fabric overlain with gravel fill, if standing water or saturated soils are present.

- Trees located outside the right-of-way would not be cut to obtain timber for equipment pads, and no more than two layers of timber or equipment pads would be utilized to stabilize the right-of-way.

- All timber pads, prefabricated equipment pads and geotextile fabric overlain with gravel fill would be removed upon completion of construction.

- The pipeline would be assembled in upland area and the "push-pull" or "float" technique would be used to place pipe in the trench whenever water and other site conditions allow.

It is currently anticipated that three wetland/riparian crossing methods would be used depending on site conditions and construction scheduling. The methods are:

Method 1: This method would be employed where the soil is dry and firm enough at the time of construction to support heavy equipment, generally during late summer and early fall when the water table is low.

Method 2: This procedure would be instituted when soil moisture at the time of construction is sufficient to prevent effective use of standard upland construction procedures. The general sequence for standard construction would still apply, but some steps would be modified to reduce construction impacts to wetland/riparian areas.

Method 3: This method would address procedures applicable to push/pull construction where water is sufficient to float the pipeline in the trench.

Specific procedures for each method (including any variations from the general mitigation measures listed previously) and the locations where each method would be used would be prepared during final design.

8.8.2.4 Temporary Erosion and Sediment Control

Erosion and sediment control structures in wetlands and riparian areas would be inspected daily and repaired as needed. Sediment filter devices would be installed at wetland edges and maintained until right-of-way revegetation is complete. Permanent slope breakers would be installed at the base of all slopes adjacent to wetlands.

8.8.2.5 Revegetation Techniques

Site-specific revegetation plans for the wetlands and riparian areas would be prepared during final design.

General commitments for revegetation include:

- Fertilizer or lime would not be used unless required by the appropriate permitting agency.

- Topsoil would be restored to original horizon and disturbed areas revegetated unless standing water is present.

- All disturbed areas would be permanently revegetated with native herbaceous and woody plant species (if present in the pre-disturbance stand).

- Specific procedures would be developed in coordination with the appropriate state or county agency, to prevent the invasion or spread of undesirable exotic vegetation.

8.8.2.6 Trench Dewatering

The trench would be dewatered so that no silt laden water flows into wetlands off the construction right-of-way.

8.8.2.7 Right-of-way Maintenance Practices

To facilitate corrosion/leak surveys, a corridor centered on the pipeline up to 10 feet wide may be maintained in a herbaceous state. In addition, trees that are located within 15 feet of the pipeline and greater than 15 feet in height may be selectively cut and removed from the right-of-way. Right-of-way maintenance and surveillance would be conducted to ensure compliance with DOT requirements.

8.8.3 Hydrostatic Testing

8.8.3.1 Timing

Each pipeline section tie-in would be 100 percent x-rayed prior to installation.

8.8.3.2 Intake Source and Rate

Commitments regarding water intake source and rate include:

- The intake hose would be screened to prevent entrainment of fish.

- State designated exceptional value waters, or streams designated as public water supplies would not be used unless appropriate state and/or local permitting agencies grant permission.

- Appropriate state agencies would be notified of intent to use specific sources at least 48 hours prior to testing activities.

- Adequate flow rates would be maintained to protect aquatic life, provide for all in-stream uses and provide for downstream withdrawals of water by existing users.

- Any state-issued withdrawal permit would be obtained as required.

8.8.3.3 Discharge Location, Method and Rate

Commitments regarding discharge include:

- Discharge rate would be regulated and energy dissipation device(s) would be used in order to prevent erosion of upland areas, streambottom scour, suspension of sediments or excessive stream flow.

- National Pollutant Discharge Elimination System (NPDES) or state-issued discharge permit would be obtained as required.

- Test water would be sampled during discharge in accordance with any NDPES or state-issued discharge permit requirements.

8.9 GEOLOGIC HAZARDS

A preliminary analysis of seismic records and faulting indicates that ground shaking is not expected to be a problem. No areas with significant probability of major landslides have been identified and since seismic risk is low in areas of potential liquefaction, it is likewise not considered a significant hazard (see Section 4.1 in main text). Some landslide potential has been identified (see Table 4.1-2 in main text). Measures to mitigate potential landslide include:

- Route Relocation. Most of the landslide areas identified to date are avoidable by minor reroutes. Relocation avoids all direct measures needed to control landslides and greatly reduces the frequency of monitoring of the areas. Relocation, if needed, would be planned after geological/geotechnical and engineering studies are completed at the sites, during the detailed design phase of the project. Many of the landslide areas identified are sufficiently stable to be crossed directly. Specific areas that would be considered for rerouting include:

  MONTANA

  Arrow Creek Breaks: As part of the detailed design phase, at the Arrow Creek Breaks (Milepost 111.0 to Milepost 115.0) a geological/geotechnical field study would locate the optimal route through landslides, some of which are active. The present route is preferable to alternative routes outside the mile-wide pipeline corridor, because it is less steep and has fewer landslides.

WYOMING

West Kirby Creek: At Milepost 417.8 to Milepost 418.1 is a large, partly active landslide. As part of the detailed design phase, an on-site geological/geotechnical study would be made to investigate the possible need to reroute around this slide. A reroute to the northeast within 0.5 miles of the present route appears feasible. This reroute follows a stable, inclined bench.

- Prevention of Slide Reactivation or Initiation. Care would be taken not to reactivate existing stabilized slides and to not initiate new ones. Specific measures which would be undertaken as needed include: diversion of seeps and concentrated surface runoff, by means of berms, ditches and slope shaping; installation of breakers at slope crests and at significant breaks in slope; installation of subsurface drains; and avoidance of undercutting landslide toes by the trench or by sidecuts on the working side. These measures, especially berms and ditch plugs, also would serve to control erosion on steep slopes and would be used especially on slopes of greater than 20 degrees, in potentially unstable shale or mudstone.

- Landslide Control. Depending on site conditions, additional measures may be needed to stabilize landslides directly crossed by the pipeline including dewatering or buttressing at the toe or within the slide mass. Dewatering by trenching to intercept subsurface water would probably be the method of choice for shallow landslides, but would require long-term maintenance. Decisions on measures would be completed during the detailed design phase.

- Monitoring Landslide Hazards.

Landslide Motion: Movement on all active landslides which are crossed by the pipeline would be monitored by site visits. Deep movement involving more than the upper several feet of ground could pose a hazard to pipeline integrity. The frequency of the visits would depend on the site conditions, as determined during the detailed design phase of the project. At present, the only likely candidate area for such site visits is the Arrow Creek area in Montana, Milepost 111.0 to Milepost 115.0.

Landslide Control Structures: If landslide motion is controlled, for example by drainage diversion structure such as trenches, berms, or subsurface drainage, then regular maintenance and monitoring of these structures would be implemented. The schedule and type of monitoring would depend on site conditions and the specific measures used.

9.0 SCHEDULE

Subject to regulatory approval, construction would commence September, 1994. Express plans to complete seasonal rehabilitation within or immediately following the construction period. Stream crossings would be conducted primarily during low-flow periods. Interim erosion control measures would be conducted as needed throughout the construction period. If weather conditions preclude revegetation of some areas during the construction period, these areas, which are not expected to be extensive, would be revegetated during fall, 1997.

Erosion and sediment control practices would be evaluated during and following construction to determine their effectiveness. Remedial measures would be implemented as soon as practicable if problems are identified. Revegetation success would be evaluated during the 1997 and 1998 growing seasons. Areas identified as having low rehabilitation potential or higher erosion potential would be scrutinized more intensively. The right-of-way would be monitored periodically during operations to ensure continued erosion and sediment control. All identified problem areas would be mitigated as soon as practicable.

Within Montana, the MDEQ has established criteria to determine the success of reclamation of soils and vegetation. One year after reseeding, vegetation coverage must be at least 30 percent of the vegetation cover on undisturbed lands immediately adjacent to the construction right-of-way. Five years after reseeding, vegetation coverage must be at least 90 percent of the vegetation cover on undisturbed lands immediately adjacent to the construction right-of-way. In the event that these reclamation objectives would not be attained in the prescribed time periods, Express would continue reclamation.

The pipeline and associated facilities are designed for a minimum 25-year operating life although the system would physically be able to operate much longer if required.

10.0 MONITORING

Construction and operational monitoring would be conducted to evaluate right of way restoration (ARM 36.7.5501(1)).

10.1 CONSTRUCTION MONITORING

Express would incorporate environmental mitigation measures into its construction specifications and would identify such on construction alignment sheets. These specifications and alignment sheets would form part of the contract documents sent to pipeline contractors bidding to construct the project. Environmental experts would be assigned to the project to act in an advisory role to formulate environmental policies, practices and procedures; provide technical expertise where required; and monitor any potential long-term issues or specific problems. Express would also employ environmental inspectors to ensure that appropriate techniques to minimize environmental impacts, as defined in the specifications and on the alignment sheets, are implemented. There would be at least one environmental inspector assigned to each construction spread.

It would be the responsibility of each environmental inspector to bring to the immediate attention of the construction supervisor and Express, any activity which may cause negative environmental impact. Daily meetings would be held between the environmental inspector(s) and the Express construction representative to discuss the environmental implications of the construction, compliance and possible impacts of the day's activities. A daily written report would be made by the environmental inspector. The environmental inspector would also act as the liaison between the construction supervisor and environmental surveillance officers employed by regulatory agencies. Should a situation arise in which there is a clear contravention of environmental specifications and in which the delay necessary for proper communications could result in unnecessary environmental impact, the environmental inspector would take immediate action to have the specific task discontinued until appropriate Express personnel have been informed. Although expected to be infrequent, these situations would be handled according to the individual circumstances demanded by each particular problem. Contingencies for such events would be worked out during preconstruction meetings.

Prior to construction, all relevant inspection and contractor personnel would attend an environmental training seminar which highlights specific environmental concerns on this project and outlines appropriate action.

After final cleanup, landowners would be contacted to determine their satisfaction with the right-of-way and temporary work space restoration.

10.2 OPERATIONAL MONITORING

Operational monitoring would be conducted to ensure that erosion and sediment control practices, revegetation and other environmental measures are effective. Following construction, site-cleanup and rehabilitation, qualified specialists would evaluate disturbed areas to ascertain the effectiveness of control measures. Inspections would cover the entire route during late summer and fall 1994 and spring-summer, 1995. Thereafter, inspections would be made routinely with other pipeline inspections with specific attention to potential problem areas. In addition, the right-of-way would be patrolled from the air on a regular basis. Remedial measures would be taken as soon as practicable at any identified problem area.

Revegetated areas would be evaluated by field reconnaissance to determine initial revegetation success. Monitoring would include a qualitative evaluation of cover and species composition. Areas with poor germination and/or growth would be evaluated to determine causes of unsuccessful revegetation. Express would consult with involved landowners or surface management agencies to determine the scope of evaluation. Reclamation techniques would be modified as necessary to address any identified problems and remedial measures taken to revegetate problem areas.

Plant vigor would be observed to assess soil fertility. If plant nutritional deficiencies appear, macro and micronutrient testing would be conducted and appropriate corrective measures would be taken.

11.0 MANAGEMENT

11.1 TRAFFIC MANAGEMENT

During construction, traffic would be restricted to the right-of-way and designated construction sites and access roads. Contractors would be informed of travel restrictions. No unauthorized off right-of-way travel would be allowed. The following traffic plan is developed to avoid unrestricted travel and is responsive to concerns raised by Federal and state agencies:

- Remove temporary construction access roads and rehabilitate to appropriate standards.

- Restore approximate original contours.

- Replace topsoil and seed the right-of-way as soon as practicable.

- Replace temporary construction gates with permanent fences constructed of similar or better quality materials than the original fence. Replace any fences removed with similar or better quality materials than the original fence.

- Regularly patrol the right-of-way by overflights. Observe pipeline at existing ground access points. (A "two track" along the right-of-way is not required for operations staff).

11.2 WEED CONTROL

Montana and Wyoming have laws which state that it is unlawful to allow noxious weeds to propagate or go to seed on municipal, state, federal, and private lands. These laws are the County Noxious Weed Control Act in Montana and the Wyoming Weed and Pest Control Act of 1973, Title 11, Chapter 5 in Wyoming. These laws designate "noxious" weeds. Noxious weeds are usually exotic plants that proliferate and reduce the value of land for agriculture, forestry, livestock, wildlife, and other beneficial uses. Noxious weeds spread rapidly, outcompete most native species, and often become established on disturbed sites. ARM 36.7.2545(4) requires an inventory of noxious weeds (see Section 4.5 in main text) and a discussion of control measures.

Where noxious weeds grow adjacent to the right-of-way, they could rapidly invade and displace reseeded plants. Long-distance transport of weeds to previously uncontaminated areas presents a greater concern. Some species, such as knapweed, often are carried by vehicles and expand their range. The route crosses large expanses of native sagebrush/grassland which do not contain significant stands of noxious weeds. The cleared right-of-way could serve as a possible conduit by which noxious weeds could become established in areas currently free of weeds. Noxious weed infestations were identified and mapped during the 1991 field season. Noxious weeds and their association with plant community types and land uses were recorded during pedestrian surveys of soil, vegetation, and wetlands.

During and following construction of the pipeline, areas disturbed on the right-of-way or along access roads would be monitored for the presence of noxious weed infestations. Areas with existing noxious weed problems that would be traversed by the pipeline would be intensively monitored and treated to prevent the spread of weeds to currently uninfested areas. Weed control would be implemented by construction and reclamation contractors under the supervision of Environmental Inspectors. Contractors would be required to have equipment arrive at construction sites in a clean condition, free of weeds. During the operational stage of the project, weeds would be controlled in a manner approved by the appropriate agencies.

Rapid revegetation of disturbed sites would be a high priority in rehabilitation to reduce the potential for noxious weed invasions. Drill seeding would be employed on the majority of areas with noxious weed infestations. Drill seeding would help ensure prompt regrowth of desirable plant species and reduce the potential for proliferation of noxious weeds. Although drill seeding may not be desirable in reducing visual contrast of the pipeline right-of-way with native vegetation, this method of seeding is effective in promoting vigorous stands of grasses which can effectively compete with noxious weeds for growing space, nutrients, and soil moisture.

Specific weed control measures would be implemented for segments of the pipeline right-of-way where noxious weeds are present. On BLM lands, chemical treatment of noxious weeds will require a pesticide use permit which would be issued and approved by the BLM. Herbicides to be used include picloram (Tordon), 2,4-D, and dicamba (Banvel). These herbicides selectively kill broadleaf species and generally do not harm grasses when applied at recommended rates. The environmental consequences of herbicide application have been addressed in detail by Bonneville Power Administration (Environmental Impact Statement, Transmission Facilities Vegetation Management Program, 1983) and the Bureau of Land Management (Environmental Impact Statement, Northwest Area Noxious Weed Control Program, 1985; Draft EIS Vegetation Treatment on BLM Lands in Thirteen Western States, 1989). The use of the herbicides noted was judged to be suitable for noxious weed control. Adverse environmental impacts of herbicide use on the human and natural environment are minimal if proper methods of application are followed.

Although chemical herbicides would be used to control the spread of noxious weeds, the need to apply large amounts of herbicide would be reduced by early detection and treatment of infestations on the right-of-way and other disturbed sites. Treating initial invasions of noxious weeds before they have become established and produce seed would be a priority in noxious weed management.

Broadcast spraying of herbicides would not be done, but rather spot spraying of individual plants would be the principal method of control. Herbicide would be carried either in tanks mounted on vehicles or in backpack tanks. Herbicide spray would be applied only when wind velocity is less than 8 miles per hour to prevent wind drift. No herbicides would be applied within 25 feet of waterbodies. All herbicide application would be:

- In compliance with all pertinent state and federal regulations.

- With only those herbicides registered and approved by the Environmental Protection Agency (EPA).

- In strict compliance with application rates and application techniques specified on EPA-approved label instructions.

- Applied only by licensed applicators or licensed supervisors.

- In strict observance of all laws and regulations governing herbicide handling, storage, disposal, and spill cleanup.

- Mixed without use of oil carriers with the herbicide.

Application rates, measured in pounds of active ingredient per acre, vary for each herbicide or combination of herbicides, depending on the target species, control objectives, and environmental conditions. Application rates commonly recommended for treatment of noxious weeds are listed in Table B-11-1.

Intensive field surveys and interviews with County Weed Boards in Montana and County Weed and Pest Control Districts in Wyoming indicate that noxious weeds most likely to be problems on the Express Pipeline are leafy spurge, Canada thistle, field bindweed, whitetop, spotted knapweed, Russian knapweed and perennial peppergrass.

11.3 FENCING

Temporary gates would be placed on existing fences and the fences subsequently restored to their original, or better condition. To allow forage to reestablish on disturbed sites, Express may negotiate with the BLM to defer or reduce grazing the right-of-way until plants have become well established and control grazing in the second growing season. If grazing is deferred, lessees may need to seek alternative pasture. In certain instances, Express may construct temporary fencing to protect plantings near stream crossings, in wetland and riparian areas or other sensitive areas.

If fencing is constructed, gates and fenced passages along and across the right-of-way would be installed to allow for vehicle, livestock and wildlife crossings at existing trails and other locations designated in cooperation with area ranchers and grazing managers. All damaged fences would be repaired or replaced. Final repair would take place after reclamation work is completed. Gates would be kept closed by all personnel travelling to and from the construction area.

TABLE B-11-1

HERBICIDES COMMONLY RECOMMENDED FOR CONTROL OF NOXIOUS WEEDS ON RANGE AND PASTURE

Noxious Weed	Herbicide	Application Rate Product per Acre	Application Timing
Leafy spurge	Tordon 22K	1-3 quarts	Full flower; fall
	Banvel	2-4 quarts	
	2,4-D	1-2 quarts	
	Roundup	1-2 quarts	
Canada thistle	Tordon 22K + 2,4-D	1 + 1 quart	After emergence to bud; fall
	Stinger		
	Curtail	2/3-1 pint	
	Banvel	2-4 quarts	
	2,4-D	1-2 quarts	
		1-2 quarts	
Whitetop	Banvel	2 quarts	Early bud; fall rosettes
	2,4-D	2-3 quarts	
Russian knapweed	Tordon 22K	1-2 quarts	Bud stage; fall
	Stinger	1-1.3 pints	
	Curtail	3-4 quarts	
	Banvel	2-4 quarts	
	2,4-D	2-4 quarts	
Spotted & diffuse knapweed	Tordon 22K	1 pint	Bolt, fall
	Stinger	2.3 pints	
	Curtail	2 quarts	
	Banvel + 2,4-D	.5 + 1 quart	
		1-2 quarts	

Source: Montana Department of Agriculture, December 1991, Draft Noxious Weed Trust Fund, Programmatic Environmental Impact Statement.

11.4 BRUSH CONTROL

A 15-foot strip centered on the pipe would be cleared periodically (every 3-5 years or as needed) to facilitate aerial and ground surveillance for detection of leaks, cathodic protection surveys, surface erosion and slope failure. When brush is cut down on the 15-foot strip, mulch could be left in the cut area to aid in erosion control. Brush control would be accomplished using mechanical means such as mowers capable of cutting down and mulching shrubs and trees or hand-slashing with brush saws. Routine mechanical vegetation maintenance would not be conducted prior to August 1 of any year. Herbicides would not be broadcast sprayed on the right-of-way to control woody plants.

11.5 SPECIAL TREATMENTS

It is not anticipated that special post-construction treatments would be necessary to achieve rehabilitation objectives. No supplemental irrigation, interseeding or other treatment is proposed.

12.0 ABANDONMENT

All surface facilities would be dismantled and removed upon abandonment. Salvageable components would be sold. Non-salvageable components would be disposed of at approved off-site areas. Cement foundations would be hauled to an approved disposal area. Gravel pads would be buried on-site or hauled away for disposal.

Appendix C

Rehabilitation Potential

Prior to presenting soil data, it is necessary to explain the rationale for identifying restrictive soil features limiting rehabilitation potential. Table C-1 lists the soil parameters used to separate the rehabilitation potential of soils along the pipeline into Good, Fair, Poor and intermediate categories (also see Table B-3-1, Appendix B, Preliminary Reclamation Plan) (Montana ARM 36.7.2545). Ratings in Table C-1 were derived from SCS guidelines for rating soil parameters for reclamation (USDA 1983). Soil parameters such as soil depth, soil texture, electrical conductivity and sodium adsorption ratio directly affect rehabilitation. Other soil parameters included in the table are not necessarily unfavorable to rehabilitation, but are attributes that may make rehabilitation difficult, such as steep slopes (erosion potentials are high), high water tables (it is difficult to prepare the seedbed and reseed), and wind and water erosion hazards (soil particle sizes and chemical characteristics make soils susceptible to erosion).

Wind and water erosion potentials for each soil were determined from SCS soil erodibility potentials. Soil textures, organic matter content, calcium carbonate content, soil structure, and permeability affect soil erodibility, and therefore indirectly affect wind and water erosion hazards. However, wind and water erosion hazards do not directly limit rehabilitation potentials. For example, fine sandy or silt loam soils are excellent substrates for revegetation but are also highly erodible. Erosion will be controlled on soils exhibiting high erosion hazards by employing construction management practices commensurate with the severity of the problem (Appendixt B, Preliminary Reclamation Plan).

The permeability classes (USDA 1983) listed below were used to support textural determinations concerning rehabilitation potentials. Slow permeabilities typify fine soil particles and rapid permeabilities typify coarse soil particles.

Permeability class	inches/hour
Very slow	<0.06
Slow	0.06-0.2
Moderately slowM	0.2-0.60
Moderate	0.6-2.0
Moderately rapid	2.0-6.0
Rapid	6.0-20
Very rapid	>20

The drainage classes (USDA 1983) listed below were used to support water table determinations and emphasize areas of increased compaction hazards.

> Very poorly drained: Water is removed from the soil so slowly that the water table remains at or on the surface the greater part of the time. These are depressed areas that are frequently ponded.

Poorly drained: Water is removed so slowly that the soil remains wet for a large part of the time. Poorly drained conditions are due to high water table.

Somewhat poorly drained: Water is removed from the soil slowly enough to keep it wet for significant periods but not all the time.

Moderately well drained: Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time.

Well drained: Water is removed from the soil readily but not rapidly.

Somewhat excessively drained: Water is removed from the soil rapidly.

Excessively drained: Water is removed from the soil very rapidly.

Tables C-2 through C-9 (Montana) and C-10 through C-14 (Wyoming) characterize the dominant and restrictive soil map units crossed by the proposed pipeline centerline, by county. Average topsoil depths are provided as determined by organic matter content (Munsell color designations in soil profile descriptions and SCS S5 forms) and surface and subsurface physical and chemical characteristics. The restrictive features column summarizes the most restrictive soil parameters in the map unit. Restrictive feature designations were used to determine rehabilitation potentials and procedures for specific areas along the pipeline. Soil rehabilitation potentials were categorized as:

G: Good - A map unit or group of map units that are located on gentle slopes and consist of deep, non-saline, non-sodic, loamy textured soils. These may exhibit wind (WE) and water (WAE) erosion hazards, high water tables (WT), or flooding (FL) but these traits are not necessarily detrimental to vegetation establishment. These are physical constraints that can be addressed with proper management.

F-G: Fair to Good - A map unit or group of map units rated either Fair or Good that are intricately mixed and difficult to separate.

F-: Fair - A map unit or group of map units that exhibit moderate categories for EC (4 to 8 mmhos/cm), NA (SAR between 4 and 8), SH (20 to 40 inches total soil), shallow topsoil depths (less than 4 inches topsoil shown on Tables D-2 to D-14) and extreme EC, NA, or C beneath the surface horizon.

P-F: Poor to Fair - A map unit or group of map units rated either Poor or Fair that are intricately mixed and difficult to separate.

P: Poor - A map unit or group of map units that exhibit one or more extremes of the following categories:

EC -	High electrical conductivity	>8 mmhos/cm
NA -	High sodium adsorption ratio	>8
ST -	Steep slopes	>15%
C -	High clay content	>40%
S -	High sand content	>85%
SS -	Excessive surface stoniness	>75% surface covered
SH -	Shallow soil	<20"

For the pipeline route, the rehabilitation potential along 73% of the pipeline route in Montana, 49% in Wyoming and 64% overall is rated as Fair or better. Approximately 23% of the route in Montana, 45% in Wyoming and 32% overall is rated Poor, primarily due to characteristics such as salinity, sodium, steep slopes, unsuitable texture, or shallow depth to bedrock.

TABLE C-1
TOPSOIL PARAMETERS, RATINGS AND RESTRICTIVE FEATURES

	Limits				
PARAMETER	GOOD	FAIR	POOR	RESTRICTIVE FEATURE	SYMBOL
Depth to Bedrock (inches)	>40	20-40	<20	Depth to rock	SH
USDA Texture[1]					
• Coarse Textured Material	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	Too sandy	S
• Fine Textured Material	---	SCL, CL, SICL	SIC, C, SC	Too clayey	C
Stoniness Class	--- surface covered	--- Stoniness	>75%	Surface	SS
Salinity (MMHOS/cm)	<4	4-8	>8	Excess salt	EC
Depth to High Water Table (ft)	---	---	<1	Wetness	WT
Sodium Adsorption Ratio	<4	4-8	>8	Excess sodium	NA
Slope (%)	<8	8-15	>15	Steep slope	ST
Wind and Water Erosion (tons/acre)	0-2	2-5	>5	Soil Loss	WE,WAE

SOURCE: USDA 1983; USDA 1978.

[1] LCOS = loamy coarse sand
LS = loamy sand
LFS = loamy fine sand

LVFS = loamy very fine sand
SCL = sandy clay loam
CL = clay loam
SICL = silty clay loam

COS = coarse sand
S = sand
FS = fine sand

VSF = very fine sand
SIC = silty clay
C = clay
SC = sandy clay

TABLE C-2
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, HILL COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
ABSHER	0-6	>60	2	(EC),(NA)	CL/C	VS-S	>6	MW-W	M/M	L	L
BADLAND-RO	25-45	<20	0-4	WAE,WE,ST,SH	L/L	S-MS	>6	W	L-M/L-M	H	M-H
CREED-GERDRUM	0-25	60+	6	NA,WAE,(EC)	L,CL/C,L	M-MS	>6	W	L/H	L-H	M
FORT BENTON-HILLON	2-8	60+	12	WE	L,FSL/L	MS-S	>6	W	L/L	L-M	H
FORT BENTON-KENILWORTH	0-3	60+	12	---	L/L	M-S	>6	W	L/L	L	M
GERDRUM-CREED-ABSHER	0-25	60+	5	NA,WAE,(EC)	L,CL/C,L	M-S	>6	W-MW	L-M/H	L-H	M
HAVRE	0-4	60+	8	WT,FL	L/L	S-MS	3.5-5.0	W	L/L	L	M
HILLON	0-45	>60	5	WAE,ST	L/L	M	>6	W	L/L	H	M
JOPLIN-HILLON	2-8	60+	9	WE	L/L	M-S	>6	W	L/L	M	H
MARVAN-VANDA	0-15	>60	4	EC,NA,WE,C	C/C	VS-S	>6	W	M-H/M-H	L-M	L-H
NISHON	0-1	>60	7	FL,(A),WT	L/C	M	0.5-3.0	SP-P	L/M	L	L
PHILLIPS-ELLOAM	0-8	60+	12	(EC),(NA)	L/L	S-VS	>6	W	L-M/L-M	L-M	M
SCOBEY-KEVIN	0-4	60+	9	---	CL/L	MS-S	>6	W	L/L	M	M
TELSTAD-HILLON	0-4	60+	12	---	L,CL	MS-S	>6	W	L/L	L-M	M
TELSTAD-JOPLIN	0-8	60+	9	---	L/L	M-S	>6	W	L/L	L	M
THOENY-ELLOAM-ABSHER	0-15	60+	5	NA,(EC)	L,CL/C,L	M-S	>6	W-MW	M/H	L-M	M

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-3
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, CHOUTEAU COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
ABSHER	0-6	60+	2	(EC),(NA)	CL/C	VS-S	>6	MW-W	M/M	L	L
ASSINIBOINE	0-4	40-60+	10	WE	FSL/L>S	M	>6	W	L/L	L	H
BEARPAW	0-8	60	6	---	CL/L	S	>6	W	L/L	L	M
BEARPAW-VIDA	0-4	40-60+	6	---	CL/L	S	>6	W	L/L	L	M
BUSBY	2-25	60+	12	WE,WAE,ST	FSL/S	MR-R	>6	W	L/L	L-H	H
CABBART	8-45	18	3	WE,WAE,EC,ST,SH	L,S,L/L	S-MS	>6	W	M-H/L	M-H	H
CABBART-HILLON	0-45	18-60	4	WE,WAE,EC,ST,SH	L,SIL/L	S-M	>6	W	M-H/L	M-H	M-H
CHINOOK	0-15	60+	12	WE	FSL/S	MR-R	>6	W	L/L	M	H
DEGRAND	0-4	60+	9	---	L/L>S	VR	>6	W	L/L	L	M
EVANSTON	0-15	60+	8	---	CL/L	MS-M	>6	W	L/L	M	M
FORT BENTON	0-4	40-60+	12	WE	FSL/L	MR	>6	W	L/L	L	H
FORT BENTON-SCOBEY	0-2	40-60+	10	WE	FSL/L	M-MR	>6	W	L/L	L	H
HILLON	0-45	60+	5	WAE,ST	L/L	M	>6	W	L/L	H	M
JOPLIN-HILLON	2-8	40-60+	9	WE	L/L	S	>6	W	L/L	M	H
KENILWORTH-FORT BENTON	0-3	60+	12	---	L/L	M-S	>6	W	L/L	L	M
MACAR	0-8	40-60+	12	---	L/L	M	>6	W	L/L	L	M
MARVAN	0-4	40-60+	3	WE	SIC/L	VS	>6	W	M/M	L	H
MARVAN-NOBE	0-2	40-60+	3	WE,FL(EC),WT	SIC/L	VS	4	MW-W	L-M/M	L	H
NELDORE-BASCOVY	15-45	10-40	4	WE,WAE,SH,ST	SIC/C	S-VS	>6	W	L/L	H	H
NISHON	0-1	40-60+	11	WT,FL	CL/C>L	S	1-3	SP-P	L/L	L	M
NISHON(HYDRIC)	0-1	40-60+	11	WT	CL/L	S	1-2	P	L/L	L	M
PHILLIPS-ELLOAM	0-4	40-60+	12	(EC),(NA)	L/L	VS-S	>6	W	L-M/L-M	M	M
PHILLIPS-KEVIN	0-4	40-60+	9	---	L,CL/L	S	>6	W	L/L	M	M
SAGEDALE	0-45	60+	11	WE,WAE,ST	SICL/C	S	>6	W	L/L	L-H	H
SAGEDALE-MACAR	0-45	40-60	11	WE,WAE,ST	SICL,L/L,C	S-M	>6	W	L/L	L-H	M-H
SAVAGE	0-2	60+	12	WE	SICL/C	MS	>6	W	L/L	L	H
SCOBEY-KEVIN	0-4	40-60+	9	---	CL/L	MS-S	>6	W	L/L	M	M
TALLY	0-25	60+	12	WE,WAE,ST	FSL/S	MR-R	>6	W	L/L	M-H	H
TELSTAD	0-2	40-60+	9	---	L/L	S	>6	W	L/L	L	M
TELSTAD-JOPLIN	0-4	40-60+	9	---	L/L	M-S	>6	W	L/L	L	M
VIRGELLE	0-6	40-60+	9	WE	LFS/S>L	R	>6	W	L/L	L	H
YAMAC-HAVRE	4-15	60	4	---	L/L	M	>6	W	L/L	L-M	M
ZAHILL-VIDA	8-35	60+	5	WAE,ST	CL/L	MS-M	>6	W	L/L	H	M

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-4
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, FERGUS COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
AMOR-CABBA	4-8	10-40	8	WE,SH	L/L	M	>6	W	L-M	L-M	M-H
CABBA-DONEY-WAYDEN	4-8	10-40	6	WE,SH	L,SICL/L	S-M	>6	W	L-M	M	H
DAGLUM-ADGER	0-2	60+	4	EC,NA,WE	CL,C/L	VS	>6	MW	M-H/M-H	L	M-H
DANVERS	0-2	60+	12	WE	CL/L	S	>6	W	L/L	L	H
DONEY-WINDHAM	8-15	20-60	5	WE	CL,L/L	M-MR	>6	W	L/L	L-M	H
ELTSAC-LAWTHER	2-8	60+	6	WE	SIC,C/C	VS-S	>6	W	L/L	L	H
FAIRFIELD	0-2	60+	9	WE	CL/L	MS	>6	W	L/L	L	H
FAIRFIELD-DANVERS	0-4	60+	9	WE	CL/L	S-MS	>6	W	L/L	L	H
FAIRFIELD-JUDELL	0-2	60+	9	WE	CL/L	M	>6	W	L/L	L	M-H
GERBER	0-4	60+	12	---	CL/C	S	>6	W	L/L	L	M
HAPLAQUOLLS	0-2	60+	8	FL,WT	L/C	S-M	1-3	P	L/L	L	L
HARLEM	0-2	60+	8	FL	SICL/L	S	>6	W	L/L	L	M
HAVRE	0-2	60+	8	FL	L/L	M	>6	W	L/L	L	M
JUDITH	0-15	60	9	WE	1CL/L	M	>6	W	L/L	L-M	H
JUDITH-JUDELL	2-4	60+	9	WE	CL/L	M-MR	>6	W	L/L	L	H
MARCOTT	0-2	60+	8	FL,WE,WT	SICL/C	S	2-3	SP	L/L	L	H
MARIAS	2-8	60+	6	WE	SIC/C	VS	>6	W	L/L	L-M	H
NELDORE-RO	15-60	10-20	0-3	WAE,WE,C,SH,S	C/C	S	>6	W	L/L	H	H
NELDORE-THEBO	25-60	10-40	3	WAE,WE,C,SH,S	C/C	VS-S	>6	W	L/L	H	H
SAVAGE	0-2	60+	12	WE	SICL/C	MS	>6	W	L/L	L	H
TAMANEEN-JUDITH	0-4	60+	9	WE	CL/L	MS	>6	W	L/L	L	M-H
TYPIC USTIFLUVENTS,SALINE	0-8	60	0	EC,NA,WT	CL/C	VS-MS	1-4	P	H/H	L-M	L
WINDHAM	0-45	60+	6	WAE,WE,ST	CL/L	MS-M	>6	W	L/L	L-H	H
WINIFRED	2-8	30-50	9	WE	CL/C	S-MS	>6	W	L/L	L-M	H
WINIFRED-JUDITH	8-15	30-60	9	WE	CL,1CL/L	S-MR	>6	W	L/L	L-M	M-H
WINIFRED-WINDHAM	15-45	30-60	6	WE,WAE,ST	CL/L	S-M	>6	W	L/L	H	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-5
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, JUDITH BASIN COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
ARVADA-LAUREL	0-8	<30-6	0	WE,NA,EC	CL,SIC,L	MS-S	1 to >6	P-MW	H/H	L-M	H
BECKTON-ARVADA	0-8	38	3	WE,NA,(EC)	CL/L>C	MS	>6	W	M-H/M-H	L	H
COBBLY ALLUVIAL LAND	0-4	60+	0	WE,FL,WAE	1LS/S	MR	>6	E	L/L	M-H	H
DANVERS	0-8	60+	6	WE	CL/L	M	>6	W	L/L	L-M	H
DANVERS-JUDITH	0-4	60+	6	WE	CL/L	M	>6	W	L/L	L	H
GALLATIN	0-2	60+	12	FL,WT	L/L	M	2-6	P-SP	L/L	L	M
GALLATIN-RAYNESFORD	0-4	60	11	WT,FL	L/L	M	2-6	SP	L/L	L	M
JUDITH	0-4	60	6	WE	1CL/1L	M	>6	W	L/L	L	H
JUDITH-UTICA	0-35	60+	6	WAE,ST	CL,L,1L/1L,1S	M-MR	>6	W-E	L/L	L-H	M
PIERRE	2-35	15-30	0	WE,WAE,C	C/C	S	>6	W	L/M	L-H	H
PROMISE	2-8	30-48	3	WE,C	C/C	S	>6	W	L/L	L-M	H
SAVAGE	0-2	60	12	WE	SIC/C	MS	>6	W	L/L	L	H
STRAW	0-2	50-60	12	WE	CL/L	M	>6	W	L/L	L	H
UTICA	8-35	20	5	WE,WAE,ST	1L/1S	MR	>6	E	L/L	M-H	H
WINIFRED	4-15	30-50	6	WAE,WE	CL,3CL/C	S-M	>6	W-E	L/L	L-H	H
WINIFRED-JUDITH	4-15	30-60	5	WE	CL/C,L	M	>6	W	L/L	L-M	H
WINIFRED-UTICA	15-35	30-50	3	WE,WAE,ST	CL/C,2L	M	>6	E	L/L	H	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-6
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, WHEATLAND COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
ABSHER	0-4	60	2	(EC),(NA),WE	CL/C	VS-S	>6	MW-W	M/M	L	H
ALLUVIAL, WET	0-4	60+	0	WT,EC	CL/C	S	<1	P	H/M	L	M
AMESHA	2-8	60+	10	WE	L/L	M	>6	W	L/L	L-M	H
BEENOM-RENTSAC	0-12	22-30	4	WE	L,FSL/L	M	>6	W	L/L	M	H
BERCAIL	2-4	60	5	---	CL/C>L	MS	>6	W	L/L	L	M
BERCAIL-WAYDEN	4-36	60	4	WAE,ST	C,CL	VS-MS	>6	W	M/L	M-H	M
CABBA	>15	24	7	WAE,ST	CL/L	M	>6	W	L/L	H	M
CRAGO	4-8	60+	6	WE	1L/1L	MS-M	>6	W	L/L	M	H
CRAGO-BERCAIL	8-20	60	5	WAE,ST	CL/L	MS	>6	W	M/L	M-H	M
HAVRE	0-4	60+	8	FL	L/L	M	>6	W	L/L	L	M
HAVRE-MARIAS	0-4	60+	5	WE,FL,(EC)	L,CL/L,C	S-M	>6	W	L/L	L	M-H
JOPLIN	0-8	60+	9	---	L/L	S	>6	W	L/L	L-M	M
JOPLIN-CABBA	10-20	24-60	8	WAE,ST	CL,L/L	S-M	>6	W	L/L	M-H	M
KOBAR	0-8	60	12	WE	SICL/L	S	>6	W	L/L	L-M	H
KOBAR-WAYDEN	2-15	60	6	WE	SICL/L	S	>6	W	M/L	M	H
KOBAR, WET	0-6	60	12	WT,WE	SICL/L	S	3-5	SP-MW	L/L	L-M	H
LAMBETH	4-15	60	8	---	SIL	MS	>6	W	L/L	M	M
LEBO-MUSSELSHELL	0-2	35-60	7	WE	L,CL/L	S	>6	W	L/L	L	M-H
MARIAS, SALINE	0-8	60+	0	WE,EC	CL/C	S	>6	W	H/M	L-M	H
MARIAS	2-4	60+	5	WE,(EC)	CL/C	S	>6	W	L/L	L	H
MARIAS-WAYDEN	8-25	60	5	WAE,WE,ST	CL/C	VS	>6	W	M/L	M-H	H
MORTON	2-4	37-60	12	---	SIL/L>C	M	>6	W	L/L	L	M
MUSSELSHELL	0-2	30-60	7	---	L/L	M	>6	W	M/L	L	M
MUSSELSHELL-CRAGO	0-2	30-60	6	---	L/L	M	>6	W	M/L	L	M
RAPELJE	0-4	60	12	---	SIL,SICL/L	MS	>6	W	L/L	L	M
RENTSAC	4-10	18-60	2	WE,SH	3FSL/3S>3L	MR	>6	W	L/L	M	H
RENTSAC-RO	25-70	16-20	0-2	WE,WAE,ST,S	3FSL	MR	>6	W	L/L	H	H
RIVERWASH COMPLEX	0-2	60	0	WT,FL,(EC)	1L/1L>S	S-M	<2	VP-W	L-M/L	L	M
ROTHIEMAY	2-4	60	6	---	L/L	S	>6	W	L/L	L	M
SAVAGE	0-2	60	12	---	CL/L	MS	>6	W	L/L	L	M
SHAAK	0-4	40-60	12	---	CL/C>L	MS	>6	W	L/L	L	M
SHAWMUT	0-4	15-25	12	SH	CL/L	M	>6	W	L/L	L	M
TWO DOT	2-8	60	12	---	CL/L	MS	>6	W	L/L	L-M	M
UTICA	10-40	20	5	WE,WAE,ST	1L/1S	MR	>6	E	L/L	M-H	H
WAYDEN	2-35	7-15	3	WAE,ST,SH	CL/L	S	>6	W	M/L	L-H	M
WAYDEN-CRAGO	15-35	7-60	3	WAE,WE,ST,S	1L,CL/1L,L	S-M	>6	W	L-M/L	M-H	M-H
WAYDEN-RO	10-60	7-15	0-3	WAE,ST,SH	CL/L	S	>6	W	M/L	M-H	M
YAMAC	4-8	60+	11	---	L/L	M	>6	W	L/L	M	M

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-7
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, GOLDEN VALLEY COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
CABBART	2-8	18	3	WE,EC,SH	L,S/L	S-MS	>6	W	M-H/L	L-M	H
CABBART-RENTSAC	2-15	18-60	3	WE,WAE,EC,SH	L,FLS/L	M	>6	W	M-H/L	M-H	H
CABBART-YAWDIM-DELPOINT	15-35	4-40	3	WE,WAE,SH,ST	L,SICL/L	MS-M	>6	W	L/L	M-H	M-H
DELPOINT	4-10	20-40	11	---	L/L	MS-M	>6	W	L/L	M	M
EVANSTON	0-8	60+	11	---	L,CL/L	M	>6	W	L/L	L	M
KOBAR	0-8	60+	12	---	CL,SICL/C	MS	>6	W	L/L	L	M
RENTSAC	4-10	18-60	2	WE,SH	3FSL/3S>3L	MR	>6	W	L/L	M	H
RENTSAC-RO	15-45	10-20	0-4	WE,WAE,SH,ST	SL/L	M	>6	W	L/L	H	H
TANNA	1-6	20-40	12	---	L/C>L	S	>6	W	L/L	L	M
YAMAC	0-8	60+	11	---	L/L	M	>6	W	L/L	L	M
YAMAC,CALCAREOUS-DELPOINT,CALCAREOUS	2-8	20-60	11	WE	L/L	M	>6	W	L/L	L	M-H
YAMAC-DELPOINT	2-8	20-60	11	---	L/L	MS-M	>6	W	L/L	L	M

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Atppendix J).

TABLE C-8
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, STILLWATER COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
ABSHER	0-6	60	2	(EC),(NA),WE	SICL/L	VS-S	>6	MW-W	M/M	L	H
ASSINIBOINE	2-15	40-60	10	WE	FSL/L>S	M	>6	W	L/L	L-M	H
ATTEWAN	0-4	60+	12	---	L/L>S	M	>6	W	L/L	L	M
ATTEWAN, WET	0-4	60+	12	WT	L/L>S	M	0.5-2.0	P-W	L/L	L	M
BONFRI-LAMBETH	2-8	20-60	8	---	L,SIL,CL/L	MS-M	>6	W	L/L	L-M	M
FLUVAQUENT	0-4	60+	12	FL,WT	L/L>S	M	0.0-1.0	VP-W	L/L	L	M
FLUVENTS-USTOCHREPTS-	0-4	60	5	WAE	SL,SIC/L,C	S-M	>6	W	L-M/L	M-H	L-M
GLENDIVE	0-4	60	6	---	FSL/L	MR	>6	W	L-M/L	L	M
GLENDIVE, WET	0-4	60	6	WT,FL	FSL/L	MR	<4	W	L-M/L	L	M
KOBAR	4-8	60	12	WE	SICL/L	S	>6	W	L/L	M	H
LAMBETH-RENTSAC	4-15	10-60	7	WAE,SH	SIL,L/L	MS-M	>6	W	L/L	M-H	M
LAMBETH-YAWDIM	4-15	60	8	---	SIL/L	MS	>6	W	L/L	M	M
LARDELL	0-2	60+	0	WE,EC,WT	CL/L	S	1.0-5.0	SP	L/L	S	H
LONNA	2-8	60	11	---	SIL/L	MS	>6	W	L/L	M	M
MCKENZIE	0-4	60	0	EC,NA,FL,C	C/C	VS	>6	P	H/M-H	L-M	L
RENTSAC	15-30	18-24	8	WAE,ST,SH	L,3L/4L	MR	>6	MR	L/L	H	M
RO-YAWDIM	25-55	0-10	2	WAE,WE,ST,S	CL/L	S	>6	W	L/L	H	H
TANNA	2-8	34	7	WE	CL/C>L	S	>6	W	L/L	M	H
TANNA-RENTSAC	4-15	10-34	7	WE,SH	CL/C>L	M-MR	>6	W	L/L	M	H
USTIFLUVENTS-USTOCHREP	0-4	40	12	WAE,WE	SI,SIC/S	MS-M	>3	MW	M/L	H	H
YAMAC	4-15	60	8	---	L/L	M	>6	W	L/L	M	M
YAWDIM-LAMBETH-RO	25-60	10-20	0-2	WAE,WE,ST,S	CL/C	S	>6	W	L/L	H	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-9
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, CARBON COUNTY, MONTANA[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
ABAC-TWIN CREEK	15-45	20-60	4	WAE,WE,ST	L,SICL/L	M	>6	W	L/L	H	H
ALLENTINE	2-4	60	0	WE,NA	CL/C	VS	>6	W	M/H	L	H
CABBA-RENTSAC	8-15	<20	5	SH	SICL/L	MS	>6	W	M/L	M	L
FORT COLLINS	0-4	60	12	---	L/L	M	>6	W	L/L	L	M
HAVERSON-HELDT	4-8	60	10	---	SICL/L	M-S	>6	W	L/L	L-M	L-M
HARVEY	2-15	60	5	WE	L/L	M	>6	W	L/L	L-M	H
HELDT	0-8	60	12	---	SICL/L	S	>6	W	L/L	L-M	L
HELDT, SALINE	0-6	60	0	EC	SICL/L	S	>6	W	H/M	L-M	L
KYLE	2-15	48-65	4	WE,C,(EC)	C/C	VS	>6	W	M/L	L-M	H
LA FONDA	0-4	60+	12	---	L,SICL/L	M	>6	W	L/L	L	M
LAMBETH	4-8	60	8	---	SIL/L	MS	>6	W	L/L	M	M
LISMAS	8-15	8-15	0	SH,WE,EC,C	C/C	VS	>6	W	H/M	M	H
MACAR-CABBA	4-15	60	7	WE	CL/L	MS	>6	W	M/L	M	H
MARIAS	2-8	60+	5	WE,(EC)	CL/C	S	>6	W	L/L	L	H
MARTINSDALE	2-8	60	12	WE	CL/L	M	>6	W	L/L	L-M	H
MIDWAY-TRAVESSILLA	25-45	6-20	3	WE,(EC),SH,ST	CL,SICL/C	MS-M	>6	W	M/L	M	H
NEVILLE	2-8	60+	4	---	SICL/L	M	>6	W	L/L	L-M	M
NIHILL	15-25	60	6	WAE,ST	2L/2L	MR	>6	W	M/L	H	M
REEDER-CASTNER	8-15	<20-40	8	SH	L,3L/L,3L	MS-R	>6	W	L/L	M	M
RENTSAC CHANNERY LOAM	8-15	<20	3	WE,SH	3L/4L	MR	>6	W	M/L	M	H

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
RENTSAC-RO	25-45	<20	0-3	WE,WAE,SH,ST	3L/4L	MR-R	>6	W	M/L	H	H
RO-ABAC	50-90	0-20	0	WAE,WE,SH,ST	L/L	M	>6	W	L/L	H	H
RO-TRAVESILLA	>15	0-20	0-2	WAE,SH,ST	SIL/L	R	>6	W	L/L	H	M
STORMITT GRAVELLY LOAM	4-8	60+	6	WE	L/L>1-2L	MS-M	>6	W	L/L	M	H
STORMITT GRAVELLY LOAM, SALINE	0-4	60+	6	WE,EC	L/L>1-2L	MS-M	>6	W	H/L-M	L	H
STORMITT LOAM	2-4	60+	6	WE	L/L>1-2L	MS-M	>6	W	L/L	L	H
STORMITT STONY LOAM	0-8	60+	6	WE	3L/3L	MS-M	>6	W	L/L	L-M	H
STUTZMAN	0-4	60	4	WE	SIC/L	S	>6	W	L/L	L	H
TOLUCA	2-8	60	6	---	CL/L	M	>6	W	L/L	L-M	M
TORCHLIGHT	8-15	60	0	EC,WE,C,NA	C/C	S	>6	W	H/H	M	H
TWIN CREEK	4-8	48-60	12	WE	SICL/L	M	>6	W	L/L	M	H
VONA	0-2	60	12	WT,(EC)	FSL/2L	MR	2-5	W	L/L	L	VH
WAYDEN-CABBA	15-45	10-20	6	WAE,WE,ST,SH	CL/L	S	>6	W	M/L	H	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-10
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, BIG HORN COUNTY, WYOMING[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
APRON	0-6	60	3	WE	SL/L	MR	>6	W	L/L	L	H
BADLAND-RO	0-100	<20	0-4	WE,WAE,NA,EC,ST,SH	CL,SIC	M-R	>6	W	H/H	H	H
BINTON, WET	0-6	60	2	WT,EC,NA	SICL,CL/L	S	1.5-3.5	SP	H/H	L	M
BINTON-YOUNGSTON	0-10	60+	5	WAE,WE	SICL,CL/L	MS-S	>6	W-MW	M/M	M-H	H
BRIBUTTE-PERSAYO-PAVILLION	3-60	10-27	3	WAE,WE,SH,ST	SICL,L,CL	VS-M	>6	W	L/L	M-H	M-H
CESTNIK, WET	0-3	60	3	WT,EC	SIC/2S	S>R	1.5-3.5	SP	H/M	L	H
CHIPETA-DEAVER-STUTZMAN	0-30	18-60+	4	WAE,WE,SH,ST	SIC,SICL/C	S-MS	>6	W	M/L	L-H	M-H
CHIPETA-PERSAYO-RO	6-90	<18	3	WAE,WE,SH,ST	SIC,CL/L	S-MS	>6	W	M/L	H	M-H
GARLAND-EMBLEM	0-3	60	12	---	CL,L,SCL/S	M>R	>6	W	L/L	L	M
GARLAND-EMBLEM, WET	0-3	60	12	WT,EC	CL,L,SCL/S	M>R	<2-4	SP-W	M-H/L	L	M
GLENTON	0-3	60	3	FL,WT,WE	SL/L	MR	4-6	MW	L/L	L	H
GLENTON-BAROID, WET	0-3	60	2	FL,WT,EC,WE	SL/S,L	MR-R	<2-4	SP	H/M	L	H
GREYBULL-PERSAYO	0-30	10-21	3	WAE,SH,ST	CL/L	MS-M	>6	W	M/L	L	M
KINNEAR-UFFENS	0-30	60+	6	WAE,WE	SCL,L/L	M	>6	W	M/L	M-H	M-H
LOSTWELLS	0-3	60	3	WE	SCL/L	M	>6	W	L/L	L	H
LOSTWELLS-KINNEAR	0-10	60	10	WE	CL,SCL/L	MS-M	>6	W	L/M	L-M	M-H
LOSTWELLS-YOUNGSTON, WET	0-6	60	3	WT,EC,WE	SCL,SICL/L	MS-M	<2-4	SP	H/M	L	H
LOSTWELLS, ALKALI	0-10	60+	12	NA,EC,WE	CL/L	MS	>6	P	H/H	L-M	H
MUFF-UFFENS-PERSAYO	0-30	12-60+	4	WAE,WE,SH,ST	FSL,L,CL/L	M	>6	W	M/L	M-H	M-H
OCEANET-PERSAYO-RO	10-60	0-15	0-3	WAE,WE,SH,ST	LFS,CL/S,L	M-MR	>6	W	L/L	H	H
OCEANET-RO	10-60	15	3	WE,WAE,SH,ST	LFS/L	MR	>6	W	L/L	M-H	H
PAVILLION-KINNEAR-PERSAYO	0-45	4-60	4	WE,WAE,SH,ST	SCL,CL/L	MS-M	>6	W	L-M/L	L-H	L-H
PREATORSON-WORLAND-WILLWOOD	3-30	32-60+	3	WAE,WE,ST	1SL,FSL/2L	R-VR	>6	W	L/L	L-H	H
RAIRDENT-UFFENS	0-10	60+	3	WAE	L/L	M	>6	W	M/L	M-H	M
SAYLES-PERSAYO	0-45	10-40	4	WAE,WE,SH,ST	C,CL/L	VS-M	>6	W	M/L	M-H	M-H
SHARLAND	0-3	28	8	WE	CL/1L	MR	>6	W	L/L	L	H
SHARLAND, ALKALI	0-10	60	4	NA	SCL,CL/2S	MS>R	>6	W	L-M/H	L-M	M
SHARLAND, WET	0-3	28	8	WT,EC	CL/1L	MR	<2-4	SP	M-H/L	L	M
SHOSHONE-WILLWOOD	0-10	60	5	WT,WE	L,LS/2S	M-R	1.5 to >6	SP-E	L/L	L-M	L-H

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
STUTZMAN	0-10	57	4	WE	SICL/L	S	>6	W	M/L	L	H
STUTZMAN, WET	0-3	60	3	WT,EC,WE	SICL/C	S	<2-4	SP	H/M	L	H
TORCHLIGHT	0-10	60	0	EC,WE,NA	SICL/C	MS-S	>6	W	H/H	M	H
UFFENS	0-10	60	5	EC	L,CL,SCL/L	MS	>6	W	H/M	L-M	M
WILLWOOD-GLENTON	0-10	60	4	FL,WT,WE	LS,SL/L,S	R-MR	4-6	E-MW	L/L	L-M	L-H
WORLAND-PERSAYO	6-45	10-32	3	WAE,WE,SH,ST	CL,SL/L	MR-M	>6	W	M/L	M-H	M-H
YOUNGSTON	0-3	60+	9	WE	CL/L	MS	<6	W	M/L	M	H
YOUNGSTON-UFFENS	0-10	60+	6	WAE,WE	CL,L/L	S	>6	W	M/L	M-H	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-11
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, WASHAKIE COUNTY, WYOMING[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
APRON-WORLAND	0-10	36-60	3	WE	SL/L	MR	>6	W	L/L	M	H
BAROID-LAS ANIMAS	0-3	60	5	WT,FL,WE	SL/L,S	MR-R	2-6	SP-W	L-M/L	L	H
FLUVAQUENTS	0-2	60	6	WT,(EC)	L,C/L,C	S-M	<2	P	M/L	L	M
FORKWOOD-HAVERDAD	0-10	60	6	WE	SL,L/L	MS-M	>6	W	L/L	L-M	H
FORKWOOD-KISHONA	1-15	60	6	WE	SL,L/L	M	>6	W	L-M/L	L-M	H
FRISITE-NEIBER	1-30	21-60	8	WE,(EC),WAE,ST	FSL/L	M	>6	W	L/L	M-H	H
GREYBULL-PERSAYO	1-40	13-23	3	WE,WAE,SH,ST	CL/L	MS	>6	W	L-M/L	L-H	H
KISHONA-SHINGLE	6-30	13-60	6	WAE,(EC),WE,SH,ST	L,CL/L,CL	M	>6	W	M-H/L	H	H
KISHONA-SHINGLE-RO	3-40	0-60	0-6	WAE,WE,SH,ST	L,CL/L,CL	M	>6	W	L-M/L	H	H
LOSTWELLS	0-6	60	4	WE	CL/L	M	>6	W	L/L	M	H
LOSTWELLS-YOUNGSTON, WET	0-6	60	3	WT,EC,WE	SCL,SICL/L	MS-M	<2-4	SP	H/M	L	H
MUFF-NEIBER	3-30	21-30	6	WAE,WE,ST	FSL/L	S-M	>6	W	L-M/L	M-H	H
PERSAYO-RO	15-40	13	0-1	WE,WAE,SH,ST	CL/L	MS	>6	W	M/M	H	H
RIVERWASH	0-2	60	0	WT,(EC),FL,SS	1L,1C/1L,1C	S-M	<2	P	L-M/L	L	M
WALLSON	1-10	60	12	WE	SL/L	MR	>6	W	L/L	L	H
WORLAND	0-10	60	6	WE	SL/L	MR	>6	W	L/L	L-M	H
YOUNGSTON	0-3	60	9	WE	SICL/L	MS	>6	W	L-M/L	L	H
YOUNGSTON, MOD. WET	0-3	60	9	WT,FL,WE	CL/L	M	4-6	MW	L-M/L	L	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-12
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, HOT SPRINGS COUNTY, WYOMING[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
BLAZON-BROWNSTO	3-45	8-20	6	WAE,WE,SH,ST	CL/CL	MS	>6	W	L/L	L-H	H
BLAZON-DIAMONDVILLE	3-30	10-40	3	WAE,SH,ST	L/L	M	>6	W	L/L	M-H	M
CADOMA-EPSIE	3-45	10-40	3	WAE,SH,ST,(EC),WE	SICL,SIC	VS-S	>6	W	M/L	H	H
FORELLE-PINELLI	3-15	60	6	WAE,WE	L,CL/L,CL	MS-M	>6	W	L/L	L-H	L-H
FORKWOOD-CUSHMAN	3-15	20-60	4	---	L/L	M	>6	W	L/L	M	M
KISHONA, ALKALI-KISHONA	0-6	60+	3	NA,WAE,EC	L/L	S-M	>6	MW-W	M-H/H	M-H	M
KISHONA-THEDALUND	3-15	20-60	4	---	L/L	M	>6	W	L/L	M	M
NIHILL-SHINGLE	3-45	10-60	5	WAE,SH,ST	1L/2L,L	M-MR	>6	W	L/L	M-H	M
RENOHILL-CADOMA-WORFKA	0-20	10-40	3	WAE,SH,ST	CL,SICL,L/L,C	S	>6	W	M/L	M-H	M
RENTSAC VARIANT-CLAYBURN VARIANT	3-30	30-60	4	WAE,ST	L/L	M	>6	W	L/L	M-H	M
RENTSAC VAR-RENTSAC-CLAYBURN VAR	3-30	4-60	4	WAE,SH,ST	L/L	M-MR	>6	W	L/L	M-H	M
SAMSIL-SHINGLE-RO	3-60	10-20	0-3	WAE,WE,SH,ST	C,L/C,L	VS-M	>6	W	L/L	H	M-H
SHINGLE-THEDALUND	3-45	10-40	3	WAE,WE,SH,ST	L/L	M	>6	W	L/L	M-H	M-H
SPEARFISH-NEVILLE	1-45	6-60	6	WAE,WE,SH,ST	SL,SIL/L	MS-M	>6	W	L/L	L-H	H
STONEHAM-KISHONA	0-8	60+	5	---	L/L	M	>6	W	L/L	M	M
TORRIFLUVENTS-FLUVAQUENTS	0-4	60	6	WT,EC,FL	VARIABLE	M-MS	0.5-6	MW-SP	M-H/M	L	L

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-13
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, FREMONT COUNTY, WYOMING[1]

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
APRON-LOSTWELLS	0-10	60	9-12	WE	SL,SCL/L	M-MR	>6	W	L/L	L	H
APRON-WALLSON-WORLAND	1-15	60	3-12	WE	SL/L	MR	>6	W	L/L	L-M	H
BADLAND-BIRDSLEY	25-45	0-40	0-3	WAE,WE	C,CL/L,C	VS-M	>6	W	M-H/M-H	L-H	L-H
BINTON-YOUNGSTON	0-3	60+	5	EC,NA,SH,ST,C WAE,WE	SiCL/CL/L	MS-S	>6	W-M	M/M	M-H	H
BLACKHALL-CARMODY	15-25	17-24	4	WE,WAE,ST,SH	FSL/L	M	>6	W	L/L	H	H
CLIFSAND-PERSAYO	15-25	4-60	4	WE,WAE,ST,SH	1L/SiCL/2L	MS-MR	>6	W	L-M/L	H	H
DIAMONDVILLE-FORELLE	2-15	24-60	6	---	L/L	MS-M	>6	W	L/L	L-M	M
DIAMONDVILLE-FORELLE	15-25	24-60+	6	WAE,ST	L/L	MS-MR	>6	W	L/L	H	M
EMBLEM-CLIFSAND-RAIRDENT	1-25	60+	4	WAE,ST	L/L,1S	M-R	>6	W	L/L	M-H	M
FORELLE-POPOSHIA	2-12	60+	3	---	L/L	M	>6	W	L/L	L-M	M
FRISITE-EMBLEM	1-8	60+	8-12	WE	FSL/L	M-R	>6	W	L/L	L-M	M-H
FRISITE-YOUNGSTON	1-8	60+	4	WE	FSL/L	MS-M	>6	W	L/L	L	H
PENSORE-RO	5-45	11	3	WAE,SH,ST	4L/4L	M	>6	W	L/L	H	L
PERSAYO-ROCK OUTCROP	15-25	13	0-1	WE,WAE,SH,ST	CL/L	MS	>6	W	M/M	H	H
SINKSON-ALMY-THERMOPOLIS	2-30	16-60+	4	WAE,SH,ST	L/L	M	>6	W	L/L	H	M
SINKSON-ALMY THERMOPOLIS	15-25	16-60+	4	WAE,SH,ST	L/L	M	>6	W	L/L	H	M
THERMOPOLIS-SINKSON	3-30	10-60+	3	WAE,SH,ST	L/L	M	>6	W	L/L	H	M
UFFENS-MUFF-FRISITE	1-12	37-60+	6	WE	SL,L/L	M	>6	W	L-M	L-M	M-H
WORLAND-OCEANET-PERSAYO	8-15	18-34	3	WE,SH,ST	SL,SiCL/L	MS-MR	>6	W	L-M/L	L	H
YOUNGSTON-EFFINGTON	0-6	60+	2-4	NA	SiCL,CL/C	VS-S	>6	W	L-M/L-H	L	M
YOUNGSTON-LOSTWELLS	1-3	60+	6	---	L,CL/L	MS-M	>6	W	L/L	M	M
YOUNGSTON-LOSTWELLS-APRON	0-3	60	3-9	WE	CL,SCL,SL/L	MS-MR	>6	W	L-M/L	L-M	H

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

TABLE C-14
DOMINANT AND RESTRICTIVE SOIL MAP UNITS, NATRONA COUNTY, WYOMING[1].

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
AMODAC	2-12	60+	7	---	FSL/L	MS	>6	W	L/L	M	M
AMODAC-KEYNER	2-12	60+	7-12	WE	FSL,SL/L	MS-S	>6	W	L/L	L-M	M-H
ARVADA-ABSTED-SLICKSPOTS	0-6	60+	0-2	EC,NA,C	C,CL/C	VS-S	>6	P-W	M-H/M-H	L	M
ARVADA-runon-SLICKSPOTS	0-3	60+	0-2	EC,NA,C	C,CL/C	VS	>6	P-W	M-H/M-H	L	M
BADLAND	0->50	0-40	0	WAE,WE EC,NA,SH,ST,C	C,L/C,L	S-M	>6	W	M-H/M-H	L-H	L-H
BLACKDRAW clay loam	3-10	60+	1	C	CL/C	S	>6	W	L/L	M	M
BOSLER-ALCOVA	2-10	60+	5-12	WE	SL,SCL/L	M	>6	W	L/L	M	H
BOWBAC-HILAND	3-10	23-60+	12	WE	LFS,SL/L	M	>6	W	L/L	L-M	H
CAMBRIA-ZIGWEID	2-15	60+	12	WE,ST	FSL,L/L	M	>6	W	L/L	M	M-H
CUSHMAN-FORKWOOD	8-15	20-60+	12	WE,ST	L,CL/L	M	>6	W	L-M/L-M	L-M	M-H
EFFINGTON-UFFENS	0-6	60+	2-4	EC,NA,WE	SL,SiCL/L,C	VS-MS	>6	W	M-H/M-H	L	M-H
ENOS-WALLSON	8-15	34-60+	12	WE,ST	SL,LS/L	MR	>6	W	L/L	L-M	H
FORKWOOD-ULM	0-6	60+	12	---	CL,L/L	S-M	>6	W	L/L	L	M
FORKWOOD-ZIGWEID	8-15	60+	12	ST	L/L	M	>6	W	L/L	L	M
GRIFFY	2-15	60+	12	WE,ST	SL/L	M	>6	W	L/L	M	H
GRIFFY-EMBLEM	0-6	60+	8-12	WE	FSL,SL/L	M-R	>6	W	L/L	L-M	H
HAVERDAD-CLARKELEN, saline	0-3	60+	6-12	WE,EC	SL,L/L	M-MR	>6	SE-W	L-M/L	L	M-H
HILAND loamy sand, gravelly substratum	1-6	60+	6-12	WE	LS/L	M	>6	W	L/L	L	H
HILAND sandy loam	0-6	60+	12	WE	SL/L	M	>6	W	L/L	L	H
KEYNER-ABSTED-SLICKSPOTS	0-6	60+	0-12	EC,NA,WE,C	SL,CL,C/C,L	VS-S	>6	P-W	L-H/L-H	L	M-H
LOLITE, dry -ROCK OUTCROP	5-50	6-20	2	EC,NA,WE,C, SH,ST	C/C	S	>6	W	M-H/M-H	H	M
MUDRAY-BRIBUTTE-BIRDSLEY	6-30	10-20	1-3	EC,NA,SH,C, ST,WAE	CL,SiCL/C,L	VS	>6	W	M-H/M-H	H	M
OCEANET-PERSAYO	6-30	10-20	5-12	WE,WAE,ST,SH	SL,L/L	M-MR	>6	W	L/L	H	M-H
ORELLA-CADOMA-PETRIE	3-30	10-60+	2-5	EC,NA,C,WAE,ST	CL,C/C,L	VS-S	2->6	SP-W	M-H/M-H	L-H	M
ORELLA-ROCK OUTCROP	3-30	0-20	0-2	EC,NA,C,WAE, SH,ST	CL,C/L	VS	>6	W	M-H/H	H	M
PERSAYO-GREYBULL	8-25	10-20	3	WAE,SH,ST	CL/L	MS-M	>6	W	M/L	L	M
PETRIE-ARVADA	0-6	60+	1-5	EC,NA,C	CL,SL/C	VS	>6	W	M-H/M-H	L	M
PETRIE-ZIGWEID, wet	0-3	60+	5-12	EC,NA,C,WT	CL,C	VS-M	1.5-3	SP	M-H/M-H	L	M
SALT FLATS	0	60+	0	EC,NA,C,WT	C/C	VS	>6	SP	H/H	L	M
SHINGLE-THEEDLE	8-15	10-40	9-12	WE,WAE,ST,SH	L,CL/L	M	>6	W	L/L	M-H	M-H

MAP UNIT	SLOPE (%)	SOIL DEPTH (IN)	TOPSOIL DEPTH (IN)	RESTRICTIVE FEATURES(S)	SURFACE/ SUBSURFACE TEXTURE	PERM.	DEPTH TO WATER TABLE (FT)	DRAINAGE	SURFACE EC/SAR	WATER EROSION HAZARD	WEG HAZARD
SILHOUTEE-PETRIE	1-6	60+	3-5	C	CL/C	VS-S	>6	W	L/L	L	M
THEEDLE-SHINGLE-KISHONA	6-40	10-60+	9-12	WAE,ST,SH	L,CL/L	M	>6	W	L/L	H	M
TYPIC TORRIFLUVENT	0-3	60+	0-12	EC,NA,WE	VFSL/L	M-MR	>6	W	M-H/M-H	L	M-H
UFFENS, runon-TYPIC TORRIFLUVENTS	0-3	60+	0-12	EC,NA,WE	VFSL,SL/L	MS-MR	>6	W	M-H/M-H	L	M-H
UFFENS, thick surface-UFFENS	0-6	60+	6	EC,NA,WE	VFSL/L	MS	>6	W	M-H/M-H	L	H
ULM-ABSTED	0-6	60+	2-12	EC,NA,C	CL,C/C,L	S	>6	W	L-H/L-H	L	M
VONALEE-HILAND	3-15	60+	4	WE,ST	LS,SL/S	M-MR	>6	W	L/L	L	M-H
ZIGWEID	2-9	60+	12	---	L/L	M	>6	W	L/L	M	M

[1]The legend to soil parameters appears following Table C-14. County locations can be found on the Pipeline Route Maps (Appendix J).

<u>FOOTNOTES</u>:

RESTRICTIVE FEATURES:
C= clay, EC = electrical conductivity (salinity), FL = flooding, NA = sodicity, S= sand, SH = shallow (<20"), SS = surface stoniness, ST= steep (>15%), WAE= water erosion hazard, WE = wind erosion hazard, WT = high water table
( ) Restrictive features in parentheses are features that are problems with depth (subsoil).

SURFACE-SUBSURFACE TEXTURE:
1 = gravelly, 2 = very gravelly, 3 = channery, 4 = very channery, > = over

SURFACE:
C = clay, CL = clay loam, FSL = fine sandy loam, L = loam, LS = loamy sand, LFS = loamy fine sand, SIL = silt loam, SICL = silty clay loam, SIC = silty clay, S = sand, SL = sandy loam, SCL = sandy clay loam, VFSL = very fine sandy loam

SUBSURFACE:
S = coarse textured soils: S,LS
L = moderately coarse-textured soils: SL
medium textured soils: L,SIL,SI
moderately fine textured soils: CL,SCL,SICL
C = fine textured soils: SC,SIC,C

PERMEABILITY:
VR = very rapid, R = rapid, MR = moderately rapid, M = moderate, MS = moderately slow, S = slow, VS = very slow, > = over

DRAINAGE:
E = excessively, SE = somewhat excessively, W = well, MW = moderately well, SP = somewhat poorly, P = poorly, VP = very poorly

SURFACE EC:
H = high (>8 mmhos/cm), M = moderate (4-8 mmhos/cm), L = low (<4 mmhos/cm)

SURFACE SAR:
H = high (>8), M = moderate (4-8), L = low (<4)

WATER EROSION HAZARD:
H = severe (>5 tons/acre), M = moderate (2-5 tons/acre), L = slight (<2 tons/acre)

WIND EROSION GROUP HAZARD (WEG):
H = severe (1-4L), M = moderate (5-6), L = slight (7-8)

R0 = Rock Outcrop
N/A = Not Available
* = Data interpolated from adjacent mapping; similar landtypes.
** = Estimated from texture only.

Appendix D

Riparian Areas and Non-Wetland Water of the U.S
Crossed by the Proposed Express Pipeline Route
in Montana and Wyoming

RIPARIAN AREAS, WETLANDS AND NON-WETLAND WATERS OF THE U.S. (WUS) CROSSED BY THE EXPRESS PIPELINE ROUTE IN MONTANA AND WYOMING.

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
MONTANA						
Milk River	8.23	Saline/Sodic Shrubland	470	70	170	240
Nondrained Depression	14.43	Deciduous Shrub/Wet Meadow Complex	300	400	0	400
Ninemile Coulee	14.90	Deciduous Shrub/Wet Meadow Complex	23	15	0	15
Sage Creek	32.84	Deciduous Shrub/Wet Meadow Complex	5	16	0	16
Twelvemile Coulee	50.79	Deciduous Shrub/Wet Meadow Complex	0	170	0	170
Missouri River North Bank	68.27	Riparian Cottonwood Forest	180	6	700	706
Missouri River South Bank	68.41	Deciduous Shrub/Wet Meadow Complex	20	12	0	12
Unnamed saline drainage	82.88	Saline/Sodic Wet Meadows	0	20	0	20
Prairie pothole	83.43	Saline/Sodic Wet Meadows	0	170	0	170
Unnamed saline drainage	87.85	Saline/Sodic Wet Meadows	0	270	0	270
Flat Creek	95.77	Saline/Sodic Wet Meadows	1385	85	0	85
Saline wetland in Flat Creek floodplain	99.77	Saline/Sodic Wet Meadows	600	4000	0	4000
Saline wetland in Flat Creek floodplain	100.68	Saline/Sodic Wet Meadows	300	0	0	0
Arrow Creek	111.90	Riparian Cottonwood Forest	148	172	40	212
Unnamed tributary to Arrow Creek	111.45	Deciduous Shrub/Wet Meadow Complex	31	3	4	7
Coffee Creek	116.63	Deciduous Shrub/Wet Meadow Complex	0	59	6	65
Spring just north of Coffee Creek	117.45	Deciduous Shrub/Wet Meadow Complex	0	15	0	15
Coffee Creek	117.46	Deciduous Shrub/Wet Meadow Complex	0	4	8	12
Wolf Creek	122.40	Saline/Sodic Wet Meadows	0	75	19	94
Coyote Creek	123.08	Deciduous Shrub/Wet Meadow Complex	0	3	12	15
Pacer Creek	124.91	Deciduous Shrub/Wet Meadow Complex	0	38	3	41
Unnamed Coulee	126.92	Deciduous Shrub/Wet Meadow Complex	0	95	0	95
Dry Wolf Creek	129.38	Saline/Sodic Wet Meadows	0	72	0	72
Sage Creek	132.30	Deciduous Shrub/Wet Meadow Complex	150	7	13	20
Squaw Coulee	134.68	Deciduous Shrub/Wet Meadow Complex	200	14	3	17

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Indian Creek	135.78	Deciduous Shrub/Wet Meadow Complex	0	80	0	80
Unnamed Drainage	137.10	Deciduous Shrub/Wet Meadow Complex	80	98	0	98
Louse Creek	138.75	Deciduous Shrub/Wet Meadow Complex	0	22	10	32
Unnamed Drainage	141.23	Deciduous Shrub/Wet Meadow Complex	0	55	0	55
Unnamed Drainage	142.72	Deciduous Shrub/Wet Meadow Complex	0	30	0	30
Unnamed Drainage	143.62	Deciduous Shrub/Wet Meadow Complex	0	285	5	290
Judith River	144.12	Riparian Cottonwood Forest	50	42	40	82
Unnamed Drainage	146.80	Deciduous Shrub/Wet Meadow Complex	0	25	3	28
Unnamed Pond	147.16	Pond	0	14	100	114
Hauck Coulee	147.87	Deciduous Shrub/Wet Meadow Complex	0	6	4	10
Big Coulee	153.10	Deciduous Shrub/Wet Meadow Complex	0	35	7	42
Ross Fork Creek	153.72	Deciduous Shrub/Wet Meadow Complex	350	10	22	32
East Buffalo Creek	155.90	Deciduous Shrub/Wet Meadow Complex	0	20	9	29
Dry Creek	157.75	Deciduous Shrub/Wet Meadow Complex	0	15	0	15
Meadow Creek	162.77	Deciduous Shrub/Wet Meadow Complex	0	116	0	116
Ross Fork Creek	163.64	Deciduous Shrub/Wet Meadow Complex	0	272	8	280
Ross Fork Creek	164.52	Deciduous Shrub/Wet Meadow Complex	0	102	8	110
Unnamed Drainage	165.69	Deciduous Shrub/Wet Meadow Complex/ Saline/Sodic Wet Meadows	0	32	4	36
East Fork Roberts Creek	170.68	Saline/Sodic Wet Meadows	0	159	0	159
Tributary to East Roberts Creek	173.58	Saline/Sodic Wet Meadows	0	20	0	20
Unnamed Stream	178.41	Saline/Sodic Wet Meadows	0	162	0	162
Roberts Creek	179.29	Deciduous Shrub/Wet Meadow Complex	0	37	60	97
Alkali Creek	182.56	Saline/Sodic Wet Meadows	0	117	0	117
Unnamed Drainage	187.61	Deciduous Shrub/Wet Meadow Complex	0	4	0	4
Unnamed Drainage	188.88	Deciduous Shrub/Wet Meadow Complex	0	5	0	5
Unnamed Drainage	190.61	Saline/Sodic Wet Meadows	0	9	0	9
Unnamed Drainage	191.42	Saline/Sodic Wet Meadows	0	900	0	900
Irrigation Ditch	192.62	Ditch	0	13	5	18
Unnamed Drainage	192.80	Deciduous Shrub/Wet Meadow Complex	0	14	4	18
Irrigation Ditch	193.10	Ditch	0	2	8	10
HWY 12 Ditch (N. Side)	193.84	Deciduous Shrub/Wet Meadow Complex	0	56	0	56

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Musselshell River	194.09	Riparian Cottonwood Forest	80	142	60	202
Irrigation Ditch	194.72	Ditch	0	242	8	250
Salt Affected Seep	195.66	Saline/Sodic Wet Meadows	0	105	0	105
Unnamed Drainage	196.28	Saline/Sodic Wet Meadows	0	10	0	10
Mud Creek	197.60	Deciduous Shrub/Wet Meadow Complex	0	325	10	335
Unnamed Drainage	201.18	Deciduous Shrub/Wet Meadow Complex	0	5	0	5
Fish Creek	202.57	Deciduous Shrub/Wet Meadow Complex	0	11	14	25
Unnamed Drainage	206.59	Deciduous Shrub/Wet Meadow Complex	0	8	0	8
Unnamed Drainage	209.91	Deciduous Shrub/Wet Meadow Complex	0	21	3	24
Tributary to Van Winkle Creek	211.23	Deciduous Shrub/Wet Meadow Complex	0	7	0	7
Van Winkle Creek	211.52	Deciduous Shrub/Wet Meadow Complex	0	132	0	132
South Fork Big Coulee Creek	214.17	Deciduous Shrub/Wet Meadow Complex	0	36	8	44
Tributary to South Fork Big Coulee Creek	214.80	Deciduous Shrub/Wet Meadow Complex	0	21	0	21
Tributary to South Fork Big Coulee Creek	216.49	Deciduous Shrub/Wet Meadow Complex	0	17	0	17
Unnamed Drainage	216.98	Deciduous Shrub/Wet Meadow Complex	0	19	0	19
Unnamed Drainage	219.32	Deciduous Shrub/Wet Meadow Complex	0	322	0	322
Unnamed Drainage	219.65	Deciduous Shrub/Wet Meadow Complex	0	4	0	4
Sixshooter Creek	220.05	Deciduous Shrub/Wet Meadow Complex	0	27	0	27
Middle Creek	223.75	Deciduous Shrub/Wet Meadow Complex	0	21	2	23
Cedar Creek	225.52	Deciduous Shrub/Wet Meadow Complex	0	11	0	11
Irrigation Ditch	226.46	Ditch	0	4	0	4
Gurney Creek	227.56	Saline/Sodic Wet Meadows	0	1356	0	1356
Unnamed Drainage	229.56	Deciduous Shrub/Wet Meadow Complex	0	18	0	18
Unnamed Drainage	230.42	Saline/Sodic Wet Meadows	0	18	0	18
Struck Creek	233.21	Deciduous Shrub/Wet Meadow Complex	0	128	0	128
Struck Creek	233.30	Saline/Sodic Wet Meadows	0	117	0	117
Toll Creek	233.09	Deciduous Shrub/Wet Meadow Complex	0	66	0	66
Greenwood Creek	234.49	Deciduous Shrub/Wet Meadow Complex	0	6	2	8
Unnamed Drainage	236.13	Deciduous Shrub/Wet Meadow Complex	30	4	0	4
Unnamed Drainage	236.24	Deciduous Shrub/Wet Meadow Complex	10	40	0	40
Unnamed Drainage	237.70	Deciduous Shrub/Wet Meadow Complex	0	18	0	18

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Unnamed Drainage	238.72	Deciduous Shrub/Wet Meadow Complex	20	0	3	3
North Fork Valley Creek	243.87	Deciduous Shrub/Wet Meadow Complex	90	3	2	5
North Fork Valley Creek	246.42	Deciduous Shrub/Wet Meadow Complex	60	5	3	8
Sawmill Gulch	246.77	Sandstone	0	0	32	32
Valley Creek	247.30	Deciduous Shrub/Wet Meadow Complex	0	25	0	25
Valley Creek	247.48	Deciduous Shrub/Wet Meadow Complex	0	0	16	16
Valley Creek	251.34	Deciduous Shrub/Wet Meadow Complex	0	75	7	82
Valley Creek	251.78	Deciduous Shrub/Wet Meadow Complex	0	15	0	15
Cove Ditch	253.10	Ditch	0	0	19	19
Big Ditch	253.70	Ditch	0	0	30	30
Unnamed Ditch	254.75	Ditch	0	15	10	25
Seep in Pasture	254.77	Deciduous Shrub/Wet Meadow Complex	0	400	0	400
Unnamed Stream	254.94	Deciduous Shrub/Wet Meadow Complex	50	150	10	160
Yellowstone River	255.53	Riparian Cottonwood Forest	0	0	900	900
Bellion Creek	255.68	Deciduous Shrub/Wet Meadow Complex	0	7	8	15
Unnamed Drainage	258.33	Deciduous Shrub/Wet Meadow Complex	15	10	0	10
Farewell Creek	260.13	Deciduous Shrub/Wet Meadow Complex	0	14	0	14
Unnamed Ditch	262.47	Ditch	0	2	2	4
Unnamed Drainage	262.51	Deciduous Shrub/Wet Meadow Complex	0	6	1	7
Unnamed Ditches	262.20	Ditch	0	6	9	15
Rock Creek	263.26	Riparian Cottonwood Forest/ Deciduous Shrub/Wet Meadow Complex	180	640	75	715
Unnamed Ditch	264.06	Ditch	0	2	2	4
Unnamed Ditch	264.88	Ditch	0	2	2	4
Clark's Fork River	266.33	Riparian Cottonwood Forest	480	20	150	170
Clark's Fork Meander Channel	266.45	Riparian Cottonwood Forest	70	3	14	17
Five Mile Creek	266.86	Riparian Cottonwood Forest	45	0	4	4
Unnamed Ditch	266.89	Ditch	0	0	1	1
Unnamed Drainage	274.56	Deciduous Shrub/Wet Meadow Complex	0	0	5	5
Unnamed Drainage	275.40	Deciduous Shrub/Wet Meadow Complex	0	0	3	3
Bluewater Creek	280.38	Deciduous Shrub/Wet Meadow Complex	0	0	6	6
Unnamed Drainage	281.50	Deciduous Shrub/Wet Meadow Complex	0	0	7	7
Unnamed Drainage	282.20	Deciduous Shrub/Wet Meadow Complex	0	0	5	5

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Unnamed Drainage	282.80	Deciduous Shrub/Wet Meadow Complex	0	0	5	5
Sage Creek	287.41	Deciduous Shrub/Wet Meadow Complex	0	0	5	5
Water Canyon Creek	291.07	Deciduous Shrub/Wet Meadow Complex	0	0	4	4
King Creek	295.28	Deciduous Shrub/Wet Meadow Complex	200	1280	0	1280
Piney Creek	296.42	Riparian Cottonwood Forest	326	70	4	74
Cottonwood Creek	297.71	Deciduous Shrub/Wet Meadow Complex	120	0	5	5
Unnamed Drainage	298.38	Deciduous Shrub/Wet Meadow Complex	0	0	2	2
Bear Canyon Creek	300.33	Deciduous Shrub/Wet Meadow Complex	0	0	2	2
		TOTAL MONTANA	6,068	14,559	2,735	17,294

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
WYOMING						
Unnamed Pond	306.53	Unvegetated	0	0	45	45
Sidon Canal	316.49	Deciduous Shrub/Wet Meadow Complex	6	8	10	18
Unnamed Drainage	317.00	Saline/Sodic Shrubland	0	10	0	10
Unnamed Drainage	317.17	Saline/Sodic Wet Meadows	0	55	0	55
Peterson Creek	318.00	Deciduous Shrub/Wet Meadow Complex	150	4	8	12
Unnamed Drainage	318.69	Deciduous Shrub/Wet Meadow Complex	9	4	2	6
Sage Creek	319.22	Deciduous Shrub/Wet Meadow Complex	80	6	25	31
Shoshone River	319.53	Riparian Cottonwood Forest	2000	275	125	400
Hunt-Godfrey Canal	319.83	Deciduous Shrub/Wet Meadow Complex	4	8	15	23
Globe Canal	320.70	Not inventoried (private)	-	-	-	-
Irrigation Lateral	321.50	Not inventoried (private)	-	-	-	-
Irrigation Lateral	322.00	Not inventoried (private)	-	-	-	-
Elk-Lovell Canal	323.80	Not inventoried (private)	-	-	-	-
Little Dry Creek	325.50	Unvegetated	0	0	5	5
Sand Draw	326.63	Unvegetated	0	0	6	6
Sand Draw	328.50	Saline/Sodic Wet Meadows	0	0	80	80
Unnamed Drainage	333.60	Xerophytic Shrub	0	0	150	150
Lovell Draw	335.40	Xerophytic Shrub	0	0	20	20
Little Dry Creek	344.57	Saline/Sodic Shrubland	25	0	5	5
Agrarian Ditch	346.95	Not inventoried (private)	-	-	-	-
Unnamed Seep	347.50	Saline/Sodic Shrubland	150	0	0	0
Dry Creek	347.69	Deciduous Shrub/Wet Meadow Complex	350	20	26	46
Greybull River	352.20	Riparian Cottonwood Forest	445	665	90	755
Unnamed Seep	352.42	Saline/Sodic Shrubland/ Saline/Sodic Wet Meadows	700	0	0	0
Antelope Creek	358.42	Unvegetated	0	0	5	5
Elk Creek	361.94	Saline/Sodic Shrubland	65	0	2	2
Dobie Creek	365.10	Unvegetated	0	0	4	4
Unnamed Drainage	366.20	Xerophytic Shrub	0	0	60	60
Alamo Creek	367.38	Xerophytic Shrub	0	0	4	4
Big Horn Canal	372.30	Disturbed/Wet Meadow Complex	0	5	0	5
Fivemile Creek	372.67	Riparian Cottonwood Forest	385	10	5	15

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Unnamed Seep	372.80	Deciduous Shrub/Wet Meadow Complex	0	150	0	150
Sixmile Creek	373.77	Saline/Sodic Wet Meadows	0	115	1	116
Big Horn River	374.32	Deciduous Shrub/Wet Meadow Complex	0	400	200	600
Fritz Canal	374.56	Deciduous Shrub/Wet Meadow Complex	0	20	7	27
Lower Hanover Canal	377.21	Not inventoried (private)	-	-	-	-
Upper Hanover Canal	379.95	Not inventoried (private)	-	-	-	-
Slick Creek	385.85	Saline/Sodic Shrubland	125	0	40	40
Unnamed Drainage	386.30	Xerophytic Shrub	0	0	30	30
Highland Hanover Canal	387.00	Xerophytic Shrub	0	0	20	20
Little Slick Creek	387.85	Xerophytic Shrub	0	0	3	3
East Fork Nowater Creek	392.09	Riparian Cottonwood Forest	120	0	20	20
Little Sand Draw	395.78	Saline/Sodic Shrubland	180	0	50	50
Unnamed isolated wetland	396.36	Saline/Sodic Wet Meadows	0	35	0	35
Unnamed isolated wetland	399.28	Saline/Sodic Wet Meadows	0	100	0	100
Nowater Creek	399.41	Deciduous Shrub/Wet Meadow Complex	188	9	3	12
Unnamed Drainage	403.76	Disturbed	0	0	100	100
Unnamed Spring/Drainage	406.39	Saline/Sodic Wet Meadows	0	70	0	70
Unnamed Drainage	406.94	Saline/Sodic Shrubland	0	0	12	12
Lake Creek	407.02	Saline/Sodic Shrubland	95	0	6	6
Kirby Creek	408.79	Saline/Sodic Shrubland	100	7	4	11
Unnamed Drainage	410.00	Disturbed	0	0	50	50
West Fork Kirby Creek	416.07	Deciduous Shrub/Wet Meadow Complex	0	225	5	230
West Bridger Creek	422.65	Deciduous Shrub/Wet Meadow Complex	0	14	12	26
South Bridger Creek	426.43	Unvegetated	0	0	4	4
Greer Draw	427.11	Grassland	0	0	0	0
Bridger Creek	433.72	Saline/Sodic Shrubland/Wet Meadow Complex	3475	10	14	24
Davis Draw	434.95	Saline/Sodic Shrubland	165	0	0	0
Cottonwood Creek	435.79	Saline/Sodic Shrubland	250	0	3	3
Badwater Creek -	439.72	Saline/Sodic Shrubland/Wet Meadow Complex	180	5	15	20
South Fork*	440.08	Saline/Sodic Shrubland	400	-	-	-
South Fork*	440.23	Saline/Sodic Shrubland	150	-	-	-

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Sand Creek	442.09	Saline/Sodic Shrubland	400	-	-	-
South Fork Sand Creek*	446.32	Saline/Sodic Shrubland	350	-	-	-
Unnamed Drainage*	448.27	Saline/Sodic Shrubland	200	-	-	-
Unnamed Drainage*	448.50	Saline/Sodic Shrubland	30	-	-	-
Unnamed Drainage*	450.98	Saline/Sodic Shrubland	75	-	-	-
Red Creek Tributary*	453.42	Saline/Sodic Shrubland	400	-	-	-
Red Creek Tributary*	453.66	Saline/Sodic Shrubland	75	-	-	-
Red Creek*	454.42	Saline/Sodic Shrubland	350	-	-	-
Alkali Creek Tributary*	456.91	Saline/Sodic Shrubland	500	-	-	-
Alkali Creek Tributary*	457.75	Saline/Sodic Shrubland	80	-	-	-
Unnamed Drainage*	459.28	Grassland	80	-	-	-
E-K Creek*	459.89	Saline/Sodic Shrubland	400	-	-	-
Alkali Creek*	460.94	Saline/Sodic Shrubland	700	-	-	-
Alkali Creek Tributary*	461.12	Saline/Sodic Shrubland	75	-	-	-
Keg Spring Draw	471.37	Wet Meadow	0	115	0	115
South Fork Powder River	477.47	Wet Meadow	125	45	5	50
Wyatt Draw	478.46	Wet Meadow	155	45	7	52
Middle Fork Casper Creek*	485.25	Unknown	1100	-	-	-
Smith Canyon Draw*	486.00	Unknown	200	-	-	-
Middle Fork Casper Creek Tributary*	486.66	Unknown	65	-	-	-
Middle Fork Casper Creek Tributary*	487.72	Unknown	100	-	-	-
Canyon Draw*	489.57	Unknown	200	-	-	-
Selby Draw*	491.35	Unknown	100	-	-	-
Selby Draw*	491.92	Unknown	300	-	-	-
Tie Bridge Gulch*	493.00	Unknown	1800	-	-	-
Unnamed Drainage*	494.34	Unknown	400	-	-	-
Unnamed Reservoir	495.38	Wet Meadow	0	300	0	300
South Fork Casper Creek	496.91	Saline/Sodic Wet Meadows	2200	4	6	10
South Fork Casper Creek	496.98	Saline/Sodic Wet Meadows	0	4	6	10
Casper Canal	498.00	Unvegetated	800	0	20	20
Casper Canal Underdrain	498.26	Wet Meadow	0	10	0	10

SITE	MILEPOST[1]	DOMINANT VEGETATION TYPE	RIPARIAN/WUS ZONES (width in ft.)			
			NON-WETLAND RIPARIAN	WETLAND WUS	NON-WETLAND[2] WUS	TOTAL JURISDICTIONAL WUS
Tudor Draw	499.47	Wet Meadow	0	0	0	0
Johnson Lateral Canal	501.34	Wet Meadow	0	4	20	24
Twelvemile Draw (Upper)	502.24	Saline/Sodic Shrubland	800	0	2	2
Unnamed Drainage	505.00	Saline/Sodic Wet Meadow	225	2	6	8
Twelvemile Draw (Lower)	505.77	Saline/Sodic Wet Meadow	3175	2	6	8
Unnamed Drainage	506.17	Saline/Sodic Wet Meadow	0	600	0	600
Unnamed Ditch	506.43	Wet Meadow	0	10	0	10
Siphon Johnson Lateral	507.96	Wet Meadow	0	4	15	19
Casper Airport Wetland	508.55	Wet Meadow	0	75	0	75
Sixmile Draw	509.44	Wet Meadow	500	8	6	14
		TOTAL WYOMING	25,757	3,458	1,390	4,848
		TOTAL MONTANA & WYOMING	31,825	18,017	4,125	22,142

[1]Mileposts taken from 1991 orthophoto worksheets for Montana (sheets 1-52) and Wyoming (sheets 1-21); and 1993 orthophoto worksheets for Wyoming (sheets 22-36).
[2]This column includes open water, stream channels with or without flowing water and mud flats.
*Information for these streams was developed from the Amoco CO_2 Project vegetation maps and orthophoto interpretation; hence only riparian zones were delineated.

Appendix E

Supplemental Information on Special-concern Species Occurring Along or Potentially Occurring Along the Proposed Express Pipeline Route

TABLE E-1

WILDLIFE SPECIES OF SPECIAL CONCERN THAT MAY OCCUR IN THE VICINITY OF THE EXPRESS PIPELINE ROUTE[1,2]

Common Name	Scientific Name	Status[3]
MONTANA		
Amphibians		
Tailed frog	*Ascaphus truei*	S3S4, C2
Spotted frog	*Rana pretiosa*	S4, C2C1
Reptiles		
Spiny softshell	*Trionyx spiniferus*	S3
Western hognose snake	*Heterodon nasicus*	S3
Short-horned lizard	*Phrynosoma douglasi*	S4, C2NL
Sagebrush lizard	*Sceloporus graciosus*	S3, C2
Mammals		
Preble shrew	*Sorex preblei*	S3, C2
Dwarf shrew	*Sorex nanus*	S3
Northern long-eared myotis	*Myotis evotis*	S2
Spotted bat	*Euderma maculatum*	S1, C2
Townsend's big-eared bat	*Plecotus townsendii*	S2
Pallid bat	*Antrozous pallidus*	S1
White-tailed prairie dog	*Cynomys leucurus*	S2
Black-footed ferret	*Mustela nigripes*	SH, Endangered
Yuma myotis	*Myotis Yumanensis*	S3, C2
Long-eared myotis	*Myotis evotis*	S4, C2
Long-legged myotis	*Myotis volans*	S4, C2
Western small-footed myotis	*Myotis ciliolabrum*	S4, C2
Eastern spotted skunk	*Spilogale putorius*	SU, C2NL
Birds		
Common loon	*Gavia immer*	S3
American white pelican	*Pelecanus erythrorhynchos*	S2
White-faced ibis	*Plegadis chihi*	S2
Trumpeter swan	*Cygnus buccinator*	S1
Bald eagle	*Haliaeetus leucocephalus*	SE, Endangered
Northern goshawk	*Accipiter gentilis*	S4, C2
Ferruginous hawk	*Buteo regalis*	S3, C2
Peregrine falcon	*Falco peregrinus*	S1, Endangered
Whooping crane	*Grus americana*	SH, Endangered
Mountain plover	*Charadrius montanus*	S2
Black tern	*Chlidonias niger*	S3
Burrowing owl	*Speotyto cunicularia*	S3
Loggerhead shrike	*Lanius ludovicianus*	S4, C2
Dickcissel	*Spiza americana*	S1
Sage sparrow	*Amphispiza belli*	S1
Baird's sparrow	*Ammodramus bairdii*	S3, C2
LeConte's sparrow	*Ammodramus leconteii*	S1
Fish		
Pallid sturgeon	*Scaphirhynchus albus*	S1, Endangered
Paddlefish	*Polyodon spathula*	S3
Northern redbelly X finescale dace	*Phoxinus* spp.	S3
Pearl dace	*Semotilus marganta*	S2
Blue sucker	*Cycleptus elongatus*	S3
Western silvery minnow	*Hybognathus argyritis*	S5, C2
Plains minnow	*Hybognathus placitus*	S5, C2
Flathead chub	*Hybopsis gracilis*	S5, C2
Invertebrates		
Tawny crescent	*Phyciodes batesii*	S2S3, C2
Cockerell's striate disc	*Discus shimeki cockerelli*	S1, C2
Land snail	*Oreohelix strigosa berryi*	S1S2, C2

Common Name	Scientific Name	Status[3]
WYOMING		
Birds		
Pacific Loon	*Gavia pacifica*	Rare
Common Loon	*Gavia immer*	Uncommon
Horned Grebe	*Podiceps auritus*	Uncommon
Clark's Grebe	*Aechmophorus clarkii*	Uncommon
American Bittern	*Botaurus lentiginosus*	Uncommon
Snowy Egret	*Egretta thula*	Uncommon
Cattle Egret	*Bubulcus ibis*	Rare
Green-backed Heron	*Butorides striatus*	Rare
Black-crowned Night-Heron	*Nycticorax nycticorax*	Uncommon
White-faced Ibis	*Plegadis chihi*	Uncommon
Tundra Swan	*Cygnus columbianus*	Uncommon
Trumpeter Swan	*Cygnus buccinator*	Uncommon
Greater White-fronted Goose	*Anser albifrons*	Rare
Snow Goose	*Chen caerulescens*	Uncommon
Ross' Goose	*Chen rossii*	Rare
Wood Duck	*Aix sponsa*	Uncommon
Canvasback	*Aythya valisineria*	Uncommon
Greater Scaup	*Aythya marila*	Rare
Lesser Scaup	*Aythya affinis*	Uncommon
Harlequin Duck	*Histrionicus histrionicus*	Uncommon
Oldsquaw	*Clangula hyemalis*	Rare
Surf Scoter	*Melanitta perspicillata*	Rare
White-winged Scoter	*Melanitta fusca*	Uncommon
Bufflehead	*Bucephala albeola*	Uncommon
Hooded Merganser	*Lophodytes cucullatus*	Uncommon
Red-breasted Merganser	*Mergus serrator*	Uncommon
Bald Eagle	*Haliaeetus leucocephalus*	Uncommon*
Broad-winged Hawk	*Buteo platypterus*	Rare
Merlin	*Falco columbarius*	Uncommon
Peregrine Falcon	*Falco peregrinua*	Rare*
Gyrfalcon	*Falco rusticolus*	Rare
Gray Partridge	*Perdix perdix*	Uncommon
Black-billed Plover	*Pluvialis squatarola*	Uncommon
Lesser Golden-Plover	*Pluvialis dominica*	Rare
Snowy Plover	*Charadrius alexandrinus*	Rare
Semipalmated Plover	*Charadrius semipalmatus*	Uncommon
Piping Plover	*Charadrius melodus*	Rare
Black-necked Stilt	*Himantopus mexicanus*	Uncommon
Upland Sandpiper	*Bartramia longicauda*	Uncommon
Whimbrel	*Numenius phaeopus*	Rare
Long-billed Curlew	*Numenius americanus*	Uncommon
Hudsonian Godwit	*Limosa haemastica*	Rare
Marbled Godwit	*Limosa fedoa*	Uncommon
Ruddy Turnstone	*Arenaria interpres*	Rare
Red Knot	*Calidris canutus*	Rare
Sanderling	*Calidris alba*	Uncommon
Semipalmated Sandpiper	*Calidris pusilla*	Uncommon
Western Sandpiper	*Calidris mauri*	Uncommon
White-rumped Sandpiper	*Calidris fuscicollis*	Rare
Pectoral Sandpiper	*Calidris melanotos*	Uncommon
Dunlin	*Calidris alpina*	Rare
Stilt Sandpiper	*Calidris himantopus*	Uncommon
Buff-breasted Sandpiper	*Tryngites subruficollis*	Rare
Red-necked Phalarope	*Phalaropus lobatus*	Uncommon
Bonaparte's Gull	*Larus philadelphia*	Uncommon
Herring Gull	*Larus argentatus*	Rare
Sabine's Gull	*Xema sabini*	Rare
Caspian Tern	*Sterna caspia*	Uncommon
Common Tern	*Sterna hirunda*	Uncommon
Band-tailed Pigeon	*Columba fasciata*	Rare
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Uncommon

Common Name	Scientific Name	Status[3]
WYOMING		
Birds (Continued)		
Yellow-billed Cuckoo	*Coccyzus americanus*	Uncommon
Eastern Screech-Owl	*Otus asio*	Uncommon
Snowy Owl	*Nyctea scandiaca*	Rare
Burrowing Owl	*Athene cunicularia*	Uncommon
Common Poorwill	*Phalaenoptilus nuttallii*	Uncommon
Chimney Swift	*Chaetura pelagica*	Rare
Lewis' Woodpecker	*Melanerpes lewis*	Uncommon
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Uncommon
Williamson's Sapsucker	*Sphyrapicus thyroideus*	Uncommon
Hairy Woodpecker	*Picoides villosus*	Uncommon
Three-toed Woodpecker	*Picoides tridactylus*	Uncommon
Black-backed Woodpecker	*Picoides arcticus*	Rare
Hammond's Flycatcher	*Empidonax hammondii*	Uncommon
Plain Titmouse	*Parus inornatus*	Uncommon
Scrub Jay	*Aphelocoma coerulescens*	Uncommon
Pinyon Jay	*Gymnorhinus cyanocephalus*	Uncomon
Pygmy Nuthatch	*Sitta pygmaea*	Uncommon
Canyon Wren	*Catherpes mexicanus*	Uncommon
Cassin's Kingbird	*Tyrannus vociferans*	Uncommon
Bewick's Wren	*Thryomanes bewickii*	Uncommon
Golden-crowned Kinglet	*Regulus satrapa*	Uncommon
Blue-gray Gnatcatcher	*Polioptila caerulea*	Uncommon
Eastern Bluebird	*Sialia sialis*	Uncommon
Western Bluebird	*Sialia mexicana*	Uncommon
Northern Mockingbird	*Mimus polyglottos*	Uncommon
Veery	*Catharus fuscescens*	Uncommon
Wood Thrush	*Hylocichla mustelina*	Rare
Varied Thrush	*Ixoreus naevius*	Rare
Sprague's Pipit	*Anthus spragueii*	Uncommon
Cedar Waxwing	*Bombycilla cedrorum*	Uncommon
Solitary Vireo	*Vireo solitarius*	Uncommon
Philadelphia Vireo	*Vireo philadelphicus*	Rare
Red-eyed Vireo	*Vireo olivaceus*	Uncommon
Tennessee Warbler	*Vermivora peregrina*	Uncommon
Orange-crowned Warbler	*Vermivora celata*	Uncommon
Nashville Warbler	*Vermivora ruficapilla*	Rare
Northern Parula	*Parula americana*	Rare
Chestnut-sided Warbler	*Dendroica pensylvanica*	Rare
Magnolia Warbler	*Dendroica magnolia*	Rare
Black-throated Blue Warbler	*Dendroica caerulescens*	Rare
Black-throated Gray Warbler	*Dendroica nigrescens*	Uncommon
Blackburnian Warbler	*Dendroica fusca*	Rare
Palm Warbler	*Dendroica palmarum*	Rare
Bay-breasted Warbler	*Dendroica castanea*	Rare
Blackpoll Warbler	*Dendroica striata*	Uncommon
Black-and-White Warbler	*Mniotilta varia*	Uncommon
American Redstart	*Setophaga ruticilla*	Uncommon
Ovenbird	*Seiurus aurocapillus*	Uncommon
Northern Waterthrush	*Seiurus noveboracensis*	Uncommon
Summer Tanager	*Piranga rubra*	Rare
Northern Cardinal	*Cardinalis cardinalis*	Rare
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Uncommon
Blue Grosbeak	*Guiraca caerulea*	Rare
Indigo Bunting	*Passerina cyanea*	Uncommon
Dickcissel	*Spiza americana*	Uncommon
American Tree Sparrow	*Spizella arborea*	Uncommon
Clay-colored Sparrow	*Spizella pallida*	Uncommon
Baird's Sparrow	*Ammodramus bairdii*	Uncommon
Swamp Sparrow	*Melospiza georgiana*	Rare
White-throated Sparrow	*Zonotrichia albicollis*	Uncommon
Harris' Sparrow	*Zonotrichia querula*	Uncommon

Common Name	Scientific Name	Status[3]
WYOMING		
Birds (Continued)		
Chestnut-collared Longspur	*Calcarius ornatus*	Uncommon
Snow Bunting	*Plectrophenax nivalis*	Uncommon
Bobolink	*Dolichonyx oryzivorus*	Uncommon
Rusty Blackbird	*Euphagus carolinus*	Uncommon
Pine Grosbeak	*Pinicola enucleator*	Uncommon
Purple Finch	*Carpodacus purpureus*	Uncommon
White-winged Crossbill	*Loxia leucoptera*	Uncommon
Common Redpoll	*Carduelis flammea*	Uncommon
Hoary Redpoll	*Carduelis hornemanni*	Rare
Lesser Goldfinch	*Carduelis psaltria*	Uncommon
Mammals		
Merriam's Shrew	*Sorex merriami*	Rare
Dwarf Shrew	*Sorex nanus*	Rare
Vagrant Shrew	*Sorex vagrans*	Rare
California Myotis	*Myotis californicus*	Uncommon
Western Small-footed Myotis	*Myotis ciliolabrum*	Uncommon
Long-eared Myotis	*Myotis evotis*	Uncommon
Fringed Myotis	*Myotis thysanodes*	Rare
Red Bat	*Lasiurus borealis*	Rare
Hoary Bat	*Lasiurus cinereus*	Rare
Silver-haired Bat	*Lasionycteris noctivagans*	Uncommon
Spotted Bat	*Euderma maculatum*	Rare
Townsend's Big-eared Bat	*Plecotus townsendii*	Rare
Pallid Bat	*Antrozous pallidus*	Rare
Yellow-pine Chipmunk	*Tamias amoenus*	Uncommon
Uinta Chipmunk	*Tamias umbrinus*	Uncommon
Allen's thirteen-lined ground squirrel	*Spermophilus tridecemlineatus alleni*	C2
Uinta Ground Squirrel	*Spermophilus armatus*	Uncommon
Northern Flying Squirrel	*Glaucomys sabrinus*	Uncommon
Plains Pocket Mouse	*Perognathus flavescens*	Rare
Water Vole	*Microtus richardsoni*	Rare
Norway Rat	*Rattus norvegicus*	Uncommon
Meadow Jumping Mouse	*Zapus hudsonius*	Rare
Western Jumping Mouse	*Zapus princeps*	Uncommon
Gray Fox	*Urocyon cinereoargenteus*	Rare
Marten	*Martes americana*	Uncommon
Ermine	*Mustela erminea*	Uncommon
Black-footed ferret	*Mustela nigripes*	Rare*
Western Spotted Skunk	*Spilogale gracilis*	Uncommon
Eastern Spotted Skunk	*Spilogale putorius*	Uncommon
River Otter	*Lutra canadensis*	Uncommon
Mountain Lion	*Felis concolor*	Uncommon
Reptiles		
Rubber Boa	*Charina bottae*	Rare
Pale Milk Snake	*Lampropeltis triangulum multistrata*	Rare
Amphibians		
None		
Fish		
Sturgeon chub	*Hybopsis gelida*	Rare
Silvery minnow	*Hybognathus nuchalis*	Rare
Mollusks		
Wyoming cave snail	*Physa spelunca*	C-2

[1]Based on known habitat availability along the proposed pipeline route.

[2]Sources: Montana Natural Heritage Program, 1993.
Wyoming Bird and Mammal Atlas, 1992.
Wyoming Game and Fish Department, 1993.
Wyoming Game and Fish Department, Cheyenne, 1992.

[a]Federally identified as Threatened and Endangered Species.

[3]Status Codes:

S1 Critically imperiled because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor to its biology making it especially vulnerable to extinction.

S2 Imperiled because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction.

S3 Either very rare and local, or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction throughout its range because of other factors; in the range of 21 to 100 occurrences.

S4 Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.

S5 Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.

SU Possibly in peril, but status uncertain; more information needed. This is the rank assigned all species on the list of plants of undetermined status and a small number of plants being tracked under select circumstances.

SH Historically known only from records before 1940; may be rediscovered.

SX Believed to be extinct; known only from records at sites where systematic relocation efforts have been unsuccessful. Note: There are no Montana plant species assigned the GX or SX rank at present.

Endangered USFWS: listed as endangered

C2 USFWS: some evidence of vulnerability but not enough data to support listing at this time.

NL Not listed by USFWS

TABLE E-2

WILDLIFE SPECIES OF SPECIAL CONCERN OCCURRING ALONG THE WYOMING PORTION OF THE EXPRESS PIPELINE

SPECIES	*MILEPOST #	LOCATION	DISTANCE FROM ROW	STATUS
PRAIRIE DOG COLONIES	309	T58N R97W S26,27	on ROW	A
	323	T56N R95W S31	1 mi. E	I
	328	T55N R95W S17	on ROW	A
	338	T55N R95W S34	1 mi. W	A
	341	T53N R94W S18		A
	342	T53N R94W S17,20		A
	344	T53N R94W S28	on ROW	A
	344	T53N R94W S28	200' W of ROW	A
	344	T53N R94W S30	1.5 Mi. W	A
	350	T52N R94W S23,26	on ROW	A
	355.5	T51N R94W S13,14,23-26	¼ Mi., on ROW	A
	355.5	T51N R93W S19,300,31	¼ Mi., on ROW	A
	361.5-362	T50N R93W S17,18	on ROW	A
	364.5	T50N R93W S28	on ROW	A
	365.5	T50N R93W S33,34	on ROW	A
	366	T49N R93W S3,4	on ROW	A
	367	T49N R93W S2,3	on ROW	A
	368	T49N R93W S2,3,9-11	on ROW	A
	369	T49N R93W S14,23	½-1 Mi. W	A
	407	T43N R92W S15	on ROW	A
	408.5	T43N R92W S28	½ Mi. W	A
	432	T39N R91W S8	on ROW	A
	434	T39N R89W S25 W ½	1 Mi. S	A
	434	T38N R89W S7 NE¼SW¼	on ROW	I
	435	" " S7	¼ Mi. S	I
	435	" " S9	¼ Mi. N	I
	435	" " S6	½ Mi. N	A
	440.5	T38N R90W S1	on ROW	A
	440.5	" " S2	on ROW	A
	442	T38N R89W S26 W½	1 Mi. SW	A
	442	T38N R87W S28 N½	½ Mi. N	A
	442	T35N R82W S33 NE¼	on ROW	A
	445	" " S34 NW¼	on ROW	A
	445	" " S28 NE¼	½ Mo. N	A
	493	" " S27 S½	¼-½ Mi. N	A
	493	T34N R81W S6 SW¼	¼ Mi. N or on ROW	A
	494	" " S7 NE14	on ROW	A
	494	T39N R90W S18 SE¼	½ Mi. E	A
	499	" " S19 E½	¼ Mi. E	A
	499.5	" " S20 NW¼	½ Mi. N	A

SPECIES	*MILEPOST #	LOCATION	DISTANCE FROM ROW	STATUS
SAGE GROUSE LEKS	395	T45N R92W S10	½ Mi. W	A
	395	" " S35	1 Mi. E	A
	395	" " S9,10,15	¼-¼ Mi. W	A
	398	" " S15	½ Mi. W	?
	399	" " S33,34	¼ Mi. W	A
	400.5	T44N R92W S3,10	¼-½ Mi. E	A
	401	" " S10	on ROW	I
	401	" " S9	½ Mi. W	?
	408.5	T43N R92W S27	¼ Mi. W	A
	408.5	" " S26	½ Mi. E	?
	412.3	T42N R92W S12,13	½ Mi. E	?
	417.5	T41N R91W S7	on ROW	A
	426.2	T40N R91W S9	on ROW	A
	426.5	" " S9	½ Mi. W	A
	427.5	" " S21	½ Mi. W	A
	428	T40N R91W S21	on ROW	A
	432	T39N R91W S8	on ROW	A
ANTELOPE				
Partuntion Areas	353	T52N R94W S36	¼-½ Mi.	
	354	T51N R94W S1,12	"	
	354	T52N R93W S31	"	
	355	T51N R93W S6,7	"	
Critical Winter Range	428.5-430.5	T40N R91W S22-27, 34-36	Thru ROW	
	430.5-433.5	T39N R91W S1-4, 7-14, 24-25	Thru ROW	
	437.5-438.5	T39N R90W S18,19,29,30,34,35	Thru ROW	
	440-441	T38N R90W S1-4,9-12	Thru ROW	
	441.5-447	T38N R89W S6-11,14-17	Thru ROW	
	450	T38N R88W S16,17,21	Thru ROW	
	459.5-460.5	T37N R87W S9-11,15-17	Thru ROW	
	480-484	T35N R84W S1-12	Thru ROW	
	484-491.5	T35N R83W S7-18	Thru ROW	
	494-497	T35N R82W S18-20,28,29,33,34	Thru ROW	
MULE DEER				
Critical Winter Range	431.5-436	T39N R91W S12,13,24,25	Thru ROW	
	433-436	T39N R90W S7,8,18,19,29,30,34	Thru ROW	
	440-441	T38N R90W S3-5	Thru ROW	
RAPTOR NESTS				
Bald Eagle roost sites	482-485	T35N R83W S7 SW¼	on ROW	A
	482-485	" " S18 W½	½ Mi. S	A
	482-485	T35N R84W S11 SE¼	on ROW	A
	482-485	" " S12 S½	on ROW	A
	482-485	" " S13 ALL	½ Mi. S	A
	482-485	" " S14 ALL	½ Mi. S	A
Golden Eagle	324.3	T56N R96W S35	½ Mi. W	
	358	T51N R93W S31	¼ Mi. E	A
	368	T49N R93W S11	½ Mi. W	A
	379.5	T48N R92W S27	½ Mi. E	A
	398	T45N R92W S27	1/8 Mi. W	I
	399	" " S34	¼ Mi. W	I
	"	" " "	½ Mi. W	I
	402.3	T44N R92W S22	½ Mi. E	A

SPECIES	*MILEPOST #	LOCATION	DISTANCE FROM ROW	STATUS
	402.2	" " S15	½ Mi. W	I
	409.5	T43N R92W S35	4 Mi. E	A
	413.5	T42N R92W S13	¼ Mi. E	A
	415.5	" " S25	¼ Mi. E	A
Red-tailed Hawk	320	T56N R96W S9	¼ Mi. W	
	372	T49N R92W S31	¼ Mi. W	A
	411.5	T42N R92W S1	½ Mi. E	A
Swainson's Hawk	350.5	T52N R94W S23	½ Mi. W	A
	392	T46N R92W S34	on ROW	I
Ferruginous Hawk	320	T56N R96W S9	½ Mi. W	A
	344	T53N R94W S28	½ Mi. E	A
	402.2	T44N R92W S22	½ Mi. E	I
	406.5	T43N R92W S16	on ROW	A
	424	T40N R91W S3	2 Mi. E	A
	424.5	T40N R91W S5	½ Mi. W	A
	424.5	T40N R91W S4	1/3 Mi. E	A
	427	T40N R91W S16	½ Mi. E	A
	427.5	" " S17	1 Mi. W	A
	427	" " S16	¼ Mi. W	A
	428?	" " S4	½ Mi. W	A
	N/A	T38N R89W S4	1 Mi. N	A
Prairie Falcon	344	T53N R94W S30	1.5 M-I. W	A
(possible nest on Dobie Butte)		T49N R93W S3	50' W	?
	379	T48N R92W S27	¼ Mi. E	A
American Kestrel	392	T46N R92W S34	¼ Mi. W	A
	402	T44N R92W S15	½ Mi. E	A
Northern Harrier	406.5	T43N R92W S15	½ Mi. E	A
Great Horned Owl	362	T50N R93W S17	¼ Mi. E	A
	372	T49N R92W S31	½ Mi. W	?
	372	T49N R92W S32	¼ Mi. E	A
	396	T45N R92W S23	½ Mi. E	A
	392	T46N R92W S27	¼ Mi. W	A

SPECIES	*MILEPOST #	LOCATION	DISTANCE FROM ROW	STATUS
UNKNOWN RAPTOR SPECIES NESTS	N/A	" " S13 SE¼	on ROW	A
	N/A	" " S24 NE¼	on ROW	A
	N/A	T38N R88W S16 SE¼	½ Mi. N	A
	N/A	T37N R87W S14 NW¼	3/4 Mi. N	A
	N/A	" " S25 SE¼	½ Mi. E	A
	N/A	T37N R86W S31 SW¼	½ Mi. E	A
	N/A	" " S31 NE¼	1 Mi. E	A
	N/A	T36N R86W S6 SW¼	½ Mi. E	A
	N/A	" " S24 SW¼	3/4 Mi. N	A
	N/A	T36N R85W S31 SE¼	¼ Mi. N	A
	N/A	T35N R84W S1 NE¼	1 Mi. N	A
	N/A	T35N R85W S4 SE¼	¼ Mi. N	A
	N/A	T35N R84W S13 SE¼	1 Mi. S	A
	N/A	T35N R83W S18 SW¼	1 Mi. S	A
	N/A	" " S19 NE¼	½ Mi. S	A
	N/A	T35N R82W S33 NW¼	¼ Mi. S	A
	N/A	" " S33 SW¼	½ Mi. S	A
	N/A	T34N R82W S4 NW¼	3/4 Mi. S	A
WATERFOWL/OTHER				
Whooping Crane		**NONE**		
GREAT BLUE HERON ROOKERIES				
Byron Heron Colony	322	T56N R96W S29,30	2.5 Mi. W	A
Lovell Lake Colony	323.5	T56N R96W S25	1.2 Mi. E	A
Yellowtail Colony	----	----------	6 Mi. NE	A
"Water Island"	344	T53N R94W S27	½ Mi. E	?
Manderson No. Colony	N/A	T50N R93W S11	2 Mi. E	A
Manderson Colony So.	N/A	T50N R93W S14,23,24	2.2 Mi. E	A
Rairden Colony	N/A	T48N R92W S7,8	2 Mi. E	A
Worland No. Colony	382	T47N R92W S7	2 Mi. W	A
Worland So. Colony	382.5	T47N R92W S7,18	2.5 Mi. W	A

A = Active within last 5 years
I = Inactive ? = Questionable status

*Please note Milepost numbers refer to MP locations from the Express Pipeline maps 1-7 in Appendix J.

TABLE E-3
SENSITIVE PLANT SPECIES LISTED BY THE MONTANA NATURAL HERITAGE PROGRAM (MTNHP) WITHIN THREE MILES OF THE EXPRESS PIPELINE CORRIDOR (AUGUST 1993)

Scientific Name	Common Name	Status[1] State	Status[1] Federal	Habitat[2]	County
Astragalus chamaeleuce	Ground milkvetch	S1/G5	None	Open, stony soil with Artr, Agsp	Carbon
Astragalus geyeri	Geyer milkvetch	S1/G5	None	Dry, sandy alluvium with Artr, Atga	Carbon
Astragalus grayi	Gray's milkvetch	S1/G4?	None	Artr grassland	Carbon
Camissonia andina	Obscure evening-primrose	S1/G4	None	Dry, sandy, rolling uplands with Artr, Agsp	Carbon
Carex vallicola	Valley sedge	S2/G5	None	Shaded, limestone convex slope with Psme, Feid	Carbon
Castilleja longispica	Parrot-head Indian paintbrush	S1/G4? T4	None	Shallow breaks with Artr, Agsp	Carbon
Cryptantha scoparia	Miner's candle	S1/G3	None	Dry, sandy, limestone uplands with Artr, Agsp	Carbon
Epipactis gigantea	Giant helleborine	S2/G4	None	Spring; wet, marly soil	Carbon
Eriogonum lagopus	Rabbit buckwheat	S3/G3Q	C2	Red, calcareous soil with Agsp	Carbon
Grayia spinosa	Spiny hopsage	S1/G5	None	Dry, sandy alluvium or breaks with Artr, Chvi, Stco, Bogr	Carbon
Malacothrix torreyi	Desert dandelion	S1/G4	None	Dry, sandy alluvium with Artr, Atga, Bogr	Carbon
Sphaeromeria capitata	Rock-tansy	S3/G3	None	Limestone outcrops	Carbon
Sphenopholis obtusata var. *major*	Slender wedgegrass	S1/G5T5	None	Margins of streams and wetlands	Fergus

Footnotes:

[1]Status:

<u>Global/State Rank</u>
<u>Definition (G = Rangewide; S = Montana)</u>

G1	S1	Critically imperiled because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
G2	S2	Imperiled because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction.
G3	S3	Either very rare and local, or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction throughout its range because of other factors; in the range of 21 to 100 occurrences.
G4	S4	Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
G5	S5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.

Other Codes:

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

T Rank for a subspecific taxon (subspecies or variety); appended to the global rank for the full species.

Federal (USFWS) Status:

C2 Notice of Review, Category 2 (some evidence of vulnerability but not enough data to support listing at this time).

[2]Species codes: Artr = *Artemisia tridentata*; Agsp = *Agropyron spicatum*; Atga = *Atriplex gardneri*; Psme = *Pseudotsuga menziesii*; Feid = *Festuca idahoensis*; Chvi = *Chrysopsis villosa*; Stco = *Stipa comata*; Bogr = *Bouteloua gracilis*

[3]From MTNHP element occurrence records (MTNHP 1993a), Lesica and Achuff (1992), and on-site field inventories

Appendix F

Common and Scientific Names for Species Cited in This Document

BIRDS

Common Name	Genus	Species
White Pelican	*Pelecanus*	*erythrorhynchos*
Double-crested Cormorant	*Phalacrocorax*	*auritus*
Great Blue Heron	*Ardea*	*herodias*
Sandhill Crane	*Grus*	*canadensis*
Whooping Crane	*Grus*	*americana*
Tundra Swan	*Cygnus*	*columbianus*
Canada Goose	*Branta*	*canadensis*
Snow Goose	*Chen*	*caerulescens*
Mallard	*Anas*	*platyrhynchos*
Gadwall	*Anas*	*strepera*
Green-winged Teal	*Anas*	*crecca*
Northern Pintail	*Anas*	*acuta*
American Widgeon	*Anas*	*americana*
Northern Shoveler	*Anas*	*clypeata*
Redhead	*Aythya*	*americana*
Common Merganser	*Mergus*	*merganser*
American Coot	*Fulica*	*americana*
Piping Plover	*Charadrius*	*melodus*
Mountain Plover	*Charadrius*	*montanus*
Long-billed Curlew	*Numenius*	*arquata*
Upland Sandpiper	*Bartramia*	*longicauda*
Gulls	*Larus*	*spp.*
Terns	*Sterna*	*spp.*
Least Tern	*Sterna*	*antillarum*
Golden Eagle	*Aquila*	*chrysaetos*
Bald Eagle	*Haliaeetus*	*leucocephalus*
Northern Harrier	*Circus*	*cyaneus*
Red-tailed Hawk	*Buteo*	*jamaicensis*
Swainson's Hawk	*Buteo*	*swainsoni*
Ferruginous Hawk	*Buteo*	*regalis*
American Kestrel	*Falco*	*sparverius*
Peregrine Falcon	*Falco*	*peregrinus*
Prairie Falcon	*Falco*	*mexicanus*
Sharptail Grouse	*Tympanuchus*	*phasianellus*

Common Name	Genus	Species
Sage Grouse	*Centrocercus*	*urophasianus*
Gray Partridge	*Perdix*	*perdix*
Ring-necked Pheasant	*Phasianus*	*colchicus*
Wild Turkey	*Meleagris*	*gallopavo*
Mourning Dove	*Zenaida*	*macroura*
Great Horned Owl	*Bubo*	*virginianus*
Burrowing Owl	*Athene*	*cunicularia*
Common Nighthawk	*Chordeiles*	*minor*
Black-billed Magpie	*Pica*	*pica*
Common Raven	*Corvus*	*corax*
Horned Lark	*Eremophila*	*alpestris*
Meadowlark	*Sturnella*	*neglecta*

FISH

Common Name	Genus	Species
Northern Pike	*Esox*	*lucius*
Channel Catfish	*Ictalurus*	*punctatus*
Sauger	*Stizostedion*	*canadense*
Longnose Dace	*Rhinichthys*	*cataractae*
Pallid Sturgeon	*Scaphirhynchus*	*albus*
Shovelnose Sturgeon	*Scaphirhynchus*	*platorynchus*
Blue Sucker	*Cycleptus*	*elongatus*
Walleye	*Stizostedeon*	*vitreum vitreum*
Smallmouth Buffalo	*Ictiobus*	*bubalus*
Bigmouth Buffalo	*Ictiobus*	*cyprinellus*
Rainbow Trout	*Oncorhynchus*	*mykiss*
Brook Trout	*Salvelinus*	*fontinalis*
Ling	*Lota*	*lota*
Flathead Chub	*Platygobio*	*gracilis*
Mountain Sucker	*Catostomus*	*platyrhynchus*
Fathead Minnow	*Pimephales*	*promelas*
White Sucker	*Catostomus*	*commersoni*
Paddlefish	*Polyodon*	*spathula*
Plains Killifish	*Fundulus*	*zebrinus*

MAMMALS

Common Name	Genus	Species
Moose	*Alces*	*alces*
Pronghorn	*Antilocapra*	*americana*
Coyote	*Canis*	*latrens*
Elk	*Cervus*	*canadensis (elaphus)*
Whitetail prairie dog	*Cynomys*	*gunnisoni*
Blacktail prairie dog	*Cynomys*	*ludovicianus*
Kangaroo Rat	*Dipodomys*	*spp.*
Porcupine	*Erethizon*	*dorsatum*
Least Chipmunk	*Eutamias*	*minimus*
Black-footed Ferret	*Mustela*	*nigripes*
Mule deer	*Odocoileus (Dama)*	*hemionus*
White-tailed Deer	*Odocoileus (Dama)*	*virginianus*
Grasshopper Mouse	*Onychomys*	*spp.*
Mountain Goat	*Oreamnos*	*americanus*
Bighorn sheep	*Ovis*	*canadensis*
Deer Mouse	*Peromyscus*	*maniculatus*
Desert Cottontail	*Sylvilagus*	*auduboni*

Plants

Common Name	Genus	Species
Blue Gramma	*Bouteloua*	*gracilis*
Needle-and-Thread	*Stipa*	*comata*
Western Wheatgrass	*Agropyron*	*smithii*
Sandberg's bluegrass	*Poa*	*secunda*
Junegrass	*Koeleria*	*spp.*
Fringed Sage	*Artemisia*	*frigida*
Broom Snakeweed	*Gutierrezia*	*sarothrae*
Hairy Golden Aster	*Heterotheca*	*villosa*
Blazing Star	*Liatris*	*spp.*
Bluebunch Wheatgrass	*Agropyron*	*spicatum*
Big Sagebrush	*Artemisia*	*spp.*
Winterfat	*Ceratoides*	*spp.*
Silver Sagebrush	*Artemisia*	*cana*
Rose	*Rosa*	*spp.*
Snowberry	*Symphoricarpos*	*spp.*
Great Basin Wildrye	*Elymus*	*cinereus*
Narrow-leaved Cottonwood	*Populus*	*angustifolia*
Rocky Mountain Juniper	*Juniperus*	*scopulorum*
Utah Juniper	*Juniperus*	*osteosperma*
Ponderosa Pine	*Pinus*	*ponderosa*
Sideoats Gramma	*Bouteloua*	*curtipendula*
Skunkbrush Sumac	*Rhus*	*trilobata*
Saltbrush	*Atriplex*	*spp.*
Greasewood	*Sarcobatus*	*spp.*
Rabbitbrush	*Chrysothamnus*	*spp.*
Mountain Mahogany	*Cercocarpus*	*spp.*
Black Sagebrush	*Artemisia*	*nova*
Basin Big Sagebrush	*Artemisia*	*tridentata*
Gardner Saltbush	*Atriplex*	*gardneri*
Yucca	*Yucca*	*spp.*

Common Name	Genus	Species
Sedge	*Carex*	*spp.*
Inland Saltgrass	*Distichlis*	*spicata*
Plains Cottonwood	*Populus*	*sargentii*
Boxelder	*Acer*	*negundo*
Willow	*Salix*	*spp.*
Kentucky Bluegrass	*Poa*	*pratensis*
Smooth Brome	*Bromus*	*inermis*
Redtop	*Agrostis*	*gigantea*
Russian Olive	*Elaeagnus*	*angustifolia*
Tamarisk	*Tamarix*	*spp.*
Chokecherry	*Prunus*	*virginiana*
Cattail	*Typha*	*spp.*
Rush	*Juncus*	*spp.*
Foxtail	*Alopecurus*	*spp.*
Curly Dock	*Rumex*	*crispus*
Saltwort	*Arenaria*	*spp.*
Kochia	*Kochia*	*spp.*
Buffalo Burr	*Solanum*	*rostratum*
Wild Licorice	*Glycyrrhiza*	*lepidota*
Annual Sunflower	*Helianthus*	*annuus*
Canada Thistle	*Cirsium*	*arvense*
Leafy Spurge	*Euphorbia*	*esula*
Russian Knapweed	*Centaurea*	*repens*
Spotted Knapweed	*Centaurea*	*maculosa*
Field Bindweed	*Convolvulus*	*spp.*
Whitetop	*Cardaria*	*spp.*
Quackgrass	*Agropyron*	*repens*
Halogeton	*Halogeton*	*glomeratus*
Buffaloberry	*Shepherdia*	*canadensis*
Rabbit Buckwheat	*Eriogonum*	*brevicaule*
Ground Milkvetch	*Astragalus*	*spp.*

Common Name	Genus	Species
Geyer Milkvetch	*Astragalus*	*geyeri*
Obscure Evening Primrose	*Oenathera*	*spp.*
Miner's Candle	*Cryptantha*	*virgata*
Spiny Hopsage	*Grayia*	*spinosa*
Desert dandelion	*Taraxacum*	*spp.*
Rock-Tansy	*Tanacetum*	*vulgare*
Townsendia spathulata	*Townsendia*	*spathulata*
Birdsfoot Sage	*Artemisia*	*pedatifida*
Prairie Junegrass	*Koeleria*	*cristata*

Appendix G

Scour Depth Methodology and Data for Major Rivers and Streams Pipeline Crossings in Montana and Wyoming

METHODS OF EVALUATION

This section describes the methodologies employed in evaluating the potential for bed scour and lateral scour at each of the 11 stream crossings.

GEOMORPHIC INVESTIGATIONS

Geomorphic investigations included aerial photo interpretation of such features as valley width, river form and historic river changes. Topographic maps were used to establish slopes and other topographic features. Geotechnical boring logs for nearby bridges and wells were collected where possible to assist in establishing the depth and character of the valley fill. Geologic maps and literature from previous studies were reviewed.

In the field, particular attention was paid to the character of materials of the floodplain and the river bed and banks. Samples were collected to accurately define the makeup of the channel bed material. A gradation analysis was performed for each sample collected.

HYDROLOGIC INVESTIGATIONS

A hydrologic investigation was performed for each crossing to determine the design flood flow. A 100-year frequency design flood was used as recommended in "Pipeline River Crossing Design Methods" (Sandmeyer, et.al., 1982).

Where available hydrologic data was collected from the United States Geological Survey (USGS), the Federal Emergency Management Agency (FEMA) from floodplain delineation studies, and the state highway departments related to the design of nearby bridges. The 100-year design flood was derived based on the data compiled. Where the crossing was located near the point where the data is applicable, the data was used directly. Where the information was not directly applicable, relationships were developed relating the 100-year flow to the drainage area. These relationships were then used to estimate the 100-year flow at the stream crossing site.

Where hydrologic data was not available, the 100-year design flood was estimated using regression equations developed by the USGS.

ANALYSIS OF LATERAL SCOUR POTENTIAL

The estimates of lateral scour potential were based on office and field investigations. The features considered in the analyses were: (1) the active channel area, (2) the past history of the river in terms of channel changes, (3) the estimated extent of the 100-year floodplain and, (4) the estimated depth of bed scour.

The aim of the investigation was to provide a realistic estimate of the potential for lateral scour while maintaining a realistic approach in terms of the probability of major channel changes occurring.

A map is included for each individual stream crossing showing the length of pipeline recommended for burial at maximum depth to account for lateral scour potential.

For all crossings we have attempted to account for potential stream migration by recommending an adequate length of burial at maximum depth rather than through the use of structural stabilization. It has been our experience that structural stabilization results in the potential for downstream impacts, requires seasonal maintenance and does not prevent upstream migration and encroachment behind the stabilized section. The disturbed banks should be returned to their approximate original configuration using the natural bank material and temporarily stabilized through the use of geosynthetics until vegetation can re-establish and provide long term stability.

Appendix G

Scour Depth Methodology and Data for Major Rivers and Streams Pipeline Crossings in Montana and Wyoming

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

where: V = Mean Velocity in feet per second
n = Coefficient of roughness
R = Hydraulic radius in feet
S = Energy grade line slope

The velocity is multiplied by the flow area (A) in square feet to obtain discharge (Q) in cfs.

$$Q = VA$$

The coefficients of roughness (n) used for the 11 crossings were taken from "Roughness Characteristics of Natural Channels" (USGS, 1987).

The energy grade line slopes (S) were estimated using the streambed slope as determined from USGS quadrangle maps.

With the exception of Arrow Creek, the channel geometry of the crossings were measured by field surveys. At most of the crossings, three cross-sections of the channel were measured near the crossing site. From these three cross-sections a single representative cross-section was developed. The channel cross-section for Arrow Creek was developed based on visual estimates from the field investigation, the USGS quadrangle map, and stereoscopic aerial photographs. As will be discussed in later sections, the effective flow area of the floodplain is limited to the active channel. The Greybull River was the single exception to this approach. For the Greybull River, the effective flow area was extended to include the right overbank area where flooding frequently occurs.

The representative cross-section is shown for each individual stream crossing.

METHODS OF EVALUATION

This section describes the methodologies employed in evaluating the potential for bed scour and lateral scour at each of the 11 stream crossings.

GEOMORPHIC INVESTIGATIONS

Geomorphic investigations included aerial photo interpretation of such features as valley width, river form and historic river changes. Topographic maps were used to establish slopes and other topographic features. Geotechnical boring logs for nearby bridges and wells were collected where possible to assist in establishing the depth and character of the valley fill. Geologic maps and literature from previous studies were reviewed.

In the field, particular attention was paid to the character of materials of the floodplain and the river bed and banks. Samples were collected to accurately define the makeup of the channel bed material. A gradation analysis was performed for each sample collected.

HYDROLOGIC INVESTIGATIONS

A hydrologic investigation was performed for each crossing to determine the design flood flow. A 100-year frequency design flood was used as recommended in "Pipeline River Crossing Design Methods" (Sandmeyer, et.al., 1982).

Where available hydrologic data was collected from the United States Geological Survey (USGS), the Federal Emergency Management Agency (FEMA) from floodplain delineation studies, and the state highway departments related to the design of nearby bridges. The 100-year design flood was derived based on the data compiled. Where the crossing was located near the point where the data is applicable, the data was used directly. Where the information was the equation was originally formulated using constricted flow, it is appropriate to compute a new "q" which approximates a constricted flow condition. Therefore, the effective flow area was restricted to the active channel only (as opposed to the total floodplain width).

The revised q was then found to be:

$$q = \text{unit discharge} = \frac{\text{Total Discharge}}{\text{Channel Width}}$$

This equation results in a conservatively high estimate of unit discharge. The higher unit discharge more nearly resembles the flow conditions found in the deepest and fastest flowing areas of the cross section. Use of this q in the scour depth equation gives results which seem much more reasonable in nearly all cases (HKM, 1979).

Blench Equation. The second equation used for scour depth computations is one developed by Blench for use with gravel bed rivers of Alaska (Blench 1966). The equation is:

$$ds = 0.212 \frac{q^{4/5}}{d^{1/5}} - D$$

Where ds, q, d, and D are the same as in the Modified Laursen Equation.

The Blench Equation is designed to give a mean, or average scour depth. To approximate the maximum scour depths, Blench suggests the use of multipliers (ranging from 1.6 to 2.25), depending on the river form. However, as was the case with the Laursen Equation, the scour depths computed using a unit discharge based on the

ANALYSIS OF BED SCOUR POTENTIAL

Two types of scour occur in channels. Local scour occurs around bridge piers and abutments and is caused by the local obstruction of flow. General scour is caused by an imbalance in sediment transport and may include constriction and degradation of the streambed and scour caused by the curvature effect. Away from bridge piers, abutments or other permanent structures, general scour governs streambed lowering during high flow events.

In the computations of scour depth, two empirical equations, a method employing tractive force, and a maximum permissible velocity approach were used. Field measured cross sections and the Manning Equation were used to determine widths, depths, velocities, and other values necessary in computing the scour depths for the design flood. Each of the four procedures is described below along with a discussion of the analysis of channel hydraulics. A discussion of historical scour and degradation at streamflow gages is also presented as well as a discussion of other pipelines or bridges in the vicinity of the crossing.

The computations of bed scour potential pertain to scour of the alluvial material. In some cases bedrock may be encountered at depths shallower than the computed depth. The maximum potential depth of scour in bedrock is estimated to be 1 foot.

CHANNEL HYDRAULICS

The scour depth computations to be discussed in the following sections require depth, flow area, and velocity for the design flood. The Manning Equation was used for this purpose and is shown below (Chow, 1959).

If the shear stress exerted on the channel bed exceeds the critical shear stress, scour will occur. As the scour progresses, the hydraulic radius (R) increases and the friction slope (S) decreases until the channel reaches a state of equilibrium. This point of equilibrium or the maximum scour depth is determined through a trial-and-error process (McDonald, 1980).

Maximum Permissible Velocity Method. The fourth method of estimating scour depth is based on the maximum permissible velocity for which bed scour will not occur. This method can be used to estimate the maximum depth of scour through the use of the following equation:

$$V = Q/A$$

where:

V	=	Mean Velocity in fps
Q	=	Discharge in cfs
A	=	Flow Area in Square Feet

If the mean velocity during the design flood exceeds the maximum permissible velocity, scour will occur. As scour progresses, the flow area (A) will increase; thereby reducing the mean velocity. Scour will continue until the mean velocity is equal to the maximum permissible velocity. Chang presents values for maximum permissible velocities for a range of bed materials (Chang, 1988).

Historic Scour Depths

The depth of scour during historical flood events was investigated as a check of the reasonableness of the estimates from the preceding four methods. Flow measurement field notes for USGS streamflow gages in the vicinity of the crossing were obtained to determine the minimum bed elevation at various levels of flow. Although these measurements are not at the crossing site or during the 100-year flood, they do provide an indication of the scour potential of the river during high flows.

Methods for Estimating Potential Depth of Bed Scour

Four methods were used to estimate the potential depth of scour: (1) the Modified Laursen Equation, (2) the Blench Equation, (3) the Critical Shear Stress Method and, (4) the Maximum Permissible Velocity Method.

Modified Laursen Equation. Emmett Laursen derived a formula for calculating scour where bridges or other structures constrict the flow in a channel (Laursen, 1963). In its simplest form, the equation is:

$$ds = 0.13 \left(\frac{q}{d^{1/3}}\right)^{6/7} - Y_1$$

where:

ds	=	Depth of scour in feet
q	=	Discharge per unit of constricted width in cfs
d	=	Mean bed material particle size (d_{50}) in feet as determined from a gradation analysis.
Y_1	=	Flow depth upstream of the constriction

In natural unconfined channels the depth is essentially constant through short reaches before a flood or scour event. William Emmett, in his studies of scour depths for stream crossings of the Trans Alaskan Pipeline, modified Laursen's equation by using the mean depth of the channel before scour occurs in place of Y_1 (Emmett, 1972). Emmett's modified Laursen formula, which we have implemented in our studies, is as follows:

$$ds = 0.13 \left(\frac{q}{d^{1/3}}\right)^{6/7} - D$$

Where all terms are the same as above except that D (mean depth in feet) replaces Y_1.

In applying the equation to the river cross-section using the total width of the flow at the 100-year discharge to determine "q", the computed scour depth is usually very small or even negative. Since

Effective Flow Area. That portion of the floodplain which is effective in carrying flow. Floodwaters beyond the effective flow area are slow moving and contribute little to the total rate of discharge through the floodplain cross-section.

Scour Depth. In this study, scour depth is defined as the depth below the streambed to which the bed material will be moved. This does not indicate that this material is transported out of an area, but only that the material is shifted downstream.

Thalweg. The lowest point of the channel cross-section. The thalweg is a subchannel of the active channel and carries the lowest of flows.

Valley Fill. This is the material that has been deposited over bedrock and on which the river is flowing.

Valley Flat. This is the area above the bank point which is relatively flat and is occasionally flooded during times of high flow. This is also called the valley floor.

Valley Walls. In this study, the valley walls were taken to be the extent of the valley fill. Often, they were at such a distance to be irrelevant to the present stream processes.

Left or Right Bank. This refers to the banks as if you are looking downstream.

entire floodplain cross section are either very small or negative, making the use of multipliers virtually meaningless. The unit discharge is therefore based on the active channel characteristics in the same way as was done for the Modified Laursen Equation and the scour depths are felt to approximate the maximum that could be expected to occur in the channel.

Critical Shear Stress Method. The third method used in estimating the scour depth is based on the critical shear stress of the bed material. The shear stress exerted by the flowing water on the channel bed is estimated using the following equation (Chang, 1988).

$$T = G_{water} \times R \times S$$

where:

T = Shear Stress in Pounds Per Square Foot

G_{water} = Specific weight of water in pounds per cubic foot

R = Hydraulic Radius in feet

S = Friction Slope (Estimated as Channel Slope)

r stress on the channel bed is compared to the shear stress of the bed material at the point of impending motion (critical shear stress). The critical shear stress of the bed material is estimated using the following equation (Chang, 1988).

$$T_c = K \times d \times (G_{sediment} - G_{water})$$

where:

T_c = Critical Shear Stress in Pounds Per Square Foot

K = A constant taken as 0.047 in this analysis

d = Mean bed particle size (d_{50}) in feet as determined from a gradation analysis

$G_{sediment}$ = Specific weight of bed material in pounds per cubic foot are common. The dominant form of lateral activity is downstream progression. There is no evidence of meander cutoff or avulsion.

The bed material is a fine grained poorly graded sand with silt (median size of 0.2 mm). The overbank soils are cohesive lean clay over alluvial sand. There is no evidence of bedrock in the valley and no well or bridge data are available in the region to estimate the depth of the alluvial material. Based on valley form, the potential exists for the valley fill to extend to a considerable depth. The fine grained bed material is highly susceptible to scour and barring the existence of a coarse gravel layer or bedrock, deep scour may occur during extreme flow events.

Lateral Scour Potential: The active flood plain extends from about 700 feet north of the left bank to about 600 feet south of the right bank. Migration to the right is limited by a bluff immediately downstream to about 300 feet beyond the right bank. Due to fine grained nature of the bank material and the lack of vegetation, burial at maximum depth will be recommended for the entire distance across the modern floodplain, or about 1500 feet.

Bed Scour Potential: The results of the analysis of bed scour potential for the Milk River crossing are:

> 100-year flood discharge: 13,900 cfs
> Maximum depth 100-year flood: 10.5 ft
> Average channel velocity: 4.6 fs
> Channel slope: 0.0006 ft/ft
> Estimated depth of scour below the minimum thalweg elevation: 22 ft
> Bed material: Poorly graded sand with silt, D_{50} = 0.2 mm

A limited drilling program is planned at Milk River to determine the nature of the soil profile at the crossing and further establish potential scour.

Other Pipelines or Bridges in the Vicinity of the Stream Crossings

As a further check of the reasonableness of the estimated depth of bed scour, information was obtained, where available, regarding other pipelines or bridges in the vicinity of the stream crossings. The depth of burial of pipelines and the depth of bridge piers was obtained through telephone conversations with the representatives of the pipeline companies and construction drawings of the bridges. The bridge drawings also provided information regarding subsurface conditions.

Degradation of Stream Channel

Channel rating data for USGS streamflow gages in the vicinity of each crossing were obtained to determine if a trend exists of degradation of the stream channel over time.

DEFINITION OF TERMS

Presented below is a listing of the more frequently used geologic and hydrologic terms used in the scour analyses.

Active Channel. This is that area of the river that is frequently used to carry the discharge. Generally, this can be taken as the non-vegetated areas or those areas with only annual vegetation.

Avulsion. A process in which the stream abandons the former channel completely and adopts an entirely new course.

Bank. In this study, bank is taken to mean that area immediately adjacent to the waters edge.

Bed. This term is defined as the bottom of the stream. The sediments which makeup the bed of the stream are referred to as bed material.

Along the proposed drill path, a series of bedrock benches capped by terrace gravels form the west valley limit. Bedrock slopes towards the valley at approximately 4 degrees. Bedrock was encountered in the center of the valley at a depth of 37.5 feet to 41.5 feet. Based on borings, the bedrock surface is relatively uniform in the area of the river. The bedrock is soft on top and becomes hard and competent with scattered fractures at depth. The bedrock may slope uniformly toward the river or erosion may have formed benches on the east valley limit.

The valley fill consists of alluvial sand and gravel overlying sandstone-siltstone bedrock. On the west edge of the valley, alluvial material is relatively fine grained, consisting of silty and clayey sand with scattered gravel with a base layer of dense gravel and cobble. The alluvial materials become progressively coarser toward the river, and the center of the valley.

A boring located approximately 80 feet from the east bank encountered 34 feet of sandy soils overlying dense sand and gravel similar to that encountered below the riverbed. Eagle Sandstone was encountered at a depth of 51.0 feet.

ARROW CREEK

Site Geomorphology: Arrow Creek occupies a large broad valley formed during glacial times by diversion of the Missouri River. The active channel of Arrow Creek exhibits a tortuous meander pattern with oxbows and cutoff channels common across the total width of the valley floor. Field evidence and discussions with SCS personnel suggest that it is not uncommon for Arrow Creek to experience drastic annual channel changes.

The active channel of Arrow Creek is incised about 10 feet below the valley floor and varies in width. Near the crossing, the active channel is about 20 feet wide and the modern flood plain is

Eleven river and stream crossing were evaluated for the Altamont Pipeline. The Express Pipeline is expected to cross these streams and rivers in the same vicinity as the Altamont Pipeline and it is anticipated that the same conditions will exists at the Express Pipeline crossing.

In general, the lateral scour investigations consisted of a geomorphic evaluation of the stream at the crossing location using available aerial photography and historical records to determine historical channel change and migration. The bed scour analysis consisted of surveying a minimum of two, and usually three, representative cross sections in the crossing area and a hydraulic analysis using established engineering techniques. In addition, available historic stream gage data and channel form were used to develop an estimate of degradation.

Scour depth refers to depth below the minimum thalweg elevation. If the crossing is in a riffle, during the field investigation a cross section of the adjacent pool sequence was used to develop the minimum thalweg elevation. In general, burial at maximum depth will be a minimum of the twice the estimated scour depth plus any allowance for degradation. If bedrock is encountered, the top of pipe will be placed a minimum of one foot below the bedrock surface.

MILK RIVER

Site Geomorphology: The Milk River has formed a broad alluvial valley about 3000 feet wide about 180 feet below the surrounding till plain. The valley walls are steep shale bluffs formed of Cretaceous shale and bentonite. The active channel is about 500 feet wide, incised four to six feet below the valley floor, and forms a sinuous channel pattern. The valley floor extends rather uniformly with no prominent terraces across the total width of the valley floor. Channel side bars, point bars and mid-channel bars crossing, and because the pipeline will be buried a minimum of twice the estimated scour depth, no additional depth of burial is recommended for degradation.

JUDITH RIVER

Site Geomorphology: The Judith River has formed a shallow valley about 1400 feet wide and 100 feet below the adjacent plains. The active channel is located against the left valley limit and is about 40 feet wide. A low terrace forms the right bank and extends about 200 feet to the south. Several higher terraces are present further to the south.

The river exhibits an irregular meander pattern with an obvious pool/riffle sequence. Downstream progression is the dominant form of lateral activity. Several ancient meander scars are present in the valley floor in this reach, but they are well above the present floodplain and there is no evidence of recent channel change. Shale bedrock outcrops along the left bank and in the bed of the stream immediately above the crossing. A thin veneer of gravel and cobble overlies the bedrock.

Lateral Scour Potential: The Judith River is relatively stable with no evidence of recent channel migration. Burial at maximum depth is recommended across the active channel and the low terrace which forms the right overbank area, or a total distance of about 220 feet.

Bed Scour Potential: The results of the analysis of bed scour potential for the Judith River crossing are:

100-year flood discharge: 5190 cfs
Maximum depth of 100-year flood: 8.8 ft
Average channel velocity: 12.8 fs
Channel slope: 0.0058 ft/ft

Historic Depth of Scour: The depth of scour during a flow of 2950 cfs was approximately 4 feet. This depth is derived from streamflow measurements at the USGS streamflow gage (No. 06135000) located approximately 14 miles upstream of the crossing.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage number 06135000) for the period 1969 to 1992. Based on these data, no trend of stream channel degradation with time is evident.

MISSOURI RIVER

The Missouri River will be crossed by directional drilling. A detailed geotechnical and laboratory investigation of the Missouri River crossing area was made for the Altamont Pipeline.

Site Geomorphology: Near Virgelle, Montana the Missouri River has formed a narrow, meandering, incised valley approximately 200 feet deep and up to 4000 feet wide. At present, the river is located near the east valley wall and forms an irregular meander pattern by deflecting off the valley walls. The valley walls are formed of white and buff colored, fine grained sandstone and siltstone of the Cretaceous Eagle Sandstone Formation. Upon exposure, the bedrock readily weathers, forming a badlands topography capped by resistant "ironstone" layers.

The Eagle Sandstone Formation conformably overlies the Marias Shale Formation. The Marias Shale dips slightly to the northeast directly under the valley fill along the preferred drill route. The Marias Shale Formation consists of a dark gray, laminated, claystone and shale with sandstone lenses.

Approximately 20 to 40 feet of glacial moraine material overlies the bedrock and forms the upland surface away from the river. The moraine consists of a heterogenous mixture of gravel and boulder-size material in a clay matrix.

with a median bed size of about 41 mm. No bedrock is apparent in the streambed or valley floor. Three logs were obtained for wells drilled in Shawmut. The valley fill varied from 21 to 28 feet deep over an underlying gray shale.

Lateral Scour Potential: The low right overbank area is frequently inundated and has several shallow flood channels. Channel adjustment upstream could result in a new channel being established in this area. The left overbank also is flooded during high flow periods and a swale accommodates flow at the left margin. Due to the potential for channel migration, burial at maximum depth is recommended across the entire floodplain, or a total distance of about 500 feet.

Bed Scour Potential: The results of the analysis of bed scour potential for the Musselshell River crossing are:

100-year flood discharge: 9000 cfs
Maximum depth of 100-year flood: 13.0 ft
Average channel velocity: 9.8 fs
Channel slope: 0.0017 ft/ft
Estimated depth of scour below the minimum thalweg elevation: 3 ft
Bed material: Well graded gravel, D_{50} = 41 mm

Historic Depth of Scour: USGS streamflow measurements (gage No. 06120500) approximately 15 miles upstream of the crossing measured a depth of scour during a flow of 2720 cfs of approximately 1 foot.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage No. 06120500) for the period 1957 to 1992. Based on these data, the channel appears to have degraded approximately 0.4 feet in 35 years.

about 300 feet wide with vertical banks. A large oxbow is present south of the active channel.

The bed of Arrow Creek is formed of poorly graded coarse sand (estimated median bed size 1.5 mm). The banks are silt and sand. There is no bedrock present within the valley floor. Considering the geologic history, the alluvial material may extend to great depth.

<u>Lateral Scour Potential:</u> Arrow Creek is geomorphically unstable at this location. Numerous recent cutoffs and meander scars occupy the valley floor. Burial at maximum depth is recommended across the entire width of the modern floodplain, or about 2800 feet.

<u>Bed Scour Potential:</u> Two deep auger holes, using a conventional engineering soils drilling rig, were drilled at the Arrow Creek crossing to determine the nature of the soil profile. In both borings, clayey soils which would impede scour were encountered with depth. The results of the analysis of bed scour potential for the Arrow Creek crossing are:

100-year flood discharge: 5890 cfs
Maximum depth of 100-year flood: 8.9 ft
Average channel velocity: 8.3 fs
Channel slope: 0.0020 ft/ft
Estimated depth of scour below the minimum thalweg elevation: 8 ft
Bed Material: Poorly graded sand, D_{50} = 2.0 mm

<u>Historic Depth of Scour:</u> Arrow Creek streamflow is not gaged by the USGS and therefore streamflow measurements and notes are not available.

<u>Degradation of Stream Channel:</u> Based on channel form, (i.e., vertical bank and recent incision), the stream appears to be degrading. However, due to the large scour depth estimated at this

Away from the active channel, about the upper four feet of the bedrock is soft and weathered. In the active channel, the bedrock surface is relatively fresh. Very little weathering or decomposition has occurred. The bedrock surface is relatively uniform and does not exhibit a U-shape below the active channel as would be expected if it had historically experienced scour. The fresh bedrock surface is interpreted to be the result of valley widening by lateral erosion of the south valley wall.

On the bluffs forming the south valley wall, 8 feet of residual silty soil overlies 26 feet of weathered sandstone, siltstone and claystone of the Cretaceous Telegraph Creek Formation. The Cretaceous Colorado Shale Formation underlies the Telegraph Creek and consists of dark gray shale and siltstone with thin irregular sand beds. The upper 20 feet of the Colorado Shale is highly weathered and fractured.

The bedrock is relatively flat. Dip was measured in the Telegraph Creek Formation from 2° E40°N to 3° E10°S. Two predominate fracture patterns were noted in the Colorado Shale. The first set of fractures trend to the east and dip approximately 85° to the north. The second set of fractures trend to the southeast and dip approximately 80° to the northeast. No zones of extreme fracturing were encountered that would indicate a subsurface fault trace in the area of interest. No faults are exposed in the bluffs in the immediate area, but a prominent fault is exposed in the bluffs approximately three miles upstream.

Lateral Scour Potential: At the crossing site there is no evidence of recent channel avulsion. The potential for avulsion appears to be minimal. Available aerial photos of the site were analyzed to determine historical lateral erosion. From 1962 to 1979 the north bank migrated 130 feet north. Since 1979, northward migration has been minimal, presumably due to the fact that the channel above the

Estimated depth of scour below the minimum thalweg elevation: 4 ft
Bed material: Well graded gravel, D_{50} = 53 mm

Historic Depth of Scour: Streamflow measurements at the USGS streamflow gage (No. 06110000) located approximately 20 miles upstream of the crossing, recorded a depth of scour during a flow of 1350 cfs of 0.7 feet.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage number 06110000) for the period 1919 to 1975. Based on these data, the channel appears to have degraded approximately one foot from 1919 to 1975.

MUSSELSHELL RIVER

Site Geomorphology: The Musselshell River has formed a broad mature valley with several terraces across the valley floor and sandstone bluffs forming the valley walls. In this reach the active channel is located near the center of the valley and is approximately 60 feet wide. The channel exhibits a tortuous meander pattern with numerous meander cutoffs. In the immediate crossing area, there is no evidence of recent channel migration. The active channel is confined into a single well formed U-shaped channel with a broad low floodplain forming the right overbank area and a low terrace about 200 feet wide forming the left overbank area. Both the left and right banks slope gently from the waters edge.

During extreme flow events, both the floodplain and low terraces are inundated. About 400 feet below the crossing, the channel splits around a small wooded island. Available aerial photography revealed that this island has been stable for at least 40 years.

The channel exhibits a pool/riffle sequence with pools about five feet deep. The bed material is a semi-rounded well graded gravel feet wide floodplain. A low irrigated terrace approximately five feet high, borders the left limit of the floodplain. The right limit of the floodplain is a steep bank approximately 20 feet high.

The bed material consists of a poorly graded gravel with sand. The median grain size is approximately 42 mm with a maximum bed material size of approximately 150 mm. There is no bedrock evident in the channel or valley floor. Only one well log in the immediate area is available. This well encountered 24 feet of alluvial sand and gravel over shale. Based on this information, bedrock may be present at a shallow depth beneath the streambed.

Lateral Scour Potential: The active channel is constantly changing across the entire width of the modern floodplain. Burial at maximum depth is recommended across the entire modern floodplain, or about 1000 feet.

Bed Scour Potential: The results of the analysis of bed scour potential for the Rock Creek crossing are:

> 100-year flood discharge: 8270 cfs
> Maximum depth of 100-year flood: 10.7 ft
> Average channel velocity: 12.2 fs
> Channel slope: 0.0059 ft/ft
> Estimated depth of scour below the minimum thalweg elevation: 5 ft
> Bed material: Poorly graded gravel with sand, D_{50} = 42 mm

Historic Depth of Scour: USGS streamflow measurements (gage No. 06214000) located downstream of the crossing, measured a 1-2 feet depth of scour during a flow of 2310 cfs.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage No. 06214000) for the period 1984 to 1992. Based on this relatively short period of time, a trend of

YELLOWSTONE RIVER

Site Geomorphology: Near Park City, the Yellowstone River has formed a broad alluvial valley approximately two miles wide. High shale bluffs capped by resistant sandstone beds border the valley. The river flows near the south edge of the valley in this reach and in some areas has encroached upon the valley walls, resulting in steep bluffs of 100 feet or more at the waters edge.

At the pipeline crossing, the river is against the south valley wall. The steep bluffs consist of shale and siltstone of the Cretaceous Colorado Shale Formation. The active channel is split with a side channel gravel bar and moderate sized island. Two terraces border the active channel. The first extends approximately 3000 feet north of the river. The second, higher terrace is separated from the first by a distinct scarp approximately 10 feet high, and extends approximately one mile to the north valley wall.

The valley fill consists of alluvial gravel and sand overlying shale and siltstone bedrock of the Cretaceous Colorado Shale Formation. In and adjacent to the active channel, the alluvial material is extremely dense and coarse. Cobbles exceeding 12-inches in diameter are common. Away from the active channel, the alluvial material is relatively finer grained with sand lenses.

An extensive geotechnical investigation including drilling and laboratory testing was completed at the Yellowstone crossing for the Altamont Pipeline. Bedrock was encountered in all drill holes. The bedrock surface appears relatively uniform. In the overbank area away from the active channel bedrock was encountered at a depth of 17 to 19 feet. The total depth of the alluvium varied from 10.1 feet to 14.5 feet. The alluvial material consisted of well graded sand, with gravel and occasional cobbles.

Lateral Activity Potential: The left bank is actively eroding at an average rate of 2 ft./yr. Burial at a maximum depth should be maintained for 100 feet beyond the left bank high point. The right overbank area is a low floodplain with an active high water channel at the right limit of the floodplain. Burial at maximum depth should be maintained across the entire width of the floodplain.

Bed Scour Potential: The results of the analysis of bed scour potential for the Clark's Fork Yellowstone River crossing are:

> 100-year flood discharge: 16810 cfs
> Maximum depth of 100-year flood: 12.4 ft
> Average channel velocity: 8.4 fs
> Channel slope: 0.0013 ft/ft
> Estimated depth of scour below the minimum thalweg elevation: 3 ft
> Bed material: Poorly graded gravel, D_{50} = 68 mm(2.7 inches)

Historic Depth of Scour: The Clarks Fork Yellowstone River channel exhibits a very low potential for bed scour. USGS streamflow measurements (gage No. 06208500) located just upstream of the crossing, measured a negligible depth of scour during a flow of 9500 cfs.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage No. 026208500) for the period 1929 to 1988. The stream channel appears to be degrading slightly over time. From 1929 to 1988, the channel appears to have lowered by approximately 1 foot.

SHOSHONE RIVER

Site Geomorphology: The Shoshone River is located on the north edge of a broad valley approximately 3 miles wide. An examination of aerial photography since 1939 revealed considerable migration of crossing is relatively straight and broad. The north bank is an abrupt shale bluff. Burial at maximum depth is recommended from the south bank to 50 feet beyond the north bank.

Bed Scour Potential: The results of the analysis of bed scour potential for the Yellowstone River crossing are:

> 100-year flood discharge: 66,900 cfs
> Maximum depth of 100-year flood: 16.2 ft
> Average channel velocity: 10.5 fs
> Channel slope: 0.0016 ft/ft
> Estimated depth of scour below the minimum thalweg elevation: 4 ft
> Bed material: Gravel and cobbles, D_{50} = 127 mm (5 inches)

Historic Depth of Scour: The nearest USGS streamflow gage to the crossing site is located in Billings, Montana (USGS gage No. 06214500). The scour depth during a 49,400 cfs flood event was found to be 0.4 feet.

Degradation of Stream Channel: A comparison of streamflow rating curves for the USGS gage at Billings, Montana from 1968 through 1990, revealed that there is no general trend of aggradation or degradation at that site.

ROCK CREEK

Site Geomorphology: Rock Creek drains a large area of high mountains and foothills in south-central Montana. The Express Pipeline crossing is about two miles upstream of the confluence of Rock Creek and Clarks Fork Yellowstone River. The valley of the two drainages in this area is about two miles wide. The active channel at the crossing exhibits an irregular meander pattern with numerous gravel bars and a low floodplain. The active channel is approximately 90 feet wide and is located in the center of a 1000

Historic Depth of Scour: USGS streamflow records (gage No. 06285100) approximately 1 mile upstream of the crossing site measured a depth of scour during a flow of 15,700 cfs of 2 to 3 feet.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage No. 06285100) for the period 1966 to 1986. Based on these data, the channel appears to have degraded by approximately 2 feet over this time period. An additional 2 feet of burial is recommended to compensate for degradation.

GREYBULL RIVER

Site Geomorphology: The Greybull River has eroded a relatively flat alluvial valley approximately 4500 feet wide approximately 200 feet below the adjacent shale hills. The active channel is located near the north edge of the valley and exhibits an irregular meander pattern. It splits at the Express Pipeline crossing with a total width of approximately 220 feet. The dominant form of lateral activity is downstream progression with active erosion on the outside and point bar deposits on the inside of bends. High flows frequently occupy a shallow floodplain approximately 1300 feet wide.

At the crossing, the left limit of the floodplain is an abrupt bluff which forms the left valley wall. The right limit of the floodplain is a shallow bench approximately 2 feet high. The valley extends at a relatively even grade to the south. The left bank slopes are steep, approximately three feet high and actively eroding. The right bank slopes gradually from the waters edge and consists of exposed gravel and cobbles.

No bedrock is evident in the channel or valley. Information from nearby bridges and pipelines indicated that bedrock could be expected beneath the channel thalweg at a depth of 8 to 12 feet.

consistent degradation with time was not apparent. However, the bed elevation did however fluctuate by approximately one-half foot through this period. "Bridge Level Notes" for the Highway 310 bridge were obtained from the Montana Department of Transportation for the period 1973 to 1988. This information indicated that the channel bed did not significantly change during this period.

CLARKS FORK YELLOWSTONE RIVER

Site Geomorphology: The Clarks Fork Yellowstone River has formed a broad alluvial valley approximately 9,000 feet wide. The active channel is incised 15 to 20 feet below the valley floor and is located near the right valley wall. The active channel is about 200 feet wide and exhibits an irregular meander pattern with occasional mid-channel and side channel gravel bars. The dominant form of lateral activity in this reach of the river is downstream progression and meander cutoff.

The crossing is located in a relatively straight stretch between a moderate bend above the crossing and a sharp bend below. The left bank is near vertical, approximately 18 feet high and actively eroding. An analysis of available aerial photography revealed that the left bank has migrated approximately 75 feet to the west since 1954 (2 feet/year). The right bank slopes gently from the waters edge to a low floodplain that extends approximately 500 feet. An active high water channel is located against the extreme right floodplain limit.

The bed material consists of coarse poorly graded gravel with a median bed size of 68 mm and maximum bed size of about 250 mm. No bedrock is visible in the streambed or valley floor. Several well logs were available. Thirty-five feet or more of alluvium was encountered in these wells. If this depth of alluvium is uniform across the valley, a minimum of five to 10 feet of alluvium should underlie the bed of the river.

and sandstone hills. The river is located approximately 4000 feet from the left valley wall. The active channel is approximately 160 feet wide and has an irregular channel pattern. Downstream progression appears to be the dominant form of lateral activity, although the presence of high water channels in the active floodplain suggest that avulsion may occasionally occur during extreme flow events. Occasional islands and prominent point bars are present.

During low flow periods, the left bank of the Express Pipeline crossing is shallow and extends approximately 200 feet to a high, steep bluff. During high flow events, flow is concentrated in the area against the bluff and in the active channel. The right bank, consisting of gravel and cobbles, gradually slopes away from the waters edge for approximately 500 feet across a broad flat. This flat is inundated only occasionally during extreme flow events. A high water channel is located approximately 200 feet to the right of the active channel.

The bed material consists of poorly graded gravel and cobbles with a median bed material size of 75 mm and a maximum bed material size of 250 mm. Bedrock is not visible in the bed or banks of the river, but does form a bluff beyond the left bank. Bedrock may be present below the channel at shallow depth.

Lateral Scour Potential: The dominant form of lateral activity is downstream progression. At the crossing, the left overbank is frequently inundated and the channel is migrating in this direction. The right overbank is less frequently inundated. However, when inundated the right overbank experiences slow backwater flow. There is a high water channel approximately 200 feet beyond the right bank which presents the possibility of channel migration during an extreme event. Burial at maximum depth will be recommended from the high bluff on the left to beyond the high water channel on the right, or about 950 feet.

the active channel in the crossing area. The active channel exhibits an irregular channel pattern with frequent islands and mid-channel and side channel bars. The modern floodplain is approximately 1100 feet wide. The active channel is approximately 120 feet wide and incised approximately 5 feet into the floodplain. Numerous side channels and sloughs are evidence of irregular lateral activity.

The confluence of Sage Creek with the Shoshone River is approximately 3000 feet below the Express Pipeline crossing. A dry sagebrush covered bench separates the Shoshone River from Sage Creek in the crossing vicinity.

The bed material consists of poorly graded gravel with a median size of 82 mm and maximum size of about 200 mm. No bedrock is visible in the bed or banks of the river. Available bridge data suggest that bedrock is at a shallow depth below the channel.

Lateral Scour Potential: Inspection of aerial photography since 1939 provided evidence of recent channel migration across the total width of the modern floodplain. Burial at maximum depth is recommended across the entire width of the modern floodplain, or about 1200 feet.

Bed Scour Potential: The results of the analysis of bed scour potential for the Shoshone River crossing:

> 100-year flood discharge: 21,000 cfs
> Maximum depth of 100-yr flood: 15.2 ft
> Average channel velocity: 13.3 fs
> Channel slope: 0.0029 ft/ft
> Estimated depth of scour below the minimum thalweg elevation: 5 ft
> Bed material: Poorly graded gravel with sand, D_{50} = 82 mm

Bed Scour Potential: The results of the analysis of bed scour potential for the Big Horn River crossing are:

> 100-year flood discharge: 20,600 cfs
> Maximum depth of 100-year flood: 17.3 ft
> Average channel velocity: 11.9 fs
> Channel slope: 0.0017 ft/ft
> Estimated depth of scour below the minimum thalweg elevation: 3 ft
> Bed material: Poorly graded gravel, D_{50} = 74 mm

Historic Depth of Scour: USGS streamflow measurements (gage No. 06269000) from approximately 3 miles downstream of the proposed crossing recorded a depth of scour during a flow of 3,330 cfs of approximately 1 foot. Approximately 40 miles downstream near Kane, Wyoming, a USGS streamflow gage (No. 06279500), recorded the depth of scour as negligible during a flow of 23,300 cfs.

Degradation of Stream Channel: Channel rating data were obtained from three USGS streamflow gages. USGS gage number 06268600 in Worland recorded stream degradation of 0.9 feet from 1965 through 1969. USGS gage number 06269000 near Manderson recorded stream degradation of 0.5 feet from 1949 through 1956, and USGS gage number 06279500 at Kane recorded stream degradation of 0.2 feet from 1956 through 1971. An additional 2 feet of burial is recommended to account for degradation.

Lateral Scour Potential: The Greybull River demonstrates active lateral activity and occupies the entire floodplain between meander bends. Burial at maximum depth will be recommended across the entire floodplain width, or about 1300 feet.

Bed Scour Potential: The results of the analysis of bed scour potential for the Greybull River crossing are:

100-year flood discharge: 21,100 cfs
Maximum depth of 100-year flood: 12.6 ft
Average channel velocity: 11.2 fs
Channel slope: 0.0032 ft/ft
Estimated depth of scour below the minimum thalweg elevation: 5 ft
Bed material: Poorly graded gravel D_{50} = 35 mm

Historic Depth of Scour: USGS streamflow records (gage No. 06277500) from approximately 4 miles upstream, measured depth of scour of approximately 10 feet during a flow of 8,120 cfs. The USGS observer noted: "Considerable scour at left upstream bridge abutment (repaired by dumping car bodies in against embankment after we left)". However, this was an occurrence of local scour at bridge abutments, and is not necessarily representative of scouring in the natural channel.

Degradation of Stream Channel: Channel rating data were obtained from the USGS (gage No. 06285100) located approximately 4 miles upstream of the crossing site for the period 1951 through 1970. These data indicate that the channel appears to have degraded by approximately 2½ feet over this period. An additional 2 feet of burial is recommended to compensate for potential bed degradation.

BIGHORN RIVER

Site Geomorphology: The Bighorn River has formed a broad valley approximately 3 miles wide and 400 feet below the surrounding shale

Appendix H

Geologic Evaluation of Unstable Slopes Along the Altamont Pipeline Route in Upper Arrow Creek, Montana

However, overall the valley walls appear very stable. The stable slopes are presumably due to the fact that the hillsides are dry and well drained.

An intermittent tributary of Arrow Creek occupies the valley bottom. The stream flows during wet periods and in response to local runoff events. The stream is actively eroding laterally and degrading with vertical soil and bedrock banks and a shallow mud and gravel bed. Due to the rapid erosion and downcutting of the drainages during valley formation, soil depths are minimal in most areas.

From Stations 5920+00 to 5980+00 the route parallels the drainage below a series of benches. The benches appear to be the remnants of streamcut benches modified by soil movement. This is evidenced by several facts. The benches extend unbroken down the valley for over a mile at a uniform gradient and grade into the next order drainage. The benches are formed of bedrock and the bedrock where exposed in side drainages that cut through the benches appears unbroken and at the same general attitude as bedrock in the adjoining hillside. Remnants of streamcut benches are visible at various elevations along the valley walls. In any case, the slopes in the lower section of the drainage are stable, dry and there is no saturated ground, seeps or willows or other water-loving vegetation in this reach.

At about Station 5980+00 the pipeline will cross the creek and the original route proceeds straight up the slope to the top of the ridge where it then follows the ridgetop along an existing two-tracked road and ends up on the Arrow Creek Bench. In this reach at the base of the slope near the stream there is an area of shallow slumps caused by the stream undercutting and oversteepening the slope. The slumps are 30 to 40 feet across, arcuate with a shallow scarp and broken ground on the upslope side. During wet periods there is ponded water and saturated ground below the scarps. The ponded water is due to the slumping and not due to groundwater seepage. The slumps extend up the slope about 300 feet. Near the north edge of the unstable area and adjacent tributary drainage, the slopes are relatively stable. Above this point, the original route traverses a broad gentle streamcut bench before encountering the steep bedrock knolls near the top of the ridge. The bench has been modified slightly by soil creep but is stable and well drained. The rock slopes are stable.

An alternative routing was developed that would bypass the steep rock slopes and narrow ridge on the valley wall.

At the base of the valley the routing crosses the creek and proceeds straight up the slope (north to south) staying adjacent to a tributary drainage and to the north edge of the area of active soil slumping near the valley bottom (Stations 5981+00 to 5990+00). After leaving the valley bottom and climbing the first rise the alternate routing deviates from the original route (Station 5990+00) by veering to the south and climbing obliquely up a gentle slope to the southeast for about 1,000 feet crossing a minor drainage. The route then proceeds straight up a steep ridge for about 500 feet and follows a gentle slope for about 800 feet to the top of the Arrow Creek Bench climbing straight up a gravel laced steep slope about 20 feet high at the very top joining the original route at about Station 6020+00.

This routing is depicted on Figure 1. With the exception of the soil instability at the bottom of the valley, the slopes are stable in this reach. Other than minor soil creep and erosion in the steepest areas no soil slumps or other evidence of slope instability were noted. During final routing and construction care should be taken to ensure that the route will bypass the unstable area at the base of the valley by staying to the north and that above the valley floor the route does not include any sidehilling

GEOLOGIC EVALUATION OF UNSTABLE SLOPES ALONG THE ALTAMONT PIPELINE ROUTE IN THE UPPER ARROW CREEK AREA, MONTANA

The following report presents the results of a geologic evaluation of an area of unstable slopes along the route of the Altamont Gas Transmission Company pipeline in the Upper Arrow Creek area. The area of slope instability is discussed in Table 3A-6 and on Page 3A-14 of the PGT/PGE and Altamont Natural Gas Pipeline Projects Final Environmental Impact Statement. Figure 1 presents the original pipeline route and a recommended alternative routing. Recommendations are provided which would mitigate the unstable slopes located in the bottom of the drainage where the route leaves the valley floor.

Geologic Setting

Arrow Creek is one of several drainages that flow across gently sloping gravel covered terraces that form the northern portion of the Judith Basin. The streams have formed steep sided valleys that range in depth from a few feet near the heads of coulees to several hundreds of feet along the major stream courses. In the route area, the elevation difference between the Arrow Creek Bench and Arrow Creek is about 600 feet. The route follows a small northward flowing tributary of Arrow Creek which has formed a deeply incised valley in highly erodible shale of the Cretaceous Colorado Shale Formation. The topography is characterized by steep sideslopes, bare headcuts and remnants of benches formed as the tributary downcut and stabilized at various levels.

Along the route near the bottom of the valley on the east valley wall several areas of small shallow soil slumps were noted (see Figure 1). Additionally, several other small slumps were noted along the valley walls where erosion has oversteepened the slopes or where drainage has ponded and allowed the soils to saturate.

in steep areas. Positive drainage and ditch plugs are recommended in this reach to prevent the trench from acting as a collector and conduit for surface and subsurface waters which could result in soil saturation and instability.

Recommendations

1. The route should avoid the unstable slopes that are present along the valley bottom by being placed adjacent to a tributary drainage and north of the area of active slumping. In this reach the routing should proceed as straight up the slope as possible. By providing positive drainage after construction, the minor instability on the north edge of the area of active slumping will be mitigated.

2. Positive drainage and ditch plugs are recommended in this area in order to prevent the trench from acting as a conduit for surface and subsurface waters.

3. The route in this area should not include any sidehilling in steep areas.

Submitted by:

HKM ASSOCIATES

Dan Nebel, P.G.
Engineering Geologist

PROFESSIONAL GEOLOGIST
DANIEL C. NEBEL
PG-331
WYOMING

DN/cc

Appendix I

Yellowstone River Crossing Feasibility Study

ALTAMONT Gas Transmission Company

FILE COPY

May 6, 1992
Our File: 52.05

Montana Department of Natural
Resources and Conservation
1520 East Sixth Avenue
Helena, Montana 59620

VIA FEDEX

Attention: Mr. Art Compton
Chief, Facility Siting Bureau
Energy Division

Dear Art:

Re: ALTAMONT GAS TRANSMISSION COMPANY
Yellowstone River Crossing

In response to your letter to FERC dated March 1, 1991 which provided final comments of the State of Montana and specifically requesting a feasibility study on directionally drilling the Yellowstone River, this letter is intended to summarize our findings and conclusions relative to the optimum installation technique.

As you are aware, there have been numerous discussions relative to the merits of installation utilizing conventional open-cut methods versus directional drilling techniques. Various field investigations, construction analyses and capital cost estimates were completed as part of Altamont's evaluation process. As presented at the Lewistown meeting on March 31, 1992, the results of this effort indicate that the open-cut method is the optimum installation technique. The following sections describe in greater detail the rationale utilized to arrive at this conclusion.

1) Capital Cost Comparison

At Altamont's request, Singleton Associated Engineering Ltd. (SINGLETON) provided capital cost comparisons for installing the Yellowstone River crossing utilizing both the open-cut and directional drilling methods. In order to prepare a comparative analysis it was necessary to select a more suitable crossing location for the directional drill. The location selected was approximately 0.5 miles downstream and actually reduced the overall pipeline length by approximately 500 feet. A subsurface investigation program was completed at the Yellowstone River crossing location by Altamont's geotechnical consultants, HKM Associates, and core samples of the Colorado Shale were obtained. Copies of this report were provided to you at our joint meeting in Lewistown on March 31.

In late January, 1992 two experienced directional drilling contractors, Cherrington Corporation and SPIE Horizontal were requested to visit the site and prepare budgetary estimates based on their field investigations, core sample analysis and previous crossing experience. The average of the two estimates was used to arrive at the directional drilling cost.

A budgetary cost estimate to install the Yellowstone River crossing utilizing conventional open cut methods was prepared by SINGLETON based on 1992 union rates. A second cost estimate was prepared by Pentzien, Inc. of Omaha, Nebraska, an experienced pipeline river crossing construction contractor, which confirmed the accuracy of the original estimate.

Post Office Box 16
Ste 600, 300 Fifth Avenue S.W.
Calgary, Alberta
Canada T2P 3C4
Phone (403) 531-1200
Fax (403) 531-1229

The resultant cost studies indicated that the directional drilling method would cost approximately $5.8 million to complete assuming that no complications were encountered that would delay or eliminate the success of the drilling operation. The risks involved to directionally drill a river crossing are significant and previous experience has shown that the costs always tend to increase after drilling operations commence. Conversely, the risk of failure associated with an open-cut installation at the Yellowstone River is minimal. By comparison, the cost estimate to install the open-cut crossing is approximately $1.2 million.

2) Open-Cut Method and Schedule

Altamont proposes to install the Yellowstone River crossing in late August or early September of 1993, a time of year when the main channel is reduced to about 200 feet in width and the water depth at the deepest point is only 5 - 6 feet. The availability of core samples along the proposed alignment allows us to accurately assess the in-stream activity and duration involved to install the pipeline utilizing conventional open-cut techniques. Attachment #1 outlines the various activities and their corresponding time frame. As noted on the schedule in-stream activity in the main channel is expected to be six (6) days.

It is presently proposed that the 1,300' river crossing section (drag section) would be welded, radiographed, continuously concrete coated and hydrostatically tested on the north bank prior to the commencement of any in-stream excavation. The concrete coating is applied to the pipe at a thickness that will ensure that the pipe will not float plus protect the pipe and external corrosion coating from damage during the installation and backfilling operations. Large hydraulic backhoes will be used to excavate the trench in the main channel and on the gravel bar to the south, a distance of approximately 1,100 feet. The final trench size is difficult to determine but will likely be in the order of 5 - 10 feet wide at the bottom and 20 - 30 feet wide at the top. Some spoil material will need to be placed in the main channel; however, sufficient gaps will be maintained so as not to restrict flow. Since pipe will be installed into the Colorado Shale it will be necessary to excavate the bedrock. It is possible that hydraulic backhoes will be able to trench through the bedrock, however, it may be necessary to drill and blast the bedrock prior to excavation. This phase of the construction would be short term and would not significantly increase downstream sedimentation. All trenching activities on both sides of the main flowing channel of the river will be completed in advance and present no disturbance to the main channel flow.

After the trenching operation the ditch will be inspected and profiled to ensure its suitability. Upon confirmation, the concrete coated drag section of pipe will be pulled into the trench and immediately backfilled with parent material. Following backfilling, the river section will again be hydrostatically tested, after tying-in the adjacent mainline sections, to ensure its integrity.

During construction on the banks, especially on the south side of the river in the Bellion Creek area, appropriate construction means will be utilized. The spoil will be excavated, handled, and piled, and the necessary silt/filter fences, hay bales, and/or ditch plugs will be installed so that soil run off into the river will not occur.

.../3

According to the HKM Associates report, the north bank of the river migrated north by approximately 130 feet between 1962 and 1979, and further migration has been minimal since that time. Altamont will maintain the necessary pipeline depth, approximately 500 feet into the north bank, and return the disturbed area back to its original contours and achieve adequate bank stabilization after the pipeline is installed. The HKM report also states that the channel is currently relatively straight and broad in the area of the crossing, so these measures will provide added assurance against lateral scour or erosion.

On the south side of the river, Altamont plans to install the pipeline with sufficient depth far enough up into the Beilion Creek intermittent drainage so that the northwest bank of Beilion Creek will act to protect the disturbed pipeline trench area from the flow of the Yellowstone River. The northwest bank of the creek will not be disturbed and the area on the southeast bank of the creek, which is disturbed during construction, will be well stabilized after pipe laying.

3) Environmental Mitigation

Altamont's objective at the Yellowstone River, as it is for all river crossings, is to install a sound and secure pipeline in an environmentally safe and acceptable manner utilizing the most efficient and cost-effective method available.

A major environmental concern is minimizing the amount of siltation and turbidity created while dredging out a river bottom. In the case of the Yellowstone, as evidenced by the soil conditions presented in the HKM Associates geotechnical investigation boring logs, the percentage of silt and clay (fines) is approximately 6% of the soil on top of the bedrock in the area of the proposed open-cut, with gravel comprising approximately 60% of this overburden material. Samples (DH-4), (DH-5), and (DH-6) indicate that the overburden consists of "well-graded gravel with sand", being coarse cobble up to 16" in diameter. When dredging, the gravel and sand will tend to settle out before travelling an appreciable distance downstream. Therefore, because the fines constitute such a small percentage and since the duration of instream activity will be minimized, there will not be the potential for suspension of fines over a large area.

4) Previous Experience

The Niagara River crossing in Niagara Falls, New York was installed by SPIE Horizontal Drilling, Inc., from August until late November, 1991. The Niagara is a river of tremendous size and current. It is approximately 1,800 feet wide, 50 feet deep throughout almost the entire width, with a massive flow created by the waters of Lake Erie emptying into the comparatively narrow channel of the Niagara River. The centerline of the river is the international border between the United States and Canada, and the Canadian banks are an archaeological site. Open cutting the Niagara River did not present clear-cut advantages over directional drilling in the preliminary phases. With the Yellowstone crossing being narrower and shallower, and with no archaeological sites, open cutting is a job of much less magnitude, impact, and cost than it would have been at the Niagara.

.../4

There are may similarities between the directional drilling conditions at the Niagara River and at the Yellowstone River, however, which warrant comparisons between the two. The Niagara was a 30" crossing, approximately 3,000 feet in length, and in Queenston shale bedrock with an average compressive strength of 3,000 to 4,000 psi. A Yellowstone directional drill would be a 30" crossing, approximately 3,000 feet in length, and in Colorado Shale bedrock with a compressive strength averaging 2,000 to 3,000 psi.

On the Niagara crossing, much experimentation occurred as several different types of downhole drilling assemblies did not perform to pre-job expectations. Reamer cutter cones and bearings had to be constantly changed out as drilling operations progressed, even though the rock was considered to be very drillable before the project started. A reamer failed downhole and parts broke loose from it. Hundreds of thousands of dollars were spent retrieving the parts before drilling could continue. There were several times over the course of the job when the success of the crossing was in question. Enough new directional drilling knowledge and technology was not developed or proven on the Niagara River crossing to ensure the successful drilling of the Yellowstone River.

The Niagara River crossing directional drilling undertaking was based on a cost reimbursable contract because none of the approved contractors were willing to bid on a firm price basis. The current overall cost of more than $3,200 per linear foot of bore is significantly greater than the highest preliminary estimates, which were based largely on budgetary information furnished by the drilling contractors. Since the drill path and material encountered at the Yellowstone is relatively similar to the Niagara, Altamont has serious concerns about entering into this type of installation attempt.

The associated risk would necessitate that Altamont develop contingency schedules and plans since the possibility of a failure or prolonged installation period exists. The risks cannot be eliminated simply by advancing the start date and assuming that the directional drill will be completed prior to the completion of the mainline segment. At the Niagara, there were already two existing 20" lines flowing natural gas across the river while directionally drilling was being performed, and thus there was not a critical completion date. Therefore, the project taking two and one third times longer to complete than was projected did not cause major gas flow problems. Altamont will not have that luxury with the Yellowstone crossing. In contrast, the time for open cutting the Yellowstone can be scheduled and projected much more accurately because all the applicable river construction procedures have been successfully performed many times. Perhaps more importantly, there is no risk of failure associated with open cutting the Yellowstone River.

.../5

5) Conclusions

Upon examining and comparing costs, scheduling, previous experiences, environmental impact, security and risk factors Altamont has concluded that the significant additional cost of $4.6 million ($5.8 million less $1.2 million) to directionally drill versus open-cutting the Yellowstone River far out weighs any anticipated benefits that would be derived from such an undertaking. We cannot reasonably justify the additional costs involved to our ultimate pipeline system users and it is therefore Altamont's conclusion that directionally drilling the Yellowstone River is infeasible and that the concept be dropped from further consideration. In conclusion, Altamont recommends that traditional open-cut crossing procedures be implemented at the Yellowstone River crossing as originally proposed.

Altamont is prepared to meet with you to go over any of the details referenced herein. In the meantime, we are pursuing the design and permitting of an open-cut crossing of the Yellowstone River.

Please advise if you have comments or questions.

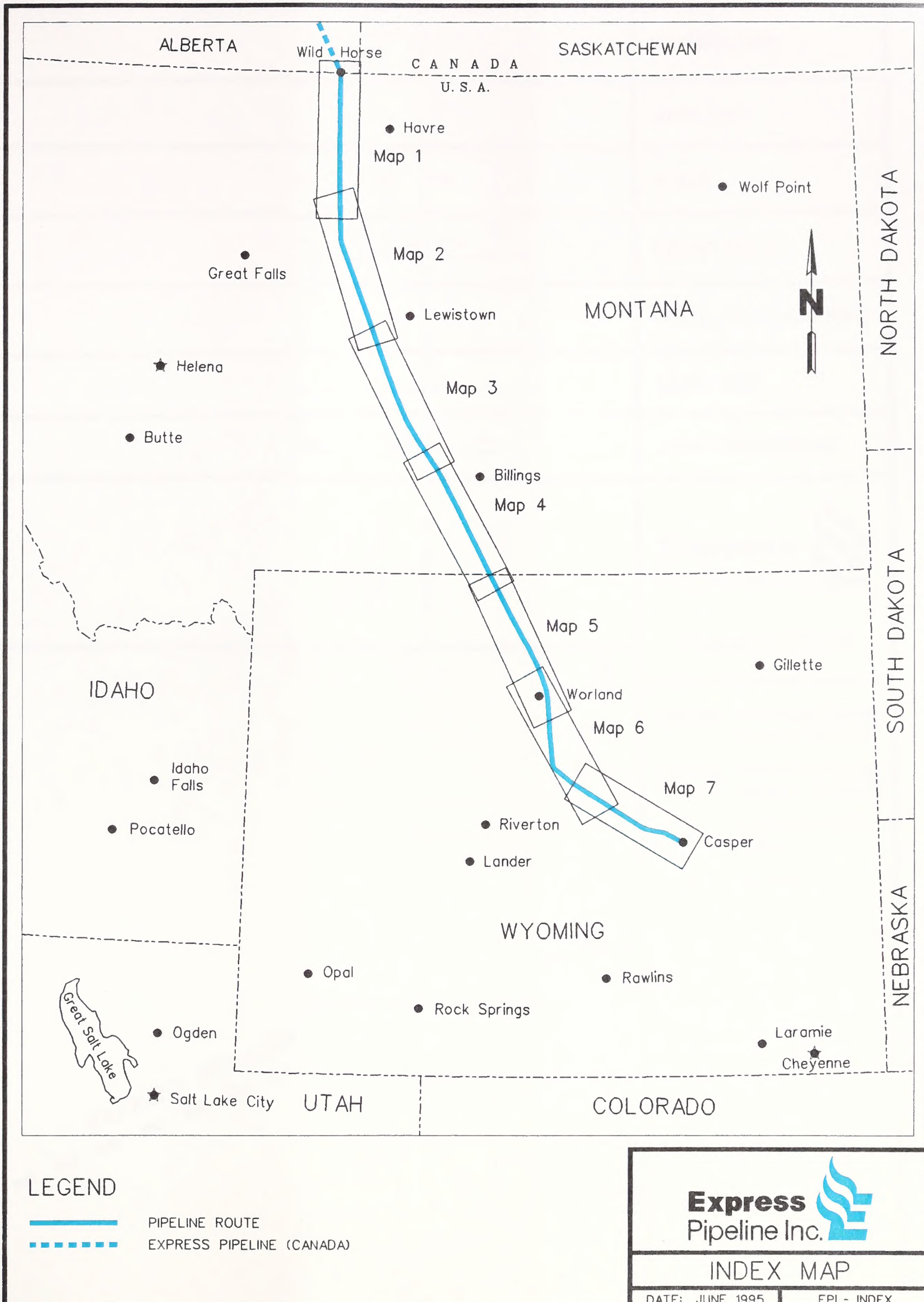
Yours very truly,
ALTAMONT GAS TRANSMISSION COMPANY

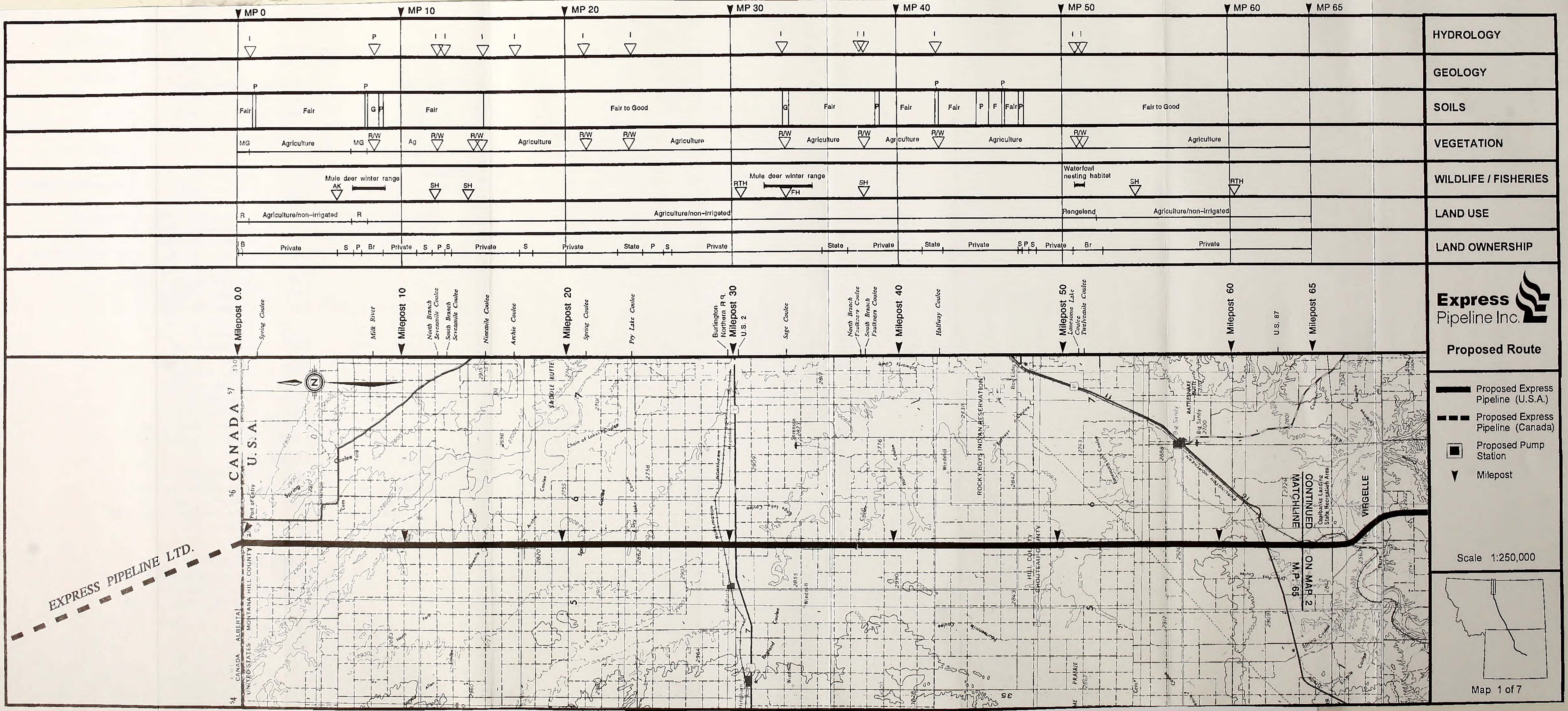
B.W. Hanna, P. Eng.
Technical Manager

BWH/jss
c.c.: Gary Cheatham
Richard Lyons
Lorraine Guevara
Barry Singleton
Dean Mutrie
Orrin Ferris/Dan Nebel

Appendix J

Strip Maps of Pipeline Route
Montana (Maps 1-4)
Wyoming (Maps 5-7)


ALBERTA
Wild Horse
CANADA
U. S. A.
SASKATCHEWAN
Havre
Map 1
Wolf Point
Map 2
Great Falls
Lewistown
MONTANA
N
NORTH DAKOTA
Helena
Map 3
Butte
Billings
Map 4
Map 5
Gillette
IDAHO
Worland
Map 6
SOUTH DAKOTA
Idaho Falls
Map 7
Pocatello
Riverton
Casper
Lander
WYOMING
NEBRASKA
Opal
Rawlins
Rock Springs
Great Salt Lake
Ogden
Laramie
Cheyenne
Salt Lake City
UTAH
COLORADO
LEGEND
PIPELINE ROUTE
EXPRESS PIPELINE (CANADA)
Express Pipeline Inc.
INDEX MAP
DATE: JUNE 1995
EPI - INDEX



MP 0
MP 10
MP 20
MP 30
MP 40
MP 50
MP 60
MP 65
HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP
Fair
Fair
Fair
Fair to Good
Fair
Fair
Fair
Fair to Good
MG
Agriculture
Ag
R/W
Mule deer winter range
AK
SH
RTH
FH
Waterfowl nesting habitat
Agriculture/non-irrigated
Rangeland
Private
State
Milepost 0.0
Spring Coulee
Milk River
Milepost 10
North Branch Sevenmile Coulee
South Branch Sevenmile Coulee
Ninemile Coulee
Archie Coulee
Milepost 20
Spring Coulee
Dry Lake Coulee
Burlington Northern R.R.
Milepost 30
U.S. 2
Sage Coulee
North Branch Faulkners Coulee
South Branch Faulkners Coulee
Milepost 40
Halfway Coulee
Milepost 50
Lonesome Lake Coulee
Twelvemile Coulee
Milepost 60
U.S. 87
Milepost 65
Express Pipeline Inc.
Proposed Route
Proposed Express Pipeline (U.S.A.)
Proposed Express Pipeline (Canada)
Proposed Pump Station
Milepost
Scale 1:250,000
Map 1 of 7
CANADA
U.S.A.
EXPRESS PIPELINE LTD.
ALBERTA
MONTANA
HILL COUNTY
CHOUTEAU COUNTY
ROCKY BOYS INDIAN RESERVATION
SADDLE BUTTE
RATTLESNAKE BUTTE
Big Sandy
VIRGELLE
MATCHLINE CONTINUED ON MAP 2 M.P. 65

KEY TO DATA GRAPHS

HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP

HYDROLOGY

C = Canal
I = Intermittent
(Includes Ephemeral streams
P = Perennial
Note: Groundwater not included

GEOLOGY

Geologic Hazards
F = Fault crossing
[Named faults are so indicated]
LL = Low landslide potential
HL = High landslide potential
(All routes are in seismic risk zone 1 unless otherwise noted)

SOILS

Rehabilitation Potential
G = Good
FG = Fair to good
F = Fair
PF = Poor to fair
P = Poor
(Additional detail is provided in Table 6-3-1)

VEGETATION

Ag = Agriculture
MG = Mixed grass prairie
PPF = Ponderosa pine forest
R/W = Riparian / Wetland
SG = Saltbrush / Wetland
SS = Sagebrush steppe

WILDLIFE / FISHERIES

Known occurrences or habitat of important fish and wildlife species within one-half mile of proposed pipeline centerline.

(C) = Cold water fishery
(W) = Warm water fishery
(C/Cl) = Cold / cool water fishery
(Cl / W) = Cool / warm water fishery
IRF = Important recreational fishery
ISH = Important spawning habitat
M = Mule deer winter range
P = Pronghorn winter range
UGB = Upland game bird nesting habitat
W = White-tailed deer winter range
Wf = Waterfowl nesting habitat
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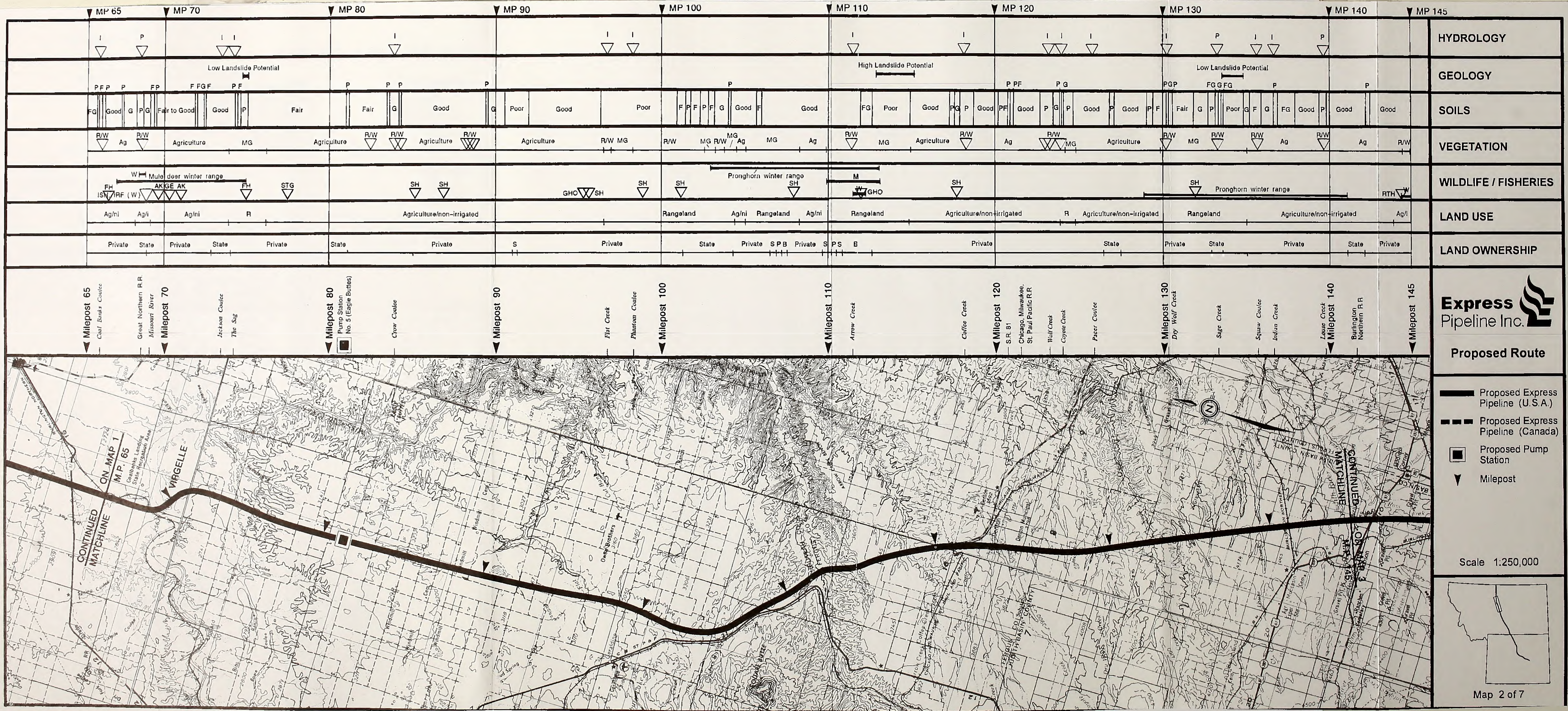
GHO = Great horned owl nest
BTPD = Black-tailed prairie dog colony
WTPD = White-tailed prairie dog colony

LAND USE

Ag/i = Agriculture / irrigated - includes broadcast & row crops
Ag/ni = Agriculture / non-irrigated - pasture & crops (dry, wheat & grass)
R = Rangeland
I = Industrial

LAND OWNERSHIP

B = Bureau of Land Management
Br = Bureau of Reclamation
I = International Boundary Commission
P = Private
S = State
C = County



MP 65
MP 70
MP 80
MP 90
MP 100
MP 110
MP 120
MP 130
MP 140
MP 145
HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP
Low Landslide Potential
High Landslide Potential
Low Landslide Potential
Mule deer winter range
Pronghorn winter range
Pronghorn winter range
Agriculture/non-irrigated
Rangeland
Private
State
Milepost 65
Coal Banks Coulee
Great Northern R.R.
Missouri River
Milepost 70
Jackson Coulee
The Sag
Milepost 80
Pump Station No. 5 (Eagle Buttes)
Crow Coulee
Milepost 90
Flat Creek
Phantom Coulee
Milepost 100
Milepost 110
Arrow Creek
Coffee Creek
Milepost 120
S.R. 81
Chicago, Milwaukee, St. Paul Pacific R.R.
Wolf Creek
Coyote Creek
Pacer Coulee
Milepost 130
Dry Wolf Creek
Sage Creek
Squaw Coulee
Indian Creek
Louse Creek
Milepost 140
Burlington Northern R.R.
Milepost 145
Express Pipeline Inc.
Proposed Route
Proposed Express Pipeline (U.S.A.)
Proposed Express Pipeline (Canada)
Proposed Pump Station
Milepost
Scale 1:250,000
Map 2 of 7
CONTINUED ON MAP 1 MATCHLINE M.P. 65
VIRGELLE
CONTINUED ON MAP 3 MATCHLINE M.P. 145

KEY TO DATA GRAPHS

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HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP

MP 145 | MP 150 | MP 160 | MP 170 | MP 180 | MP 190 | MP 200 | MP 210 | MP 220 | MP 225

HYDROLOGY: P P P P P P P P P P I C P I P I I I I I

GEOLOGY: F P G G P G G G F F P G G P P G P G G F P P G P F

SOILS: P FG P G P Good P G Poor Good FG G FG P Good Fair Good P P P F Fair to Good P G F Good P Good G Good P G Poor G Poor Poor Good G Poor Fair Poor P Poor Good Poor G P G Poor Good G Good P F P F Poor G F Good

VEGETATION: Agriculture R/W R/W Ag R/W R/W Ag Ag R/W R/W MG R/W Ag MG R/W Ag MG R/W Ag R/W MG Ag Mixed grass prairie R/W R/W Ag MG Ag MG Ag R/W MG Ag MG Ag R/W R/W R/W Mixed grass prairie R/W Ag

WILDLIFE / FISHERIES: W Pronghorn winter range FH FH W IRF (CI/W) BTPD GE AK

LAND USE: Agriculture/non-irrigated Ag/i Agriculture/non-irrigated Rangeland Ag/ni Rangeland Ag/ni Rangeland Ag/ni R Ag/ni Rangeland Ag/i Rangeland Ag/ni Rangeland Ag/ni R Ag/ni R Ag/ni Rangeland Ag/ni

LAND OWNERSHIP: Private S Private State Private State Private State P S P State Private State Private S

Milepost 145 — Judith River — U.S. 87 — Hauck Coulee — Milepost 150 — Big Coulee — Ross Fork Creek — Chicago Milwaukee, St. Paul Pacific R.R. (Abandoned) — East Buffalo Creek — Pump Station No. 5 (Straw) — Dry Creek — Chicago, Milwaukee, St. Paul Pacific R.R. (Abandoned) — Milepost 160 — Meadow Creek — Ross Fork Creek — U.S. 191 — Milepost 170 — Unknown R.R. — East Fork Roberts Creek — Milepost 180 — Roberts Creek — Alkali Creek — Milepost 190 — Deadman's Basin — Supply Canal — U.S. 12 — Chicago, Milwaukee, St. Paul Pacific R.R. (Abandoned) — Musselshell River — Mud Creek — Milepost 200 — Fish Creek — Rock Creek — Milepost 210 — Van Winkle Creek — North Fork Big Coulee Creek — South Fork Big Coulee Creek — Milepost 220 — Sixshooter Creek — Milepost 225

Express Pipeline Inc.

Proposed Route

- Proposed Express Pipeline (U.S.A.)
- Proposed Express Pipeline (Canada)
- Proposed Pump Station
- Milepost

Scale 1:250,000

Map 3 of 7

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HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP

MP 225 | MP 230 | MP 240 | MP 250 | MP 260 | MP 270 | MP 280 | MP 290 | MP 300 | MP 307

HYDROLOGY	P, P, I, P P P, P, P, P I P I P C C CC P, I, C PC P PPPC, P, I I P, P, I I I P I, I
GEOLOGY	GFP, G, P P, PGP P, PF FG FG/F P, P, P, GF, F, G, P, P, G PG PG G P, P FG, P
SOILS	F P Fair P F P Fair, Poor, Fair to Good, P P FG F F F Poor, FG, G FG, Poor, G G FG, FG, FG P G P, Good, Poor, F, Poor, G P FG, Good, Good PF, Poor, Poor to Fair, P G PF F Poor G PF, Good, PG P FG, Poor FG FG Fair
VEGETATION	R/W R/W R/W R/W, Ag MG, R/W, Agriculture, R/W PPF, MG, R/W, R/W MG, R/W, Ag, R/W MG, Ag, MG, R/W, Ag, R/W, Agriculture, Saltbrush - greasewood & Sagebrush steppe, Agriculture, Mixed grass prairie & saltbrush - greasewood, R/W, R/W, Mixed grass prairie & saltbrush - greasewood, R/W
WILDLIFE / FISHERIES	AK, RTH, W, ISH, IRF (C/CI), W, ISH, IRF (C/CI), W, RTH, Upland game bird nesting habitat, GE, SG, BTPD, IRF (C/CI), IRF (C), WTPD GE
LAND USE	Agriculture/non-irrigated, R, Agriculture/non-irrigated, Rangeland, Ag/ni, Ag/i, R, Ag/ni, Rangeland, Ag/i, Ag/ni, Rangeland, Ag/ni Ag/i, Ag/i, Ag/ni Ag/ni, Rangeland
LAND OWNERSHIP	S, Private, S, Private, S, Private, S, Private, State, Private, State, Private, S, P, B, Private, B, Private, B, S, Private, S, Private, Bureau of Land Management, Private

Milepost 225, Middle Creek, Cedar Creek, Gurney Creek, Milepost 230, Struck Creek, Toll Creek, Greenwood Creek, Milepost 240, North Fork Valley Creek, Valley Creek, Milepost 250, Valley Creek, Cottonwood Creek, Swamp Creek, Dry Creek, Valley Creek, Cove Ditch, Big Ditch, U.S. 10 / I 90, Northern Pacific R.R., Italian Ditch, Old Mill Ditch, Yellowstone River, Milepost 260, Farewell Creek, Free Silver Ditch, U.S. 212, Burlington Northern R.R., Rock Creek, Clawson Ditch, Unnamed Stream, U.S. 310, Pump Station No. 7 (Edgar), Northern Pacific R.R., Clark's Fork Yellowstone River, Five Mile Creek, Edgar Canal, Milepost 270, Five Mile Creek, Milepost 280, North Fork Bluewater Creek, Bluewater Creek, South Fork Bluewater Creek, Sage Creek, Milepost 290, Water Canyon, Inferno Canyon, King Canyon, Piney Creek, Cottonwood Coulee, Milepost 300, Bear Canyon, Milepost 307

Express Pipeline Inc.

Proposed Route

- Proposed Express Pipeline (U.S.A.)
- Proposed Express Pipeline (Canada)
- Proposed Pump Station
- Milepost

Scale 1:250,000

Map 4 of 7

KEY TO DATA GRAPHS

HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP

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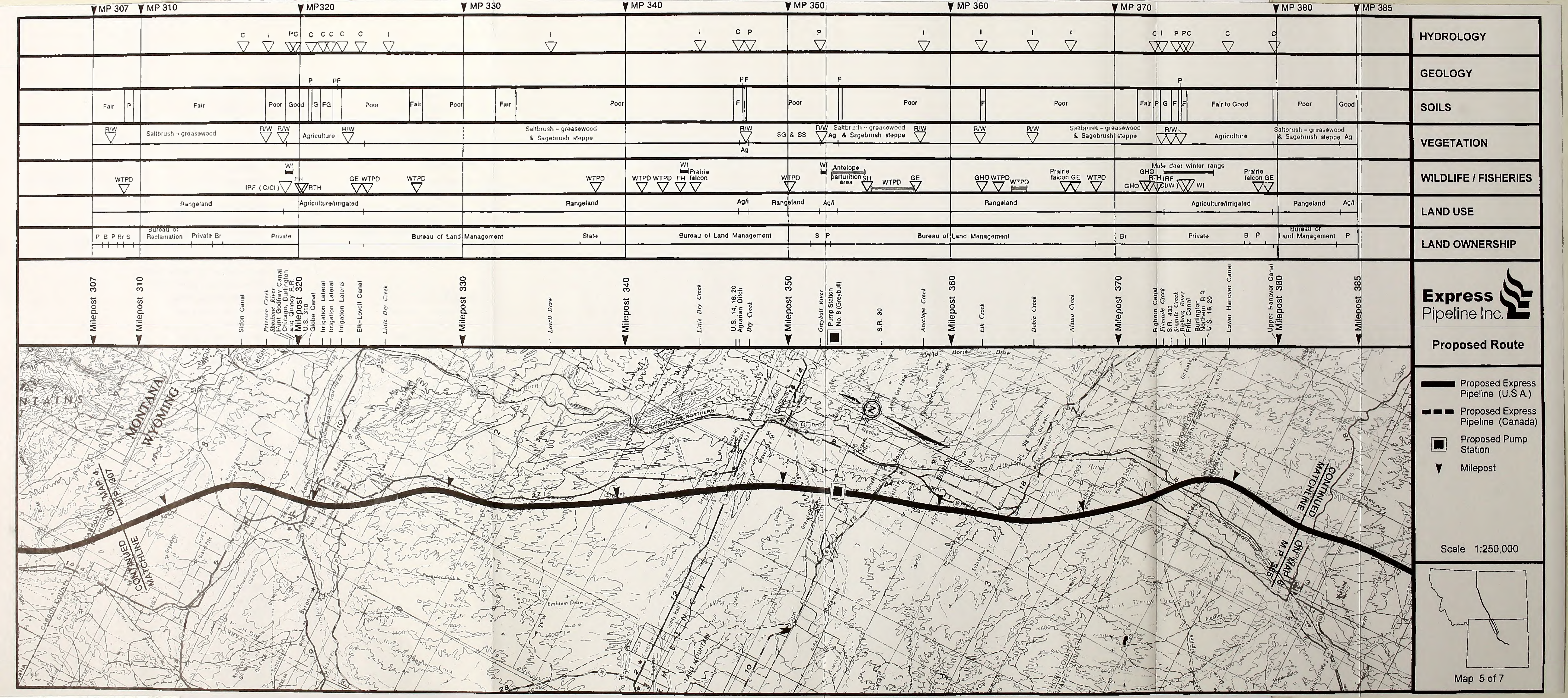

MP 307
MP 310
MP320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 385
HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP
Saltbrush - greasewood
Agriculture
Saltbrush - greasewood & Sagebrush steppe
Mule deer winter range
Antelope parturition area
Prairie falcon
Rangeland
Agriculture/irrigated
Bureau of Reclamation
Private
Bureau of Land Management
State
Milepost 307
Milepost 310
Sidon Canal
Peterson Creek
Shoshone River
Hunt Godfrey Canal
Chicago, Burlington and Quincy RR
Milepost 320
U.S. 310
Globe Canal
Irrigation Lateral
Elk-Lovell Canal
Little Dry Creek
Milepost 330
Lovell Draw
Milepost 340
U.S. 14, 16, 20
Agrarian Ditch
Dry Creek
Milepost 350
Greybull River
Pump Station No. 8 (Greybull)
S.R. 30
Antelope Creek
Milepost 360
Elk Creek
Dobie Creek
Alamo Creek
Milepost 370
Bighorn Canal
Fivemile Creek
S.R. 433
Bighorn River
Fritz Canal
Burlington Northern R.R.
U.S. 16, 20
Lower Hanover Canal
Upper Hanover Canal
Milepost 380
Milepost 385
MONTANA
WYOMING
CONTINUED ON MAP 4 MATCHLINE M.P. 307
CONTINUED ON MAP 6 MATCHLINE M.P. 385
Express Pipeline Inc.
Proposed Route
Proposed Express Pipeline (U.S.A.)
Proposed Express Pipeline (Canada)
Proposed Pump Station
Milepost
Scale 1:250,000
Map 5 of 7

KEY TO DATA GRAPHS

HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP

HYDROLOGY

C = Canal
I = Intermittent
(Includes Ephemeral streams
P = Perennial
Note: Groundwater not included

GEOLOGY

Geologic Hazards
F = Fault crossing
[Named faults are so indicated]
LL = Low landslide potential
HL = High landslide potential
(All routes are in seismic risk zone 1 unless otherwise noted)

SOILS

Rehabilitation Potential
G = Good
FG = Fair to good
F = Fair
PF = Poor to fair
P = Poor
(Additional detail is provided in Table 6-3-1)

VEGETATION

Ag = Agriculture
MG = Mixed grass prairie
PPF = Ponderosa pine forest
R/W = Riparian / Wetland
SG = Saltbrush / Wetland
SS = Sagebrush steppe

WILDLIFE / FISHERIES

Known occurrences or habitat of important fish and wildlife species within one-half mile of proposed pipeline centerline.

(C) = Cold water fishery
(W) = Warm water fishery
(C/Cl) = Cold / cool water fishery
(Cl / W) = Cool / warm water fishery
IRF = Important recreational fishery
ISH = Important spawning habitat
M = Mule deer winter range
P = Pronghorn winter range
UGB = Upland game bird nesting habitat
W = White-tailed deer winter range
Wf = Waterfowl nesting habitat
STG = Sharp-tailed grouse lek
SG = Sage grouse lek
AK = American kestrel nest
SH = Swainson's hawk nest
RTH = Red-tailed hawk nest
FH = Ferruginous hawk nest
GE = Golden eagle nest
GHO = Great horned owl nest
BTPD = Black-tailed prairie dog colony
WTPD = White-tailed prairie dog colony

LAND USE

Ag/i = Agriculture / irrigated - includes broadcast & row crops
Ag/ni = Agriculture / non-irrigated - pasture & crops (dry, wheat & grass)
R = Rangeland
I = Industrial

LAND OWNERSHIP

B = Bureau of Land Management
Br = Bureau of Reclamation
I = International Boundary Commission
P = Private
S = State
C = County

HYDROLOGY

GEOLOGY

SOILS

VEGETATION

WILDLIFE / FISHERIES

LAND USE

LAND OWNERSHIP

Express Pipeline Inc.

Proposed Route

- Proposed Express Pipeline (U.S.A.)
- Proposed Express Pipeline (Canada)
- Proposed Pump Station
- Milepost

Scale 1:250,000

Map 6 of 7

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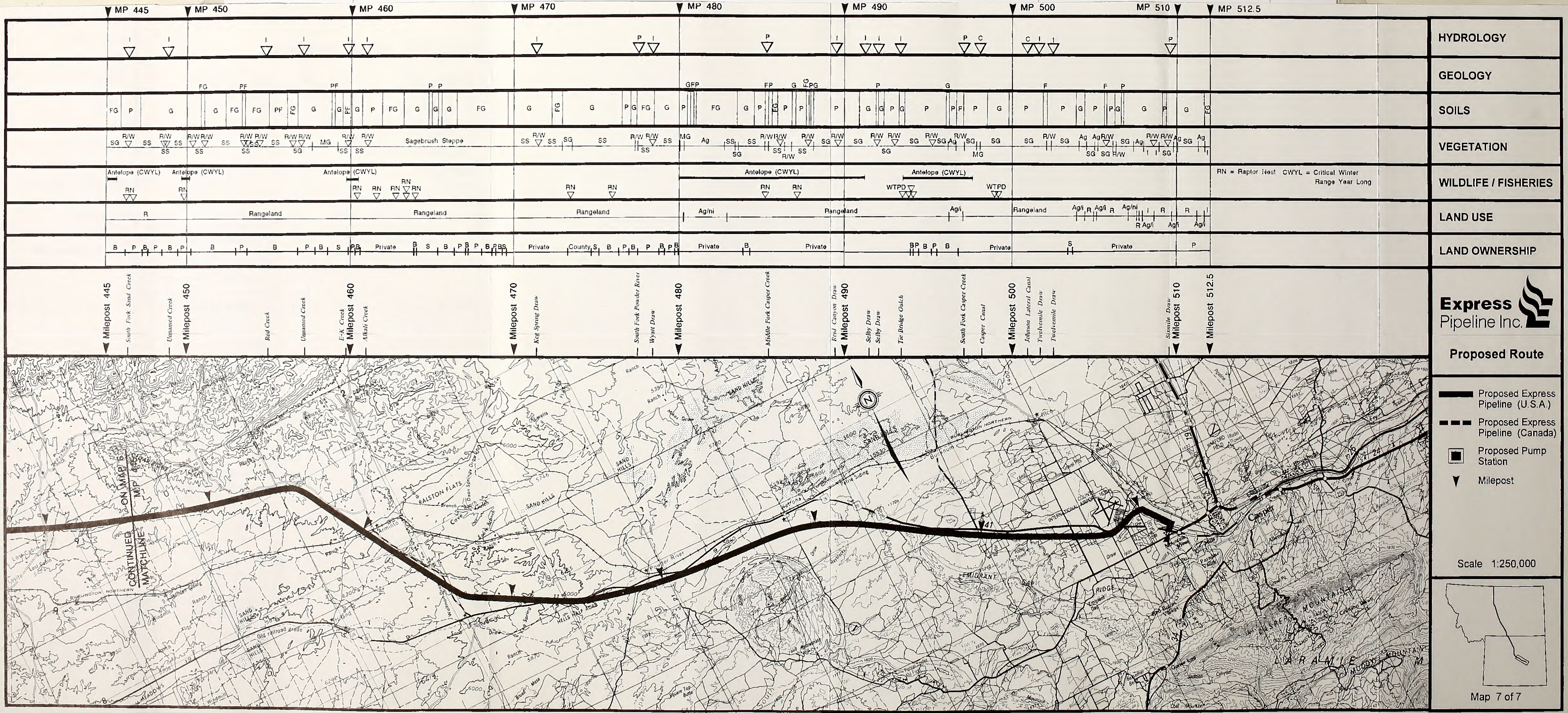
MP 445
MP 450
MP 460
MP 470
MP 480
MP 490
MP 500
MP 510
MP 512.5
HYDROLOGY
GEOLOGY
SOILS
VEGETATION
WILDLIFE / FISHERIES
LAND USE
LAND OWNERSHIP
Sagebrush Steppe
Antelope (CWYL)
RN = Raptor Nest CWYL = Critical Winter Range Year Long
Rangeland
Private
Milepost 445
South Fork Sand Creek
Unnamed Creek
Milepost 450
Red Creek
Unnamed Creek
Elk Creek
Milepost 460
Alkali Creek
Milepost 470
Keg Spring Draw
South Fork Powder River
Wyatt Draw
Milepost 480
Middle Fork Casper Creek
Red Canyon Draw
Milepost 490
Selby Draw
Selby Draw
Tie Bridge Gulch
South Fork Casper Creek
Casper Canal
Milepost 500
Johnson Lateral Canal
Twelvemile Draw
Twelvemile Draw
Sixmile Draw
Milepost 510
Milepost 512.5
Express Pipeline Inc.
Proposed Route
Proposed Express Pipeline (U.S.A.)
Proposed Express Pipeline (Canada)
Proposed Pump Station
Milepost
Scale 1:250,000
Map 7 of 7
CONTINUED ON MAP 6
MATCHLINE MP 445
RALSTON FLATS
SAND HILLS
Powder River
Natrona
Casper
EMIGRANT
RIDGE
CASPER MOUNTAIN
LARAMIE
MUDDY MOUNTAIN
BURLINGTON NORTHERN

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Appendix K

Draft 404 (b)(1) Evaluations for the Yellowstone River and Missouri River Proposed Pipeline Crossings

DRAFT 404 (B) (1) EVALUATION

EXPRESS PIPELINE PROJECT

MISSOURI AND YELLOWSTONE RIVERS CROSSINGS

1.0 MISSOURI RIVER CROSSING

Directional drilling is the method of choice for crossing the Missouri River. However, this Draft 404(b)(1) evaluation considers trenching the crossing as a contingency in the event that directional drilling proves infeasible.

1.1 FACTUAL DETERMINATIONS

1.1.1 Physical substrate determinations.

The proposed crossing of the Missouri River is at pipeline milepost. The site is located in Chouteau County, Montana, in the SW¼ Section 7 T26N R12E. The substrate material in the area of the crossing is believed to be sandy soils overlying dense sand and gravel. The pipeline would be placed in a trench approximately 15 feet deep (the greater of a minimum of five feet of cover or twice the scour depth plus the diameter of the pipe). The material proposed for backfilling the trench is the excavated substrate material. The trench would be inspected prior to placement of the pipe to verify full bearing and free stress conditions. Only minor changes in bottom contour would be expected to occur as the trench is backfilled to original contours.

1.1.2 Water circulation and fluctuation determinations.

Placement of the pipeline will, temporarily and to a minor degree, disrupt water circulation in the immediate work area during placement. The crossing would be accomplished during periods of low flow in a period from August to October. Excavated river substrate materials will be stockpiled immediately downstream of the trench with gaps between the piles, resulting in minor diversions of separated portions of the water body. Only brief, minute changes in water fluctuation would be caused by the pipe. The segment of pipeline within the limits of the river crossing would be preassembled and prepared for burial prior to being floated into position and sunk, or drawn, into the trench. Portions of the pipe segment would be in the flow streams of the river a matter of minutes if floated and sunk into the trench. After backfilling is complete, water circulation would immediately return to pre-construction conditions.

1.1.3 Suspended particulate and turbidity determinations.

Pipeline trench excavation (underwater disturbance of substrate material and deposition into mid-stream piles) and backfill (disturbance and underwater placement) would temporarily increase suspended particulates and turbidity in the vicinity of the crossing. However, such increases would be low and the extent very limited due to the low flows at the time of the crossing.

1.1.4 Contaminant determinations.

The substrate material to be excavated and used for backfill for the trenches at the crossing is not suspected of containing contaminants.

1.1.5 Aquatic ecosystem and organism determinations.

Construction of the crossing could degrade aquatic habitats by increasing sedimentation, and impeding movement of fish across the construction area. Impacts to aquatic organisms would occur from construction activities. Such impacts would include destruction of substrate and associated benthic invertebrates in the immediate work area of the pipeline crossings and short-term increases in turbidity and sedimentation in the close vicinity of the crossing. Mobile species would likely avoid the immediate areas of disturbance during construction and to return shortly thereafter. Benthic invertebrates would likely rapidly re-inhabit the reclaimed areas from adjacent communities.

Surveys did not document any pallid sturgeon in the vicinity of the pipeline crossing, although potential spawning habitat was available. Preliminary surveys indicated two bald eagle nests located two to three miles west of the crossing. Impacts to Federally-listed endangered or threatened species are not expected.

1.1.6 Proposed disposal site determinations.

Most of the excavated substrate will be used as backfill in the trench. Excess materials would be disposed of in accordance with applicable regulations and landowner requests. Due to the composition of the excavated materials (coarse grained) and low river flows, the mixing zone would not be extensive.

1.1.7 Cumulative effects determinations.

A natural gas pipeline (the Altamomt pipeline) crossing has been certified in the vicinity of the proposed action. Impacts to the river system from the Altamomt crossing would be similar to those of the proposed action. The project schedule for the proposed action is a year before the Altamomt project. Short term impacts would not likely have a cumulative effect. No significant cumulative impacts to geological, air quality and noise, threatened, endangered and sensitive species, land use, recreation, transportation, socioeconomics, or cultural resources would occur. Due to the separation of construction schedules, no cumulative impacts to hydrology are expected. Cumulative impacts to fisheries could be significant if river crossings would be conducted during spawning periods. Cumulative impacts to visual resources would be significant from the 190-foot wide clearing of riparian forest along the banks. Due to the change in character of the pipeline products, there would be no cumulative effects from pipeline leaks.

1.1.8 Secondary effects determinations.

An impact on fisheries could occur during the operational phase by a leak of the pipeline at the crossing. The progression and fate of oil in the river depends on the volume, rate of spill, streamflow, stream gradient, type of stream bottom, and the effectiveness of the cleanup. A block valve would be placed upstream, and a check valve placed downstream, of the crossing. A Spill Prevention, Containment, and Control Plan would be developed and approved before construction would begin, and would contain measures to lessen the probability of a significant spill, and to immediately respond to a spill to begin clean-up and remediation actions.

1.2 COMPLIANCE WITH THE GUIDELINES

State water quality standard violations: None are expected.

Toxic effluent standard violations: None are expected.

Endangered/threatened species jeopardized: None are expected.

Significant adverse effects on aquatic ecosystems: A remote and significant secondary and cumulative adverse effect of high fish and fish food organism mortality due to a rupture or leak in the product pipeline has been determined.

Significant adverse effects on recreational, aesthetic, and economic values: None have been determined. The route crosses the Upper Missouri National Wild and Scenic River, but does so in a corridor specifically designated for utilities.

Steps taken to minimize adverse effects are:

a. Seasonal timing of placement of pipeline to avoid fish spawning activities.

2.0 YELLOWSTONE RIVER CROSSING

2.1 FACTUAL DETERMINATIONS

2.1.1 Physical substrate determinations.

The proposed crossing of the Yellowstone River is at pipeline milepost 255. The site is located in Stillwater County, Montana, in the NW¼ Section 6 T2S R70W. The substrate material in the area of the crossing is believed to be extremely dense and coarse alluvial gravel (60%) and sand, the percentage of silt and clays approximately 5%, with cobbles exceeding 12-inches in diameter, overlying shale and siltstone bedrock of the Cretaceous Colorado Shale Formation. The pipeline would be placed in a trench approximately 10 feet deep [twice the 4-foot scour depth plus the 2-foot diameter pipe. The substrate material proposed for backfilling the trenches is the excavated substrate material. The trench would be inspected prior to placement of the pipe to verify full bearing and free stress conditions. Only minor changes in bottom contour would be expected to occur as the trench is backfilled to original contours.

2.1.2 Water circulation and fluctuation determinations.

Placement of the pipeline will, temporarily and to a minor degree, disrupt water circulation in the immediate work area during placement. The crossing would be accomplished during periods of low flow. Excavated river substrate materials will be stockpiled immediately downstream of the trench with gaps between the piles, resulting in minor diversions of separated portions of the water body. Only brief, minute changes in water fluctuation would be caused by the pipe. The segment of pipeline within the limits of the river crossing would be preassembled and prepared for burial prior to being floated into position and sunk, or drawn, into the trench. Portions of the pipe segment would be in the flow streams of the river a matter of minutes if floated and sunk into, and not at all if drawn through, the trench. After backfilling is complete, water circulation would immediately return to pre-construction conditions.

2.1.3 Suspended particulate and turbidity determinations.

Pipeline trench excavation (underwater disturbance of substrate material and deposition into mid-stream piles) and backfill (disturbance and underwater placement) would temporarily increase suspended particulates and turbidity in the vicinity of the crossing. However, such increases would be low and extend very limited due to the low flows at the time of the crossing and the coarse-grained texture of the substrate materials.

2.1.4 Contaminant determinations.

The substrate material to be excavated and used for backfill for the trenches at the crossing is not suspected of containing contaminants.

2.1.5 Aquatic ecosystem and organism determinations.

Impacts to aquatic organisms would occur from construction activities. Such impacts would include destruction of substrate and associated benthic invertebrates in the immediate work area of the pipeline crossings and short-term increases in turbidity and sedimentation in the close vicinity of the crossing. Mobile species would likely avoid the immediate areas of disturbance during construction and to return shortly thereafter. Benthic invertebrates would likely rapidly re-inhabit the reclaimed areas from adjacent communities. Brown trout exist in the Yellowstone River. The prime brown trout spawning period is during October, and their eggs do not hatch until spring. Construction of the pipeline crossing is proposed between July 15 and October 1. There are no active bald eagle nests within two miles of the proposed pipeline crossing. Impacts to Federally-listed endangered or threatened species are not expected.

2.1.6 Proposed disposal site determinations.

Most of the excavated substrate will be used as backfill in the trench. Excess materials would be disposed of in accordance with applicable regulations and landowner requests. Due to the composition of the excavated materials (coarse grained) and low river flows, the mixing zone would not be extensive.

2.1.7 Cumulative effects determinations.

A natural gas pipeline (the Altamomt pipeline) crossing has been certified in the vicinity of the proposed action. Impacts to the river system from the Altamomt crossing would be similar to those of the proposed action. The project schedule for the proposed action is a year before the Altamomt project and two years before the Amoco project. Short term impacts would not likely have a cumulative effect. No significant cumulative impacts to geological, air quality and noise, threatened, endangered and sensitive species, land use, recreation, transportation, socioeconomics, or cultural resources would occur. Due to the separation of construction schedules, no cumulative impacts to hydrology would. Cumulative impacts to fisheries could be significant if river crossings would be conducted during spawning periods. Cumulative impacts to visual resources would be significant from the 190-foot wide clearing of riparian forest along the banks. Due to the change in character of the pipeline products, there would be no cumulative effects from pipeline leaks.

2.1.8 Secondary effects determinations.

An impact on fisheries could occur during the operational phase by a leak of the pipeline at the crossing. The progression and fate of oil in the river depends on the volume, rate of spill, streamflow, stream gradient, type of stream bottom, and the effectiveness of the cleanup. A control valve would be placed upstream, and a check valve placed downstream, of the crossing. A Spill Prevention, Containment, and Control Plan would be developed and approved before construction would begin, and would contain measures to lessen he probability of a significant spill, and to immediately respond to a spill to begin clean-up and remediation actions.

2.2 COMPLIANCE WITH THE GUIDELINES

The crossing is proposed between July 15 and October 1 to protect brown trout spawning periods.

State water quality standard violations: None are expected.

Toxic effluent standard violations: None are expected.

Endangered/threatened species jeopardized: None are expected.

Significant adverse effects on aquatic ecosystems: A remote and significant secondary and cumulative adverse effect of high fish and fish food organism mortality due to a rupture or leak in the product pipeline has been determined.

Significant adverse effects on recreational, aesthetic, and economic values: None have been determined.

Steps taken to minimize adverse effects are:

a. Seasonal timing of placement of pipeline to avoid fish spawning activities.

Appendix L

Cultural Resources Programmatic Agreement

PROGRAMMATIC AGREEMENT

AMONG

THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
THE MONTANA STATE HISTORIC PRESERVATION OFFICER
THE WYOMING STATE HISTORIC PRESERVATION OFFICER
THE U.S.D.I. BUREAUS OF LAND MANAGEMENT AND RECLAMATION
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION, MONTANA
AND
EXPRESS PIPELINE Inc.

REGARDING THE

EXPRESS PIPELINE PROJECT

WHEREAS, the Bureau of Land Management (BLM), as lead Federal Agency in accordance with the Express Pipeline Project Memorandum of Understanding with the Bureau of Reclamation (BOR), the Montana Department of Natural Resources and Conservation (DNRC), and Express Pipeline Inc., signed ************, proposes to administer the Express Pipeline Project as authorized by Title I and Title II of the Minerals Leasing Act of 1920, as amended (30 USC 185); and

WHEREAS, the Wyoming BLM (through the Worland District Office referred to as the BLM in this document) will act as lead agency for all Federal agencies involved in this project;

WHEREAS, the Express Pipeline Inc. (Express) has applied for and the BLM is considering the issuance of Federal right-of-way grants and associated permits for the project on federal lands administered by both the BLM and the BOR; and

WHEREAS, the former Montana Department of State Lands (DSL) and the DNRC have participated in the development of this document, and will require similar measures as those addressed in this document to issue State right-of-way grants and associated permits on state lands in Montana; and

WHEREAS, the Montana and Wyoming State Historic Preservation Officers (SHPOs), the BLM, BOR, the former DSL, and DNRC have determined that issuance of rights-of-way (ROW) for the Express Pipeline Project, as described in the BLM's Notice of Intent to Prepare an EIS published in the Federal Register, September 7, 1993, will have an effect on properties included in, or eligible for the National Register of Historic Places (historic properties) and have requested the comments of the Advisory Council on Historic Preservation (Advisory Council) pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C

470 as amended) (NHPA) and its implementing regulations (36 CFR Part 800.13); and

NOW, THEREFORE, the signatories to this agreement agree that the proposed project (undertaking) shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties and to satisfy all Section 106 NHPA responsibilities for all aspects of the project.

STIPULATIONS

The BLM shall ensure that the following measures are carried out:

I. Inventory and Evaluation

A. BLM, in consultation with the other parties to this Agreement, has established the Area of Potential Effect (APE) for the project by defining the study area for the project Environmental Impact Statement (EIS). Based on the APE the BLM has initiated efforts to identify interested parties that might wish to be involved in the project.

B. The BLM has initiated efforts to identify Native American peoples with interests in the APE. The results of previous consultations are included in Chapter 3 of the project EIS, and the results of ongoing efforts will be documented in a report to the consulting parties. The concerns of Native American peoples for sites or localities within the APE will be obtained for consideration throughout the implementation of the Agreement. The BLM will consult with the identified Tribes in appropriate style which may include site visits, meetings, letters, or telephone calls to address the concerns identified. BOR, and DNRC will be included in all consultation and communication with Native American groups and other interested parties regarding resources or concerns relating to lands they administer.

C. The known cultural resource sites within the APE have been identified and discussed Chapter 3 of the project EIS. BLM shall ensure that Express completes an intensive pedestrian inventory (BLM-type Class III) of the construction zones which have not been previously inventoried, or areas where the BLM, BOR, DNRC, or the SHPOs determine the results of previous inventories to be inconclusive or inadequate. The consultants performing the inventory work for Express shall obtain the required permits and permissions prior to initiating the work. The inventory will include pump station areas, lateral areas, borrow areas, haul roads, staging areas, and other ancillary areas related to the undertaking, and be consistent with the Secretary of the Interior's Standards and Guidelines for Identification of Historic Properties (48 FR 44720-23).

D. Express shall provide the BLM with separate intensive inventory reports for Montana and Wyoming. Any additional ancillary facilities or reroutes will be addressed in addendums to the appropriate state report and provided to the recipients of that report. The BLM will coordinate consultation among the parties to this agreement. BLM shall ensure that reports documenting the inventory results, historic properties evaluation recommendations, and other related historic properties investigations, will be distributed to the parties to this Agreement and interested Tribes for review. BLM may require Express to distribute reports or other documentation to the reviewing agencies.

E. BLM shall ensure that concurrent receipt and review of reports and site documentation by appropriate Federal and State agencies is completed. The Federal and State agencies (other than the SHPOs) participating in this Agreement shall have **30 calendar-days** to review the inventory and evaluation reports and comment upon them to the BLM. These comments will address the eligibility of cultural resources identified for inclusion on the National Register of Historic Places (National Register) and the effects of the project on any cultural resources considered to be historic properties. Based on the comments received the BLM will require Express to revise the reports. Any revised reports will be submitted to the same agencies which received the original reports for a final **15 work-day** review. If any party has an objection to the revised report they shall notify BLM within the **15 work-day** review period in accordance with subsection G. below. The Federal and State agencies (other than the SHPOs) participating in this Agreement will provide to the BLM for the appropriate sites, their determinations of site eligibility and the results of the their application of the criteria of effect at 36 CFR 800.9.

F. The BLM will provide to the SHPOs for a **30 calendar-day** review and comment period the revised reports and findings on eligibility and project effect. BLM shall seek consensus determinations with the appropriate SHPO of eligibility for all properties identified in the APE.

G. If consensus among the BLM, the appropriate SHPO, Federal and State agencies, and Interested Parties on the eligibility of any cultural resource cannot be reached, BLM shall obtain a determination from the Keeper of the National Register (Keeper). The Keeper's determination will be final.

II. Treatment Plan for Historic Properties

A. The preferred treatment alternative is avoidance of effects on historical properties by project relocation.

B. Upon completion of Stipulation I. F. or G. Express will develop for Montana and Wyoming Treatment Plans which set forth means to avoid or mitigate the project's adverse effects to historic properties where it is not feasible and prudent to avoid effects to historic properties by project relocation. These treatment plans will address all historic properties in the appropriate State for which effects are anticipated. Comments from the BLM, SMAs, the appropriate SHPO, interested parties, and the Advisory Council will be addressed in preparation of the treatment plans. The treatment plans will be in conformance with the principles in Part I and the recommendations in Part II of the Advisory Council's "Treatment of Archaeological Properties: A Handbook" and the "Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation" (Federal Register, Vol. 48 No. 190, September 29, 1983, pp. 44716-44742).

C. Each treatment plan will be developed by Express with the active participation of the BLM and the appropriate SMA and SHPO. The measures to be implemented will be sensitive to the concerns of Native American peoples raised during the consultation processes. The treatment plans will include, but not be limited to:

1. Specification of all historic properties and portions of historic properties to be affected by the project, including a description of the nature of the effects;

2. A detailed description of the treatments proposed for historic properties eligible for the National Register under criteria (a), (b), and /or (c) at 36 CFR part 60.4 or portions of such properties, with an explanation or rationale provided for the choice of the proposed treatments. Where appropriate existing landforms and rolling topography shall be used to the maximum extent feasible to reduce the visibility of the pipeline route from sensitive areas. Revegetation in the vicinity of the sensitive areas will be designed to ensure maximum vegetative blending within five years of completion of construction. Other appropriate measures to protect critical elements of the setting of historic properties may be employed;

3. An archaeological research design will be developed for historic properties eligible for the National Register under criterion (d) found at 36 CFR part 60.4. The research design will specify and explain the:

a. research questions to be explored with the data recovery efforts;
b. data needed to explore the questions posed;
c. sites and portions of each of those sites to be further investigated;
d. methods to be used to collect data needed to explore the research questions posed;

e. justification of the appropriateness of the chosen research questions;
f. proposed disposition of the recovered materials and records;
g. The timing for the preparation and distribution of reports.

4. A description of the areas of the project proposed for controlled grading, construction monitoring (a qualified archaeologist present to observe ground surfaces exposed during the actual construction activities), and construction inspection (a qualified archaeologist conducting an inspection of areas of ground disturbance after specific phases of construction are completed). A justification or rationale for the areas proposed will be included in the treatment plan.

5. A listing of all historic properties that will be affected by the project for which no further treatment is proposed, with a justification or rationale.

6. An explanation of the methods for involving the interested public in the data recovery, and for disseminating the results of the data recovery to the interested public. These methods will be consistent with the Archaeological Resources Protection Act, Native American Grave Protection and Repatriation Act, and the Freedom of Information Act.

III. Review of the Treatment Plans

A. The BLM will review the Treatment Plan provided by Express to assure that it addresses the concerns of the consulting parties involved in its preparation in accordance with II.C. above. The Treatment Plan shall then be submitted to the BLM Field Offices, BOR, DNRC, Advisory Council, and SHPOs for their review. The reviewing parties shall have **30 calendar-days** to comment on the Treatment Plan. If any party to this Agreement fails to comment within the review period the BLM shall assume that party's concurrence. Based on the comments received during this review, the BLM will direct Express to make any required revisions.

B. The revised Treatment Plan shall be submitted to the BLM. The BLM will assure that the required changes have been incorporated and then forward to the BLM Field Offices, BOR, DNRC, Advisory Council, and SHPOs for their review. The reviewing parties shall have **15 work-days** to comment on the revised Treatment Plan. If any party to this Agreement fails to comment within the review period the BLM shall assume that party's concurrence.

C. The final decision on the acceptability of the treatment plan will be made by the BLM, any disputes will be resolved in accordance with Stipulation VIII. Upon BLM acceptance of the Treatment Plan, it will be incorporated into the Construction and Use Plan required for the project ROW grant, and the BLM and/or the appropriate Federal/State SMA shall provide authorization to proceed with the implementation of the Treatment Plan. This authorization will include Archaeological Resources Protection Act (ARPA) excavation and removal permits for Federal lands. Termination of the project after initiation of the Treatment Plan will require completion of work in progress, and amendment of the Treatment Plan as described below. Amendments to the Treatment Plan will be incorporated by written agreement among the BLM, affected SMA, the appropriate SHPO, Express, and the Advisory Council . Amendments to the appropriate ARPA permits will be included in the approval of the amendments. Reports will be provided to the BLM, SMAs, and SHPOs every two weeks documenting progress in the implementation of the Treatment Plan. These reports will include:

1. dates of mitigation work included in the report;
2. historic properties where treatment was conducted;
3. type and amount of treatment performed;
4. very brief summary of the results of the treatment during the period covered by the report;
5. concerns or comments of the project principal investigator.

D. Upon acceptance by the BLM, appropriate SMAs, and SHPO of documentation that the Treatment Plan for a spread of the project has been completed construction may be authorized within that spread by the BLM and/or the appropriate SMAs. Construction of pumping stations located in negative inventory areas for which reports have been accepted by the appropriate SMA and SHPO may be authorized in advance of authorization of the construction of the spread.

IV. Changes in Ancillary Areas/Construction ROW

A. The BLM will notify the consulting parties and interested Tribes of changes in ancillary areas or the construction ROW. The BLM will ensure that the construction zone of the new ancillary area or reroute is inventoried. The reports addressing these areas will be reviewed in accordance with Stipulation I except there will be **10 work-days** for the review of both the initial or a revised inventory and evaluation reports by the BLM and SMAs.

B. The BLM will provide to the SHPOs for a **20 work-day** review and comment period the revised reports and findings on eligibility and project effects. BLM shall seek consensus determinations of eligibility for all properties identified in the APE. If consensus can not be reached the process at

Stipulation I.G. will be followed.

C. A Treatment Plan Amendment will be prepared for any historic properties within the additional APE in accordance with Stipulation II except there will be **20 work-days** for the review for both the initial or a revised Treatment Plan Amendment by the consulting parties and interested Tribes. Upon acceptance of the amendment by the BLM it will be incorporated into the treatment plan in accordance with Stipulation III.C.

V. Documentation of Treatment

A. A report will be prepared to document the results of the Treatment Plan. This report will be the Final Cultural Resource Report for the project. The report will contain a synthesis of the information gained during the project in addition to the information relating to the work required to mitigate the effects of construction. The report will be provided by Express to the BLM for distribution to the parties to this Agreement for review. The reviewers will have **90 calendar-days** to review and comment on the report. The BLM will provide the consolidated comments to Express, Express will provide the Final Cultural Resource Report to the BLM for distribution within **120 calendar-days** of receipt of the comments from BLM.

VI. Curation

A. The BLM, and the appropriate SMA's shall ensure curation of all records and other items resulting from identification and data recovery efforts is completed in accordance with 36 CFR Part 79, and the provisions of the Native American Graves Protection and Repatriation Act (PL 101-601) (NAGPRA). Documentation of the curation of these materials shall be provided to the BLM, and the appropriate SMA and SHPO within **30 calendar-days** of acceptance of the Final Cultural Resource Report for the Project.

B. The BLM will encourage private land owners to curate collections from their lands in an appropriate facility. Materials from private lands to be returned to the private land owners shall be maintained in accordance with 36 CFR Part 79 until any specified analysis is complete. Documentation of the return of these materials to the private land owner shall be provided to the BLM and the appropriate SHPO within **30 calendar-days** of acceptance of the Final Cultural Resource Reports for the Project.

C. Materials from state lands in Montana will be returned to the DNRC for curation. These materials shall be maintained in accordance with 36 CFR Part 79 until any specified analysis is complete. Documentation of the return of these materials to the DSL shall be provided to the BLM and the appropriate SHPO within **30 calendar-days** of acceptance of the Final Cultural Resource

Reports for the Project.

VII. Human Remains

A. The BLM shall ensure that any human remains encountered during the course of this undertaking are treated in a respectful manner. No construction activities will be allowed in the vicinity of the discovery until written authorization is provided by the BLM. A reasonable and good-faith effort shall be made to identify the appropriate Native American tribe(s), or other ethnic group(s) related to the burial. The BLM will consult with the appropriate group regarding the appropriate treatment of the remains and associated grave goods. The BLM shall ensure that any human remains and associated funerary objects excavated during the Express project are treated in accordance with the wishes of the descendants or the authorized group after completion of analysis specified in the Treatment Plan.

B. If human remains are encountered on Federal lands the appropriate SMA shall consult with the Native American tribe or other ethnic groups related to the human remains identified to determine the treatment and disposition measures consistent with the applicable Federal laws (eg. NAGPRA), regulations, and policies.

C. If human remains are encountered on State or private lands, BLM shall ensure, in consultation with the appropriate SHPO and the Native American tribe or other ethnic groups related to the human remains, that they are treated according to the provisions of the applicable State laws, regulations, or policies.

VIII. Dispute Resolution

A. Should any party to this Agreement provide notice to the BLM of their objection to an action under this Agreement, or implementation of the measures stipulated in this Agreement within **30 calendar-days** of becoming aware of an action the BLM shall consult with the objecting party to resolve the objection unless otherwise specified in this document. If the BLM determines that the objection cannot be resolved, the BLM shall forward all documentation relevant to the dispute to the Advisory Council. Within **30 calendar-days** after receipt of all pertinent documentation, the Council shall either:

1. provide BLM with recommendations, which BLM shall take into account in reaching a final decision regarding the dispute; or

2. notify BLM that it will comment within an additional **30 calendar-days** in accordance with 36 CFR Part 800.6(b). Any Advisory Council comment provided in response to such a request will be taken into account by BLM in accordance with

36 CFR Part 800.6(c)(2) with reference to the subject of the dispute.

Any recommendation or comment provided by the Advisory Council will be understood to pertain only to the subject of the dispute; the BLM's responsibility to carry out all actions under this agreement that are not the subject of the dispute will remain unchanged.

IX. Amendment

Any party to this Agreement may request that it be amended, whereupon the parties will consult in accordance with 36 CFR 800.13 to consider such amendment.

X. Termination

Any party to this Agreement may terminate it by providing **30 calendar days** written notice to the other parties, the parties shall consult during the period prior to the termination to seek agreement on amendments or other actions that would avoid termination. The Advisory Council will be afforded an opportunity to comment during this period as well. In the event of termination, the BLM will comply with 36 CFR 800.4 through 800.6.

XI. Failure to Carry Out the Terms of the Agreement

In the event that the terms of this Agreement are not carried out, the BLM shall comply with 36 CFR 800.4 through 800.6 with regard to individual actions covered by this Agreement.

Execution and implementation of this Agreement evidences that the BLM and the BOR have satisfied their National Historic Preservation Act Section 106 responsibilities and the Montana Department of State Lands has satisfied its obligations under the Montana State Antiquities Act for all individual actions of the Express Pipeline Project.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: ____________________________________ Date: _______
Executive Director,

BUREAU OF LAND MANAGEMENT

By: ____________________________________ Date: _______
District Manager,

BUREAU OF RECLAMATION

By: ________________________________ Date: ______
Regional Director

MONTANA STATE HISTORIC PRESERVATION OFFICER

By: ________________________________ Date: ______

WYOMING STATE HISTORIC PRESERVATION OFFICER

By: ________________________________ Date: ______

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION, MONTANA

By: ________________________________ Date: ______
Director

Concur:
EXPRESS PIPELINE Inc.

By: ________________________________ Date: ______

Appendix M

Economic Evaluation
of the Express Pipeline Project
prepared for
Montana Department of Environmental Quality

EVALUATION OF AEC EXPRESS PIPELINE

Prepared
For
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Prepared By

ENERGY ANALYSTS INTERNATIONAL, INC.

July 28, 1995

B

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

BACKGROUND

This study was performed in response to a request by Montana Department of Natural Resources and Conservation (DNRC) for an analysis of no action alternatives to Alberta Energy Corporation's Express Pipeline project. This program included the following efforts:

- Characterization of the crude oil and refined product supply system serving the Rocky Mountain (RM) region
- Analyses of production and drilling trends for distinct production areas within the Rockies.
- A ten-year forecast of production trends for each area and an overall summary for the RM region.
- Integration of the crude oil production forecast with EAI's RM crude oil balances and downstream analysis.
- Evaluation of the sensitivity of AEC pipeline project to crude production decline rates.
- Evaluation of viable alternatives to the AEC project and their relative cost competitiveness with the AEC project.
- Other topics addressed include: IPL-Sarnia reversal, other proposed IPL projects, outlook for replacing crude imports with refined product imports, and crude segregation issues.

PETROLEUM NETWORK CHARACTERIZATION

The primary crude oil pipelines comprising the Rocky Mountain (RM) crude oil distribution network are illustrated in Figure B-1. A more detailed schematic of the physical supply network and linkages with the primary crude production areas is presented in Figure B-2. ***The major interregional transport systems are the Platte and Amoco pipelines which have traditionally carried excess RM crude supply to Midcontinent (MC) and Midwest***

(MW) markets. Canadian crude is imported into the RM region via the Rangeland, Milk River, and Wascana pipelines. The Rangeland and Milk River systems feed the Conoco Glacier system at Aurora, Canada. The Wascana system originates in Regina and is connected into Texaco's pipeline at Poplar, Montana. The most significant trends and issues relating to crude oil supply and distribution in the Rocky Mountain region are shown in Figure B-3 and summarized below:

- ***Salt Lake City refiners will continue to experience a declining supply of local crude production and replacement with sweet crude supply from the eastern RM area at a significantly higher cost.***

- ***Canadian crude imports will continue to replace declining RM production contingent on the availability of supply and pipeline capacity. Currently, the import pipeline system is operating at near bottleneck conditions on a peak seasonal basis. The future pipeline expansion needs and import levels will depend on Canadian crude production trends and the draw on this finite resource by competing markets, i.e. refineries located in Eastern Canada and the U.S. northern markets (Midwest, Northern Tier and Pacific Northwest).***

- ***The future availability of replacement light sweet crude is critical to the survivability of a significant fraction of the RM refining base. Ultimately, light sweet crude refiners will have to be in the following situation to survive:***

    (1) Have a presence in a market where the replacement cost of competing refined products supports refinery investment payout.

    (2) Assuming item 1 is true, have the financial capability to support a major RM refinery investment along with other priority corporate investments.

The refined product network associated with the RM region is shown in Figure B-4. The area shown in Figure B-4 encompasses most of the area served by refined products from RM refiners. Included in this area are the states of Colorado, Idaho, Montana, Utah, and Wyoming plus eastern Washington State.

The Rocky Mountain (RM) product supply network is composed of twelve major local refineries and ten major product pipelines. In addition, there are four minor refineries serving localized areas. Compared to the Gulf Coast, Midwest, and Midcontinent, the RM pipeline network is relatively simple. There are two major markets in this network—Salt Lake City (SLC) and the Colorado Front Range. Major volumes of product are imported into the RM region from Texas Panhandle refineries via the Diamond Shamrock and Phillips pipelines and from Midcontinent/Gulf Coast (GC) refiners via the Chase pipeline. These import products effect the Colorado Front Range market but do not physically travel further into the Rockies. Important product pipelines within the RM include Wyco, Continental, Sinclair, Pioneer, Chevron, and Yellowstone pipelines. Product exports from the RM to the east occur via the CENEX, Wyco, and Cheyenne pipelines, and to the west (eastern Washington State) via Yellowstone and Chevron pipelines.

AEC EXPRESS PIPELINE

The proposed AEC Express pipeline is a 24 inch, 510 mile crude oil pipeline connecting Hardisty, Alberta, Canada to Casper, Wyoming. The U.S - Canada border crossing would be at Wild Horse. The pipeline would have 16 pump stations and an initial capacity of 180 MBPD. Capital costs are estimated by AEC to be 395 million dollars and the proposed tariff from Hardisty to Casper would be 1.35 (U.S.)$/BBL. AEC published economics are based on an initial through-put of 142 MBPD increasing to 260 MBPD after eight years.

Target markets for the AEC Express pipeline are refineries in the Rocky Mountain region (Wyoming, Utah, Colorado) and in the Midwest (Illinois, Indiana, Ohio, Michigan and Kentucky). To access Midwest refineries, the AEC Express pipeline would transfer shipments to Platte or Amoco pipelines at Casper. To access Utah refineries, AEC shipments would be transferred to Frontier or Amoco pipelines at Casper. One of the primary driving forces for construction of the AEC Express pipeline is the decline of U.S. crude production. In the U.S. Rockies, Canada is the only source of crude supply for the refineries besides production within the region. Midwest refineries have access to U.S. production in the Permian Basin of West Texas, Midcontinent, Gulf Coast, Gulf Coast offshore, waterborne foreign crudes landed in the Gulf Coast, Canadian crude shipped via Interprovincial pipeline, and locally produced crudes.

Supply for the AEC Express pipeline would be from Bow River, Husky, Gibson, and Chauvin pipelines at Hardisty. Interprovincial pipeline also moves through Hardisty.

No action alternatives to the proposed AEC Express pipeline involve both the refined products and the crude oil supply options. Responses to crude production declines can involve some combination of:

1. Accessing alternative crude supplies via other transportation routes (such as expansions or new pipelines)

2. Closure of refining capacity or reducing crude runs

3. Retraction of refined products from export pipelines such that less crude is needed to be refined

4. Accessing additional refined product supply through import pipelines such that less crude is needed to be refined.

Refineries in Billings, Montana are already adequately supplied with Canadian crude via existing pipelines (Glacier, Conoco, Exxon) and the announced Cenex pipeline.

TARGET REFINERIES

Primary target refineries for the AEC Express pipeline are located in Wyoming, Utah, and Colorado. Secondary target refineries are in the Midcontinent and Midwest that are accessible via Platte or Amoco pipelines from the Rockies. The locations of the Rocky Mountain refining centers and the associated refined product pipeline network are shown in Figure B-5. Target refineries are listed in Table B-1 along with their crude slate categorization. In general, most of the target refining base uses light sweet crude. As sweet crude supplies become tight in the RM region, there will be increasing pressure for additional refinery closures in the Rocky Mountain region and/or implementation of alternative crude supply projects. The refineries that are closure targets (Phillips, Total, Little America and Flying J) have crude run levels in the range of 20 to 25 MBPD(individual refinery runs). A closure would offset part of the forecast crude production deficit and, for a short time, potentially increase crude exports to the Midwest through Platte/Amoco pipelines. This occurred in 1992 following the closure of the Amoco-Casper refinery.

CRUDE NETWORK RESPONSE

The crude pipeline network response to the crude production shortfalls includes both on-going and announced projects and potential expansion projects in the study stage, see Figure B-6. On-going projects include the initial Cenex project to expand capacity of their system from Santa Rita to the Canadian-U.S. border. Cenex has announced a second phase project to construct a new 65,000 BPD line from the Canadian border to Laurel, Montana. ***The impact of the expansion will be to potentially increase the importation of Canadian heavy crude into Billings, potential displacement of Big Horn Basin crude that currently moves north into Billings, and a partial shift of Rangeland-Glacier crude to the Cenex system*** . The level of imports is limited by Billings refinery capacity to handle heavy crude, the production level of Big Horn Basin crude and the export level of Big Horn production to the Midwest.

Another pipeline project was recently announced by Amoco and Conoco to construct a 75 mile, 12 inch crude pipeline from Billings to Elk Basin, Wyoming. As part of this project, Amoco will acquire part ownership in Conoco's Glacier system from Cut Bank to Billings; and Conoco will acquire part ownership in Amoco's system from Elk Basin to Guernsey. The intent of this system is to utilize unused capacity on Conoco's existing Glacier system (more will become available with the Cenex pipeline construction) to move light sweet Canadian crude into Casper and Guernsey for further movement to Utah and Colorado refineries. The estimated capacity of the Amoco-Conoco pipeline segment is approximately 40,000 to 60,000 BPD. This pipeline segment would allow space vacated by Cenex on the Glacier pipeline to be used for crude transport to Casper and Guernsey. The effective capacity of the system could be limited by Glacier's open capacity into Billings.

Another route to move light sweet Canadian crude into the Rockies is via the Wascana-Texaco-Butte pipeline route from Regina to Casper or Guernsey. This routing is relatively more complicated in that it requires transfers of crude between three systems upstream of Guernsey and four systems upstream of Casper. The capacity of the Wascana system is 42 MBPD and it can be expanded to 55 MBPD by adding pumping capacity at an existing station. With the addition of another pump station, Wascana could expand its segment to 75 MBPD. The Texaco segment extends from Poplar to Baker, Montana where it feeds the Butte Pipeline system. The Texaco segment can handle 34 MBPD of Wascana crude feed and could be expanded to handle 42 to 45 MBPD. Currently, this corridor is under utilized and with the decline of Williston Basin crude, the effective capacity of the Texaco segment could increase. Based on EAI's analysis, there is approximately 50 to 85 MBPD of incremental capacity to transport Canadian crude into the RM region. The effective capacity of the Glacier-Cenex system(with Cenex's expansion accounted for) to transport crude beyond Billings destination loadings was estimated to be 57 MBPD by EAI. The ultimate capacity of the proposed Amoco-Conoco pipeline to Elk Basin will determine the level of the Glacier-Cenex open capacity that can be utilized.

Given the aforementioned crude pipeline capacity, EAI developed a forecast of crude oil requirements and transportation capabilities through the year 2005. The results of this analysis are presented in Table B-2.

Based on this analysis, the following observations and conclusions are most noteworthy:

- EAI adjusted its original RM crude production forecasts to reflect more recent trends and the long term outlook for the RM region.

- On an average annual basis, the results of the Network Balance Forecast indicate that the a net shortfall of crude supply increasing from 4.8 MBPD in 1997 to 77.7 MBPD by the year 2005 on an average annual basis. Incremental crude supply for the RM region that is included in this forecast is as follows:

    1) Incremental Wascana supply increasing to 13.9 MBPD by the year 2005.

    2) SW Nebraska and Northeast Colorado crude retraction assuming to have begun in 1993 and declining throughout the forecast period reflecting crude production declines.

- With the addition of the Cenex pipeline expansion, there is an additional crude capacity of 57 MBPD beyond EAI's estimate of heavy crude requirements. This declines to 42.6 MBPD by the year 2005 due to the decline of Big Horn supply to Billings and the resulting need to import additional Canadian heavy. With this additional capacity, there is adequate pipeline capacity through the year 2002 to transport replacement crude supply into the RM region. On a seasonal basis, additional crude supply capabilities may be needed as early as 2001.

- The aforementioned forecast of crude oil supply logistics into the RM region does not take into account several factors that were beyond the scope of this study including comparative pipeline route service and transit times, relative capabilities to handle specific crude types and support segregation.

REFINED PRODUCT NETWORK RESPONSE

As mentioned previously, the refined product pipeline network is also undergoing changes that will decrease the amount of crude needed to be refined in the Rockies. The RM region is experiencing a transition period where the incremental petroleum supply could be refined products or crude oil. Recent history has supported incremental crude supply economics with limited closure of RM refinery capacity. There are several product pipeline projects that could change this historical equilibrium:

1) ***The Olympic Pipeline is considering building a new segment from the Puget Sound area to Pasco Washington.*** An overview of this project is shown in Figure B-7. This project will tend to improve transportation costs for moving West Coast supply to eastern Washington and would tend to displace SLC supply (4,000 BPD of gasoline - 1993) and Portland supply moving up the Columbia River to Pasco (16,000 BPD of gasoline - 1993). This pipeline segment could place additional downward pressure on Salt Lake City refinery margins. It is also possible that Chevron pipeline from Boise to Pasco may be reversed such that Salt Lake City product may be displaced from the Boise market. Ultimately, the impact of this project will depend on product demand growth rate in Salt Lake City and the ability of the Utah market to absorb displaced product.

2) ***Explorer Pipeline is expanding from Houston to Greenville (north central Texas) and increasing the capacity to transport Gulf Coast supply into the Midcontinent and Midwest market areas.*** This would tend to increase the availability of Midcontinent product supply to move into the Rocky Mountain market via Chase

Pipeline. Chase has debottlenecked its pipeline which effectively added 25,000 BPD of capacity on the El Dorado to Denver segment. In addition to this pipeline expansion, Farmland is increasing the capacity of their refinery in Coffeyville, KS. from 65 MBPD to 125 MBPD by 1996.

3) ***Diamond Shamrock has built a pipeline segment from their refinery in McKee, Texas to Colorado Springs.*** They are planning to extend the system to Denver. In the short term, EAI believes that Diamond is somewhat product short and the additional product supply into the Rocky Mountain region will be limited to retraction of supply from the Dallas market. The gasoline retraction volume level is approximately 12 to 14 MBPD.

Product supply loss due to closure of a Colorado Front Range refinery could be made up by increasing imports through Chase, Phillips, or Diamond Shamrock pipelines. Product supply loss due to closure of a Salt Lake City refinery could be made up by a combination of retraction of product volumes from Boise to Pasco on the Chevron pipeline, retraction of Utah truck exports to Nevada, retraction of Denver Products pipeline volumes to Denver and re-routing to Salt Lake City via Pioneer products pipeline. In this latter case, Pioneer pipeline may have to be expanded due to its current high utilization of capacity.

CONCLUSIONS

1. AEC Express pipeline target refineries in the Rockies process mostly sweet crude. The decline rate of production in the Rockies was 5.0 to 6.0 percent in 1994 which is lower than the crude production decline used as the basis for the AEC volume projections, 7.2 percent per year. In 1994, a large decline in Rocky Mountain crude production (-9.8 percent) was recorded. In the first four months of 1995, this production decline was not sustained and the rate of production actually increased over 1994 levels. The actual volumes realized by AEC will depend not on the decline rate of total crude production but on the decline rate of light sweet crude. According to EAI analysis and forecasts, light sweet crude is declining at a fairly steep rate in the Salt Lake City

area but not as steeply in other major Rocky Mountain basins. EAI's composite, long term decline rate for Rocky Mountain crude production is in the range of 4.0 to 4.4 percent per year.

2. AEC pipeline project is the most expensive of the new pipeline alternatives;AEC Express pipeline capital cost is 395 million dollars for 510 miles of pipe. The Amoco-Conoco alternative is estimated to cost 30 million dollars for 75 miles of 12 inch pipe. The cost for expanding the Wascana-Texaco corridor is not known. However, Wascana can by expanded to 77 MBPD by adding a pumping stations and additional pumping capability to an existing pump station. The Texaco system from Poplar to Baker can be expanded to 42 to 45 MBPD with limited investment. It is EAI's belief that beyond this capacity level the system would have to be looped. The total Texaco segment is approximately 137 miles long and assuming a looping cost of 400,000 dollars per mile, the total capital cost would be in the range of 55 million dollars.

3. On-going and announced crude pipeline projects in the U.S. Central Corridor will add significant crude supply capacity from the Gulf Coast to the Midwest markets. Mobil has reversed a pipeline from Ringgold, OK to Corsicana, TX and is reversing a major crude pipeline segment from Corsicana to Beaumont, TX. This will increase access of foreign waterborne crude to Midwest markets. The Seaway pipeline project includes conversion of a gas pipeline to move offshore foreign crude from Freeport, TX to Cushing, OK. The Seaway project is moving ahead. A similar project has been studied by Trunkline Gas to convert a major gas pipeline segment from Lake Charles, LA to Patoka, IL to crude service. These pipeline projects will significantly reduce incentives for Midwest refiners to access Canadian crude through the AEC-Platte route.

4. Platte pipeline is considering conversion to gas service or selling the line to a company that will convert it to natural gas service. This will force Midwest destination shipments to move on Amoco pipeline. Amoco only delivers to the Midcontinent and to Chicago. Amoco no longer delivers crude to Wood River/Sugar Creek. This will limit AEC Midwest market access if Amoco

pipeline is the only long haul transportation route remaining from the Rockies to the Midwest. The AEC - Amoco routing is in direct competition with Interprovincial pipeline. Interprovincial tariff to Chicago is 154 cents per barrel versus 229 cents per barrel on AEC - Amoco. Amoco (or Platte) would have to agree to a more favorable joint tariff to support the AEC transport route to the Midwest.

5. Given the foregoing outlook for increased pipeline capacity into the Midwest crude market, it is unlikely that AEC Midwest destination volumes will materialize on a consistent basis. Thus, the AEC project will most likely have to depend on RM refinery markets for its base level throughput. .

6. The IPL reversal of the Sarnia-to-Ontario segment could increase light crude available to Midwest markets at a lower transportation tariff than the either the AEC - Platte or AEC - Amoco route. The would occur by retracting Western Canadian crude supply from Ontario/Quebec markets and replacing eastern Canada crude supply with imports from the east coast. The retracted crude would consist largely of light sweet and light sour crude since very little heavy crude is transported to Ontario from Alberta.

7. AEC's proposed tariff of 135 cents per barrel is lower than the current tariff structure of the Rangeland-Glacier-Amoco route to Casper (240 cents per barrel) or the IPL-Wascana-Texaco-Butte-Permian route to Casper (180 cents per barrel). It is likely that the Amoco - Conoco joint venture pipeline would restructure tariffs to be competitive with AEC. If AEC's anticipated volume capture does not occur, it is likely they would have to restructure their proposed tariff rate.

8. AEC Express pipeline probably will deliver more consistent crude quality batches than the Rangeland or Wascana routes due to the lower number of pipeline transfers that would occur. Depending on their ability to segregate crude relative to competitive routes this could be of value to Salt Lake City refiners.

However, all systems may be limited by segregation capabilities on the Frontier and local Salt Lake City pipeline systems.

9. Overall, EAI's analysis indicates that there are alternative pipeline routes in existence or that have recently been announced (Amoco-Conoco and Cenex) that could provide adequate crude replacement capacity though the year 2002. This does not include the expansion potential of the Wascana and Texaco systems which appear to be considerably less capital intensive than the proposed AEC pipeline. The AEC system would have additional economies of scale that could offer more competitive tariffs but this would depend on capture of significant volumes that greatly exceed EAI's crude replacement forecast.

TABLE B-1

CRUDE TOWER CAPACITIES AND SLATES OF ROCKY MOUNTAIN REFINERIES

COLORADO	
Total - 28,000	100% Colorado/Wyoming sweet
Conoco - 57,500	55% Wyoming sweet; 22% sour; 23% asphalt
MONTANA	
Cenex - 41,450	55% Canadian (LSW/MSR); 31% WY Big Horn; 14% MT mix
Conoco - 49,500	89% Canadian (LSR/LSW/MSR); 9% WY; 2% MT mix
Exxon - 42,000	58% Big Horn; 3% MT mix; 39% Canadian (LSW/MSR)
Montana - 6,900	75% Canadian (LSW/MSR); 25% MT mix
UTAH	
Amoco - 50,000	50% Overthrust; 49% black; 1% yellow
Chevron - 45,000	1% Overthrust; 72% black; 27% yellow
Husky - 24,000	50% Overthrust; 9% black; 41% yellow
Phillips - 25,000	70% Overthrust; 14% black; 16% yellow
Crysen - 12,500	50% Overthrust; 50% Nevada
Pennzoil - Closed	100% yellow
WYOMING	
Amoco - Closed	70% Wyoming sweet; 30% Overthrust
Husky - 38,670	60% Wyoming sweet; 40% sour (asphaltic capability)
Little America - 24,500	65% Wyoming sweet; 35% sour
Sinclair - 54,000	50% Wyoming sweet; 22% sour; 23% asphalt, 5% Canadian LSW
Wyoming Refinery-12,555	100% Wyoming sweet

Crude tower capacities in BPD

LSW = Light Sweet
LSR = Light Sour
MSR = Heavy or Medium Sour

TABLE B-2

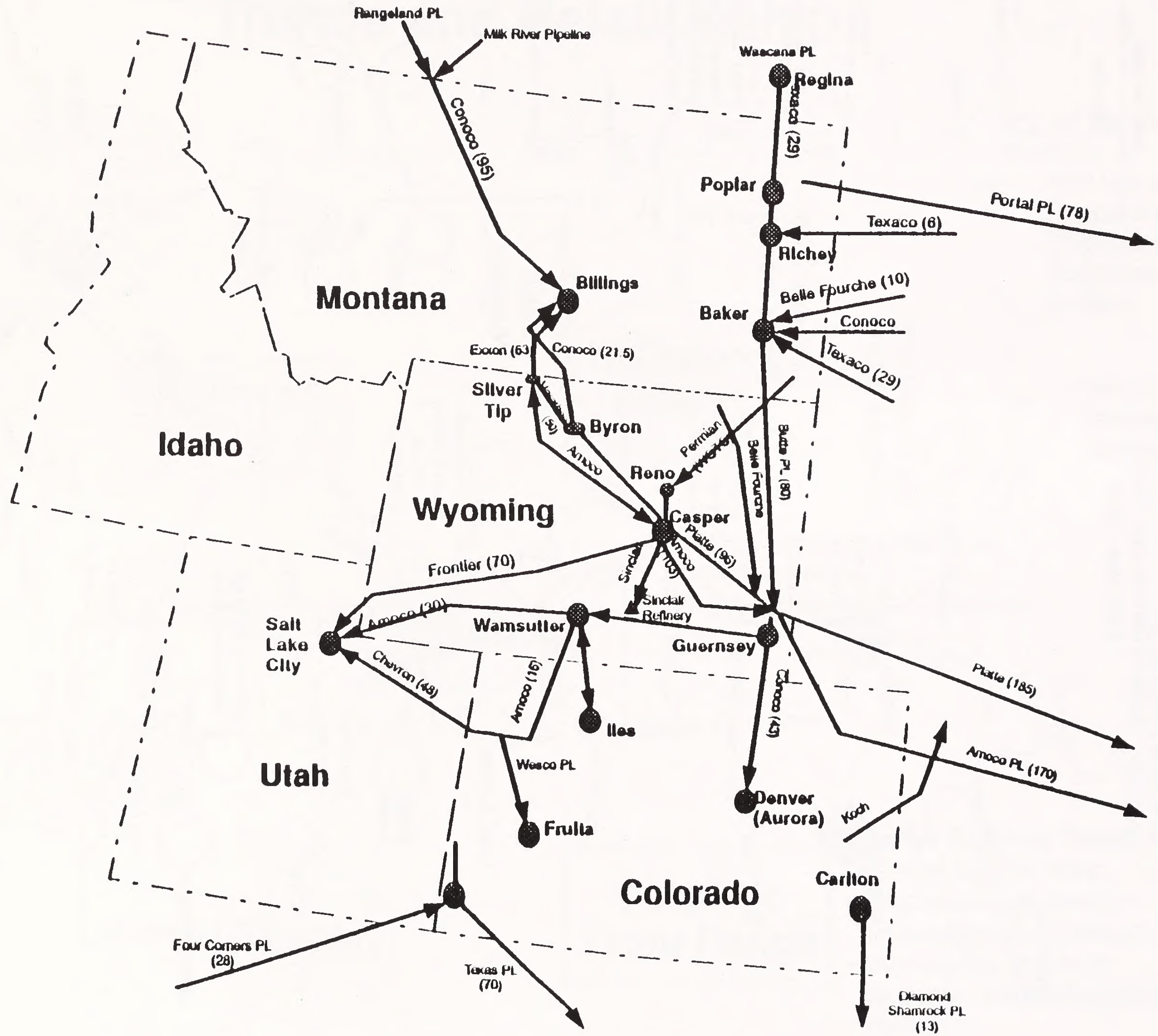
RM NBF SUMMARY
BPD

NETWORK COMPONENT	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CRUDE DEMAND											
Refining	459701	459701	459701	459701	459701	459701	459701	459701	459701	459701	459701
Exports	39128	31865	24857	18259	12044	6189	670	0	0	0	0
Total Demand	498829	491566	484558	477960	471745	465890	460371	459701	459701	459701	459701
CRUDE SUPPLY											
Production	355437	340265	325102	310757	297157	284257	272014	260389	249345	238848	228867
Base Imports											
Rangeland Base	105000	105000	105000	105000	105000	105000	105000	105000	105000	105000	105000
Wascana Base	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
Total Base Imports	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000
Balance Error	605	605	605	605	605	605	605	605	605	605	605
Total Supply	481042	465870	450706	436362	422762	409861	397618	385993	374949	364453	354471
ShortFall	17787	25696	33852	41598	48983	56028	62753	73708	84752	95248	105230
Incremental Wascana	11481	11802	12100	12377	12637	12882	13115	13337	13549	13753	13949
SW Nebraska/NE Co Retract	17340	17340	16907	16484	16072	15670	15279	14897	14524	14161	13807
Net Shortfall	0	0	-4845	-12737	-20274	-27475	-34359	-45474	-56679	-67335	-77474
Incremental Montana Corridor											
Excess Cenex/Rangeland Cap.	57493	55518	53671	51944	50329	48820	47408	46088	44854	43700	42622
Shortfall net of Cenex Expansion	0	0	0	0	0	0	0	0	11824	23634	34852

FIGURE B-1

Major Crude Oil Pipelines

Rocky Mountain Region



Pipeline
Capacities
In Parentheses
(In 1000 BPCD)

EAI

FIGURE B-2

Crude Network Flowsheet
Rocky Mountain Region

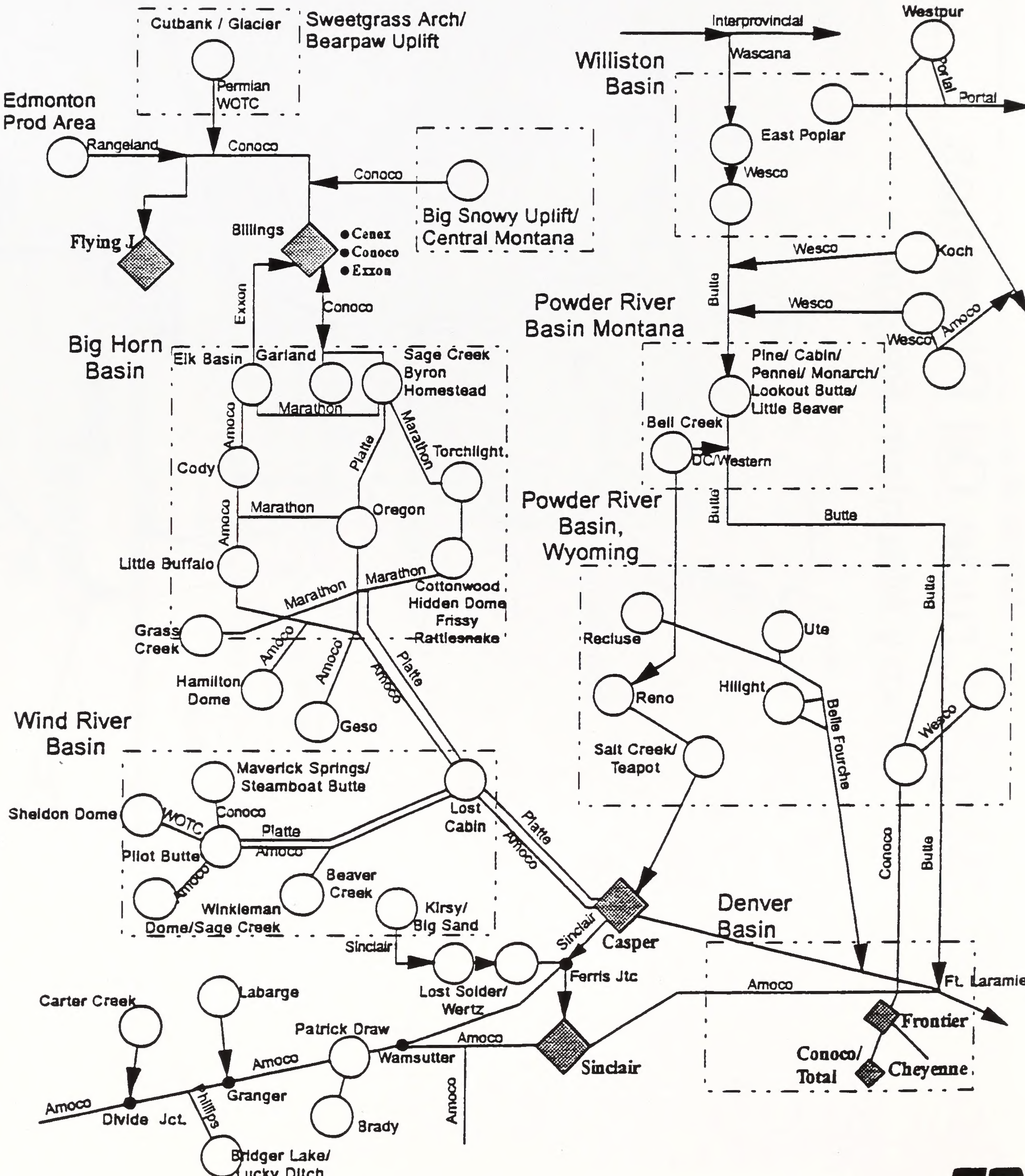


FIGURE B-3

Rocky Mountain Crude Oil Network

Trends and Relationships

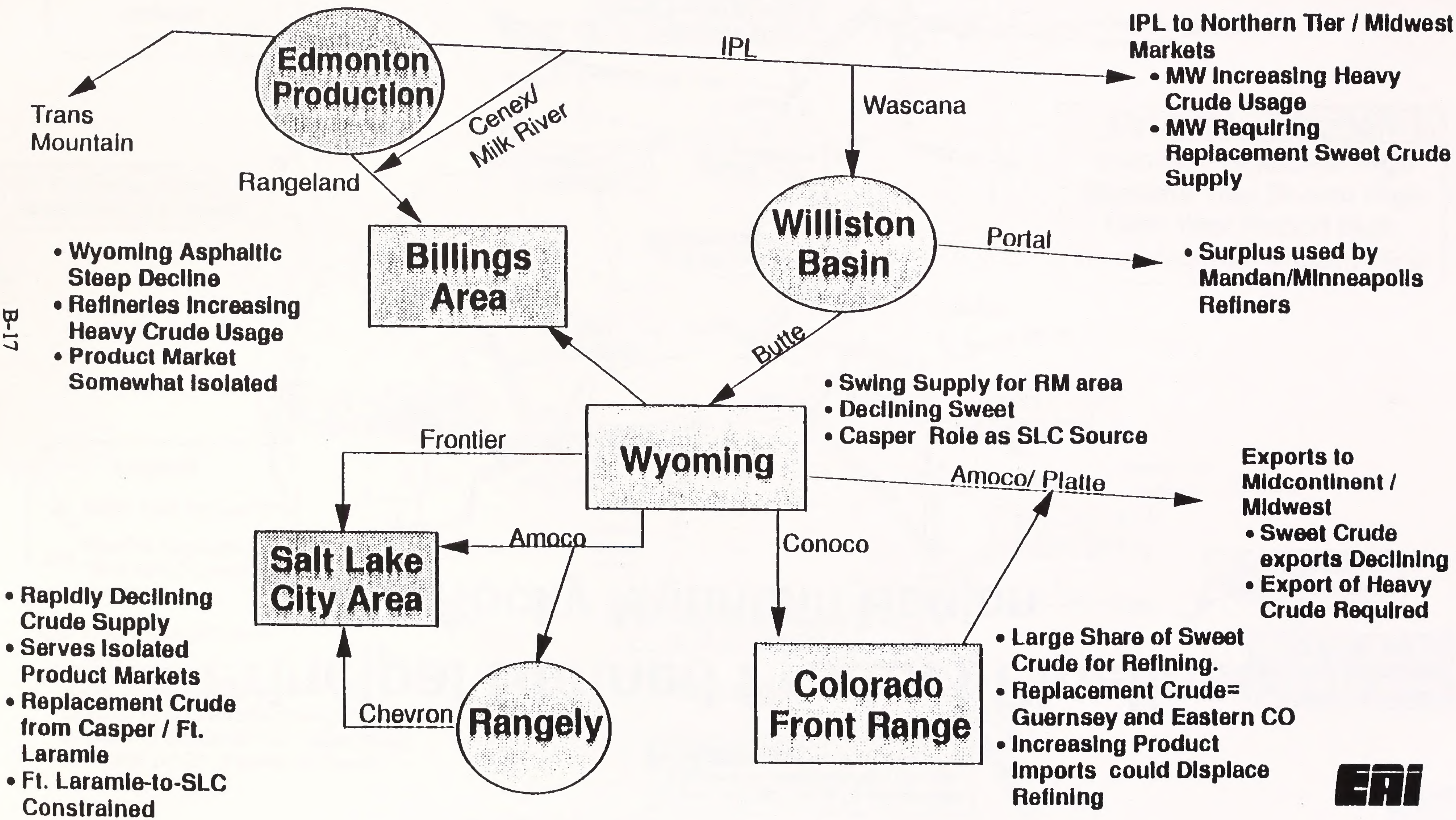
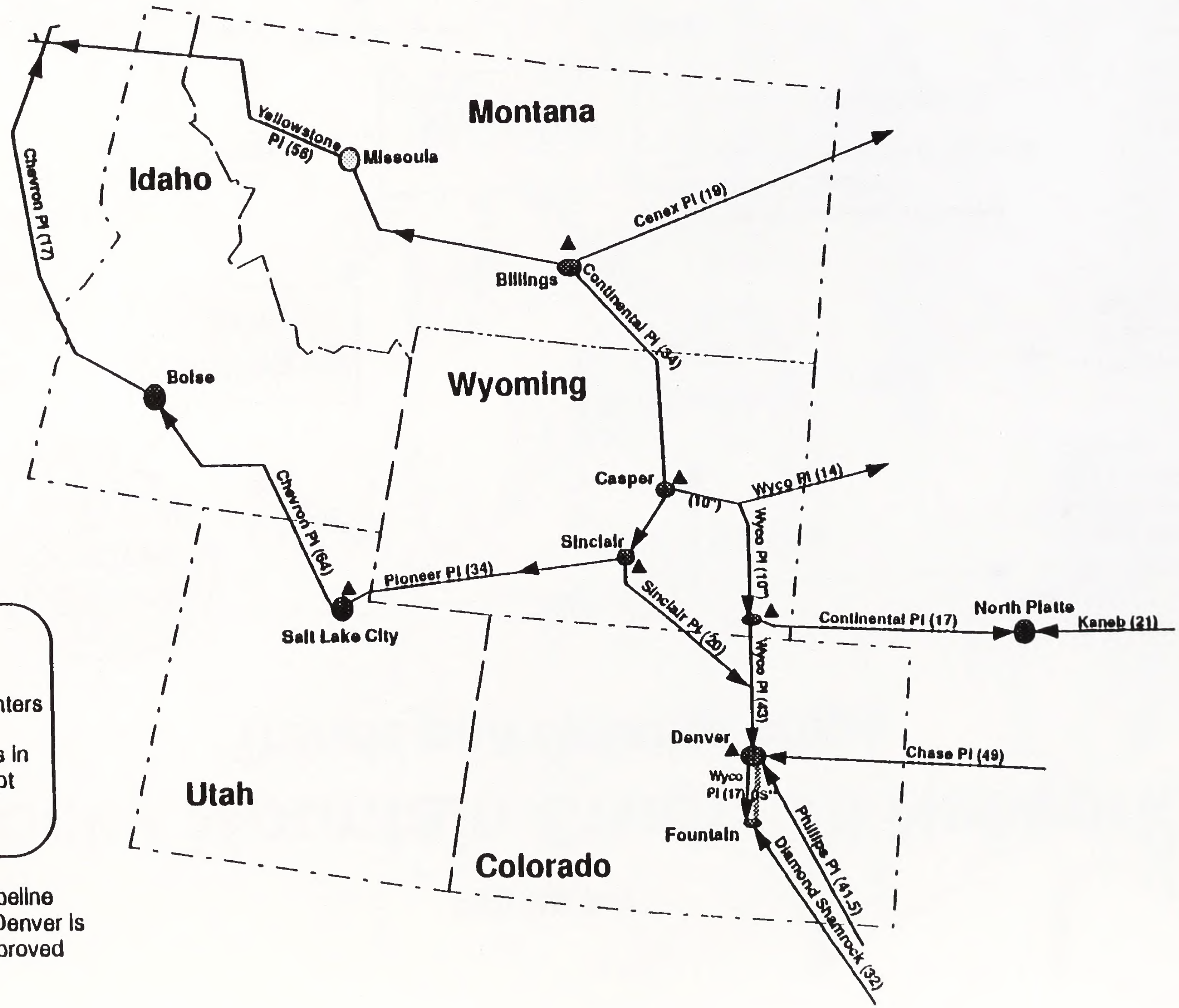


FIGURE B-4

Principal Refined Product Pipelines
Rocky Mountain Region



Legend

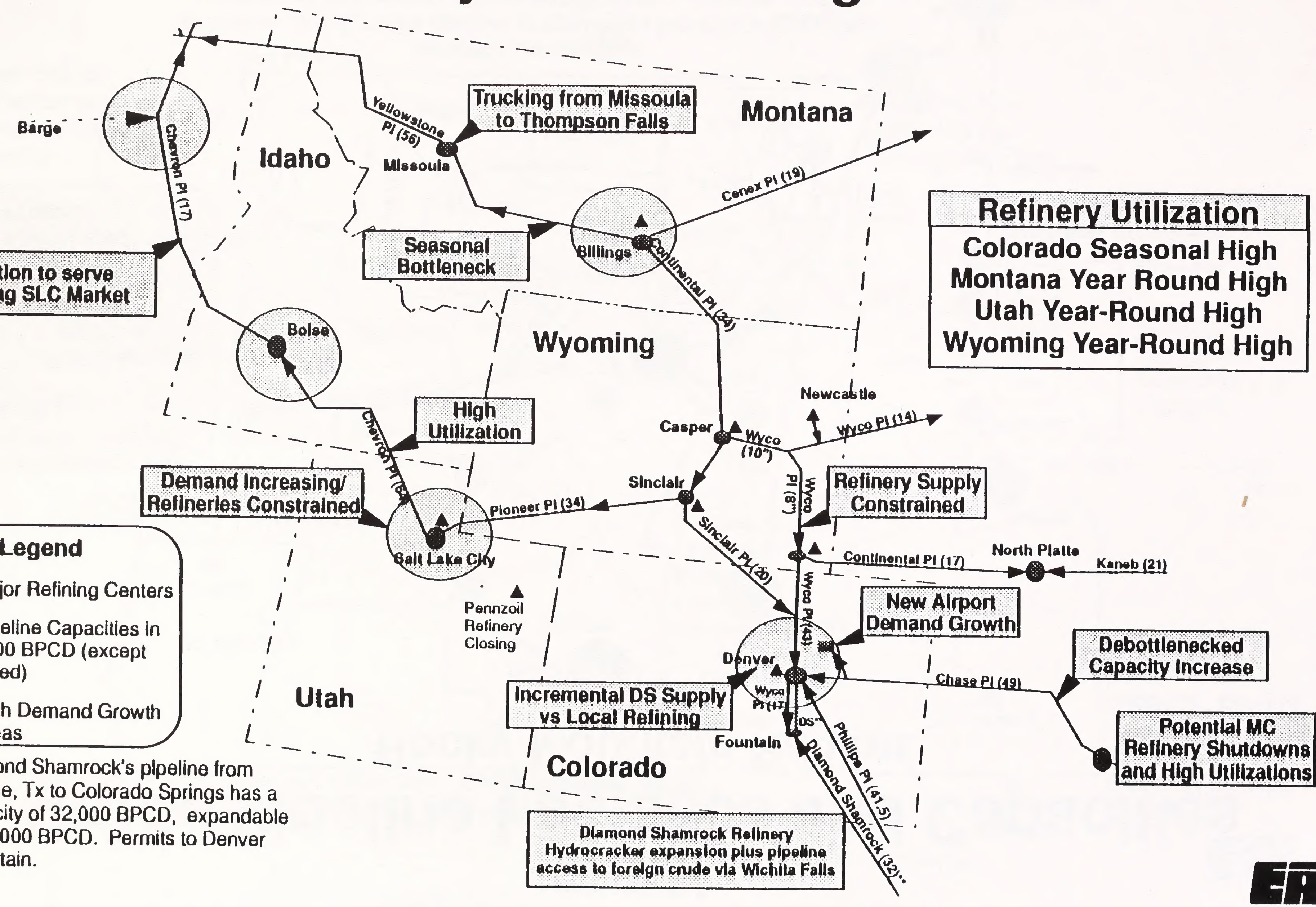
▲ Major Refining Centers

(xx) Pipeline Capacities in 1000 BPCD (except noted)

** Diamond Shamrock's pipeline from Colorado Springs to Denver is planned, but not yet approved

FIGURE B-5

Refined Product Network Status
Rocky Mountain Region



Refinery Utilization
Colorado Seasonal High
Montana Year Round High
Utah Year-Round High
Wyoming Year-Round High

Legend

- ▲ Major Refining Centers
- (xx) Pipeline Capacities in 1000 BPCD (except noted)
- ◯ High Demand Growth Areas

** Diamond Shamrock's pipeline from McKee, Tx to Colorado Springs has a capacity of 32,000 BPCD, expandable to 50,000 BPCD. Permits to Denver uncertain.

FIGURE B-6

Crude Pipeline Logistics and Capacities

Rocky Mountain Region

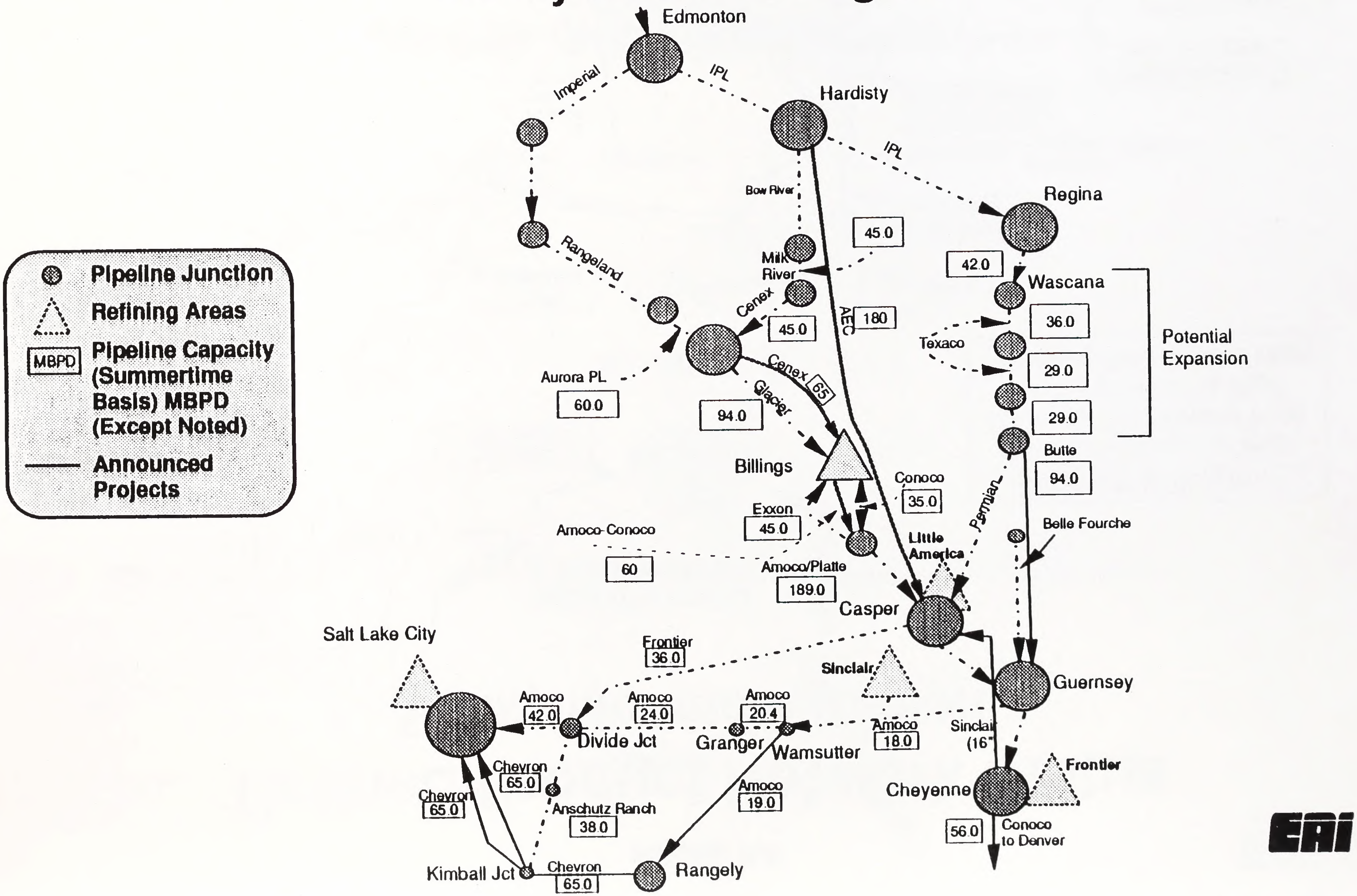


FIGURE B-7

PNW Supply Distribution Trends: 1994