SIDNEY - NORTH YUMA 230-kV TRANSMISSION LINE

NEBRASKA AND COLORADO

ENVIRONMENTAL ASSESSMENT

U.S. Department of Energy

WESTERN AREA POWER ADMINISTRATION

Loveland Area Office - Loveland, Colorado

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**U.S. DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
LOVELAND AREA OFFICE
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**DOE/EA-0354
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EXECUTIVE SUMMARY

Project Location

The Sidney to North Yuma 230-kV Transmission Line Project is located in western Nebraska, south of Sidney, in Cheyenne County, and in northeastern Colorado, north of Yuma, in Logan, Washington, and Yuma Counties.

Project Participants

Participants in the Sidney to North Yuma project are Western Area Power Administration (Western), Tri-State Generation and Transmission Association (Tri-State), and Public Service Company of Colorado (Public Service). Western, an agency of the U.S. Department of Energy, is responsible for marketing Federal electric power and transmission service in 15 central and western states. Western markets power to 532 customers consisting of cooperatives, municipalities, public utility districts, private utilities, Federal and state agencies, and irrigation districts.

Tri-State is a non-profit, rural electric cooperative that provides generation and transmission service to 25 member rural electric cooperatives in Colorado, Nebraska, and Wyoming. A large portion of Tri-State's power requirement is purchased from Western.

Public Service is an investor-owned utility serving approximately 974,000 electric customers in Colorado and Wyoming.

Purpose and Need

Transmission deficiencies exist in eastern Colorado during peak load conditions. In eastern Colorado, irrigation demand is nearly ten times greater than the demand for all other customer classifications. While other classifications have experienced a small but steady growth, irrigation loads are weather dependent and fluctuate substantially with precipitation. Such uncertainties require a transmission system capable of serving a large increase in irrigation demand.

Power flow studies indicated that the existing transmission system in eastern Colorado has a major load-serving deficiency: an outage of the Story-North Yuma 230-kV Line during heavy load periods could cause severe low voltages at numerous locations on the underlying 115-kV system. These voltages would be well below the minimum acceptable level (92 percent of

nominal) and could result in substantial equipment damage. Joint planning studies predicted voltages below minimum acceptable levels at 13 locations in 1991. Operating procedures presently in place require load to be shed (i.e., service to be temporarily disconnected from customers) in order to restore voltages to minimum acceptable levels. If an outage of the Story-North Yuma 230-kV Line occurred during a load level equal to the historical peak for eastern Colorado, approximately 30 MW of load would be shed. Construction of the Sidney-North Yuma 230-kV Line would eliminate the need to shed load under outage conditions.

Western requires additional 230-kV transmission capacity to provide adequate import capability to eastern Colorado to serve customers entitled to receive Federal power (Federal loads). Western currently serves Federal loads from the 115-kV system (Beaver Creek-Deering Lake-Wray-Arapahoe) in eastern Colorado. The load-serving capability of that 115-kV system is presently limited and not adequate to cover Federal and non-Federal loads. The construction of the proposed Sidney-North Yuma 230-kV Line would increase the load-serving capability into the area to a level adequate to serve both present and future Western loads.

The existing transmission system is not adequate to support the full capacity of the Sidney DC Tie. Western is obligated to ensure sufficient Federal transmission system capability to deliver 200 MW at the DC Tie. The current west-side Sidney Tie Remedial Action Scheme (RAS) requires that the power flow on the Tie be reduced to between 125 and 30 MW for an outage of the Sidney-Stegall 230-kV Line or the Laramie River Station - Story 345-kV Line. Reducing the power flow on the DC Tie results in a substantial reduction of power transfer between Colorado and Wyoming. This reduction, in turn, limits Western's ability to market power between Wyoming and Colorado and between the east and west power systems. Construction of the proposed Sidney-North Yuma 230-kV Line would eliminate the need to reduce power flow across the DC Tie during any critical west-side outages and allow the transmission system between Wyoming and Colorado to be more fully utilized.

Public Service needs to insure its ability to serve load growth in the Sterling area. The present wheeling agreement with Western entitles Public Service to 35 MW of capacity on Western's transmission system to serve loads at Sterling. Public Service has also identified a need to

have an option to purchase power from the electrical east system. Potential power purchases from the electrical east system require Public Service to have transmission access to the Sidney DC tie. The Sidney-North Yuma 230-kV Line would provide a transmission path to serve this load, plus provide for load growth above the existing wheeling limit.

Five transmission lines connect Wyoming and Nebraska with northeastern Colorado. The total power flowing on these five lines is referred to as the "Total 3AR." One of the five lines, the Sidney-Sterling 115-kV Line, is presently a limiting element, or "bottleneck" for transferring power from north to south into the eastern Colorado system. Planning studies indicate that the existing TOT3AR transfer limit may be exceeded for heavy schedules under heavy summer loading conditions. During outage conditions, this would result in overloads on the transmission system. The installation of the Sidney-North Yuma 230-kV Line would raise the north-south power flow capability and eliminate overloads on the transmission system.

Alternatives

Proposed Action. Western, Tri-State, and Public Service propose to construct and operate a single-circuit, 230-kV transmission line between the Sidney Substation north of Sidney, Nebraska and the North Yuma Substation north of Yuma, Colorado. Western is responsible for the design and construction of the line. Tri-State is responsible for the design, construction, and maintenance of the line terminals at the Sidney and North Yuma Substations.

The proposed transmission line structures would be single-circuit, wood-pole, H-frame structures. A single-circuit, steel, single-shaft pole could be used in situations where it is necessary to minimize disturbance at the structure base or where a tall, narrow, "compact" line is required because of space limitations. This structure would be used for the line approach into the Sidney Substation.

Western's proposed routing alignment, Route Q, is also the environmentally preferred alternative and is described in Section 2.5, Summary of Impacts for the Proposed Route.

Construction of the line would require approximately 1 year and is scheduled to begin in the Fall 1992 and be completed in late Fall 1993. The peak construction work force is estimated to be 25 to 35 workers.

No Action. Under the No Action Alternative, no new transmission lines would be built in the project area. The No Action Alternative would compound the local and regional transmission system's inability to meet Western Systems Coordinating Council reliability criteria. The existing transmission system would continue to experience deficiencies in northeastern Colorado and in southwestern Nebraska. The deficiencies could be remedied by shedding approximately 30 MW or more of load in eastern Colorado and automatically reducing power flows to 135 MW, or to 30 MW, on the Sidney DC Tie for certain line outages. However, these remedies are only temporary measures that allow the existing intact systems to be used to serve load above its capability until additional facilities can be added. When a system outage occurs during heavy load conditions, loads would have to be disconnected from the system. Widespread outages would occur if these remedies do not operate correctly. The probability of widespread outages occurring would increase as the customer load grows.

Continued operation of the transmission system in its present mode would result in reduced system reliability and efficiency, a less than adequate safety environment, and eventually reduce service to customers. Thus, while implementation of the No Action Alternative would preclude most of the short-term impacts to the environment that would be associated with construction of a new transmission line, it would not meet the need for improved system reliability, nor the need for the increase in transfer capacity at the Sidney DC Tie.

Description of Study Corridors

The first step in the identification of alternative routes for the Sidney-North Yuma Transmission Line was to establish a study area encompassing the area from the Sidney Substation in the northwest corner to the North Yuma Substation in the southeast corner. It measures approximately 64 miles long by 21 miles wide.

The second step was to narrow the area under consideration by developing study corridors between the two substations. This was done by

first developing study corridor selection opportunities and then study corridor selection objectives. A study corridor network was evaluated and refined. The width of the study corridors was determined by local opportunities and constraints and varies from about 0.25 mile wide to 4 miles wide.

Description and Comparison of Alternative Routes

The third step in the route identification process was to develop and evaluate route links within the study corridors. In developing the 44 route links, the selection objectives were used again. Each link was inventoried for consistency with the selection objectives and the results tabulated.

The fourth step in the process was to combine a series of links into complete transmission line routes between the Sidney and North Yuma Substations. Using the data compiled and the impact analysis prepared for each discipline, certain links were eliminated from further consideration due to potentially significant impacts. The remaining links were assembled into alternative routes for initial evaluation and comparison. A total of 19 routes (A through S) was initially defined. The totals for each environmental factor for each of the 19 alternative routes initially considered were compiled.

The next step was to review and eliminate those routes that were undesirable because of major inconsistencies with one or more of the route selection objectives. The ten remaining alternative routes (B, G, H, M, N, O, P, Q, R, and S) were carried forward for final evaluation. Each route was then rank ordered (1 through 10) based on consistency with the objectives represented by each environmental factor.

The final step was to add all ranks for each of the 32 environmental factors for each of the 10 routes being evaluated. Since 1 was always assigned for the highest consistency with an objective, the route with the lowest total score was the environmentally preferred route. Route Q had the lowest score and was given a final rank order of 1. In June 1990, the Draft EA was submitted to DOE for review.

On September 10, 1990, Western attended a meeting with the Sidney-Cheyenne County Joint Airport Zoning Board of Cheyenne County, Nebraska to discuss the proximity of the proposed route to the Sidney Municipal Airport. At the conclusion of the meeting, it was brought to Western's

attention that a local farmer had installed a new center pivot irrigation system along the proposed route. Western field inspected the route and discovered that Link 8b bisected the center pivot field, resulting in a significant impact to the farmer's operation. Links 8f, 8g, and 8i were added to avoid the new center pivot.

After Links 8f, 8g, and 8i were added, Western's ROW staff contacted the affected property owners and it was discovered that these links would conflict with the planned installation of two additional center pivots. The property owner suggested moving the route further to the west and placing it at the western edge of his property. As a result of this suggestion, Links 8j and 8k were added. Links 8b, 8f, 8g, and 8i were eliminated from further consideration because of significant impacts to center pivots.

The elimination of Links 8b, 8f, 8g, and 8i affected all of the routes on the west side of the Sidney Substation, particularly the routes which include Links 8c, 8d, and 9. Links 8l, 8m, and 8n were added to retain these routes in the analysis.

The next step in the route evaluation process was to reassess the rank order for each route (1 through 10) based on consistency with the objectives represented by each environmental factor. The final step was to add all ranks for each of the 32 environmental factors for each of the 10 routes being evaluated. Route Q had the lowest score and was given a final rank order of 1. As originally reported in the Draft EA (May 1990), Route Q is Western's proposed route and the environmentally preferred alternative.

Summary of Impacts for the Environmentally Preferred Alternative

Route Q, Western's proposed route, and the environmentally preferred alternative, would have no significant impacts based on the significance criteria and impact analysis conducted. However, Route Q would have certain impacts, both beneficial and adverse that should be highlighted. Route Q would be the shortest route at 80.4 miles, compared to 83.2 miles for the longest. (All of the alternative routes are located within the 1,344 square-mile study area.) Route Q would require cross country access for construction across 9.9 miles of cropland and 14.2 miles of rangeland, for a total of 24.1 miles without existing access roads. It would cross the South Platte River at the most favorable location in terms of wildlife

and wildlife habitat, but it would also cross 7.8 miles of irrigated cropland, primarily along Lodgepole Creek and the South Platte River. The proposed route crosses 1.5 miles of the South Platte River floodplain (Link 14), and 0.8 mile of the Lodgepole Creek floodplain (Link 8j). Approximately nine transmission line structures would be constructed within the South Platte River floodplain and approximately five structures within the Lodgepole Creek floodplain. There are no practicable alternatives to constructing within the floodplains. No applicable floodplain protection standards would be violated and no significant impacts to floodplains are anticipated. Route Q would be located along section lines for 88 percent of its length (70.7 miles). There would be 36 occupied residences within 0.25 mile of the route; none would require removal. Route Q would conflict with 7.1 miles of distribution line and require 47 special structures. (Special structures could include small, medium, or heavy angle structures, dead end structures, or other special transmission line structures.)

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1.0 PURPOSE AND NEED

1.1 Introduction

Tri-State Generation and Transmission Association, Inc. (Tri-State), Western Area Power Administration (Western), and Public Service Company of Colorado (Public Service) propose to construct and operate a single-circuit, 230-kilovolt (kV) transmission line between the Sidney Substation north of Sidney, Nebraska and the North Yuma Substation north of Yuma, Colorado. The proposed line would be designed and constructed by Western. Tri-State would be responsible for the design, construction, and maintenance of the line terminals at the Sidney and North Yuma Substations. Western is the lead Federal agency for compliance with the National Environmental Policy Act of 1969 (NEPA). The Rural Electrification Administration (REA) has been designated as a cooperating agency for NEPA compliance. This environmental assessment was prepared in accordance with NEPA to assess the impacts of constructing and operating the proposed transmission line. The report has been prepared in accordance with Council on Environmental Quality (CEQ) guidelines for implementing NEPA (40 CFR 1500-1508) and DOE final guidelines for compliance with NEPA dated December 15, 1987.

Tri-State is a non-profit, rural electric cooperative that provides generation and transmission service to 24 member rural electric cooperatives in Colorado, Nebraska, and Wyoming. A large portion of Tri-State's power requirement is purchased from Western. Tri-State owns approximately 200 megawatts (MW) of the capacity in Units 1 and 2 at Craig Station in Colorado. Tri-State also owns approximately 400 MW of coal-fired capacity at the Laramie River Station in Wyoming and approximately 100 MW of oil-fired combustion turbine capacity in eastern Colorado. Tri-State is a member of the Inland Power Pool (IPP), which coordinates reserves and emergency procedures of utilities interconnected with the transmission grid in Arizona, Colorado, New Mexico, Texas, Utah, and Wyoming.

Western, an agency of the U.S. Department of Energy, is responsible for marketing Federal electric power and transmission service in 15 central and western states. Western markets power to 532 customers consisting of cooperatives, municipalities, public utility districts, private utilities, Federal and state agencies, and irrigation districts.

The wholesale power customers, in turn, provide service to millions of retail consumers in Arizona, California, Colorado, Iowa, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Texas, Utah, and Wyoming. Electric power marketed by Western is generated by the Bureau of Reclamation, the U.S. Army Corps of Engineers, and the International Boundary and Water Commission, which operate 48 hydropower generating plants in Western's marketing area. In Colorado, Western's Loveland Area Office markets 400 MW of generation capacity and has approximately 372 MW of load responsibility. With regard to the project participants, Western markets power to Tri-State, and maintains interconnections with Public Service.

Public Service is an investor-owned utility serving approximately 974,000 electric customers in the states of Colorado and Wyoming. Public Service's High Plains Division headquartered in Sterling, Colorado serves the towns of Sterling, Brush, Atwood, Merino, Hillrose, Iliff, Julesburg, Ft. Morgan, New Raymer, Padroni, Peetz, Snyder, Stoneham, Weldona, and Willard. Public Service has the capability to generate approximately 3,672 MW of electricity which serves customers throughout the State and is interconnected to the power grid of the western United States by transmission lines and switching facilities.

1.2 System Needs

Transmission deficiencies exist in eastern Colorado during peak load conditions. In eastern Colorado, irrigation demand is nearly ten times greater than the demand for all other customer classifications. While other classifications have experienced a small but steady growth, irrigation loads are weather sensitive and fluctuate substantially with precipitation. During the dry summer of 1988, the demand in eastern Colorado was approximately 15 percent greater than the forecasted demand. By contrast, in 1983 there was an 18 percent drop in demand over the previous year. The decline was a result of the Payment-In-Kind (PIK) program administered by the Department of Agriculture and above normal precipitation in eastern Colorado. Discontinuation of the PIK program in 1984 resulted in a return of the irrigation pumping load. Such uncertainties require a transmission system capable of serving a large increase in irrigation demand.

The Northeastern Colorado Joint Planning Study Group was formed in February 1986 to perform a regional planning study to determine the need for new transmission facilities to eliminate existing voltage problems in eastern Colorado and to adequately serve existing and future loads. The participants included Western, Tri-State, Public Service, and the Nebraska Municipal Power Pool. Planning studies predict voltages and power flows throughout the transmission system. This process is automated with the use of a computer program commonly referred to as a power flow program. The power flow programs executed for the Northeast Colorado Joint Planning Study examined regional voltages and flows for a variety of conditions for the 1991 and 1996 time frames. These conditions focused on periods of heavy demand for electricity (summer peak) and the loss of each of the regional transmission lines.

The power flow study indicated that the existing transmission system (owned by Tri-State and Western) in eastern Colorado has a major load-serving deficiency: an outage of the Story-North Yuma 230-kV Line during heavy load periods could cause severe low voltages at numerous locations on the underlying 115-kV system. These voltages would be well below the minimum acceptable level (92 percent of nominal) and could result in substantial equipment damage. This criteria for minimum acceptable voltages is agreed to by the participating utilities in order to meet American National Standards Institute (ANSI) Standard C84.1-1970. The Northeastern Colorado Joint Planning Study predicted voltages below minimum acceptable levels at 13 locations in 1991. Operating procedures presently in place require some load to be shed (i.e., service to be temporarily disconnected from customers) in order to restore voltages to minimum acceptable levels for the remaining customers. To shed load, the system dispatchers open certain circuit breakers and switches in pre-arranged sequences. If an outage of the Story-North Yuma 230-kV Line occurred during a load level equal to the historical peak for eastern Colorado, approximately 30 MW of load would need to be shed.

Power flow studies demonstrate that the existing transmission system can serve approximately 180 MW of load in northeastern Colorado during the worst single transmission line outage. This amount is based on the sum of the power flows on the transmission lines serving the region. The addition of the proposed project would increase the load serving

capability of the transmission system by approximately 90 MW. This incremental amount reflects a new load level where additional transmission support or transmission additions would be needed.

1.2.1 Tri-State

It should be noted that the turbine units at Wray, Colorado have been declared surplus generation by Tri-State and have been sold. The sale of these turbine units has been approved by the REA and Colorado Public Utility Commission. The Sidney-North Yuma Project does, by virtue of its proximity to the turbine site, confirm that elimination of the need for the turbines provides better reliability of service, and allows for future load growth.

Many of Tri-State's loads in eastern Colorado are served from Western's 115-kV system. Tri-State is obligated, on an annual basis, to request wheeling by Western for Tri-State loads system wide. This request is for a contract wheeling path on a 4-year rolling basis. Western has been unable to provide Tri-State with transmission service in eastern Colorado, due to a lack of available transmission capacity. Tri-State's participation in this project would eliminate this deficiency, allow for modest growth, and provide firm transmission service to Member deliveries in northeastern Colorado.

Tri-State and Public Service entered into a Transmission Service Agreement (Agreement) on October 5, 1979. The Agreement designates existing points of interconnection between Tri-State and Public Service and identifies future points of interconnection. A future point of interconnection is identified at Sterling, Colorado. The Agreement states that Public Service will construct a Brush (Story Substation) to Sterling 230-kV transmission line, and Tri-State will construct a 230-kV transmission line from Sterling, Colorado to Sidney Substation. This proposed transmission line and the Sterling Interconnection were studied in the referenced Northeastern Colorado Joint Planning Study. The study demonstrated that the Sidney-North Yuma Project was far superior with respect to cost and electrical performance. The Sidney-North Yuma Project would also establish a new point of interconnection between Public Service and Tri-State at Tri-State's North Yuma Substation. Tri-State would obtain an additional point of interconnection with Public Service which

would be beneficial to the Member systems at a lower cost than originally planned in the Agreement.

The participants of the proposed Sidney-North Yuma 230-kV Transmission Line Project recognize the regional value of this project in:

- increased load serving capability, and
- increased transfer capability.

These regional benefits are documented in the Northeast Colorado Joint Planning Study. Tri-State's justification for participation lies in correcting the existing load serving deficiency and providing an adequate transmission system for future growth.

Due to the regional value of this transmission line addition, Tri-State also benefits from increased transfer capability. The Sidney-North Yuma 230-kV Transmission Line would cause an approximately 370-MW increase in the transfer capability of the five transmission lines between Colorado and the Wyoming-Nebraska boundary. Of the 370-MW increase, approximately 180 MW of additional capability flows on the proposed Sidney-North Yuma line and the remaining 190 MW flows on the existing transmission lines that cross the boundary. Of the 190 MW allocated to the existing lines, 175 MW is allocated to the Missouri Basin Power Project (Laramie River Station) facilities of which Tri-State is a 24.13 percent participant.

Tri-State has elected to participate on the basis of load serving capability since existing transfer capability is adequate for Tri-State's needs and existing load serving capability is deficient. Tri-State's Member systems of Highline, Y-W Electric, and K. C. Electric make up 91 percent of all loads on the interconnected transmission system in northeastern Colorado.

1.2.2 Western

Western requires additional 230-kV transmission capacity to provide adequate import capability to eastern Colorado to serve customers entitled to receive Federal power (Federal loads). Western currently services Federal loads from the 115-kV system (Beaver Creek-Deering Lake-Wray) in eastern Colorado. The load-serving capability of that 115-kV system is presently limited and not adequate to cover Federal and non-Federal loads.

The construction of the proposed Sidney-North Yuma 230-kV Line would increase the load-serving capability into the area to a level adequate to serve both present and future Western loads.

The existing transmission system is not adequate to support the full capacity of the Sidney DC Tie. Western is obligated to ensure sufficient Federal transmission system capability to deliver or receive 200 MW at the DC Tie. The current west-side Sidney Tie Remedial Action Scheme (RAS) requires that the power flow on the Tie be reduced to 125 MW in either direction for an outage of the Sidney-Stegall 230-kV Line. It also requires that, for the loss of the Laramie River Station-Story 345-kV Line, the DC Tie be reduced to 30 MW for east-to-west power transfers. Implementation of the RAS results in a substantial reduction of power transfer between Colorado and Wyoming. This reduction, in turn, limits Western's ability to market power between Wyoming and Colorado and between the east and west power systems. Construction of the proposed Sidney-North Yuma 230-kV Line would eliminate the need to reduce power flow across the DC Tie during any critical west-side outage and allow the transmission system between Wyoming and Colorado to be more fully utilized.

1.2.3 Public Service

Public Service needs to insure its ability to continue to serve the Sterling area loads. The present wheeling agreement with Western entitles Public Service to 35 MW of capacity on Western's transmission system to serve loads at Sterling. The Sidney-North Yuma 230-kV Line would provide a transmission path to serve this load, plus provide for load growth above the existing wheeling limit.

Public Service relies heavily on north-south energy transfer. A north-south path is used to replace forced outage generating units with power schedules from the north as well as providing opportunities for scheduling inexpensive economy power from the north to replace more expensive Public Service units. During the summer peaks of 1988 and 1989, Public Service purchased approximately 400 MW of seasonal power from Laramie River Station in Wyoming.

Five transmission lines connect Wyoming and Nebraska with Colorado. These lines currently are being metered, totaled, and displayed on a recording wattmeter at Western's Loveland Dispatch Office. This total is

referred to as the "Total 3AR." One of the five lines, the Sidney-Sterling 115-kV Line, is presently a limiting element, or "bottleneck" for transferring power from north to south into the Public Service system. In other words, this line is a limiting element for the TOT3AR transfer.

Planning studies indicate that the existing TOT3AR transfer limit may be exceeded for heavy schedules under heavy summer loading conditions. During outage conditions, this would result in overloads on the transmission system.

As previously stated, the installation of the Sidney-North Yuma 230-kV Line would raise the north-south power flow capability (or TOT3AR limit) by approximately 370 MW. Power flow studies indicated that of the 370 MW increased TOT3AR capability, approximately 180 MW is carried by the Sidney-North Yuma 230-kV Line and the remaining 190 MW is carried by the other TOT3AR transmission lines.

Public Service has identified a need to have an option to purchase power from the electrical east system. Potential power purchases from the electrical east system require Public Service to have transmission access to the Sidney DC tie. Public Service, as well as the other project participants, would benefit from this increased transfer capability.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 Description of the Proposed Action

Western, Tri-State, and Public Service propose to construct and operate a single-circuit, 230-kV transmission line between the Sidney Substation north of Sidney, Nebraska and the North Yuma Substation north of Yuma, Colorado. Map 2-1 shows the study area and study corridors, while Map 2-2 (bound at the back of Chapter 2) shows the alternative routes that were identified during the alternative route selection process. This process is described in more detail in Section 2.4. Potential impacts from Western's proposed route, and the environmentally preferred alternative, Route Q, are presented in Section 2.5. All terminal facilities would be constructed within the existing substations, thus no additional land requirements would be associated with the terminals of the proposed line.

While Western and Public Service would share ownership of the proposed transmission line, Western has been given the responsibility for the design and construction of the line. Following construction, Western would maintain the northern half of the line and Public Service would maintain the southern half. These aspects of the project are described in Section 2.1.1. In addition, Standard Construction Practices that will be applied to this project on an as needed basis are presented in Section 2.1.2.

2.1.1 Transmission Facilities

2.1.1.1 Design Characteristics. Physical characteristics of the proposed facilities are shown on Table 2-1. Western designs, constructs, operates, and maintains transmission lines to meet or exceed the requirements of the National Electrical Safety Code (NESC), U.S. Department of Labor Occupational Safety and Health Standards, and Western's own policies for maximum safety and protection of landowners, their property, and the public. All permanent improvements in proximity to the line, such as fences, metal gates, and metallic structures, would be grounded in accordance with existing codes.

The proposed transmission line structures would be single-circuit, wood-pole, H-frame structures. The structures are depicted in Figure 2-1.

TABLE 2-1

TYPICAL SINGLE CIRCUIT 230-kV TRANSMISSION LINE DESIGNS
(APPROXIMATE FIGURES)

Description	Proposed Structure H-Frame Wood Pole	Special Structure Single-Shaft Steel Pole
Voltage: Initial Operation	230-kV	230-kV
Right-of-way (ROW) Width	150 ft	100 ft
Span Between Structures: Typical	700 ft	1,000 ft
Span Between Structures: Typical Maximum	875 ft	1,300 ft
Number of Structures/Mile (typ. span)	7.5	5.2
Height of Structures: Typical	75 ft	115 ft
Height of Structures: Typical Range	65 to 97 ft	85 to 135 ft
Structure Base Area	100 sq. ft	60 sq. ft
Land Disturbed at Each Structure Base (maximum)	10,000 sq. ft	10,000 sq. ft
Miles of Line Per Conductor Stringing Site	2 to 3	2 to 3
Land Disturbed at Each Stringing Site	1 acre	1 acre
Minimum Ground Clearance Beneath Conductor at 120°F	30 ft	30 ft
Minimum Ground Clearance Beneath Conductor at its Maximum Temperature (176°F)	28 ft	28 ft
Maximum Height of Agricultural Machinery That Can Be Safely Operated on the ROW	16 ft	16 ft
Conductor Configuration	Horizontal	Staggered vertical
Conductor Size (thousand circular mils)	1,272	1,272

FIGURE 2-1 PROPOSED 230-KV WOOD H-FRAME TANGENT STRUCTURE

Near the top of each structure would be a horizontal member that would hold the line conductors above the ground and away from the structure. Insulators would be suspended from the horizontal member; and conductors, which would provide the medium for the transfer of electrical energy, would be hung from the bottoms of the insulators. The nonspecular conductors would consist of steel cable encased by aluminum strands. Insulators would be made of a polymer material (plastic) and would be light brown or gray in color. Overhead shield wires would be installed at the top of the structure to provide protection to the conductors from direct lightning strikes. An angle (or deadend) transmission line structure is illustrated in Figure 2-2.

At the South Platte River and Lodgepole Creek crossings, orange aerial markers (balls) and yellow aerial ball markers with black stripes would be attached to the two overhead shield wires and would be placed on enough spans to clearly mark the river crossing. These markers would be highly visible to aircraft conducting aerial surveys along the river.

A special structure would be single-circuit, steel, single-shaft poles. This special structure is also described in Table 2-1 and illustrated in Figure 2-3. This structure could be used in situations where it is necessary to minimize disturbance at the structure base or where a tall, narrow "compact" line is required because of space limitations. The only location identified at this time where the special structure would be used is in the vicinity of the Sidney Substation.

2.1.1.2 Right-of-Way Needs. Typically, 150 feet of right-of-way (ROW) width would be needed for the 230-kV single-circuit line to meet the clearance requirements of electrical safety codes, to provide working space for maintenance activities, and to protect buildings or other structures near the ROW from electrical hazards. Easements would be acquired for the new transmission line ROW and for roads and trails required for off-ROW access to and from the line. All land rights would be acquired in accordance with Western's and Public Service's policies and other applicable laws and regulations governing acquisition of property rights. Landowners would be paid a negotiated fee for rights to use their property. All transmission line and access road easements acquired would provide for the payment of damages caused by the construction or maintenance of the line.

PLAN

ELEVATION

FIGURE 2-2 PROPOSED 230-KV DEADEND STRUCTURE

FIGURE 2-3 230-KV STEEL SINGLE-POLE SPECIAL TANGENT STRUCTURE

2.1.1.3 Construction. Construction of the proposed transmission line would include the following roughly sequential major activities performed by small crews progressing along a length of line:

- Surveying
- Access road upgrading
- Structure site clearing/grading
- Construction materials hauling
- Foundation excavation
- Structure assembly/erection
- Groundwire and conductor stringing
- ROW cleanup and restoration

The approximate number of personnel and equipment required for construction of the project is shown in Table 2-2. The peak work force is estimated to be 25 to 35 workers. Construction of the line would require approximately 1 year and is scheduled to begin in October 1992 and be completed in October 1993. The disturbance associated with the construction of the project is shown in Table 2-3 by project components.

Surveying. Survey work would locate the transmission line centerline, determine accurate profiles along the centerlines, locate structures, and determine the exact location and rough profiles of access roads.

Access. Access along the ROWs would be required for the construction, operation, and maintenance of the proposed transmission system. Access by heavy construction vehicles and equipment would be required to the site of each structure, but not necessarily along the entire length of the ROW between structures. Wherever possible, access to each structure and along the ROW would be by existing roads and trails. Since some of the new line would be built parallel to existing lines, road or trail access already exists to almost all of the potential sites of new structures. Sometimes these roads or trails are within the existing ROW and sometimes they detour from them. In some locations, particularly where crossing steep slopes, broken terrain, and drainageways, the existing roads and trails would require improvement (grading, widening, and culverting of drainage way crossings) to allow passage of the required equipment.

TABLE 2-2
TYPICAL PERSONNEL AND EQUIPMENT
FOR TRANSMISSION LINE CONSTRUCTION

Activity	No. of Persons	Equipment
Surveying	4	Pickup trucks
Access road construction and structure and site grading	2	Dozer or blade, pickup trucks
Clearing of ROW, construction yard, wire handling site, and structure site	2	Dozer or blade, pickup trucks
Materials hauling	8 - 12	2 tractor trailers, 2 hydro- cranes, 3 pickup trucks, 2 flatbed trucks
Foundation excavation	4 - 8	2-4 tractors with augers, 2-4 pickup trucks, 2 backhoes
Structure assembly	6 - 12	1-3 hydrocranes, 4-6 pickup trucks, 1-3 flatbed trucks
Structure erection	4 - 6	1 crane (50- to 100-ton capacity), 2 pickup trucks
Groundwire and conductor stringing	5 - 10	Reel trailer, tensioner, puller, digger, winch truck, pickup trucks, high reach dozers (bucket trucks)
Cleanup	3 - 6	Flatbed and/or pickup trucks
Seeding	3	Disc plow with tractor hydroseeder, pickup truck, flatbed truck

Note: Most of the activities above are expected to progress sequentially, and the peak number of people in the area at any time for transmission line construction is expected to be 25 to 35.

TABLE 2-3
DISTURBANCE ASSOCIATED WITH THE CONSTRUCTION OF THE
SIDNEY-NORTH YUMA TRANSMISSION LINE PROJECT¹

Project Component	Miles	Acres Disturbed
Travel Way ²	24.1	35.1
Structure Sites ³	NA	139.2
Conductor Stringing Sites ⁴	NA	32.2
Staging Areas (2 required)	NA	10
Total	NA	216.5

¹Based on Route Q with a total line length of 80.4 miles.

²Travel way width is 12 feet. The travel way is the total rangeland and cropland cross-country access required (see Table A-2, Appendix A).

³Average span between structures is 700 feet and land disturbance at each structure is 10,000 square feet.

⁴Average miles of line per conductor stringing site is 2.5 miles. Land disturbance at each conductor stringing site is 1 acre.

NA = Not Applicable.

Where no roads or trails exist, and where the terrain is gentle enough (below 12 to 15 percent slope) and soil conditions allow, access would be by overland travel, preferably along the ROW. Where this occurs, a trail would develop as a result of vehicle use. Where the terrain along the ROW is steeper than 12 to 15 percent, access to structure sites would be, wherever possible, by overland travel on more gentle adjacent terrain outside the ROW. Where no such adjacent gentler terrain exists within reasonable proximity, new graded access trails would be constructed. In many cases, new access trails would be short spurs leading from existing roads to structure sites.

Off-ROW access trails are expected to be required in the rugged areas to the north and south of the South Platte River. In general, access trails would be routed to minimize damage to terrain and vegetation. Roads and trails would be arranged to cross streams and washes at right angles, wherever possible, and would normally cross without culverts, if this can be done without breaking down the banks. If a stream is narrow with steep, high banks, then a culvert adequately sized to carry the heaviest construction equipment and large enough to carry the highest projected runoff would be installed. These trails would not only be used for construction, but would also be used throughout the life of the transmission lines for operation and maintenance activities. Access trails would be 10 to 12 feet wide on the running surface and would be outsloped.

ROW Clearing. Clearing of trees is expected to be very limited. Clearing of other vegetation types would be performed where necessary to provide access for construction equipment. As part of this task, gates would be installed wherever an access road ROW crosses an existing fence. Gates would be kept closed but not locked, unless locks are requested by landowners.

Construction Yard and Material Handling Sites. It is estimated that two temporary construction yards of not more than 5 acres each would be required. These would serve as reporting locations for workers, parking space for vehicles, and for equipment and materials storage. It is

anticipated that yard facilities would be located on the north and south sides of the South Platte River at as yet unidentified locations as needed by the construction contractor.

Structure Site Clearing and Grading. At each structure site, an area would be disturbed by the movement of vehicles, assembly of structure elements, and other operations. An area measuring approximately 80 x 125 feet would be required for 230-kV structures.

Construction Materials Hauling. Construction materials would be hauled to the construction yards from the local highway or rail network and then to structure sites using the access roads described above.

Foundation Construction. In general, structures would be set directly into holes augered in the ground. The holes would be backfilled and compacted, and excess excavated material spread evenly around or adjacent to the site.

Structure Assembly/Erection. Erection crews would assemble the structures and, using a large crane, position them in foundation excavations.

Shield Wire and Conductor Stringing. Reels of conductor and overhead shield wire would be delivered to wire-handling sites spaced about every 2 to 3 miles along the ROWs. Level locations would be selected so little or no earth moving would be required. These sites may have to be cleared of vegetation and would be disturbed by the movement of vehicles and by other activities. The conductors and shield wires would then be pulled into place from these locations.

ROW Cleanup and Restoration. All structure assembly and erection pads not needed for normal maintenance would be graded to their original contour or to blend with adjacent landforms. Waste construction materials and rubbish from all construction areas would be collected, hauled away, and disposed of at approved sites. All disturbed areas not being returned to cultivation would be reseeded to minimize erosion. The intent would be

to restore all construction areas as near as feasible to their original condition. Any damaged gates and fences would be repaired.

Safety Program. Western would require the contractor to prepare and conduct a safety program (subject to Western's approval) in compliance with all applicable Federal, state, and local safety standards and requirements, and Western's general practices and policies. The safety program would include, but not be limited to, procedures for accident prevention, use of protective equipment, medical care of injured employees, safety education, fire protection, and general health and safety of employees and the public. Western would also establish provisions for taking appropriate actions in the event the contractor fails to comply with the approved safety program.

2.1.1.4 Operation and Maintenance. The ROW may be used by the landowner for any purpose that does not create a safety hazard or interfere with the rights of Western. The day-to-day operation of the line would be directed by system dispatchers in power control centers. These dispatchers use communication facilities to operate circuit breakers that control the transfer of power through the line. These circuit breakers also operate automatically to ensure safety, e.g., in the event of structure failure or a conductor failure.

Western's preventive maintenance program for transmission lines would include routine aerial and ground patrols. Aerial patrols would be conducted once per year. Ground patrols would be conducted once a year to detect equipment needing repair or replacement. In addition, climbing inspections would be conducted on an on-going basis, with each structure being climbed and inspected once every 5 years. Maintenance may include repairing damaged conductors, inspection and repair of wooden towers, and replacing damaged and broken insulators. In addition to maintaining the structures, conductors, and ROW, Western would maintain gates installed by Western on access roads and maintain the access roads to minimize erosion. Transmission lines are sometimes damaged by storms, floods, vandalism, or accidents and require immediate repair. Emergency repair would involve prompt movement of crews to repair damage and replace any equipment. If

access roads are damaged as a result of the repair activities, Western would repair them as required.

Various practices may be used at structures and along the transmission line ROW to prevent undesirable vegetation. Because of the semiarid, sparsely vegetated nature of the project area, very minor and infrequent measures would be necessary to control vegetation. Herbicides would not be used within the transmission line ROW.

2.1.1.5 Abandonment. When the proposed project is no longer needed, the transmission structures would be removed. In either case, the old shield wires, conductors, insulators, and hardware would be dismantled and removed from the ROW. The structures embedded in the ground would be pulled out, and structures embedded in concrete foundations would be removed along with their foundations. Cranes, large trucks, and pickup trucks, as well as earth-moving equipment in a few of the steeper areas, would be required for efficient removal of the transmission line. Following abandonment and removal of the transmission line, any areas leveled for equipment required to dismantle the line would be regraded as near as feasible to their original condition. Similarly, areas disturbed and stripped of vegetation during the dismantling process would be regraded and reseeded to prevent erosion.

2.1.2 Standard Construction Practices

The project's Standard Construction Practices, which have been adopted by the Proponents for the proposed project, are presented in Table 2-4. Additional site-specific mitigation measures identified during the analysis of environmental impacts are described in Chapter 4.

2.2 No Action Alternative

Under the No Action Alternative, the Proponents would not build the new transmission line, and the existing transmission system would continue to be operated according to existing procedures. Effects of the No Action Alternative are discussed in Section 4.15.

TABLE 2-4

STANDARD CONSTRUCTION PRACTICES

-
1. The project participants will limit the movement of crews and equipment to the right-of-way (ROW), including access routes. The project participants will limit movement on the ROW so as to minimize damage to grazing land, crops, orchards, and property, and will avoid marring the lands.
 2. When weather and ground conditions permit, the project participants will obliterate all construction-caused deep ruts that are hazardous to farming operations and to movement of equipment. Such ruts will be leveled, filled and graded, or otherwise eliminated in an approved manner. In hay meadows, alfalfa fields, pastures, and cultivated productive lands; ruts, scars, and compacted soils will have the soil loosened and leveled by scarifying, harrowing, disking, or other approved methods. Damage to ditches, tile drains, terraces, roads, and other features of the land will be corrected. At the end of each construction season and before final acceptance of the work in these agricultural areas, all ruts will be obliterated, and all trails and areas that are hard-packed as a result of construction operations will be loosened and leveled. The land and facilities will be restored as nearly as practicable to their original condition.
 3. Water turnoff bars or small terraces will be constructed across all ROW trails on hillsides to prevent water erosion and to facilitate natural revegetation on the trails.
 4. The project participants will comply with all federal, state, and local environmental laws, orders, and regulations. Prior to construction, all supervisory construction personnel will be instructed on the protection of cultural and ecological resources. To assist in this effort, the construction contract will address: a) federal and state laws regarding antiquities and plants and wildlife, including collection and removal, and b) the importance of these resources and the purpose and necessity of protecting them.
 5. The project participants will exercise care to preserve the natural landscape and will conduct his construction operations so as to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. Except where clearing is required for permanent works, approved construction roads, or excavation operations, vegetation will be preserved and will be protected from damage by the project participant's construction operations and equipment.
 6. On completion of the work, all work areas except access trails will be scarified or left in a condition which will facilitate natural revegetation, provide for proper drainage, and prevent erosion. All destruction, scarring, damage, or defacing of the landscape resulting from the project participant's operations will be repaired by the project participants.

TABLE 2-4 (CONTINUED)

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7. Construction roads not required for maintenance access will be restored to the original contour and made impassable to vehicular traffic. The surfaces of such construction roads will be scarified as needed to provide a condition which will facilitate natural vegetation, provide for proper drainage, and prevent erosion.
 8. Construction staging areas will be located and arranged in a manner to preserve trees and vegetation to the maximum practicable extent. On abandonment, all storage and construction materials and debris will be removed from the site. The area will be regraded as required so that all surfaces drain naturally, blend with the natural terrain, and are left in a condition that will facilitate natural revegetation, provide for proper drainage, and prevent erosion.
 9. Borrow pits will be so excavated that water will not collect and stand therein. Before being abandoned, the sides of borrow pits will be brought to stable slopes, with slope intersections shaped to carry the natural contour of adjacent undisturbed terrain into the pit or borrow area giving a natural appearance. Waste piles will be shaped to provide a natural appearance.
 10. Construction activities will be performed by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, and other objectionable pollutants and wastes into streams, flowing or dry watercourses, lakes, and underground water sources. Such pollutants and wastes include, but are not restricted to, refuse, garbage, cement, concrete, sanitary waste, industrial waste, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.
 11. Dewatering work for structure foundations or earthwork operations adjacent to, or encroaching on, streams or watercourses will be conducted in a manner to prevent muddy water and eroded materials from entering the streams or watercourses by construction of intercepting ditches, bypass channels, barriers, settling ponds, or by other approved means.
 12. Excavated material or other construction materials will not be stockpiled or deposited near or on streambanks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff or can in any way encroach upon the actual watercourse itself.
 13. Waste waters from concrete batching, or other construction operations will not enter streams, watercourses, or other surface waters without the use of such turbidity control methods as settling ponds, gravel-filter entrapment dikes, approved flocculating processes that are not harmful to fish, recirculation systems for washing of aggregates, or other approved methods. Any such waste waters

TABLE 2-4 (CONTINUED)

discharged into surface waters will be essentially free of settleable material. For the purpose of these specifications, settleable material is defined as that material which will settle from the water by gravity during a 1-hour quiescent detention period.

14. The project participants will utilize such practicable methods and devices as are reasonably available to control, prevent, and otherwise minimize atmospheric emissions or discharges of air contaminants.
 15. The emission of dust into the atmosphere will not be permitted during the manufacture, handling, and storage of concrete aggregates, and the project participants will use such methods and equipment as are necessary for the collection and disposal, or prevention, of dust during these operations. The project participant's methods of storing and handling cement and pozzolan will also include means of eliminating atmospheric discharges of dust.
 16. Equipment and vehicles that show excessive emissions of exhaust gases due to poor engine adjustments, or other inefficient operating conditions, will not be operated until corrective repairs or adjustments are made.
 17. Burning or burying of waste materials on the ROW or at the construction site will not be allowed. The project participants will remove all waste materials from the construction area. All materials resulting from the project participant's clearing operations will be removed from the ROW.
 18. The project participants will make all necessary provisions in conformance with safety requirements for maintaining the flow of public traffic and will conduct construction operations so as to offer the least possible obstruction and inconvenience to public traffic.
 19. Project participants will apply necessary mitigation to eliminate problems of induced currents and voltages onto conductive objects sharing a ROW, to the mutual satisfaction of the parties involved. Project participants will install fence grounds, where required, on fences that cross or are parallel to the proposed line.
-

2.3 Alternatives Considered but Eliminated from Detailed Analysis

2.3.1 System Alternatives

As part of the Northeastern Colorado Joint Planning Study, line outages were simulated for the existing system. Seven potential system alternatives were identified to address potential system problems. These system alternatives are summarized in Table 2-5 and comparisons are presented for both costs and ability to solve the identified problems.

Alternative F, as described in the Joint Planning Study, recommends three additional system modifications in the region. The first is the upgrade of the existing 115-kV transmission line between Vernon, Idalia, and Southfork; this project has been initiated by Tri-State. The second modification is the reconductoring of the 115-kV transmission line between North Yuma and Yuma (Deering Lake Substation); this project has been completed. The third modification is the future addition of capacitors at the Joes Substation. These capacitors will be added when the system requires additional voltage support.

Public Service has load responsibility in the Sterling area and the electrical, economic, and environmental considerations of routing the proposed line through the Sterling area were examined following the identification of system alternatives.

Electrical. The electrical objectives of the project would be met by the proposed line without a 230/115-kV interconnection at the Sterling Substation. Public Service projects a need for additional transmission support at Sterling, however, the load serving capability at Sterling could be enhanced by tapping the proposed transmission line at the location where it crosses the existing Sterling-Fleming-Haxtun-Frenchman Creek 115-kV Line. This approach would increase the long-term transmission support to the Sterling area without constructing a new line into the Sterling area.

Economic. Routing the line near Sterling adds approximately 20 miles to the length of the transmission project. At an approximate cost of \$165,000 per mile, the Sterling alternative would increase the project cost approximately 20 percent (or an additional \$3.3 million).

TABLE 2-5

SYSTEM ALTERNATIVES COMPARISON

Alternative	Description	Relative Cost ¹	Eliminates System Problems
A	Sidney-Sterling-Beaver Creek 230-kV Line with Sterling 230/115-kV Transformer	1.27	No
B	Sidney-Sterling-North Yuma 230-kV Line with Sterling 230/115-kV Transformer; North Yuma-Joes-Vona 230-kV Line with Joes 230/115-kV Transformer and new Vona Substation	2.57	Yes
C	Sidney-Sterling-North Yuma 230-kV Line with Sterling 230/115-kV Transformer; Wray-Burlington 230-kV Line	2.18	Yes
D	Sidney-Sterling-Beaver Creek 230-kV Line Sterling 230/115-kV Transformer; Beaver Creek-North Yuma 230-kV Line #2; North Yuma-Joes-Vona 230-kV Line with Joes 230/115-kV Transformer and new Vona Substation	3.10	Yes
E	Sidney-Sterling-Beaver Creek 230-kV Line with Sterling 230/115-kV Transformer; Beaver Creek-North Yuma 230-kV Line; Wray-Burlington 230-kV Line	2.71	Yes
F	Sidney-North Yuma 230-kV Line	1.00	Yes
G	Sidney-Sterling 230-kV Line with Sterling 230/115-kV Transformer	0.74	No

Note: The Beaver Creek Substation is adjacent to the Story Substation.

¹The Relative Cost is the ratio of the cost of each alternative to the cost of the preferred alternative (Alternative F).

Environmental. Locating the proposed ROW in the vicinity of Sterling increases the potential for conflicts with existing land uses in and around the Sterling area. There are very limited transmission line siting opportunities to the existing Sterling Substation. Locating the proposed transmission line away from populated areas is preferred if other alternative ROWs are available. The study area to the east of Sterling offers a number of routing alternatives.

Due to these electrical, economic, and environmental factors, the system alternatives that included routing the transmission line through Sterling were eliminated from further consideration.

2.3.2 Underground Construction

Certain environmental impacts of underground lines are increased when compared with overhead lines of similar capacity. The decreased visual impact would be partly offset by the need for cooling system pumping and pressurizing facilities at intervals of about 15 miles along the line. Certain construction impacts would occur (and maintenance access would be required) along the entire length of the ROW as with a buried pipeline, not just at intervals as at the structure sites of an overhead line. These impacts would include greater hazard of soil erosion and disturbance to riparian vegetation and water bodies crossed. Underground transmission lines may have some environmental advantages over conventional overhead lines but have much higher costs. Visual impacts would be less; the ROW required is much narrower and, therefore, some land use impacts and ROW acquisition costs would be reduced; waterfowl losses from collisions with conductors and shield wires would be obviated.

The reliability of the two types of line is probably comparable. While underground lines are immune to the effects of weather, they are susceptible to damage from geologic or subsoil instabilities and to mechanical failure of their cooling systems. A failure in an underground system often results in a power outage of several days or even weeks, since failures are difficult to locate and repair. In contrast, overhead line outages can often be repaired within hours.

Construction and operation costs are where the differences between underground and overhead lines become dramatic. A publication by the Bonneville Power Administration (U.S. Department of Energy [DOE] 1980)

reports that underground lines (of the voltages being considered here) are generally seven to eight times as costly as comparable overhead lines. A more recent publication by the DOE reports that the cost of undergrounding a 230-kV transmission line would be roughly eight to ten times the cost of constructing an overhead system of comparable capability (DOE 1982). The reason for the extremely high costs of underground systems is primarily the need for elaborate cooling systems to dissipate the heat generated by high voltage lines.

Underground construction is generally used only at lower voltages, where the problems of heat dissipation are far less severe, or for distances of not more than a few miles in very intensively developed urban areas, extremely critical scenic areas, or areas where overhead lines would have a very severe impact on waterfowl from collisions.

For the above reasons, undergrounding of any of the elements of the Proposed Action is not considered a viable alternative.

2.3.3 Energy Conservation

As part of their marketing policies, the Proponents encourage energy conservation through the elimination of wasteful, uneconomic, or unnecessary uses of energy, and through the use of renewable resources such as hydro, wind, solar, and geothermal energy sources. Energy conservation programs have the advantage of reducing energy consumption and have no significant environmental impacts. However, the purpose and need for the Sidney-North Yuma 230-kV Transmission Line Project cannot be met through energy conservation. The project is needed to increase transfer capacity and reliability. Since energy conservation only affects the demand for energy but does not provide the means for transferring electric power, it cannot be considered as an alternative action for meeting the stated need.

2.4 Description of Study Corridors and Identification of Alternative Routing

The first step in the identification of alternative routes for the Sidney-North Yuma Transmission Line was to establish the study area shown on Map 2-1. This study area places the Sidney Substation in the northwest corner and the North Yuma Substation in the southeast corner. It measures approximately 64 miles long by 21 miles wide.

The second step was to narrow the area under consideration by developing the study corridors between the two substations that are also shown on Map 2-1. This was done by first developing the study corridor selection opportunities shown on Table 2-6 and then the study corridor selection objectives shown on Table 2-7. The opportunities range from high to none depending on the feature being considered and its sensitivity to the construction and operation of a transmission line. The objectives contain items the study team wished to maximize, to avoid entirely if possible, or to minimize.

Early in the study process (July 1988), the Colorado Division of Wildlife (CDOW) indicated that it would not want the proposed line to cross the Tamarack Ranch State Wildlife Area (SWA) (see Map 2-2, Sheet 2, found at the end of Chapter 2). Therefore, the center of the study area along the South Platte River was eliminated from consideration. After reviewing irrigation development along the river and existing corridors across the river, two crossing points on either side of Tamarack SWA (one at Red Lion to the east and one at Iliff to the west) looked feasible. These two points located potential north-south corridors on the east and west sides of the study area (see Map 2-3).

Within the study area, five major east-west corridor selection opportunities also exist. These are two bands of rangeland on either side of the South Platte River and three major existing transmission lines listed below, proceeding from north to south in the study area.

- The east-west transmission corridor that passes through the Sidney Substation (see Map 2-2, Sheet 1),
- The Sterling-Holyoke 115-kV Transmission Line that passes south of Fleming (see Map 2-2, Sheet 3), and
- The Story-Wray 230-kV Transmission Line that passes through the North Yuma Substation (see Map 2-2, Sheet 5).

These five potential corridors were evaluated and the two southern transmission corridors were eliminated because of conflicts with farmsteads adjacent to the existing lines. The elimination of these east-west corridor opportunities then caused the elimination of the south half of the western north-south corridor (see Map 2-3).

The study corridor network that remained following the evaluation and refinement of the initial two north-south and five east-west corridors is

TABLE 2-6

STUDY CORRIDOR SELECTION OPPORTUNITIES

High Opportunity Areas

- Rangeland and uncultivated areas in cropland areas.
- Areas adjacent to existing transmission lines where land use conflicts would not occur.
- Areas along section or quarter section lines where conflicts with existing land uses would not occur.

Limited Opportunity Areas

- Areas adjacent to water systems containing sensitive aquatic species.
- Nesting and foraging areas of migratory waterfowl and shorebirds.
- Swift fox natal den areas.
- Active prairie dog colonies.
- Agricultural areas using other than moving irrigation systems.
- Non-irrigated cropland areas.
- Floodplains.
- Potentially unstable soils (e.g., steep slopes).
- Known areas of recoverable mineral resources (e.g., oil or gas wells, sand and gravel pits).
- Areas within the limits of a city.
- Areas zoned for residential development.
- Commercial areas where the project would require new right-of-way.

Low Opportunity Areas

- Whooping crane foraging areas.
- Lekking grounds or nesting areas of the state-listed greater prairie chicken.
- Riparian areas and wetlands greater than 10 acres in size.
- Federal or state wildlife areas or preserves.

TABLE 2-6 (CONTINUED)

-
- Areas within 0.5 mile of nesting or roosting areas of the bald eagle, peregrine falcon, ferruginous hawk, prairie falcon, and other raptor species.
 - Historic or prehistoric sites eligible for the National Register.
 - Designated (zoned) natural, open space, or scenic areas.
 - Agricultural areas utilizing center-pivot or roll-type irrigation.
 - Prime and unique farmlands as designated by the SCS.
 - Residential areas where the project would require new right-of-way.
 - Shelter belts.

No Opportunity Areas

- Sensitive areas located within State Wildlife Areas (SWA) as identified by CDOW.
 - Nesting or roosting sites for the federally-listed bald eagle, whooping crane, peregrine falcon, or piping plover.
 - Designated parks, recreation areas, or campgrounds.
 - Hospitals, schools, churches, farm houses, rural residences, or places of business.
 - National Register-listed historic or prehistoric sites.
 - Airport and private landing strip restricted areas as defined by the FAA.
 - Radio, television, or microwave tower sites.
 - Missile silos.
-

TABLE 2-7

STUDY CORRIDOR SELECTION OBJECTIVES

-
- Maximize use of rangeland and uncultivated areas in cropland.
 - Maximize use of existing rights-of-way, double circuiting, or parallel construction when system reliability is not jeopardized, costs are not substantially increased, and adjacent land uses are compatible.
 - Maximize location of the line along section, quarter section, or property lines.
 - Avoid farmsteads and occupied dwellings.
 - Avoid incompatible obstacles or systems such as airports and landing strips, missile silos, oil wells, or communication systems that would result in interference.
 - Avoid identified recreational, historical, archaeological, paleontological, or other culturally significant areas.
 - Avoid disturbance of endangered wildlife species.
 - Minimize effects on existing irrigation systems.
 - Minimize disturbance of prime and unique farmlands.
 - Minimize disturbance of cultivated croplands.
 - Minimize conflicts with existing and planned urban land uses, including residential, commercial, and industrial areas.
 - Minimize effects on designated State Wildlife Areas (SWAs).
 - Minimize possible destruction of shelterbelts, riparian areas, wetlands, and other areas of conservation and ecologic importance.
 - Minimize siltation of aquatic systems.
 - Minimize length of line located in floodplains.
 - Minimize crossing potentially unstable or highly erosive soils.
 - Minimize interference with extraction of economic minerals.
 - Minimize circuitous routing which would increase costs and could increase overall impacts.
 - Minimize engineering, construction, and maintenance hazards.
 - Enhance electrical reliability of the transmission system.
-

shown on Maps 2-1 and 2-2. The width of the study corridors was determined by local opportunities and constraints and varies from about 0.25 mile wide along the existing transmission corridor proceeding east and west out of the Sidney Substation to 4 miles wide in the southern corridor segment bounded by Fleming, Dailey, and the North Yuma Substation.

The third step in the route identification process was to develop and evaluate route links within the study corridors. In developing the 53 route links shown on Map 2-2, the selection objectives shown on Table 2-7 were used again. Each link was then inventoried for consistency with the selection objectives and the results were tabulated. The initial set of route links was evaluated and refined several times, following an engineering review in the field and public meetings in Yuma, Fleming, and Sidney where the route links were presented and public comments received. Two new route links (10a and 21d) were added as a result of public comments.

The fourth step in the process was to combine a series of links into complete transmission line routes between the Sidney and North Yuma Substations. Using the data compiled and the impact analysis prepared for each discipline and presented in Chapter 4 of this EA, certain links were eliminated from further consideration due to potentially significant impacts. These included Link 5a (visual impacts at the F&H Golf Course) and Link 11 (vegetation impacts at the South Platte River crossing and cultural resource impacts on the south side of the South Platte River). Link 11 also had significant engineering problems related to crossing Interstate 76. Link 15b was also eliminated because it did not follow section or half-section lines and it offered no engineering advantage over Link 15a for crossing Interstate 76.

The remaining links were assembled into alternative routes for initial evaluation and comparison. A total of 19 routes (A through S) was initially defined (see Table A-1 in Appendix A). These included two eastern corridor routes (A and B) and one cross-over route (S) which utilized Link 2. Link 2 posed potentially significant impacts to visual and biological resources at the Tamarack Ranch SWA; however, the public expressed interest in an eastern and a cross-over route at the public meetings. Therefore, Routes A, B, and S were developed.

The next step was to review and eliminate those routes that were undesirable because of major inconsistencies with one or more of the route selection objectives. Route A was eliminated because it was very similar to Route B, but crossed more pivot irrigation systems and required more cross-country access across cropland. Routes I, J, K, and L were eliminated because they followed section lines for less of their length, resulting in 2 to 4 times more cross country access across cropland than other routes. Routes C, D, E, and F were eliminated primarily for engineering reasons, specifically the number of vacant farmsteads crossed and the number of miles in conflict with existing distribution lines. The ten remaining alternative routes (B, G, H, M, N, O, P, Q, R, and S) were carried forward for final evaluation.

The next step in the route evaluation process was to rank order each route (1 through 10) based on consistency with the objectives represented by each environmental factor. For example, if the objective was to maximize the amount of the route located along section lines, the highest route (in miles) would be ranked 1, while the lowest would be ranked 10. If two routes had the same value for a factor, they were given the same rank and the subsequent rank was skipped. For example, if two routes tied for first, they were both given a rank of 1 and the third route was given a rank of 3 rather than 2.

The final step was to add all ranks for each of the 32 environmental factors for each of the 10 routes being evaluated (i.e., add by row). The results of this addition are presented below.

	<u>Total of Ranks</u>	<u>Rank Order of Routes</u>
Route B	154	(9)
Route G	130	(7)
Route H	131	(8)
Route M	100	(2)
Route N	111	(4)
Route O	127	(6)
Route P	123	(5)
Route Q	95	(1)
Route R	107	(3)
Route S	160	(10)

Since 1 was always assigned for the highest consistency with an objective, the route with the lowest total score would be the environmentally preferred route. As can be seen above, Route Q had the

lowest score and was given a final rank order of 1. In June 1990, the Draft EA was submitted to DOE for review.

On September 10, 1990, Western attended a meeting with the Sidney-Cheyenne County Joint Airport Zoning Board of Cheyenne County, Nebraska to discuss the proximity of the proposed route to the Sidney Municipal Airport. At the conclusion of the meeting, it was brought to Western's attention that a local farmer had installed a new center pivot irrigation system along the proposed route. Western field inspected the route and discovered that Link 8b bisected the center pivot field, resulting in a significant impact to the farmer's operation. Links 8f, 8g, and 8i were added to avoid the new center pivot.

After Links 8f, 8g, and 8i were added, Western's ROW staff contacted the affected property owners and it was discovered that these links would conflict with the planned installation of two additional center pivots. The property owner suggested moving the route further to the west and placing it at the western edge of his property. As a result of this suggestion, Links 8j and 8k were added. Links 8b, 8f, 8g, and 8i were eliminated from further consideration because of significant impacts to center pivots.

The elimination of Links 8b, 8f, 8g, and 8i affected all of the routes on the west side of the Sidney Substation, particularly the routes which include Links 8c, 8d, and 9. Links 8l, 8m, and 8n were added to retain these routes in the analysis.

The next step in the route evaluation process was to reassess the rank order for each route (1 through 10) based on consistency with the objectives represented by each environmental factor shown on Table A-2. Table A-3 shows the rank order (in parentheses) for each route for each environmental factor. The final step was to add all ranks for each of the 32 environmental factors for each of the 10 routes being evaluated (i.e., add by row on Table A-3). The results of this addition are presented below.

<u>Route</u>	<u>Total of Ranks</u>	<u>Rank Order of Routes</u>
B	161	(10)
G	121	(8)
H	119	(7)
M	97	(2)
N	107	(4)

<u>Route</u>	<u>Total of Ranks</u>	<u>Rank Order of Routes</u>
O	116	(6)
P	113	(5)
Q	94	(1)
R	102	(3)
S	157	(9)

As can be seen above, Route Q had the lowest total score and was given a final rank order of 1. As originally reported in the Draft EA (May 1990), Route Q is Western's proposed route and the environmentally preferred alternative. Route Q is highlighted on Map 2-2.

2.5 Summary of Impacts for the Environmentally Preferred Alternative

Route Q, Western's proposed route, and the environmentally preferred alternative, would have no significant impacts based on the significance criteria and impact analysis presented in Chapter 4. However, Route Q would have certain impacts, both beneficial and adverse that should be highlighted. Route Q would be the shortest route, of the 10 evaluated, at 80.4 miles, compared to 83.2 miles for the longest. It would require cross country access for construction across 9.9 miles of cropland and 14.2 miles of rangeland, for a total of 24.1 miles without existing access roads. It would cross the South Platte River at the most favorable location in terms of wildlife and wildlife habitat, but it would also cross 7.8 miles of irrigated cropland, primarily along Lodgepole Creek and the South Platte River. The proposed route crosses 1.5 miles of the South Platte River floodplain (Link 14), and 0.8 mile of the Lodgepole Creek floodplain (Link 8j). Approximately nine transmission line structures would be constructed within the South Platte River floodplain and approximately five structures within the Lodgepole Creek floodplain. There are no practicable alternatives to constructing within the floodplains. No applicable floodplain protection standards would be violated and no significant impacts to floodplains are anticipated. Route Q would be located along section lines for 88 percent of its length (70.7 miles). There would be 36 occupied residences within 0.25 mile of the route; none would require removal. Route Q would conflict with 7.1 miles of distribution line and require 47 special structures. Please refer to Table A-3 for detailed quantification of Route Q for each environmental factor and for comparison to the other nine routes evaluated.

LEGEND

ENVIRONMENTALLY
PREFERRED ALTERNATIVE

STUDY CORRIDOR BOUNDARY

PROPOSED LINKS

NODES

GREATER PRAIRIE CHICKEN
LEK SITE AND
PRODUCTION AREA

BALD EAGLE WINTER
CONCENTRATION AREA

OCCUPIED DWELLING

STATE WILDLIFE AREA

HISTORIC SITES

PIVOT IRRIGATION SYS

LEGEND

ENVIRONMENTALLY
PREFERRED ALTERNATIVE

STUDY CORRIDOR BOUNDARY

PROPOSED LINKS

NODES

GREATER PRAIRIE CHICKEN
LEK SITE AND
PRODUCTION AREA

BALD EAGLE WINTER
CONCENTRATION AREA

OCCUPIED DWELLING

STATE WILDLIFE AREA

HISTORIC SITES

PIVOT IRRIGATION SYSTEM

LEGEND

- **ENVIRONMENTALLY
PREFERRED ALTERNATIVE**
- **STUDY CORRIDOR BOUNDARY**
- **PROPOSED LINKS
NODES**

- **GREATER PRAIRIE CHICKEN
LEK SITE AND
PRODUCTION AREA**
- **BALD EAGLE WINTER
CONCENTRATION AREA**

- **OCCUPIED DWELLING**
- **STATE WILDLIFE AREA**
- **HISTORIC SITES**
- **PIVOT IRRIGATION SYSTEM**

NOTE: FINAL ROUTE ALIGNMENT IS
DEPENDENT ON DETAILED ENGINEERING.

MILES

MAP 2-2 STUDY CORRIDORS AND
ALTERNATIVE ROUTES

SHEET 4 OF 5

LEGEND

**ENVIRONMENTALLY
PREFERRED ALTERNATIVE**

STUDY CORRIDOR BOUNDARY

PROPOSED LINKS

NODES

**GREATER PRAIRIE CHICKEN
LEK SITE AND
PRODUCTION AREA**

**BALD EAGLE WINTER
CONCENTRATION AREA**

OCCUPIED DWELLING

STATE WILDLIFE AREA

HISTORIC SITES

PIVOT IRRIGATION SYSTEM

NOTE: FINAL ROUTE ALIGNMENT IS
DEPENDENT ON DETAILED ENGINEERING.

MILES

MAP 2-2 STUDY CORRIDORS AND
ALTERNATIVE ROUTES

SHEET 5 OF 5

3.0 AFFECTED ENVIRONMENT

3.1 Climate and Air Quality

The climate of the study area may be characterized as semi-arid continental. The topography between Sidney and Yuma is relatively flat across this portion of the South Platte River Basin. The Rocky Mountains are some 100 miles to the west.

The mean annual temperature in the region is 48.9°F recorded at both Sterling and Sidney. Monthly average temperatures range from 73.9°F at Sterling, 76.8°F in Yuma, and 74.8°F at Sidney in July to 24.8°F at Sterling, 29.6°F in Yuma, and 26.0°F at Sidney in January. The maximum temperatures on record were 106°F in Sterling and 108°F in Yuma; the minimum temperatures on record were -29°F in Sterling and -27°F in Yuma (National Oceanic and Atmospheric Administration 1974.)

Precipitation in the panhandle of Nebraska and northeast Colorado is primarily a result of Gulf of Mexico, Pacific Ocean, and orographic influences. The Gulf of Mexico serves as the major source of moisture with frequent contributions from the Pacific. Maximum precipitation occurs during the spring; minimum precipitation occurs during the winter. Mean annual precipitation totals of 15.65 inches, 14.10 inches, and 16.73 inches occur in Sidney, Sterling, and Yuma, respectively. Mean annual snowfall averages 21 inches in Sterling and 34 inches in Yuma. Yuma has an average of 27.5 days per year with one inch or more of snow cover. Average growing season length is 139 days and 168 days in Sterling and Yuma, respectively (National Oceanic and Atmospheric Administration 1974.)

Severe weather in the region can include periods of heavy snowfall accompanied by strong winds and blowing and drifting snow resulting in blizzard conditions. Springtime and summer bring severe thunderstorms accompanied by brief periods of heavy downpours, hail, lightning, strong gusty winds, and occasional funnel clouds. In the spring and fall, the region can experience freezing rain accompanied by strong winds, resulting in icing of trees and overhead lines; however, these are infrequent. Visibility in the region is excellent with median yearly visual range of approximately 70 miles or more.

Air quality in the region is good. No problems with gaseous pollutants exist in the region. Some concern for particulates could

exist. Particulate concentrations at Sterling in the past have occasionally exceeded the Federal annual standard. However, this has not occurred since 1981 and any particulate problems in Sterling are likely a result of its urban setting. Particulate levels in rural areas are generally lower than those found in urban settings.

3.2 Paleontology, Geology, and Soils

3.2.1 Paleontology

One documented location of paleontological resources (vertebrate fossils) occurs along the north side of Lodgepole Creek east of Sidney, Nebraska (Diffendahl 1989). This site is in the Ogallala Formation in Section 19 and Section 30, T14N, R48W. The site is crossed by two existing transmission lines.

Both the commonly fossiliferous Ogallala Formation (Miocene) and White River Formation (Oligocene) occur within the study area in Nebraska and Colorado, but no additional locations of paleontological resources have been reported (Stuckey 1989).

3.2.2 Geology

The study area is located within the Great Plains physiographic province, High Plains section. The rocks that underlie and outcrop in the area are sedimentary and range in age from Oligocene (Tertiary) to Recent (Holocene).

In Nebraska, the Brule Formation of the White River Group of Oligocene age is the oldest exposed formation, and alluvium of Pleistocene and Holocene age are the youngest. Sediments of the Brule Formation were laid down in a broad basin lying east of the mountains during a period of relative quiescence. The sediments were composed of silt and volcanic ash and today constitute a moderately hard, compact, brittle siltstone that locally may be sandy or argillaceous (Bjorklund 1957).

Overlying the Brule in Nebraska and Colorado is the fluvial Ogallala Formation which consists of lenticular beds of clayey, silty, sandy, and gravelly materials, in part cemented with calcium carbonate. The cemented beds are resistant to erosion and form prominent ledges. These are more common in Nebraska and underlie the Peetz Table area along the Nebraska-

Colorado border (Scott 1978). A small area immediately south of the Peetz Table contains exposures of the Arikaree Formation of Lower Miocene age. This fluvial (i.e., streamlain) deposit consists of gray to brown, moderately well consolidated conglomerate, sandstone, siltstone, and claystone, but also contains some sand and gravel (Scott 1978).

The South Platte River floodplain (as well as the Lodgepole Creek floodplain in Nebraska) contains Holocene streamlain alluvium. The sediments are yellowish-gray loose gravel, sand, and silt. Immediately south of the South Platte River is an area of Pleistocene and Holocene well-sorted, loose, windblown sand. This eolian material forms sheets of sand as well as dunes, many of which are more than 100 feet high. The dunes are largely stabilized with few active blowouts.

No geologic hazards were observed during a reconnaissance of the study area. No areas of slumping, subsidence, or unstable soils were observed. Only a few areas of steep slopes were noted. The study area is also generally stable from a seismic consideration.

3.2.3 Soils

Soil surveys have been completed for the entire study area in Cheyenne County, Nebraska; and Logan, Washington and Yuma Counties, Colorado. All are modern, published surveys except Cheyenne County which is completed but unpublished at this time.

Four major soil landscape types are contained within the study area. Soils are underlain by both consolidated and unconsolidated sediments on uplands which comprise the major portion of the study area. These areas are found in Cheyenne County (Nebraska) south of Sidney as well as in northern and southern Logan County and also in Yuma and Washington Counties in Colorado.

Soils forming in unconsolidated loamy alluvial and eolian (i.e., wind deposited) materials comprise the first soil landscape type and are generally deep and have sandy loam to clay loam texture. They are nearly level to strongly sloping. Soils found on sandstone, siltstone, or shale cored uplands constitute the second soils group and are of variable depth and texture and are nearly level to strongly sloping. Some upland ridge and fan areas have deep soils forming in unconsolidated gravelly materials. Dryland and irrigated wheat farming, as well as grazing and wildlife habitat, are the principal land uses.

Soils forming in unconsolidated alluvium on stream terrace, flood plains, and bottomlands associated with the South Platte River in Logan County comprise the third major soil area. These soils are deep, nearly level, well drained to poorly drained, and have formed in loamy to clayey alluvium. Prime farmland soils can be found in these areas. Much land is in irrigated cropland. Some wetland soils are also present.

South of the South Platte River in Logan County is a band of soils forming in deep sandy and fine sandy loam eolian materials which comprise the fourth major soil landscape type. This is an area of old sand dunes, now largely stabilized, on which these excessively drained, nearly level to hilly soils are found. Grazing and wildlife habitat are the principal land uses on these sandy soils.

3.3 Water Resources

The study area is located within the South Platte River Basin. The South Platte River is the largest river that flows through the study area. Lodgepole Creek is the only other perennial stream in the study area. There are numerous ephemeral streams within the study area that flow into the South Platte River including Surveyor Creek, Rock Creek, Sandy Creek, Frenchman Creek, Wildhorse Creek, and Cottonwood Creek. Sidney Draw and Cow Creek flow into Lodgepole Creek. Irrigation canals run parallel to the South Platte River in most of the study area.

Hydrologic changes in the South Platte River have occurred as a result of irrigation development and large reservoir construction. Construction of reservoirs within and upstream from the study area has resulted in decreased historic peak flows in the river. Julesburg Reservoir is the only large reservoir located within the study area.

Water quality near Julesburg, Colorado, the closest U.S. Geological Survey (USGS) gaging station to the study area, is good (Table 3-1). In general, there tends to be an increase in dissolved solids concentration in the river in a down-valley direction (Hurr et al. 1975). Flows range from zero flows in late July to mid-August on several occasions to over 35,000 cubic feet per second (cfs) in mid-June (Table 3-2). Average flow is 543 cfs.

Lodgepole Creek near Kimball, Nebraska also has good water quality (Table 3-1). Flows range from less than 0.1 cfs to over 16,000 cfs

TABLE 3-1

REPRESENTATIVE SURFACE WATER QUALITY PARAMETERS

Stream Station	Instantaneous Flow (cfs)	Conductivity (μ mhos/cm)	Temperature (°C)	Hardness (mg/l as CaCO ₃)	Total Dissolved Solids (mg/l)
South Platte River at Julesburg, CO ¹	228-2,350	852-1,960	0.5-23.0	290-720	520-1,500
South Platte River near Weldona, CO ¹	145-1,250	806-1,810	2.5-29.0	270-680	490-1,300
Lodgepole Creek at Kimball, NE ²	0.42-17.0	700-1,010	1.0-26.0	210	343-580

¹USGS 1987.²USGS 1981.

TABLE 3-2
 REPRESENTATIVE STREAMFLOWS
 (in CFS)

Stream Station	Mean	Minimum	Maximum
South Platte River at Julesburg, CO ¹	543	No flow	37,600
South Platte River near Weldona, CO ²	572 (prior to completion of Chatfield Dam)	39.0	26,800
	1,059 (after completion of Chatfield Dam)		
Lodgepole Creek at Bushnell, NE ³	11.0	0.09	16,500

¹USGS 1987.

²USGS 1981.

³USGS 1986.

(Table 3-2). Average flow is about 11.0 cfs. Flows below Oliver and Bennett Reservoir (both upstream of the study area) are modified due to the reservoirs' influence.

The principal use of both surface and groundwater along the South Platte River in the study area is for irrigation. The South Platte River is underlain by valley-fill containing an unconfined aquifer which is in hydraulic connection with the river. Recharged groundwater is higher in dissolved solids than the applied irrigation water resulting in a general increase in dissolved solids concentration in a down-gradient and down-valley direction (Hurr et al. 1975). The valley-fill aquifer along the South Platte River is recharged principally by precipitation, applied irrigation water, and leakage from canals and reservoirs.

Groundwater away from and underlying the South Platte alluvial aquifer occurs in the Ogallala aquifer. Depth to groundwater in Yuma County is 200 to 250 feet and is probably at similar depths in the remainder of the study area (Weist 1964). Recharge to the aquifer is from precipitation and seepage losses from streams. Discharge is from underflow and evaporation as well as other consumptive uses. Water quality is generally good although the water is somewhat hard (Weist 1964).

3.4 Floodplains and Wetlands

The study area is located within the South Platte River basin. The hydrology of the area is discussed in Section 3.3 of this document. The 100-year floodplain along the South Platte River in the study area ranges from approximately 5,000 feet to 12,000 feet in width. Along Lodgepole Creek, the 100-year floodplain ranges from approximately 4,000 feet to 7,000 feet in width.

Few wetlands occur on the eastern plains of Colorado and western Nebraska. The majority of wetlands are found in depressional areas adjacent to small creeks. Common plants associated with these wetlands include floatingleaf pondweed, arrowhead, American waterplantain, American bulrush, cattail, alkali cordgrass, woolly sedge, and softstem bulrush. There is only one wetland that is found within the corridor boundaries. This wetland is found within the corridor adjacent to Lodgepole Creek west of Link 1.

3.5 Vegetation

The following information was extracted from the completed, unpublished soil survey of Cheyenne County in Nebraska, and the soil surveys of Logan, Washington, and Yuma Counties in Colorado (SCS 1986, 1981, and 1977). The study area is located in the short-grass prairie region; however, portions of the study area support plant species representative of the mixed and tall-grass prairies. Due to the rainshadow effect caused by the Rocky Mountains to the west, this area receives only 13 to 19 inches of precipitation annually. Vegetation differences that are present, whether cultivated crops or native vegetation, are largely determined by the soils and topography of the study area.

The northern end of the study area, which extends from Sidney to just inside the Colorado border, is characterized by nearly level to gentle slopes on loamy and clayey plains. The majority of this area is nonirrigated cropland with few, isolated irrigated areas, and some rangeland areas. The nonirrigated cropland is used to grow wheat, millet, and grain sorghum. The rangeland areas are dominated by upland sedges and such grass species as blue grama, western wheatgrass, buffalograss. Some forbs and shrubs which are commonly found in this area and within all other rangeland areas are western yarrow, woolly plantain, scarlet globemallow, cudweed sagewort, Lambert crazyweed, woolly loco, skinflower scurfpea, fringed sagebrush, wild rose, and chokecherry. During a normal year, the clayey and loamy plains produce 900 to 1,800 pounds of forage per acre, respectively.

The area that extends south to the Sterling Quiet Canal, is characterized by gentle slopes to moderately steep gravel ridges and fans. This area consists of gravel breaks, loamy plains, and sandy plains dissected by drainageways. The majority of this area is rangeland although some nonirrigated cropland is present. Blue grama, sideoats grama, little bluestem, buffalograss, and upland sedges are the most abundant plant species present on the rangeland. The yield of forage from these rangelands areas may range from 900 to 2,000 pounds of forage per acre.

The area south of the Sterling Quiet Canal to the South Platte River floodplain is characterized as high-lying upland flats. This area

consists of irrigated and nonirrigated cropland and rangeland. Corn is the major irrigated crop, and wheat is the primary nonirrigated crop. Rangeland vegetation mainly consists of blue grama, western wheatgrass, and buffalograss which produces an average yield of 1,700 pounds of forage per acre.

The South Platte River floodplain area is characterized as nearly level terraces and bottomlands. This area contains loamy plains, clayey plains, and salt meadows. The majority of the floodplain is used as irrigated cropland, however, some areas are used for grazing and wildlife habitat. The major irrigated crops are corn, alfalfa, sugarbeets, and small grains. The loamy and clayey plains support sedges and native grass species such as blue grama, western wheatgrass, buffalograss. The sandy meadows, which are too wet for cropland, support grass species such as sand bluestem, sand seedgrass, little bluestem, and switchgrass. The salt meadows support grass species such as inland saltgrass, alkali sacaton, and switchgrass. The forage production for the floodplain area ranges from 900 to 4,000 pounds of forage per acre for the clayey plains and salt meadows, respectively.

The next distinguishable land area is the sandhill region. This region is located south of the South Platte floodplain and extends south to the town of Fleming. This region is characterized by nearly level to moderately sloping sandy plains which are used primarily for grazing. A few areas are used as nonirrigated and irrigated cropland areas. The most abundant plant species occurring in this region are blue grama, sand seedgrass, little bluestem, switchgrass, and sand sagebrush. Forage yields for this region range from 1,800 to 2,000 pounds of forage per acre. Nonirrigated crops include wheat and millet and irrigated crops include corn and alfalfa.

The area from Fleming south to Yuma is characterized as nearly level to sloping loamy plains. This land is primarily used for nonirrigated crops, however, some rangeland and wildlife areas are present. The major nonirrigated crop is wheat and the major irrigated crops are corn and alfalfa. The dominant grass species found on the rangeland are blue grama, green needlegrass, western wheatgrass, and buffalograss. Forage yield for a normal year is 1,200 pounds of forage per acre.

Riparian habitats are found within the corridor boundaries. These riparian areas can be relatively inconspicuous (intermittent creeks and springs) to quite obvious (South Platte River). Riparian areas located along intermittent water sources consist mainly of sedges and other plants which are tolerant of periodic saturated soils. Many of the creeks within the corridor are ephemeral water sources. The botanical composition of riparian habitats near permanent water sources, such as Lodgepole Creek and the South Platte River, include woolly sedge, arrowhead, American bulrush, American waterplantain, alkali cordgrass, and pondweed. Cottonwoods and willows are the common tree species. Other plant species which inhabit moist habitats in the sand hill region of Colorado are redtop, switchgrass, big bluestem, saltgrass, common blue-eyed grass, and nodding beggers-tick.

There are no federally or state-listed plant species found within the corridor boundaries (Rocky Mountain Heritage Task Force 1989; Nebraska Natural Heritage Program 1988). Three plant species which may or may not occur in Logan, Washington, and Yuma Counties are classified by the State of Colorado as plant species of special concern. These plant species are mountain cat's-eye, Platte River milkvetch, and summer orophaca (Naumann 1989).

Mountain cat's-eye is found on list 2 of the list of Colorado plant species of special concern. List 2 classification includes plant species which are rare in Colorado but relatively common elsewhere within their range. Mountain cat's-eye inhabits dry hills and plains and may be found in Logan and Washington Counties.

Platte River milkvetch is found on list 3 of the State's list of plant species of special concern. List 3 classification includes plant species which appear to be rare but for which conclusive information is lacking. Platte River milkvetch inhabits prairies and plains at lower elevations especially near the Platte River and its branch tributaries. This plant species may be found in Washington County.

Summer orophaca is also found on list 3 of the State's list of plant species of special concern. This plant species inhabits dry sandy or clayey plains and hills at lower elevations. This plant species may be found in Yuma County.

3.6 Wildlife

3.6.1 Non-Game Species

The Sidney-North Y Prt encompasses an area containing a variety of wildlife resos. study area is predominantly composed of agricultural fields wreg; of native rangeland located north and south of the South Pl R riparian area. State Wildlife Areas (SWAs) under the manager of Colorado Division of Wildlife (CDOW) are located near the pzed mission line routes, and include the Tamarack Ranch SWA, Duckek and Red Lion SWA (see Map 2-2). The SWAs are set aside by tktatr habitat and wildlife development and protection. Wildlife Hat is (WHAs) also occur within the study area in the southern pon oan County. These areas are privately owned parcels leased to CDOW habitat development (Pusateri 1988); the bulk of the CDOWasesr WHAs are for 10 to 15 years. The landowner sets aside thea habitat development, with the agreement that the land is exempt f prcion and grazing use (Moss 1989).

Jumbo (Julesburg) Irvois located directly north of the Red Lion SWA (see Map 2-2). Jumeser and the riparian area along the South Platte River support a sterersity and abundance of wildlife species than in the open agricual rangeland habitats. The protected SWAs also support numerousecie Small, isolated riparian areas are primarily associated withall often intermittent streams.

Amphibian speciescuring the South Platte River, Jumbo Reservoir, perennial anterent streams, and farm stock ponds. The tiger salamander, greatinsd, and boreal chorus frog are among the more common species occng he study area. Reptile species include the northern earless ard,-lined racerunner, great plains skink, eastern yellowbelly rac norm water snake, bullsnake, and prairie rattlesnake (Hammerson Lans 1981). In addition, the western spiny softshell turtle is amcomresident within the South Platte River habitat (Bennett 1989; B 19)

Bird species occurthin study area throughout the year, but are most abundant during ratiand the breeding season. Species are associated with two pry itats: 1) open native grasslands and agricultural areas, ar2) rian vegetation and open water. Common

non-game birds occurring in the project area include the horned lark, western meadowlark, western kingbird, great blue heron, and pied-billed grebe. Nesting birds of prey include the golden eagle, prairie falcon, northern harrier, red-tailed hawk, and burrowing owl (Crooks 1988; Lock 1988; Chase et al. 1982). An active heronry is located along the western edge of Jumbo Reservoir and contains approximately 65 active nests. Species utilizing the heronry include the great blue heron, black-crowned night heron, and double-crested cormorant (Crooks 1988).

Common non-game mammals include the prairie vole, thirteen-lined ground squirrel, black-tailed prairie dog, black-tailed jackrabbit, and white-tailed jackrabbit (Bissell 1982).

3.6.2 Game Species

A variety of game bird species occur within the project area. Common upland species include the mourning dove, northern bobwhite, and ring-necked pheasant (Chase et al. 1982). A recent program initiated by the CDOW has reintroduced the Merriam's wild turkey along the riparian habitat of the South Platte River (Crooks 1988). A large concentration of both resident and migrant waterfowl species exists along the South Platte River and Jumbo Reservoir. Species also utilize scattered riparian areas located throughout the project area. Waterfowl species occurring along these habitats include the Canada goose, snow goose, mallard, green-winged teal, northern pintail, and bufflehead (Chase et al. 1982).

The South Platte River is a migratory flyway bordered by agricultural fields, native rangeland, and the SWAs as discussed in Section 3.6.1. A total of 10 warm water sloughs are either existing or proposed for construction by the CDOW within the Tamarack Ranch and Red Lion SWAs for waterfowl use during the winter months (Crooks 1988; Dillinger 1989; Moss 1989). Due to the combination of these habitats, concentrated waterfowl numbers move daily between the roosting and foraging sites located along Jumbo Reservoir and the South Platte River. The annual waterfowl counts conducted in December 1988 and January 1989 by the CDOW estimated 35,000 individuals inhabiting the project area surrounding the South Platte River, Jumbo Reservoir, and associated habitats (Crooks 1988; CDOW 1989). These waterfowl move daily from the reservoir or pond areas to the river bottom, adjacent corn and wheat fields, or the SWAs. Although the river

provides a concentration area, the waterfowl often disperse throughout these areas for foraging (Crooks 1988; Dillinger 1989).

Many game mammal species occur in the habitats within the study area. Important furbearers within the project area include the muskrat, mink, raccoon, red fox, bobcat, and coyote. Other small mammal game species include the eastern cottontail, desert cottontail, and fox squirrel (Bissell 1982). Both mule deer and white-tailed deer inhabit the project area. Mule deer are predominantly found within the sandhills habitat; white-tailed deer are common throughout. The South Platte River corridor is considered important to both wintering deer species. White-tailed deer comprise approximately 75 percent of wintering individuals, with mule deer representing 25 percent (Crooks 1988). Pronghorn predominantly occur within the native range area north of the South Platte River and into Nebraska (Davis 1989; Metzel 1989).

3.6.3 Threatened or Endangered Species

Computerized database searches were requested from both the Nebraska Natural Heritage Program and the CDOW. Four federally-listed endangered bird species were reported within the project area from this data source: bald eagle, peregrine falcon, whooping crane, and interior least tern (Crooks 1988; CDOW 1988; Chase et al. 1982). In addition, the piping plover is federally-listed as threatened within the project area and has been reported by other sources (Sheppard 1989).

The bald eagle (Haliaeetus leucocephalus) is a common winter resident within the floodplain of the South Platte River, along Jumbo Reservoir, and may be periodically seen within portions of the project area in Nebraska. Eagles begin migrating into Colorado beginning in late October. Peak numbers usually occur from late January to mid-February, although numbers can also be high in March as southern migrants move through the state (Crooks 1988; Dennis 1989). Observations during the annual waterfowl survey, conducted December 1988 and January 1989, recorded up to 32 bald eagles along the South Platte River from Sterling to Julesburg, including 15 individuals observed at Jumbo Reservoir (CDOW 1989). Feeding areas, night roosts, and diurnal perches are habitat requirements for wintering bald eagles (Swisher 1964). Eagles utilize the river bottom

and reservoir area for these activities. Map 2-2 outlines the bald eagle winter concentration areas within the study area (CDOW 1988).

Two subspecies of the peregrine falcon occur as occasional migrants through the project area (Craig 1989). The American peregrine falcon (Falco peregrinus anatum) is federally-listed as endangered; the Arctic peregrine falcon (Falco peregrinus tundrius) is federally-listed as threatened. Both subspecies may occur along the South Platte River, particularly near waterfowl concentration areas. However, occurrences in both eastern Colorado and southwestern Nebraska may vary from year to year (Crooks 1988; Lock 1988).

The proposed project area is also along the western edge of the whooping crane (Grus americana) migratory path. Two individual sightings have been recorded near Sidney and west of Jumbo Reservoir; however, occurrences of this species would be rare along the transmission line corridors (Andelt 1988; Crooks 1988; Lock 1988).

The interior least tern (Sterna antillarum) currently breeds along the South Platte River as far west as Ogallala (USFWS 1989). The proposed study area intersects with the western boundary of this species' breeding range and migratory route. Three sightings of interior least tern individuals have been recorded within the study area. Two observations occurred near the Dune Ridge Wildlife Area, Colorado in June and July 1989 by a Colorado Bird Observatory Volunteer. A third sighting was recorded near Iliff, Colorado during a CDOW and USFWS survey, which was also performed in June and July of 1989 (Carlson 1989; Dennis 1989).

The piping plover (Charadrius melodus) is federally-listed as threatened within the project area. An estimated 355 breeding pairs occur in Nebraska, with the majority nesting along the Platte River (Nebraska Game and Parks Commission 1985). The study area is located near the western boundary of the piping plover breeding range and migratory route; few sightings have been recorded in this area. Plover individuals have been observed, however, at Jumbo Reservoir in 1975 and 1986. Although this species is considered a migrant within the project area, the piping plover may also nest in the region (Sheppard 1989; Sidle 1991).

The federally-endangered black-footed ferret (Mustela nigripes) historically occurred within the project area. Ferrets rely on prairie dogs as their primary food source and are generally associated with

prairie dog colonies. Prairie dog colonies occur throughout the study area; therefore, ferrets could potentially occur within the appropriate habitat.

Two Federal candidate bird species listed as category 2 (i.e., candidate for federal threatened or endangered status) occur within the project area. Both the Swainson's hawk (Buteo swainsoni) and ferruginous hawk (Buteo regalis) breed in the study area (Chase et al. 1982; Lock 1988). The swift fox (Vulpes velox) is another Federal candidate species category 2, and listed as endangered within the State of Nebraska (Lock 1988). Two probable sightings of swift fox individuals were recorded near Sidney in 1981 and potential habitat could exist within the study area (Nebraska Natural Heritage Program 1988).

The plains sharp-tailed grouse (Tympanuchus phasianellus) is listed as endangered within the State of Colorado and is known to winter in the Tamarack Ranch SWA (Crooks 1988). The greater prairie chicken (Tympanuchus cupido) is also listed as endangered in Colorado. A reintroduction program initiated by the CDOW in 1984 has been successful in maintaining a small population of prairie chickens within the Tamarack Ranch SWA and surrounding sandhill habitat (Crooks 1988; Dillinger 1989). Map 2-2 outlines existing greater prairie chicken production areas, which incorporates the lek or breeding site and surrounding nesting habitat (CDOW 1988). The CDOW predicts that this population may expand with subsequent reintroduction of individuals (Crooks 1988).

The American white pelican (Pelecanus erythrorhynchos) is listed in Colorado as a species of special concern (CDOW 1988). Pelicans occur primarily along Jumbo Reservoir as migrants (Crooks 1988; Chase et al. 1982).

A Biological Assessment has been prepared for submittal to the U.S. Fish and Wildlife Service (USFWS) for review of the bald eagle, peregrine falcon, whooping crane, interior least tern, piping plover, and black-footed ferret. The USFWS (1988) outlined these species for analyses, according to Section 7 of the Endangered Species Act of 1973.

3.7 Aquatic Ecology

The major aquatic resources in the study area are found in the South Platte River. This reach of the South Platte River is managed as a

warmwater fishery. A total of 26 species of fish potentially occur in this river segment (Probst 1982; Goettl 1982). One species, the common shiner (Notropis cornutus), is listed as a "species of special concern" by the CDOW (Bennett 1988). One individual was found in the South Platte River near Sterling, Colorado by Goettl (1982). The primary recreational species are largemouth bass and channel catfish. The most abundant species include the sand shiner, white sucker, fathead minnow, creek chub, bigmouth shiner, carp, red shiner, and plains killifish (Probst 1982).

Lodgepole Creek, located south of Sidney, Nebraska, is considered a coldwater fishery by the Nebraska Game and Parks Commission. This stream is periodically stocked with catchable trout at a location about 20 miles west of Sidney near Potter, Nebraska. The fishery value decreases quickly downstream from Potter until it becomes a negligible resource within the study area (Hanson 1988). Only a few trout and suckers inhabit Lodgepole Creek within the study area boundary.

Other streams of lesser importance in the study area include Cow Creek and Cottonwood Creek, both located south of Sidney, Nebraska. These streams are intermittent and do not support aquatic life (Hanson 1988).

3.8 Land Use and Zoning

The study area is located in Cheyenne County, Nebraska, and Logan, Washington, and Yuma Counties, Colorado. Cities and towns in, or near, the study area include Sidney, Sunol, and Lodgepole, Nebraska; and Fleming, Daily, Crook, Proctor, Iliff, Yuma, and Sterling, Colorado.

Agriculture, both irrigated and dry cropland, and open rangeland used for livestock grazing are the principal land uses in the study area. Most irrigated cropland is found along the South Platte River valley; however, there are other irrigated parcels scattered throughout the study area. Center-pivot irrigation systems are generally concentrated along the south side of the South Platte River. In most areas, the amount of irrigated cropland decreases and dry cropland and rangeland increases as one moves away from the South Platte River valley. There is some prime farmland located within the study area.

Nebraska law (Legislative Bill 917) strongly discourages any alignment not following existing land use and section lines. Sidney, Nebraska has planning and zoning jurisdiction 2 miles beyond the city

limits. The City of Sidney has adopted a planning and zone code (1985). Utility lines are allowed in all zoning districts within the City of Sidney's jurisdiction and no permits are required (Haskins 1988). Cheyenne County has also developed a comprehensive plan and adopted zoning and subdivision regulations (1975). A conditional use permit would be required for construction of the proposed transmission line (Haskins 1988). Finally, the Sidney-Cheyenne County Joint Airport Zoning Board has adopted amended airport zoning regulations for the Sidney Municipal Airport (1988). The Sidney Municipal Airport Zoning Regulations specify airport zones, height restrictions, and permit requirements.

Colorado Revised Statutes, Section 30-28-110, states that no road, structure, or utility can be located and/or constructed in the unincorporated sections of a county that has an adopted master plan without the approval of the county or regional planning commission. Logan County has developed a comprehensive plan (1984) and zoning ordinance. Under 30-28-109, construction of the proposed transmission line would require a conditional use permit from the county (Debus 1988). The decision on the conditional use permit application would be made by the Board of County Commissioners. Additional county permits which might be required include a building permit and road use permit.

Washington County has adopted an official zoning resolution (1983). The Board of County Commissioners also functions as the County Planning Commission in implementing the zoning resolution (Florian 1989). According to the chairman of the Board of County Commissioners, there are no specific county permits required for overhead transmission lines (Florian 1989). Permits and fees might be required if there was activity proposed within the county road ROWs that could result in damage to the county road (Florian 1989). However, all proposed land uses not expressly addressed in the zoning resolution as being by right or with approval of the Board of County Commissioners will require an amendment to the resolution. Transmission lines are not expressly addressed as being by right; consequently, the proposed project might require an amendment to the zoning resolution. The Board of County Commissioners must also determine if the proposed amendment is for an activity so significant to be of state interest. The process established by Washington County regarding proposed amendments to the zoning resolution provides an

opportunity for public input into land use decisions. It is not necessarily an obstacle to proposed development.

Yuma County has adopted land use regulations rather than a zoning ordinance (Goodman 1988). All utilities, including transmission lines, must submit a Determination of Significance application to the County Planning Commission to ascertain if there would be any impact on the surrounding land uses. The County Planning Commission is a 5-member commission appointed by the County Commissioners. If some impact is anticipated by the County Planning Commission, public hearings before the County Commissioners would be required (Goodman 1988). All major utilities, including transmission lines, must follow the guidelines outlined in the regulations for Site Selection and Construction of Major Facilities of a Public Utility. These regulations are administered through the County Planning Commission.

3.9 Recreation

Key outdoor recreation resources in the study corridors are limited to the City of Sidney's Fairgrounds and Rodeo Arena, the South Platte River valley, Tamarack Ranch SWA, the F&H Golf Course, and the Haxtun Rod and Gun Club.

The study area offers good opportunities for hunting big game animals (deer, antelope), waterfowl, and upland game birds. The South Platte River valley offers significant bird watching opportunities. A visitor to this area may well see a wintering bald eagle, wild turkey, or greater prairie chicken along with hundreds of other species. The Tamarack Ranch SWA is located in the South Platte River valley and runs along approximately 13 miles of wildlife habitat for both game and non-game species. The area is open year-round to visitors. The F&H Golf Course is a 9-hole course, located approximately 1.5 miles southwest of Daily, Colorado, and is in the process of converting from sand greens to grass (Logan County Chamber of Commerce 1988). The Haxtun Rod and Gun Club is located on the east side of the Tamarack Ranch SWA, along the south side of the South Platte River.

3.10 Visual Resources

The visual resource baseline addressed a study area within 2 miles of alternative links associated with the project. Landscape sensitivity units were mapped based on the characteristic landscape, viewer sensitivity and distance zones, and relative number of viewers. Landscape character is defined through spatial analysis of homogeneous zones having common characteristics of topography, irrigated and dryland agriculture, cities and towns, riparian vegetations, and rangeland. The data were verified with aerial and ground reconnaissance to refine character type and landscape pattern mapping.

Viewer sensitivity mapping is based on identification of degrees of sensitivity of viewers with regard to specific land uses and cultural features. Distance zone mapping is based upon the relative proximity of land areas to major use areas and travel routes. Distance zone classifications, based upon the distance at which a 230-kV wooden pole H-frame and associated conductors would be visually apparent, are as follows: 0.5 mile (foreground); 2 miles (middleground); and greater than 2 miles (background).

Use volume information is a component of landscape sensitivity analyses. Criteria for volume of viewers is based upon that of the Bureau of Land Management Visual Resource Management System. Criteria include relative rankings for use sites and areas and transportation routes.

Landscape sensitivity unit classifications are standards based upon the ability of the landscape to accommodate visual change. Class I units are most sensitive to changes to the characteristic landscape. Class II units are moderately sensitive to changes to the characteristic landscape. Class III units are least sensitive to changes to the characteristic landscape.

The physiography of the study area is characteristic of the high plains of eastern Colorado and southern Nebraska. Two expansive flat plains are cut by two valleys, the larger South Platte River valley in Colorado and the smaller Lodgepole Creek valley in Nebraska. The predominant landforms of the study area consist of the Lodgepole Creek valley on the northern edge, the relatively flat agricultural plain extending from Lodgepole Creek valley to South Platte River valley, the undulating South Platte River valley and very flat floodplain, and the

flat to rolling agricultural plain extending from the South Platte River valley south to the area of Yuma. The South Platte River runs northeast to southwest, while Lodgepole Creek runs predominately east to west. The origin-destination axis of the transmission line project is predominantly northwest to southeast.

Vegetation in the study area consists of the riparian vegetation along the South Platte River and Lodgepole Creek, the farmstead and shelterbelt vegetation, rangeland vegetation within the valleys, and dryland and irrigated croplands. Cultural vegetation in the study area introduces strong linear elements that are relatively absorptive of linear activities such as transmission lines.

Major portions of the study area landscape have been culturally modified. Most significant modifications occur in the form of communities of Sidney, Iliff, Fleming, and Dailey and ranches and farmsteads within the floodplains, valley, and high agricultural plain. In addition, the far northern and southern edges of the study area are visually dominated by existing high voltage transmission structures. Center-pivot irrigation sprinklers created dominant landscape patterns from the ground and from the air.

Landscape character is significantly enhanced by topography and landscape patterns associated with riparian vegetation, the South Platte River corridor, and irrigated cropland. These areas represent the highest level of visual quality in this physiographic region.

Due to their importance as recreation destinations, areas accommodating highly sensitive viewers include the South Platte River corridor, Tamarack Ranch State Wildlife Area, Red Lion State Wildlife Area, and F&H Golf Course. The communities of Sidney, Lodgepole, Iliff, Fleming, and Dailey comprise moderate sensitivity viewer locations. Travel routes I-80, I-76, U.S. Route 138, U.S. Routes 30 and 385, Nebraska State Route 19, and U.S. Route 6 are also classified as moderate sensitivity viewer locations. Travel routes 55 and 59 (Colorado) are classified as low sensitivity viewer locations. High and moderate sensitivity use areas and travel routes are utilized as origins for distance zone classification.

High use volume travel routes include I-80 and I-76. The only high use volume community within 2 miles of an alternative route is Sidney,

Nebraska. Moderate use volume communities include Lodgepole, Iliff, Fleming, and Dailey. Moderate use volume travel routes include U.S. Route 138, U.S. Routes 30 and 385, Nebraska State Route 19, and U.S. Route 6. Moderate use volume areas include the South Platte River corridor, Tamarack Ranch State Wildlife Area, Red Lion State Wildlife Area, and F&H Golf Course. All remaining areas are designated as low use volume.

Class I landscapes consist of areas within the foreground of the South Platte River and floodplain and areas within the foreground of the Tamarack Ranch and Red Lion State Wildlife Areas and F&H Golf Course. Class II is assigned to those areas in the foreground distance zone from the communities of Sidney, Iliff, and Dailey, and travel routes I-80, I-76, U.S. Route 138, U.S. Routes 30 and 385, Nebraska State Route 19, and U.S. Route 6. Class III is assigned to all remaining locations in the study area.

3.11 Cultural Resources

The project vicinity is known to have been inhabited for the past 11,000 to 12,000 years (Eighmy 1984; Butler 1986; Holliday 1987; Mehls 1984). Three principal stages of prehistoric (aboriginal) occupation are known: Paleo-Indian (12,000 to 7,500 years before present), Archaic (7,500 to 1,800 years before present), and Ceramic (1,800 to 200 years before present). Prehistoric inhabitants participated in a hunting/gathering economy which often emphasized bison procurement. Historic (Euro-American) occupation and use of the area began in the late 18th or early 19th century. Important historic themes are early exploration/trapping/trading (pre-1870), Anglo-Indian conflict (1860-1869), trails/transportation/railroading (1859-1895), and homesteading/agricultural settlement (1860-1930).

A file search was conducted in December 1988 and January 1989 through the Colorado Office of Archaeology and Historic Preservation, Colorado Historic Society, Denver, and the Nebraska State Historical Society, Lincoln. The area covered by the file search was 298 square miles in Colorado and 54 square miles in Nebraska. Two prior surveys and four sites are on record for the Nebraska portion of the project area. Both surveys were undertaken by the Nebraska State Historical Society. The

first was of the Interstate 80 ROW in the vicinity of Sidney Draw approximately 5 miles west of Sidney (Nebraska State Historical Society Records 1970); the second was of a high voltage transmission line ROW within the present east/west-trending study corridor (Carlson 1978). Three of the four known sites are prehistoric; none have been assessed for NRHP eligibility. Site 25CN20 is on a stream terrace in T13N, R50W, Sec. 3. Site 25CN21 occupies a ridge top in T13N, R50W, Sec. 2. Site 25CN52 is in T14N, R47W, Sec. 27.

The single known historic site, which as yet has no permanent number, is an intact segment of the Sidney-Black Hills Trail. Approximately 1.5 miles in length, it is located a short distance northwest of Sidney in T14N, R50W, Sec. 24 and 25. The trail segment ascends Deadwood Draw in a north-northwesterly direction, then becomes indistinct in tablelands further north. It is manifested as deep ruts, in some places individual sets and in other places up to three parallel sets. A quarry, from which stone was extracted during the early construction of Sidney, is located along the trail in Deadwood Draw. Stone was hauled the short distance from the quarry to Sidney via the trail. The quarry and trail are, for management purposes, regarded as the same site. The Sidney-Black Hills Trail was laid out by the U.S. Army in 1873 and was used originally to freight supplies to the Red Cloud Agency at Fort Robinson. With the opening of the Black Hills gold fields in the mid-1870s, the trail became a supply route for the miners and, secondarily, an access route for people bound for the Black Hills in search of employment in the mines. The trail was essentially abandoned in 1882 when a rail spur was completed to the Black Hills (Curley 1877; Mahnken 1949). The Sidney-Black Hills Trail, comprised of the segment near Sidney and two other intact segments 10 to 20 miles north of Sidney, is presently being nominated to the National Register of Historic Places by the Cheyenne County (Nebraska) Historical Society.

In Colorado, records indicate that three cultural resource inventories have been conducted within the study area. In 1980, Western Area Power Administration inventoried the Sterling-Holyoke 115-kV transmission line, which generally parallels U.S. Route 6 between those communities and crosses a Sidney-North Yuma study corridor in the Fleming vicinity (Commonwealth Associates 1980). The Trailblazer Pipeline ROW lies parallel to and

just south of the Colorado-Nebraska state line, and crosses Sidney-North Yuma study corridors in two places. It was surveyed in 1981 by Commonwealth Associates (Hunt and Weir 1981). The third inventory was a 14.5-acre survey by the Colorado Department of Highways in extreme northwestern Yuma County (Gilmore and Baugh 1987). No cultural resources were recorded. Four cultural resources, none associated with specific projects, are known from the project area within Colorado. All are in central Logan County. Site 5LO23 is a prehistoric lithic scatter located in T8N, R49W, Sec. 11. It was assessed in the field as not significant. Sites 5LO63, 5LO64, and 5LO232 are all historic sites for which NRHP evaluations have not been made. 5LO63 is located in T9N, R51W, Sec. 11. It is the Iliff Ranch site, dated ca. 1870 to 1879 and associated with J. W. Iliff, one of Colorado's early cattle barons. This site may include a log structure that is still standing. Site 5LO64 is a stage stop, the River Side Station, dated ca. 1860 to 1869 and situated in T9N, R51W, Sec. 11.

Four historic routes traverse the Sidney-North Yuma study area in northeastern Colorado. All follow the course of the South Platte River. These are The Overland Trail and Stage Route, the Platte River Trail (ca. 1840s to 1900), the route of Major Stephen H. Long's 1820 exploration party, and the route of the Villasur Expedition, ca. 1720 (Mehls 1984; Schweigert 1987). No physical evidence of these routes has been recorded in the study area.

3.12 Socioeconomics and Community Resources

3.12.1 Population

Table 3-3 shows the population characteristics for the four-county study area which includes Logan, Washington, and Yuma Counties in Colorado, and Cheyenne County, Nebraska.

Logan, Washington, and Yuma Counties all experienced a net population decline between 1980 and 1987. The net reduction in population during this period ranged between 0.8 percent in Yuma County, 3.0 percent in Washington County, and 5.2 percent in Logan County. The population decreases in these counties contrasted sharply with the State of Colorado, in general, which experienced a 14.1 percent increase in population between 1980 and 1987 (Colorado Division of Local Government 1980 to 1987).

TABLE 3-3

POPULATION OF THE STUDY AREA AND VICINITY

	April 1980	July 1981	July 1982	July 1983	July 1984	July 1985	July 1986	July 1987	1980-1987 ¹ Change (#)	1980-1987 ¹ Change (%)	1980-1987 ¹ Annual Average Change (%)
State of Colorado	2,889,735	2,983,873	3,071,614	3,148,475	3,189,651	3,234,340	3,266,149	3,296,269	+406,534	+14.1	+1.9
Logan County	19,800	19,957	19,970	20,266	20,002	19,832	19,039	18,776	-1,024	-5.2	-0.7
Crook	177	173	165	172	173	171	164	162	-15	-8.5	-1.2
Fleming	388	373	351	371	382	376	361	356	-32	-8.2	-1.2
Iliff	218	210	198	215	225	223	214	211	-7	-3.2	-0.3
Merino	255	252	248	263	270	270	259	255	+0	+0.0	+0.0
Peetz	220	212	200	210	213	209	200	197	-23	-10.5	-1.5
Sterling	11,385	11,557	11,666	11,857	11,719	11,668	11,190	11,018	-367	-3.2	-0.5
Unincorporated	7,157	7,180	7,142	7,178	7,020	6,915	6,651	6,577	-580	-8.1	-1.9
Washington County	5,304	5,206	5,373	5,545	5,499	5,359	5,150	5,146	-158	-3.0	-0.4
Akron	1,716	1,715	1,811	1,848	1,813	1,773	1,703	1,697	-19	-1.1	-0.1
Otis	534	523	537	573	587	579	558	559	+25	+4.7	+0.7
Unincorporated	3,054	2,968	3,025	3,124	3,099	3,007	2,889	2,890	-164	-5.4	-0.8
Yuma County	9,682	9,776	9,443	10,102	10,026	9,969	9,714	9,606	-76	-0.8	-0.1
Eckley	262	255	248	240	226	215	210	206	-56	-21.4	-3.4
Wray	2,131	2,202	2,302	2,306	2,256	2,254	2,196	2,178	+47	+2.2	+0.3
Yuma	2,824	2,860	2,921	2,973	2,957	2,946	2,873	2,840	+16	+0.6	+0.1
Unincorporated	4,465	4,459	4,472	4,583	4,587	4,554	4,435	4,382	-83	-1.9	-0.2
State of Nebraska	1,569,825	1,583,000	1,590,000	1,597,000	1,605,000	1,605,000	1,598,000	1,594,000	+24,175	+1.5	+0.2
Cheyenne County	10,057	10,100 ²	10,100	10,000 ²	10,000	10,100 ²	10,100	10,100 ²	+43	+0.4	+0.1
Sidney	6,010	N/A	5,997	N/A	5,965	N/A	6,030	N/A	+20	+0.3	+0.1

Sources: Colorado Division of Local Government 1980-1987; Nebraska Natural Resources Commission 1980-1987.

¹Data for Sidney, Nebraska is available only for the years 1980, 1982, 1984, and 1986.²N/A - not available.

All of the unincorporated areas within these three counties experienced population decreases between 1980 and 1987. In fact, all of the incorporated cities and towns within these three counties experienced similar reductions in population except for Merino (Logan County), which was able to maintain the status quo, Otis (Washington County), and Wray and Yuma (Yuma County), which showed slight increases in population.

Cheyenne County and the City of Sidney increased by less than 1 percent since 1980. The population increases in these areas were similar to the State of Nebraska, in general, which experienced a 1.5 percent increase in population during the same period.

3.12.2 Economic Base

The economic base of the four-county study area is primarily derived from the agriculture, government, trade, and service sectors. Table 3-4 shows the labor force and employment by industry summary of the study area for 1986 and 1987. The 1987 annual average unemployment rates ranged from a high of 7.7 percent in Logan County to a low of 4.1 percent in Yuma County.

3.12.3 Housing

Since 1980, the housing vacancy rates in Logan, Washington, and Yuma Counties have increased. In 1987, vacancy rates varied from 13.8 percent in Yuma County, to 15.7 percent in Logan County, to 20.7 percent in Washington County (Colorado Division of Local Government 1980-1987). These vacancy rates include year-round and seasonal housing units. The increase in the housing vacancy rates between 1980 and 1987 generally corresponds to the net reduction in population these counties experienced during the same period. Similar data are not available at this time for Cheyenne County or the City of Sidney.

There are approximately 845 hotel/motel rooms in the study area and surrounding vicinity distributed as follows: Sidney, Nebraska (246 rooms) (Nebraska Department of Economic Development 1987); Sterling, Colorado (400 rooms) (Lozier 1989); and Yuma (42 rooms), Wray (82 rooms), Akron (35 rooms), and Holyoke (40 rooms) (Haluzea 1989). Occupancy rates for these rooms are not available. Availability will vary depending on the time of year.

TABLE 3-4

LABOR FORCE AND EMPLOYMENT BY INDUSTRY SUMMARY OF THE STUDY AREA 1986-1987

	1986 Annual Average				1987 Annual Average				1987 Percent of							
	Cheyenne County		Logan County		Washington County		Yuma County		Cheyenne County		Logan County		Washington County		Yuma County	
Labor Force (Total)	4,944	9,303	2,476	4,583	4,866	8,961	2,486	4,573	N/A ¹	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Employment	4,721	8,588	2,283	4,364	4,638	8,273	2,309	4,388	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unemployment	223	715	193	219	228	688	177	185	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unemployment Rate	4.5	7.7	7.8	4.8	4.7	7.7	7.1	4.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Work Force																
Farm (Total)	763	NDA ²	NDA	NDA	736	NDA	NDA	NDA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Non-Farm (Total) (Wage and Salary)	3,534	6,352	983	2,193	3,533	6,324	1,007	2,132	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Manufacturing	303	635	20	89	317	694	27	68	9.0	11.0	2.7	3.2	3.2	3.4	5.2	5.2
Construction and Mining	228	398	37	132	179	356	34	111	5.1	5.6	3.4	5.2	5.2	5.6	3.4	5.2
Trans., Comm., and Util.	320	540	73	74	304	520	68	78	8.6	8.2	6.8	3.7	3.7	6.8	3.7	3.7
Retail Trade	1,040	1,508	173	541	1,066	1,466	155	477	30.2	23.2	15.4	22.4	22.4	23.2	15.4	22.4
Wholesale Trade	206	439	123	243	193	430	141	252	5.5	6.8	14.0	11.8	11.8	6.8	14.0	11.8
Fin., Ins., and Real Estate	140	286	58	189	130	305	71	204	3.7	4.8	7.1	9.6	9.6	4.8	7.1	9.6
Services	508	1,289	102	224	496	1,258	101	223	14.0	19.9	10.0	10.5	10.5	19.9	10.0	10.5
Government	789	1,257	397	701	848	1,295	410	719	24.0	20.5	40.7	33.7	33.7	20.5	40.7	33.7

Sources: Nebraska Department of Labor, Research and Statistics 1986-1987; Colorado Division of Local Government 1986-1987.

¹N/A - not applicable.²NDA - no data available.

3.12.4 Fiscal Conditions

Table 3-5 shows the assessed valuations by county for the years 1983 through 1987. Assessed valuations in Logan and Yuma Counties increased 12.4 percent and 3.7 percent, respectively, between 1983 and 1987. Assessed valuations in Cheyenne and Washington Counties decreased 0.9 percent and 22.5 percent, respectively, during the same period.

3.13 Transportation and Communications

Surface transportation in the study area is provided by a highway network and the Burlington Northern and Union Pacific Railroads. The major east-west highways in the study area include U.S. Route 30 and Interstate 80 (I-80) in Cheyenne County, Nebraska, and U.S. Routes 138 and 6, and Interstate 76 (I-76) in Logan County, Colorado. The principal north-south routes include U.S. Route 385, and Nebraska State Routes 17 and 19 in Cheyenne County, and Colorado State Highway 55 in Logan County. An extensive network of two-lane paved and gravel roads complete the roadway system.

The Sidney Municipal Airport is located approximately 0.5 mile to the east of the study corridor; however, portions of the airport's transition zones, including the inner area approach zones, extend into the study corridor.

There are a number of existing transmission lines and pipeline corridors in the study area. The three major east-west transmission line corridors that cross the study area are described in Section 2.2.

TABLE 3-5

ASSESSED VALUATION BY COUNTY
1983 to 1987

	1983	1984	1985	1986	1987	Annual Average Percent Change 1983-1987
Cheyenne County	\$360,473,429	\$357,627,723	\$358,065,179	\$352,801,784	\$357,314,753	-0.23
Logan County	\$116,980,000	\$120,140,000	\$116,300,000	\$110,260,000	\$131,943,670	+3.48
Washington County	\$98,850,000	\$111,150,000	\$106,650,000	\$95,020,000	\$76,654,280	-5.46
Yuma County	\$93,500,000	\$112,420,000	\$121,540,000	\$100,350,000	\$96,966,300	+1.89

Sources: Colorado Division of Local Government 1983-1986; Valdez 1989; Wagner 1989; Phiringer 1989; Knoche 1989.

4.0 ENVIRONMENTAL CONSEQUENCES

The discussion of anticipated impacts includes all potential impacts which could occur from construction of the proposed transmission line within the study corridors. The evaluation of links discusses specific impacts as they relate to particular links.

4.1 Climate and Air Quality

4.1.1 Anticipated Impacts

Impacts to air quality would be considered significant if:

- emissions from construction would violate any state or Federal air quality standards.

Local climatological conditions would not be affected by construction or operation of the proposed transmission line. A small amount of dust would be produced by construction activities during dry periods, but this would not greatly exceed the dust generated by normal road traffic. No long-term air quality impacts would result from line construction or operation. No state or Federal air quality standards would be violated during construction or operation of the Proposed Action.

4.1.2 Mitigation Measures

No mitigation measures in addition to the standard construction practices (see Table 2-4) were deemed to be necessary for air quality.

4.1.3 Evaluation of Links

The short-term, minor impacts to air quality that would result from the proposed project would not differ among links.

4.2 Paleontology, Geology, and Soils

4.2.1 Anticipated Impacts

The Proposed Action would cross approximately 80 miles of surface soils. The following significance criteria were used to determine if the proposed project would have any significant impacts to paleontology, geology, or soils.

Impacts to paleontologic resources would be considered significant if:

- Important paleontological resources are disturbed without appropriate scientific data recovery.

Impacts associated with geological features would be considered significant if:

- Any geologic feature or condition that could cause collapse of transmission line structures is crossed.

Impacts to soils would be considered significant if:

- Highly erosive soils on moderate to steep slopes or in dune areas are disturbed and cannot be stabilized to predisturbance conditions within 5 years.
- Any soils classified by the Soil Conservation Service as prime farmland or potentially prime farmland are disturbed and cannot be reclaimed to predisturbance conditions.
- Productivity is eliminated due to compaction caused by construction activities.

Paleontology. One important paleontologic resource location could be disturbed by the proposed project. It is located in Section 30, T14N, R48W east of Sidney, Nebraska. This site will require further investigation since it would not be possible to avoid or span the site if Link 1 were selected for the proposed route. Link 1 crosses 14.9 miles of a potentially fossiliferous formation, while Link 8a crosses 1.7 miles of the same formation on the west side of the Sidney Substation. No other paleontologic resources are encountered within the study corridors.

Geology. The majority of the study corridors cross geologic formations of siltstone, sandstone, shale, or alluvium that should provide an adequate foundation for tower structures. No landslide deposits would be crossed. Approximately 48 miles of eolian sand deposits would be crossed along the links south of the South Platte River in Logan County, Colorado. This eolian area is largely stabilized with few active blowouts and no impacts are anticipated concerning tower foundation stability or erosion hazards. No permanent two-track access roads would be created for future line inspection; therefore, erosion hazards would be minimal. No other geologic hazards are expected along route options.

Soils. Approximately 18.2 miles of prime farmland soils occur along the links in Nebraska and Colorado, although only a small portion of this total would be crossed by any one route alternative. The majority of this land occurs south of the South Platte River in Logan County, Colorado. The majority of these soils have a sandy loam, loam, or silt loam texture and are stable. Vehicular traffic across prime farmland soils would be kept to a minimum and would occur only during construction activities. This additional vehicle traffic should not significantly increase compaction to the point of lowering cropland productivity. Approximately 149.2 miles of high potential dry cropland (prime if irrigated) soils exist across all links. As with prime farmland soils, only a small portion of this total would be crossed by any one route alternative. Projected impacts to these lands would be minimal and are similar to those for prime farmland soils.

Slopes in excess of 10 to 15 percent occur along less than 5 percent of the total link length. Some increased wind and water erosion may occur in these areas until vegetation is reestablished, although it is expected that most of these areas would be spanned and would not require structure construction.

4.2.2 Mitigation Measures

The following measures have been developed to mitigate the impacts that were identified for paleontology and soils.

Paleontology

1. Measure: A qualified paleontologist will evaluate the reported paleontological resource location east of Sidney, Nebraska (Section 30, T14N, R48W) along Link 1 if this link is part of the selected alternative. Appropriate scientific data recovery would be undertaken prior to line construction if impacts to the significant attributes of the paleontological resources could not be avoided by structure spotting.

Soils

1. Measure: In potential soil erosion areas such as found in the eolian sand areas south of the South Platte River, tower construction disturbance and movement of heavy equipment will be kept to a minimum. This measure will greatly reduce the potential for wind erosion.

4.2.3 Evaluation of Links

Link 1 crosses 14.9 miles of potentially fossiliferous formation and has one important paleontologic resource location that would be crossed. Link 8a crosses 1.7 miles of the same formation. No other links have paleontologic localities or known fossiliferous formations.

Most individual links do not cross prime farmland soils, but a few links do cross considerable prime farmland acreage. Links 10a and 10b each cross approximately 3 miles of these soils. Link 1, which extends eastward from Sidney, Nebraska and then southward into Colorado, has 1.2 miles of prime farmland. Link 14 has 1.3 miles and Link 6 has 1.9 miles. Links 8b (1.1 miles), 8f (2.3 miles), and 8j (2.2 miles) also cross prime farmland.

Most links cross small amounts of high potential dry cropland (prime if irrigated), although a few links do cross significant acreages. Link 21a crosses 19.2 miles of Mesa soils compared to 12.4 miles for Link 21d and 11.4 miles for Link 21c. Link 5a crosses 17.7 miles compared to 19.1 miles for Link 5b. Link 1 crosses 14.7 miles at the northern end of the study area.

Links utilizing the eastern corridor would have fewer miles of eolian sand areas to cross compared to Links 11 and 16 which cross the sand areas south of the South Platte River. All other soil and geologic factors would, in general, be similar for all route alternatives.

4.3 Water Resources

4.3.1 Anticipated Impacts

Impacts to surface water would be considered significant if:

- The quantity and quality of discharges from streams are modified by instream construction or accidental contamination (e.g., oil or gasoline spills) to the extent that water used by established users (e.g., public water supplies and irrigation) is measurably reduced; aquatic habitats support reduced fish populations; or the water quality is in violation of state water quality criteria.
- Sedimentation downstream of transmission line crossings affects water quality or the operation of irrigation water control structures.

The study corridors traverse rangeland with relatively little topographic relief. Some construction within the 100-year floodplain would be necessary in crossing the South Platte River and Lodgepole Creek. The structures that are planned to be placed within the 100-year floodplain of the South Platte River are wood pole H-frame type structures. These structures would be placed out of the active channel area. Some cottonwood and willow trees would need to be cleared prior to construction; however, the lower growing shrubs would be allowed to return and should stabilize the area for erosion control. All crossings would occur in valleys with very gentle slopes, so erosion potential would be fairly low at all crossings. The minor amount of potential sedimentation would not be expected to adversely affect the operation of irrigation water control structures. Any water pollution resulting from soil disturbance would be minor and of short duration, occurring only during the construction phase. Temporary disturbance in other areas may be necessary and the potential for some wind and water erosion on disturbed areas does exist. The potential for surface water contamination from accidental oil or gasoline spills is very unlikely since refueling trucks would not be operated near river crossings. Since any potential spills would be small and infrequent, adverse impacts to groundwater are not anticipated.

4.3.2 Mitigation Measures

No additional mitigation measures will be necessary since there would essentially be no impacts to the South Platte River or Lodgepole Creek. Any impacts that may occur would be minor and of short duration.

4.3.3 Evaluation of Links

Section 4.4.3 contains a comparison of links in floodplain areas. Since no wetlands would be crossed by the transmission line, no evaluation of links is presented.

4.4 Floodplains and Wetlands

4.4.1 Anticipated Impacts

Impacts to floodplains and wetlands would be considered significant if:

- A flood event would cause damage to the transmission line structures, or the construction of the transmission line structures in a floodplain would increase the potential for flooding or violate applicable floodplain protection standards.
- Construction resulted in the long-term loss of wetland vegetation.

Currently, there are three alternative crossings proposed for the South Platte River. These crossings occur in Links 2 (east crossing), 11, and 14 (west crossings). The alternative river crossings involve traversing approximately 2.3 miles, 1.1 miles, and 1.5 miles, respectively, of the South Platte 100-year floodplain (Corps of Engineers 1977). Four alternative crossings of Lodgepole Creek occur in Link 1 (east crossing) and Links 8b, 8f, and 8j (west crossings) and would involve traversing approximately 1.3 miles, 0.8 mile, 0.8 mile, and 0.8 mile, respectively, of the 100-year floodplain (FEMA 1980). The floodplain areas at crossings of both Lodgepole Creek and the South Platte River are vegetated and have gentle slopes. Construction of transmission lines across these areas can therefore be accomplished with minimal erosion of soils.

The floodplains of the South Platte River and Lodgepole Creek are the only floodplains potentially impacted by the proposed transmission line. The proposed route crosses 1.5 miles of the South Platte River floodplain (Link 14), and 0.8 mile of the Lodgepole Creek floodplain (Link 8j). Approximately nine transmission line structures would be constructed within the South Platte River floodplain and approximately five structures within the Lodgepole Creek floodplain. There are no practicable alternatives to constructing within the floodplains. Surface disturbance associated with the construction of a structure and the physical presence of the structure during operation are not expected to alter the floodplain storage volume or cause a local increase in the flood stage. The final design for the transmission structure foundations would consider site-specific soil conditions, as well as elevation of the 100-year flood

and potential debris loading of the structure during a flood. For these reasons, failure of the structure during a flood is not expected. No applicable floodplain protection standards would be violated and no significant impacts to floodplains are anticipated. A notice that the floodplain may be affected has been published in the Federal Register (Vol. 53, No. 73; April 15, 1988) in accordance with 10 CFR 1022. In addition, no wetlands would be crossed by the transmission line; therefore, no significant impacts to wetland resources are anticipated. This environmental assessment constitutes the floodplain/wetlands assessment as required by 10 CFR 1022.

4.4.2 Mitigation Measures

No significant impacts to floodplains or wetlands were identified, therefore, no mitigation measures are proposed.

4.4.3 Evaluation of Links

All links crossing Lodgepole Creek and the South Platte are essentially the same in terms of overall potential impacts resulting from the crossings. There may be slight differences in the potential impacts due to the difference in length of the line required to cross the 100-year floodplain between the east and west crossings.

The east crossing of the South Platte River (Link 2) requires traversing 2.3 miles of the 100-year floodplain. The west crossing of the South Platte has two options, Links 11 and 14, which present slightly different potential impacts since the two links differ in length. Link 11 requires crossing 1.1 miles of the 100-year floodplain, while Link 14 requires crossing 1.5 miles of the 100-year floodplain.

The east crossing of Lodgepole Creek (Link 1) requires traversing 1.3 miles of the 100-year floodplain. The west crossings (Links 8b, 8f, and 8j) each require crossing 0.8 mile of the 100-year floodplain.

Overall the east crossings of both Lodgepole Creek and the South Platte River would involve traversing 3.6 miles of a 100-year floodplain. The west crossings would involve traversing either 1.9 or 2.3 miles of a 100-year floodplain depending on which link was used at the west crossing of the South Platte River. In general, the link requiring the least distance of floodplain to be traversed would result in the least potential

impact. The overall difference in any potential impacts between the various crossings, however, would be minor.

4.5 Vegetation

4.5.1 Anticipated Impacts

Impacts to vegetation would be considered significant if:

- Construction results in the long-term loss of more than 10 acres of riparian vegetation.

There are no federally or state-listed (threatened or endangered) plant species found within the corridor boundaries. Riparian areas located adjacent to the South Platte River would be subjected to initial removal of cottonwoods and willows and subsequent reclearing of cottonwoods to avoid transmission line obstruction and potential flash-overs. The vegetation occurring in the other corridor areas would sustain minimal and short-term damage. Agricultural lands would not be taken out of production as a result of transmission line construction. Disturbance of vegetation in rangeland areas would not reduce forage production or grazing capacity. The impacts to vegetation associated with wetlands are discussed in Section 4.4.

4.5.2 Mitigation Measures

The amount of riparian vegetation disturbed will be limited to that which is necessary for the safe construction and operation of the transmission line. No other mitigation measures in addition to the standard construction practices (see Table 2-4) were deemed to be necessary for vegetation.

4.5.3 Evaluation of Links

After transmission line construction, subsequent vegetation regrowth would be permitted. Any regrowth of cottonwood trees within the ROW would be cleared as needed. All other plant species would be allowed to grow beneath the transmission lines. Some long-term destruction of riparian habitats would occur in Links 2, 11, and 14. Selection of Link 2 would require 9.0 acres of long-term loss of riparian habitat along the South Platte River. Link 14 would disturb 7.3 acres of riparian habitat

along the South Platte River. These losses would be long-term, but this disturbance would not be considered a significant impact. However, Link 11 would disturb 10.9 acres of riparian vegetation, which slightly exceeds the significance criteria of 10 acres.

4.6 Wildlife

4.6.1 Anticipated Impacts

Impacts to wildlife resources would be considered significant if:

- Effects from transmission line construction or operation, such as loss of individuals or long-term loss of habitat for federally-listed species, result in a "jeopardy" Biological Opinion under Section 7 of the Endangered Species Act of 1973, or impacts to state-listed species under Title 33 of the Colorado State Statutes and Sections 37-430 through 438 of the Nebraska Nongame and Endangered Species Conservation Act.
- Construction activities occur on established lek areas or nesting grounds of the greater prairie chicken during the breeding season.
- Important white-tailed deer and mule deer winter range is affected by construction during critical winter conditions, causing disturbance or displacement of wintering animals.
- Active raptor nests are disturbed.

The majority of the study area covers agricultural land where few sensitive wildlife species occur. The proposed line would not intersect SWAs. Temporary displacement of wildlife species would occur within WHAs during construction activities; however, resident individuals would be expected to return following construction completion. Loss of riparian areas would affect those species associated with this habitat type. Permanent habitat removal and disturbance would occur for areas not reclaimed for the life of the project. This loss of habitat would be long-term.

Non-Game Species. Construction of the project ROW would result in the displacement or death of small, less mobile wildlife species within the ROW. Amphibians, reptiles, and small mammals would be more subject to mortality from construction than other groups, but impacts would be minor on a regional basis. Many of these species have high reproductive

potential and are common in surrounding habitats. Any population losses would be restored within one or two reproductive seasons. An exception would be the western spiny softshell turtle, an uncommon resident along the South Platte River. Tower placement within the river's sandbars may affect spawning activities (Bennett 1989), and mortality to this species due to construction activities would affect the small population found within this area. Since towers would not be placed on active sandbars, no significant impact to the species would occur.

Some species of ground-nesting birds (e.g., western meadowlark, ring-necked pheasant) may experience disruption of nesting activities within the ROW during construction. However, these species are common and would likely utilize surrounding habitats and return to nesting areas within the transmission line ROW following reclamation.

If transmission line construction occurred adjacent to an active raptor nest, it is likely that individual production would be lost for that year and impacts would result. During operation, raptor species may be susceptible to power line strikes when preoccupied or distracted (e.g., territorial defense, prey pursuit) (Olendorff and Lehman 1986; Thompson 1978). However, several physical and behavioral attributes of raptors, such as keen eyesight, slow flight speed, maneuverability in flight, and use of utility poles for nest and perch sites, decrease their susceptibility to collisions. Studies suggest that collisions with utility lines do not result in a noticeable effect on raptor population dynamics, except in the case of critically endangered species or when rare, threatened, or endangered species are experiencing population declines (Olendorff and Lehman 1986).

No impacts to the active heronry located adjacent to Jumbo Reservoir are expected from the proposed project. Lesser sandhill cranes, however, migrate through the project area in concentrated numbers during the fall migration (Crooks 1988). Current studies suggest that collisions with overhead wires contribute to a substantial portion of crane mortality (Faanes and Johnson in press; Drewein 1973); however, these collision rates include not only transmission lines, but also telephone and distribution lines.

Game Species. The developing population of Merriam's wild turkey located along the South Platte River may be affected during ROW construction; however, no significant impacts to this species would be anticipated.

Impacts to both resident and migrant waterfowl species and other waterbirds located along the South Platte River could occur from mortality associated with collisions with transmission line conductors and static wires. Migratory bird species commonly use the river corridor as a natural flyway, which tends to funnel the birds directly through the river bottom. In addition, resident or wintering birds travel daily from foraging and roosting areas located along the SWAs, Jumbo Reservoir, warm water sloughs, and agricultural fields. These flight intensities peak at sunset and immediately prior to sunrise, when lighting and visibility is poor (Crooks 1988; Meyer and Lee 1979). Highest reported mortality from collisions occurs in areas characterized by a mosaic of habitat types in proximity to transmission line corridors, particularly when a line separates feeding and roosting areas (Faanes 1987; Thompson 1978).

Transmission line collision potential is dependent upon variables such as habitat types, line orientation to migratory flyways and foraging flight patterns, numbers of migratory and resident bird species, species' composition and area familiarity, visibility, types of disturbance, and line design (Beaulaurier et al. 1982; Anderson 1978). Flight altitude and flight speed of species approaching the line are key factors in collisions (Beaulaurier et al. 1982). Species maintaining high speed and/or low altitude flights are especially susceptible to collisions with lines (Faanes 1987; Meyer and Lee 1979; Thompson 1978), particularly if the individuals are preoccupied by other factors (e.g., predators, foraging, courtship). In addition, individuals approaching at or below line height are most vulnerable to colliding with the conductors or static wires (Beaulaurier et al. 1982), and many species will alter their flight path to cross above the line (Meyer and Lee 1979; Willard et al. 1977). Species will often fly at lower altitudes during feeding flights or during inclement weather (Willard 1978); the timing and duration of inclement weather and low-light conditions may also affect bird collision rates (Faanes and Johnson in press; Meyer and Lee 1979; Thompson 1978).

Human disturbance appears to have a substantial impact on bird collision rates with power lines under certain conditions. Birds flushed near power lines may be more susceptible to collision than those routinely crossing the lines (James and Haak 1979). In addition, waterfowl fly at higher altitudes during the hunting season than during non-hunting periods. Although this may reduce the potential for daylight collisions, collision vulnerability may increase if hunting pressure causes waterfowl night flights to increase (Meyer and Lee 1979).

Previous studies on avian collisions with transmission lines have indicated that 80 to 93 percent of observed collisions occurred with the overhead groundwire or static wire (Beaulaurier et al. 1982; Faanes 1987). Approximately 87 percent of the individuals that collided with the lines flared to climb prior to the collision. In most instances, this involved flaring to clear the conductor wires and colliding with the static wires (Faanes 1987; James and Haak 1979).

Historically, as many as 200,000 waterfowl utilized Jumbo Reservoir and habitats surrounding the South Platte River (Ryder 1955). Population numbers have been declining since the 1940s and continue to decrease with the reduction of wetland habitats in the species' northern breeding range. Waterfowl species occupying the roosting and foraging areas associated with the South Platte River would cross the proposed transmission line corridor daily between these habitat types (Moss 1989; Crooks 1988). Previous studies on avian collisions with transmission lines were examined to evaluate bird collisions potentially occurring along the proposed line crossings of the South Platte River. Although collision and mortality rates resulting from the proposed project cannot be quantified. Stout and Cornwell (1976) have estimated in previous studies that wire strikes comprise about 0.1 percent of total manhunting mortality in waterfowl species. In comparison, hunting mortality may affect 20 to 30 percent of waterfowl populations (Willard et al. 1977). It is anticipated that the eastern corridor crossing of the South Platte River would potentially result in a higher frequency of collisions of waterfowl species with the transmission line than the western corridor crossings, because of the larger numbers of individuals utilizing the variety of habitat features found in the Tamarack Ranch SWA (near the South Platte River) and the

low-flight patterns of the waterfowl during the daily flights between Tamarack Ranch and Jumbo SWAs.

Marking of the static wires at the river crossings may reduce bird collision rates up to 45 percent (Beaulaurier et al. 1982). Recommended markers are yellow aerial balls with black vertical stripes (Morkill 1989). The mid-span region of the lines is the most important in marking. Birds tend to avoid the airspace within about 150 feet of the towers, due to the high visibility of the structures. Placement of markers along the spans on each side of the river crossing will also aid in decreasing bird collisions (Faanes 1989).

Transmission line construction across the South Platte River could affect wintering white-tailed deer and mule deer individuals that occupy important wintering areas along the river, if construction occurs during the winter period. Deer would avoid areas associated with construction activities, thereby potentially reducing the amount of winter habitat available. ROW clearance would not significantly alter the amount of thermal or snow-intercept cover for wintering individuals and may increase the amount of available forage. Impacts to other furbearer and game species (e.g., mink, red fox, pronghorn) occurring in the area would be temporary during the construction period. Species would avoid areas during construction, but should return upon completion of reclamation procedures.

Threatened or Endangered Species. Wintering bald eagles occur primarily along open water areas along reservoirs and the South Platte River and are often observed near the warm water sloughs utilized extensively by waterbirds (Dillinger 1989). Construction activities during the winter would inhibit eagles from utilizing the habitat near the disturbance area; however, individuals would return upon completion of construction. Potential impact to wintering bald eagles would occur from the permanent removal of roost sites along the river, particularly if communal roost sites occur within the proposed corridor (Lockhart 1989; Craig 1989). Siting of the corridor near or through a communal roost area may also potentially impact individuals by increasing the likelihood of collision (Olendorff and Lehman 1986). Wintering eagles, however, may utilize the towers for roosting or foraging sites along the river.

No impacts to either subspecies of the peregrine falcon or the whooping crane are expected from the proposed Sidney-North Yuma project. Individual peregrines would occur only as occasional migrants through the project area. A whooping crane occurrence would be rare.

It is unlikely that the proposed project would impact migrating interior least terns. However, breeding or nesting terns, potentially present, could be adversely affected during construction, if disturbances inhibited incubation or other breeding activities. No significant impacts to this species are anticipated from collision with the transmission line. Mortality from line collision is not a common occurrence with terns, because of their typical flight behavior. If line placement, however, occurs near active breeding sites, the potential for line collision would increase (Faanes 1989).

It is unlikely that the proposed project would adversely affect migrating, breeding, or nesting piping plovers. Based on the CDOW field surveys conducted within the study area in June and July 1989, no plovers were recorded, and no breeding birds are known to occur along this area of the South Platte River (Carlson 1989). No impacts to plovers are anticipated from transmission line collision.

Impacts to the black-footed ferret could occur if the proposed line crossed active prairie dog colonies and affected ferret individuals potentially occurring within the colony area. Impacts to the ferruginous hawk or Swainson's hawk would occur if construction disrupted nesting activities along the proposed route. Impacts to the swift fox would result if natal areas or active den sites were affected during construction activities.

The plains sharp-tailed grouse is known to winter along the Tamarack Ranch SWA and in Nebraska. No impacts to this Colorado state-listed species are anticipated. However, impacts could occur to the greater prairie chicken from construction activities. Disturbance to lek areas or nesting habitat during the breeding season would disrupt breeding activities of the prairie chicken, resulting in a loss of production for that year. In addition, raptor use of transmission line poles as perch sites could increase predation of prairie chickens at the lek sites, thereby affecting the reproducing population. Production loss could affect the status of this reintroduced population. No impacts are

anticipated for the American white pelican, which utilizes Jumbo Reservoir for both nesting and foraging activities (CDOW 1988).

A Biological Assessment has been prepared for submittal to the USFWS for review of the bald eagle, peregrine falcon, whooping crane, interior least tern, piping plover, and black-footed ferret. The USFWS (1988) outlined these species for analysis, according to Section 7 of the Endangered Species Act of 1973.

The Biological Assessment and USFWS correspondence are included in this EA as Appendix C. Comments from the USFWS review of the Draft Biological Assessment are contained in the attached letter dated September 8, 1989. Based on USFWS guidelines, surveys for black-footed ferret cannot be conducted sooner than 12 months prior to construction startup. Western will continue consultation with USFWS. The results of any required ferret surveys will be provided to USFWS, CDOW, and the Nebraska Game and Parks Commission.

4.6.2 Mitigation Measures

The following mitigation measures are structured to minimize impacts to wildlife species potentially impacted within the Sidney-North Yuma study area:

- Upon determination of the preferred route, clearance surveys will be conducted within wooded riparian habitat and along hedgerow areas for the identification of active raptor nests along the transmission line route. Surveys will be performed following the initiation of nesting activities. If construction occurs adjacent to an active nest during the nesting season (April 1 through August 1), construction will be limited within 0.5 mile of the nest site.
- Construction activities at the South Platte River crossing will be curtailed from December through March to prevent construction impacts to wintering bald eagles and winter habitat for white-tailed deer and mule deer.
- Based on the results of the CDOW interior least tern surveys, restriction of construction activities may be implemented at the South Platte River crossing from April 15 through July 31 to prevent impacts to breeding individuals. These restrictions are contingent on the surveys locating breeding terns at or near the crossing site.
- Construction activities will be curtailed within greater prairie chicken production areas during the breeding and nesting season (March 1 through July 15).

- Upon determination of the preferred route, active prairie dog colonies will be mapped along the route. The USFWS will be contacted to determine if black-footed ferret clearance surveys will be required for identified colonies. If clearance surveys are required, they will be conducted prior to construction initiation, in accordance with the USFWS guidelines for ferret surveys.
- Upon location of the preferred route, potential swift fox habitat will be identified and state agencies contacted to determine sensitive areas potentially requiring swift fox clearance surveys.

4.6.3 Evaluation of Links

Map 2-2 locates the sensitive wildlife resources crossed by the proposed links. WHAs are crossed by the proposed project in the southern portion of Logan County. Link 5a crosses 2.1 miles, Link 5b crosses 0.8 mile, Link 21a crosses 1.3 miles, Link 21c crosses 0.5 mile, and Link 21d crosses 1.2 miles.

Riparian areas capable of supporting furbearer species and a diversity of other wildlife occur along the South Platte River crossings. Loss of 9 acres of riparian habitat would occur along Link 2 within the eastern corridor, and losses of 10.9 and 7.3 acres would occur along Links 11 and 14, respectively, within the western corridor. These same areas represent the amount of wintering habitat for white-tailed deer and mule deer that would be removed for construction.

The eastern corridor contains Link 2 which crosses 4.6 miles of area determined to be a concentrated waterfowl movement area. This area was estimated from analysis of habitat features, flyway configuration, and line orientation. The western corridor would cross 1.3 miles of waterfowl movement area along Link 11 or 1.2 miles along Link 14. Due to the combination of features associated with the eastern corridor, it is anticipated that the crossing of the waterfowl movement area would produce a greater frequency of collisions with the proposed transmission line than the western corridor.

Link 2 along the eastern corridor crosses 1.3 miles of wintering bald eagle concentration area. Along the western corridor, Link 11 crosses approximately 1.1 miles, while Link 14 crosses 1.4 miles. A greater density of trees occurs along Links 11 and 14 than along Link 2. The trees found within the river bottom area provide potential roost sites for wintering eagles.

The eastern corridor crosses more miles of greater prairie chicken production areas than the western corridor. Two potential routes are located along each of these corridors. Links 2 and 3a cross 5.6 miles while Links 2 and 3b cross 5.3 miles for the eastern corridor. Link 11 crosses 4.4 miles, while Link 16 crosses 3.4 miles for the western corridor.

4.7 Aquatic Ecology

4.7.1 Anticipated Impacts

Impacts to aquatic resources would be considered significant if:

- Critical habitats (e.g., spawning and rearing areas) for important recreational fish species are affected by increased sedimentation, habitat removal, or fuel spills for a period exceeding one year, one life cycle, or the length of the reproductive season.

The potential impacts to aquatic resources resulting from construction of the proposed transmission line would be a temporary increase in suspended solids and subsequent siltation if stream banks and/or floodplains were disturbed. The adverse effects of erosion and siltation on aquatic biota are well documented (Cordone and Kelley 1961; Chutter 1969; Farnsworth et al. 1979; Gray and Ward 1982). Siltation affects aquatic life by reducing light penetration, blanketing of substrates, and interfering with respiration. Fish are most sensitive to siltation during the spawning and egg incubation periods, when substrates may be blanketed.

Bank and floodplain disturbance can also lead to a reduction in habitat through destruction of cover (i.e., vegetation). These impacts would be minimal because the streams would be easily spanned by transmission line structures without disruption of bank or floodplain habitats. If the crossing sites at the South Platte River segments require some floodplain construction to erect structures, minor impact to the fishery may occur on a temporary basis during construction and until the vegetation becomes reestablished.

The probability of accidental oil or gasoline spills would be minimal since refueling trucks would not be operated near river crossings; however, the resultant effects of a spill would be significant if it

occurred in the South Platte River or Lodgepole Creek since both streams support viable fisheries.

4.7.2 Mitigation Measures

No mitigation measures in addition to the standard construction practices (see Table 2-4) will be required for the protection of aquatic resources in the South Platte River and Lodgepole Creek.

4.7.3 Evaluation of Links

Two streams that support viable aquatic resources, the South Platte River and Lodgepole Creek, would be crossed by both corridors. The east corridor would cross the South Platte River at Link 2 and Lodgepole Creek at Link 1. The west corridor would cross the South Platte River at Link 11 or 14, and Lodgepole Creek at Links 8b, 8f, and 8j. None of these crossings are located in areas that would be considered critical habitat for important fish species.

The amount of potential disturbance to a fishery resulting from floodplain construction would increase as the number of structures erected in the floodplain increased. Thus, a comparison of floodplain widths at stream crossings is important where floodplain construction is required. The west corridor is the only area where two alternative Links, 11 and 14, cross the South Platte River floodplain. The width of the floodplain at the Link 11 crossing is 1.1 miles, compared to a width of 1.5 miles at the Link 14 crossing. Both segments are within 1 mile of each other. The floodplain in the South Platte River at Link 2 of the east corridor is 2.3 miles wide. The floodplain width for Lodgepole Creek is 1.3 miles at the Link 1 crossing along the east corridor and 0.8 mile each at Links 8b, 8f, and 8j along the west corridor. Based on these comparisons, the west links would cross narrower floodplains of streams that support aquatic life than the east links.

4.8 Land Use and Zoning

4.8.1 Anticipated Impacts

Impacts to land use and zoning would be considered significant if:

- Construction of the line would result in the removal of any occupied farmstead or dwelling.
- Construction or operation would preclude the use of an existing irrigation system.
- Proposed development is neither compatible nor consistent with land use plans, regulations, or controls adopted by local, state, or federal agencies.
- Construction or operation would preclude the operation of existing oil or gas wells or missile silos.

A small portion of Sidney, Nebraska is the only existing urban area within the study corridors. There are also occupied farmsteads and dwellings scattered throughout the study corridors. The proposed links were located to avoid passing over any occupied farmsteads or dwellings and would not result in the removal of any of these structures. The acquisition and removal of some abandoned structures might be necessary. In addition, the proposed links were routed to avoid passing over any known existing oil or gas wells or missile silos and would not preclude their use.

Areas where irrigation systems are in use will be avoided to the extent possible. In those instances where a proposed link crosses over an existing irrigation system, the transmission line would be engineered and designed so that it would not preclude the use of the existing system. Transmission line structures on cropland would constitute a minimal loss of cropland in a small zone around the structure, usually isolated to the area between the two H-frame poles. Depending on farming practices, the structures could be an obstacle to the maneuvering of farm machinery. Following construction, the majority of cultivated land within the ROW can be returned to production. Transmission line structures placed on rangeland would have a minimal effect on hunting and livestock management. There are no proposed crossings of SWAs.

The proposed transmission line is compatible and consistent with local comprehensive plans, land use regulations, and zoning ordinances. The proposed project might require an amendment to Washington County's zoning resolution. This procedure is not expected to be significant. Each county has its own permitting process and requirements which Public Service will be required to complete. Additional permits will be required from the U.S. Department of Transportation for the crossings of I-76 and

I-80; the state highway departments for the crossings of state roadways; and the U.S. Corps of Engineers for the crossing of the South Platte River. Public Service anticipates initiating the permitting process in August 1990.

A permit may be required from the Building Inspector of the City of Sidney under the authority of the Sidney Municipal Airport Zoning Regulations (1988). Portions of the airport's transition zones, including the inner area approach zones, turning zones, and outer area approach zones extend into the study corridor. Sections of Links 8b, 8c, 8f, 8g, 8j, 8k, 8l, 8m, and 8n are located within the airport's turning zone and outer area approach zone. There is a maximum 150-foot height restriction for any structure constructed within these zones. Pole height for the proposed transmission line is expected to be 70 to 80 feet. A permit is required for the construction of any structure higher than 75 feet within the turning zones and outer area approach zones of the airport. The need for a permit will depend on the final route selection and structure design.

4.8.2 Mitigation Measures

No mitigation measures in addition to the standard construction practices (see Table 2-4) were deemed to be necessary for land use and zoning.

4.8.3 Evaluation of Links

Links 1, 8g, 29, and 30 are proposed to parallel existing transmission lines for a total of 16.8 miles. Link 1 would parallel the existing line east of Sidney Substation for almost 15 miles. Link 1 has the highest number of occupied residences (29) within 0.25 mile of the proposed transmission line. The majority of these residences are located in the town of Sunol. The proposed line is located just north of the town. Link 10a has the second highest number of occupied residences within 0.25 mile (11).

Links 1, 2, 6, 7, 8b, 8f, 8i, 8j, 10a, 10b, 10c, 11, 14, and 15b cross irrigated land for a total of 22.0 miles. Links 1, 6, and 11 cross 2 center-pivot irrigation systems, while Links 2, 8b, and 15b cross 1 each. Links 1, 2, 6, 7, 8b, 8f, 8j, 10a, 10b, 10c, 11, and 14 cross prime farmland for a total of 18.2 miles.

Links 5b, 8h, 10b, 21c, and 21d cross shelter/woodlands for a total of 0.5 mile. Links 5a, 5b, 21a, 21c, and 21d cross WHAs for a total of 5.9 miles. Links 8m, 9, and 21a cross one gravel pit each.

4.9 Recreation

4.9.1 Anticipated Impacts

Impacts to recreation would be considered significant if:

- The ROW would preclude recreation uses in any national, state, or locally designated park or recreation area.

As discussed in Section 3.9, there are few key outdoor recreation resources in the study area; however, the proposed transmission line would be located so it would not preclude recreation use in any of these areas. Construction of the proposed transmission line could change the visual conditions for recreation users in these areas. Please refer to Section 4.10 for a discussion of potential visual resource impacts.

4.9.2 Mitigation Measures

No mitigation measures in addition to the standard construction practices (see Table 2-4) were deemed to be necessary for recreation resources.

4.9.3 Evaluation of Links

Link 5a is located adjacent to the F&H Golf Course. The proposed location of Link 5a would not preclude the use of the golf course; however, it could change the visual conditions for golfers using the area. Please refer to Section 4.10 for a discussion of potential visual impacts to the golf course from Link 5a. Link 2 is located near the Tamarack Ranch SWA and the Haxtun Rod and Gun Club. Links 2, 11, and 14 cross the South Platte River Valley. The proposed location of these links would not preclude recreation use of these areas; however, they could change the visual conditions for recreation users in these areas. Please refer to Section 4.10 for a discussion of the potential visual impact on these areas. No other proposed links are located near a key outdoor recreation resource.

4.10 Visual Resources

4.10.1 Anticipated Impacts

Impacts to visual resources would be considered significant if:

- Construction of the line would result in high visual contrasts in a Class I landscape in proximity to high and medium numbers of high sensitivity viewers.

Moderate impacts would occur in Class I landscapes where viewer sensitivity and viewer volume is moderate or low. Moderate level impacts would occur in Class II landscapes in proximity to medium and low numbers of moderate sensitivity viewers. Low level impacts would occur in all remaining areas.

Impacts to visual resources were evaluated based on the degree of visual change resulting from the construction of a transmission line along alternative links and the degree of allowable change based upon the sensitivity of the landscape. The amount of contrast between the proposed project and the existing landscape character can be measured by separating the landscape into its component features (land and water, vegetation, and structures), and then predicting the magnitude of change in contrast to each of the basic visual elements (form, line, color, and texture) to each of the features. Assessing the project's contrast in this manner indicates the severity of impact and guides the development of mitigation measures to reduce visual contrast.

The assessment of impacts to visual resources was conducted from vantage points along each of the alternative links/corridors in the study area. Areas and travel routes of high and moderate sensitivity were utilized as vantage points for impact assessment. A summary of impacts to visual resources by link is provided in Table 4-1.

4.10.2 Mitigation Measures

The primary mitigating measure for visual impacts due to the new transmission line focuses on reducing visual contrast. Conductors would have a dulled, non-reflective finish. Insulators would be a dark shade of a neutral color such as brown or gray.

TABLE 4-1

SUMMARY OF IMPACTS TO VISUAL RESOURCES (IN MILES)¹

Link Number	Significant Impact	Moderate/High Impact	Moderate Impact	Low Impact
1			4.0	25.5
2	1.4		6.7	6.0
3a				3.5
3b				3.2
4a				1.9
4b				1.9
5a	1.2			24.2
5b			1.0	24.4
6				6.1
7				6.2
8a			0.5	1.2
8b			2.0	
8c				4.7
8d				11.1
8e				0.6
8f			2.9	
8g			1.6	
8h				14.9
8i			0.2	1.0
8j			3.8	1.1
8k			0.8	
8l			1.1	
8m			1.7	0.8
8n				1.0
9				16.6
10a			1.0	4.5
10b		0.1	1.3	
10c		0.4	0.2	
11		2.0	1.7	10.8
12				2.1
13				0.3
14		1.8		0.8
15a		0.3	2.1	0.8
15b		0.3	1.7	0.4
16				11.8
17				2.1
18				0.3
19				2.0
20				0.2
21a			1.0	24.8
21b			1.0	6.2
21c				16.1
21d				17.0
22				1.9
23a				1.1
23b				1.9

TABLE 4-1 (CONTINUED)

Link Number	Significant Impact	Moderate/High Impact	Moderate Impact	Low Impact
24				0.8
25				0.6
26				0.2
27				0.3
28				6.5
29				0.6
30				0.5

¹All measurements are approximate (taken from 1:100,000 maps).

4.10.3 Evaluation of Links

Due to its location in Class I, Class II, and Class III landscapes and presence of high, moderate, and low visual contrasts, the visual impacts of Link 2 were assessed to be significant for a distance of 1.4 miles. Link 2 crosses the South Platte River riparian area in the vicinity of Tamarack Ranch State Wildlife Area. Link 2 also crosses I-76 and Route 138 and is highly visible from both the Tamarack Ranch State Wildlife Area and Red Lion State Wildlife Area.

Links 14 and 11 cross Route 138 approximately 1.5 and 2 miles west of Iliff, respectively. Both links would be highly visible within the valley floodplain; however, the existing cultural modifications are present and recreation use is limited in this area. Link 11 crosses the South Platte River riparian area and I-76. The proximity of an angle structure along I-76 would create contrasts.

Links 15a and 15b cross a small part of the South Platte River riparian area and I-76; high contrasts would be associated with the proximity of an angle structure to I-76 along Link 15a.

Due to its location in Class I and Class III landscapes, the visual impacts of Link 5a were assessed to be significant for a distance of 1.2 miles. Link 5a crosses Route 6 approximately 4 miles east of Fleming and is highly visible from the F&L Golf Course. Link 5b crosses Route 6 approximately 4.5 miles east of Fleming and 1 mile west of Dailey. It is 0.5 mile east of the F&L Golf Course and would not have significant impacts.

4.11 Cultural Resources

4.11.1 Anticipated Impacts

Impacts to cultural resources would be considered significant if:

- construction or maintenance activities cause an adverse, non-mitigatable impact to a historic or prehistoric site eligible for or listed on the National Register of Historic Places (NRHP) (reference 36 CFR 60);
- construction or maintenance activities disturb sites of cultural or religious significance to contemporary Native Americans (reference American Indian Religious Freedom Act of 1978); or

- accelerated erosion or increased public access result in secondary impacts to NRHP-eligible sites.

Sites 25CN20, 25CN21, and 25CN52 in Nebraska are prehistoric; none has been assessed for NRHP eligibility. Site 25CN20, situated on a stream terrace in T13N, R50W, Sec. 3, is approximately 1 mile west of Link 18a and would not be impacted by it. Site 25CN21, which occupies a ridge top in T13N, R50W, Sec. 2, lies at least 100 meters east of the proposed alignment of Link 8b and would probably not be impacted. Site 25CN52, in T14N, R47W, Sec. 27, lies almost 1 mile east of Link 1 and would not be impacted. The Sidney-Black Hills Trail (no site number) is the sole recorded historic site in the Nebraska portion of the project area. It traverses the western portions of Sections 24 and 25 in T14N, R50W, and is crossed by Link 8a about 1 mile west of the Sidney Substation. Potential impacts exist both to the trail itself and an associated stone quarry.

In Colorado, four cultural resources, none associated with specific surveys, are known to occur in the project area. All are in central Logan County. Site 5LO23, a prehistoric lithic scatter, is located in T8N, R49W, Sec. 11. It is 1 mile west of Link 21a and would not be impacted. Sites 5LO63, 5LO64, and 5LO232 are historic sites for which NRHP evaluations have not been made. Site 5LO63, the Iliff Ranch site, is located in T9N, R51W, Sec. 11, and could be impacted by Link 14. Site 5LO64, the Riverside Station, is situated in T9N, R51W, Sec. 11. Its exact location is unrecorded but the site could be impacted by Link 11, which diagonally traverses the quarter-quarter section that the site is believed to be located in. Site 5LO232 is a ca. 1910 railroad depot located in T9N, R51W, Sec. 16. It lies 1.5 miles west of Link 14 and would not be impacted.

The potential impacts on other historic routes through the study area (Overland Trail and Stage Route, Platte River Trail, Long Expedition, Villasur Expedition) are impossible to gauge without benefit of intensive inventory. No vestiges of these routes have been recorded within the Sidney-North Yuma study corridors.

No properties listed on, or officially determined eligible for, the NRHP are located within the study area. However, the Sidney-Black Hills Trail probably meets eligibility criteria, and is currently being nominated to the NRHP.

After project design is completed and the proposed transmission line centerline has been surveyed and staked, Western will conduct an intensive (Class III) cultural resources inventory within the ROW of the proposed routing alternative and access road easements. This survey will be conducted prior to initiation of construction, in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and the provisions of 46 CFR 800.

4.11.2 Mitigation Measures

Just eight cultural resources have been recorded within the study corridors. Three of these sites, two in Colorado (5L063 and 5L064), and one in Nebraska (Sidney-Black Hills Trail), could be directly impacted by construction. However, little of the project area has been subjected to intensive inventory, and the total number of cultural resources that could potentially be impacted is unknown. Very generally, high site probability areas are expected to be those near permanent watercourses (particularly the terraces along the South Platte River) where plowing has not occurred; medium probability areas are unplowed uplands away from permanent watercourses; and low probability areas are those that have been subjected to plowing or other unnatural disturbances.

Assessment of effects on cultural resources would necessitate an intensive (Class III) inventory of all unsurveyed lands within the selected ROW and access easements. The inventory would be conducted prior to initiation of construction, and would include the evaluation of significance for all recorded cultural resources that would be impacted by the project. Effects assessment would take into account possible visual impacts to historic sites, particularly those which exhibit standing structures. A mitigation plan would be developed in consultation with the respective State Historic Preservation Officers (Colorado or Nebraska) to guide the treatment of all National Register properties that would be impacted. Avoidance would be the preferred mitigation measure. Where avoidance is not possible, data retrieval would be carried out which would include partial or complete excavation, mapping, surface collecting, photo documentation, records research, or various combinations thereof.

The possibility exists that archaeological and historical sites will be discovered during construction. In the event that this occurs, work in

the immediate vicinity of the discovery should cease until it can be evaluated by Western and, if necessary, impacts to the site can be mitigated.

4.11.3 Evaluation of Links

Most links are unsurveyed and are not associated with known cultural resources. Links 8a, 11, and 14 could each affect known historic sites (one along each link), although available locational data for the sites associated with Links 11 and 14 are limited and exact impacts therefore difficult to predict. Until all project ROWs are intensively inventoried, meaningful comparisons among links will not be possible.

4.12 Socioeconomics and Community Resources

4.12.1 Anticipated Impacts

Impacts to socioeconomics would be considered significant if:

- Project-related population increases result in housing or public service demands that could not be met by existing or currently planned facilities.

Study area population changes due to construction of the proposed transmission line are expected to be minimal and of short duration. Construction is proposed to commence in October 1992 and would require 1 year to complete. Table 2-2 shows the number of workers by activity for construction of the transmission line. The peak number of workers in the area would be 25, but could be less depending on the scheduling of activities. It is unlikely that any out-of-region workers would relocate their families for the relatively brief construction period. No significant amount of secondary employment or population growth is expected because of the low number of out-of-region workers and the brevity of the construction period.

No significant impacts to housing are projected because of the availability of housing, particularly the high vacancy rates for housing in the three Colorado counties, the number of total hotel/motel rooms in the study area, and the low number of nonresident construction workers. Public facilities and services would not be significantly affected by

construction of the proposed transmission line due to its low associated population changes.

Acquisition of additional or new ROWs would result in payments to landowners along the selected alignment. This would result in an economic benefit to some local landowners. There would also be a beneficial fiscal tax base impact associated with the project in the form of property tax revenues. Construction costs of the transmission line are estimated to be approximately \$165,000 per mile. The total length of the proposed transmission line would be approximately 80 miles for a total estimated construction cost of \$17 million, which included the terminals at the Sidney and North Yuma Substations. Actual tax revenues generated would depend on the length of transmission line constructed within each county, and the tax rates levied by each taxing jurisdiction.

4.12.2 Mitigation Measures

No mitigation measures in addition to the standard construction practices (see Table 2-4) were deemed to be necessary for socioeconomics and community resources.

4.12.3 Evaluation of Links

Impacts to socioeconomics and community resources would generally be the same regardless of which links are selected except for property tax revenue generation. In this case, the selection of one link over another would influence the actual amount of property tax revenue generated. Links 8a, 8b, 8c, 8f, 8g, 8i, 8j, 8k, 8l, 8m, 8n, and portions of Links 1, 8d, 8h, and 9 are located in Cheyenne County, Nebraska. Based on total line length in Cheyenne County, Link 1 would have a greater impact on property tax revenue generated. The only segment of transmission line proposed to be located in Washington County, Colorado is approximately 6.5 miles of Link 21a, or approximately \$1.6 million at \$250,000 per mile. All the other proposed links are located either in Logan County or Yuma County, or both.

4.13 Transportation

4.13.1 Anticipated Impacts

Impacts to transportation would be considered significant if:

- Construction of the line results in traffic delays greater than 15 minutes for highways, railroads, or airports.
- The transmission line conflicts with the operation of any airport or landing strip.

Only very minor traffic delays (less than 15 minutes) or interference with the study area highway and railroad transportation systems would result from project construction. Transmission line construction techniques should not require even temporary closure of main highways, like Interstate-80 or Interstate-76. Users of smaller gravel roads may experience minor delays. Western would work closely with state and county road departments, so that crossings are posted and detours provided where necessary.

As discussed in Section 3.13, the Sidney Municipal Airport is located approximately 0.5 mile east of the study corridor; however, portions of the airport's transition zones, including the inner area approach zones, extend into the study corridor. All of the proposed links are located outside these zones; consequently, no impacts to airport operations are anticipated. A permit may be required from the Building Inspector of the City of Sidney, under the authority of the Sidney Municipal Airport Zoning Regulations (1988), for construction of the proposed transmission line within the airport's outer area approach zones and in the turning zones. Please refer to Section 4.8.1 for a more detailed discussion of possible permitting requirements. When the final transmission line route is selected, appropriate notice will be given to the FAA and airport operators, if necessary, concerning the effects on airport operations.

4.13.2 Mitigation Measures

No mitigation measures in addition to the standard construction practices (see Table 2-4) were deemed to be necessary for transportation.

4.13.3 Evaluation of Links

Only Links 1, 8b, 8f, and 8j would cross Interstate-80. Link 8b is located adjacent to an existing interchange; whereas, Links 1 and 8j are approximately 0.5 mile away from the nearest overpass. Link 8f is located approximately 0.25 mile away from an existing interchange. Only Links 2, 11, 15a, and 15b would cross Interstate-76. Link 2 is located adjacent to an existing interchange; whereas, the other links are approximately 1.3 to 3.8 miles from the closest interchange. Links 8b, 8g, and 8m are the only links located near an existing airport; however, they are located outside the airport's transition zones. Links 1, 2, 5a, 5b, 8g, 8i, 8j, 8k, 8l, 8m, 11, 14, 21a, and 21b cross railroad corridors. Link 8m crosses two railroad corridors; whereas, the other links cross only one each.

4.14 Electrical Characteristics

Potential electrical effects associated with transmission lines include ozone generation, radio and television interference, audible noise, electric and magnetic field interference, and health and safety concerns. The first three of these potential effects are caused by corona, which is the electrical breakdown of air into charged particles created by the electrical field at the surface of the conductors.

Corona effects are generally associated with transmission lines operating at voltages of 345-kV or above. For the proposed action (built to 230-kV), corona effects would be negligible; ozone generation would be undetectable; and radio and television interference is not expected to be a problem. However, mitigative techniques do exist, and, if any problem occurred, Western would take corrective action. Noise may be noticeable directly under a line during foul weather. However, line noise would remain very low and would probably be masked by background storm noise during inclement weather. Audible noise is not expected to be an annoyance.

Anticipated electric and magnetic field strength levels for the proposed 230-kV line are given in Appendix B (Summary Table). The proposed lines would be designed and constructed to meet or exceed all applicable requirements of the NESC. However, persons working near the lines should exercise caution not to contact the conductors with long,

metallic objects (e.g., irrigation pipe). Such contact would produce a lethal electric shock.

For more detail regarding electrical characteristics, (including a discussion of electric and magnetic field exposures) refer to Appendix B.

4.15 No Action Alternative

Under the No Action Alternative, no new transmission lines would be built in the project area. The No Action Alternative would compound the local and regional transmission system's inability to meet Western Systems Coordinating Council reliability criteria. The existing transmission system would continue to experience deficiencies in northeastern Colorado and in southwestern Nebraska. The deficiencies could be remedied by shedding approximately 30 MW of load in eastern Colorado and automatically reducing power 135 MW, or to 30 MW, on the Sidney DC Tie for certain line outages. However, these remedies are only temporary measures that allow the existing intact systems to be used to serve load above its capability until additional facilities can be added. When a system outage occurs during heavy load conditions, loads would have to be disconnected from the system. Widespread outages would occur if these remedies do not operate correctly. The probability of widespread outages occurring would increase as the customer load grows.

Continued operation of the transmission system in its present mode would result in reduced system reliability and efficiency, a less than adequate safety environment, and eventually reduce service to customers. For example, the following transmission problems could occur.

1. The Sidney-Sterling 115-kV line overloads for an outage of the Story-Laramie River Station 345-kV line.
2. Numerous substations have low voltages in eastern Colorado for an outage of the Story-North Yuma 230-kV line.

Thus, while implementation of the No Action Alternative would preclude most of the short-term impacts to the environment that would be associated with construction of a new transmission line, it would not meet the need for improved system reliability, nor the need for the increase in transfer capacity at the Sidney DC Tie.

4.16 Cumulative Impacts

The cooperative effort proposed by Western, Public Service, and Tri-State, and described and analyzed in this EA, would minimize cumulative impacts by avoiding the need for each of the participants to pursue separate projects in order to meet their respective transmission and transfer capability requirements. There are no other proposed transmission line projects in the study area that could result in cumulative impacts.

4.17 Long-Term Effects

The long-term effects associated with the physical presence of the proposed transmission line would include loss of cropland production or rangeland for grazing around the structure bases; loss of approximately 7.3 acres of riparian habitat along the South Platte River; potential collision hazards in waterfowl movement areas and to wintering bald eagles; and a potential increase in prairie chicken predation from raptors using the transmission structures as perch sites. The long-term effect on cropland, rangeland, and riparian habitat would be minimal and not significant. The potential long-term effects to wildlife would be minimized through implementation of the mitigation measures described in Section 4.6.2. and would not be significant. These long-term effects would continue until the proposed project is no longer needed and the transmission structures are removed. Following abandonment and removal of the transmission line, any areas leveled for equipment required to dismantle the line would be regraded as near as feasible to their original condition. Similarly, areas where vegetation is disturbed during the dismantling process would be regraded and reseeded to prevent erosion.

5.0 LIST OF PREPARERS FOR THE SIDNEY-NORTH YUMA 230-KV TRANSMISSION LINE ENVIRONMENTAL ASSESSMENT

Name	Education/Experience	EA Responsibility
<u>WESTERN AREA POWER ADMINISTRATION</u>		
Fred Weiss	B.S. (Electrical Engineering) University of North Dakota 31 Years Professional Experience	Engineering Coordination
John Crowfoot	B.S. (Electrical Engineering) Colorado University 18 Years Professional Experience	Project Engineer
Rodney Jones	M.S.E. (Environmental Engineering) The Johns Hopkins University B.A. (Biology) University of Delaware 20 Years Professional Experience	Environmental compliance, project management, coordination, and review
Bill Melander	B.S. (Wildlife Management) Utah State University 36 Years Professional Experience	Environmental Compliance
Jim Hartman	M.S. (Zoology) University of Michigan B.S. (Zoology) University of Wisconsin at Madison 14 Years Professional Experience	Review and Coordination
<u>J.F. SATO AND ASSOCIATES</u>		
Ben Phillips	M.A. (Public Administration) University of New Mexico B.S. (Archaeology) University of New Mexico Bachelor of Music Education, Eastern New Mexico University 15 Years Professional Experience	Cultural resources review
Germaine Reyes-French	B.S. (Zoology) Colorado State University 16 Years Professional Experience	Project management, coordination, and review
<u>TRI-STATE</u>		
Donald Y. Shanfelt	MBA, University of Santa Clara B.A. (Chemistry/Physics) University of Colorado 25 Years Professional Experience	Project E&O committee chairman
Karl W. Myers	B.S. (Environmental Resource Management) Pennsylvania State University 10 Years Professional Experience	Project environmental subcommittee chairman
Arthur A. Mander, P.E.	B.S. (Electrical Engineering) Colorado State University 18 Years Professional Experience	Project design subcommittee chairman
Dillwyn H. Ramsay, P.E.	B.S. (Electrical Engineering) University of Wyoming M.S. (Electrical Engineering) University of Southern California 26 Years Professional Experience	Project planning subcommittee chairman

Name	Education/Experience	EA Responsibility
Steve Brodsky	M.S. (Electrical Engineering) Carnegie-Mellon University Post Graduate Studies (Engineering and Public Policy) Carnegie-Mellon University B.S. (Electrical Engineering) University of Illinois, Urbana-Champaign Registered Professional Engineer, Colorado 11 Years Professional Experience	Project planning subcommittee chairman
<u>PUBLIC SERVICE</u>		
Inez Dominguez	B.S. (Electrical Engineering) B.S. (Mathematics, Emphasis in Applied Mathematics) New Mexico State University 18 Years Professional Experience	Project E&O committee
Larry Keith	BLA (Bachelor of Landscape Architecture) Kansas State University 15 Years Professional Experience	Environmental subcommittee, coordination of electrical effects discussion
Alla Goldin	M.S. (Electrical Engineering) Power Engineering Institute of Moscow 21 Years Professional Experience	Planning subcommittee
Ron Carrington, P.E.	B.S. (Civil Engineering) Registered Professional Engineer, University of Colorado 9 Years Professional Experience	Design subcommittee
<u>ENSR</u>	M.S. (Resource Planning & Conservation) University of Michigan M.S. (Zoology) University of Michigan B.S. (Zoology) University of Michigan 18 Years Professional Experience	Project management, coordination of technical studies, EA preparation, quality review
Sophie Sawyer Assistant Project Manager	M.Ed. (Science Education) East Carolina University B.A. (Biology) East Carolina University 12 Years Professional Experience	Project coordination and editing of EA sections and graphics
Bill Theisen Project Coordinator	M.S. (Recreation Resources) Colorado State University B.S. (Natural Resources) University of Michigan 9 Years Professional Experience	Project coordination, EA preparation, land use, recreation, transportation, and socioeconomics
Lori Nielsen	B.S. (Wildlife Management) Oklahoma State University 6 Years Professional Experience	Wildlife
Jim Nyenhuis	M.S. (Soil Science) Candidate Michigan State University M.A. (Communication Research) Michigan State University 15 Years Professional Experience	Paleontology, geology, and soils

Name	Education/Experience	EA Responsibility
Ronald Sutton	M.A. (Zoology) Southern Illinois University B.S. (Fishery Biology) Colorado State University 13 Years Professional Experience	Aquatic ecology
<u>CENTENNIAL ARCHAEOLOGY, INC.</u>		
Chris Zier	Ph.D. (Anthropology) University of Colorado M.A. (Anthropology) University of Colorado B.A. (Anthropology) University of Colorado 12 Years Professional Experience	Cultural resources
<u>MERLYN PAULSON, INC.</u>		
Merlyn Paulson	M.A. (Landscape Architecture) Harvard University B.A. (Landscape Architecture) Utah State University 16 Years Professional Experience	Visual resources

6.0 CONSULTATION AND COORDINATION

During preparation of the EA, the following agencies and private organizations were contacted to obtain data:

Federal

Fish & Wildlife Service - Endangered Species Office - Denver, CO
Fish & Wildlife Service - Fish & Wildlife Enhancement - Grand Junction, CO
Fish & Wildlife Service - Grand Island, NE
Fish & Wildlife Service - Crescent Lake National Wildlife Refuge, NE
Soil Conservation Service - Akron, CO; Denver, CO; Lincoln, NE; and
Sidney, NE; Sterling, CO; Wray, CO
U.S. Geological Survey - Denver, CO

State

Colorado Department of Labor and Statistics - Denver, CO
Colorado Department of Natural Resources, Natural Areas Program
Colorado Division of Highways - Denver, CO
Colorado Division of Local Government - Denver, CO
Colorado Division of Wildlife - Denver and Fort Collins, CO
Colorado State University
Colorado Water Conservation Board
Nebraska Department of Revenue - Lincoln, NE
Nebraska Department of Roads - Lincoln, NE
Nebraska Game & Parks Commission - Lincoln, NE
Nebraska Natural Heritage Program - Lincoln, NE
Rocky Mountain Heritage Task Force
Wyoming Game & Fish Department

County & Local

City of Fleming, City Clerk's Office - Fleming, CO

City of Sidney, Cheyenne County, City Inspector's Office - Sidney, NE

City of Sterling Community Development Department - Sterling, CO

City of Sterling Public Works Department - Sterling, CO

Logan County Assessor's Office - Sterling, CO

Logan County Planning Department - Sterling, CO

Washington County Assessor's Office - Akron, CO

Washington County Commissioners Office - Akron, CO

Yuma County Assessor's Office - Wray, CO

Yuma County Commissioners Office - Wray, CO

Private & Other

Audubon Society - Rowe Refuge

Chamber of Commerce - Logan County, CO

Goodman Realty

Holly Realty - Sidney, NE

Leibert-McAtee & Associates, Inc.

National Wildlife Federation - Virginia

Northern Prairie Wildlife Research Center

Peregrine Fund - Boise, ID

Platte River Whooping Crane Trust - Grand Island, NE

University of Minnesota - Raptor Rehabilitation Foundation

University of Nebraska - Remote Sensing Center

University of Wyoming - Wildlife Coop. Unit

Yuma County Abstract Company

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LIST OF ABBREVIATIONS AND ACRONYMS

A	- amperes or amps
AN	- audible noise
ANSI	- American National Standards Institute
CDOW	- Colorado Division of Wildlife
CEQ	- Council on Environmental Quality
cfs	- cubic feet per second
dBA	- decibels-A-weighted
DOE	- U.S. Department of Energy
EA	- Environmental Assessment
FAA	- Federal Aviation Administration
Hz	- hertz
IPP	- Inland Power Pool
kHz	- kilohertz
kV	- kilovolt
kV/m	- kilovolts/meter
mA	- milliamperes
MEAN	- Municipal Energy Agency of Nebraska
mG	- milligauss
mT	- microtesla
MW	- megawatts
NEPA	- National Environmental Policy Act of 1969
NESC	- National Electrical Safety Code
NRHP	- National Register of Historic Places
PIK	- payment-in-kind
RAS	- Remedial Action Scheme
REA	- Rural Electrification Administration
RI	- radio interference
ROW	- right-of-way
SCS	- Soil Conservation Service
SWA	- State Wildlife Area
T	- Tesla
TVI	- television interference
USFWS	- U.S. Fish and Wildlife Service
USGS	- U.S. Geological Survey
V	- volts

V/m - volts/meter
WHA - Wildlife Habitat Area
WSCC - Western Systems Coordinating Council

APPENDIX A

ALTERNATE ROUTE CONSIDERATIONS

TABLE A-1

ALTERNATIVE ROUTES INITIALLY CONSIDERED

Eastern Corridor Routes using Link 5b (section line)

<u>Route A</u>	<u>Route B</u>
1	1
2	2
3b	3b
4b	4b
5b	5b
6	27
30	26
	7
	29
	30

Western Corridor Routes using Link 5b (section line)

<u>Route C</u>	<u>Route D</u>	<u>Route E</u>	<u>Route F</u>
8a	8a	8a	8a
8j	8j	8j	8j
8k	8k	8k	8k
8l	8l	8l	8l
8h	8n	8h	8n
8e	8c	8e	8c
10b	8d	10b	8d
10c	10b	10c	10b
14	10c	14	10c
15a	14	15a	14
16	15a	16	15a
17	16	17	16
18	17	18	17
5b	18	5b	18
6	5b	27	5b
30	6	26	27
	30	7	26
		29	7
		30	29
			30

TABLE A-1 (CONTINUED)

Western Corridor Routes using Link 21c (section line)

<u>Route G</u>	<u>Route H</u>
8a	8a
8j	8j
8k	8k
8l	8l
8h	8n
8e	8c
10b	8d
10c	10b
14	10c
15a	14
16	15a
20	16
21b	20
21c	21b
23a	21c
23b	23a
7	23b
29	7
30	29
	30

Western Corridor Routes using Link 21a (half-section line)

<u>Route I</u>	<u>Route J</u>	<u>Route K</u>	<u>Route L</u>
8a	8a	8a	8a
8j	8j	8j	8j
8k	8k	8k	8k
8l	8l	8l	8l
8h	8n	8h	8n
8e	8c	8e	8c
10b	8d	10b	8d
10c	10b	10c	10b
14	10c	14	10c
15a	14	15a	14
16	15a	16	15a
20	16	20	16
21a	20	21a	20
24	21a	24	21a
28	24	25	24
29	28	7	25
30	29	29	7
	30	30	29
			30

TABLE A-1 (CONTINUED)

Western Corridor Routes using Link 21c (section line)
and Link 10a (section line suggested at public meetings)

<u>Route M</u>	<u>Route N</u>
8a	8a
8j	8j
8k	8k
8l	8l
8h	8n
10a	8c
14	8d
15a	8e
16	10a
20	14
21b	15a
21c	16
23a	20
23b	21b
7	21c
29	23a
30	23b
	7
	29
	30

Western Corridor Routes using Link 21d
(section line suggested at public meetings)

<u>Route O</u>	<u>Route P</u>	<u>Route Q¹</u>	<u>Route R</u>
8a	8a	8a	8a
8j	8j	8j	8j
8k	8k	8k	8k
8l	8l	8l	8l
8h	8n	8h	8n
8e	8c	10a	8c
10b	8d	14	8d
10c	10b	15a	8e
14	10c	16	10a
15a	14	20	14
16	15a	21b	15a
20	16	21d	16
21b	20	23b	20
21d	21b	7	21b
23b	21d	29	21d
7	23b	30	23b
29	7		7
30	29		29
	30		30

TABLE A-1 (CONTINUED)

Combination Western and Eastern Corridor Route
Suggested at Public Meeting

Route S

8a
8j
8k
8l
8n
8c
9
2
3b
4b
5b
27
26
7
29
30

¹Proposed route and environmentally preferred alternative.

TABLE A-2

SUMMARY OF ALTERNATIVE ROUTES

ROUTE	TOTAL LINK LENGTH (MILES)	RANGE- LAND CROSSED (MILES)	PARALLEL TO EXISTG LINE(1) (MILES)	ALONG SECTION LINE (MILES)	ALONG 1/2 SECTION LINE (MILES)	OCCUPIED RESIDENCES WITHIN 1/4 MILE		VACANT FARMSTEADS CROSSED (NUMBER)	IMPROVEMENT FAVORABLE FEATURES CROSSED(2)		RECREATION / HISTORIC FEATURES CROSSED(3)		SIGHT OBSTACLE IMPROVEMENT FAVORABLE AREAS CROSSED(4)		WATERFOWL MOVEMENT AREAS CROSSED(4)
						(NUMBER)	(MILES)		(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	
ROUTE R	81.60	38.00	15.70	55.20	0.00	42.00	0.00	9.00	0.00	0.00	1.00	1.00	1.00	1.00	1.20
ROUTE G	81.60	23.90	0.80	65.70	10.10	29.00	0.00	3.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE H	82.90	27.00	0.80	67.10	10.10	27.00	0.00	3.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE M	80.60	24.00	0.80	70.90	3.90	36.00	0.00	4.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE N	83.10	27.70	0.80	73.50	3.90	34.00	0.00	4.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE O	81.40	23.90	0.80	65.50	10.10	29.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE P	82.70	27.00	0.80	66.90	10.10	27.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE Q	80.40	24.00	0.80	70.70	3.90	36.00	0.00	2.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE R	82.90	27.70	0.80	73.50	3.90	34.00	0.00	2.00	0.00	0.00	1.00	1.00	0.00	0.00	1.20
ROUTE S	83.20	40.50	0.80	66.80	3.90	21.00	0.00	8.00	0.00	0.00	1.00	1.00	1.00	1.00	4.60

FOOTNOTES:

- (1) Miles of a proposed link parallel to an existing transmission line.
 (2) Incompatible features include airports and landing strips, missile silos, oil wells, or communication systems that would result in interference if crossed by a proposed link.
 (3) Recreational, historical, archaeological, paleontological, or other culturally significant areas.
 (4) Segment of a proposed link crossed by concentrated waterfowl movement.

TABLE A-2 (CONTINUED)

PRAIRIE CHICKEN PRODUCTION AREAS	BALD EAGLE WINTERING AREAS	IRRIGATED LAND	PRIME FARMLAND	PIVOT SYSTEMS	DRY CROPLAND	HIGH POTENTIAL		STATE WILDLIFE AREAS	RIPARIAN AREAS	SHELTER- BELTS/ WOODLANDS	
						DRY CROPLAND	WET CROPLAND			CROSSED	CROSSED
ROUTES	CROSSED	(MILES)	CROSSED	(MILES)	(NUMBER)	(MILES)	(MILES)	(MILES)	(MILES)	(MILES)	(MILES)
ROUTE B	5.30	1.30	4.10	2.30	3.00	38.60	42.50	0.00	0.00	1.50	0.10
ROUTE G	3.40	1.40	8.50	7.50	0.00	47.70	34.80	0.00	0.00	1.00	0.30
ROUTE H	3.40	1.40	8.50	7.50	0.00	45.90	36.70	0.00	0.00	1.00	0.20
ROUTE M	3.40	1.40	7.80	6.80	0.00	47.40	34.20	0.00	0.00	1.00	0.20
ROUTE N	3.40	1.40	7.80	6.80	0.00	46.20	36.50	0.00	0.00	1.00	0.10
ROUTE O	3.40	1.40	8.50	7.50	0.00	47.60	34.70	0.00	0.00	0.90	0.30
ROUTE P	3.40	1.40	8.50	7.50	0.00	45.80	36.60	0.00	0.00	0.90	0.20
ROUTE Q	3.40	1.40	7.80	6.80	0.00	47.30	34.10	0.00	0.00	0.90	0.20
ROUTE R	3.40	1.40	7.80	6.80	0.00	46.10	36.40	0.00	0.00	0.90	0.10
ROUTE S	5.30	1.30	3.90	3.30	1.00	37.70	35.80	0.00	0.00	1.10	0.10

FOOTNOTES:

(5) Irrigated land and dry cropland was measured off 1:58,000-scale color infrared aerial photographs.

(6) Prime Farmland-Those areas where the soil meets the requirements for prime farmland, as defined by the USDA Soil Conservation Service (SCS), and the soil is being irrigated with an adequate supply of water.

High potential dry cropland- Those areas where the soil would become prime if irrigated. Sources: Colorado- measured off the Important Farmland Inventory Maps, by county, published by the SCS and Colorado State University Experiment Station. Nebraska- measured off unpublished soil survey maps for Cheyenne County.

(7) The number of center-pivot irrigation systems crossed by a proposed link. Pivot systems were identified off the 1:58,000-scale color infrared aerial photographs (high altitude photographs).

TABLE A-2 (CONTINUED)

ROUTES	WILDLIFE HABITAT AREAS		PERENNIAL STREAMS		FLOOD-PLAINS		EROSIVE SOILS		GRAVEL PITS		RANGELAND CROSS-COUNTRY ACCESS(11)		CROPLAND CROSS-COUNTRY ACCESS(11)		PROPERTY OWNERS' DISTRIBUTION LINE		CONFLICT WITH SPECIAL STRUCTURES REQUIRED(12)	
	CROSSED(8)	(MILES)	CROSSED	(NUMBER)	CROSSED	(MILES)	CROSSED(9)	(MILES)	CROSSED(10)	(NUMBER)	CROSS-COUNTRY ACCESS(11)	(MILES)	CROSS-COUNTRY ACCESS(11)	(MILES)	CROSSED	(NUMBER)	REQUIRED(12)	(NUMBER)
ROUTE R	0.80		2.00		3.60		48.10		0.00		14.40		9.30		126.00		14.60	39.00
ROUTE G	0.50		2.00		2.30		42.90		0.00		15.00		13.10		141.00		5.60	45.00
ROUTE H	0.50		2.00		2.30		43.60		0.00		20.80		12.00		144.00		4.30	48.00
ROUTE M	0.50		2.00		2.30		42.90		0.00		14.20		9.20		134.00		6.40	45.00
ROUTE N	0.50		2.00		2.30		43.60		0.00		20.60		8.70		141.00		5.10	52.00
ROUTE O	1.20		2.00		2.30		42.10		0.00		15.00		13.80		139.00		6.30	47.00
ROUTE P	1.20		2.00		2.30		42.80		0.00		20.80		12.70		142.00		5.00	50.00
ROUTE Q	1.20		2.00		2.30		42.10		0.00		14.20		9.90		132.00		7.10	47.00
ROUTE R	1.20		2.00		2.30		42.80		0.00		20.60		9.40		139.00		5.80	54.00
ROUTE S	0.80		2.00		3.10		47.70		1.00		25.70		5.50		131.00		14.10	51.00

FOOTNOTES:

(8) Wildlife Habitat Areas- private land leased by the Colorado Division of Wildlife for habitat development. Measured off the 1:100,000-scale USGS planimetric maps.

(9) The 100-year floodplain as defined for the South Platte River by the Corps of Engineers (Special Flood Hazard Information Report, South Platte River, Volume 3 1977) and for Lodgepole Creek by the Federal Emergency Management Agency (Flood Insurance Study, City of Sidney, Nebraska 1980).

(10) Primarily those soils subject to wind erosion based on SCS criteria.

(11) Cross-country access is that segment of a proposed link not accessible from an existing road.

(12) Includes small angle, medium angle, heavy angle, dead end, and special transmission line structures.

TABLE A-3

RANK ORDER OF ENVIRONMENTAL FACTORS

ROUTE	TOTAL LINK LENGTH (MILES)	RANGE- LAND CROSSED (MILES)	PARALLEL TO EXISTG LINE(1) (MILES)	ALONG SECTION LINE (MILES)	ALONG SECTION LINE (MILES)	OCCUPIED ALONG 1/2 SECTION LINE (MILES)	RESIDENCES WITHIN 1/4 MILE (NUMBER)	VACANT FARMSHEADS CROSSED (NUMBER)	INCOMPAT- IBLE FEATURES CROSSED(2) (NUMBER)	RECREATION /HISTORIC FEATURES CROSSED(3) (NUMBER)	SIGNIFICANT	
											VISUAL IMPACT AREAS CROSSED(4) (MILES)	WATERFOWL MOVEMENT AREAS CROSSED(4) (MILES)
ROUTE B	81.50(5)	38.00(2)	15.70(1)	55.20(10)	0.00(10)	42.00(10)	8.00(9)	0.00(1)	1.00(1)	1.00(1)	1.70(9)	4.50(9)
ROUTE S	81.50(4)	23.90(4)	0.80(2)	65.70(8)	10.10(1)	29.00(4)	3.00(5)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.70(1)
ROUTE H	82.90(7)	27.00(5)	0.80(2)	67.10(5)	10.10(1)	27.00(2)	3.00(5)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE M	80.50(2)	24.00(7)	0.80(2)	70.90(3)	3.90(5)	36.00(8)	4.00(7)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE N	83.10(9)	27.70(3)	0.80(2)	71.50(1)	3.90(5)	34.00(6)	4.00(7)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE O	81.40(3)	23.90(4)	0.80(2)	65.50(9)	10.10(1)	29.00(4)	1.00(1)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE P	82.70(6)	27.00(5)	0.80(2)	66.90(6)	10.10(1)	27.00(2)	1.00(1)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE U	80.40(1)	24.00(7)	0.80(2)	70.70(4)	3.90(5)	36.00(8)	2.00(3)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE R	82.70(7)	27.70(3)	0.80(2)	73.30(2)	3.90(5)	34.00(6)	2.00(3)	0.00(1)	1.00(1)	1.00(1)	0.00(1)	1.00(1)
ROUTE V	83.20(10)	40.50(1)	0.80(2)	66.80(7)	3.90(5)	21.00(1)	8.00(9)	0.00(1)	1.00(1)	1.00(1)	1.70(9)	4.50(9)

FOOTNOTES:

- (1) Miles of a proposed link parallel to an existing transmission line.
 (2) Incompatible features include airports and landing strips, missile silos, oil wells, or communication systems that would result in interference if crossed by a proposed link.
 (3) Recreational, historical, archaeological, paleontological, or other culturally significant areas.
 (4) Segment of a proposed link crossed by concentrated waterfowl movement.

TABLE A-3 (CONTINUED)

ROUTES	CHICKEN PRODUCTION AREAS		BALD EAGLE WINTERING AREAS		IRRIGATED LAND		PRIME FARMLAND		PIVOT SYSTEMS		DRY CROPLAND		HIGH POTENTIAL		URBAN AREAS		STATE WILDLIFE AREAS		SHELTER BELTS/ WOODLANDS	
	CROSSED	(MILES)	CROSSED	(MILES)	CROSSED (5)	(MILES)	CROSSED (6)	(MILES)	CROSSED (7)	(NUMBER)	CROSSED (5)	(MILES)	DRY CROPLAND	(MILES)	CROSSED	(MILES)	CROSSED	(MILES)	CROSSED	(MILES)
ROUTE B	5.30(9)	1.30(1)	4.10(2)	2.30(1)	3.00(10)	38.60(2)	40.50(10)	0.00(1)	0.00(1)	1.30(10)	0.10(1)	0.30(9)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE G	3.40(1)	1.40(3)	8.50(7)	7.50(7)	0.00(1)	47.70(10)	34.80(4)	0.00(1)	0.00(1)	1.00(5)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE H	3.40(1)	1.40(3)	8.50(7)	7.50(7)	0.00(1)	45.90(4)	36.70(9)	0.00(1)	0.00(1)	1.00(5)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE M	3.40(1)	1.40(3)	7.80(3)	6.80(3)	0.00(1)	47.40(8)	34.20(2)	0.00(1)	0.00(1)	1.00(5)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE N	3.40(1)	1.40(3)	7.80(3)	6.80(3)	0.00(1)	46.20(6)	36.50(7)	0.00(1)	0.00(1)	1.00(5)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE O	3.40(1)	1.40(3)	8.50(7)	7.50(7)	0.00(1)	47.60(9)	34.70(3)	0.00(1)	0.00(1)	0.90(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE P	3.40(1)	1.40(3)	8.50(7)	7.50(7)	0.00(1)	45.80(8)	36.60(8)	0.00(1)	0.00(1)	0.90(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE Q	3.40(1)	1.40(3)	7.80(3)	6.80(3)	0.00(1)	47.30(7)	34.10(1)	0.00(1)	0.00(1)	0.90(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE R	3.40(1)	1.40(3)	7.80(3)	6.80(3)	0.00(1)	46.10(5)	36.40(6)	0.00(1)	0.00(1)	0.90(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)
ROUTE S	5.30(9)	1.30(1)	3.90(1)	3.30(2)	1.00(9)	37.70(1)	35.80(5)	0.00(1)	0.00(1)	1.10(9)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.10(1)	0.30(9)

FOOTNOTES:

(5) Irrigated land and dry cropland was measured off 1:50,000-scale color infrared aerial photographs.

(6) Prime Farmland—Those areas where the soil meets the requirements for prime farmland, as defined by the USDA Soil Conservation Service (SCS), and the soil is being irrigated with an adequate supply of water.

High potential dry cropland—Those areas where the soil would become prime if irrigated. Sources: Colorado measured off the Important Farmland Inventory Maps, by county, published by the SCS and Colorado State University Experiment Station. Nebraska—measured off unpublished soil survey maps for Cheyenne County.

(7) The number of center-pivot irrigation systems crossed by a proposed link. Pivot systems were identified off the 1:50,000-scale color infrared aerial photographs (high altitude photographs).

TABLE A-3 (CONTINUED)

ROUTES	WILDLIFE HABITAT AREAS		PERENNIAL FLOOD-STREAMS		EROSIVE SOILS		GRAVEL PITS		RANGELAND CROSS-COUNTRY ACCESS(11)		CROPLAND CROSS-COUNTRY ACCESS(11)		PROPERTY OWNERS DISTRIBUTION LINE		CONFLICT WITH SPECIAL STRUCTURES REQUIRED(12)	
	CROSSED(8)	CROSSED	CROSSED(9)	CROSSED	CROSSED(10)	CROSSED	CROSSED(11)	CROSSED	CROSSED(12)	CROSSED(13)	CROSSED	CROSSED(14)	CROSSED	CROSSED(15)	CROSSED	CROSSED(16)
(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)	(NUMBER)	(MILES)
ROUTE B	0.80(5)	2.00(1)	3.60(10)	48.10(10)	0.00(1)	14.40(3)	9.30(4)	126.00(1)	14.60(10)	39.00(1)						
ROUTE G	0.50(1)	2.00(1)	2.30(1)	42.90(5)	0.00(1)	15.00(4)	13.10(9)	141.00(7)	5.60(4)	45.00(2)						
ROUTE H	0.50(1)	2.00(1)	2.30(1)	43.60(7)	0.00(1)	20.80(8)	12.00(7)	144.00(10)	4.30(1)	48.00(6)						
ROUTE M	0.50(1)	2.00(1)	2.30(1)	42.90(5)	0.00(1)	14.20(1)	9.20(3)	134.00(4)	6.40(7)	45.00(2)						
ROUTE N	0.50(1)	2.00(1)	2.30(1)	43.60(7)	0.00(1)	20.60(6)	8.70(2)	141.00(7)	5.10(3)	52.00(9)						
ROUTE O	1.20(7)	2.00(1)	2.30(1)	42.10(1)	0.00(1)	15.00(4)	13.80(10)	139.00(5)	6.30(6)	47.00(4)						
ROUTE F	1.20(7)	2.00(1)	2.30(1)	42.80(3)	0.00(1)	20.80(8)	12.70(8)	142.00(9)	5.00(2)	50.00(7)						
ROUTE Q	1.20(7)	2.00(1)	2.30(1)	42.10(1)	0.00(1)	14.20(1)	9.90(6)	132.00(3)	7.10(8)	47.00(4)						
ROUTE R	1.20(7)	2.00(1)	2.30(1)	42.80(3)	0.00(1)	20.60(6)	9.40(5)	139.00(5)	5.80(5)	54.00(10)						
ROUTE S	0.80(5)	2.00(1)	3.10(9)	47.70(9)	1.00(10)	23.70(10)	5.50(1)	131.00(2)	14.10(9)	51.00(8)						

FOOTNOTES:

- (8) Wildlife Habitat Areas- private land leased by the Colorado Division of Wildlife for habitat development. Measured off the 1:100,000-scale USGS planimetric maps.
- (9) The 100-year floodplain as defined for the South Platte River by the Corps of Engineers (Special Flood Hazard Information Report, South Platte River, Volume 3 1977) and for Lodgepole Creek by the Federal Emergency Management Agency (Flood Insurance Study, City of Sidney, Nebraska 1980).
- (10) Primarily those soils subject to wind erosion based on SCS criteria.
- (11) Cross-country access is that segment of a proposed link not accessible from an existing road.
- (12) Includes small angle, medium angle, heavy angle, dead end, and special transmission line structures.

APPENDIX B
ELECTRICAL CHARACTERISTICS

APPENDIX B - ELECTRICAL CHARACTERISTICS

A. Line Characteristics

Both current and voltage are required to transmit electrical energy over a transmission line. The current is a flow of electrons measured in amperes or amps (A) and is the source of a magnetic field. The voltage is expressed in units of volts (V) or kilovolts (kV) and is the source of an electric field. The proposed Sidney to North Yuma Transmission Line is a 230-kV line. At maximum capacity approximately 1128 A could flow in each of the three phases. However, present system limitations will not allow the line to operate above 582 A and the projected capability to serve the load of the proposed line would be significantly less.

Because the current and voltage are varying at 60 hertz (Hz), or cycles per second, the magnetic and electric fields are also varying at 60 Hz. The fields extend out from the conductors and decrease as distance from the transmission line decreases. The electric fields at two locations are important for the electrical characteristics associated with a transmission line. First, the electric field at the surface of the conductors is responsible for corona occurring at that location. Corona is the electrical breakdown of the air into charged particles which can result in audible noise (AN), electromagnetic interference, and the production of various oxidants. Second, the electric and magnetic fields at ground level responsible for induced currents and voltages and related effects.

Analysis of the electrical characteristic of the proposed Sidney to North Yuma Transmission Line was conducted for the configuration shown on Figure B-1.

Table B-1 shows the various values for audible noise, radios and television interference, ozone levels, and the magnetic and electrical fields.

1. Corona Characteristics

The electric field of a high voltage transmission line can cause corona to occur at the surface of the conductors, insulators, and hardware of the line. Corona represents a conversion of electrical energy into AN, electromagnetic interference, visible light, and heat. Chemical reactions take place between the ionized gas molecules near the conductors and photochemical oxidants such as ozone and oxides of nitrogen are produced. The electric field at the surface of a conductor is the most important factor in determining the amount of corona. Electric-field strength is dependent on the voltage and the size of the conductor and is also influenced by altitude above sea level. The smaller the radius of curvature of an object, the higher will be the electric field at the surface of the object for a given voltage. Corona on conductors occurs where protrusions such as nicks, insects, or water drops exist on the conductor. During fair weather

the number of these sources is small and corona is very low. However, during rain, fog, and snow the number of these sources increases substantially because of raindrops, snowflakes, and condensation on the surface of the conductors. Therefore, corona activity is greater during foul weather.

- National Electrical Safety Code

Minimum Ground Clearance will occur during periods of maximum load with conductor temperature at 176° F (80° C) or 32° F (0° C) with 1 inch of Radial Ice, whichever produces the greater sag. The minimum ground clearance under these conditions would be 28.0'. The clearance will be greater under all other operating load conditions.

Spans	
Avg.	700'
Max.	875'

Figure B-1. Horizontal Conductor Configuration (Typical Loading)
Proposed Sidney-North Yuma 230 kV Transmission Line

TABLE B-1

EDGE OF ROW VALUES FOR AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, ELECTRIC FIELD AND MAGNETIC FIELD

Configuration/ ROW Width	Audible Noise			RI / TVI		Ozone Concentration 0.05*/hr@ Ground Level	Electric Field	Magnetic* Field
	L50 Rain dB(A)	L50 Fair dB(A)	L50 Rain dBuV/m	L50 Fair dBuV/m	TVI Rain dBuV/m	ppb	Kilovolts/m kV/m	Milligauss mG
Proposed Action: Single Circuit 230 kV Wood H-Frame Horizontal Configuration, 150' Typical Right-of-Way (75' Between Centerline and Edge of ROW	44.8	19.8	54.3	37.3	18.2	0.14	0.65	8.2 (Maximum on Right-of-Way = 40.8mG)

* - Magnetic field values are reported for "normal" loading conditions. Temporary "emergency" loading conditions would increase the ROW edge value to about 19.6 mG and the ROW maximum value to about 98.8 mG.

Corona on transmission lines has been studied extensively for many years. The equations used to calculate levels have been verified and shown to accurately predict the corona performance of proposed ones. The parameters of importance in the calculations are the line voltage, line configuration or geometry, number and diameter of the conductors, altitude above sea level, and the weather condition.

- a. Audible Noise. Corona-generated AN from transmission lines is generally characterized as a crackling, hissing sound. The AN is most noticeable during wet conductor conditions such as rain, snow, or fog. Sometimes a 120 Hz hum is also present during foul weather. During fair weather, AN from transmission lines may be barely perceptible as a very sporadic cracking sound. Transmission line AN is measured and computed in units of decibels (A-weighted) or dBA. The A-weighted sound level scale weighs the various frequency components of a noise in the same way that the human ear responds. An increase of 10 dBA is usually perceived subjectively as a "doubling" of the sound.

Some typical noise levels are: a library, 40 dBA; light automobile traffic at 100 feet, 50 dBA; an air conditioning unit at 20 feet, 60 dBA; and freeway traffic or a freight train at 50 feet, 70 dBA. The 70 dBA level represents the point at which a contribution to hearing impairment begins. Sleep disturbance occurs for steady noises above about 35 dBA at the location of the sleeping individual (Scott-Walton, 1979). Continuous noise levels of 44 dBA do not interfere with normal conversation at up to 25 feet separation between individuals (Scott-Walton, 1979). Noise decreases with distance, and outdoor noise is attenuated (i.e., reduce) with distance and when passing through objects such as buildings.

In most instances the AN from the Sidney to North Yuma Line would be masked by naturally occurring sounds at locations beyond the edge of the right-of-way. The attenuation associated with distance from the line and with passing through a building would reduce the maximum levels inside a house located at the edge of the right-of-way to levels below where interference occurs with sleep, conversation, or television viewing.

Transmission line noise is commonly expressed in terms of exceedance levels: for example, L50 refers to the noise level in dBA that are exceeded 50 percent of the time. Separate exceedance levels are given for rain and fair weather. The L50 rain level corresponds closely to an average value over all rains for a long period of time, usually 1 year. The overall average noise level depends on the amount of rain or foul weather at a particular location. The Sidney to North Yuma Line is located in an area of below average precipitation based upon national standards.

Predicted L50 AN levels for the edge of the right-of-way during rain for the proposed line configuration is shown on Table B-1.

The average (L50) rain noise level at the edge of the right-of-way is 44.8 dBA for the proposed action. The predicted average (L50) fair weather noise level at the edge of the right-of-way is 19.8 dBA. These levels would most likely be below ambient (existing) noise levels.

The state of Colorado has adopted regulations which prohibit noise levels in residential, commercial, light industrial, and industrial areas which exceed certain levels at a distance of 25 feet or more from the property line. For example, from 7 a.m. to the next 7 p.m. the maximum allowable level in a residential area is 55 dBA. Noise from the Sidney to North Yuma Line will comply with the applicable Colorado regulations. Nebraska has not adopted any noise regulations.

- b. Radio and Television Interference. Corona on transmission line conductors can generate noise at the frequencies at which radio and television signals are transmitted. This noise can cause interference with the reception of these signals and is called radio interference (RI) and television interference (TVI), depending on frequency. Radio reception in the AM broadcast band (535 to 1605 kHz) is most often affected with what is commonly referred to as static. FM radio reception is rarely affected.

Only radio receivers very near to transmission lines have the potential to be affected by RI. An acceptable level of maximum fair weather RI at the edge of a right-of-way is 40 to 45 dBuV/m (decibels above 1 microvolt per meter). Average levels during foul weather are, as a general rule, 16 to 22 dB higher than average fair weather levels.

The predicted rain and fair weather RI levels for the proposed Sidney to North Yuma Line are shown in Table B-1. The levels are within acceptable guidelines.

Another and more prevalent source of RI and TVI from electrical systems is spark gaps on distribution and low voltage transmission lines. If for some reason, such as mechanical failure, vibration or corrosion, a connection between two parts that is usually conducting becomes nonconducting, then a voltage can develop across the gap between the two components. If the voltage is large enough then a spark occurs which generates RI, TVI, and sometimes AN. This type of interference is primarily a fair weather phenomenon. Water tends to short out the gaps during foul weather. Obviously spark gaps will occur more often on old lines where loose and damaged hardware, and dirty insulators are undoubtedly present. New lines are designed with corona and gap-free hardware.

If RI generated by the proposed transmission line proves annoying in a given situation, mitigating techniques exist and will be applied on a case-by-case basis.

Corona can affect the reception of the video (picture) portion of a TV signal. TVI due to corona appears as three bands of "snow" on the television screen. TVI at the edge of the right-of-way due to corona occurs during foul weather and is generally of concern only for transmission lines with voltage of 345-kV or above.

As with RI, gap sources on distribution and low voltage transmission lines are the principal source of TVI. The proposed line would be designed to minimize such sources of TVI. Other forms of television interference from transmission lines are signal reflection (ghosting) and signal blocking caused by the relative locations of the transmission structure and receiving antenna with respect to the incoming television signal.

In those instances where television reception is degraded by the line, mitigating techniques exist and would be applied on a case-by-case basis.

- c. Other Interference. Corona-generated interference usually does not cause disruption on other communication bands such as the citizens' (CB) and mobile bands due to the higher frequencies of these signals. Complaints of interference to CB radios are rare. A more likely cause of interference to CB is sparking on a transmission or distribution line. Mobile radio communications are not susceptible to transmission line interference because they are generally frequency modulated (FM). These FM signals would not be affected. In the unlikely event interference occurs with these or other communications, mitigation can be achieved with the same techniques utilized for TV and AM radio interference.

A recent study of interference to electronic monitoring equipment used in agriculture indicated that a limited number of problems have arisen in the past. The exact cause of the interference was not completely identified but seemed to be related to abnormal operating conditions of the lines in question; e.g., dirty or leaky insulators which would be a source of RI. In the few instances of this type of interference, no damage to the monitoring devices was reported and they operated normally when away from the line. Given the increasing sophistication of manufacturers and the necessity to shield from other sources such as communications, ignitions, and solenoid generating noise, the noise immunity of agricultural monitoring systems to electromagnetic interference is being increased as new models are developed. In the unlikely event that problems arise from the transmission line, mitigation can be accomplished by proper shielding.

- d. Visible Light. Corona can be dimly visible as a bluish glow or as bluish plumes. On the proposed line, corona on the conductors would be observable only under the darkest and/or rainiest conditions, when the corona is most intense, and probably would be visible only with the aid of binoculars. Without a period of

adaptation for the eyes, and without intentionally looking for the corona, it would probably not be noticeable.

- e. Photochemical Oxidants. When corona is present, the air surrounding the conductors is ionized and chemical reactions may take place producing extremely small amounts of ozone and other oxidants. Measurements in the laboratory and near transmission lines have shown that the amount of oxidants produced by operating transmission lines is usually not measurable and of no environmental consequence.
- f. Ozone. Ozone is a colorless, unstable gas with a pungent odor. It can be measured in micrograms per cubic meter (g/m^3) or parts per billion (ppb). Natural sources of ozone at ground level are: diffusion from the stratosphere where ozone is formed by sunlight, and production by electrical processes such as lightning. Photochemical oxidants that are formed by the action of sunlight on hydrocarbons and nitrogen oxides are another principal source of ambient ozone. Ozone sources are usually associated with man's activities where combustion is involved, such as transportation and industrial processes.

Ozone is also the principal naturally occurring oxidant and the principal constituent (90 percent) of the photochemical oxidant mixtures associated with air pollution.

The national primary ambient air quality standard for photochemical oxidants, of which ozone is the principal component, is $235 \text{ g}/\text{m}^3$ or 120 ppb. This is a maximal 1 hour concentration not to be exceeded more than once per year. In rural areas, concentrations are usually in the range of 10 to 30 ppb, with higher levels present during the summer.

The maximum incremental ozone levels at ground level calculated for either the proposed or alternative conductor configurations of the proposed line would be less than approximately 0.14 ppb for a 1.0 mph perpendicular wind and a 0.05 inch/hr rain. Because the resolution of ozone instrumentation is approximately 1.0 ppb, it is very unlikely that corona-generated ozone from the proposed line could be measured. Furthermore, the incremental levels of ozone predicted for this line are insignificant when compared to natural levels, fluctuations in natural levels and air quality criteria.

- g. Nitrogen Oxides. Corona discharges from high voltage transmission lines produce nitrogen oxides. However, studies conducted to determine the amount of nitrogen oxides produced show the amount produced is normally one-tenth the quantity of ozone produced. The maximum ground level concentration of nitrogen oxides produced by the proposed transmission line is expected to be negligible.

2. Electric and Magnetic Fields.

- a. Electric Field. The electric field created by a high voltage transmission line exists in the region around the energized conductors. The electric field or voltage gradient is expressed in units of volts/meter (v/m) or kilovolts/meter (kV/m). The unperturbed electric field at a height of 3.3 feet is used to describe the field near transmission lines. This quantity is easily measured. The most important parameters for determining the ground level electric field of a transmission line are conductor height above ground, line geometry, and line voltage.

Because of practical considerations, measured values of the electric field can, and do, deviate from calculated values. It is therefore common practice to calculate the electric fields for a line under a specific extreme condition. The National Electrical Safety Code (NESC) states the condition for evaluating electric-field-induced currents is with the conductors at 120° and at a final unloaded sag. The computed electric-field profiles at 3.3 feet above ground for the proposed conductor configuration is shown in Figure B-2. The maximum field directly under the line with minimum 29.75-foot ground clearance is 3.0 kV/m. Also, as shown in Table B-1, the electric field at the edge of the right-of-way and at 3.3 feet above the ground is 0.65 kV/m.

The NESC, rule 232B1C, limits the maximum electric field under transmission lines with voltages greater than 169 kV and requires that ground clearance at a conductor temperature of 120°F be sufficient to keep the induced short-circuit current to the largest anticipated vehicle to less than 5 milliamperes (mA). Because the induced current depends on the electric field, this criterion established the maximum allowable electric field for a known vehicle.

- (1) Induced Currents. When a conducting object is placed in an electric field, currents and voltages are induced in the object. The magnitude of the induced current depends on the electric-field strength and the size and shape of the object. If the object is grounded, then the induced current flows to earth and is called the short-circuit current of the object. In this case, the voltage on the object is effectively zero. If the object is insulated (not grounded), then it assumes some voltage relative to ground. These induced currents and voltages could represent a potential source of nuisance shocks near a high voltage transmission line.

Some representative short-circuit currents in unperturbed fields of 1.0 kV/m and 3.0 kV/m are given in Table B-2. With the conductor at 120°F, and 29.75-foot ground clearance, the short-circuit current to the largest anticipated vehicle is 2.79 mA, which is less than the NESC criterion of 5 mA.

Figure B-2. Lateral Profile of Electric and Magnetic Fields at 3.3-Foot Height

Large pieces of farm equipment, such as hay wagons and combines, would have large short-circuit currents but would not exceed this level.

The possibility of the total short circuit-current being available for a shock is further diminished by less than ideal conditions such as conducting tires, vegetation touching the vehicle, moisture, etc. However, the values in Table B-2 do allow an upper limit to be placed on short circuit currents. If a person provides the only conducting path from the object to ground, then the currents listed in Table B-2 would flow through the person.

- (2) Steady-State Induced Current. Steady-state currents are those that flow continuously after a person contacts an object and provides a path to ground for the induced current. The response of persons to such currents has been extensively studied and levels of human response documented (Keeseey, 1969; IEEE, 1978). Primary shocks are those that can result in direct physiological harm. The lowest category of primary shocks is "let go" which represents the steady-state current that cannot be released voluntarily. The "let go" threshold was established for adult males at 9.0 mA and 6.0 mA for adult females. These thresholds were established for adult men weighting 180 pounds and adult women weighing 120 pounds. Let-go thresholds for adults have been established from actual experimentation. Thresholds for children; however, have been derived from the data for adults, since no actual measurements were taken from children. The derivation of a threshold for children was based on body weight, and is generally accepted as 5.0 mA (the value adopted by the NESC). Primary shocks will not be possible from the induced currents under the proposed Sidney to North Yuma Line because of the line's relatively low field strengths and the grounding practices which will be used.

TABLE B-2

SHORT-CIRCUIT CURRENTS FOR VARIOUS OBJECTS
IN MILLIAMPERES (ma) - 120°F NESC CONDITIONS

Object	Currents Given These Electric Field Strengths	
	1 kV/m	3.0 kV/m
Person	0.016	0.05
Cow	0.024	0.07
Sedan	0.11	0.33
Camper Truck (28' long)	0.28	0.84
Largest anticipated vehicle without special permit (70 x 8.5 x 13) ¹	0.93	2.79 *
Large haystacker and 4 WD tractor ²	0.89	2.67 *
3-strand fence (200' long)	0.30	0.90

¹ Largest anticipated vehicle (CRS 42-4-401 et. seq.).

² Estimated from vehicle with increment of 0.07 mA/kV/m for 4-wheel drive versus 2-wheel drive tractor.

* - Note: Practically, the average field over the larger objects will result in a lower induced current than reported here.

The maximum induced current criterion for vehicles is 5 mA. Potential steady-state current from vehicles under the proposed Sidney to North Yuma Line would be at or below the secondary shock level, where secondary shocks are defined as those that could cause an involuntary and potentially harmful movement but cause no direct physiological harm.

Several factors tend to reduce the opportunity for secondary shocks to occur. If activities are distributed over the whole right-of-way, then only a small percentage of time will be spent in areas where the field is at or close to the maximum value. If road crossings are kept near the towers, where conductors are highest, the vehicular traffic in high-field-strength areas, where conductors are lowest, will be restricted to farm machinery on soil or vegetation which tends to reduce shock currents substantially.

Because of these mitigating factors it is very likely that most steady-state current shocks will be below the 1.1 mA perception level for 50 percent of men and, in fact, less than the 0.5 mA standard for maximum leakage current from portable appliances. This steady-state current shocks are not anticipated often, and when they occur they will represent a nuisance rather than a hazard.

- (3) Spark Discharge Shocks. Induced voltages appear on objects such as vehicles when there is an inadequate ground. If the voltage is sufficiently high, then a spark discharge shock will occur as contact is made with the object. Such shocks are similar to "carpet" shocks, which occur when touching a door knob after walking across a carpet on a dry day. Spark discharge shocks could occur under the Sidney to North Yuma Line. The magnitude of the electric field will be low enough so that this type of shock would rarely occur and then only in a small area under the line near midspan.

Carrying or handling conducting objects under the line can also result in spark discharges that are a nuisance. Irrigation pipe should be carried as low to the ground as possible and preferably unloaded at a distance from the transmission line to eliminate spark discharge nuisance shocks. The primary hazard with irrigation pipe is direct contact with the conductors.

- 4) Field Perception. When the electric field under a transmission line is sufficiently great, it can be perceived by hair erection on an upraised hand with the sensation of a slight breeze blowing over the hand or arm. It is very unlikely that the electric field under the Sidney to North Yuma Line would be perceivable when standing on the ground. When working on top of equipment there is probably enough

extraneous skin stimulation during normal activities to preclude perception of the field at all.

- (5) Grounding and Shielding. Normal grounding policies effectively mitigate the possibility of nuisance shocks due to induced currents from stationary objects such as fences and buildings. Since the electric field extends beyond the right-of-way, grounding requirements extend beyond the right-of-way for very large objects or extremely long fences. Electric fences require a special grounding technique because they can only operate if they are insulated. Application of the grounding policy during and after construction will effectively mitigate the potential for shocks from stationary objects near the proposed line.

Mobile objects such as vehicles and farm machinery cannot be grounded permanently like a fence or building. Limits to coupled currents to persons from such objects are accomplished in three ways. First the NESC requires and lines are designed such that the conductor clearance for lines with voltage exceeding 169-kV results in an induced short-circuit current in the largest anticipated vehicle under the line of less than 5 mA.

A second method of reducing potential currents to persons is through the intentional use of grounds. For example, a chain or other conductor can be dragged by a vehicle; a ground strap can be attached to the vehicle when it is stopped.

Third, the very nature of large vehicles and their use tend to provide some grounding and reduce the electrical resistance of the vehicle to ground. Tires tend to be conductive, farm machinery is usually in direct contact with the soil, and conducting vegetation is in contact with equipment. Because of these factors, the realization of a well insulated (worst-case) vehicle is a remote possibility.

Electric-field reduction and the accompanying reduction in induced effects such as shocks is also accomplished by conductive shielding. Persons inside a conducting-vehicle cab or canopy will be shielded from the electric field. Similarly, a row of trees or a low voltage distribution line will reduce the field on the ground in their vicinity. Metal pipes, wiring, and other conductors in a residence or building will shield the interior from the electric field due to the transmission line.

Impacts of electric-field coupling can be mitigated through grounding policies and adherence to the NESC. Worst-case levels are used for safety analysis, but, in practice, currents and voltages are reduced considerably by both

intentional and inadvertent grounding. Shielding by conducting objects, such as vehicles and vegetation, also reduces the potential for electric-field effects.

- b. Magnetic Field. The engineering units for the magnetic field vector, H , are Amperes (A) per meter. However, the most common units reported in the scientific literature to characterize the field are often the magnetic flux density, B , in Gauss. Because the Gauss is a relatively large quantity, the milligauss (mG) unit is often used ($1 \text{ Gauss} = 1000 \text{ mG}$, or $0.001 \text{ G} = 1 \text{ mG}$). Some technical reports also use the Tesla (T) or microtesla (T) to describe the magnetic flux density ($1 \text{ mG} = 0.1 \text{ T} = 0.0000001 \text{ T}$). Magnetic field values in this section are presented in units of mG.

The maximum calculated 60 Hz magnetic field on the right-of-way (directly under the line) during normal loading conditions for the proposed Sidney-North Yuma 230-kV Transmission Line is 40.8 mG. This field would occur with the conductors at 29.75 feet above ground level (at 120°F) and under normal loading conditions (193 A). This maximum level is comparable with maximum magnetic fields of other transmission lines and with levels of magnetic field measured close to some common household appliances as shown on Table B-3; Lee, et al., 1985; Gauger 1985). At the right-of-way edge under these conditions, the calculated magnetic field is 8.2 mG.

The actual level of magnetic field will vary with current loading, conductor temperature, and ground clearance. Under temporary emergency loading conditions (460 A at 176°F), the maximum calculated 60 Hz magnetic field would increase to approximately 98.8 mG and the edge of right-of-way value to approximately 19.6 mG. The dc magnetic field of the earth is a static field and it is approximately 540 mG in the region near the line route.

Impacts associated with magnetic fields from an ac transmission line include magnetically induced voltages and currents in long conducting objects and possible biological effects due to long-term exposure to transmission line fields. The latter possibility is discussed in the section on long-term exposure to transmission line fields.

Magnetically Induced Currents and Voltages. Alternating magnetic fields induce voltages at the open ends of conducting loops. The conducting loop can be formed by such things as a fence, an irrigation pipe, a pipeline, an electrical distribution line, or a telephone line. The earth to which one end of the conductor is grounded forms the other portion of the loop. The possibility for a shock exists if a person closes the loop at the open end by contacting both the ground and the conductor.

Shocks due to magnetically induced currents and voltages are the same type as those due to electric field induced currents and voltages. In the case of magnetic induction, the voltages are generally quite low and the currents are limited by the resistance in the current path.

Normally, the resistance of shoes will limit the current to levels below the threshold for perception. However, a low resistance contact (standing barefoot on damp earth) with a long insulated fence parallel to a heavily loaded transmission line can result in steady-state currents above threshold and even above let-go. This latter possibility is very unlikely because of the line length of ungrounded fence required. Mitigation measures, such as grounding and breaking electrical continuity, that are implemented for electric-field induction will also mitigate magnetic-field induction effects.

Magnetically induced currents from powerlines have been investigated for many years (IEEE, 1974; Jaffa and Stewart, 1981; Jaffa, 1981; Taflove and Dabkowski, 1979; Olsen and Jaffa, 1984). Calculation methods and mitigating measures are available. A recent comprehensive study of gas pipelines near transmission lines developed prediction methods and mitigation techniques specifically for induced voltages on pipelines (Taflove and Dabkowski, 1979; Dabkowski and Taflove, 1979). Similar techniques and procedures are available for irrigation pipes and fences.

TABLE B-3

MAGNETIC FIELD ENVIRONMENT

Summary of Domestic Appliance Magnetic Field Measurements

<u>Appliance Type</u>	<u>Body Location</u>	<u>Magnetic Field - mG</u>	
		<u>Typical Range</u>	<u>Maximum Value</u>
Range	Belt	1-80	175-625
Refrigerator	Chest	1-8	12-187
Microwave Oven	Belt	3-40	65-812
Can Opener	Belt	30-225	288-2750
Oven	Belt	1-8	14-67
Toaster	Belt	2-6	9
Coffee Maker	Chest	1-2	4-25
Freezer	Head	1-3	4-6
Mixer	Belt	2-11	16-387
Clothes Dryer	Belt	1-24	45-93
Dishwasher	Belt	1-15	28-712
Garbage Disposal	Belt	1-5	8-33
Ceiling Fan	Head	1-11	125
Electric Blanket	Belt	3-50	65
Waterbed Heater	Belt	1-9	20-27
Blow Dryer	Head	1-75	112-2125
Computer	Belt	1-25	49-1875
Typewriter	Belt	1-23	38
Make-up Mirror	Chest	1-29	44-125
Shaver	Head	50-300	500-6875
Aquarium	Belt	1-40	50-2000
Sewing Machine	Chest	1-23	26-1125
Electric Drill	Chest	56-194	300-1500
Circular Saw	Belt	19-48	84-562

Induction effects in adjacent facilities such as pipelines and communication systems have been well studied and mitigation is handled with the affected parties on a case-by-case basis (Elek and Rokas, 1977; Taflove et al., 1979).

The magnitude of magnetic-field induced currents for both pipes and fences is very dependent on the electrical unbalance (unequal currents) of the three phases of the line. Thus, a distribution line where a phase outage can go unnoticed for long lengths of time can represent a larger source than a transmission line where the loads are well balanced (Jaffa, 1981).

Results from an investigation of electric-shock due to magnetically coupled currents to fences during electrical-fault conditions concluded that a hazardous situation would be extremely unlikely to occur (Mohan et al., 1982). Although a 400-kV dc line in Minnesota was considered, the results apply to an ac line as well, because they were considering fault conditions.

Furthermore, standard grounding practices, for fences are effective in reducing the energy available for shock well below that considered to be dangerous.

Knowledge of the phenomenon, grounding practices and the availability of mitigation measures mean that magnetic induction effects from the Sidney to North Yuma Line can be minimized. It is therefore unlikely that magnetically induced voltages and currents would have an adverse impact.

3. Long-Term Exposure to Transmission Line Fields

The question of whether long-term direct exposure to the electric and magnetic fields from transmission lines cause biological or health effects in humans is a controversial subject. However, in no case has a specific deleterious effect been identified from exposure to transmission line fields.

- a. Electric Fields. Much of the concern and activity related to the question of long-term exposure effects was stimulated by reports from the Soviet Union in the early 1970s. These reports indicated that workers in substations with voltages greater than 600-kV were suffering from such debilitating effects as headaches, tiredness, nausea, loss of libido, and other functional disorders (Knickerbocker, 1975). These effects were attributed to electric fields (greater than 5 kV/m). Subsequent studies in the United States and elsewhere have failed to substantiate the Soviet findings (as discussed by Michaelson, 1979, Mehn, 1979, Male and Norris, 1981, Lee, et al., 1985). Bridges (1978) evaluated the Soviet studies in terms of other environmental factors present in the substations and concluded that the electric field could not be solely identified as the causal agent of the reported effects.

More recently, Soviet papers have expressed reservations about the validity and extent of earlier reports of adverse effects (Savin et al., 1978 and Bourgsdorf, 1980: cited in Male and Norris, 1981).

The original impetus for concern has been tempered and the possibility of dramatic effects essentially eliminated. Over the past decade, research addressing the existence and implications of possible effects has been conducted with humans, animals, and cells and tissues. The results of this research and the question of possible health effects due to 60-Hz electric and magnetic fields have been analyzed and reviewed by numerous authors and scientific panels. Recent reviews of the literature and research related to possible health effects of 60-Hz electric and magnetic fields have been prepared by: World Health Organization (WHO, 1984); American Institute of Biological Sciences (AIBS, 1985); Florida Electric and Magnetic Fields Science Advisory Commission (FEMFSAC, 1985); Bonneville Power Administration (BPA) (Lee et al., 1985); Western Energy Supply and Transmission Associates (WEST, 1986); New York State Power Line Project (NYSPLP) (Ahlbom et al., 1987), and Ontario Ministry of Health (Ontario, 1987).

These reviews were prepared by groups of scientists familiar with the scientific literature. Each group evaluated, wholly or in part, the results of epidemiology studies, human laboratory studies, animal studies, and cell and tissue studies. Although the reviews addressed the electric and magnetic field bioeffects literature with varying degrees of thoroughness and with different emphases, no panel of experts has ever concluded that the existence of adverse effects has been established.

Although it is virtually impossible to demonstrate "no risk" from electric field exposures, the degree of uncertainty is continually reduced through research.

- b. Magnetic Fields. Initially concern and research about possible biological effects from 60-Hz fields focused on electric fields. Magnetic fields from transmission lines did not receive the same emphasis as electric fields because:
- (1) Magnetic fields associated with transmission lines are at a low level compared to levels where effects have been observed and magnetically induced currents are at levels below endogenous levels in the body (FEMFSAC, 1985).
 - (2) Field levels in the home from appliances are comparable to or greater than those from transmission lines.
 - (3) Induced current densities from the peak magnetic fields under transmission lines are approximately an order of magnitude less than those from peak electrical fields (FEMFSAC, 1985).

Thus, the relatively low level of induced currents from 60-Hz transmission line magnetic fields and the lack of significant amounts of magnetic material in any but specialized organisms make magnetic interaction with biologic material slight when compared with 60-Hz electric-field interaction.

There are two basic, but fundamentally different, approaches to investigating environmental effects of agents on living organisms. The first approach involves laboratory studies either on intact, living organisms or on isolated cells growing in tissue culture. The second is the epidemiological approach of studying patterns of diseases in populations using statistics. The laboratory approach is more direct in that animals or cells are actually exposed to an agent in a controlled laboratory setting, preferably over a considerable time period. Effects on cellular components, growth, reproduction, development, mortality, and other biological parameters are then evaluated.

- c. Laboratory Studies. Studies on animals and cells in controlled laboratory settings have investigated a number of possible health parameters, including cellular genetics, reproduction, and development.

Cellular genetics studies are important in assessing the possible relationship of a particular agent to cancer or other health effects as might be suggested by epidemiologic studies. With the discovery of DNA, the genetic material of cells, has come a much fuller understanding of the processes by which environmental agents can cause health effects. It is now clear that chemical and other agents can cause health effects. It is now clear that chemical and other agents which damage DNA by breaking the molecular bonds between molecules have consistent effects on cells, tissues, and organisms. Such effects from environmental agents are seen at the cellular level and also affect fetal growth, development, and overall mortality. In addition, cancer, which is caused by alterations in DNA, can be and consistently is caused by those agents which damage DNA.

Molecular and cellular level studies show that power frequency fields produce no detectable changes in DNA (Reese et al., 1988). These findings of no cellular level effects on DNA have been confirmed in studies on fetal growth, development and mortality, and provide strong evidence that cancer causation (initiation, promotion and/or progress in) does not relate to the electric and/or magnetic fields in our everyday environment.

Extensive laboratory studies on animals have been conducted to assess whether power frequency electric and/or magnetic fields affect birth outcome, reproduction, growth, or development. In a study of electric fields, Graves, et al., (1985) exposed thousands of chick embryos to power frequency electric fields ranging from 0.1 to 100 kV/m. The highest level of exposure was about 10 times the highest level found

under any transmission line. The researchers found no effects on embryo mortality, malformations, growth, hatching or behavior, growth and development, or overall health of the animals.

A suggestion of possible effects of 60-Hz electric fields on offspring in one study using swine led to several followup experiments (e.g., Rommereim, et al., 1987). The results clearly demonstrated that reproductive behavior, mortality, body weights of offspring, and other measures of reproduction and development were not affected even by exposure to electric fields as high as 150 kV/m. In recent years, both electric and magnetic fields have been tested for reproductive and overall health effects. For example, a recent well-designed, multigenerational study using two strains of mice examined the effects of different exposures of both 60-Hz electric and magnetic fields on over 2,000 subjects. The results showed no detrimental effects on fertility, reproduction and development, or overall health.

Studies of magnetic field effects in the visual system, nervous system, and various cellular and tissue systems have been reviewed by Tenforde (1986). Magnetophosphenes are luminous sensations in the eye that are caused by magnetic fields at levels above approximately 100,000 mG. This phenomenon is well studied and occurs at field levels well above those found at ground level under transmission lines.

In order for magnetic fields to affect isolated nerve electrical activity, the induced currents must exceed the endogenous level of 1 to 10 mA per square meter (mA/m^2) (Tenforde, 1986). The 60-Hz fields generally used in the laboratory or encountered in an occupational setting are not strong enough to induce such currents. However, effects on integrated neural networks and behavior could result from an additive response mechanism.

Reports on behavioral effects of magnetic fields are inconsistent: negative studies (showing no effect) occur at higher field levels than positive studies; negative studies were done at field levels that produced currents in the head above 1 mA/m^2 , a theoretical lower threshold for effects; and some studies showing effects have been done in fields below these threshold levels. Laboratory exposures to magnetic fields require great care to eliminate artifacts such as AN and vibration associated with magnetic field coils (Tucker and Schmitt, 1978). Consequently, the literature on behavioral effects associated with magnetic field exposures are inconsistent and are not easily interpreted. These studies do not demonstrate repeatable effects.

After a review of 34 reports on a variety of cellular and tissue systems, Tenforde (1986) was able to identify four reported bioeffects on cellular and tissue systems that had occurred where exposures were comparable with environmental field levels (1G or 1000 mG): decreased rate of respiration, altered metabolism, decreased cellular growth

rate, and teratology and development effects. In all instances, positive experiments that showed these effects were also observed at higher field levels. However, Tenforde (1986) cautioned about the acceptance of these findings because of the lack of a plausible mechanism in the low field region where induced currents do not approach endogenous levels. He also concluded that "it is difficult at present to draw firm conclusions concerning the bioeffects of these (magnetic) fields at the cellular and tissue levels. . ." this difficulty is caused by the variety of exposure regimens that have been used, by the lack of replication in independent laboratories, and by inconsistencies in the literature that are similar to those already cited for behavioral studies. Other reviews of the magnetic field effects literature also support the lack of consistency among studies. (FEMFSAÇ, 1985; Ahlbom et al., 1987).

In summary, it is now generally accepted that agents that cause cancer damage the genetic material of the cell, the DNA. Indeed, without alteration of the DNA, a cancer cell would not give rise to daughter cancer cells and tumors would not result. There is an abundance of scientific data which shows no genetic damage in cells or tissues as a result of exposure to power frequency electric and/or magnetic fields.

Furthermore, carcinogens have effects that are not limited to the expression of cancer but also cause adverse effects on reproduction, pregnancy, fetal or embryo growth and development, on general health, and on mortality. There is now an abundance of studies that demonstrate no adverse effects on any of these indicators of health, even after generations of high levels of exposure to power frequency electric and/or magnetic fields.

- d. Epidemiologic Studies. In recent years there has been heightened concern about possible effects of prolonged exposure to weak magnetic fields associated with residential and occupational exposure because of epidemiologic studies that have linked cancer with magnetic fields. Certain reports have associated childhood cancers with residential magnetic field exposures. Similarly, other reports have associated increased incidence of certain types of cancer with "electrical worker" occupations, which purportedly have high magnetic field exposures when compared with other occupations. There are also contradictory or null reports of association with cancer in studies involving both residential and occupational exposure. Recent reviews of these studies include Tenforde (1986), WEST (1986), Ahlbom et al. (1987), and Savitz and Calle (1987).

Epidemiologists evaluate several factors in assessing the quality of epidemiologic studies. These include: the basic design of the study; the adequacy of the case and control groups; the quality of the data used, especially the exposure assessment data; the adequacy of the analyses; the consistency of the findings within

and among studies; and the pattern of any relationship found, e.g. is increasing exposure associated with increased incidence of the disease in question.

The adequacy of the case and control groups is important because if these groups are not properly constructed the results of the study are not likely to be meaningful. For example, after selecting a control group that is representative of the general population, individuals in that group may decide not to participate in the study. As a result, those who do participate in the study may differ in important ways from those who do not and it may be improper to extrapolate the results of the study to the general population.

Epidemiologists examine several factors in assessing the quality of the data. For example, the quality of the study design is considered in order to determine, among other things, whether the investigator has eliminated sources of bias such as confounders. Confounders include other environmental factors, e.g., chemical solvents or cigarette smoking, that are associated with the type of cancer being examined that can obscure the relationship or lack of relationship between a particular exposure and cancer risk and such things as socioeconomic status which may affect overall health care and thereby influence incidence of disease or mortality data. Conducting blind studies is another means of controlling bias in studies. A study is considered blind when the researchers gathering the data are unaware of whether or not the individuals being interviewed are cancer cases or control cases. If researchers know that an individual is a member of the cancer group, there is a potential that they may (unconsciously) misclassify or otherwise distort the data gathered.

Some of the epidemiology studies with magnetic fields group together different cancer types. From a medical perspective, this does not make sense because "cancer" is a generic term for several different diseases caused by different susceptibilities, exposures, and heredities. When looking for causes of cancer, it is important to look at the associations of exposures with specific tumor types (e.g., smoking and lung cancer or sun exposure and skin cancer).

An accurate measure of exposure is an important factor to consider in assessing the quality of the data, because the accuracy of a reported association is only as good as the accuracy of the exposure measurement. Unfortunately, there is no generally accepted measure of exposure to magnetic fields in either residential or occupational settings. Therefore, studies often use some type of surrogate, or substitute, such as has been done with wiring configurations, in an attempt to estimate exposure to

magnetic fields. The extent to which these proxies represent actual or meaningful exposures to magnetic fields is not known.

In judging the validity of a statistical association between exposure to an agent and a disease, epidemiologists look for certain types of results in the studies. For example, a valid statistical relationship between an agent and a disease usually cannot be based upon one epidemiology study alone. In the field of epidemiology - even more so than in other scientific disciplines - multiple studies are necessary before conclusions about associations can be made. A single epidemiology study can rarely isolate a true index of exposure with sufficient certainty to conclude that an observed association is not attributable to other confounding exposures. Reproducibility of results in more than one study and consistency of results within and across studies are also important in defining relationships between a particular agent and a disease. Consistency within studies provides information on whether the study has conflicting data, and consistency among studies provides information on whether the same exposure is associated with the same outcome.

Also, epidemiologists look for a pattern of increasing risk with increasing exposure, i.e., a dose-response relationship. Absent this pattern, a single statistical association is likely to be due to some statistical fluke such as random chance. Even with a dose-response relationship, the association may be statistically valid but biologically meaningless. For example, a statistically valid association may exist between lung cancer and coffee consumption, but if the association exists only because smokers consume more coffee, then the coffee consumption - lung cancer association is biologically meaningless. Hence, epidemiology studies proving valid statistical associations serve as hypothesis-generating mechanisms for controlled laboratory experiments which can then actually test cause-effect relationships.

Both residential and occupational studies have examined associations between presumed exposure to power frequency fields and cancer. The results of the residential studies have been very inconsistent: some report a possible increased risk of cancer, others find no evidence of an increased risk, and still another study shows that the risk of cancer decreased for individuals living in homes near power lines.

Residential Studies. The possible association of childhood leukemia with magnetic fields was first raised by Wertheimer and Leeper (1979). They observed a positive association between the electrical distribution system wiring in Denver, Colorado, and the incidence of childhood leukemia. They found that cancer cases were more likely to live near high-current configurations (HCC), than near low-current configurations (LCC). HCC's are primary and secondary wiring configurations that because of their location or

wire size are assumed to carry more electric current and hence to be stronger sources of magnetic fields than LCC's. These configurations are proxy measurements of magnetic fields and the study was not based upon measurements of actual magnetic field exposure. The researchers concluded from their observations that an association may exist between magnetic fields from residential distribution lines and childhood cancer. The cancer risk appeared to be two to three times greater for residences near HCC's. Wertheimer and Leeper (1982), in a second study in the Denver area, found an association of the incidence of adult cancer with HCC's. Both studies have been widely criticized because of problems in the methodology and the analysis (e.g. Miller, 1980; Roth, 1985).

Fulton et al., 1980 performed a similar study in Rhode Island but did not observe an association between childhood cancer and wiring configuration. A more recent study in the Seattle area employing improved exposure characteristics found no association between measured magnetic fields or wiring codes and the incidence of adult leukemia (Stevens, 1986). In the Seattle study, exposure in each of 43 houses was characterized by: 24-hour measurement of field; spot field measurements on a different day; and, the wiring coding classification according to the Wertheimer-Leeper code (Kaune et al., 1987). There was a weak correlation between the 24-hour measurements and wiring code. However, the best prediction of 24-hour residential magnetic fields was a formula developed through post-hoc regression analysis of the data. The three characteristics within 140 feet of a home that could be used to predict magnetic fields were the presence of transmission lines, number of primary phase conductors, and number of service drops. This latter factor seemed to be the most important. Again, this improved study showed no association.

Tomenius et al., 1982 (Tomenius, 1986) measured magnetic field levels at the front door of residences of childhood tumor cases and matched controls in Stockholm, Sweden. The incidence of cancer was greater than expected in residences near 200-kV lines and with measured fields of 3 mG or greater. An approximate two-fold increase in tumor rate was reported for dwellings with visible 200-kV lines. However, the increased incidence of tumors was not apparent for residences with fields that exceeded 4 mG (Tenforde, 1986), and the data shows that the relative risk of cancer consistently decreases with homes nearer power lines.

The most recent childhood cancer study was performed in the Denver area by Savitz et al. (1987a; 1987b). This work was part of the NYSPLP and used both the Wertheimer-Leeper wiring codes and magnetic field measurements in the home as exposure indicators. Magnetic field measurements in residences were made in both a low power condition (MAGLO) with the major appliances and lights off and with the same sources turned on (MAGHI). The childhood cases

and controls in this study were different than those in the previous Denver study (Wertheimer and Leeper, 1979). Savitz observed a slight association between cancer cases and proximity to HCC's: a risk ratio of 1.53 was observed relative to non-HCC homes; i.e., the increased risk associated with HCC's was about 50 percent. Because of the limited number of cases and other uncertainties, this did not vary significantly (statistically) from no increased risk. (A risk ratio of 1.0 represents no increased risk.) These results have been reinterpreted by Savitz in his recent publication, but again the statistical significance of the data falls short of establishing any clearly defined risk when viewed in light of other studies.

In both epidemiologic studies done for the NYSPLP, (Stevens, 1986; Savitz, 1987) a correlation between measured magnetic field and wire coding was found, giving some credence to the use of wire coding as a surrogate for historical exposure to magnetic fields. However, the association between magnetic fields and the incidence of cancer is very tenuous. One of the investigators in the recent Denver study has speculated that there is some factor other than magnetic fields, associated with wiring code that may be linked more strongly with cancer (Wachtel et al., 1987).

In summary, the epidemiologic evidence from residential studies for an association between electric and/or magnetic fields and cancer is inconclusive and does not demonstrate a casual link. More definitive information is required on exposure assessment and other cancer determinants.

Occupational Studies. During the past several years, there have been several epidemiologic reports showing an association between the incidence of adult leukemia or cancer and occupations that purportedly involve exposure to electric and magnetic fields, the so-called "electrical worker" categories. Milham (1982) reported an elevated number of leukemia deaths (36 percent) for workers in 10 electrical occupations in the state of Washington. Numerous surveys of other occupational populations have subsequently appeared with varying results. Savitz and Calle (1987) compiled data from eleven studies in which incidence of leukemia was investigated as a function of possible occupational exposure. These data sets included the original Milham data. Their intent was to assess the consistency of the data that suggested an increased risk of leukemia among electrical workers. The summary relative risk across all studies and all jobs was a modest 1.2 for leukemia and a higher 20 to 50 percent increase in risk for acute leukemia. However, they noted that the available data were not adequate to conclude that electric and magnetic field exposures are the source of the increased risk.

In assessing the significance of their results, Savitz and Calle (1987) noted the lack of specificity of risk for leukemia: that is, other cancers also showed increased risks when analyzed by job title, which would imply that magnetic fields were associated with multiple types of cancer, an unlikely occurrence. Identification of exposure through related occupation was also a weakness in the studies because of variation of exposure within a specific occupation, and the possible absence of exposure measurements for some of these occupations. Confounding factors such as other carcinogenic agents in the workplace, medical ionizing radiation and family cancer history were also not addressed in these studies.

The NYSPLP Report (Ahlbom et al., 1987), identified areas of potential concern for public health: In particular, the possible association of residential magnetic fields with incidence of childhood cancer was singled out. However, both the New York State Department of Health (Carpenter) and Savitz (1987c) have stressed that people should not be unduly alarmed by the information in the NYSPLP Report (Ahlbom et al., 1987) and that children are exposed to a number of other environmental factors that pose a greater risk than the as-yet unproved association between cancer and magnetic field exposures. The NYSPLP Report, as well as the other reviews, urged that additional research was required before a decision about the significance of this association could be assessed.

Six studies of human reproductive effects attributable to electric and magnetic field exposures have been reviewed by the Ontario Ministry of Health (1987). These studies included reproductive experience of the female spouses of high voltage workers (Nordstrom et al., 1983) and possible effects associated with the use of electric blankets and heated waterbeds. The conclusion reached by the Ontario Ministry of Health was that "none of the studies to date presents convincing evidence to support an association between adverse reproduction outcomes and electromagnetic field exposure."

Other recent reviews of the epidemiologic literature have not identified health hazards associated with electric and magnetic field exposure nor have they found support for a causal relationship between cancer and magnetic fields (WEST, 1986; Ahlbom et al., 1987; Ontario, 1987). These findings are consistent with numerous earlier reviews, which have been summarized in Lee et al. (1985) and WEST (1986).

The epidemiologic evidence from both residential and occupational studies for an association between electric and/or magnetic fields and cancer or the adverse effects on humans is inconclusive and does not demonstrate a causal link. Research is underway in the United States and elsewhere to provide better exposure, assessment

and other determinants in both residential and occupational studies.

- e. Summary. Over most of the right-of-way the electric-field will be below the perception level for humans. Anticipated use of the right-of-way is transitory. Both electric and magnetic fields from the proposed line outside the right-of-way will be comparable with levels of magnetic fields measured close to some common household appliances. Operational experience over several decades with 230 kV and higher voltage transmission lines has indicated no adverse biological or health effects related to electric or magnetic field exposure. The current state of epidemiological and laboratory evidence is not sufficient to support a conclusion that the proposed transmission line poses any adverse health or biological effects. Therefore, the electric and magnetic fields of the Sidney to North Yuma Transmission Line are not anticipated to cause adverse health or biological effects.

4. Effects on Agriculture

- a. Honeybees. Effects of transmission line fields on honeybees have been studied extensively (Wallenstein, 1973; Rogers et al., 1982; Greenberg et al., 1981; Greenberg and Bindokas, 1980; Greenberg et al., 1984). When hives are placed in electric fields of 2 to 4 kV/m behavioral effects can occur in honeybees. Fields of 7 to 12 kV/m can result in a variety of problems, including mortality. Intensive studies of the nature of the problem and its causation have demonstrated that bees are not harmed by electric fields per se of 10.50, or even 100 kV/m even when exposed for 800 hours. Hence, foraging and other activities are not likely to be affected. However, when honeybee hives are placed in strong electric fields, currents and voltages are induced in the hive which are dependent on field strength, hive characteristics, and moisture conditions. If the field is high enough, there is a significant voltage difference across the dimensions of a bee's body. This "step potential" results in a shock to the bee when it takes a step. These shocks, and not the electric field per se, are a source of irritation for bees and can cause physiological damage, including death (Greenberg et al., 1984). Not surprisingly, honey production falls off and other activities become erratic. Fortunately, there are two simple solutions to the problem. One is to avoid keeping bees in high field regions on transmission line rights-of-way, and the other is to place grounded metal cages or screens over the hives.

The fact that no behavioral effects have been seen in shielded hives under operating transmission lines indicates that 60-Hz magnetic fields are not sufficient to cause the shock conditions that exist from electric field induction.

Beekeepers with hives located on the final right-of-way of the proposed line will be advised of the possible adverse effects to bees and compensated fairly to assist in relocation of hives. The maximum fields beyond the right-of-way for the proposed line will not exceed the threshold levels where effect on bees have been observed. Therefore, there will be no impact beyond the right-of-way.

- b. Crops. High electric fields (15 kV/m) have been observed to induce corona on the uppermost parts of plants (McKee, et al., 1978; Rogers et al., 1982). The induced corona causes minor damage to leaf tips. Studies of the effects of electric fields on crops and other plants have been conducted under controlled greenhouse conditions and under transmission lines.

The most extensive analysis on effects of 60-Hz electric fields on living plants has been done by McKee and coworkers at the Pennsylvania State University (McKee et al., 1978). In initial studies, several thousand plants from 85 different species were exposed to fields from 0 to 50 kV/m in a very controlled greenhouse environment. "Damage" to plants was associated with sharp, or pointed, leaf tips and amounted to self-limiting corona damage to a few millimeters of these pointed plant parts. Tip damage began for some species at fields of 15 to 20 kV/m. The damage was less than that seen due to routine drying under normal field conditions and, even at 50 kV/m, never threatened the overall growth, viability, yield, or reproduction of exposed plants.

In followup studies, McKee (1985) exposed five types of plants - alfalfa, tall fescue, sweetcorn, and two types of wheat - to 60-Hz electric fields for extended periods.

Plants were extensively analyzed for chemical element content and for an extremely wide species-specific array of size and mass parameters. There were "no statistically significant effects on seed germination, seedling growth, plant growth, phenology, flowering, seed set, biomass production, plant height, leaf area, plant survival, and nodulation." The only consistent effect that resulted from exposure was the expected occasional damage to a few millimeters of the terminal tip of plant parts exposed to fields of 30 kV/m or greater.

Studies of peas and barley conducted over several years under a 30 A 1200-kV test line indicated no consistent adverse effects attributable to exposure to about 12 kV/m (Rogers et al., 1982). In this same study, conifers growing close to a 1200-kV test line exhibited corona at the tips of needles and corona damage to the growing tips of some trees closest to the line. Right-of-way management practices normally limit tree growth in the immediate vicinity of the conductors, and there is no suggestion that forest growth or timber production adjacent to power lines would be affected by electromagnetic fields.

Electric fields up to 12 kV/m under operating lines and up to 16 kV/m under a test line had no noticeable effects on growth or productivity of corn and other crops commonly grown in Indiana (Hodges and Mitchell, 1979; 1984). However, some crops growing in the maximum field area exhibited minor damage from induced leaf-tip corona.

In summary, the effects of 60-Hz electric fields on plants is limited to corona damage at sharp terminal plant parts. This effect is too limited to be noticeable under field conditions found under operating transmission lines and does not result in crop damage. The electric fields associated with the proposed line are well below levels where the leaf-tip corona phenomenon has been observed. No damage or harm to crops will occur due to the fields under the proposed line.

- c. Livestock. Numerous studies have investigated the performance of livestock in the electrical environment of high voltage ac transmission lines. Over a 2-year period, Amstutz and Miller (1980) studied livestock, including beef and dairy cattle, on 11 farms located near a 765-kV ac transmission line in Indiana. Typical maximum electric fields were 8.5 kV/m with levels up to 12 kV/m. Magnetic flux densities of .056 G (56 mG) were measured with higher values expected during periods of higher current flow. Short-circuit currents for cows were 0.1 to 0.2 mA in a 6 to 8 kV/m field. Cows seemed to react to induced currents of about 0.7 - 0.8 mA from an insulated feed trough. The authors concluded that "neither health, behavior, nor performance were affected by the electric and magnetic fields created by the 765-kV line."

Williams and Beiler (1979) investigated 55 dairy farms located within 1/2 mile of 765 kV lines in Ohio. Hard performance was evaluated from milk production records, farm records, and interviews for a six-year period - 3 years before line energization and 3 years after. Milk production did not appear to be affected by the presence of the 765-kV lines. After the lines had been constructed, the incidence of calf mortality and birth defects per farm increased. However, the investigators felt these changes may have been due to larger herd sizes after the line was constructed, to changes in farm management and to bias in reporting. Farmers involved in the study did not believe there was any significant change in the performance of their herd following line energization. The study indicated that there were no obvious effects of the 765-kV transmission line. The data suggested that the largest factors in herd performance were farm management, quality of feed and, on occasion, change in ownership.

A Swedish study of 106 farms, located under 400-kV ac transmission lines, found that herds exposed to 400-kV lines for more than 15 days per year did not have decreased fertility relative to other herds (Hennichs, 1982). There was also no relationship between exposure and the number of cows slaughtered on each farm because of reduced fertility. All herds used artificial insemination. Exposure days for each herd were estimated from the percent of pasture occupied by the

transmission line and the number of days animals were in the pasture. No field measurements were made in this study, but the maximum electric field strength measured under 400-kV lines on 11 farms in Sweden was 5 kV/m (Algers, Ekesbo, and Hennichs, 1981). Magnetic fields were not reported but would presumably be at least comparable with those of 230-kV lines in the USA: In one case, a maximum of 0.12 G, 120 mG, has been reported (Lee et al., 1985).

In a behavioral study conducted underneath the BPA 1200-kV prototype ac line in Oregon for 5 years, cattle showed no reluctance to graze or drink beneath the line (Rogers et al., 1982). The maximum electric field was 12 kV/m. There was no magnetic field associated with the prototype line. However, an adjacent 230-kV line would have resulted in magnetic fields above typical rural levels.

Exposure of swine to a 345-kV ac transmission line in Iowa resulted in no observable effects in exposed animals relative to control animals (Mahmond, Zimmerman, and Cowan, 1982; Mahmond and Zimmerman, 1984). Body weight, carcass quality, behavior, feed intake, pregnancy rate, frequency of birth defects, birth weight or weight gain of young were investigated. Electric field exposures ranged from 3.5 to 4.1 kV/m. Magnetic field was not measured. However, the magnetic flux density from the 345-kV line is presumably comparable with those of 230-kV lines: e.g., a maximum of 0.12 G, 120 mG (Lee et al., 1985).

There are no indications that exposures to the fields beneath operating transmission lines affect livestock behavior or productivity. However, both ac and dc currents can cause definite behavioral responses in dairy and beef cattle. For this reason metal water and feed troughs, like all conducting objects under the proposed line, should be grounded to eliminate the possibility of nuisance shocks.

Microshocks to animals from so-called "stray" or neutral-to-earth voltages have given rise to problems of animal health and production (Gustafson and Albertson, 1982). Voltages between a grounded-neutral system and true earth can produce low level current shocks in and around barns. These shocks can affect livestock, particularly dairy cows, which can apparently perceive a voltage as low as 0.75 to 1 V across parts of the body. The results of these low level shocks can be a significant loss in production.

Neutral-to-earth voltages have been observed from both on-farm and off-farm sources. The sources are generally related to current flow in the primary distribution and farmstead neutral systems and not to field induction from transmission lines. Similarly, the mitigation of neutral-to-earth voltages involves modifications to the primary neutral system, the farmstead neutral system, the farmstead electrical load, or the conducting surfaces in the affected area (Gustafson and Albertson, 1982). Mitigation is done on a case-by-case basis. The

effects of "stray" voltages are considered an electrical distribution system problem and not a transmission line problem.

5. Cardiac Pacemakers

Currents and voltages that are introduced internally to the body represent a possible source of interference to cardiac pacemakers. Internal currents can be caused by electric fields, by magnetic fields, or by direct contact. In the last case, the person might provide a path between a large vehicle under a transmission line and ground, or between an appliance with inadequate grounding and ground.

Recognition of and concern for the possible effects on pacemakers from transmission line electric and magnetic fields has led to considerable research on this topic in the last decade. A study at the University of Rochester will expose pacemaker patients to electric fields in a substation under medical supervision. Possible effects of transmission lines on pacemakers have been addressed in the reviews/hearings conducted in New York, Minnesota, Michigan, and California.

The conclusion drawn from the research and reviews is that the overall risk to pacemaker wearers from transmission lines is minimal. This is especially true of 230-kV lines like the proposed Sidney to North Yuma Line, because of the relatively low electric fields when compared to 500 and 765-kV lines. The threshold for interference to the most sensitive pacemakers is estimated to be 3.4 kV/m. Reversion of pacemakers is the most substantial effect noted to wearers of pacemakers and is not considered a serious problem. To date, no evidence has been found that a transmission line has caused a serious problem to the wearer of a pacemaker.

6. Safety

The proposed line would be constructed to meet or exceed the NESC. Nevertheless, electrical equipment of any kind can be a safety hazard and special care must be taken when working or playing near transmission lines to avoid hazardous situations.

7. Hazards

- a. Direct Electrical Contact. The greatest hazard from a transmission line is direct electrical contact with the conductors at any voltage. In fact, contact is more likely with lower voltage transmission lines, because of their lower clearance compared to 230-kV lines. Physical contact between a grounded object and the high voltage conductors is not necessary for electrical contact to be made. Arcing can occur across an air gap.

The following list of precautions indicates the care that must be taken near a high voltage line to avoid direct electrical contact. Extreme caution must be used when operating tall equipment, such as cranes or drilling equipment, near the line. Irrigation pipes and

systems cannot be tipped up near the line. Trees near the transmission line should not be felled onto the conductors. Kites should not be flown near transmission lines and only nonmetallic string and kites should be used on dry days. The wind should carry the kite away from the transmission line. Towers should not be climbed.

If there is adequate clearance to the conductors of the proposed transmission line, then normal agricultural and other activities can be carried on safely.

- b. Irrigation. Both fixed and mobile irrigation systems can be operated safely near transmission lines. However, certain precautions are necessary to minimize the hazards involved. The hazards associated with irrigation near transmission lines fall into three categories: direct contact, induced shocks, and transferred potentials. With appropriate precautions all can be minimized as a source of danger.

Direct contact is the most dangerous and, unfortunately, the most likely to occur without special precautions. Irrigation pipes are often long enough to reach within flashover distance of the conductors. Therefore, pipes should never be tipped up to remove dirt or small animals when in proximity to an overhead line. Equipment used to install irrigation systems can be tall; therefore, precautions should be taken to maintain adequate electrical clearance during installation. When moving a high pressure system with long booms, such as a Vermeer mobile system, special precautions should be taken to insure that it does not tip.

Steady streams of water contacting the energized conductors can provide a direct path to ground for leakage current or a flashover. Therefore, precautions should be taken to prevent steady water streams from striking the conductors. If this does happen, one should avoid contacting or being near the irrigation system. Thus, when a steady stream of water reaches a conductor, the water should be turned off at its source before correcting the problem. Nozzle risers in the vicinity of transmission lines should be equipped with spoilers or automatic shutoffs. High volume, high pressure systems have the potential to send a steady stream considerable distances. Safe operating distances for this type of equipment are based on several factors, including nozzle diameter and line voltage. Information is available to determine safe distances for this type of equipment.

Both electric-field and magnetic-field coupling can occur on irrigation systems. The former is easily reduced or eliminated by unloading and handling pipes away from the transmission line and by attaching only short lengths of pipe to a grounded header or riser. Potentially hazardous, magnetically induced voltages can occur in long irrigation pipelines and maintenance of long pipes such as pivot systems should be done with the pipe perpendicular to the transmission line. In the event this orientation cannot be achieved, then the

system should be grounded at each end. If the pipe is cut into sections, then each section should also be grounded.

To avoid the possibility of a transferred potential from the power system to the irrigation system during an electrical fault, buried portions of the irrigation system, or any pipeline, should not be too close to the tower or the tower grounding system.

In summary, irrigation near transmission lines can be hazardous to personnel, if certain precautions are not taken. Cooperation between the landowner and the operator of the line is essential for safe operation.

- c. Refueling. In a high electric field it is theoretically possible for a spark discharge from the induced voltage on a large vehicle to ignite gasoline vapor during refueling. However, the probability for exactly the right conditions to occur for ignition is remote. According to results obtained from studies conducted by Johns Hopkins University, the ignition of fuel under a transmission line would require that an individual be standing on damp earth or vegetation and that the vehicle to be refueled must be exposed to the maximum intensity of the electric field. The vehicle must also be insulated. Finally, the air-fuel mixture must approach optimal flash-point conditions. Therefore, the number of precise conditions to be met to achieve fuel ignition reduces the likelihood of the occurrence. The report points out that "even if spark energies were sufficient to ignite fuel, then the person making the attempt would likely experience uncomfortable sparks, which would serve as a healthy warning of a potentially hazardous situation." For the Sidney to North Yuma Line the maximum electric field is low enough that it is very doubtful the right conditions could ever be achieved.

Because of the theoretical possibility of ignition, some utilities recommend that refueling not be done near transmission lines unless necessary. In the event refueling must be done under a line, grounding is recommended.

- d. Fires. Large fires near transmission lines represent a potential electrical hazard. The hot gases and smoke can create a conductive path to ground. If a flashover occurs along this path, then people near the fire could possibly experience dangerous shocks. Flashovers also cause outages and jeopardize the reliability of the transmission system.

Because of the hazards associated with fires, storage of flammables, construction of flammable structures, and other activities which have the potential to cause or provide fuel for fires on rights-of-way will be prohibited.

- e. Explosives. Use of explosives on or near the right-of-way can be affected by electrical interference from the power line to the

circuits used for detonation. There is also a potential for damage to the transmission system.

- f. Lightning. Transmission line towers, wires, and other tall objects are the most likely points to be hit by lightning during a thunderstorm. The proposed Sidney to North Yuma Line is designed with overhead ground wires and well grounded towers to protect the system from lightning. When the overhead ground wire or tower is hit, the lightning strike is conducted to ground at the tower. Since it is hazardous to be in the area where lightning enters the ground, it is advisable to stay away from the towers (and all tall objects such as trees) during electrical storms.

SUMMARY TABLE OF VALUES FOR
SIDNEY-NORTH YUMA COMPUTER CALCULATIONS*

ELECTRIC FIELD

MAXIMUM ELECTRIC FIELD:

At 29.75' Ground Clearance (Normal Load of 193 A)	: 3.004 kV/m
At 29.64' Ground Clearance (Peak Load of 307 A)	: 3.022 kV/m
At 29.39' Ground Clearance (Emergency Load of 460 A)	: 3.065 kV/m

ROW EDGE ELECTRIC FIELD

At 29.75' Ground Clearance (Normal Load of 193 A)	: 0.652 kV/m
At 29.64' Ground Clearance (Peak Load of 307 A)	: 0.651 kV/m
At 29.39' Ground Clearance (Emergency Load of 460 A)	: 0.650 kV/m

MAGNETIC FIELD

MAXIMUM MAGNETIC FIELD:

At 29.75' Ground Clearance (Normal Load of 193 A)	: 40.8 mG
At 29.64' Ground Clearance (Peak Load of 307 A)	: 65.2 mG
At 29.39' Ground Clearance (Emergency Load of 460 A)	: 98.8 mG

ROW EDGE MAGNETIC FIELD:

At 29.75' Ground Clearance (Normal Load of 193 A)	: 8.2 mG
At 29.64' Ground Clearance (Peak Load of 307 A)	: 13.0 mG
At 29.39' Ground Clearance (Emergency Load of 460 A)	: 19.6 mG

INDUCED CURRENT

THE SHORT CIRCUIT CURRENT FOR THE LARGEST ANTICIPATED VEHICLE @
120°F AND 29.75' GROUND CLEARANCE (3.0 kV/m) : 2.79 mA

* VOLTAGE - 230-kV
CONFIGURATION - HORIZONTAL
STRUCTURE TYPE - WOOD

REFERENCES CITED

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ATTACHMENT 1 - AGENCY CORRESPONDENCE

1.0 INTRODUCTION

Federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS), are required to ensure that any action they authorize, fund, or carry out will not adversely affect a federally listed threatened or endangered species. A biological assessment is required if Federal actions of major construction activities potentially jeopardize the continued existence of any federally listed species or results in the destruction or adverse modification of its critical habitat. This biological assessment is presented to facilitate the project's compliance with Section 7(a)(2) of the Endangered Species Act (ESA) of 1973.

Western Area Power Administration (Western), of the U.S. Department of Energy, is the Federal agency responsible for the preparation of the biological assessment for the proposed Sidney-North Yuma 230-kV Transmission Line. Western will determine either a "no affect" or "may affect" conclusion for threatened or endangered species based on this assessment. A "may affect" decision would initiate a request for formal consultation with the USFWS under Section 7(a) of the Endangered Species Act. The USFWS would then prepare a Biological Opinion on the projected effects of the project on threatened or endangered species, if further consultations are required.

A biological assessment is required for the Sidney-North Yuma 230-kV Transmission Line Project because five federally-endangered and one federally-threatened species may occur within the study area, based on range, habitat requirements, and historical occurrence. The endangered species include the black-footed ferret, bald eagle, peregrine falcon, interior least tern, and whooping crane. The federally-threatened species is the piping plover. These sensitive species could be adversely affected by construction and operation of the transmission line. The bald eagle, peregrine falcon, piping plover, interior least tern, and whooping crane assessments were prepared from existing data and interviews with local biologists.

The baseline information for the black-footed ferret has been completed. However, the assessments for this species cannot be finalized until mapping of active prairie dog colonies along the preferred route have been completed. The USFWS will be contacted to determine if

black-footed ferret clearance surveys will be required for identified colonies. If clearance surveys are required, they will be conducted prior to construction initiation, according to USFWS guidelines for ferret surveys.

2.0 ENDANGERED SPECIES EVALUATIONS

2.1 Black-footed Ferret

2.1.1 Status

The black-footed ferret (Mustela nigripes) is federally-listed as endangered, is a member of the mustelid or weasel family, and is the only ferret native to North America (Hall and Kelson 1959). The black-footed ferret is seldom seen because of their secretive nature and nocturnal habits and may have always been rare throughout its range (Hillman and Carpenter 1980; Fortenbery 1972).

Many authorities considered the black-footed ferret extinct by the middle of this century, until it was observed in South Dakota in 1964 (Hillman 1968). The population eventually disappeared, and only scattered reports of the animals persisted until 1981, when another viable population was discovered in northwest Wyoming near Meeteetse (Clark et al. 1984). The Wyoming population was the only known wild population of the black-footed ferret in existence. Census results estimated a high of 130 ferrets at that location during the summer of 1984 (Wyoming Game and Fish Department [WGFD] 1985). The population declined to roughly 65 known animals during the winter of 1984-1985. With the outbreak of canine distemper in the colony during the summer of 1985, the colony declined further to only a few remaining individuals. In an attempt to save the ferret from possible extinction, 6 animals were captured during the fall of 1985, and 11 animals were captured during the summer of 1986. These 17 animals provided the basis for a captive breeding program. As a result of this program, a total of 122 ferrets existed in captivity in July 1989; 107 individuals were located at the Sybille Wildlife Research and Conservation Unit in Wyoming, 7 were located at the National Zoological Park Conservation and Research Center in Virginia, and 8 were placed at the Henry Doorly Zoo in Nebraska. Sixty-four ferrets located at Sybille were young ferrets born in the Spring of 1989. These population numbers may fluctuate, due to potential juvenile mortality (Russell 1989). The colony of wild ferrets near Meeteetse has since disappeared; no populations of black-footed ferrets are known to exist in the wild (WGFD 1989).

2.1.2 General Distribution

Historically, the range of the black-footed ferret coincided closely with that of the prairie dog throughout the Great Plains, semi-arid grasslands, and mountain basins of North America (Hillman and Carpenter 1980). The species is thought to have been distributed from southern Alberta and Saskatchewan, south to Arizona and Texas (Henderson et al. 1974). Although no black-footed ferrets are known to occur outside of the captive populations, remnant ferret populations may exist in portions of its former range (Hillman and Carpenter 1980).

2.1.3 Life History and Habitat Requirements

Black-footed ferrets are nearly always associated with either white-tailed or black-tailed prairie dog colonies. In addition to relying on prairie dogs as their primary prey source, ferrets utilize the burrows to raise their young. Ferrets are primarily nocturnal, but also may be active during daylight hours, particularly during the summer period (Henderson et al. 1974; Linder et al. 1972; Fortenbery 1972; Hillman 1968).

Black-footed ferrets breed in March and early April. The gestation period is 42 to 45 days, with as many as five young born in late May and early June. The kits remain underground until late June or early July. In early summer, the kits most often occupy one burrow; however, as the season progresses, the female may place the offspring in separate burrows scattered throughout the prairie dog colony. The kits may then accompany her during nocturnal foraging within the colony. Ferrets are most commonly observed in late summer or early fall. Male ferrets are not active in rearing the young and live a solitary life except during the breeding season. A detailed discussion of the black-footed ferret's life history is presented in Hillman and Carpenter (1980).

2.1.4 Endangerment Factors

Black-footed ferrets are dependent on prairie dog populations, as stated in Section 2.1.3. The ferret's present decline is related to the continued decrease in both prairie dog populations and the suitable habitat provided by their colonies. Prairie dog numbers and acres of occupied towns have been reduced drastically with the major land use changes and extensive poisoning campaigns aimed at eradicating the prairie

dog from western rangelands (Linder et al. 1972; Clark 1978). Although prairie dogs still occupy much of their former range, their numbers are only a small fraction of those that occurred in the late 1800s. Habitat alterations, such as plowing of the grasslands, have impacted prairie dog numbers more than any other factor (Black-footed Ferret Recovery Team 1978). Poisoning programs by Federal, state, and local agencies and various private groups have poisoned hundreds of thousands of acres throughout the west, dramatically reducing prairie dog populations and potentially reducing the number of black-footed ferrets as well (Clark 1978; Henderson et al. 1974; Smith 1967; Cottam and Caroline 1965; Calahane 1954).

The number of animals necessary to maintain the biological diversity for a stable or increasing ferret population is unknown. Past efforts to maintain a captive black-footed ferret population have revealed inbreeding characteristics, which reduce reproductive success and survival. Such disorders may also occur in small isolated wild ferret populations and may influence their viability (Hillman and Carpenter 1980).

2.1.5 Presence in the Study Area

The black-footed ferret historically inhabited the project vicinity of the proposed Sidney-North Yuma Transmission Line; however, no ferret populations are known to occur in the study area. Prairie dog colonies are found in the study area north of the South Platte River; therefore, ferrets could potentially occur within the appropriate habitat.

Upon determination of a preferred route, a mapping survey for active prairie dog colonies along this route will be conducted. The USFWS will be contacted to determine if black-footed ferret clearance surveys will be required for the identified colonies. Clearance surveys, if required, will be conducted prior to construction initiation, according to USFWS guidelines for ferret surveys.

2.1.6 Impact Evaluation

Because the black-footed ferret is so closely associated with prairie dog populations, all prairie dog colonies are considered to be potential habitat for this endangered species. In order to maintain ferret numbers, a stable prairie dog population incorporated with a

sufficiently large colony or complex of colonies appear to be necessary (Black-footed Ferret Recovery Team 1978). Disturbance of prairie dog colonies located within the transmission line ROW, as a result of line construction or maintenance, may significantly impact ferrets, if present within the project area. To determine this potential, prairie dog colonies will be mapped along the proposed transmission line route; active colonies will be delineated; and clearance surveys within these active areas for black-footed ferrets will be conducted prior to construction initiation, if required by the USFWS (see Section 2.1.5). Clearance surveys will determine ferret presence in areas impacted by the route. Final impact assessment will subsequently follow the scheduled mapping and clearance surveys.

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2.2 Bald Eagle

2.2.1 Status

The bald eagle (Haliaeetus leucocephalus) is federally-listed as endangered in 43 of the 48 conterminous United States. The species is federally listed as threatened within the states of Washington, Oregon, Minnesota, Wisconsin, and Michigan (USFWS 1987). Bald eagles are also protected under the Bald Eagle Protection Act of June 8, 1940, as amended and the Migratory Bird Treaty Act of July 3, 1918, as amended June 20, 1936 in all states, including Alaska.

An accurate population estimate for the bald eagle is difficult to establish, especially for remote regions of Alaska and Canada. The estimated world population in 1987 was approximately 80,000 eagles, with the majority occurring in Alaska and Canada. Individuals that typically breed in Alaska and Canada may migrate into and disperse throughout the lower 48 states during the winter period. Within these states, the 1988 mid-winter bald eagle survey estimated 11,241 eagles for the 40 states that regularly participate in this annual count. In 1986 and 1987, estimated eagle numbers in these areas were 9,279 and 9,258, respectively. The current breeding population in the lower 48 states is 1,482 nesting pairs; Alaska contains an estimated 7,500 breeding pairs (Hastings 1989).

2.2.2 General Distribution

The bald eagle's breeding range formerly included most of the continent; the species historically nested in areas where suitable habitat occurred (USFWS 1986). Eagles nested throughout the Rocky Mountain region, including the wooded mountains and river woodland areas of Wyoming, Montana, and North Dakota. During the 19th and 20th centuries, the bald eagle breeding range diminished and the species disappeared from many parts of its range. However, in recent years, eagles have been returning to breed successfully at historic nest sites and have been establishing new territories. Bald eagles currently nest in Alaska, Canada, the Pacific Northwest, the central and northern Rocky Mountain states, the Great Lakes area, Florida, and Chesapeake Bay. The winter range includes most of the breeding range but extends predominantly southward from southern Alaska and southern Canada (USFWS 1986).

Most bald eagles that breed in the 48 conterminous states also winter there. Individuals nesting in northern states may migrate south in the winter to utilize the more open water areas and increased prey availability. In addition, some eagles that nest in Alaska and Canada also migrate south to wintering areas within the lower 48 states. These movements begin during the post-fledging dispersal period and are usually triggered by freezing water in northern areas. The largest wintering eagle concentrations occur in the Klamath Basin, California; in the Midwestern states along the Mississippi, Missouri, Illinois, Platte, and Arkansas Rivers; and in the Northwest encompassing Washington, Oregon, Idaho, and western Montana. Major rivers and other open water bodies in Wyoming, Montana, and North Dakota also serve as wintering grounds for the bald eagle (Spencer 1976). In 1988, the State of Colorado maintained 500 wintering individuals (Hastings 1989) and 8 pairs of nesting birds (Craig 1989).

2.2.3 Life History and Habitat Requirements

The breeding season of the bald eagle varies with latitude. Bald eagles normally reach breeding age at about 5 years, which roughly coincides with full adult plumage (Hancock 1973). Pre-nesting activities occur as early as January, but typically take place in February or early March, and include courtship flights, nest repair, and nest building. Egg

laying and incubation usually begins in March, lasting 34 to 35 days. One to four eggs (average two) are laid (Brown and Amadon 1968). The period from hatching to fledging is about 10 to 13 weeks, with a post-fledging period of 3 to 10 weeks (Todd 1979).

Nests are usually located in trees; optimum nesting habitat includes proximity to open water providing an adequate food source, large nest trees with sturdy branches at sufficient height, and stand heterogeneity. Good visibility from the nest and a clear flight path are essential requirements (Grubb 1976). Eagles often use the same nest each year and will supplement with new nesting material or rebuild the nest, if destroyed. Prey items during the nesting season consist primarily of fish (Grubb and Hansel 1978). Other food items include songbirds, invertebrates, small animals, and carrion.

Bald eagles migrate from breeding areas between September and December and generally winter as far north as open water and food are available. The major components of habitat on wintering grounds include a food source and suitable trees for diurnal perching and night roosting. Wintering eagles usually gather along lakes and major river systems, but may use arid valleys as well (Edwards 1969). Bald eagles may gather in large aggregations and share communal roosts, diurnal perches, and feeding areas. Eagles are attracted to large bodies of water, particularly areas located downstream of hydroelectric dams where there is access to dead or dying fish or waterfowl (Cooksey 1962; Ingram 1965). Food availability is probably the single most important factor affecting winter eagle distribution and abundance (Steenhoff 1976). Waterfowl, particularly dead or crippled individuals, are often taken when fish are not readily available (Shickley 1961; Spencer 1976). In some regions, carrion is an important food source; deer, cattle, sheep, antelope, and road-killed cottontails and jackrabbits are readily utilized. Live mammals such as mice, cottontails, jackrabbits, gophers, woodrats, and kangaroo rats are also taken (Lish and Lewis 1975; Platt 1976; Beck 1980). Eagles may utilize alternate food sources, as availability changes.

Perches are an essential element in bald eagles' selection of foraging areas, since they are necessary for hunting and resting (Stalmaster and Newman 1979). Perch sites must be in open view of potential food sources and are generally within 160 feet of water

(Vian 1971). Night roost sites offer protection from predators and a degree of protection from inclement weather. Large, live trees that occur in sheltered areas are preferred (Lish 1975). Eagles may roost individually or in small groups, and roosts can be used for successive years. Eagles generally leave the roost for feeding areas in the early morning and return in the evening, except during severe weather when they may remain at the roost throughout the day. Cottonwoods comprise preferred perches and roosting areas in the vicinity of the proposed project.

2.2.4 Endangerment Factors

The decline in eagle numbers, especially nesting pairs, was first reported by Howell (1937), with breeding populations disappearing entirely in some regions (Sprunt 1969). These declines were attributed to loss of habitat; human disturbance of nests, roosts, and perches; pesticide and lead contamination of prey, resulting in thinning egg shells and reduced reproductive success; illegal shooting, poisoning, and trapping; and electrocution.

Habitat loss for both breeding and wintering bald eagles is increasing within the United States. Increasing human activity and land development are adversely affecting the suitability of these wintering and breeding habitats, potentially resulting in increased harassment or killing of eagles.

Direct and indirect effects of organochlorine pesticides have severely impacted bald eagle populations (Bailey 1984). Dieldrin and DDE (DDT) are implicated most often in deaths of individual birds. Chronic exposure to DDE is known to inhibit reproduction by interfering with calcium metabolism; resulting in thinning eggshells and hatching failure (Bailey 1984). Heavy metals such as mercury and lead have also caused eagle deaths. Secondary poison from eating lead-contaminated prey, particularly in wintering areas where eagles feed on crippled ducks and geese, appears to be a growing problem.

Electric distribution lines do pose an electrocution hazard to bald eagles. Transmission lines, however, do not present the same

electrocution hazard as smaller distribution lines. Eagle collisions with power lines seem to occur with less frequency than electrocutions (USFWS 1986).

2.2.5 Presence in the Study Area

Bald eagles are common winter residents within the floodplain of the South Platte River, along Jumbo (Julesburg) Reservoir, and periodically in portions of the project area in Nebraska. Individuals begin migrating into Colorado in late October, when southern migrants may move through the study area. Peak numbers of wintering birds usually occur in late January to mid-February (Crooks 1988; Dennis 1989). Wintering individuals predominantly utilize the cottonwood trees along the South Platte River bottom and Jumbo Reservoir for roosting and perching sites. The annual waterfowl and eagle counts, conducted December 1988 and January 1989 by the Colorado Division of Wildlife (CDOW), reported up to 32 bald eagles along the South Platte River from Sterling to Julesburg, including 15 individuals inhabiting the reservoir area (CDOW 1989). Map 2-2 outlines the bald eagle winter concentration areas within the project area (CDOW 1988).

2.2.6 Impact Evaluation

Wintering eagles primarily occupy the open water areas along area reservoirs, the South Platte River, and near the warm water sloughs, which are located in the proximity of the South Platte River and are used extensively by waterbirds (Dillinger 1989). Aerial surveys were conducted during the early evening hours on March 6, 1989 to determine the potential for communal roost sites along the two proposed river crossings. No bald eagles were observed within the area of the crossings; therefore, it is assumed that no communal roosting areas would be disturbed by the proposed project.

Construction activities during the winter period would inhibit eagles from utilizing the habitat located in the vicinity of the disturbance; however, individuals would return upon completion of construction. To prevent potential impacts to wintering bald eagles, construction activities will be curtailed from December through March at the South Platte River crossing. In addition, alternating orange and yellow aerial

markers will be installed on the overhead static wires located at the river crossings to minimize potential collision impact to eagles. The physical dimensions of the proposed 230-kV transmission line will reduce potential electrocution hazards to bald eagles. No significant impacts are anticipated for wintering bald eagles within the Sidney-North Yuma project area.

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2.3 Peregrine Falcon

2.3.1 Status

The American peregrine falcon (Falco peregrinus anatum) is federally-listed as endangered and both breeds in and migrates through the continental United States. The Arctic peregrine falcon (F. p. tundrius) breeds from arctic Alaska through Greenland and migrates through the lower 48 states. The Arctic peregrine is listed as threatened on its breeding range, but either peregrine falcon occurring within the lower 48 states is considered endangered.

The peregrine falcon became extinct as a breeding species east of the Rocky Mountains in the mid-1960s, and breeding populations within the western states were reduced by over 50 percent (Hickey 1969). By 1975, at least 75 percent of peregrine eyries in the western United States were inactive (Fyfe et al. 1976).

Peregrine reintroductions in the west began in 1974. Approximately 1,500 individuals have been reintroduced since the program initiation (Heinrich 1989). A total of 128 captive-bred young were placed in eyries in Idaho, Wyoming, Utah, Colorado, South Dakota, and New Mexico between 1974 and 1982. An estimated 33 pairs of wild peregrines occurred in Colorado during the summer of 1988 (Craig 1989).

2.3.2 General Distribution

Historically, the American peregrine falcon bred in an area ranging from treeline in Canada and Alaska south to Mexico. Reintroduction and management efforts have reestablished nesting peregrine falcons in many areas of the Rocky Mountains. Both the American and Arctic peregrine falcon may winter in or migrate through much of the lower 48 states.

2.3.3 Life History and Habitat Requirements

Peregrine falcons mature at about 2 to 3 years of age. Adults usually return in mid-March to the same nest site each year, exhibiting a strong nest site attachment; however, an alternate nest site may also occur within the breeding territory (Fyfe et al. 1976). The female lays a clutch of three to four eggs in April, and both the male and female birds may incubate. The female typically performs the majority of the incubation, while the male provides prey species. The young hatch at about 33 days and are then cared for by both parents. Fledging occurs in June or July; soon afterwards the young are independent.

The four major habitat requirements for nesting are: 1) an inaccessible nest site; 2) adequate prey base; 3) proximity to water; and 4) isolation from human disturbance (Haynam et al. 1977). Peregrine falcons typically nest on cliffs near rivers, lakes, or marshes. Most nest sites are 150 feet or more in height with a small cave or overhanging ledge (USFWS 1982). The nest ledge will have loose soil, sand, gravel, and dead vegetation to allow the peregrine to construct a scrape for egg laying (Enderson and Craig 1974; Cade 1960).

The average hunting territory for a peregrine pair is usually within 10 miles of the nest. Preferred hunting areas include cropland, meadows, marshes, lakes, and rivers where prey species are abundant (Porter and White 1973).

2.3.4 Endangerment Factors

Several important factors have historically contributed to the decline of the peregrine: 1) eggshell thinning caused by pesticide poisoning; 2) trapping and taking of young by falconers; 3) shooting; 4) disturbance of nest sites by human encroachment; and 5) habitat destruction, resulting in reduction of prey availability (Herbert and Herbert 1965; Peakall 1974).

The peregrine falcon's position on the food chain greatly increases the impacts of pesticide accumulation, causing behavioral and physiological changes that result in reproductive failure. Eggshells collected between 1973 and 1979 in Colorado and New Mexico were 16 percent thinner than those collected prior to 1947 (Enderson et al. 1982). Concentrations of DDT as low as 15 parts per million can result in unsuccessful hatching (Peakall 1974).

Migratory birds, common prey species for the peregrine, return to the United States from Latin America and may significantly contribute to peregrine contamination. These birds often accumulate significant amounts of pesticides which then can be passed on into the food chain.

Disturbance of nest sites by human activities and habitat loss are also considered important factors that have contributed to peregrine falcon decline. The most sensitive period of disturbance is during courtship and incubation.

2.3.5 Presence in the Study Area

No active or historic peregrine falcon eyries are located near the study area (Craig 1989). Both the American and Arctic peregrine falcons occur as occasional migrants through the study area, primarily during spring migration; although, migrants also occur in the area in late summer (Craig 1989). These occurrences may vary from year to year.

2.3.6 Impact Evaluation

No adverse impacts to peregrine falcons are anticipated from the proposed project, due to the absence of active peregrine eyries in the project region. The likelihood of the project affecting migrating individuals is low. The potential for line strikes by migrating peregrines may increase along high use areas (e.g., South Platte River, riparian areas); however, this would not be expected to be a frequent occurrence or produce significant impact to the species. Alternating orange and yellow aerial markers will be installed on the static wires located at river crossings to minimize the potential for collisions by peregrine falcons.

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2.4 Whooping Crane

2.4.1 Status

The whooping crane (*Grus americana*) is federally-listed as endangered. Allen (1952) postulated that whooping cranes were never abundant and estimated a maximum population size of 1,500 birds, based on the extent of available winter range. The actual population ranged between 1,300 and 1,400 birds until around 1860, when the population began to decline (Allen 1952). There was a continuous decrease in the whooping crane population until 1941, when numbers reached their lowest point. At that time, a total of 21 birds remained, only 15 of which were wild.

Intensive management of the whooping crane has resulted in an increase in its population. In the winter of 1976-1977, 102 whooping cranes existed (USFWS 1977); of these, 75 were wild birds. Six were raised by "foster parent" sandhill cranes as part of the USFWS experimental project to establish a second wild flock of whooping cranes west of the Rocky Mountains at Grays Lake, Idaho. The remaining 69 birds constituted the Wood Buffalo-Aransas flock. As of December 1985, this flock totaled 94 cranes. Currently, the world population totals approximately 198. The Wood Buffalo-Aransas flock currently contains 134 birds, the Grays Lake population contains 14 birds, and 50 birds exist in captivity (Lewis 1989).

2.4.2 General Distribution

The historic breeding range during the period of North American settlement extended across the central plains states into the Canadian prairied provinces. Winter distribution occurred primarily along the Gulf of Mexico. Another breeding population, believed to have been nonmigratory, occurred in southwestern Louisiana.

Whooping cranes from the Wood Buffalo-Aransas flock annually nest at Wood Buffalo National Park, Northwest Territories, Canada and winter at Aransas National Wildlife Refuge on the Texas Gulf Coast. During spring and fall, these birds migrate approximately 2,400 miles between winter and summer ranges. Their migration passes through the states of Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Montana, and the Canadian provinces of Saskatchewan and Alberta. Fall departures from Canada begin during the last 2 weeks in September, with the majority of the birds arriving in Texas by mid-November (USFWS 1977), and the latest arrivals occurring in early December (Erickson 1976). Spring departures from Texas occur in April and early May (Allen 1952); breeding pairs generally arrive on the nesting grounds during late April (USFWS 1977).

Whooping cranes in the Grays Lake population summer in southern Idaho and western Wyoming near Grays Lake, Idaho. These birds migrate with sandhill cranes through northeastern Utah and Colorado to the Rio Grande Valley of New Mexico, where a majority of the birds winter. A few birds also winter in northern Mexico (Lewis 1986).

2.4.3 Life History and Habitat Requirements

Wintering grounds, breeding and nesting areas, and migration stopovers are selected by individuals primarily as a combination of migratory behavior and habitat requirements. Selection of migratory stopover areas by cranes is opportunistic. Selection may be influenced by the time of day, the distribution and abundance of potential roosts, weather conditions, and the physical status of the birds. Two primary habitat types are needed in close proximity to migration stopovers: roost sites and feeding sites (Johnson 1981).

Whooping cranes select an open expanse of shallow water in rivers, lakes, reservoirs, and native wetlands for nightly roosting. These sites include stockponds (as small as 0.25 acre), marshes, flooded grain fields, and shallow reservoirs and rivers. Such sites provide protection from predators, a high degree of visibility, and isolation from human disturbance. Birds observed on the ground during migration are found either on a roost site or within a short flight distance of a roosting area. Whooping cranes are opportunistic feeders; during migration, a suitable roosting area is typically the factor in crane stopover selection. An evaluation of whooping crane roost sites (Johnson and Temple 1980) indicated that out of a sample of 64 sites, whooping cranes were observed in standing water wetlands on 56 sites (88.5 percent); the remaining areas were shallow rivers (12.5 percent).

The USFWS conducted 9 whooping crane radio tracking surveys from fall of 1981 through spring of 1984, which monitored 27 individual birds as they migrated through Nebraska. These surveys recorded 8 stopovers in Nebraska, none of which were on the critical habitat reach of the Platte River. These studies also confirmed that whooping cranes do not use the same migration stopover sites from season to season, or from year to year.

Feeding sites include the same wetland types as those used for roosting, agricultural areas, and other upland types. Whooping cranes feed on native wet meadows, upland grasslands, rivers and wetlands, alfalfa fields, and small grain fields.

2.4.4 Endangerment Factors

An estimated 500 to 700 whooping cranes existed in 1870 (Lewis 1986). The population declined drastically in the late 19th and early 20th

centuries. The principle reasons for this decline included hunting, specimen collection, human disturbance, and conversion of the primary nesting habitat to hay, pastureland, and grain production (Allen 1952). Current threats to the whooping crane include collisions with powerlines (10 deaths since 1956), human disturbance, disease, and accidental shooting (Lewis 1986).

2.4.5 Presence in the Study Area

The proposed project area is along the western edge of the whooping crane migratory path. The majority of whooping crane sightings in Nebraska occur in the central portion of the state. Although two individual sightings have been recorded in or near the project area (one west of Jumbo Reservoir and one near Sidney), whooping crane occurrences would be rare along the transmission line corridor (Andelt 1988; Crooks 1988; Lock 1988).

2.4.6 Impact Evaluation

It is unlikely that the proposed Sidney-North Yuma transmission line project would adversely affect whooping cranes within the project area. The project location is along the western edge of the crane's migratory path, and individual sightings in this area have been rare. Due to the rare occurrences of this species in the project vicinity, no significant impacts are anticipated from the proposed transmission line. Alternating orange and yellow aerial markers will be installed on the static wires located at river crossings to minimize the remote possibility of collisions by whooping cranes.

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2.5 Piping Plover

2.5.1 Status

The piping plover (Charadrius melodus) is federally-listed as both threatened and endangered. Piping plovers of the Great Lakes are listed as endangered, while the Northern Great Plains and Atlantic birds are listed as threatened. Migrating piping plovers and birds located within wintering areas are also classified as threatened. Piping plovers breed along prairie rivers and alkali wetlands of the Northern Great Plains of the United States and Canada, on sandy beaches along Great Lakes shorelines, and on Atlantic coast beaches. The birds winter along Gulf of Mexico and southern Atlantic coastlines (Haig and Oring 1988a).

The 1986-1987 estimate for breeding pairs in the Northern Great Plains of the United States is 680, with a total pair count throughout North America ranging between 2,020 to 2,088 (USFWS 1988). An estimated 355 breeding pairs occur in Nebraska, with the majority nesting along the Platte River (Nebraska Game and Parks Commission 1985).

2.5.2 General Distribution

Historically, piping plovers breed across three regions: 1) the United States and Canadian Northern Great Plains from Alberta east to Manitoba and south to Nebraska; 2) Great Lakes beaches; and 3) Atlantic coastal beaches from Newfoundland to North Carolina. Piping plovers were generally seen wintering along the Gulf of Mexico, on southern Atlantic coastal beaches from North Carolina to Florida, in eastern Mexico, and on scattered Caribbean Islands (Haig and Oring 1985). Other historical records indicate piping plovers have been irregular summer residents and migrants in both Colorado and New Mexico (Bailey and Niedrach 1965).

The species' current range is similar to the historic range, except that piping plover breeding has almost disappeared in the Great Lakes region, with Michigan retaining the only viable breeding population in the area. A piping plover breeding population was sighted at Neenoshe Reservoir in southern Colorado during the summer of 1989. This is the first occurrence of a breeding population in Colorado in over 40 years (Sheppard 1989b).

2.5.3 Life History and Habitat Requirements

Piping plovers are migratory shorebirds that spend approximately 3 to 4 months on their breeding sites in the northern United States and southern Canada, arriving mid-April to mid-May (Prindiville 1986; Niemi and Davis 1979). Courtship activities begin shortly after arrival, with nesting occurring in May and the first 3 weeks of June (Faanes 1983). The piping plover may nest with other shorebirds, including the least tern.

Nests are hollows or scrapes in the sand or gravel. Average clutch size is 4 eggs with an incubation period of about 28 days (Wilcox 1959; Cairns 1982). The young are brooded for approximately 3 weeks and fledge at 21 to 35 days (Haig and Oring 1988b; Prindiville 1986; Wilcox 1959). Adults depart the breeding areas from mid-July to late August with juveniles usually departing a few weeks later (Wiens 1986).

Piping plovers require a sparsely vegetated, open area and a sandy or gravelly substrate for nesting habitat (Dinsmore 1983). In the Great Plains, piping plovers nest along sand and gravel shores of rivers and lakes. Piping plovers nesting on the Missouri, Niobrara, Platte, and other prairie rivers use beaches and dry barren sandbars located midstream

in wide, open channel beds. Vegetative cover on nesting islands is usually less than 25 percent (Faanes 1983). The piping plover also uses off-river habitats in the Midwest, including lake beaches and unvegetated flats near alkaline or salt lakes (Renaud et al. 1979). They have been known to colonize manmade habitats and dredge fill areas (Dinsmore 1983).

Little is known about the piping plover diet or their foraging behavior, although they have been observed feeding on marine worms, insects, crustaceans and small molluscs (Bent 1929; Cairns 1977). Piping plovers appear to feed primarily on exposed beach substrates by pecking for invertebrates at or less than 2 inches below the surface (Cairns 1977; Whyte 1985). Foraging efforts are usually concentrated within 15 feet of the water's edge (Whyte 1985).

2.5.4 Endangerment Factors

Early records report that shorebird hunting caused the first major decline of the piping plover population (Bent 1929; Hall 1960). Current threats are mainly related to habitat destruction or alteration including increased recreational/commercial development of beaches, wetland drainage, water level manipulation on rivers, increased predation, lack of undisturbed nesting habitat, and stabilization of winter sites (USFWS 1988). Agricultural runoff into wetlands, pesticide drift, botulism, and environmental contaminants have not been carefully investigated; further studies may prove these factors to be related to the piping plover population decline (USFWS 1988; Haig 1986).

2.5.5 Presence in the Study Area

The study area lies near the western boundary of the piping plover breeding range and migratory route; few sightings have been made in this area. Piping plover individuals, however, were observed at Jumbo (Julesburg) Reservoir in 1975 and 1986. Although the species is currently considered a migrant within the study area, there is a possibility that the piping plover also nests in the region (Carlson 1989a; Sheppard 1989a; Sidle 1991). A breeding pair was observed in Washington County, Colorado in 1949 (Johnsgard 1979). Piping plover surveys conducted by the CDOW in northeastern Colorado during the summer of 1989, however, located no piping plover individuals (Carlson 1989b). No additional field surveys

for this species were conducted along the South Platte River in 1990 (Dennis 1991).

2.5.6 Impact Evaluation

It is unlikely that the project would impact migrating, breeding, or nesting piping plovers. Based on the CDOW piping plover and interior least tern survey conducted within the study area June and July 1989, it appears that there are no current breeding populations of piping plover in the study area (Carlson 1989b). No piping plovers were sighted during the survey.

No significant impacts to this species are anticipated from collision with the proposed transmission line. Mortality from line collision is not a common occurrence with plovers because of their typical flight behavior.

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2.6 Interior Least Tern

2.6.1 Status

The interior least tern (Sterna antillarum) is federally-listed as endangered, and is state-listed as threatened in Nebraska. Interior least terns breed along prairie rivers and reservoirs in the Mississippi and Rio Grande River Basins from Montana to Texas and from eastern New Mexico and Colorado to Indiana and Louisiana. The birds' specific wintering areas are unknown, although interior least terns have been sighted wintering in Central American and along the north coast of South America from Venezuela to northeastern Brazil (USFWS 1989).

The estimated current population of interior least terns in the United States is 4,800 (USFWS 1989). The 1988 population estimate for breeding pairs in the Missouri River system was 600 (USFWS 1989). Approximately 29 percent of the total interior least tern population is found along the Missouri River system, which includes the Platte River.

2.6.2 General Distribution

The interior least tern historically occurred along the Mississippi, Red, Missouri, Arkansas, Ohio, and Rio Grande River systems, and along rivers of central Texas. Its breeding range extended from Montana south to Texas and from southern Indiana west to eastern Colorado and New Mexico (American Ornithologists' Union 1957; Anderson 1971; Coues 1874; Burroughs 1961; Hardy 1957; Youngworth 1930, 1931; Ducey 1981). There have also been occasional sightings of interior least terns in Michigan, Minnesota, Wisconsin, Ohio, and Arizona (Campbell 1935; Jung 1935; Mayfield 1943; Phillips et al. 1964; Monson and Phillips 1981; Janssen 1986).

The species currently continues to breed in most of its historic range although its distribution in this area has been restricted to less altered river sections (Sidle et al. 1988). In the Missouri River system, interior least terns nest on sparsely vegetated riverine sandbars and at sand and gravel pits along the Platte River from the confluence of the Missouri River to the North Platte and along the South Platte River as far west as Ogallala (USFWS 1989). Interior least terns also nest at Adobe Creek Reservoir, in southern Colorado, on a small tributary of the Arkansas River (Chase and Loeffler 1978; USFWS 1989).

2.6.3 Life History and Habitat Requirements

Interior least terns are migratory shorebirds that spend approximately 4 to 5 months at their breeding locations, arriving at the sites from late April to early June (Hardy 1957; Youngworth 1930; Wilson 1984; Faanes 1983; Wycoff 1960; USFWS 1987).

Nests are shallow scrapes or hollows in open, sandy areas or exposed flats. The birds nest in colonies and nest sites are scattered (Stiles 1939; Hardy 1957). Interior least terns are often found in association with the piping plover and snowy plover. Egg-laying begins by late May. Clutch size averages 2 to 3 eggs and incubation generally lasts 20 to 25 days (Hardy 1957; Faanes 1983; Moser 1940). The precocial chicks are brooded for about 1 week and fledge after 3 weeks (Hardy 1957; Tomkins 1959; Massey 1972). Both adults and fledglings have largely departed the colonies by early September (Hardy 1957; Stiles 1939; Bent 1921).

Interior least terns require broad expanses of unvegetated river channel and exposed sandbars for feeding and breeding (Currier 1985). The birds often nest in sand and gravel pits and up to 90 percent of the upper Platte River population nests in these areas.

The interior least tern is piscivorous and feeds while in flight, hovering and diving for food near the water's surface. The bulk of their diet is minnows and includes the genera Fundulus, Notropis, Camptostoma, Pimephales, Gambusia, Blanesox, and Lepomis (Hardy 1957; Grover 1979; Schulenberg et al. 1980). According to Whiteman (1988) other least terns feed on crustaceans, insects, annelids, and mollusks. Interior least

terns may fly between 2 to 4 miles from their nesting sites to fish in shallow waters of rivers, streams, and lakes (USFWS 1989; Talent and Hill 1985).

2.6.4 Endangerment Factors

Habitat loss, artificial changes in river morphology and flow regimes due to stream channelization and the construction of reservoirs and pools, and human disturbance caused by recreational use within the interior least tern nesting areas are the principal reasons for the birds' current distribution and numbers (USFWS 1989). Extreme and unpredictable fluctuations due to reservoir releases can inundate nesting areas, eliminate feeding areas, result in fewer suitable sandbar nesting sites, and cause vegetation encroachment on sandbars and along river banks. Sandbars used for nesting have virtually disappeared in river areas which have been channelized.

2.6.5 Presence in the Study Area

The study area lies near the western boundary of the interior least tern breeding range and migratory route; few sightings have been recorded within the project area. An interior least tern was observed, however, near the Dune Ridge Wildlife Area, Colorado in June and July 1989 by a Colorado Bird Observatory Volunteer. Another interior least tern was recorded near Iliff, Colorado during a CDOW and USFWS survey, which was also performed in June and July 1989 (Carlson 1989; Dennis 1989).

2.6.6 Impact Evaluation

It is unlikely that the project would significantly impact migrating interior least terns. However, since two interior least terns were sighted in the vicinity of the study area during the CDOW survey in June and July 1989, breeding or nesting birds may potentially be present within the project area during the appropriate season (Dennis 1989; Sidle 1991). Breeding or nesting interior least terns could be adversely affected during construction, if disturbances inhibited incubation or other breeding activities. To prevent potential impacts to breeding birds, construction activities along the South Platte River crossing will be curtailed during the nesting months from April 15 through July 31. The CDOW is planning

additional surveys along the South Platte River during the spring of 1991 (Dennis 1991). Construction curtailment will be contingent upon the findings of these CDOW surveys. No significant impacts to migrating interior least terns are anticipated from collision with the proposed transmission line because of the birds' typical flight behavior.

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3.0 SUMMARY

3.1 Black-footed Ferret

Prairie dogs are known to occur throughout the study area. The potential for adverse impacts to ferrets exists because any active prairie dog colony is considered potential black-footed ferret habitat. Ferret clearance surveys must be conducted before a final evaluation of ferret impacts can be addressed.

3.2 Bald Eagle

Bald eagles do not nest in the study area, but they are common along the South Platte River in the winter. Eagles utilize portions of the study area along the South Platte River and Jumbo Reservoir for winter roosting and feeding. No communal roost sites occur at the proposed river crossings for the project. To prevent potential impacts to wintering eagles, construction would not be conducted from December through March; aerial markers would also be installed to decrease collision potential.

3.3 Peregrine Falcon

Peregrine falcons do not nest in or near the study area, but occur as occasional migrants. The potential for increased collisions exists primarily within the riparian areas (preferred peregrine hunting habitat) along the South Platte River. However, impacts to peregrine falcons should not be significant, due to the infrequent occurrence of this species within the study area. Aerial markers would be installed at the South Platte River crossing to decrease any collision potential.

3.4 Whooping Crane

Whooping cranes may occur in the study area as rare migrants. However, due to the rarity of migrating whooping cranes in the study area, no impacts to this species are anticipated. Aerial marks would be installed at the South Platte River crossing to reduce the potential for collisions.

3.5 Piping Plover

Piping plovers have been historically observed in the study area both as migrants and as breeding pairs. Based on the 1989 surveys conducted by

ATTACHMENT 1

AGENCY CORRESPONDENCE

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
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(FWE)

May 3, 1988

Mark H. Silverman
Area Manager
Western Area Power Administration
Loveland Area Office\P.O. Box 3700
Loveland, CO 80539

Dear Mr. Silverman:

This responds to your April 4, 1988, letter regarding the Sidney-North Yuma 230-kV Transmission Line Project. The following federally listed species may occur within the influence of the proposed project.

Black-footed ferret
Whooping Crane
Bald eagle
Peregrine falcon

Mustela nigripes
Grus americana
Haliaeetus leucocephalus
Falco peregrinus

Historically, the black-footed ferret was believed to occur in portions of the construction work area. Literature documents a close association between prairie dogs and black-footed ferrets. Your pre-construction surveys should determine whether the activities will disturb prairie dog colonies. If so, black-footed ferret surveys may be required.

Whooping cranes characteristically engage in low level flight between roosting and feeding areas, usually wetlands and agricultural fields, respectively. Whooping cranes have collided with powerlines bisecting such habitats, sometimes with fatal results. Powerlines and their potential hazard to birds, including cranes, have been addressed in a recent publication titled "Bird Behavior and Mortality in Relation to Power Lines in Prairie Habitats." This publication is available from the Publications Unit, U.S. Fish and Wildlife Service, Matomic Building, Room 148, Washington, D C 20240. Additionally, there are studies being initiated in Nebraska and Colorado to further evaluate the collision hazard of powerlines, and identify feasible methods to reduce/eliminate this hazard. Conclusions of these studies may be useful to Western in designing/routing the proposed powerlines. Due to the occurrence of whooping cranes in the Sidney area, Western should evaluate the potential impacts of the powerline to this endangered bird.

Since 1980, up to 105 wintering bald eagles have been annually observed along the South Platte River and associated reservoirs. Wintering bald eagles also occur in portions of the project area in Nebraska. While ninety percent of all electrocution victims are golden eagles, bald eagles also die from

electrocution and powerline impact injuries (Steenhof, 1978). Bald eagles are known to fly up to 18 miles from night roosts to feeding areas and it is likely that even greater distances are traveled searching for food. Western should therefore evaluate the potential impact of the powerline on bald eagles.

Peregrine falcons are migratory through portions of the project area. Western should therefore also consider the potential impact if the line to this endangered species.

In recent years, much attention has been given, especially in the West, to the protection and enhancement of raptor populations (hawks, owls and eagles) with respect to powerlines. Eagles and other raptors perch on the distribution poles and consequently become primary victims of electrocution. To offset the possibility of adverse impacts to bald eagles or peregrine falcons or other large raptors, we suggest that you consider measures to protect raptors from electrocution as outlined in the recent document: Suggested Practices for Raptor Protection on Powerlines - The state of the Art - 1981. Raptor Research Report #4, Raptor Research Foundation, Inc. 1981. Copies of this report may be obtained from the Raptor Research Foundation, c/o Department of Veterinary Biology, University of Minnesota, St. Paul, Minnesota 55101.

Section 7 of the Endangered Species Act requires that the federal agency proposing a major federal action significantly affecting the quality of the human environment to conduct and submit to the Service a biological assessment to determine effects of the proposal on listed species. The biological assessment shall be completed within 180 days after the date on which initiated or a time mutually agreed upon between the agency and the Service. The assessment must be completed before physical project modification/alteration begins. If the biological assessment is not begun within 90 days, the species list above should be verified prior to initiation of the assessment.

The lead federal agency should evaluate the potential impacts of the proposed powerline and determine if the action may affect any listed species. If a determination is "may affect" for listed species, the federal agency must request in writing formal consultation from this office and should provide this office with a biological assessment, and any other relevant information used in making impact determinations.

The Fish and Wildlife Service can enter into formal Section 7 consultation only with another federal agency or its designee. State, county, or other governmental or private organizations can participate in the consultation process, help prepare information such as the biological assessment, participate in meetings, etc.

With respect to the area potentially influenced by the powerline, the Service has additional concerns over project impacts to wetlands, other high value wildlife habitats (e.g. riparian corridors), and raptors and other migratory birds. Any development of a Federal environmental assessment or environmental impact statement for the project should include a thorough evaluation of project effects on these fish and wildlife resources as well.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
COLORADO FIELD OFFICE
730 SIMMS STREET
ROOM 292
GOLDEN, COLORADO 80401

IN REPLY REFER TO:

FWE/CO

MAY 12 1989

Fred J. Weiss
Assistant Area Manager, Engineering
Western Area Power Administration
Loveland Area Office
P.O. Box 3700
Loveland, Colorado 80539

Dear Mr. Wiess:

The Fish and Wildlife Service (Service) has received your letter of April 26, 1989, requesting an updated threatened and endangered species list for the proposed Sydney-North Yuma 230-kV transmission line. The Service recommends the piping plover (Charadrius melodus) be added to our list of May 3, 1988. Breeding piping plovers are known from the North Platte River in Nebraska not far from the Colorado border. Sightings of plovers have been reported from the South Platte in the vicinity of the proposed powerline crossing. A survey to attempt to determine if breeding plovers are present along the South Platte will be carried out this summer. The Service will inform Western Area Power Administration of the survey's results as soon as they are available.

The other species presented in our May 3, 1988, list remains valid. If we can of further assistance, please contact Bill Noonan of my staff at FTS 776-2675 or comm. 303-236-2675.

Sincerely;

LeRoy W. Carlson
Colorado State Supervisor

cc: FWE, SLC
CDOW, Ft. Collins (Attn: Don Bogart)
FWE, RO

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Reference the installation of aerial marker balls at the South Platte River crossing in section 3.3.6.

Whooping Crane

Reference the installation of aerial marker balls at the South Platte River crossing in section 3.3.6.

Piping Plover and Interior Least Tern

The Colorado Division of Wildlife (Division) and the Service conducted a survey for piping plovers and interior least terns along the South Platte River during June and July of 1989. No piping plovers were observed during the survey. One interior least tern was observed by Division personnel near Iliff, Colorado (Jim Dennis, personal communication). Additionally, a volunteer observer for the Colorado Bird Observatory reported a tern sighting near Dune Ridge Wildlife Area, Colorado, during the same general time period (Jim Dennis, personal communication). Habitat along the South Platte River can be considered suitable for both species although not optimum. Based upon the results of the survey, we recommend continued inclusion of the piping plover and the addition of the interior least tern in the evaluation of project impacts to threatened and endangered species.

We hope this information will be of assistance to you in preparation of a final document. Should you have any questions or need additional information, please contact Bill Noonan at FTS 776-2675.

Sincerely,

LeRoy W. Carlson
Colorado State Supervisor

cc: FWE, SLC
CDOW, FT Collins (Attn: Don Bogart)
CDOW, Ft. Collins (Attn: Jim Dennis)

If the Service can be of assistance to you in the future, please contact this office.

Sincerely,

Jeffrey D. Updycke
State supervisor

cc: FWS/FWE: SLC
FWS/FWE: Grand Island
Official file
Reading file

RELEACHMAN;cjharris
WAPA.CON

END

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