FINAL TECHNICAL REPORT

COOPERATIVE AGREEMENT NO. DE-F-CO2-81RA50404 BETWEEN WYCOALGAS, INC. AND U.S. DEPARTMENT OF ENERGY

Period of Performance
NOVEMBER 1980 - MAY 1982

A Subsidiary of
PANHANDLE EASTERN CORPORATION

WyCoalGas, Inc.

APPENDIX S

BLM BIOLOGICAL ASSESSMENT FOR T & E SPECIES FOR THE WYCOALGAS PROJECT

DISCLAIMER

DISCLAIMER

BLM BIOLOGICAL ASSESSMENT FOR
T&E SPECIES FOR THE WYCOALGAS PROJECT

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BIOLOGICAL ASSESSMENT
WYCOALGAS PROJECT
CAMPBELL/CONVERSE COUNTIES, WYOMING

INTRODUCTION

On January 28, 1981, the Wyoming Office of the Bureau of Land Management (BLM) requested the the Billings Area Office of the U. S. Fish and Wildlife Service (FWS) provide a list of threatened and endangered species (Attachment 1) present in the vicinity of the proposed WyCoalGas project.

On February 10, 1981, in accordance with Section 7(c) of the Endangered Species Act, as amended, the FWS responded (Attachment 2) with the following list:

Listed Species	Expected Occurrence
Bald eagle (Haliaeetus leucocephalus)	winter, spring-fall migrant, communal roosting
Peregrine falcon (Falco peregrinus anatum)	possible wintering, spring-fall migrant
Black-footed ferret (Mustela nigripes)	resident
Whooping crane (Grus americana)	spring-fall downstream migrational use

Proposed Species

None

By letter of July 28, 1981 (Attachment 3), the BLM requested a 60-day extension to the 180-day period provided for biological assessment preparation for reasons of data acquisition constraints relating to

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whooping crane/hydrology interaction studies currently ongoing for the North Platte River system. The FWS responded on August 3 with a grant of a 60-day extension (Attachment 4).

Meetings have been held with representatives of the FWS on several occasions throughout the biological assessment preparation period in Billings, Montana; Jamestown, North Dakota; and Cheyenne, Wyoming. Additional coordination with respect to endangered species has occurred through the cooperative effort between FWS and BLM in preparation of the EIS for the WyCoalGas project.

This biological assessment presents data on four federally listed species that could occur in areas affected by the WyCoalGas complex as listed in the FWS letter of February 10, 1981 (Attachment 2). The complex as referred to in detail later in this report includes the:

A. Rochelle Coal Mine.

B. Electric Railroad.

C. Coal Gasification Plant.

D. Water Intakes, Well Fields and Pipeline.

E. Product Pipeline.

Based upon data in the assessment, BLM has determined that the peregrine falcon is not affected by the WyCoal project. Three species, however, have been determined to be in a "May Affect" category. These species are black-footed ferret, bald eagle, and whooping crane. Each of the three species in the "May Effect" category are discussed from a historical occurrence and biological standpoint as well as their relationship to the WyCoalGas project construction and operational effects.

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Project Description

A detailed description of the proposed WyCoalGas facility and its attendant operational regime is contained in the Preliminary Draft Environmental Impact Statement (PDEIS). This document was provided to the Billings Office of the U. S. Fish and Wildlife Service as part of its cooperative function in the EIS effort and is incorporated by reference into this biological assessment.

The proposed coal gasification project would consist of five major operating facilities: (1) coal gasification plant, (2) water supply system, (3) product pipeline, (4) electric railroad, and (5) surface coal mine. These facilities are shown conceptually in Figure 1. Figure 1.4-2 shows the location of the facilities.

Commercially proven Lurgi and Texaco gasification technologies would be used to produce 300 million standard cubic feet per stream day. At this designed production and heating value, the plant would produce the equivalent of approximately 300 billion Btu per day or 100 trillion Btu per year.

Coal gasification would be supplied from the Rochelle Mine, located approximately 40 miles north of the proposed plant site, in southeast Campbell County, Wyoming. At full capacity the mine would supply 11 million tons of coal per year to the plant, in a truck and shovel operation. Estimated coal reserves at the Rochelle Mine are in excess of 500 million tons of subbituminous coal.

Delivery of the coal to the gasification plant would be by a 40-mile electric railroad. The railroad and rolling stock would be owned by WyCoalGas. Unit trains consisting of two locomotives and 100 bottom-dump cars would move coal to the plant; ash generated in the gasification of coal would be returned to the mine using this railroad system.

WyCoalGas, Inc., a wholly-owned subsidiary of Panhandle Eastern Corporation (PEC), proposes to construct and operate a coal gasification project in southeastern Wyoming and northeastern Colorado. At full production, the project would produce approximately 300 million standard cubic feet per stream day (MMSCF/SD) of high-Btu synthetic pipeline gas (SPG) from about 10.2 million tons per year of Powder River basin subbituminous coal. Coal would be transported approximately 40 miles to the proposed gasification plant from a proposed surface mine dedicated to the project. WyCoalGas would construct and operate a private electric railroad to transport the coal and return ash from the plant to the mine for disposal. Gas produced at the plant would be transported approximately 160 miles via a proposed pipeline to an existing transmission system. The gas would ultimately be used by residential and industrial customers of Panhandle Eastern Pipe Line Company in Michigan, Illinois, Indiana, Ohio, and Missouri.

The coal gasification plant would require approximately 7,900 acre-feet of water per year at full production, of which 1,720 acre-feet would be supplied from moisture contained in the coal. Raw water requirements for the remainder would be met by a three-part supply system. Surface water would be obtained from the existing LaPrele Reservoir southwest

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of Douglas, and from flood flow in the North Platte River. Ground water would augment these surface sources when necessary; proposed ground water sites are the South Well Field, west of Douglas; and the North Well Field, west of the plant site. The water well fields are shown in Figure 2. Water from these sources would be pumped directly to the plant when needed.

A private storage reservoir, Combs Reservoir, would be constructed to store water. Water from LaPrele Reservoir would flow down LaPrele Creek to the North Platte River and be pumped from an intake structure on the river to the storage reservoir; thus no pipeline would be required for this source. Flood water from the North Platte River would be diverted to the reservoir at the same intake. Collection and transmission pipelines and several pumping stations would complete the system.

The choice of water sources would be as follows. North Platte River flood flow would be used first, when available. LaPrele Reservoir water would be used secondly, as available, to the allowed maximum of 5,000 acre-feet per year. If necessary, water from the South Well Field, ~~up to~~ 2,000 acre-feet per year, would be used next, f~~ollowed by a maximum of~~ 2,000 acre-feet per year from the North Well Field. In the event that both surface-water sources were unavailable, total water demands of the plant could be met by these ground water sources.

SYSTEM COMPONENTS

<u>Surface Water Supply</u>

A computer operation study (Panhandle Eastern Water Supply Operation Study) was used to model the combined use of the above water sources

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and Combs Reservoir. A description of each surface-water source and its anticipated yield follows.

LaPrele Reservoir. LaPrele Reservoir is located in T. 32 N., R. 73 w., sec. 21, and operates under the two permits listed below:

Permit	Priority	Storage Right
728R	September 21, 1905	15,106 acre-feet
1581R	July 7, 1909	4,894 acre-feet

Use of LaPrele waters by the WyCoalGas project results from an agreement reached between Panhandle Eastern and the Douglas Reservoirs Water Users Association. Panhandle Eastern contracted for up to 5,000 acre-feet of water per year in exchange for guaranteeing a loan financing the rehabilitation of LaPrele Dam. The main elements of the agreement and of further regulations placed on the agreement by the Wyoming State Board of Control Order No. 20 are as follows:

1. No water rights on LaPrele Creek shall be injured.

2. WyCoalGas can receive up to 2,500 acre-feet on a reasonably uniform basis during the nonirrigation season (October 1 to April 30).

3. During the irrigation season (May 1 to September 30), WyCoalGas can receive up to the difference between actual deliveries during the immediately preceding nonirrigation season and 5,000 acre-feet, delivered on a reasonably uniform basis.

4. During the irrigation season, if insufficient water is impounded to supply both the irrigation needs and Panhandle's contract, the available

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water shall be apportioned 75 percent to irrigation needs and 25 percent to WyCoalGas.

5. Any dam leakage shall be accounted for as storage water and charged and delivered to WyCoalGas as a portion of their 5,000 acre-foot entitlement.

6. The reservoir shall be operated under the one-fill criterion, with all releases to WyCoalGas deducted from the annual entitlement of water for LaPrele Reservoir.

7. Conveyance losses from LaPrele Dam to WyCoalGas' point of diversion shall be considered.

Based on the above criteria, a separate operation study of LaPrele Reservoir was conducted, modeling the period 1930-1979. The study showed that, on the average, a volume of 4,610 acre-feet of water per year would have been available below the LaPrele Dam for the WyCoalGas project. The lowest amount of water available for WyCoalGas in any one year would be 2,400 acre-feet. A conveyance loss of 10 percent was assumed from LaPrele Dam to WyCoal's point of diversion, a distance of approximately 20 miles along LaPrele Creek and 4.3 miles along the North Platte River.

In almost every year, little or no water was modeled to be available to WyCoalGas in the months of August and September. Because of the large amount of land served by the relatively small LaPrele Reservor, shortages to the irrigators and WyCoalGas occurred as early as June several times in the operation study; shortages to the irrigators would occur almost every year in the late irrigation season without WyCoalGas' involvement. Historically, such shortages have been the case. In the model, the most consistent yield to the WyCoalGas project occurs during the nonirrigation season, when the average effective yield would be the full nonirrigation season apportionment of 2,500 acre-feet.

Direct Flow Right from the North Platte River. Panhandle Eastern obtained a direct flow right from the North Platte River with a priority date of 1974, and a storage right for the North Platte water in Combs Reservoir. The extraction point on the North Platte would be in T. 33 N., R. 71 W., sec. 7. The WyCoalGas project would be able to obtain water from the North Platte, when in priority, at a maximum rate of 201.2 cfs, not to exceed 26,539 acre-feet for storage in any year.

The availability of North Platte water in the Panhandle Eastern Water Supply Operation Study was based on the North Platte River Operational Study developed by WRRI (Water Resources Research Institute). This model simulates the North Platte River System, accounting for all gains, storage rights, and power operation needs for the large government reservoirs, irrigation requirements, river losses, and interstate compacts with Nebraska. The model was first developed in June of 1977, and has since been revised and updated. Agencies participating in and reviewing the revised model are the Wyoming State Engineer's Office and the U. S. Water and Power Resources Service.

From this operation study, the gain in the North Platte River System above all demands and interstate agreements (referred to as "Owed To the River" water), would be available under Panhandle Eastern's 1974 priority. For the Panhandle Eastern Water Supply Operation Study it was assumed that

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there must be more than 6,000 acre-feet of "owed To the River" (O.T.R.) water available in any month before any water becomes available to WyCoalGas. This provides an administrative water "cushion" to assure that no adverse effects would result to prior rights on the North Platte River. All O.T.R. water in excess of 6,000 acre-feet per month, but limited to WyCoalGas' right of 201.2 cfs (approximately 12,000 acre-feet per month), was made available to WyCoalGas. In many cases, water that was available to WyCoalGas was bypassed because of a lack of storage space in Combs Reservoir. The 50-year average of O.T.R. water for the period 1930-1979, obtained from the North Platte River Operational Study, was 124,300 acre-feet per year. The Panhandle Eastern Water Supply Operation Study projected that the average availability of O.T.R. water to the WyCoalGas project would have been 11,500 acre-feet per year, and indicated that WyCoalGas would have been able to divert, on the average, only 3,600 acre-feet per year of this water available to them during the study period 1930-1979, or less than 3 percent of the total O.T.R. water in the North Platte River.

The North Platte water is not available to WyCoalGas every year and is typically available only in the months of April through June. During the period of 1954-1967, WyCoalGas would have had North Platte water available to them only during three months and in quantities insufficient to completely fill Combs Reservoir. The volume of O.T.R. water is usually large when it does occur; for example, as much as 758,400 acre-feet has been available in a single month.

Combs Reservoir lies on Soldier Creek drainage and would be entitled to flows from Soldier Creek. No records of flows for Soldier Creek are available.

Similar drainages show a great variation in the amount of flow available from year to year, ranging from 2 to over 2,000 acre-feet. It was felt that flows from Soldier Creek would not be a reliable source of water. Therefore, to remain conservative relative to the overall water supply, Soldier Creek flows were not included as a water source.

Ground Water Supply

Applications for nine wells in the South Well Field and 19 wells in the North Well Field area were submitted to the State Engineer February 12, 1974, and are currently being held in a pending status. According to current operation studies being conducted for Combs Reservoir, ground water would be required to make up surface water deficits for 5 years of a total 50-year simulation period. The ground water requirements during these years (1930-1979) range from 1,050 to 2,680 acre-feet per year.

South Well Field. The South Well Field is expected to consist of approximately 10 to 12 wells with capacities of 300 to 600 gallons per minute each. Due to the close proximity of some of the wells to each other, some of the wells would be used for standby purposes. The location of the wells in the well field is shown in Figure 3.6-2.

North Well Field. The North Well Field is anticipated to consist of 20 wells with capacities of 100 to 300 gallons per minute each, as shown in Figure 3.6-3.

Combs Reservoir and Dam

Combs Reservoir would be located on Soldier Creek northwest of Douglas and would have a storage capacity of 26,540 acre-feet. The major function of this reservoir would be the storage of water from Panhandle Eastern's 1974 North Platte right. The reservoir would also serve to store any excess water delivered from the LaPrele Reservoir supply. Water is appropriated for and diverted to the reservoir under the permits shown in Table 3.6-1.

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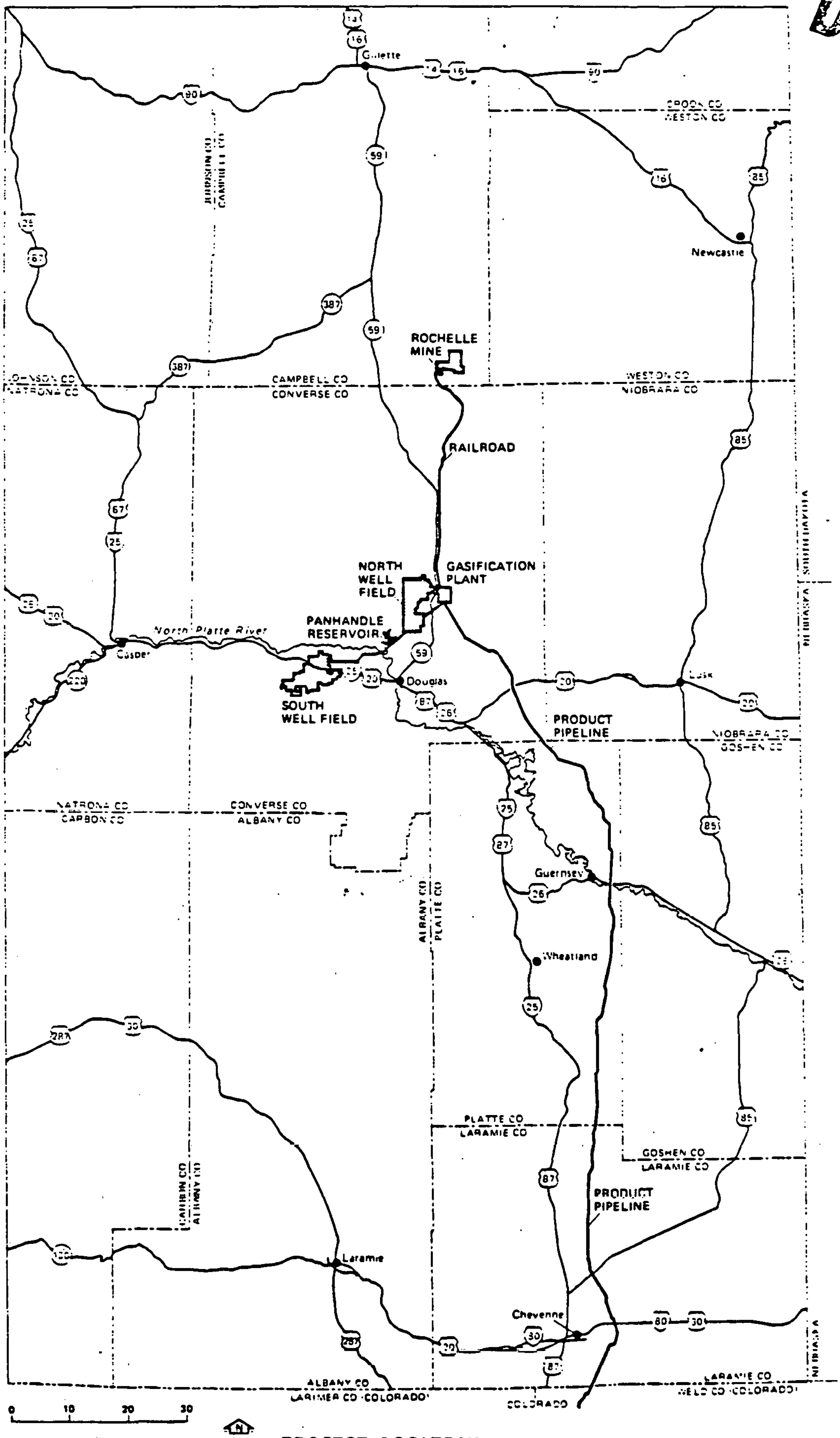

PROJECT LOCATION

Figure 2

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Table 1.4-1

ACREAGE REQUIREMENTS, WYCOALGAS PROJECT[a]

Component	Disturbed Acreage, Construction	Occupied Acreage, Operation
Coal Mine[b]	5,210[c]	5,210[c]
Railroad	900	607
Gasification Plant	1,000	815[d]
Product Pipeline	1,855	5[e]
Water Supply System	2,288	1,459[f]
Total	11,253	8,096

[a]Values do not include power or telephone line corridors.

[b]Refer to section 3.4.1 for annual disturbances.

[c]Total lease area is 6,600 acres.

[d]Total lease area is 3,697 acres.

[e]Operational surface use limited to 9 valve stations, each occupying 1/2 acre.

[f]Total lease area is 43,169 acres.

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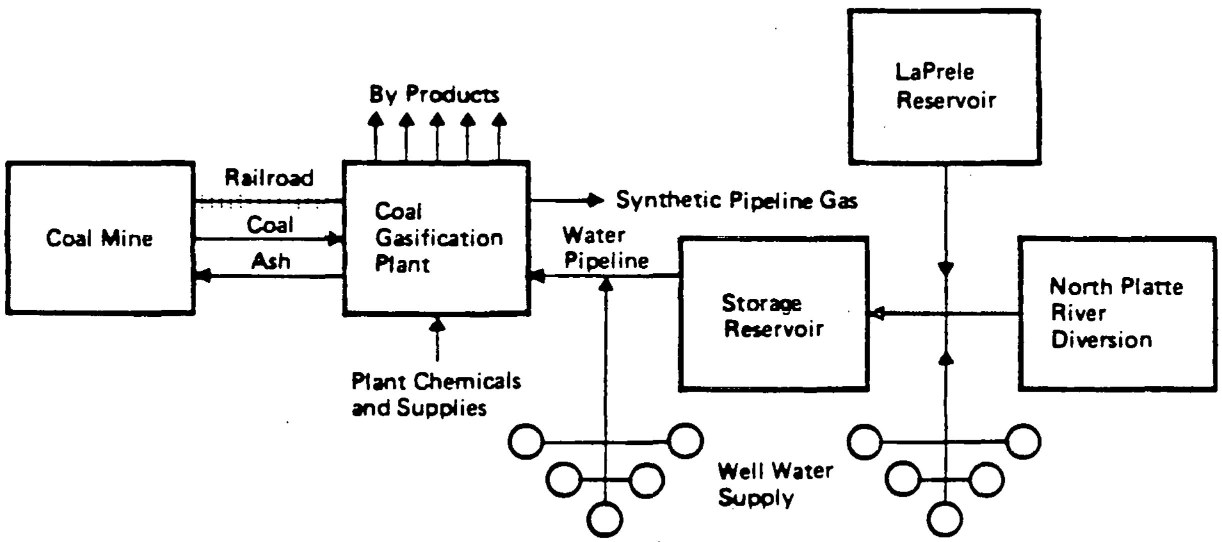


Figure 1
COAL GASIFICATION COMPLEX—PROPOSED MAJOR FACILITIES

Black-Footed Ferret (*Mustela nigripes*)

The black-footed ferret (*Mustela nigripes*) is endangered throughout its entire range as reported in the Federal Register (32 FR 4001, March 11, 1967; and 35 FR 8495, June 2, 1970).

The original range of the black-footed ferret extended from Saskatchewan and Alberta, Canada, to Texas, New Mexico, and Arizona, closely coinciding with the distribution of prairie dogs (*Cynomys* spp.) (Hall and Kelson 1959). Many authors cite this general distribution (Linder et al. 1972; Hillman and Linder 1973; Henderson et al. 1974; and Black-Footed Ferret Recovery Team 1978). Recent evidence reported by Clark (1978) indicated the ferret probably occurred further west (in Wyoming) than Hall and Kelson reported, and this evidence has been confirmed by discovery of skeletal remains in southwest Wyoming (Martin and Schroeder 1978).

The ferret was found throughout the Great Plains, mountain basins, and semiarid grasslands of North America (Hillman and Clark 1979). Henderson et al. (1974) indicate that the ferret was characteristic of the short and midgrass prairie grasslands, and Clark (1978) indicates that 97 percent of reported ferret sightings in Wyoming (n=105) were in a sagebrush/grassland vegetation type. Even though ferrets have been reported from haystacks, under buildings, and in ground squirrel colonies, the majority of evidence indicates that their principal habitat is prairie dog colonies (Hershkovitz 1966; Hillman 1968; Fortenberry 1972; Linder et al. 1972; Snow 1972a; Hillman and Linder 1973; Henderson et al. 1974; Clark 1975; Black-Footed Ferret Recovery Team 1978; and Clark 1978).

Many authors indicate that ferrets and prairie dogs have been and still remain in close association (Hall and Kelson 1959; Hershkovitz 1966; Hillman 1968; Fortenberry 1972; Linder et al. 1972; Snow 1972a; Hillman and Linder 1973; Henderson et al. 1974; Clark 1975; Black-Footed Ferret Recovery Team 1978; Clark 1978; Hillman and Clark 1979; and Hillman et al. 1979). Sheets et al. (1972) found prairie dog remains in 91 percent of the ferret scats analyzed (n=82), and mice in 26 percent. The prairie dog reproductive potential apparently offsets any effect the predation may have, though this is somewhat dependent on prairie dog town size (Hillman 1968; Hillman and Linder 1973).

Parts of towns frequented by ferrets are thinly populated while densities are higher where ferrets are occasional. When a ferret is active during the day, the prairie dogs stay above ground. In the locality of the ferret they may appear very agitated. The prairie dogs frequently cover up the burrows in which ferrets are present or apparently where there is an odor of recent ferret presence. The ferrets seem to have no difficulty digging out of these situations (Snow 1972a; Martin and Schroeder 1978).

Prairie dog burrows also provide shelter and denning habitat for the ferret (Hillman 1968; Sheets et al. 1972; and Hillman et al. 1979).

Observations to date have been made of single adults and families. The female alone cares for the young, although occasionally the male may stay in the same town. The young ferrets rarely appear above ground during the daylight in the summer, although the female at times may sunbathe. Both the young and the adults are primarily nocturnal. The behavior patterns of the different families that have been observed are essentially the same (Snow 1972a).

Ferrets are primarily nocturnal and spend most of their life underground. Ferrets may at one time have been somewhat more abundant than earlier reports indicated (Linder et al. 1972; Henderson et al. 1974; Black-Footed Ferret Recovery Team 1978; and Hillman and Clark 1979). For example, at least 44 ferrets were mentioned in U.S. Bureau of Biological Survey reports filed at Pierre, South Dakota, during the seven-year period from 1923 to 1929. Linder et al. (1972) indicated that ferrets must therefore have been, if not abundant, at least "not uncommon."

The presence or absence of the black-footed ferret in any area is very difficult to determine. Even surveys and searches may be inconclusive, and all that may be stated is that a ferret or ferret sign was or was not found on the dates searched (henderson 1980). Many of the recent observations are questionable because some were made by individuals with no field training, and photographs or specimens have not generally been available.

Any prairie dog colony could provide suitable havitat for the black-footed ferret but several towns, including some large ones, in relatively close proximity and with a stable prairie dog population appear to be necessary for the maintenance of a ferret population (Black-Footed Ferret Recovery Team 1978; Colorado Division of Wildlife 1978; Queal et al. 1978).

In Wyoming, ferrets have been reported from all counties affected by components of the proposed project. Though, due to the high likelihood of misidentification, all reports not supported by physical evidence (skin, skull, photo, etc.) are suspect. Clark (1977 and 1978) has compiled the following reports:

County	Ferret Reports 1851-1969	Ferret Reports 1970-1975	Estimated Prairie Dog Acreage in County
Campbell	3	1	30,000 acres (Black-Tailed Prairie Dog)
Converse	2	2	8,000 acres (Black-Tailed Prairie Dog)
Laramie	4	-	1,500 acres (Black-Tailed Prairie Dog)
Platte	4	-	- - -

The lack of recent verifiable ferret reports even with extensive ferret surveys conducted by the Denver Wildlife Research Center under contract to the BLM, supports the conclusion that ferret populations have been considerably reduced. Several factors have probably contributed to this reduction. Natural predators, parasites, diseases, human-related deaths (e.g., automobiles, domestic pets), shooting, land use changes, and prairie dog eradication programs have all been mentioned as possible contributing factors (Hillman 1968; Linder et al. 1972; Snow 1972a; Henderson et al. 1974; Black-Footed Ferret Recovery Team 1978; Clark 1978; and Hillman and Clark 1979). Control and eradication programs conducted by government agencies have certainly reduced prairie dog populations within much of their former range. For example, Clark (1978) guessed that in Wyoming prairie dog populations have been reduced by at least 75 percent. The various prairie dog control programs have undoubtedly had an effect on black-footed ferrets. Poinsoning prairie dogs reduces the available ferret food supply; certain chemical compounds and poison gases could affect ferrets as well as prairie dogs.

Since all prairie dog towns in Wyoming are considered potential ferret habitat, any WyCoalGas project component which causes surface disturbance in prairie dog towns "may affect" the ferret. The U.S. Fish and Wildlife Service has derived some recommended survey methodologies for linear and area type projects which apply to potential habitat. The employment of these surveys will negate the possibility of direct and indirect ferret mortality during construction activities. The "may affect" determination will stand until such time as approved FWS surveys clear the "May effect" areas.

The BLM will stipulate that WyCoalGas will conduct ferret surveys according to the above mentioned methodologies on all components of the project which disrupt prairie dog towns. Disruptions will occur only during construction and project abandonment (if pipeline segments are removed). Project maintenance and operation will have no effect on the ferret.

Peregrine Falcon

The peregrine falcon (F.P. anatum) breeds across the United States from the taiga portions of Alaska south to Baja California (except the coast of southern Alaska and British Columbia), central Arizona, S.W. Texas, Mexico, Colorado and Quebec. It winters chiefly in its breeding range, with the more northern birds moving somewhat south. The peregrine nests in the eastern U.S. only as the result of recent reintroduction efforts.

In 1969, Nelson indicated that 80-90 percent of the nesting peregrines in Utah, Idaho, Oregon, Washington, western Wyoming and western Montana have deserted their former nesting sites. Enderson (1969), in a 1964-65 survey, estimated approximately 25 breeding pairs of peregrines in Colorado and Wyoming and 25 pairs in Montana.

State wide peregrine searches were initiated by the Wyoming Game and Fish Department and the BLM. No active eyries were found in association with BLM lands. The only recent peregrine activity in Wyoming occurs in the southwestern corner. Thus components of this project will not effect breeding peregrines.

Migratory behavior is largely restricted to tundrius falcons, although anatum in the more northern latitudes will move southward if the food supply is not adequate for the winter. Any migrating that anatum does apparently occurs in the interior of the United States but is not extensive.

Migrating peregrines are regularly reported throughout Wyoming. However, migrating or wintering peregrines probably do not restrict their activities to any one area for any length of time. So no phase of this project is expected to impact migrating or wintering peregrines.

Bald Eagle (Haliaeetus leucocephalus)

The bald eagle (Haliaeetus leucocephalus) is classified as endangered in all the conterminous states except Washington, Oregon, Maine, Wisconsin, and Minnesota, and is listed as threatened in those five states, as published in the Federal Register (32 FR 4001, March 11, 1967; and 43 FR 6233, February 14, 1978). Additionally, the bald eagle has been afforded protection since the passage of the Bald Eagle Act in 1940 (Snow 1973). The bald eagle formerly bred throughout much of the United States; now it breeds primarily in the northern states and in Florida. A small Rocky Mountain breeding population is centered in northwest Wyoming, southeast Idaho, and southwest Montana, with a few breeding pairs scattered throughout adjoining states.

The former and present distribution of the bald eagle are essentially the same, but numbers in the continental U.S. are reduced from further abundance (Snow 1973). In some areas of the country, pesticide residues in eagles have apparently played a significant roll in their decline. Studies have shown that high residue levels, particularly of dieldrin, have lowered reproductive success by rendering the egg shells thin and easily broken. In other locations, including large parts of Florida, the most significant factors have probably been loss of feeding and nesting sites, and human disturbance during the nesting period. Additional factors responsible for the decline include illegal shooting and the loss of nest trees (Fish and Wildlife Service 1980a).

The bald eagle is primarily a fish-eater, but it also consumes carrion and will catch crippled waterfowl. Nests are usually built in tall trees and are renovated yearly.

Most bald eagle nesting areas have several common features which include: (1) the proximity of water (usually within a half mile) and a clear flight path to a close point on the water; (2) the largest living tree in a span; and (3) an open view of the surrounding area. The proximity of good perching trees may also be a factor in site selection.

Statewide bale eagle nesting inventories conducted by the BLM in 1979 and 1980 failed to locate any active nests within the vicinity of any of the project components in Wyoming. Thus no impacts caused by the project will effect breeding bald eagles in Wyoming.

Bald eagles breeding in the northern portion of the continental U.S. and Canada commonly migrate to the lower 48 states for the winter. Approximately 600 bald eagles winter in Wyoming. Wintering eagles have been sighted in all Wyoming counties, however, only 16-18 winter roost/concentration sites have been located.

During the winter eagles disperse over dry upland areas to feed on winter killed big game and domestic livestock. They also concentrate along open water portions of major streams to forage on fish and waterfowl. The presence of large trees in riparian zones is a most important habitat component.

The proposed project could effect wintering bald eagles in several ways:

1. Any activity which results in the removal of potential roost trees along major water courses may effect wintering eatles. Pipelines, railroad and access construction may cause the destruction of such riparian vegetation along the Platte and Laramie rivers. Stipulations

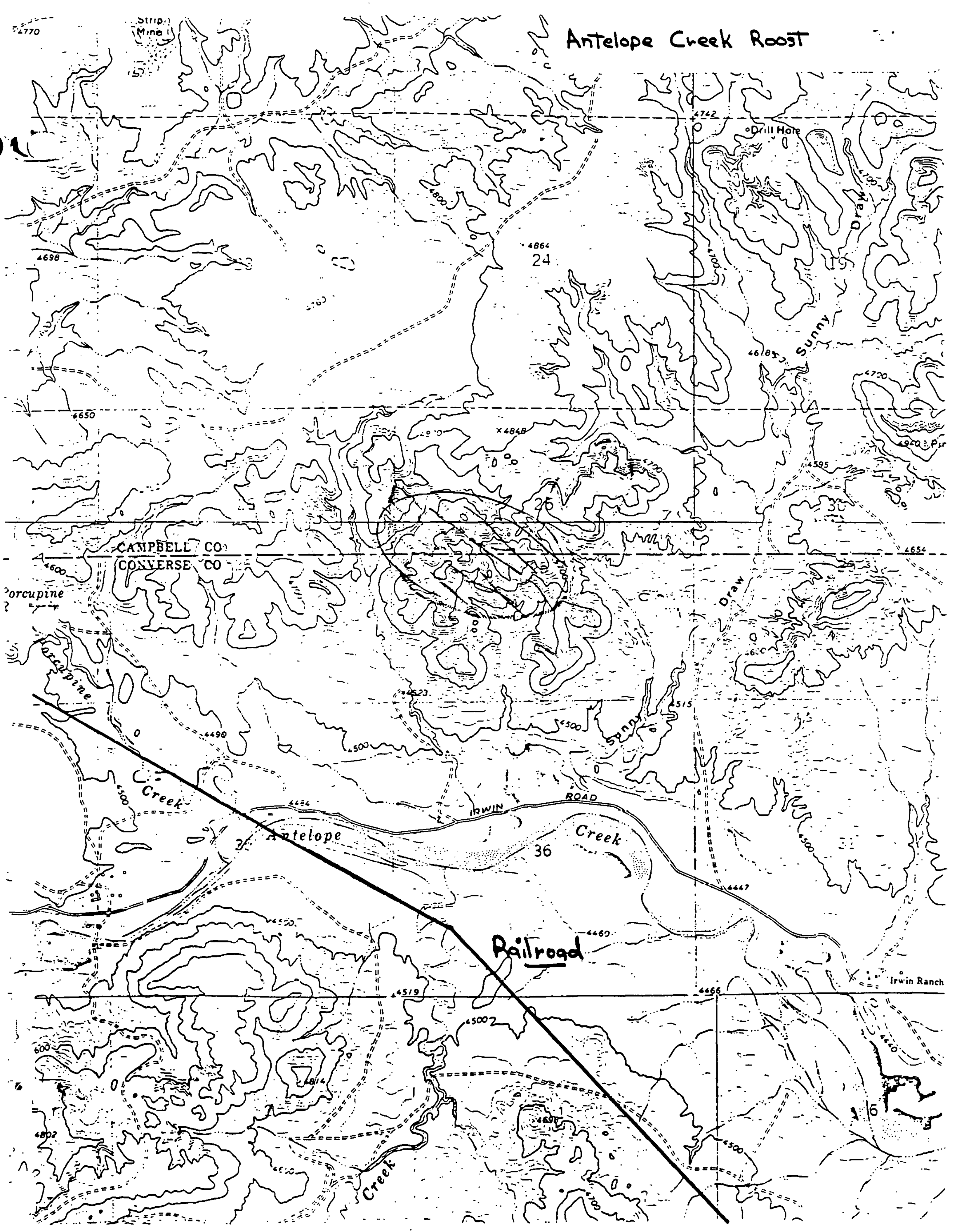
which limit the removal of mature trees and which obligate revegetation of disturbed areas will minimize impacts.

2. The electric railroad could pose a potential obstruction hazard to eagles as well as other raptors. Stipulations which eliminate the possibility of electrocution will eliminate conflicts.

3. The proposed railroad route passes within one mile of the Antelope Creek winter roost located on the Campbell/Converse County line (T. 41 N., R. 70 W., Sec. 25). Construction during the winter may effect roosting eagles. A stipulation which prohibits construction during the period November 1 - March 30 will eliminate construction conflicts.

   The operation and maintenance of the railroad may also effect bald eagle activities in the vicinity of the roost. However, as long as the railroad is kept one mile from the roosting area, any effects on eagle behavior will be minimal and insignificant.

4. Reduced water flows in the Platte River may encourage the further invasion of woody vegetation adjacent to the river channel. Additional vegetation will probably improve the habitat for bald eagles by providing additional perching sites and foraging opportunities.



Antelope Creek Roost
Strip Mine
4770
4742
Drill Hole
4698
4864
24
Sunny Draw
4650
4848
4595
25
30
CAMPBELL CO
CONVERSE CO
4600
4654
Porcupine
Porcupine Creek
4523
4515
4490
4500
IRWIN ROAD
Antelope Creek
36
4447
4460
Railroad
Irwin Ranch
4519
4466
4814
4698
4802
Creek

Whooping Crane (<u>Grus americana</u>)

The whooping crane was probably never abundant in North America, probably numbering from 1,300 to 1,500 around the middle of the century (Grayrocks Biological Opinion). The original breeding range extended northward to central Alberta and Saskatchewan, southward to Iowa and Nebraska, east to Minnesota, and west to Montana and Alberta (Bent 1964). A small non-migratory population occurred in southwestern Louisiana.

The whooping crane is a migratory species, adhering to traditional migratory routes through Nebraska and the Dakotas, and to ancestral breeding and wintering areas. Extensive agricultural development in the Great Plains, which included such practices as wetland drainage, burning, plowing, and their associated human activity, probably ~~lead~~ led to the cranes' decline. Shooting was also the cause of significant mortality. A hurricane in 1940 reduced the Louisiana population to a point beyond recovery. By 1890 whooping cranes had disappeared from the heart of their breeding range, and reached an all time low of 21 individuals in 1941. In the early 1950's a small breeding area was discovered in Wood Buffalo National Park in northern Alberta.

Recovery efforts initiated by the FWS, state wildlife agencies, and other interested parties, have included the acquisition or protection of critical breeding, wintering, and migratory habitat, the initiation of studies to learn more about the cranes life history and habitat requirements, and the establishment of a new population at Grays Lake. These efforts have succeeded in increasing the whooping crane population to a total of 119 in 1980.

Whooping cranes use the Platte River of Nebraska as a migratory stopover between Wood Buffalo and Texas. The first reports of the whooping crane along the Platte coincide with the settlement of the west and the use of the westward trails. Swenk (1933), reported 93 sightings involving 998 whooping cranes between 1912 and 1933. Allen (1952) re-evaluated all historic records and reported 17 confirmed sightings on or near the river between 1890 and 1919. From 1929 to 1949 there were 65 crane sightings, and from 1950 to 1980 there were only five sightings. This apparent decrease in the use of the Platte River can be related to decreased water flows, reduced channel width, encroachment of woody vegetation, and increased human activity in the vicinity of the river (Krapu 1981).

The large numbers of sandhill cranes which use the Platte River as a migration stopover, spending several weeks along the river foraging on waste agricultural crops, and building up large fat reserves to provide sufficient energy for continued migration and breeding.

In May 1978 (43 FR 20938, May 15, 1978), the Fish and Wildlife Service designated the area of the Platte River from Lexington to Denman, Nebraska (about 53 river miles in the "Big Bend" area), as critical habitat for the whooping crane. The critical habitat is approximately 320 miles east of the proposed intake.

The Big Bend area is an extremely important natural resource, especially with respect to wildlife (Aronson and Ellis 1979). Along with the whooping crane, many other wildlife species, including bald eagles, ducks, geese, and sandhill cranes, utilize the Central Platte River valley.

The whooping cranes use the Big Bend area in the spring months (late February to early May) as a staging area, and in the fall months as a stopover point, during their normal migratory flights (Aronson and Ellis 1979). Wet meadows adjacent to the river are important feeding areas for the cranes (Frith 1974). Whooping cranes, however, probably do not use the Platte River as a staging area where they prepare psychologically for the next phase of the migration. Whoopers migrate as individuals and small groups. They stay along the river no more than 5-7 days with shorter stays being more common. Thus little time is available to build up fat reserves. However, this does not diminish the rivers value as a "nontraditional" stopover area (Krapu 1981).

Several important habitat features contribute to the suitability of the river for whooping cranes.

A. Roosting Sites

Whooping cranes roost on sand bars and in shallow water areas in wide river channels with the following characteristics:

1. Wide channel, with 9 of 10 sites being between 155 and 365 m (170 and 400 yards);

2. Slow flow, i.e., approximately 0.4-1.8 ms^{-1} (1-4 mph) although water in the main channel may be flowing faster;

3. Shallow water except in the main channel (all sites evaluated were <30 cm (12 inches) deep and six of nine sites were 5-15 cm (2-6 inches) deep;

4. Unvegetated;

5. Fine substrate, usually sand;

6. Good horizontal visibility unobstructed from river bank to river bank and at least a few hundred yards upstream and downstream (or to a bend in the river) at all sites;

7. Good overhead visibility without tall trees, tall and dense shrubbage or high banks near the roost;

8. Close proximity (usually <1.6 km or 1 mile) to suitable feeding sites;

9. Isolation (0.4 km or 0.25 miles) from roads, houses, and railroad tracks; and

10. The presence of sandbars with the characteristics: gradual steps into the water (often less than $1-2^{\circ}$), low topographic relief (often less than 0.3 m (1 foot)), no banks over several cm high and had little or no vegetation.

Roosting sites with these characteristics are probably selected because they are more secure from the approach of terrestrial and avian predators.

B. Foraging Sites

Whooping cranes feed in both upland and wetland sites. Upland feeding sites are characterized by excellent horizontal visibility (usually an unobstructed view for at least 91 m (100 yards) in all directions and often an unobstructed view for several hundred meters in all directions), a lack of tall trees and dense shrubs immediately around the site, short vegetation on the site (often less than 30 cm high), little topographic relief (usually less than 9-12 m (30-40 feet) of relief, often less than 1.5-3.0 m (5-10 ft)), and gradual slopes (usually less than 7-9° of slope, often less than 4-5°). Feeding sites in wetland habitats were usually characterized by water less than 0.4-0.6 m (1.5-2.0 feet) deep, excellent horizontal and overhead visibility, and either very short or very sparse emergent vegetation.

Quantative information on sandhill crane feeding behavior show that they obtain the bulk of their required energy from waste agricultural grain in upland sites and pick up essential minerals and nutrients from animal foods in wetland sites. Though little information is available on whooping crane diet, it is probably quite similar to that of the sandhills. Thus, the availability of both upland and wetland feeding sites are essential to the continued suitability of the Platte River.

Disease Considerations

Sandhill cranes and probably whooping cranes are susceptible to avian cholera. Cholera outbreaks in waterfowl occur periodically in areas near the Platte River. Further deterioration of whooping crane habitat along the Platte will result in increased displacement of whooping cranes into areas where they are more likely to contract the disease.

Vegetation

The grasslands adjacent to the Platte River have probably existed for at least the last 900 years. High flood flows and ice scouring reportedly prevented the invasion of woody trees and shrubs in the wide stream channel. Kellogg (1905) states that timber along the Platte shoreline was either absent or consisted of only scattered cottonwood and willows in 1905.

Extensive thickets of woody vegetation now line much of the shoreline and have colonized many of the islands within the Platte River channel. Most trees were established between 1930 and 1950. Reduced water flows caused by dams and diversions have enhanced the continued invasion of woody vegetation.

A reduction in Platte River flows along with a reduction in ground water levels will have the most significant potential impacts on whooping cranes. Reduced river flows may enhance the invasion of woody vegetation in the stream channel making it less desirable to whooping cranes. Reduced ground water levels could further reduce wet meadow foraging habitat which is necessary if the whooping crane is to meet nutritional requirements.

There are many unknowns related to the hydrologic regimen of the river, vegetation/water relationships, and whooping crane biology, which inhibit direct cause and effect analysis. However, the available evidence supports the inescapable conclusion that any reduction of river flows result in a corresponding degradation of whooping crane habitat. Due to the already degraded quality of the cranes critical habitat, further water withdrawals, no matter how small, are critical and, thus are of significant concern.

Several mitigation or compensation strategies are possible. Some of these are discussed on the following pages.

GASIFICATION PLANT EFFECTS

Aerial surveys conducted in April 1981 (Woodward-Clyde Consultants 1981) revealed that potential ferret habitat (prairie dog towns) does not exist at the proposed plant site. Therefore, this absence of suitable black-footed ferret habitat precludes any effect upon this species as caused by the construction, operation, maintenance or abandonment of the plant site.

The peregrine falcon occurs in eastern Wyoming only as an occasional migrant. Since no nesting sites occur in the vicinity of the proposed plant site and peregrines' presence in the area is infrequent, construction of the proposed plant is not anticipated to affect peregrine falcons. No known bald eagle nests or roosting sites occur in the vicinity of the proposed plant site (Wyoming Game and Fish Department 1980a) although wintering bald eagles have been sited in the area (Oakleaf et al. 1979). Construction could alter the daily activities of a few bald eagles; however, no significant impacts are anticipated.

No staging, nesting, or roosting habitat for the whooping crane exist in the vicinity, therefore, similar to the previous three species no effect from plant construction operation, maintenance or abandonment on the whooping crane are envisioned.

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RAILROAD EFFECTS

Three federally classified endangered species could occur in the general vicinity of the railroad corridor: black-footed ferret, peregrine falcon, and bald eagle. The peregrine falcon occurs in this portion of Wyoming only as an occasional migrant. Any active prairie dog town provides potential habitat for the black-footed ferret. Although no bald eagle nests are known in the vicinity of the proposed railroad corridor, the route would pass approximately 1 mile to the west of a bald eagle winter roost (Figure 2). Individual eagles could be encountered along the entire railroad route, especially at the proposed Antelope Creek crossing. The proposed railroad corridor would traverse or run adjacent to (within .0 miles of) 11 prairie dog towns. These towns are listed in Table 2-24 and mapped on Figure ___.

A total of 2,016.6 acres of prairie dog towns, all within the Thunder Basin National Grasslands, lie within 1 mile of the railroad right-of-way. Only 4 of the towns would actually be traversed. In theory, all of these towns provide potential black-footed ferret habitat. However, in actuality, the probability of a ferret occuring in any of these towns is extremely remote. Until ground surveys can be conducted to verify the presence or absence of the black-footed ferret in the area of influence, a tentative "may affect" conclusion must be made.

There are no known bald eagle nests in the vicinity of the proposed railroad corridor. However, a major bald eagle/golden eagle winter roost occurs approximately 1 mile east of the proposed corridor. Wintering bald eagles could be encountered along most of the railroad corridor, especially at the proposed Antelope Creek crossing. Construction of the proposed rail line could affect the bald eagle in two ways: removal of perch trees at river and stream crossings, and displacement of individual bald eagles from the construction area. The removal of perch trees represents a localized impact which would be insignificant if other suitable perch trees exist in the affected area. If construction removed the only perch tree in the vicinity of the proposed crossing, the impact would be locally significant. However, such an isolated case is highly unlikely. Displacement of individual eagles would be significant only if other available habitat is lacking. Displaced individuals would most likely settle on other stream or river reaches until construction was completed.

Stipulations requiring the construction of the railroad in the vicinity of the Antelope Creek roost during non-winter periods, combined with a stipulation limiting the cutting of potential roost trees during construction would minimize any potential impacts with respect to the bald eagle.

No effects to black-footed ferret, bald eagles, or peregrine falcon would be expected as a result of railroad operation, maintenance or abandonment, assuming electrocution possibilities are eliminated. A certain degree of acclimation to railroad operation by wintering eagles in the Antelope Creek roost area may be required, but effects are expected to be insignificant.

Whooping cranes would not be affected in any way by railroad construction, operation, maintenance or abandonment.

ROCHELLE COAL MINE EFFECTS

Econ Inc. (1980a) and Combarak (1980) reported that prairie dog colonies occur near the mine site, although none were known to occur within the lease boundaries. However, May 1981 aerial surveys conducted by Woodward-Clyde Consultants, of the mine site located a dog town in the middle of the proposed mine site (see Table ___). Consequently, potential black-footed ferret habitat exists on the mine site. Surveys of prairie dog colonies revealed no positive sign that ferrets occur in the area (Econ Inc. 1980a).

Although no bald eagle nests occur near the site (Wyoming Game and Fish Department 1980a), a relatively large communal roost occurs roughly 2.5 miles to the south. Williams and Matteson (1973) stated that the peregrine falcon is not common as a summer resident in Wyoming, being more frequently encountered as a migrant.

No whooping crane nesting, staging, or roosting habitat occurs within the vicinity of the mine and, therefore, no effects on this species are expected.

In conclusion, a "may effect" condition exists pending survey for black-footed ferrets on the mine site for the construction and operational phases of mine development. If no ferret sign is identified in pre-construction FWS approved surveys a "no effect" situation for the mine will be concluded.

No effects would be incurred upon bald eagle, peregrine falcon and whooping crane as a result of mine construction, operation, maintenance or abandonment due to the fact that no habitat for these species has been identified at the mine site.

PRODUCT PIPELINE EFFECTS

Three federally protected wildlife species could occur in the vicinity of the proposed product pipeline. A May 1981 aerial reconnaissance of the proposed pipeline corridor revealed two prairie dog towns to be traversed by the proposed right-of-way. One town is approximately 230 acres; the other is about 30 acres, and are located at mileposts 67 and 148 respectively (see Table ___).

These two prairie dog towns are potential habitat for the black-footed ferret. Clark (1973) reported six ferret sightings in Converse, Platte, and Laramie Counties, Wyoming, between 1851 and 1973. The most recent sighting was reported from Platte County near Shawnee in 1948. Clark also estimated that 15,340 acres of potential ferret habitat (black-tailed prairie dog towns) existed in Converse, Platte, and Laramie Counties in 1971. Even though the potential exists for the occurrence of a black-footed ferret in any prairie dog town, the probability of such an occurrence is subject to FWS approved surveys. However, until ground surveys are conducted to determine the absence or presence of black-footed ferrets in these towns, a "may affect" conclusion must be made.

There are no known bald eagle nests on winter roosts in counties which would be traversed by the proposed pipeline corridor. However, wintering bald eagles could be encountered along most of the pipeline corridor, in particular at the river crossing of the North Platte.

Construction could possibly affect the bald eagle in two ways: removal of perch trees at river crossings, and displacement of individual bald eagles from the construction area.

The removal of perch trees would represent a localized impact only which, if other suitable perch trees exist in the affected area, would be insignificant. If construction removed the only perch tree in the vicinity of the proposed crossing, the impact would be locally significant. However, such an isolated case is highly unlikely. Displacement of individual eagles would be significant only if other available bitat is lacking. Displaced individuals would most likely settle on another river reach until construction was completed.

Stipulations limiting the removal of potential perch trees at river crossings would minimize the impact to bald eagles.

Peregrine falcon nesting habitat is lacking in the portions of Converse, Platte, and Laramie Counties, Wyoming, and Weld County, Colorado, which would be traversed by the product pipeline (Wyoming Game and Fish Department 1980a). Significant impacts are not anticipated.

No significant impacts to threatened, endangered, or status review species are anticipated from operation, maintenance, and abandonment of the proposed product pipeline.

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ENDANGERED, THREATENED, RARE, AND STATUS REVIEW SPECIES THAT COULD OCCUR IN THE VICINITY OF THE PROPOSED PRODUCT PIPELINE

Species	Designation
Mammals	
Black-footed ferret[a] (*Mustela nigripes*)	
Birds	
Bald eagle[a] (*Haliaeetus leucocephalus*)	Endangered[b,c]
Peregrine falcon[a] (*Falco peregrinus*)	Endangered[b,c]

[a]These species are protected under provisions of the Endangered Species Act of 1973. Wyoming does not have state-level Endangered species legislation. Colorado's state-level endangered species legislation does not protect habitat.

[b]*Federal Register* 45(99): 33768-33781.

[c]Listed as endangered in Colorado under provisions of the State Nongame and Endangered Species Act of 1973 (Colorado Division of Wildlife 1978).

[d]Although at the present time these plants receive no protection, they are under review by the U.S. Fish and Wildlife Service for possible inclusion on the federal list (*Federal Register* 45(242): 82481-82569).

Canada to wintering areas on the Texas Gulf Coast (Aronson and Ellis 1979). Wet meadows adjacent to the river are important feeding areas for the cranes (Frith 1974). According to Keech (1964), these wet meadows are linked to the Platte River hydrological system. Consequently, changes in river level are reflected in the ground water levels in these wet meadows. Aronson and Ellis (1979) concluded that "there is no doubt that there has been a degradation of usable crane habitat in some locations, and the evidence strongly suggests that the decline in flow has reduced the natural scouring which once kept vegetative encroachment from becoming well established within the main channel."

Annual scouring of the main channel is an important factor for maintenance of crane habitat. In areas where the river is wide, flows have not kept vegetation scoured (Aronson and Ellis 1979); whereas in narrower channels, even recently reduced flows have kept islands and sand bars free of encroachment.

With respect to the water supply facility effect upon whooping crane it is our opinion that the operation of the North Platte intake diversion and use of LaPrele irrigation water for coal gasification purposes, constitutes a "may affect" situation.

While the effect on the whooping crane critical habitat area will be only occasional and difficult to accurately measure nonetheless water losses will occur. The ultimate effect on the whooping crane is compounded and dependent upon the uncertainties associated with vegetative encroachment, channel width, and depth decreases, downstream water uses, and the relatively unknown factors of the whooping crane biology itself.

The following hydrologic analysis was prepared by Woodward-Clyde Consultants under contract to the BLM and constitutes the basis for the "may effect" determination, the magnitude of expected impacts and the conclusions drawn with respect to mitigation strategies following.

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~~July 17, 1981~~

Impacts of WyCoal Gas ~~Decision~~ Diversions on ~~in~~ Critical Habitat Reach of Platte River between Lexington and Grand Island, Nebraska

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I. Introduction

The Platte River, prior to settlement, was a very wide and shallow river with low herbaceous vegetation on the sandbars and banks of the river. Trees were wholly absent or consisted only of scattered cottonwoods and willows (Kellogg 1905). During the past century, the river channel has narrowed significantly, and dense forest growth has occurred on the islands and the banks. At many places, the river channel today is only one-tenth to one fifth as wide as it was in 1965 (Table 1). The decrease in channel width has been caused by many factors, but the most important factor has been the decrease in flow caused by development in the Platte River system. Other important factors have been the planting of trees by the settlers which has provided a source of seeds, climatic change, bridge and road construction and agricultural activity (Endangered Species Committee 1979).

The decreases in channel width have been most dramatic in the reach of the Platte River between North Platte and Lexington which is the reach where flow reductions have also been the most dramatic (Figure 1). The Tri-County project diverts about 85% of the annual flow of the Platte River below North Platte for irrigation and power production, and about 50% of the water diverted returns to the river as hydro plant returns near Lexington. ~~The present channel from North Platte to~~

TABLE ~~2-4~~ 1

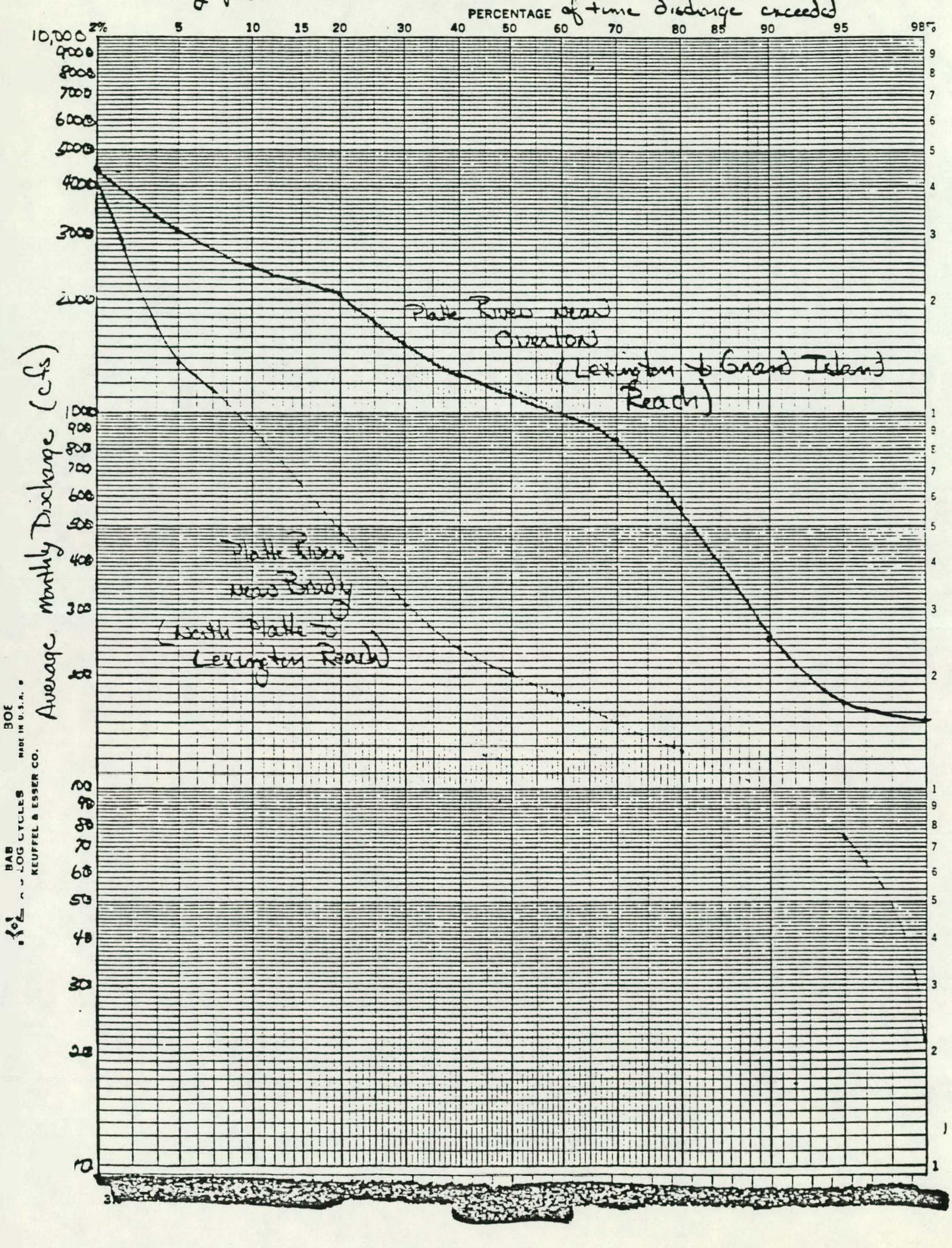
CHANNEL WIDTH IN THE NORTH PLATTE
AND PLATTE RIVERS, NEBRASKA

Location	River Distance Below State Line (miles)	Total Channel Width (feet)[a]		
		1865	1938	1965
Minatare	33	3,200		180
Bridgeport	56	3,740		400
Levellen	114	2,900		490
North Platte	188	2,590	1,705	295
Overton	260	5,280	4,985	1,100
Grand Island	329		2,395	2,490

Source: Williams 1978.

[a]Channel widths determined from following sources:
1865 -- U.S. Government Plats of Nebraska
1938 -- U.S.D.A. 1938 aerial photographs
1965 — U.S. Geological Survey topographic maps

Figure 2 Calculated Flow Duration Curves for the Platte River near Brady and Platte River near Overton based upon monthly flows calculated using present river demands and 1931-1977 climatic conditions.



~~returns near Lexington.~~ The present channel from North Platte to Lexington averages between 200 and 600 feet wide, which represent about a 90% reduction from historical widths. Between Lexington and Grand Island, the channel is now about 1500 to 3000 feet wide, about two-thirds as wide as at the turn of the century (FWS 1978). The Fish and Wildlife Service (1970) reported that vegetation growth has been particularly heavy in the reach above Lexington, and that encroachment has been significant in some reaches between Overton and Grand Island, and minor in others.

Sandhill cranes, and presumably Whooping cranes, formerly utilized most of the Platte River in south-central Nebraska. Today, cranes distribution is largely restricted to a 70 mile reach between Overton and Grand Island, with high densities of cranes found only in the Kearny to Grand Island reach and in the Elm Creek to Odessa reach (Krapur 1981). Crane use is highly coorelated with channel widths of greater than 500 feet (Krapu 1981).

The purpose of this section is to analyse the impacts the diversion by WyCoal Gas may have on channel widths in the critical habitat reach between Overton and Grand Island, and determine if the diversions will accelerate the forest encroachment that is now occuring in the Overton to Grand Island reach.

II. Impact on Water Flows in the Overton to Grand Island reach of the North Platte River.

(a) Method

An operations model of the North Platte River in Wyoming developed for the Bureau of Reclamation by the Wyoming Water Resources Research Institute (Wei 1977, Akerbergs 1980, 1981) was used to estimate the impacts of the proposed WyCoalGas diversions at the Tri-State dam below the Wyoming-Nebraska state line (refer to Chapter III of the PDEIS). Then an operations study developed by the Bureau of Reclamation for the Lewellan/Julesburg to Duncan section of the Platte system (study CP-1, Otradovsky 1981) was used to calculate monthly flow reductions at Overton and Grand Island. Flow changes at Tri-State dam and Lewellan were assumed to be identical.

Water charge assumptions for the above operation modelling effort were assumed to be as follows:

a.	1974 Flood Flow Appropriation average		3,100 acft/yr
b.	LaPrele diversion average		1,600 acft/yr
c.	Municipal growth (Douglas, Glenrock and Casper)	Average	500 acft/yr
	Total water consumption as affecting the whooping crane critical habitat area		5,100 acft/yr

The operations studies were run initially with present operating conditions and present river demands to calculate base river flows, irrigation deliveries, and power generation for a 37 year period with climatic conditions identical to those in the period 1930-1980. A second set of runs was then made in which WyCoalGas diversions were added to the system. The river flows, irrigation deliveries, and power generation calculated in this run were then subtracted from the values obtained in the initial run to calculate impacts caused by WyCoalGas. The SPSS statistical package was then used to calculate the percentage reductions in base flows and rates, and the probabilities of reductions.

WATER SUPPLY EFFECTS

Components of the WyCoalGas water supply system have been broken down into the following categories:

A. South Well Field.

B. North Well Field.

C. North Platte Diversion and Reentry Channel.

D. LaPrele Reservoir.

E. Combs Reservoir.

F. Water Pipelines.

Aerial surveys conducted in April 1981 by Woodward-Clyde Consultants indicate (see Table ___) that the only water supply component containing potential black-footed ferret habitat is the South Well Field. Prairie dog colonies (2.5 acres) both located in the northwest corner of the South Well Field would be considered "may affect" situations for black-footed ferret if well field facilities exist in the proximity of prairie dog colonies and pending clearance by approved FWS ground surveys. No effect on the black-footed ferret as a result of construction, operation, maintenance, or abandonment of the remaining facilities is expected.

No known peregrine falcon or bald eagle nesting or roosting sites exist at the locations of any of the water supply facilities. Consequently a "no effect" determination is concluded for project water facilities for these species for construction, operation, abandonment, and maintenance.

Construction of the reentry channel and the South Well Field to plant site pipeline could remove bald eagle perch trees from the North Platte River shoreline. The effect of any loss of individual perch trees may be localized. Wintering bald eagles could be displaced from the immediate vicinity by construction-related disturbances. Stipulations protecting potential bald eagle perch trees in the vicinity of the water intake structure will further minimize any effects this structure may have on individual eagles.

The potential exists for possible impacts to the whooping crane (*Grus americana*) downstream on the Platte River from operation of the North Platte intake. The whooping crane is listed as endangered by the U.S. Fish and Wildlife Service (32 FR 4001, March 11, 1967; 35 FR 8495, June 2, 1970). In May 1978 (43 FR 20938, May 15, 1978), the U.S. Fish and Wildlife Service designated the area of the Platte River from Lexington to Denman, Nebraska (about 53 river miles in the Big Bend area), as critical habitat for the whooping crane. The critical habitat is approximately 320 miles east and downstream of the proposed intake.

The Big Bend area is an extremely important natural resource, with respect to wildlife (Aronson and Ellis 1979). Along with the whooping crane, many other wildlife species, including bald eagles, ducks, geese, and sandhill cranes, utilize the central Platte River valley.

Whooping cranes use the Big Bend area in the spring months (late February to early May) as a staging area and in the fall months as a stopover point during their normal migratory flights from breeding grounds in northwestern

(b) <u>Calculated Flow Reductions</u>

The impact of the WyCoalGas diversion on river flows in the Overton to Grand Island reach was calculated to be an average flow reduction of 6.0 cfs, about a 0.4 percent flow reduction. Flows though will not be reduced every year, the probability of a flow reduction occurring in any given year is about 40 percent. Flow reductions will most probably occur in years of above average flows in the river: in year of below average river flow there is little probability that flow in the critical habitat reach will be measurably affected.

Flow reductions during the period May through August, when tree seeds are viable, were calculated to only have about a fifteen percent probability of occuring in any given year. These reductions were calculated as occuring only when flows during the period May to August were above average.

Various descriptive statistics, which describe the impact of the WyCoal Gas diversion on river flows in the critical habitat reach are listed in Tables 2 and 3. Other descriptive statistics are listed in Appendix I.

III. Impacts of Flow Reductions on Channel Widths

The channel of the Platte River was maintained prior to the settlement of the river basin by the combined effects of stream flows and their variation, ice formation and break-ups, and occasional large floods. River flows during the important tree seed shed period (mid-May to mid-June) were generally adequate to cover most of the channel sandbar area; therefore, the seeds were washed away before seedling germination could occur. Summer flows were generally very low, which reduced the likelihood that newly established seedlings would survive because of drought stress. ~~High~~ flows caused the lateral migration of sandbars and the thalweg, this channel shifting and scouring removed both mature and recently established vegetation along shorelines and islands. The development of the Platte River basin has resulted in marked reduction in peak flows (~~Figure~~ __ refer to Chapter II of DEIS), a large reduction in average flows in the period May to June, and an increase in summer river flows. As a result, the channel width of the Platte River has decreased significantly during the past century.

No empirical relations have been developed to date to explain quantitatively the processes that determine the present channel widths of the Platte River. A well accepted concept, though, is that a

TABLE 2

Calculated Changes in Hydrologic Regime of Platte River near Overton due to Wy [illegible] Diversion

Flow statistics	Baseline	Change
average flow	1400 cfs	-.4%
median monthly flow	1100 cfs	0
monthly flow exceeded 2 percent of time	4500 cfs	0
monthly flow exceeded 10% of time	2500 cfs	.4%
monthly flow exceeded 98% of the time	160 cfs	0
streampower[a] of flows that occurs 3 percent of the time or less		- 0.6 %
streampower of flows that occur 6 percent of the time or less		- 0.4%
streampower of flows that occur 10 percent of the time or less		- 0.5%
maximum monthly flow in 37 year period simulated	12100	- 0.1%
minimum monthly flow in 37 year period simulated.	110	0

note: Streampower is determined by integrating the flow duration curve over the interval indicated.

TABLE 3

Frequency of a reduction in average monthly flow near Overton as a result of Wy Cal Gr. diversion

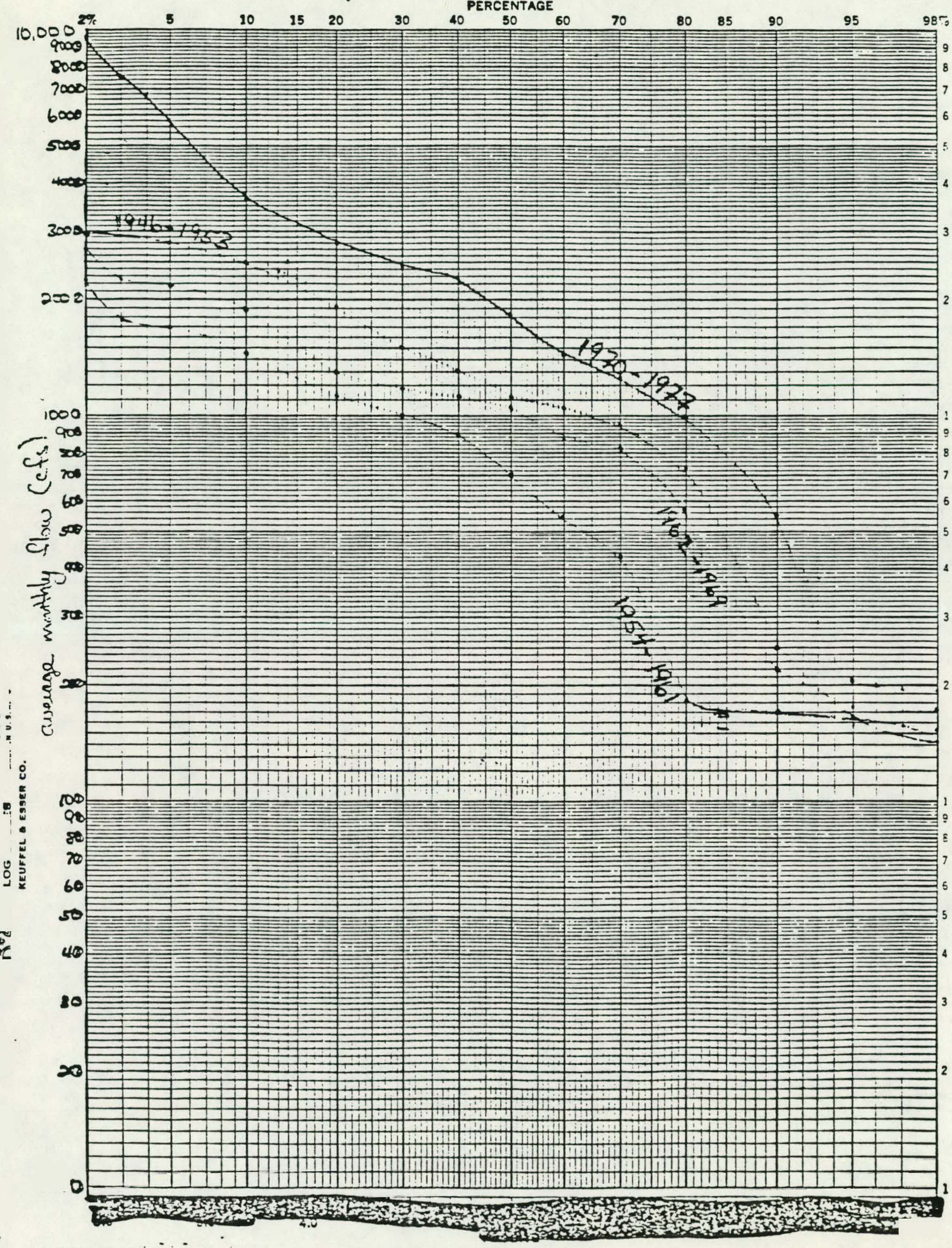
period	times flow reduced in 38 years simulation	percentage of time flow reduced
years	16	42 %
month	27	6 %
January	0	-
February	1	3 %
March	5	13 %
April	7	18 %
May	3	8 %
June	4	11 %
July	1	3 %
August	0	-
September	0	-
October	2	5 %
November	2	5 %
December	2	5 %

river channel maintains its pattern and cross section by a dominant discharge that occur resonably frequent. The U.S.G.S. (Karlinger et al. 1981) has calibrated a method to determine the discharges (effective discharge) required to maintain the existing channel widths. This method is based on equations by Parker (1978) that were developed for rivers with bed and bank material consisting of non-cohesive sands. Karlinger et al. (1981) show that for a hypothetical 500 foot channel near Overton that the effective discharge is about 3600 cfs. They suggest that the total volume of flow that occurs at discharges greater than 3600 cfs represents the streampower needed to maintain a 500 foot channel.

The WyCoal Gas diversion will reduce the volume of high flows in the critical habitat area over the life of the project between 0.4 and 0.6 percent (Table 2). The concept of an effective discharge, can be used to translate this change in flow to a theoretical change in channel width. Using the method of Karlinger et al. (1981), this change in flow translates into a width reduction in the critical habitat area of 0.4 to 0.6 percent.

This calculated width reduction should not be construed as something that could be measured. The Platte River, even though it is highly developed, is still a dynamic river system in which river flow varies markedly from year to year. Flow duration curves for the Platte River near Overton for four consecutive eight year periods in the interval 1936 to 1977 are shown in Figure 1. The fifty percentile flow varied from 776 cfs in the period 1944-1951 to 2291 cfs in the period 1969-1977, and the average flow varied from about 700 cfs to about 1900 cfs over the same periods. By contrast, the WyCoal Gas diversions are calculated to have no effect on the median flow, and to cause only a 0.4 percent reduction in long term average flows. Theoretically, channel width is also a dynamic characteristic

Figure 2 Calculated Flow Duration Curves for the Platte River near Overton for four consecutive eight year periods based upon monthly flows calculated using present river demands and 1936-1977 climatic conditions



of the river that varies with long term natural changes in stream flow. As a result any calculated changes due to WyCoalGas would be masked by changes due to climatic variability.

This theoretical reduction may have little significance for the Platte River in the critical habitat area because the method of calculation assumes beds and banks composed of cohesionless sands. The method would be valid if high flows and ice scouring were sufficient to remove vegetation that becomes established, but this is apparrently not the case in most reaches of the Platte River today (Karlinger et al. 1981, Aronson and Ellis 1979, Krapu 1981). Peak flows have been diminished to the point where they are no longer sufficient to remove established vegetation in a channel of sufficient width for crane use. As a result, the channel of the Platte River in many reaches now adjusts to changing flows regimes by adjustments in channel depth rather than channel width as is predicted by the Parker (1978) equations.

Tree seedlings will not become established if water levels are sufficient to cover the sandbars and banks during the tree seed shed period. Krapu (1981) states that a water level of 2.6 feet at Overton (about 2600 cfs) during the period mid-May through mid-August would be sufficient to prevent seedling establishment and preserve a channel of sufficient width for crane roosting in the critical habitat area. With present river demands, in only one out of twelve years will river flows during the period May through August average 2600 cfs or greater. Flows during the main tree shed period, mid-May to mid-June, will exceed 2600 cfs about once every six years. Clearly then, either 1) significant encroachment will occur in the critical habitat reach in the future without WyCoal Gas, or 2) water levels of less than 2.6 feet are sufficient to prevent seedling establishment, or 3) water levels need to exceed 2.6 feet relative to Overton for only very short periods to prevent seedling estalishment. The field evidence support the first conclusion.

The WyCoal Gas diversions were calculated to cause a reduction in flows in the critical habitat reach during the period May through August in six of the thirty-eight years simulated. Flows were calculated to be reduced in a total of eight months in those six years. In ~~a few~~ four of the months, average monthly flow near Overton exceeded 2600 cfs (stage above 2.6 feet); therefore, the critical sandbar and bank areas defined by Krapu (1981) would be submerged. The changes in flow in these months would have no effect on seedling development on the critical sandbar and bank areas. In the other four months, the impact of the WyCoal Gas diversion would be to cause lower river levels, at stages below 2.6 feet relative to Overton, than would have occurred without the project (Table 4). The reductions in stage are small, less than 0.1 feet, in three of the four months, and in the other months a stage reduction of 0.2 feet was calculated. What these stage reductions would mean in terms of increased seedling germenation and survival and channel width reduction is uncertain and cannot be

Table 4 Calculated Monthly Flow Reductions During May to August Period in the Critical Habitat Area and Corresponding Changes in River Stage and Channel Width.

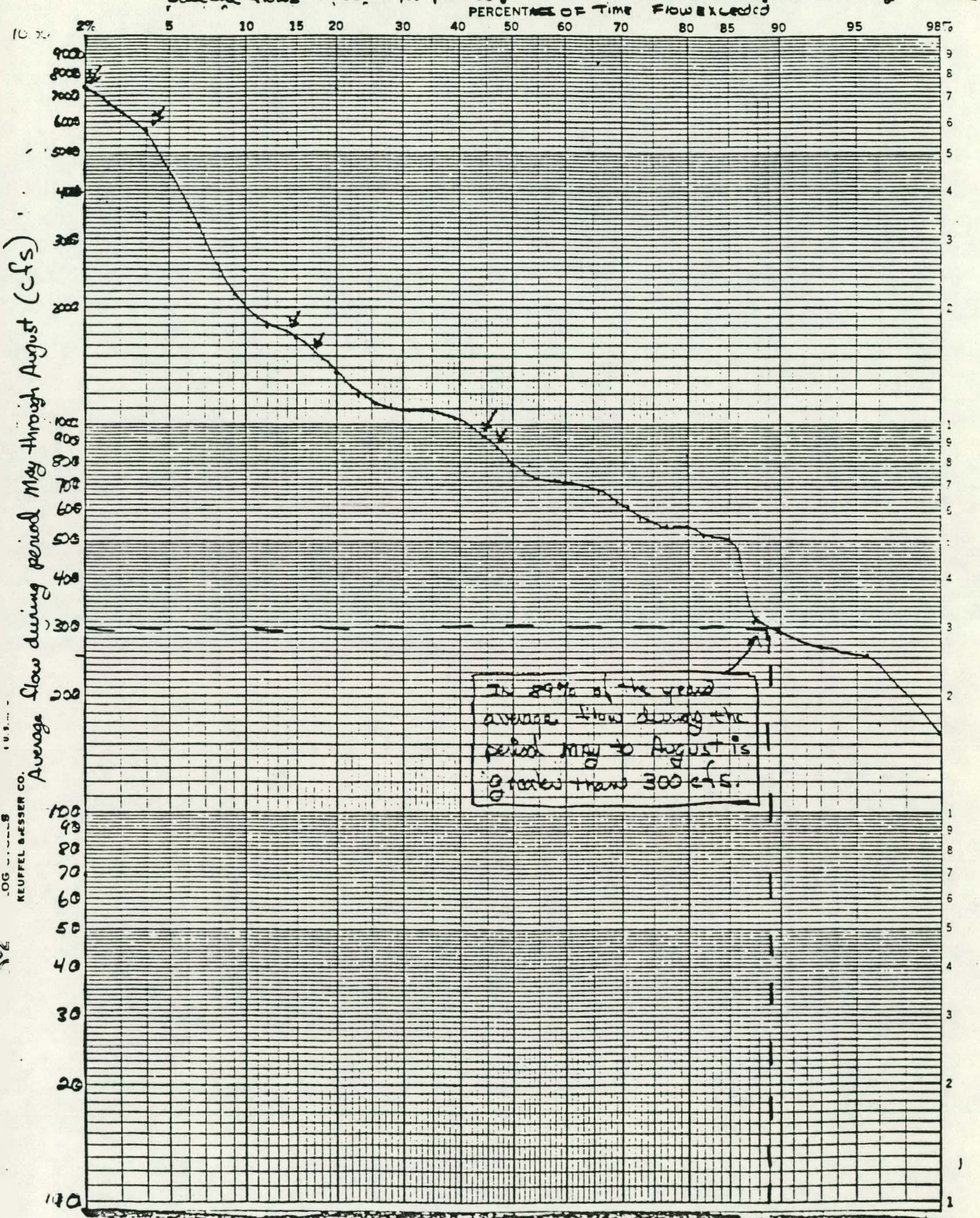
Base flow (cfs)	Flow with WyCoal Gas (cfs)	Change in Stage at Overton (ft)	Base channel width at Odessa (ft)	Change in width caused by WyCoal Gas (ft)	Mon
501	242	-0.20	262	-68	Jul
1080	905	-0.09	359	-25	Jun
1507	1471	-0.02	412	-4	May
2372	2337	-0.01	?	-4	May
3765	3526		601	-16	Jun
9642	9564		886	-3	Jun
9902	9897		896	-3	May
12126	12113		975	-5	Jun

quantified. Certainly, though, more sandbar and bank area would be exposed; and therefore, the potential exists for more seedlings to be established, even though the additional area exposed and duration of exposure are small.

The flow reductions all occur in months in which flows are near or above normal with respect to average flows for the month calculated in the 38 year simulation, and in years in which flows during the period May through August are greater than average flows for this period (Figure 3). Tree seedlings are most likely to become established in years of low flow during the period May through August, rather than in years of average to above average flows. Therefore, because the impact of WyCoal Gas's diversions have a quantifiable impact of affecting flows in the period May through August only when flows during this period are above average, the WyCoal Gas diversions should be insignificant in causing any further decreases in channel widths of the Platte River in the critical habitat area.

The probability of a flow reduction occuring during the period May through August when river flows are less than 2600 cfs cannot be accurately determined from the operation studies because the number of months in which effects were calculated is so small: eight months total during period May through August in thirty eight years. Undoubtedly though, because WyCoal Gas will only divert large quantities of water from the river during periods of high flows, and because of the operation schedule for Lake McCanough, the conclusion that flow reductions in the critical habitat reach will occur at relatively high flows during the May through August period is valid. Some flow reductions, though, will occur during months in the period May through August in which flows are less than 2600 cfs, and this will allow the potential for more seedlings to be established. The operation studies calculated an occurance interval of only four months in thirty-eight years for these reductions (3 percent of the months),

Figure 3 Flow-duration curve for average flow during period May-August in Platte River near Overton, Nebraska. Curve based on calculated baseline flows for a 37 year period. The arrows denote average flows during May through August in years in which those were calculated to be reduced due to Wy[oming] diversions.



but also only calculated reductions in years in which flows during the period May through August are above average. Calculated stage changes are 0.2 feet or less. Because the flow reductions-will-be-small, and because reductions occur in years of above average flows, the impact of the WyCoalGas project on Platte River channel widths will be ~~very~~ minor ~~minor to non-existent.~~

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DRAFT

CALCULATED CHANGES IN HYDROLOGIC REGIME OF PLATTE RIVER
NEAR OVERTON DUE TO WYCOALGAS DIVERSIONS

Flow Statistics	Baseline	Change
Average flow	1,450 cfs	-0.4%
Median monthly flow	1,100 cfs	0
Monthly flow exceeded 2% of time	4,500 cfs	0
Montly flow exceeded 10% of time	2,500 cfs	-0.4%
Monthly flow exceeded 98% of time	160 cfs	0
Streampower of flows that occur 3 percent of the time or less		-0.6%
Streampower of flows that occur 6 percent of the time or less		-0.4%
Streampower of flows that occur 10 percent of the time or less		-0.5%
Maximum monthly flow in 37 year period simulated	12,100	-0.1%
Minimum monthly flow in 37 year period simulated	110	0

NOTE: Streampower is determined by intergrating the flow duration curve over the interval indicated.

Cumulative Effects

By memo dated August 27, 1981[1], the Associate Solicitor, Conservation and Wildlife set forth the legal requirements for consideration by federal agencies of the "cumulative effects" of other projects and impacts in determining whether a particular proposed action complies with section 7(a) of the ESA." The memorandum withdrew all prior legal opinions on cumulative impacts and section 7 and will henceforth control the scope of consultation and cumulative impact analysis under the ESA.

The following cumulative analysis relates only to the hydrologic impacts upon the whooping crane and its designated critical habitat on the Platte River from Overton to Grand Island. It is our opinion that the operational impacts of the WyCoalGas water supply system is the only project component which may conceivably have a cumulative effect upon a designated threatened or endangered species. It is furthermore our opinion that the following cumulative effects analysis exceeds the level required in the August 27, 1981 Solicitor's opinion and that it is the obligation of the consultation team to consider or weigh the identified effects per the instructions contained in that memorandum.

In preparing the cumulative hydrological impact analysis for the WyCoalGas project the following assumptions were made by Woodward-Clyde Consultants on behalf of the BLM.

- Baseline conditions for the project are static; therefore, it was not relevant to describe conditions for 1985, 1995, and 2015. In preparing the baseline, present water demands were assumed. Baseline flows were best defined by a flow duration table or curve such as Table 3.3-3. In addition, the impacts of the WyCoalGas project are also static since withdrawals do not increase with time. The river regime is again best defined by a flow duration table or curve.

- It was assumed that none of the cumulative projects would be operating in 1985. It was also assumed that all of the most probable projects would be operating by 1995. Therefore, impacts in 1995 and 2015 would be identical.

- Probable increases in ground water pumping have been described by the Missouri River Basin Commission (1975). Refer to Table 2 of this report.

CUMULATIVE HYDROLOGICAL IMPACT ANALYSIS FOR THE WYCOALGAS PROJECT

In most years, the Platte River system has flows above those needed to satisfy the requirements of present water users. Approximately 1,[illegible]00,000 acre-feet per year of water flows in the Platte River past Grand Island, Nebraska (Kuzz 1981), and eventually into the Missouri River. Average annual flows above those required to meet present water demands have been calculated to be approximately 150,000 acre-feet in the North Platte basin in Wyoming (Akerbergs 1981) and approximately 210,000 acre-feet in the South Platte basin in Colorado (Weideman 1981). Almost all of this "excess" water is present in the system only during the non-irrigation season and flood flows.

Numerous water development projects have been proposed that would use ~~some of the~~ water in the river system that is not currently ~~used.~~ allocated. The proposed projects that are being seriously considered for construction are listed in Table 1. In addition to the WyCoalGas Project, these developments (for purposes of this report termed the most probable projects) include:

- The Narrows Unit, a multi-purpose federal water project whose principal feature is a reservoir to be located on the South Platte River with a storage capacity of 973,000 acre-feet. The reservoir would provide supplemental irrigation water for approximately 230,000 acres.
- Corn Creek Watershed Project in Wyoming, which would supply irrigation water from Grayrocks and Glendo reservoirs to approximately 12,000 acres near Fort Laramie.
- Wildcat Dam and Reservoir in the South Platte basin near Brush, Colorado, which would supply supplemental irrigation water to approximately 22,500 acres and 7,000 acre-feet of water per year to the two power generating units of the Pawnee Station. The first of these units is scheduled for completion in the fall of 1981.

TABLE 1

MOST PROBABLE CUMULATIVE WATER DEVELOPMENT PROJECTS:
PLATTE RIVER BASIN ABOVE GRAND ISLAND, NEBRASKA[a]

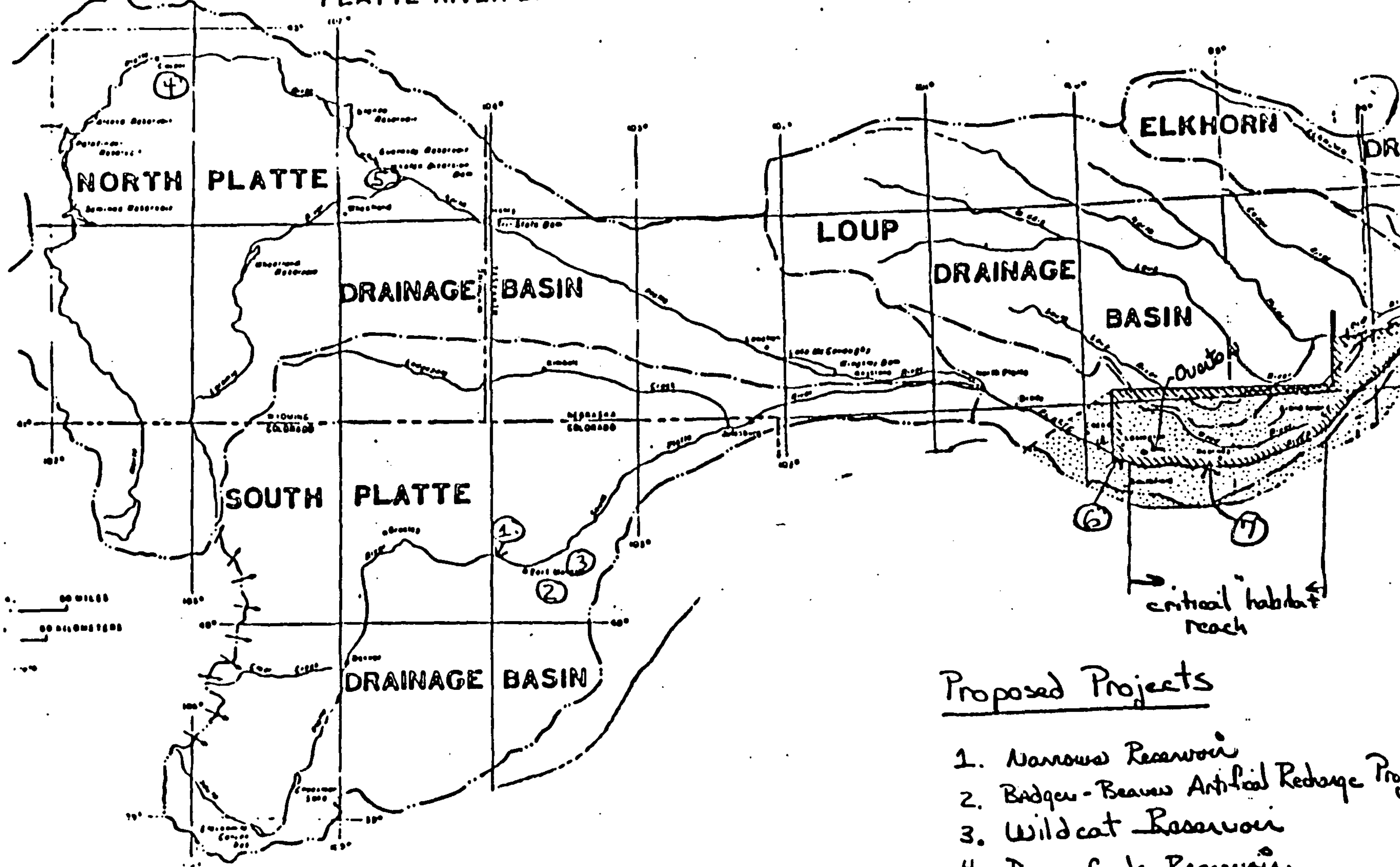
Project	Location	Type of Project	Calculated Consumptive Use (acre-feet)	Time of Diversion	Status
Narrows Unit	S. Platte River near Ft. Morgan, Colorado	Multi-purpose federal water development project	100,000	October to June	FEIS filed near 1976, plans completed, no funds authorized.
Corn Creek Watershed	Corn Creek basin near Ft. Laramie, Wyoming	irrigation	11,000-30,000	irrigation season	Wyoming State Engineer has found the project feasible and Wyoming Farm Loan Board has approved a construction loan.
Wildcat Dam and Reservoir/ Pawnee Power Plants	Wildcat Creek near Brush, Colorado	irrigation and cooling water	7,000 (1 unit) 14,000 (2 units)	flood flows	Construction design completed and conditional decree approved by Colorado Water Court. Construction of Pawnee Unit No. 1 scheduled for completion in fall 1981.
Prairie Bend Unit	Hall and Buffalo counties, Nebraska	irrigation	43,000	mid-September to January, April	Water rights filed for, preliminary investigation comcompleted.
WyCoalGas	Near Douglas, Wyoming	coal gasification plant	4,000	all year flood flow	EIS in preparation 1979 flood flows [illegible]

[a]Project locations are shown on Figure 1.

Location of Proposed Water Development Projects in the Platte River Basin

Figure 1

PLATTE RIVER DRAINAGE BASIN IN COLORADO, WYOMING, AND NEBRASKA



Proposed Projects

1. Narrows Reservoir
2. Badger-Beaver Artificial Recharge Proj
3. Wildcat Reservoir
4. Deer Creek Reservoir
5. Corn Creek Project
6. Little Blue Diversion Point
7. Prairie Bend Diversion Point

FIGURE 1

- o The Prairie Bend Unit, which would provide supplemental irrigation water to 38,000 acres between Kearny and Grand Island, Nebraska.

The most probable projects would consume an average of approximately 170,000 acre-feet of water per year.

In addition to these projects, ground-water development in aquifers adjacent to the Platte River system in Nebraska is projected to cause depletions in stream flow. If ground-water development continues into the future at historical rates, annual stream flow depletions above Overton, Nebraska, caused by pumping would be approximately 100,000 acre-feet per year by 2000 and approximately 230,000 acre-feet per year by 2015 (Table 2) (MRBC 1975).

Development of the Platte River system on the magnitude proposed by future irrigation projects would decrease flows in the whooping crane critical habitat reach between Overton and Grand Island, Nebraska. Monthly flow reductions resulting from the development of the most probable projects and increased ground-water pumping were calculated using the U.S. Bureau of Reclamation's operation model for the Platte River system in Nebraska (Kutz 1981). A brief description of this model is provided in Appendix A. In calculating the changes in flows, it was assumed that ground-water development would deplete stream flow near Overton by 96,000 acre-feet per year in 2000 and 200,000 acre-feet per year in 2015. The calculated monthly changes in flows near Overton averaged 19 percent, with maximum changes (25 percent) occurring in the high flow months of May and June (Table 3). The large flow reductions during May and June would be attributable largely to developments in the South Platte River basin. Flow duration curves for the Platte River near Overton, calculated with both present and cumulative demands, are provided in Figure 2. Peak flows (stream power of flows occurring 10 percent of the time or less)

TABLE 2

STREAM FLOW DEPLETIONS DUE TO GROUND-WATER DEVELOPMENT IN NEBRASKA[a]

	Year 2000 (acre-feet/year)	Year 2015 (acre-feet/year)
South Platte River above North Platte	63,000	110,000
North Platte River above Lake McConaughy	6,000	14,000
North Platte River above North Platte	13,000	43,000
Platte River above Overton	96,000	200,000
Platte River above Grand Island	120,000	244,000

[a]Source of data is Missouri River Basin Commission (1975). Figures in MRBC (1975) were adjusted downward by 20 percent of year 2000 depletions to account for evapo-transpiration salvage to agree with method used by U.S.FWS (1978). These depletions are based on the assumption that future ground-water development will occur at the same rate as development occurred during the period 1945 to 1972 (MRBC 1975).

Figure 2 Flow Duration Curve for Platte River Near Overton, Nebraska for present and cummulative conditions. Calculated using Platte River Operation Model (Kuetz 1981) and 1947-1974 runoff conditions.

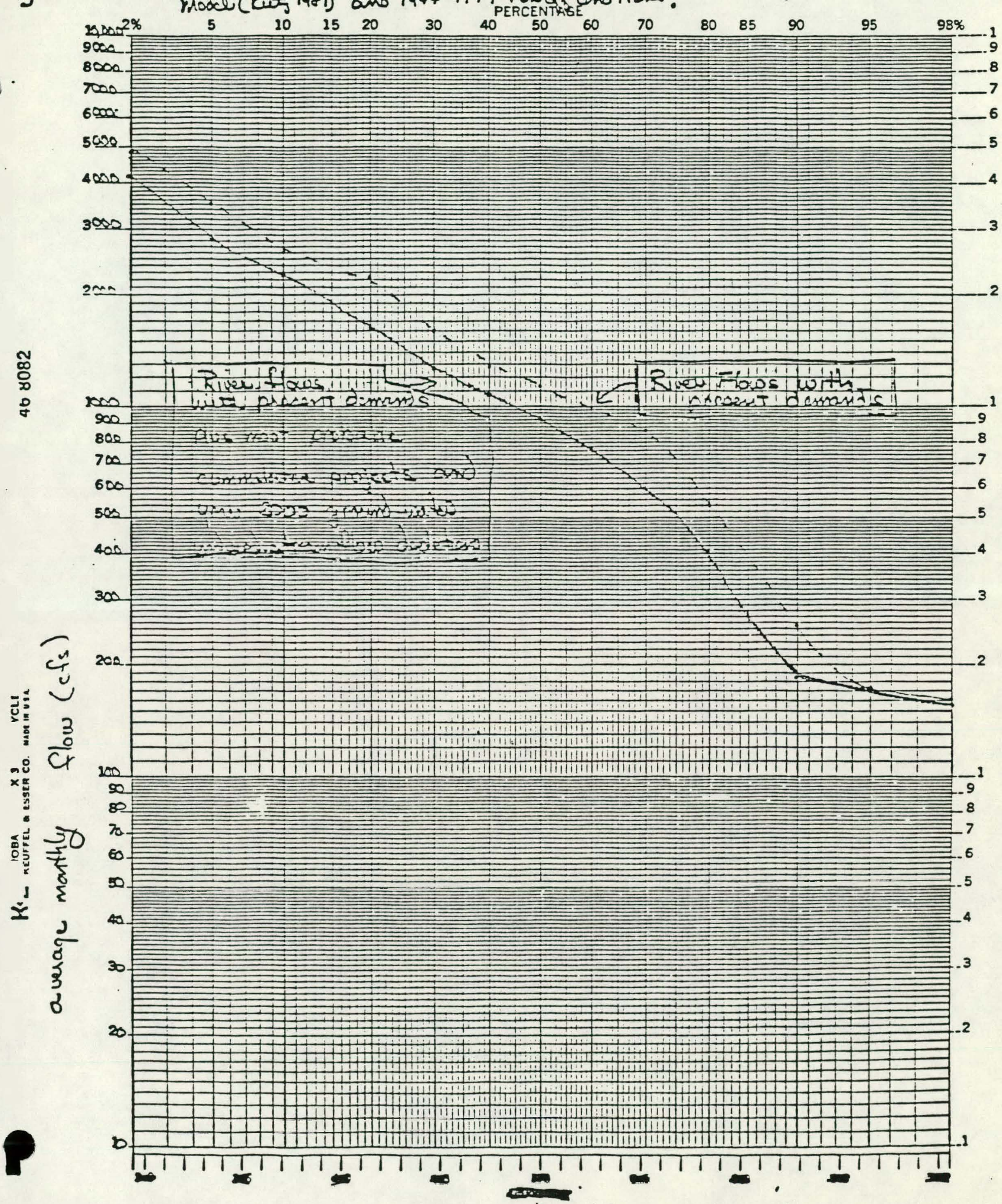


TABLE 3

CALCULATED CHANGES IN PLATTE RIVER FLOWS NEAR OVERTON AND GRAND ISLAND DUE TO THE DEVELOPMENT OF THE MOST PROBABLE CUMULATIVE PROJECTS[a]

	Calculated Changes with Year 2000 Ground-water Development Induced Stream Flow Depletions and Cumulative Projects						Calculated Changes with Year 2015 Ground-water Development Induced Stream Flow Depletions and Cumulative Projects			
	Near Overton			At Grand Island			Near Overton		At Grand Island	
	Average flow present condition (acre-feet)	Change due to development (acre-feet)	Percent change	Average flow present condition (acre-feet)	Change due to development (acre-feet)	Percent change	Change due to development (acre-feet)	Percent change	Change due to development (acre-feet)	Percent change
January	94,000	-19,000	20	82,000	-20,000	24	-27,000	29	-30,000	37
February	95,000	-15,000	16	101,000	-16,000	16	-23,000	24	-26,000	26
March	123,000	-19,000	15	138,000	-28,000	20	-28,000	23	-38,000	28
April	111,000	-21,000	19	116,000	-41,000	35	-29,000	26	-51,000	44
May	106,000	-26,000	25	105,000	-26,000	25	-34,000	32	-36,000	34
June	124,000	-31,000	25	124,000	-29,000	23	-40,000	32	-39,000	31
July	45,000	-9,000	20	49,000	-5,000	10	-17,000	37	-15,000	31
August	39,000	-7,000	18	30,000	—	0	-15,000	38	-10,000	33
September	69,000	-11,000	16	55,000	-11,000	20	-20,000	29	-21,000	38
October	77,000	-14,000	18	66,000	-21,000	32	-22,000	29	-31,000	47
November	82,000	-11,000	13	73,000	-28,000	38	-19,000	23	-38,000	52
December	89,000	-17,000	19	75,000	-35,000	47	-26,000	29	-45,000	60
Annual	1,054,000	-200,000	19	1,014,000	-260,000	25	-300,000	28	-360,000	36

[a]Most probable cumulative projects are those listed in Table 1.

would be reduced approximately 13 percent and the median flow would be reduced approximately 18 percent as a result of the development of the most probable projects and increased ground-water pumping.

The average percentage reduction in flow would be greater near Grand Island than Overton due to depletions from ground-water pumping and winter diversions for the Prairie Bend Unit. Percentage flow reductions during the critical period for tree seedling establishment (May and June) are similar for the reaches near Grand Island and Overton.

Flow reductions resulting from ground-water pumping and development of the most probable water projects would have some affect on channel width in the reach considered to be critical habitat for the whooping crane. However, the affect cannot be quantified given the current state of knowledge on the dynamics of the Platte River system. Hydrologists generally maintain that the width of the channel is a function of the magnitude of the flow it carries (Williams 1978). Karlinger et al. (1981) calibrated a method to determine the discharges required to maintain existing channel widths in the critical habitat area. As discussed in the PDEIS, this method cannot explain the large differences in channel width upstream and downstream of Overton. The decreases in channel width that have occurred in the river are clearly related to vegetation encroachment; however, the mechanisms for encroachment are not clear. Krapu (1981) suggested that high water levels during the period May through August were needed to prevent encroachment of vegetation, but the water levels he suggests have not existed historically. Other factors that may influence the establishment of plant species in the Platte River channel may include relatively high water tables adjacent to the stream caused by agricultural return flows, availability of plant seeds, and grazing.

as necessary to inhibit encroachment

The changes in flow that would occur in the critical habitat reach of the Platte River as a result of the probable additional water developments can be compared to the existing flow regime between North Platte and Overton, where the habitat is no longer suitable for whooping cranes. Assuming present river demands and 1941 through 1977 climatic conditions, peak flows, average flow, and median flow in the North Platte to Overton reach of the river are 50, 66, and 80 percent less than in the Overton to Grand Island reach. Channel widths now average 400 feet in the reach upstream of Overton and 2,000 feet in the critical habitat reach. Assuming ground-water depletions of 230,000 acre-feet per year and depletions from the most probable water projects, peak flows in the critical habitat reach would be reduced by approximately 16 percent, and average and median flows would be reduced by about 30 percent. Therefore, peak flows, average flow, and median flow in the critical habitat reach would be significantly greater than those now occurring in the North Platte to Overton reach. If channel width is linearly correlated with these flow parameters, then channel width in the critical habitat reach could be expected to remain significantly greater than 500 feet even with the calculated cumulative changes in flow resulting from projected ground-water pumping and development of the most probable water projects.

In addition to the most probable water projects listed in Table 1, several other projects on the Platte River system are being considered (Table 4). Assessment of the impact that these projects would have on river flows in the critical habitat reach is not straightforward because water yields have not been calculated for some of the projects, and others may not be feasible if the projects listed in Table 1 are constructed. Burns (1980) assessed the effect of water depletions from the Badger-Beaver Project; however, he noted

TABLE 4

WATER DEVELOPMENT PROJECTS IN THE PLATTE RIVER BASIN CURRENTLY BEING STUDIED

Project Name	Location of Diversion Point	Description
Little Blue	Platte River near Lexington, Nebraska	The project would consumptively use about 120,000 acre-feet per year of return flows from the Johnson Hydro plants to be diverted for irrigation use in the Little Blue River basin. Water would only be diverted between September and January, and during April, and the water would be stored in a reservoir near the service area.
Deer Creek	North Platte River near Casper, Wyoming	This project would consist of a reservoir with a capacity of about 86,000 acre-feet located on Deer Creek that would be filled with flood flow diversions from the North Platte River. The water would be used for irrigation. Average annual consumptive use is unknown, but based on the analyses in for Panhandle Reservoir No. 1, use is not likely to exceed 10,000 acre-feet per year.
Badger-Beaver Artificial Recharge Project	South Platte River between Fort Morgan and Brush, Colorado	This project would divert the South Platte into several ponds along Badger and Beaver creeks to promote recharge of the depleted alluvial aquifers in the area. If the Narrows Project were not built, average annual diversions by the project would be about 100,000 acre-feet but if the Narrows Project were built, diversions would be much less and the project might not be feasible. Annual average consumptive use would be about 50 percent of diversion after 10 years and would decrease with time (Burns 1980).

that the analysis would be invalid if the Narrows Project was implemented. Little Blue would probably not be a feasible project if the Prairie Bend Unit is constructed (Overing 1981). The Deer Creek Reservoir in Wyoming is proposed to be a relatively large project; however, based on the operation studies conducted for the WyCoalGas Project, annual yields from the reservoir can be expected to be less than 10,000 acre-feet. Because construction of Badger-Beaver and Little Blue would imply that projects on the most probable list would not be built and the annual depletions from the Deer Creek Reservoir would be minor, no separate analysis of stream flow impacts in the critical habitat reach were performed for these projects.

APPENDIX A METHOD USED TO CALCULATE CUMULATIVE HYDROLOGIC IMPACTS

The impacts on river flows in the critical habitat reach that may occur as a result of the future development of water projects were calculated using an operations model of the Platte River system in Nebraska developed by the U.S. Bureau of Reclamation (Kutz 1981). This is essentially a mass balance model that simulates the operation of the Platte River system from Julesburg and Lewellan to Duncan, Nebraska. The model operates the river on a monthly basis.

The operations model was used in the following manner to calculate impacts:

- An artifical baseline flow condition was generated by simulating the operation of the Platte River using present river demands and operating conditions and recorded 1947 through 1974 climatic conditions. River flows were calculated on a monthly basis for this 28-year period. The flow duration curve (Figure 2) developed from these calculations defined the present river hydrologic regime. Present demands were defined as demands incorporated in Kutz (1981) plus Grayrocks depletions as defined by Banner Associates (1981).

- The operations model was run a second time with the most probable cumulative demands placed on the system. These demands are defined in Table A-1. River flows in the critical habitat reach were again calculated on a monthly basis for a 28-year period. The flow duration curve (Figure 2) developed from the calculations defined river flows with the cumulative demands. This procedure was only used to calculate flows with ground-water depletions projected for 2000. Flows for 2015 were calculated by subtracting a uniform amount from flows calculated for the 2000 case.

TABLE A-1

MOST PROBABLE CUMULATIVE DEMANDS USED IN OPERATIONS MODEL

Project	Average Annual Consumptive use	Comments
Narrows Unit	100,000	Depletions for 1947-1974 period at Julesburg taken from Bureau of Reclamation Operations study of Narrows Unit (Weidelman 1981).
Wildcat Dam and Reservoir	6,900	Proposed diversion schedule unknown. Because diversions are relatively small, a diversion rate of 2,300 acre-feet in months of March, April, and May was assumed. Assumed that only Pawnee Unit No. 1 is built.
WyCoalGas	4,000	Depletions for 1947-1974 period at Lewellan derived from operations studies by Banner Associates (1981).
Corn Creek Watershed	11,300	Depletion schedule taken from Supplemental EIS for Grayrocks (USDA 1980). Figures listed in report multiplied by 0.5 to simulate the effect of release of replacement water as required by the Grayrocks decision (Andrus 1979). Total depletion subtracted from baseline flow at Lewellan.
Prairie Bend Unit	43,000	Diversions in all years were assumed to be identical, with 85,000 acre-feet being diverted in months of September, November, December, March, and April. Fifty percent of water diverted assumed to return to river as return flows.
Ground-Water Pumping		Depletions assumed to be uniform throughout the year. Following depletions used (acre-feet per year) for year 2000 and 2020 scenarios:

Julesburg to North Platte	63,000 (2000)	125,000 (2020)
North Platte above Lake McConaughy	6,000 (2000)	16,000 (2020)
Keyston to North Platte	11,000 (2000)	
North Platte to Overton	20,000 (2000)	
Overton to Grand Island	23,000 (2000)	

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