Preliminary Draft Environmental Statement for the Federal Coal Management Program

Volume I

Prepared by the
U.S. Department of the Interior
Bureau of Land Management
with the Assistance of the
Metrek Division of The MITRE Corporation

September 29, 1978

THE MITRE CORPORATION
METREK Division

WORKING PAPER

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Subject: Preliminary Draft Environmental Statement for the Federal Coal Management Program

To: Stephen H. Lubore

Contract No.: AA551-CT8-19(551)

Sponsor: DOI Bureau of Land Management Office of Coal Management

From: BLM Project Team

Project No.: 1605D

Dept.: W-54

Date: 29 September 1978

DRAFT

Approved for MITRE/METREK Distribution: ______________________

ABSTRACT:

This is Volume 1 of two volumes of the Preliminary Draft Environmental Statement for the Federal Coal Management Program proposed by the Department of the Interior. It is a programmatic statement, addressing environmental impacts on a regional, non site-specific basis.

THIS DOCUMENT IS A PRELIMINARY WORKING DRAFT. IT IS INTENDED FOR INTERNAL REVIEW PURPOSES. IT WILL BE REVISED IN RESPONSE TO REVIEWER COMMENTS. IN ADDITION, INTERNAL ANALYSIS AND REVISION OF MATERIALS ARE CONTINUING.

THIS INFORMAL PAPER PRESENTS TENTATIVE INFORMATION FOR LIMITED DISTRIBUTION.

SPECIAL NOTE TO PDES REVIEWERS:

Due to a technical error, 1990 production in the San Juan Region was inadvertently allocated to other regions. Because of this, the San Juan consumption numbers for 1990 declined to a lower level than for 1985. This error will be corrected prior to the issuance of the draft environmental statement.

To facilitate review, certain appendices contain sample tables of various impacts by coal region, state, or sub-state area. More complete appendices will be provided in the draft environmental statement.

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CHAPTER 1

This document is a preliminary working draft of the Department of the Interior's Coal Management Environmental Statement. The document is intended for internal review purposes. It will be revised in response to reviewer comments. In addition, internal analysis and revision of materials are continuing.

CHAPTER 1

INTRODUCTION AND BACKGROUND OF COAL MANAGEMENT PROGRAM AND ENVIRONMENTAL IMPACT STATEMENT

1.1 INTRODUCTION

This environmental impact statement comes at a critical juncture in a long history of starts and stops for a Federal coal management program administered by the Department of the Interior. The purpose of this impact statement is to address four major questions: (1) Should a new Federal coal management program be adopted by the Department of the Interior; (2) What should be included in the program; (3) Is Federal coal leasing necessary to meet the Nation's future energy needs; and (4) What environmental impacts might result from the adoption of a new Federal coal management program?

Why these questions need resolution at this time can be placed in a proper perspective through a brief review of the background of the coal management program. From the beginning of Federal land ownership, a policy of disposal of public domain lands was implemented In the century and a half during which this policy held sway, 1.1 billion acres, or more than half of the public domain, was sold or granted to states and private owners. Concomitant with the policy of disposal of Federal lands was the practice of transferring coal and other mineral resources to private owners. However, with the passage of the Mineral Leasing Act of 1920, it became Federal policy to lease rather than transfer Federally-owned coal. Until 1971, large amounts of Federal coal were leased with little regard to the need for leasing, the amount of reserves contained within leases or when (or if) the leases would be developed. There was no enforcement of the Mineral Leasing Act requirement that leases be diligently developed.

A Bureau of Land Management (BLM) study issued in 1970 reported that, while the amount of Federal coal under lease was rapidly increasing, production was declining. As a result of this study, the Department of the Interior, in May 1971, imposed an informal leasing moritorium in order to reassess its leasing policy. In February 1973 a formal leasing moritorium was declared. At the same time, the Secretary of the Interior announced his intention to establish a new coal leasing policy. In the short term, the Department would issue leases only for bypass situations and to maintain existing coal operations. For the long term, the Secretary announced his intention to establish a new coal leasing system.

The newly designed long-term leasing system was presented in May 1974 in the Department of the Interior's Federal Coal Leasing Draft Environmental Impact Statement. The heart of the program was the Energy Minerals Allocation Recommendation System (EMARS I), under which the Department of the Interior would specify leasing needs on the basis of estimates of national energy requirements. The final impact statement, issued in September 1975 modified the system to the Energy Minerals Activity Recommendation System (EMARS

II). Under the revised system, the Department adopted procedures for industry nominations and placed a much greater emphasis on market determination of the amounts and location of future leasing.

The new Federal leasing system was short lived. From 1975 on, the development of a Federal coal management program has been significantly influenced by actions of each branch of government. Congress enacted four major statutes with important consequences for Federal coal management. The first, the Federal Coal Leasing Amendments Act (FCLAA) of 1975, passed in August 1976 over President Ford's veto, was designed to correct the leasing problems that had been experienced under the Mineral Leasing Act of 1920. The Federal Lands Policy Management Act (FLPMA), passed in October 1976, provides the Bureau of Land Management with a modern management mandate, including requirements for land use planning before leasing or other actions.

The third major statute was the Surface Mining Control and Reclamation Act (SMCRA), passed in August 1977 after similar bills were introduced in 1973, 1974, and 1975. SMCRA was a result of Congressional concern over the adverse environmental effects associated with the significant shift in technology from underground to surface mining methods. Finally, the Department of Energy Organization Act (DOE Act), passed in August 1977, transferred to the Department of Energy several important coal management responsibilities, including issuance of diligent development and bidding system regulations.

The Judiciary has provided guidance for the preparation of a new coal management program, particularly in two recent decisions. The Supreme Court's 1976 decision, Sierra Club v. Kleppe, prescribed the nature of environmental reviews which must accompany major coal management decisions. Of more direct importance, however, is the September 1977 decision in NRDC v. Hughes. The court's order enjoined most Federal coal leasing activity until the Department of the Interior issued supplemental draft and final environmental impact statements on its coal management program. This impact statement is in response to that court order.

This discussion provides a brief overview of the recent history of Federal coal management activities. The background of Federal leasing, beginning with the Mineral Leasing Act of 1920, is presented in more detail in subsequent sections of this chapter.

1.1.1 Purpose of Draft Environmental Impact Statement (DEIS)

The purpose of this statement is to address the overall environmental impacts of a Federal coal management program administered by the Department of the Interior (Department) and to fully analyze the alternatives to the proposed program. The statement attempts to discover the probable effects of the total Federal coal management program in order to serve as a decision making document, allowing for comparisons of the various alternatives.

The statement also provides an analytical framework for consideration of the four questions presented in the first paragraph of Section 1.1. Resolution of the questions, however, is not the purpose of this document. Rather, the document will be one of many inputs into decisions to be made by the Department concerning the nature and need for a Federal coal management program.

1.1.2 Summary of Program Alternatives

Seven broad Federal coal management program alternatives are analyzed in this statement. Unlike most impact statements prepared by the Department and other Federal agencies, a proposed "action" and its alternatives are not treated in separate chapters. Rather, the statement presents a series of alternatives, one of which is tentatively "preferred" by the Department. This is consistent with the Secretary of the Interior's direction that the Department critically evaluate its entire coal management process. An integral part of this evaluation is and will continue to be input from interested parties, including other Federal agencies, state and local governments, private and public organizations, and concerned individuals. Initial comments from these parties have already been obtained (see Chapter 9). Further comment is invited during the public review of this draft environmental impact statement (EIS) and will be responded to in a final environmental impact statement (FEIS). These comments, along with continuing evaluation within the Department, may result in modification of the preferred and other alternatives in the FEIS.

Additional public input will be invited and considered during the program decision-making process which will follow issuance of the FEIS.

A brief overview of the program alternatives follows. A more complete description is contained in Chapter 3.

- o <u>Preferred Alternative</u>. Federal coal leases under this alternative would be granted on the basis of need in order to meet Department of Energy (DOE) production goals. Extensive involvement would be required from private industry, state and local governments, and other interested parties to determine the validity and the feasibility of these goals. This non-Federal involvement would provide a continual reassessment of the local and regional energy needs in order to eliminate much of the inherent uncertainty of developing and implementing national energy policy.
- o <u>No Federal Leasing</u>. No new Federal coal would be leased until at least 1985, including coal needed for by-pass situations or to maintain existing operations (see section 1.2.6 for description of terms). Preference right lease applications (PRLAs) would be either rejected, not processed, exchanged, or purchased.
- o <u>Process Outstanding PRLAs</u>. Leasing until at least 1985 would be limited to PRLAs that meet commercial quantities tests.

- o <u>Emergency Leasing</u>. There would be limited competitive leasing and issuing of PRLAs to meet by-pass standards and to maintain existing operations. The need for new competitive leasing would be reviewed in 1985.
- o <u>Satisfy Industry Indications of Need</u>. This alternative is effectively the Energy Minerals Activity Recommendation System (EMARS II), as proposed in the Department's 1975 programmatic impact statement on the Federal coal leasing program (see section 1.2.4).
- o <u>State Determination of Leasing Levels</u>. States would have the responsibility to determine the timing and extent of new leasing.
- o <u>Lease to Meet DOE Production Goals</u>. Under this alternative, DOE regional production goals would drive the coal tract selection process. Adjustments in these projections (as envisioned under the preferred alternative) would not be called for.

1.1.3 <u>Approach to Environmental Statement</u>

It has been determined that development of a new coal management program is a major Federal action which may significantly affect the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969. The Council on Environmental Quality (CEQ) has determined that NEPA should apply to policy statements, as well as revision of ongoing programs.

An environmental statement must be prepared for "adoption of programs, such as a group of concerted actions to implement a specific policy or plan" (U.S. Council on Environmental Quality, 1978).

This is a programmatic statement which assesses the overall impacts of the Federal coal management program and related Federal coal policies. The statement is necessarily general and oriented toward policy, procedures, program implementation, and issues of national and regional interest.

The statement presents an overview of impacts of the total coal management program. The function of this approach is to cover all major national aspects of the leasing program and alternatives, as well as to assess impacts in ten specified coal regions. The approach will not answer all questions to all parties, but will serve as general guidance to assist the Federal decision-making process from the perspective of environmental effects. Thus, the issues discussed in analysis of the overall program would be quite different from those discussed for a particular lease area. A broad statement on overall impacts of the program will, nevertheless, serve as a useful adjunct to subsequent statements covering localized impacts.

The methodology used in this programmatic statement is, therefore, a general predictive approach based on regional data and many assumptions. Reasonable forecasting and speculation is implicit in NEPA. There is no specific "site" for the proposed action. With 27 coal states and ten regions which could be directly affected by coal extraction, and other states indirectly affected by the consumptive use of coal, data used in this statement must be generic; however, impacts are quantified, wherever possible, to display the trade-offs of the various alternatives.

The impact analysis utilizes two principal models. One is the Department of Energy's ICF model, which predicts the high, moderate, and low coal demands for coal regions, in 1985 and 1990, under various demand scenarios and constraints. The second model used is a MITRE Corporation computerized methodology which relates quantifiable "environmental loadings" to predicted coal production and use levels by region.

The methodology used in impact analysis assesses broad impacts of coal-related actions and regionally unique impacts, where applicable. Nonquantifiable aspects are also addressed, such as aesthetics, life-style changes, and cultural resources.

The statement addresses the total national demand for coal, and impacts associated with Federal and non-Federal coal development are explored. Consideration of non-Federal coal resources is necessary: first, to place impacts of the management program in a broader perspective; and second, management program and implementation alternatives shift and aggregate production between private and public coal. Presentation of total coal demand establishes a base-line from which environmental analysis may proceed. Thus, the approach identifies the extent to which area ecological and social system impacts are intensified in response to a particular coal development scenario. Finally, the coal management program, particularly viewed in the context of the Department's planning system, will directly influence the location and intensity of private resource development. This can occur when Federal right-of-way access is needed to reach private coal reserves or where Federal leasing is needed to form logical mining units and insure maximum economic recovery of coal resources.

The content and format of the statement, as outlined in the table of contents, represents a combination of approaches. It contains a standard format as required in BLM Manual 1792, plus revisions as suggested by the Council on Environmental Quality (CEQ) in its proposed National Environmental Policy Act (NEPA) of 1969 rules (CEQ, 1978), with emphasis on the requirements of the NRDC v. Hughes court order.

Chapter 1 provides the background to this statement. Included is discussion of prior and current coal leasing policy directives and applicable laws and regulations. The importance of coal as an energy resource is discussed in Chapter 2. This chapter also describes the characteristics of coal development activities as well as the relationship of coal to other energy sources. Past and projected coal production levels and the need for additional Federal coal leasing are then addressed.

Chapter 3 presents the issues and options identified during the course of the Department's review of its coal management responsibilities.

The Secretary of the Interior's option preferences are then indicated. Next, the Secretary's preferred coal management program is described in detail. The chapter concludes with a description of alternative methods to implement the preferred program and a description of two alternative structures to the program. Chapter 4 provides a brief overview of the existing environmental conditions in each of the ten coal regions.

Chapter 5 assesses the environmental impacts related to the preferred and alternative leasing strategies. This chapter concludes with a comparative analysis of all program alternatives. Further options to important features of the program are expanded in Chapter 6, where coal lease issues and program options are addressed. Chapter 7 addresses potential legislative proposals which can mitigate some of the more significant adverse impacts of the coal program. Chapter 8 contains the summary analysis required by section 102(2)(C)(iii-v) of NEPA. Finally, the coordination activities involved in preparation of this statement are summarized in Chapter 9.

1.1.4 Relationship to Other Environmental Studies

Section 102(2)(C) of the National Environmental Policy Act of 1969 requires preparation and consideration of detailed environmental statements for all Federal actions significantly affecting the quality of the human environment. The Department is currently complying with this requirement through the production of impact statements prepared at three levels. The first level involves the preparation of this programmatic statement, as well as its predecessor programmatic statement issued in final form in September 1975.

The second level of NEPA compliance is through a series of comprehensive regional statements. Regional analyses have been called for when the Department is expected to be faced with multiple coal-related actions in a broad geographic area. These actions could involve issuing coal leases, approving mining and reclamation plans on existing leases, and right-of-way permit requests for coal-haul railroads, access roads, or transmission lines.

Regional areas have been determined considering coal basin boundaries, drainage areas, areas of common reclamation characteristics, administrative boundaries, areas of economic interdependence, and other relevant factors. The regional statements include a broad, overview analysis of environmental impacts associated with current and potential coal development activities, as well as site-specific analyses of leases, mine plans, and right-of-way permits for which administrative action is probable in the near future. These statements also address related coal development activity not requiring specific Departmental approval, such as mine-mouth electrical generating or energy conversion facilities, and the expansion or construction of new communities to accommodate coal-induced population increases.

The need for eight regional statements has been identified, as depicted on Figure 1-1. Table 1-1 summarizes pertinent coal development activities analyzed in these statements. It is noted that these

FIGURE 1.1-1

MAP OF REGIONAL EIS AREAS

(to be inserted)

TABLE 1-1

SITE-SPECIFIC PROPOSED ACTIONS
IN THE COAL REGIONAL ENVIRONMENTAL STATEMENTS (a)

REGIONAL STATEMENT (b)	PROPOSED SITE-SPECIFIC ACTIONS		
	MINING AND RECLAMATION PLANS	SHORT-TERM COMPETITIVE LEASES	RIGHTS-OF WAY APPLICATIONS
Southwest Wyoming	5	0	13
South Central Wyoming	3	0	9
Eastern Powder River, Wyoming, Supplement	1	0	0
Southern Utah	3	0	0
Central Utah	10	0	15
West Central Colorado	6	0	0
Star Lake-Bisti, New Mexico	0	1	2
Northern Powder River, Montana	5	0	1
TOTAL	33	1	40

(a) Source: U.S. Department of the Interior, 1978.

(b) Two additional Environmental Planning Studies, the Northwest Colorado Environment Planning Study and the West Central North Dakota Environmental Planning Study are also underway.

"regions" are smaller geographic areas than the ten coal regions assessed in this statement. The ten regions are described in Chapter 4.

Finally, coal leases and mining plans are analyzed and an environmental analysis prepared to determine whether a detailed environmental statement is required. If associated impacts are significant within the meaning of NEPA, site-specific statements are prepared, either separately or as part of a regional analysis.

Current Departmental policy thus covers generic (programmatic), regional, and site-specific considerations. Proposals to modify this approach as part of a revised coal management program are discussed in Chapter 3.

1.1.5 General Purpose of Coal Management Policy

The need for a new look at the Federal coal management program is related to three broad conditions. The first is the Nation's serious energy problem, characterized by declining domestic oil and gas resources and limited alternatives. A national policy goal has been advanced to reduce reliance on imported oil. The National Energy Plan (NEP) announced by President Carter in April 1977 presented detailed steps to be taken to achieve this goal. Salient features of the NEP include energy conservation, rational pricing policies, and increased use of abundant domestic energy sources. Although coal comprises 90 percent of the country's fossil fuel reserve, only 18 percent of the national energy needs are met by coal. A cornerstone of the National Energy Plan is to establish goals to correct this imbalance between coal reserves and consumption. A doubling of 1977 annual production is possible by 1985. Coal from mines under Federal leases, particularly in the western states, has and is expected to continue to account for a significant share in the expanding use of this resource.

The second condition is the problem with coal management practices. Major concerns expressed both within and outside of the Department are the Government's historically passive role in coal leasing decisions, lack of effective control over production from Federal leases, lack of an effective system to insure fair market return for the right to mine Federal coal, and the potential for serious social, economic, and ecological impacts of expanded coal production and use.

Finally, as briefly discussed in the introduction to this chapter, a reassessment of the coal management program has been precipitated by recent critical reviews of management practices by the Executive, Judicial, and Legislative branches of the Federal Government.

1.2 HISTORICAL BACKGROUND

The Federal coal management program is concerned with the development of coal resources on public domain lands. The public domain refers to those lands which are subject to the public land laws of the United States.* These lands were acquired primarily by purchase,

*Tracts acquired for Federal purposes are referred to as "acquired lands" and are generally subject to special land laws not applicable to the public domain.

cession, and treaty. Table 1-2 summarizes acquisitions of the public domain between 1781 and 1867.

Almost as fast as the land was acquired, it was disposed of by the Federal Government to further national goals. These dispositions provided rewards for soldiers and other deserving persons, encouragement for the rapid settlement and development of the western states, incentives for construction of railroads and canals, and many other purposes. Dispositions of public lands included more than 1.1 billion acres between 1781 and 1963 (see Table 1-3).

Early development of Federal coal lands was governed by laws controlling land entry and sale. Two general features of the various Federal statutes were criteria on acreage permitted and land payments. The maximum acres permitted to an individual was 160 acres and to a group of individuals, 320 acres. Up to 640 acres was allowed to groups of four or more persons who had expended at least $5,000 in work and improvements, where mines were opened and improved, and when the group was in actual possession. Land payments ranged from $10 to $20 per acre, depending upon the distance from a railroad. A claimant who discovered minerals on public domain land received complete transfer of mineral ownership.

1.2.1 Mineral Leasing Act of 1920

Enactment of the Mineral Leasing Act of 1920 provided a radical policy change for disposal of Federal coal lands. The new policy was to lease coal rather than sell it. Under the act, rights to explore,

TABLE 1-2

ACQUISITIONS OF THE PUBLIC DOMAIN, 1781-1867

ACQUISITION	AREA			COST[1]
	LAND (acres)	INLAND WATER (acres)	TOTAL (acres)	
State cessions (1781-1802)	233,415,680	3,409,920	236,825,600	$ 6,200,000
Louisiana Purchase (1802)	523,446,400	6,465,280	529,911,680	23,213,568
Red River Basin	29,066,880	535,040	29,601,920	- -
Cession from Spain (1819)	43,342,720	2,801,920	46,144,640	6,674,057
Oregon Compromise (1846)	180,644,480	2,741,760	183,386,240	- -
Mexican Cession (1848)	334,479,360	4,201,600	338,680,960	16,295,149
Purchase from Texas (1850)	78,842,880	83,840	78,926,720	15,496,448
Gadsden Purchase (1853)	18,961,920	26,880	18,988,800	10,000,000
Alaska Purchase (1867)	365,481,600	9,814,400	375,296,000	7,200,000
Total public domain	1,807,681,920	30,080,640	1,837,762,560	85,079,222

[1]Cost data for all except "State Cessions" obtained from: Geological Survey, Boundaries, Areas, Geographic Centers (Washington, U.S. Government Printing Office, 1939), pp. 249-251.

Source: U.S. Department of the Interior, Office of the Secretary, Areas of Acquisitions to the Territory of the United States (Washington, U.S. Government Printing Office, 1922).

TABLE 1-3

DISPOSITION OF PUBLIC LANDS, 1781-1963

TYPE OF DISPOSITION	ACRES
Disposition by methods not elsewhere classified[1]	301,800,000
Granted or sold to homesteaders[2]	287,300,000
Granted to States for:	
Support of common schools	78,600,000
Reclamation of swampland	64,900,000
Construction of railroads	37,200,000
Support of miscellaneous institutions[3]	22,300,000
Purposes not elsewhere classified[4]	118,000,000
Canals and rivers	6,100,000
Construction of wagon roads	3,400,000
Total granted to States	330,500,000
Granted to railroad corporations	94,300,000
Granted to veterans as military bounties	61,000,000
Confirmed as private land claims[5]	34,000,000
Sold under timber and stone law[6]	13,900,000
Granted or sold under timber culture law[7]	10,900,000
Sold under desert land law[8]	10,100,000
Grand total	1,143,800,000

[1] Chiefly public, private, and preemption sales, but includes mineral entries, scrip locations, sales of townsites and townlots.

[2] The homestead laws generally provide for the granting of lands to homesteaders who settle upon and improve vacant agricultural public lands. Payment for the land is sometimes permitted, or required, under certain conditions.

[3] Universities, hospitals, asylums, etc.

[4] For construction of various public improvement (individual items not specified in the granting acts), reclamation of desert lands, construction of water reservoirs, etc.

[5] The Government has confirmed title to lands claimed under valid grants made by foreign governments prior to the acquisition of the public domain by the United States.

[6] The timber and stone laws provided for the sale of lands valuable for timber or stone and unfit for cultivation.

[7] The timber culture laws provided for the granting of public lands to settlers on condition that they plant and cultivate trees on the lands granted. Payment for the lands was permitted under certain conditions.

[8] The desert land laws provide for the sale of arid agricultural public lands to settlers who irrigate them and bring them under cultivation.

Source: Trelease, F.J., H.S. Bloomenthal, J.R. Geraud, Cases and Materials on Natural Resources, West Publishing Co., 1965.

develop, and remove coal (and other minerals) were acquired through a lease or prospecting permit issued by the Bureau of Land Management.

In areas with no known coal deposits, the Secretary of the Interior could issue prospecting permits for a period of two years. The permit entitled the permittee to the exclusive right to prospect for coal. Coal prospecting permits could be extended for an additional two years if the permittee was unable, with the exercise of reasonable diligence, to determine the existence or workability of coal deposits in the area covered in the permit. Permittees were entitled to a preference right lease if it could be demonstrated that the land contained coal in commercial quantities.

Lands containing known coal deposits were divided into leasing tracts and leases were awarded competitively. The competitive leasing system adopted by the Department was to award leases to the highest bidder. A lump sum cash bonus was collected at the time the lease was awarded. The Department reserved the right to reject all bids for, among other reasons, inadequacy of the bid.

The Mineral Leasing Act imposed limitations on the amount of acreage that could be held in one state for a single purpose. No person could hold more than 46,080 acres in one state and prospecting permits could not be held for more than 5,120 acres. An additional 5,120 acres on a lease could be issued upon a determination that it was in the public interest to expand the lease to enable an applicant to carry on its business economically. The purpose of the acreage limitation was to limit speculative holdings and to avoid monopoly of the public domain.

Another anti-speculative feature of the act was the requirement that leases be for an indeterminate period as long as conditions of diligent development and continuous operations were satisfied. These conditions would be waived if operations were interrupted by strikes, the elements, or casualties not attributable to the holder of the lease. Lease terms and conditions could be readjusted at the end of 20 year periods. In addition, leases could not be assigned or sublet without the consent of the Secretary of the Interior.

Other major provisions of the Mineral Leasing Act were:

- o Leases could be modified by an additional 2,560 contiguous acres;
- o Additional tracts up to 2,560 acres could be leased if workable deposits of coal would be exhausted within three years;
- o Single leases could contain noncontiguous tracts;
- o Royalties were set at not less than 5 cents a ton of coal. Annual rentals were set at not less than 25 cents, 50 cents; and $1 for the first, third through fifth, and sixth year onward from lease issuance, respectively;
- o Limited licenses or permits could be issued to municipalities (without royalties) if the coal mined was sold without profit to local residents.

1.2.2 1971 Leasing Moritorium

Prior to 1970, the Department's coal leasing policy was reactive in nature. Lease requests were processed on a case-by-case basis. There was no consideration given to the total coal reserves under lease or to the need for additional leasing, and environmental impacts of leases were not addressed.

A 1970 Bureau of Land Management (BLM) study (U.S. Department of the Interior, 1970) pointed out that leased coal acreage on public lands in six western states - Colorado, New Mexico, North Dakota, Montana, Utah and Wyoming - rose sharply from roughly 80,000 acres in 1945 to about 788,000 acres in 1970. However, according to the study, Federal lease production dropped from 10 million tons of coal in 1945 to 7.4 million tons in 1970. Of the total acreage under lease, over 90 percent was not producing coal.

As a result of this internal Departmental study, the Secretary of the Interior, in 1971, directed BLM to halt the issuance of coal leases and prospecting permits.

1.2.3 Short-Term Leasing Since 1973

The informal 1971 moritorium was replaced in February 1973 with a new coal leasing policy that embodied both short-term and long-term actions.

The long-term action consisted of the formulation of a comprehensive planning system to determine the size, timing, and location of future coal leases. The Department was also committed to prepare an environmental impact statement for its entire Federal coal leasing program.

The short-term action included a complete moritorium on the issuance of new prospecting permits and near-total moritorium on the issuance of new Federal coal leases. New leases would be issued only to maintain existing mines or to supply reserves for production in the near future. BLM issued instructions implementing this short-term policy in July 1973. The instruction stated that the decision to issue new leases would be based upon sufficient indications that a prospective lessee needs coal to satisfy an existing market and intends to begin development within three years.

Between 1974 and 1977, leases, covering acres, were issued. Seven of these leases were producing coal by the end of 1977.

1.2.4 1975 Federal Coal Leasing Environmental Statement

As part of its long-term leasing policy, the Department, in May 1974, issued a draft Programmatic Environmental Impact Statement (U.S. Department of the Interior, 1974). Approximately 2,100 sets of the two-volume draft statement were distributed to Federal and state agencies, U.S. Senators and Representatives, industry organizations, conservation groups, and others. Local public hearings were held and 117 formal comments on the draft statement were received.

Comments and testimony were received from a diverse group of individuals, groups, organizations, companies, and agencies. Comments ranged from support of the statement to requests for a complete rewrite. However, two areas of major concern were readily apparent. These were: (1) the need for a more detailed description of the proposed Federal coal leasing program, and (2) the need to further analyze the nation's need for additional Federal coal in light of the large acreage and coal reserves presently under lease but on which no development has taken place.

The focus of the draft statement was on implementation of a new coal leasing system entitled the Energy Minerals Allocation Recommendation System (EMARS I). As described in the draft PEIS, EMARS was basically a three-part system: (1) allocation, (2) tract selection, and (3) leasing.

During the allocation process, Federal agencies were to relate inventoried Federal coal resources to projections of coal-related energy needs. Total national energy needs were to be disaggregated into regional demands for coal. In the tract selection phase, Federal coal leasing targets would be established in each coal region or area. These targets would be derived in part from total national projections for coal-based energy needs. The leasing phase was to begin with detailed pre-planning of the coordinated mining and rehabilitation factors required for reclamation and subsequent surface resource management. This last phase would conclude with pre-sale evaluations, lease sales, post sale evaluation procedures, and, finally, lease issuance.

The Department's final programmatic statement (U.S. Department of the Interior, 1975d) was released in September 1975, salient features of which are discussed briefly below.

EMARS was modified and retitled the Energy Minerals Activity Recommendation System (EMARS II). The three phases of this revised leasing system became (1) nominations and programming, (2) scheduling, and (3) leasing. While the system envisioned in the draft statement emphasized interdepartmental Federal identification of coal reserves to be considered for leasing, the revised EMARS program involved annual industry nominations and public identification of areas of concern. Nominations would be accepted for any area, with industry providing information on where and how much coal to lease. Based upon these nominations, the Department would prepare land use plans and environmental analyses, resolve or mitigate resource conflicts, and hold lease sales if found to be compatible with the environment. The reasons behind the changes in the EMARS program between draft and final statements were not provided.

The following points were offered in the final PEIS to support continued leasing:

- o Changing economic conditions made it probable that much of the coal under lease in 1975 was no longer suitable for development;
- o Diligence requirements extended to existing leases would cause production or relinquishment over a period of a few years;

- o Additional leasing may be required to avoid increases in energy costs;
- o Some existing leases may be environmentally unsuitable for development. Leasing in new areas may be substituted for leases in unsuitable areas, thereby decreasing the relative value of the latter leases and possibly causing their relinquishment;
- o Additional leasing would provide access to firms interested in penetrating a new market area but not currently holding Federal coal leases.

Analysis of the environmental impacts associated with the leasing program was quite brief in the final PEIS, consisting of only 28 pages. Impact analyses were consistently generic in nature, addressing effects resulting from typical phases of the coal development process.

Following the decision in NRDC v. Hughes (see Section 1.2.6) the Department, in November 1977, solicited comments on the final environmental statement. Commenters were requested to focus their responses on the following questions:

- o Is there a need for renewed Federal Coal leasing?
- o If there is a need, how should the program be defined?
- o If new Federal leasing should be undertaken, how would different types of Federal leasing systems affect the environment?

Over 100 comments were received from Federal agencies, state and local governments and agencies, coal industry representatives, and private individuals and organizations. Comments included criticisms of the final PEIS and suggestions on preparation of an improved statement, as well as responses to the three questions listed above. Major suggestions offered for an improved revised impact statement included:

- o Further analyses of the need for renewed Federal coal leasing and a clearer description of the proposed leasing program;
- o Detailed analysis of potential environmental, social, and economic impacts of renewed leasing and alternatives;
- o Consideration of current data and recent legislation (e.g., Surface Mining Act, Mineral Leasing Act Amendments, and 1977 Amendments to the Clean Air Act);
- o Consideration of the impacts of processing, transportation, and ultimate use of coal;
- o Improved consideration of alternative energy sources (e.g., solar, geothermal, wind, conservation);
- o Consideration of state policy;
- o Definition of the role of more detailed regional and site-specific environmental statements.

All of the major concerns identified in these comments are addressed in this statement.

1.2.5 Kleppe Decision of 1976

The decision in Sierra Club v. Kleppe, 427 U.S. 390 (1976), was the Supreme Court's first extensive treatment of NEPA's impact statement requirements. As such, it provides constructive background to the discussion in Chapter 2 of this statement on the Department's policy options for incorporation of environmental analyses into the evolving Federal coal management program.

The litigation began in July 1973. It was contended that the Federal agencies could not allow further coal development in the Northern Great Plains region (encompassing portions of four states - northeastern Wyoming, eastern Montana, western North Dakota, and western South Dakota) without preparing a comprehensive environmental impact statement for the entire region. The United States Court of Appeals of the District of Columbia Circuit found that there was no Federal regional plan or program for coal development in the Northern Great Plains region. Nevertheless, the court concluded that the involved Federal agencies "contemplated" such a regional plan. The agencies were ordered to inform the District Court of their role in the further development of the region; if they decided to control that development, an impact statement would be required. The Court of Appeals also enjoined Department of the Interior approval of the four mining plans analyzed in the multiproject Eastern Powder River Coal Basin regional impact statement.

The Court further proposed a four-part balancing test for determining when preparation of an impact statement must begin during contemplation of a plan or action. Factors to be considered were:

- o Likelihood that the program would soon be initiated;
- o Extent to which information is available on the effects of program implementation;
- o Extent to which irreversible commitments of resources are being made or options precluded;
- o Severity of resultant environmental impacts.

In reversing the Court of Appeals decision, the Supreme Court affirmed the NEPA requirement for comprehensive impact statements when cumulative impacts are involved. When several proposals for coal-related actions that will have cumulative or synergistic environmental impact are pending concurrently before an agency, their environmental consequences must be considered together. This process would help assure that agencies comprehensively evaluate different courses of action. Nevertheless, the Supreme Court found that an impact statement is not required until the time at which a Federal agency makes a recommendation or report on a proposal for Federal action. Mere contemplation of action does not trigger the need for a statement and, thus, the Court of Appeals balancing test had no statutory authority. Further, even in instances where interactive proposals are likely, agencies have wide discretion to determine which regions, if any, may require a comprehensive EIS.

1.2.6 NRDC v. Hughes Decision

On September 27, 1977, the U.S. District Court for the District of Columbia ruled in NRDC v. Hughes, 437 F. Supp. 981 (D.D.C. 1977), that the coal leasing programmatic environmental impact statement was inadequate and enjoined the Department from "taking any steps whatsoever directly or indirectly to implement the new coal leasing program including calling for the nominations of tracts for Federal coal leasing and issuing any leases, except when the proposed lease is required to maintain an existing mining operation at the present levels of production or is necessary to provide reserves needed to meet existing contracts and the extent of the proposed lease is not greater than is required to meet these two criteria for more than three years in the future." The court stated that the standard should be applied to both preference right and competitive leases.*

In addition, the court ordered the Department to issue an official press release, publish a notice in the Federal Register, and take other steps appropriate to receive additional comments on the final EIS issued in September 1975. The Department was further ordered to prepare a draft supplemental to the coal programmatic EIS, receive comments on the supplemental, and prepare a final EIS. These documents were to address the issues which the court identified as being deficient. After

*The rights of holders of PRLAs was recently addressed in related litigation. The issue in NRDC v. Berkland, Civil Action No. 75-0313, was whether the Secretary's duty to issue a "preference right" lease to an otherwise qualified applicant is mandatory or discretionary. The United States District Court for the District of Columbia ruled, on June 30, 1977, that the Secretary does not have discretion to reject PRLAs where coal has been found in commercial quantities. However, if the issuance of a PRLA would constitute a major Federal action significantly affecting the quality of the human environment, an EIS must first be prepared.

the environmental impact statement is completed, the injunction will cease and the Department may, 30 days after the final EIS is filed, adopt a new coal management program and resume full-scale coal leasing if necessary.

The Department has made the required request for public comments. In addition, although the Department filed a notice of appeal of the court's decision, it also attempted to negotiate a settlement with the plaintiffs in the case to avoid continued protracted litigation. On February 25, 1978, the Department of the Interior and the plaintiffs reached a proposed settlement.

The District Court approved the proposed settlement on June 14, 1978, in an amended order issued by Judge Pratt. The settlement permits substantially more leasing during the interim before the new final programmatic impact statement is issued than would be allowed under the court's initial standards. The agreement will remain in effect until the injunction is lifted.

The agreement embodied in the amended order permits leasing under any of the following six standards:

By-pass Leases are permited where Federal coal may be otherwise lost if it is not developed by an existing mine because subsequent costs (either economic or environmental) would be much higher. Up to 5 years of reserves may be included in a lease issued under this provision. Mining operations must exist on September 27, 1977.

Employment Leases may be issued in order to maintain production and employment in existing mines which are running short of reserves needed to maintain past production or where additional reserves are needed to meet existing contracts. Up to 8 years of reserves may be included in a lease under this provision.

ERDA Project Leases of no more than 500,000 tons annual production may be issued to support Energy Research and Development Administration (ERDA) projects authorized under section 908 of the Surface Mining Control and Reclamation Act (SMCRA) of 1977. Leasing is allowed if the technology assessed cannot be demonstrated on existing leases or private coal holdings.

Lease Exchanges are permitted to implement exchanges for Federal leases in an alluvial valley floor under section 510(b)(5) of SMCRA.

Hardship Leases involve seven particular lease applications specified in the agreement as being not subject to the injunction regardless of any other particular standard. The basis for these leases varies, but each has some special circumstances or hardship which justifies proceeding with them in advance of the completion of the final coal management program environmental impact statement.

Preference Right Leases may be processed but not issued for the 20 PRLA's having the least environmental impact. Preference is to be given to tracts containing 90 percent of reserves which can be mined by deep mining and to tracts which would not require substantial additional transportation facilities or water storage or supply systems in the regions. All activities including completion of the commercial quantities test and NEPA compliance are permitted under this standard.

In addition to the six standards, the agreement allows the Department to proceed with a hardship lease for the Edison Development Corporation. If granted, the lease would involve the annual production of 5 million tons of coal.

Although the total amount of coal to be leased under all of these provisions cannot be stated precisely, the Department estimates as many as 35 leases involving a total of 275 to 300 million tons of coal reserves could be involved. If these leases were granted, the increased annual production from Federal lands could be as much as 13 to 17 million tons before the final programmatic EIS is completed. The present annual coal production from mines on or containing Federal leases is approximately 96 million tons.

The modified order will enable the Department to achieve production in areas where needs are critical and to avoid unnecessary loss of Federal coal resources in the by-pass situation. In addition, the settlement allows the Department to continue with the overview portion of the regional environmental impact statements. Although only lease proposals meeting the revised short-term standards will be studied on a site-specific basis, the regional environmental impact statements will study the social, economic, and environmental effects of increased coal leasing in particular areas, including impacts which could occur under various leasing levels. This information will be useful both to this coal management programmatic impact statement and to subsequent leasing decisions.

The amended order is subject to further review by higher courts.

1.3 CONSTRAINTS AND AUTHORITIES OVER COAL MANAGEMENT PROGRAM

This section presents an overview of the major laws and regulations and Federal agency jurisdictional authorities which influence the development of Federal coal resources. Primary emphasis is on statutes which directly control leasing and mining activities. Other authorities are cited in less detail to provide a perspective on factors which may indirectly influence the demand for coal resources and the location and intensity of related activities.

1.3.1 Laws Governing Development of Federal Coal

1.3.1.1 Federal Coal Lease Amendments Act of 1975. The Department's concern in the early 1970's with the efficacy of its coal management program was shared by the Congress, particularly as it related to deficiencies in the coal provisions of the Mineral Leasing Act of 1920. Major deficiencies of the 1920 Act are discussed below (U.S. House of Representatives, 1975; U.S. Senate, 1975).

Speculation. While the 1920 Act provided for lease termination, no leases were ever cancelled. In addition, issuance of preference rights leases made it possible to gain control of public resources at virtually no cost. According to a 1974 study by the Council on Economic Priorities (1974), 45 percent of all Federal leases were issued with no competitive bidding. Consequently, holding companies and energy resource speculators have entered the market for Federal coal in large numbers.

Lease Concentration. In 1974, approximately 66 percent of Federal and Indian acreage under lease was held by 15 leaseholders. This dominance by a few large corporations was due in part to the system of cash bonus bidding for competitive leasing. The substantial front-end capital required made it difficult for smaller companies to secure competitive leases.

Fair Return to the Public. Under preference rights leasing procedures, no competitive sales were held and leasees who discovered commercial quantities of coal had only to pay minimum royalties and rentals. Also, although more than 50 percent of all leases had been offered competitively, 72 percent of the competitive sales had less than two bidders (U.S. Council on Economic Priorities, 1974).

Social and Economic Impacts. When areas were newly opened to large scale mining, state and local governments had the responsibility of providing needed public services. The 1920 Act limited monies returned to states from lease sales to use for schools and roads. This restriction made it difficult for affected areas to meet the needs of their new inhabitants. The attendant problems were exacerbated by the possible "boom-bust" economic cycle associated with rapid resource development in rural areas.

Maximum Economic Recovery. The norm for existing leases was to develop only easily reached surface deposits which yielded the highest profits to developers. Vast resources of coal not so easily reached were often left in place. This practice resulted in the waste of valuable resources, and to the creation of severe environmental impacts.

Congress responded to these problems with the passage, over Presidential veto, in August 1976 of the Federal Coal Leasing Amendments

Act (FCLAA) of 1975 (90 Stat. 1083; 30 U.S.C. 181). The broad purpose of the new Coal Act is to provide a more orderly procedure for the lease and development of coal presently owned by the United States and to assure lease development in a manner consistent with the public interest.

Major features of FCLAA, governing the award and development of Federal leases, include the following stipulations:

- All leasing must be by competitive bidding;
- Preference rights leasing is abolished (subject to valid existing rights);
- Leases may be consolidated into logical mining units (LMU) when needed to insure maximum economic recovery of the coal deposit;* all LMU reserves must be mined within 40 years;
- Leases are automatically terminated if there is no production of coal in commercial quantities within 10 years;
- Diligent development and continuous operation is required (except continuous operation may be waived upon payment of advance royalties);
- Leases to a single person are limited to 100,000 acres nationwide (as well as 46,080 acres in a particular state).

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*An LMU is defined in FCLAA as "an area of land in which the coal resources can be developed in an efficient, economical, and orderly manner as a unit with due regard to conservation of coal reserves and other resources. A logical mining unit may consist of one or more Federal leaseholds, and may include intervening or adjacent lands in which the United States does not own the coal resource, but all the lands in a logical mining unit must be under the effective control of a single operator, be able to be developed and operated as a single operation, and be contiguous."

Economic, social, and environmental deficiencies inherent in the 1920 Act were also addressed in FCLAA. Comprehensive land use plans are ordinarily required prior to leasing. Prior restrictions on the use of coal royalties were removed. State shares of royalties were raised to 50 percent, with the monies available for providing a wide range of public services and facilities in impacted areas. Finally, public bodies were entitled to have reserved a reasonable number of leasing tracts for their own energy production.

1.3.1.2 Federal Lands Policy Management Act of 1976. Bureau of Land Management's dependence on a vast number of outmoded public land laws developed when disposal and largely uncontrolled development of the public domain reflected then-current Federal policy. The Bureau's difficulties in fulfilling its myriad land management responsibilities were examined in detail in the late 1960's by the Public Land Law Review Commission (PLLRC). In June 1970, after five years of extensive investigations, the PLLRC submitted its final report (Public Land Law Review Commission, 1970) to the President and the Congress. A major recommendation of the Commission was that the policy of large-scale disposal of public lands reflected by the majority of statutes then in force should be revised and that future disposal should involve only those lands that will achieve maximum benefit for the general public in non-Federal ownership. Federal ownership should be retained for those lands whose values must be preserved so that they may be used and enjoyed by all Americans.

The Commission also emphasized the need to develop a clear set of goals for the management and use of public lands.

The Commission's work, among other things, led to the passage in October 1976 of the Federal Lands Policy Management Act (FLPMA) of 1976 (90 State. 2743; 43 U.S.C. 1701). The purpose of FLPMA is to provide the first comprehensive statutory statement of purposes, goals, and authority for the use and management of about 448 million acres of Federally-owned lands administered by the Secretary of the Interior through the Bureau of Land Management.

Title II of FLPMA provides BLM with a statutory framework for land use planning for public lands (U.S. Senate, 1976). In the development of land use plans, BLM must:

- o Use the principles of multiple use and sustained yields;*
- o Give priority to the protection of areas of critical environmental concern (such as historic, cultural, or scenic values, fish and wildlife resources, etc.);
- o Consider present as well as future uses of public lands;
- o Coordinate planning activities with those of Federal, state, or local agencies.

The Act also provides new standards for the sale of public lands. Tracts of public lands may be sold if the Department determines that the tract:

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*"Multiple-use" means the combination of resource values that consider changing needs and conditions, long-term needs for renewable and nonrenewable resources, land productivity, environmental values, and economic return. "Sustained yield" means the achievement and maintenance of a high-level output of public lands natural resources consistent with multiple use.

- Is difficult to manage as part of the public lands;
- Is no longer needed for the specific purpose for which it was acquired; or
- Will serve public objectives, such as expansion of communities and economic development.

Sales must normally reserve mineral rights. Exchanges of unsuitable lands for lands more suitable for mining (but not currently leased) are also authorized under the Act.

1.3.1.3 Surface Mining Control and Reclamation Act of 1977. The Surface Mining Control and Reclamation Act (SMCRA) of 1977 (91 Stat. 445; 30 U.S.C. 1201) was passed in August 1977 in response to technological changes which now favor surface over underground mining. By 1976, over 60 percent of the coal produced came from surface mines. About 1,000 acres of land are disturbed each week by surface mining. By 1972, 4 million acres of land were disturbed by this method. Only about half of these lands have been reclaimed.

Surface coal mining activities have imposed large social and environmental costs on the public at large in many areas of the country in the form of unreclaimed lands, water pollution, erosion, floods, slope failures, loss of fish and wildlife resources, and a decline in natural beauty. Uncontrolled surface coal mining in many regions has resulted in a stark, unjustifiable, and intolerable degradation in the quality of life in local communities (U.S. Senate, 1976a).

In the western coalfields, many of which are in arid or semi-arid areas, the environmental problems associated with surface mining are significant. Erosion rates on western range lands are among the highest in the United States for upland areas not under cultivation. The arid climate does not provide sufficient moisture for a protective vegetal cover. Once this fragile vegetative cover has been disturbed, its restoration is virtually impossible without irrigation. Furthermore, in most of the western coalfields the coal beds that lie close to the surface are also aquifers. Removal of the coal by surface mining operations could intersect such aquifers that are the source of water for many wells. Flow patterns in such aquifers could be changed and some parts undoubtedly could be drained or contaminated, resulting in reduced availability of water for other uses.

In passing SMCRA, Congress recognized that many states already had laws to regulate surface coal mining operations. However, these laws were considered inadequate, or were not fully enforced. Most existing state laws and Federal regulations for surface mining and reclamation were inadequate in that they were tailored to suit ongoing mining practices, rather than requiring modification of mining practices to meet established environmental standards. Regardless of the adequacy of a state's mining and reclamation laws, Congress felt that problems of enforcing such laws frequently stemmed from a lack of funding and manpower to adequately insure compliance. As a result, violations of the law and regulations were frequent.

SMCRA, therefore, established uniform minimum Federal standards for regulating surface mining and reclamation activities throughout the country, on both public and private lands, and for assuring adequate environmental protection from the environmental impacts of surface mining in all states.

The Act has several features directly relevant to the coal management program. While FLPMA and the Federal Coal Lease Amendments Act are applicable only to Federal coal and surface estates, SMCRA applies to all surface mining operations, whether Federal, state, or private. Thus, many of the prior advantages of developing private coal resources (such as reduced administrative burden and related environmental and reclamation standards) have been eliminated. Of additional importance to this statement are the Act's provisions regarding environmental protection performance standards (section 515) and designation of areas unsuitable for surface coal mining (section 522). A synopsis of these sections follows.

Section 515 performance standards are minimum standards applicable to all surface coal mining and reclamation operations. Primary standards are:

- o Maximum utilization and conservation of the solid fuel resource being recovered;
- o Restoration of disturbed land to support the same or better conditions;
- o Restoration of the original land contour;

- Stabilization and protection of all surface areas;
- Preservation and protection of all surface areas;
- Protection of prime farmlands through specific reclamation techniques;
- Minimization of disturbances to the existing hydrological balance;
- Limitation on mining of steep slopes.

Section 522 of SMCRA establishes a procedure to designate lands unsuitable for all or certain types of coal mining operations. Areas may be so designated if, upon petition, it is determined that reclamation of disturbed lands is not economically or technologically feasible. Areas may also be classified unsuitable if mining operations will:

- Be incompatible with existing land use plans;
- Significantly affect fragile or historic lands;
- Result in substantial loss or reduction in the productivity of renewable resource lands;
- Endanger life and property in substantially natural hazard lands.

Unsuitability designations must be preceded by a report addressing an area's potential coal resources, the demand for these resources, and the impact of designation on the environment, the economy, and the supply of coal. The Secretary of the Interior determines unsuitability on Federal lands. The states have authority to determine unsuitability for non-Federal lands.*

Other features of SMCRA relevant to the development of a Federal coal management program are:

- o Authority to exchange Federal lands already under lease but which have been designated as unsuitable for mining;
- o A requirement for the consent of private surface owners before the Department can lease any Federal coal under privately-owned land.

Interim regulations under SMCRA were published in final form in December 1977, and will remain in effect until they are supplanted by a final set of permanent regulations. The Department of the Interior's Office of Surface Mining Reclamation and Enforcement (OSM) drafts of proposed regulations on the permanent regulatory program were made available to the public in July 1978 (U.S. Department of the Interior, 1978). A draft environmental impact statement for the regulations was issued in September 1978.

The impact statement and proposed regulations are incorporated by reference into this document.

1.3.1.4 <u>Mineral Leasing Act for Acquired Lands</u>. The Mineral Leasing Act for Acquired Lands (61 Stat. 913; 30 U.S.C. 351) governs

*The states are expected to be primarily responsible for administration and enforcement of the Act under Federally-approved state programs. The Secretary must approve state programs; the Department will assume administrative responsibilities if a state program under the Act is found to be inadequate.

leasing on Federally acquired lands. The Act requires the consent of the head of the Federal agency having administrative jurisdiction over the lands before a coal deposit can be leased. In addition, the agency head may subject the lessee to certain conditions to insure use of the land for the purposes for which it was acquired. The agency may also sell or convey the land, subject to existing mineral leases. Otherwise, leasing provisions are the same as those for nonacquired lands.

1.3.1.5 Other Relevant Laws. Numerous other Federal laws regulate aspects of coal development and energy conversion. Pertinent laws are summarized in Table 1-4. In addition to these laws, other Federal regulations and state and local laws and regulations may have relevance to the implementation of a Federal coal management program.

1.3.2 Federal Coal Management Interrelations

The jurisdictional interrelationships involved in a Federal coal management program are complex and overlapping. Many Federal departments and agencies are involved through their specific mandates or related authorities. This section summarizes the major points of interaction both within and external to the Department of the Interior.

1.3.2.1 Department of Energy Responsibilities. While many agencies across the Federal structure are involved in coal management activities, Federal coal leasing program would be carried out mainly between agencies in the Department of the Interior and the Department

TABLE 1-4

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

Popular Name	Public Law/U.S. Code Citation	Purpose	Major Relevance
Antiquities Act of 1906	34 Stat. 225; 16 U.S.C. 469	o Regulates antiquities excavation and collection (including fossil remains). o Protects historical values on public land.	o Mitigates potential harm to historical, archaeological, and paleontological resources.
Archaeological and Historical Preservation Act of 1974	93-291; 16 U.S.C. 469	o Provides for recovery of data from areas to be affected by Federal actions.	o Mitigates potential harm to historical and archaeological resources.
Archaeological Salvage Act	74 Stat. 220; 16 U.S.C. 469	o Provides for preservation of data (including relics and specimens) at every Federal construction project.	o Mitigates potential harm to historical and archaeological resources.
Bald Eagle Protection Act of 1969	86-70; 16 U.S.C. 668	o Protects bald eagle and eagle habitat.	o May make certain coal lands unsuitable for development.
Clean Air Act Ammendments of 1977	95-95; 42 U.S.C. 7401, *et seq.*	o Establishes requirements for areas failing to attain National Ambient Area Quality Standards (NAAQS). o Provides for prevention of significant deterioration of areas where air is cleaner than NAAQS. o Modifies 1970 air act provisions regarding Federal facilities; enforcement strategies; coal utilization impacts; and interstate air pollution.	o Limits industrial development within and adjacent to areas exceeding NAAQS and areas preserving clean air quality. o Reduces commercial attractiveness of low-sulphur Western coal as new source standard changed to percent emissions reduction.
Clean Water Act of 1977	95-217; 33 U.S.C. 1251, *et seq.*	o Establishes effluent limitations for new and existing industrial discharges into U.S. waters. o Limitations set for public treatment discharges; with pretreatment by industrial users. o Provides mechanism to restore and maintain integrity of the nations's waters.	o May reduce development options in areas where anti-degradation policy restricts discharges into high quality waters. o Treatment facilities in areas with rapidly expanding infrastructures must meet water quality standards. o Effluent standards apply to coal mining point sources.
Endangered Species Act of 1973	93-205; 16 U.S.C. 1531	o Protects endangered species and critical habitat from impact from Federal activities. o Requires prior consultation with Fish and Wildlife Service.	o May make certain coal lands unsuitable for development.
Fish and Wildlife Coordination Act of 1934	48 Stat. 401; 16 U.S.C. 661	o Requires consultation about actions which might affect habitat of fish or associated wildlife resource.	o Mitigates potential Federal coal development impacts.
Historic Preservation Act of 1966	89-665; 16 U.S.C. 470	o Establishes system of classifying properties on or eligible for inclusion on Historic Register. o Mandates Federal agency consultation with Advisory Council and State historic Preservation Officers.	o Mitigates potential harm to historical and archaeological values

TABLE 1-4 (Continued)

FEDERAL LAWS AFFECTING COAL DEVELOPMENT AND ENERGY CONVERSION

Popular Name	Public Law/U.S. Code Citation	Purpose	Major Relevance
National Environmental Policy Act of 1969	91-190; 42 U.S.C. 4321, et seq.	o Makes environmental protection part of the mandate of every Federal agency. o Requires impact statements for major Federal actions with potentially significant impacts.	o Provides legislative authority to control energy development on environmental grounds. o Impact statement process must be integral part of coal leasing system.
Noise Control Act of 1972	92-574; 42 U.S.C. 4901, et seq.	o Requires publication of information on limits of noise required to protect public health and welfare. o Pre-empts local control of railroad equipment and yard noise emissions.	o Regulations may be proposed to control coal mining areas and activities.
Resource Conservation and Recovery Act of 1976	94-580; 42 U.S.C. 6901, et seq.	o Establishes guidelines for collection, transport, separation, recovery and disposal of solid waste. o Creates major Federal hazardous waste regulatory program. o Provides assistance to establish state or regional solid waste plans.	o Mining locations may be affected by EPA regulations governing disposal of coal mining wastes. o Coal industry faced with stringent permit requirements if coal wastes classified by EPA as hazardous.
Safe Drinking Water Act of 1977	95-190; 42 U.S.C. 300	o Establishes mechanism for National Primary Drinking Water Standards. o Protects sole source aquifers	o EPA conducting study of the impacts of pits, ponds, lagoon, etc. on underground water supplies for public water systems.
Soil and Water Resources Conservation Act of 1977	99-192; 16 U.S.C. 2001, et seq.	o Requires appraisal by Secretary of Agriculture of information and expertise on conservation and use of soils, plants, woodlands, etc.	o Provides opportunity for expanded data base
Multiple-Use Sustained Yield Act of 1960	86-519; 16 U.S.C. 528-531	o Requires management of national forests under principles of multiple use so as to produce a sustained yield of products and services.	o Mandates land management practices similar to those required under the Department's coal management program.
National Forests Management Act of 1976	95-233; 16 U.S.C. 472a	o Establishes guidelines for the Secretary of Agriculture for the sale of forest products from the national forest system.	o Principles should be considered in BLM's land use planning process.
Department of Energy Organic Act of 1977	95-91; 42 U.S.C. 7101	o Transfers certain coal management functions from DOI to DOE. o DOE determines long-term national coal production goals. o Gives DOE responsibility to establish due diligence and production requirements.	o Limits coal management authority exercised by the Department of the Interior. o Requires program establish proper coordination mechanisms.

of Energy (DOE). The Department of Energy was established in August 1977 following enactment of the Department of Energy Organization Act (P.L. 95-91; 42 U.S.C. 7101, et seq.). The DOE Act was passed in response to the nation's increasing shortage of nonrenewable energy resources and to the national security implications of increasing dependence on foreign energy supplies. Under the Act, many of the energy-related functions of a myriad of agencies were consolidated under a single departmental organization. It was envisioned that the reorganization would foster cooperation among Federal, state, and local governments in the development of national energy programs.

Prior to the Act, the Department of the Interior had exclusive jurisdiction over Federal coal leasing decisions for public lands administered by the Department. However, the DOE Act transferred to the Department of Energy authority to promulgate regulations for:

- o Fostering competition for Federal leases;
- o Implementing alternative bidding systems for the award of Federal leases;
- o Establishing diligence requirements for coal development operations on Federal leases;
- o Setting rates of production for Federal leases;
- o Specifying procedures, terms, and conditions for the acquisition and disposition of Federal royalty interests taken in kind.

Activities specified in the DOE Act which the Secretary of the Interior will remain solely responsible for are:

- o Issuance and supervision of Federal leases;
- o Enforcement of all regulations applicable to leasing of mineral resources, including but not limited to lease terms and conditions and production rates.

The Department is also required to provide DOE not less than 30 days in which to disapprove any proposed lease term or condition which relates to any matter which DOE has authority to promulgate regulations under the DOE Act. No such term or condition may be included in a lease if it is disapproved. Reasons for such disapproval and acceptable alternatives must be furnished in writing to the Department by DOE.

More detailed interpretations of the above responsibilities are still being worked out within the two departments.

1.3.2.2 <u>DOE-Interior Leasing Liaison</u>. When DOE was organized in the fall of 1977, the Office of Leasing Policy Development was established and staffed to manage DOE's responsibilities for participating in Federal energy leasing programs. This office is responsible for drafting regulations to implement leasing responsibilities addressed in the prior section and for fostering close coordination with the Department of the Interior and other agencies. A Leasing Liaison Committee was authorized by the DOE Organization Act. This committee has been established and now serves as an executive level coordinating mechanism on Federal energy leasing and other interagency energy programs.

The Department of Energy's Office of Coal Supply Development was established to monitor, from a broad viewpoint, restraints to coal supply. The office has no direct mandate in coal leasing, but has been looking at coal supply as a system. Its aim is to isolate potential constraints and attempt to ameliorate these by alerting appropriate policy offices and by drafting corrective legislation. Some subjects currently under study by the office include ascertaining the effect of SMCRA on coal production; transportation problems (rising rates, equipment shortages); manpower demand in the mines; coal leasing (or lack of it) as a potential constraint for competition; and constraints in supply from growing production costs.

1.3.2.3 Department of the Interior's Coal Management Functions. The division of the Department of the Interior's functions and responsibilities concerning management of Federal coal between the OSM, USGS, and BLM was revised in a jointly signed memorandum in July 1978. Table 1-5 presents the three agencies' broad coal management responsibilities. The table is divided into three sections--Pre-leasing Functions, Post-leasing Pre-Mining Functions, and Functions and Responsibilities During Mining Operations. It indicates the prime responsibility, joint responsibility, consulting, and concurrence requirements of the departmental agreement.

TABLE 1-5

- DEPARTMENT OF THE INTERIOR -

DIVISION OF FUNCTIONS AND RESPONSIBILITIES CONCERNING MANAGEMENT OF FEDERAL COAL BETWEEN THE OFFICE OF SURFACE MINING, THE U.S. GEOLOGICAL SURVEY AND THE BUREAU OF LAND MANAGEMENT (OSM, GS AND BLM)

FUNCTIONS	PRIME RESPONSIBILITY	JOINT RESPONSIBILITY	IN CONSULTATION WITH	CONCURRENCE FROM
A. PRE-LEASING FUNCTIONS				
1. Evaluate coal resources	GS	—	—	—
2. Petition process - designation of Federal lands unsuitable for all or certain types of surface coal mining operations	OSM - Receives petitions - Conducts hearings - Issues decisions	Surface managing agencies - Overall planning - Management of public lands	—	—
3. Federal coal lands review	BLM	BLM - applies criteria in determination of suitability	OSM, GS & other surface managing agencies	OSM - establishes ground rules; criteria Federal coal lands review
4. Review process and petition process for designation of Federal lands unsuitable for coal mining	BLM	—	OSM, GS & other agencies as appropriate	—
5. Preparation, regional EIS, or site-specific pre-lease EIS concerning lease tract selection	BLM lead agency (unless other agency designated lead agency) - Relating to lease tract selection	—	OSM, GS & other appropriate agencies; state and local interests	—
6. Preparation, special lease terms and conditions	BLM	—	OSM (responsibilities under SMCRA - to administer protection requirements of the act) GS (responsibilities under the MLA)	—
7. Act as Secretary's official representative in dealing with lease applicants	BLM	—	—	—
8. Surface owner consent	BLM (lease tract selection function)	—	—	—
B. POST-LEASING PRE-MINING FUNCTIONS				
1. Prepare recommendations on applications for use of Federally owned surface over leased coal for uses unrelated to rights granted under Federal coal lease	—	OSM & GS (BLM receives applications) - prior to receipt of coal mining plan it is solely GS responsibility to report on surface use application	—	After receipt of coal mining plan, GS retains responsibility with OSM concurrence
2. Delineation of "area of operations" (AO) on coal leases and approved surface use areas within the AO	GS - retains responsibility until mining plan is received	—	—	Then OSM assumes responsibility with concurrence of BLM and GS
3. Review, approval of mining plans and major modifications; lead agency for preparation of site specific EA/EIS and coordination with other agencies outside DOI	OSM (formerly assigned to GS because essential function to OSM under Sec. 201, SMCRA)	—	—	—
4. Responsibility for all nonlessee activity on lease land prior to operations	BLM	—	—	—

TABLE 1-5 (Continued)

.- DEPARTMENT OF THE INTERIOR -

DIVISION OF FUNCTIONS AND RESPONSIBILITIES CONCERNING MANAGEMENT OF FEDERAL COAL
BETWEEN THE OFFICE OF SURFACE MINING, THE U.S. GEOLOGICAL SURVEY AND THE BUREAU OF LAND MANAGEMENT (OSM, USGS AND BLM)

(Continued)

FUNCTIONS	RESPONSIBILITY	JOINT RESPONSIBILITY	IN CONSULTATION WITH	CONCURRENCE FROM
C. FUNCTIONS AND RESPONSIBILITIES DURING MINING OPERATIONS				
1. Act as Secretary's representative in dealing with lessees and/or operators during operations	(formerly GS & BLM)	GS retains production functions OSM assumes environmental and enforcement functions BLM retains nonmining functions outside AO, including rights-of-way and ancillary activities related to mining GS & BLM inspection in connection with GS, BLM functions, are coordinated with OSM inspections except BLM inspections outside the AO GS makes royalty audits and other nonfield inspections independent of OSM	—	—
2. Take necessary action in emergency environmental situation	(formerly GS & BLM)	OSM has primary emergency authority BLM & GS have such authority when OSM inspectors are unable to take action before significant harm or damage will occur OSM has authority since this function applies to emergency actions for environmental damage GS & BLM retain their present procedures for emergencies involving loss, waste, or damage to coal and other mineral resources and to other MLA functions)	—	—
3. Conduct inspection prior to abandonment and specify and approve abandonment procedures	OSM (primary authority to approve abandonment procedures and approve abandonment of operations)	OSM, GS, BLM - all have joint abandonment inspection responsibility	—	BLM concurrence in approval of compliance, special requirements: protection of natural resources & post-mining land use of affected lands GS concurrence: compliance with production and coal resource recovery requirements
4. Release of performance bond	BLM	—	—	OSM & GS concurrence during initial regulatory program

The Department's Office of Coal Leasing, Planning and Coordination serves as the focal point for developing and carrying out the Department's coal policy review and related development of a program for management and leasing of Federally-owned coal resources in accordance with the President's directives as contained in the National Energy Plan and Environmental Message. The Office is responsible for developing and coordinating Departmental policies affecting Federal coal management. It assists the Secretary, through the Assistant Secretary for Land and Water Resources, in implementing the Federal coal management responsibilities vested in the Department under the Mineral Leasing Act of 1920 and the Federal Coal Leasing Amendments Act of 1975.

Other Department agencies with lesser coal related responsibilities are the National Park service and the Heritage Conservation and Recreation Service. The U.S. Fish and Wildlife Service conducts surface mining studies and monitoring relating to impact on wildlife in general and in endangered species in particular. These studies are used to assess and predict coal-related effects on fish, wildlife, and their habitats on Federal, state and private lands.

Coal activities in the U.S. Bureau of Mines include developing advanced coal mine health and safety research and conducting demonstration projects on backfilling and subsidence.

1.3.2.4 Other Federal Agencies with Coal Related Responsibilities. Table 1-6 summarizes relevant coal management functions within the

TABLE 1-6

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
1. Energy Department (including functions relating to coal from ERDA, FEA and FPC; and some from Interior)	Ass't Secretary, Energy Technology	Fossil Energy Program Office	o Coal mining technology development o Coal utilization R&D (e.g., gasification; liquefaction) o Coal cleaning technology
	Ass't Secretary, Resource Application	Fossil Energy Division	o Coal utilization technology demonstrations o Leasing of publicly-owned coal lands (with Interior) o Forced use of coal by utilities and industry through regulation o Coal loan guarantee program
	Ass't Secretary, Environment	Biomedical and Environmental Research Division Control Technology Division	o Biomedical and environmental effects research o Environmental control technology
	Administrator, Energy Regulatory Administration	Energy Regulatory Administration	o Regulation, conversion to coal and use of coal o Regulation of gas from coal
	Administrator, Energy Information Administration	Energy Information Administration	o Data collection and analysis relating to coal
	Director, Energy Research		o Coordinates all energy research, presumably including coal
	Assignment not yet clear		o Grants for University Coal Research Laboratories (title VIII of H.R. 2)
2. Interior Department	Ass't Secretary, Energy and Minerals	Bureau of Mines	o Develop mining technology o Mine reclamation demonstrations o Coal mine health and safety R&D o Technology for cleaning coal

TABLE 1-6 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
		Geological Survey	o Coal resource investigations o Coal hydrology investigations o Classification of publicly-owned lands o Regulation of operations on leased coal lands o Environmental studies related to coal
		Office of Surface Mining	o Regulate surface mining o Regulating surface effects of underground mining o Assistance to states for mining and reclamation programs o Assistance for state mining and mineral research institutes o Reclamation of abandoned mined areas o Develop mining technology, production, environment, health and safety
	Ass't Secretary, Land and Water	Bureau of Land Management	o Leasing and operations--publicly-owned coal lands (with DOE) o Environmental studies relating to coal
	Ass't Secretary, Fish and Wildlife and Parks	U.S. Fish and Wildlife Service	o Surface mining studies relating to wildlife
3. Agriculture Department	Ass't Secretary, Conservation, Research and Education	Forest Service	o Leasing and leasing operations on publicly-owned lands controlled by Department o Mined land reclamation program o Land management planning and environmental impact statements - National forests
		Soil Conservation Service	o Technical assistance on conservation planning, soil surveys, plant materials, river basis surveys, and hydrological studies

TABLE 1-6 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
		Science and Education Admin.	o Mined land reclamation research
	Ass't Secretary, Rural Development	Rural Electrification Administration	o Loans and loan guarantees for electrical generating, transmission and distribution systems
4. Labor Department	Ass't Secretary, Mine Safety and Health	Mine Safety and Health Administration*	o Regulation of coal mine safety and health
	Ass't Secretary, Employment	Office of Workers' Compensation	o Pneumoconiosis benefits
5. Transportation Department		Federal Railroad Administration	o Railroad assistance programs, including revitalization, important to coal transportation
6. Commerce Department	Ass't Secretary for Economic Development	Economic Development Administration	o Assistance for planning for socioeconomic planning for energy development
7. Health, Education and Welfare Department	Ass't Secretary for Health	National Cancer Institute	o Biomedical effects research
		National Institute for Environmental Health Sciences	o Biomedical and environmental effects relating to coal
		National Institute for Occupational Safety and Health	o Biomedical and environmental effects research (e.g., coal workers occupational diseases)
8. Environmental Protection Agency (EPA)	Ass't Administrator Air and Waste Management	Office of Air Quality Planning and Standards	o Air quality standards and regulations
	Ass't Administrator, Water and Hazardous Materials	Office of Water Planning and Standards	o Water quality standards and regulations
		Office of Toxic Substances	o Toxic materials regulation
	Ass't Administrator, Enforcement	Office of General Enforcement Office of Water Enforcement	o Enforcement of EPA standards and regulations

*Formerly Mining Enforcement and Safety Administration (MESA)

TABLE 1-6 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES
AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
	Ass't Administrator, Research and Development	Office of Health and Ecological Effects	o Biomedical and environmental effects research
		Office of Energy, Minerals and Industry	o Environmental control technology development o Coal utilization R&D o Coal cleaning technology
9. Corps of Engineers	(Reports to Secretary of the Army)	Civil Works	o Waterways projects important to coal transportation o Regulation relating to standards and criteria on design, location, construction, maintenance, enlargement, modification, removal and abandonment of new and existing coal mine waste piles
10. Interstate Commerce Commission			o Regulation of railroads
11. Appalachian Regional Commission			o Mine reclamation studies and demonstrations o Supplemental funding for variety of activities (technology, economic assistance, etc.)
12. Tennessee Valley Authority (TVA)			o Surface mine reclamation o Coal technology R&D (ammonia from coal)
13. Treasury Department			o Tax policy and collection
14. Justice Department			o Litigation involving public lands
15. Housing and Urban Development			o Housing and development of new communities
16. Community Services Administration			o Assistance to solve economic problems in communities

TABLE 1-6 (Continued)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION
17. Small Business Administration			o Small business loans for coal-related facilities, machinery, equipment
18. National Science Foundation			
		Other Independent Commissions	
19. Federal Trade Commission			o Promotes fair competition; prevents restraint of trade, and price fixing
20. Securities and Exchange Commission			o Regulates public utility holding company systems; reviews mining disclosures
21. Federal Energy Regulatory Commission			o Has regulatory authority over gasification in interstate sales of power; establishes and enforces rates and charges for electric energy transmission and sale
22. Appalachian Regional Commission			o As a joint Federal-state partnership this agency is concerned with 13 states, AL, GA, KY, MD, MS, NY, NC, OH, PA, SC, TN, VA, WV in economic development of highways, access roads, housing, reclamation of land damaged by past mining, water resources survey

o And also various water resources and regional agencies and commissions: Water Resources Council, Susquehanna River Basin Commission, Delaware River Basin Commission, Missouri River Basin Commission, Regional Action Planning Commissions: Coastal Plains, Four Corners, Old West, Ozarks and Upper Great Lakes REgions, involved with coal and mining planning water resources, environmental and economic impacts, regional developments.

TABLE 1-6 (Concluded)

PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN ACTIVITIES AFFECTING THE PRODUCTION, TRANSPORTATION AND UTILIZATION OF COAL

DEPARTMENT OR AGENCY	ASSISTANT SECRETARY OR ASSISTANT ADMINISTRATOR	MAJOR ORGANIZATIONAL UNIT WITHIN THE DEPARTMENT OR AGENCY (BUREAU, ETC.)	PROGRAM OR FUNCTION

- o Activities of organizations and agencies within the Executive Office of the President such as:
  - o The Office of Management and Budget (OMB)
  - o The Domestic Policy Staff
  - o Council on Environmental Quality (CEQ)
  - o Office of Science and Technology Policy (OSTP)
- o Activities of the Departments of Treasury (e.g., tax policy and collection, proposed tax rebates for coal utilization facilities) and Justice (e.g., litigation involving public lands)
- o Activities of Ass't Secretaries and Administrators having major activities relating to coal but not in line program activities; e.g., those concerned with policy analysis, planning, management, budgeting, general counsel
- o Activities of numerous additional agencies or elements of agencies that participate in or comment upon Environmental Impact Statements prepared by the organizations listed on the chart above.
- o Energy related basic research activities, such as that of Energy Department, National Science Foundation and Bureau of Standards (Commerce Department)
- o Agencies purchasing coal for their use, such as TVA and Department of Defense
- o Activities -- usually studies -- of the agencies of the Legislative Branch:
  - o Library of Congress
  - o General Accounting Office (GAO)
  - o Office of Technology Assessment (OTA)
  - o Congressional Budget Office (CBO)

Federal structure. Policy and evaluation functions relating to coal, not previously addressed, are assigned within the Executive Office of the President to the Office of Management and Budget (OMB), the Council of Environmental Quality (CEQ), the Domestic Policy Staff, the National Security Council (NSC), and the Office of Science and Technology Policy (OSTP).

The Department of Agriculture, U.S. Forest Service, has been given added responsibility relating to coal management functions through the Federal Coal Lease Amendments Act of 1975. Under the Act, the Secretary of Agriculture has consent authority for Federal leases on lands over which the Secretary has jurisdiction. The Secretary may add terms and conditions to coal leases on these lands to protect resource and environmental values. This authority extends to allowing the Secretary, through the U.S. Forest Service, to concur in the mining and reclamation plans for Federal leases.

New responsibiliites have also been mandated to the Soil Conservation Service (SCS), including assisting with identification of prime farmlands within areas that may be surface mined in the future, and in reviewing and commenting on permits for surface mining which involve prime farmland. SCS is also authorized to review and comment on state reclamation plans.

Legislative organizations with coal management involvement are:

- o Library of Congress, Congressional Research Service;
- o General Accounting Office;

- Congressional Budget Office;
- Office of Technology Assessment.

These organizations provide research monitoring and oversight capabilities for the U.S. Congress.

1.4 EXISTING ENERGY POLICIES

1.4.1 Role of Coal in National Energy Policy

In April 1977, President Carter released the Administration's National Energy Plan (NEP), which combines legislative, administrative, and budgetary proposals aimed at solving the Nation's energy crisis. The following seven energy goals for 1985 were announced:

- Reduce total energy growth to below 2 percent/year;
- Reduce oil imports below 6 million barrels a day;
- Reduce gasoline consumption by 10 percent from 1977 levels;
- Increase coal production by at least 400 million tons over 1976 levels;
- Insulate 90 percent of all buildings;
- Use solar energy in 2.5 million homes;
- Acquire a strategic oil reserve of 1 billion barrels of oil.

An important element of the NEP is the belief that coal must be the fuel which makes possible a reduction in the U.S. economy's energy related uses of oil and gas. The National Energy Plan sets goals for replacing oil and gas with coal and other energy alternatives. Meeting those goals will require increases in the production of coal, with the predicted added production ranging from 400 million more tons per year to 600 million more tons per year, or a possible doubling of 1977 annual production by 1985.

The President also stressed that projected increases in coal production can and must take place without increasing the damage caused by traditional coal mining and burning practices. In his environmental message of May 23, 1977, the President said:

> "The newly enacted Coal Leasing Amendments and the Federal Land Management and Policy Act provide the Secretary of the Interior with the necessary authority to carry out environmentally sound, comprehensive planning for the public lands. His duty now is to implement an affirmative program for managing coal lands and associated resources in a manner that fully protects and public interest and respects the rights of private surface owners."

Following this message, the President, by memorandum of May 24, 1977, instructed the Secretary of the Interior to "manage the coal leasing program to assure that it can respond to reasonable production goals by leasing only those areas where mining is environmentally acceptable and compatible with other land uses."

The President further directed that the Department "scrutinize existing Federal coal leases (and applications for preference right leases) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications." The Department was also instructed by the President to review the basis for granting or denying preference right leases and to propose legislation authorizing the Department to condemn outstanding leases upon payment of reasonable compensation, if necessary, to prevent unacceptable environmental damage. Implementation of these Presidential directives are addressed in subsequent chapters of this statement.

1.4.2 Congressional Action

Prior Congressional action in the coal management area was addressed previously in terms of major legislative proposals (see section 1.3). In the near term, Congressional action on energy policy matters will focus on the President's proposed National Energy Act.

The National Energy Act was submitted to Congress on April 29, 1977, in response to the President's April 20, 1977 energy message to a joint session of Congress. The Act was then divided into five major legislative initiatives to correspond to the jurisdictions of appropriate standing committees. Summaries of these bills, as agreed to by House and Senate conferees, follow.

Conservation. The Energy Conservation Bill Agreement contains incentives to reduce residential energy use. The bill would provide grants for weatherizing lower income homes and grants to states to improve the energy efficiency of schools, hospitals, and municipal buildings. A $5 billion program for Federally subsidized energy conservation loans to elderly and moderate income families would be provided. Finally, the bill would establish a program requiring utilities to inform their customers of suggested energy conservation and solar energy measures. These measures could indirectly affect coal use by potentially reducing electrical demand from utilities.

Coal Conversion. The Coal Conversion Act would prohibit use of oil or natural gas in new utility generation facilities or in new industrial boilers, gas turbines, internal combustion, and combined cycle units with a capacity greater than 10 megawatts, unless exemptions are granted by DOE. For existing power plants and industrial facilities, DOE could require conversion to coal and other fuel use to require use of coal-oil mixtures or alternative fuels. An $800 million loan program would assist companies to raise necessary funds for pollution control.

Utility Rate Reform. The Public Utility Rate Reform Bill would establish eleven rate-making standards as voluntary guidelines for states to encourage conservation (including time-of-day rates, seasonal rates, cost of service pricing, and interruptible rates). State regulatory authorities and utilities would be required to formally consider standards within prescribed periods. The bill also would require the Federal Energy Regulatory Commission to prescribe rules favoring industrial cogeneration facilities.

Coal use could be effected by the bill through a levelization of electrical demand, thereby reducing the number of generating plants needed to supply peaking power.

Natural Gas. The Natural Gas Bill is particularly significant in that it would settle a 39-year confrontation between natural gas producers and consumers over the question of natural gas price controls. It would provide continued controls through 1985 with appropriate safeguards beyond that period of time. The controlled, but escalating, price would substantially increase the incentives for new gas production. Most importantly, the bill would (1) create a single national market for natural gas production; (2) increase production; and (3) increase producer revenues because of the ability of all producers to help satisfy the demand for natural gas in the interstate market. The one-to-two trillion cubic feet per year of extra gas that would flow into the interstate market would replace up to one million barrels per day of foreign oil imports.

Tax Incentives Act. The fifth part of the National Energy Act, the Energy Production and Conservation Tax Incentives Act, contains in the House Bill most of the President's proposed program, including a crude oil conservation tax, an industry and utility oil and gas user tax, and a "gas guzzler" tax.

The Senate measure includes mainly tax incentives for business conversion to other fuels, conservation, and production of alternative sources of energy. It contains an industry and utility gas user tax which applies to boiler use only.

As of September 21, 1978, the National Energy Act was still pending in Congress. It is not known at this time which provisions will be approved by both Houses or if the Act will be signed into law during the current term of Congress. However, given the importance of the Act, it is likely that the Act's status will change in the time between the drafting of this section and the release of this impact statement for public review.

1.4.3 Department of Energy Policy

The Department of Energy's coal policy was set by the President in his 1977 National Energy Plan (NEP) in which coal was emphasized as a vital component of the Administration's overall energy program.

The NEP indicated further that western coal should play a major role in meeting the National Energy Plan's 1985 production goal of 1.2 billion tons. DOE's responsibility to identify future national energy needs includes the role of including what contribution coal will provide (both Federal and non-Federal) in meeting those energy requirements.

The Department of Energy's projections for 1985 and 1990 coal production and use are discussed in detail in Chapter 2. These projections forecast coal production from the six major western coal producing states (Montana, North Dakota, Wyoming, Colorado, Utah and New Mexico), ranging from a low of 297 million tons to a maximum of 436 million tons in 1985 (U.S. Department of Energy, 1978d).

The Department of Energy emphasizes that any production shortfall estimates that result in gaps between production projections and production commitments to date do not necessarily indicate that they should be satisfied from new leasing. Instead, expansion of existing approved mining operations, development of existing leases not now in production, expanded development of non-Federal coal, new leasing, or a combination of these optional policies may be required. In fact, the Deputy Secretary of Energy in May 1978 told a House Interior Subcommittee that no additional coal leasing is needed to meet the President's 1985 coal production goals (Environmental Reporter, 1978c). According to the Deputy Secretary, enough of the billions of tons of coal on existing Federal leases is recoverable to meet the NEP's coal production goals.

The Department of Energy's Office of Policy and Evaluation provided the following objectives of DOE policies relating to coal:

- o Stimulate the use of coal as a substitute for oil and natural gas;
- o Promote direct combustion of coal;
- o Promote development of technology to convert coal to heavy liquids as a substitute for residual fuel oil;
- o Develop technology to produce solvent refined coal for utilities and retrofit utilization;
- o Support continued research and incentives for coal gassification;
- o Emphasize conversion of coal into gasoline - quality liquids or distillate oil.

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CHAPTER 2

This document is a preliminary working draft of the Department of the Interior's Coal Management Environmental Statement. The document is intended for internal review purposes. It will be revised in response to reviewer comments. In addition, internal analysis and revision of materials are continuing.

CHAPTER 2

THE NATIONAL ENERGY ROLE FOR WESTERN AND FEDERAL COAL

2.1 INTRODUCTION

More than 50 percent of the coal reserves in the United States are located west of the Mississippi River. Until recently, western coal has played only a minor role in National coal production. In the past few years, however, western coal production has increased very rapidly, reaching 166 million tons in 1977, or 24 percent of total United States coal production. This upward trend is expected to continue, as coal will play an increasingly important role in providing the Nation's energy supplies, especially for electric power generation.

Of western coal reserves, 60 percent are owned by the Federal Government and an additional 20 percent are dependent on the availability of complementary Federal coal for their production.

Federally owned coal is concentrated in the key western coal producing states of Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming, which together accounted for 71 percent of 1977 overall western production. Because of the large Federal ownership, development of western coal is very closely linked with the development of Federal coal.

The Federal coal leasing program is the instrument by which needed Federal coal is made available for private development.

2.2 COAL RESERVES AND CHARACTERISTICS

In describing the production potential of coal, it is customary to distinguish between coal "resources" and "reserves." The term "resource" describes the estimated total amount of coal for which economic extraction could eventually become feasible. The coal "reserve" is that limited portion of the resource which is judged to be minable at a profit under existing market conditions. The total coal resource of the United States is estimated to be 3.97 trillion tons. Of this resource, only 438 billion tons have thus far been identified with enough certainty and with sufficient economic prospects to be included in the reserve category.

For this impact statement, ten coal regions were selected as basic units for analysis. These regions are shown in Figure 2-1. The regions are smaller in the West than in the East. This provides the greater geographic resolution needed because the western regions are the primary focus of this impact statement. The ten regions contain over 92 percent of the reserve base of the United States and account for over 98 percent of current U.S. coal production.

Table 2-1 shows the estimated coal reserve base for each of the ten impact statement regions. The 1976 regional production levels are also shown. As the data shows, approximately 48 percent) of the Nation's coal reserves are located west of the Mississippi River. Of the total reserves in the West, a large

Source: Adapted from U. S. Geological Survey Map, "Coal Fields of the United States," 1960.
NOTE: Shaded areas indicate coal regions described in this statement.

FIGURE 2-1

TEN COAL SUPPLY REGIONS OF THE UNITED STATES

TABLE 2-1

REGIONAL AND U.S. COAL RESERVE BASE AND PRODUCTION LEVEL

REGION	RESERVE BASE (b) (millions of tons)			PRODUCTION (a) 1976 (thousands of tons)		
	DEEP	SURFACE	TOTAL	DEEP	SURFACE	TOTAL
1. Appalachian						
Northern	59,266	6,292	65,558	92,028	83,931	175,959
Central	27,321	7,589	34,910	125,928	80,889	206,817
Southern	1,963	250	2,213	8,605	14,783	23,388
Subtotal	88,550	14,131	102,681	226,561	179,603	406,164
2. Eastern Interior	71,110	17,801	88,911	55,366	81,075	136,441
3. Western Interior	10,125	5,467	15,592	339	11,111	11,450
4. Texas Gulf	0	3,271	3,271	0	14,063	14,063
5. Powder River	86,500	56,024	142,524	119	37,290	37,409
6. Green River-Hams Fork	13,396	2,147	15,543	768	24,916	25,684
7. Fort Union	0	23,101	23,101	0	11,414	11,414
8. San Juan River	1,906	2,258	4,164	17	8,824	8,841
9. Uinta	5,656	308	5,964	10,144	0	10,144
10. Denver-Raton Mesa	3,865	0	3,865	1,453	409	1,862
Total of 10 Regions	281,108	124,508	405,616	294,767	368,705	663,472
U.S. Total (c)	296,976	141,361	438,337	294,771	383,914	678,685
Regions as Percent of U.S.	94.7	88.3	92.6	100	96.0	97.8

(a) Source: Coal--Bituminous and Lignite (preliminary) U.S. Department of the Interior Bureau of Mines.

(b) U.S. Department of the Interior, 1977b, Demonstrated Coal Reserve Base of the U.S. as of January 1, 1976. Mineral Industry Surveys, Bureau of Mines, Washington, D.C.

(c) Alaska coals and anthracite coals not included.

proportion (66 percent) are located in one region, the Powder River Basin. The next most important western regions are the Fort Union (10 percent of western reserves), Western Interior (7 percent) and Green River-Hams Fork (7 percent) Regions. In the East, reserves are divided almost equally between the Appalachia (54 percent) and the Eastern Interior (46 percent) regions.

The proportion of surface minable coal reserves in the West is significantly larger than the proportion for the Nation's total surface reserves. Seventy-four percent of the Nation's surface minable reserves (as compared with 48 percent of all reserves) are located west of the Mississippi River. Western surface minable reserves in many cases are close to the surface, and lie in thick beds by eastern standards. This generally results in relatively lower mining costs. The Powder River Basin contains 40 percent of the United States' surface minable reserves, and has an exceptionally high average seam thickness of 25 feet. Another western region, the Fort Union Region, contains 16 percent of total National reserves of surface minable coal, although largely comprised of less valuable lignite.

Surface mining of coal has increased steadily as a proportion of overall coal production. In the nineteenth century, all mining was by underground methods. However, by 1950 surface mining was 76 percent overall production. By 1976, it was 43 percent.

There are substantial variations in the amount of energy (i.e., Btu's) generated per unit of coal. Eastern coal is almost entirely bituminous coal (94 percent) and anthracite, and accordingly has a higher heat content than western coal. Western coals, on the other hand, are predominantly subbituminous and lignite. Of total western coal, only 10 percent is the more desirable bituminous, with 75 percent being subbituminous and 15 percent lignite. The overall distribution of coal types by state is shown in Table 2-2.

Sulfur content is a key factor in assessing the value of coal. The sulfur content of coal in the United States generally ranges from 0.2 to 7.0 percent by weight. The presence of sulfur lowers the quality of coke and the resulting iron and steel products. Sulfur also contributes to corrosion and to the formation of boiler deposits. Sulfur compounds in spoil banks inhibit the growth of vegetation. These compounds may react with water to form sulfuric acid, which is the main deleterious compound in acid mine waters contributing to stream pollution. Most importantly, sulfur compounds are a major source of air pollution, particularly in the form of sulfur dioxide.

The percentage of sulfur and of pyritic sulfur is highest in the Appalachian and Eastern Interior Regions. Western Interior Region coals are also relatively high in sulfur content. The sulfur percentage is relatively low in the subbituminous coals and lignite of the western states which contain large Federal coal reserves. Because of the varying heat (Btu) values of coal, a given sulfur percentage by weight involves varying sulfur content by energy provided. But generally coal with less than 1 percent sulfur is

TABLE 2-2

DEMONSTRATED RESERVE BASE[a] OF COALS IN THE UNITED STATES ON JANUARY 1, 1976
POTENTIALLY MINABLE BY UNDERGROUND AND SURFACE METHODS[b]
(million short tons)

State	Anthracite Under.	Anthracite Surface	Bituminous Under.	Bituminous Surface	Subbituminous Under.	Subbituminous Surface	Lignite Under.	Lignite Surface	Under. Total	Surface Total	State Total
Alabama	-	-	1,724.2	284.4	-	-	-	1,083.0	1,724.2	1,367.4	3,091.6
*Alaska	-	-	617.0	80.5	4,805.9	640.7	-	14.0	5,422.9	735.2	6,158.1
*Arizona	-	-	-	325.5	-	-	-	-	-	325.5	325.5
Arkansas	88.6	7.8	163.1	107.0	-	-	-	25.7	251.7	140.5	392.2
*Colorado	25.5	-	8,467.9	676.2	3,972.1	149.2	-	2,965.7	12,465.5	3,791.1	16,256.6
Georgia	-	-	0.5	0.4	-	-	-	-	0.5	0.4	0.9
Idaho	-	-	4.4	-	-	-	-	-	4.4	-	4.4
Illinois	-	-	53,128.1	14,841.2	-	-	-	-	53,128.1	12,841.2	67,969.3
Indiana	-	-	8,939.8	1,774.5	-	-	-	-	8,939.8	1,774.5	10,714.3
Iowa	-	-	1,736.8	465.4	-	-	-	-	1,736.8	465.4	2,202.2
Kansas	-	-	-	998.2	-	-	-	-	-	998.2	998.2
Kentucky, East	-	-	9,072.5	4,467.6	-	-	-	-	9,072.5	4,467.6	13,540.1
Kentucky, West	-	-	8,510.4	3,950.4	-	-	-	-	8,510.4	3,950.4	12,460.8
Louisiana	-	-	-	-	-	-	-	(c)	-	(c)	(c) 28
Maryland	-	-	913.8	134.5	-	-	-	-	913.8	134.5	1,048.3
Michigan	-	-	125.2	1.6	-	-	-	-	125.2	1.6	126.8
Missouri	-	-	1,418.0	3,596.0	-	-	-	-	1,418.0	3,596.0	5,014.0
*Montana	-	-	1,385.4	-	69,573.5	33,843.2	-	15,766.8	70,958.9	49,610.1	120,569.0
*New Mexico	2.3	-	1,258.8	601.1	889.0	1,846.8	-	-	2,150.1	2,447.9	4,598.0
North Carolina	-	-	31.3	0.4	-	-	-	-	31.3	0.4	31.7
*North Dakota	-	-	-	-	-	-	-	10,145.3	-	10,145.3	10,145.3
Ohio	-	-	13,090.5	6,139.8	-	-	-	-	13,090.5	6,139.8	19,230.3
Oklahoma	-	-	1,192.9	425.2	-	-	-	-	1,192.9	425.2	1,613.1
*Oregon	-	-	(c)	-	14.5	2.9	-	-	14.5	2.9	17.4
Pennsylvania	6,966.8	142.7	22,335.9	1,391.8	-	-	-	-	29,302.7	1,534.5	30,837.2
*South Dakota	-	-	-	-	-	-	-	426.1	-	426.1	426.1
Tennessee	-	-	627.2	337.9	-	-	-	-	627.2	337.9	965.1
Texas	-	-	-	-	-	-	-	3,181.9	-	3,181.9	3,181.9
*Utah	-	-	6,283.8	267.9	1.1	-	-	-	6,284.9	267.9	6,552.8
Virginia	137.5	-	3,277.0	888.5	-	-	-	-	3,414.5	888.5	4,303.0
*Washington	-	-	255.3	-	835.3	481.5	-	8.1	1,090.6	489.6	1,580.2
West Virginia	-	-	33,457.4	5,149.1	-	-	-	-	33,457.4	5,149.1	38,606.5
*Wyoming	-	-	4,002.5	-	27,644.8	23,724.7	-	-	31,647.3	23,724.7	55,372.0
Subtotal Western States	27.8	-	22,275.1	1,951.2	107,736.2	60,689.0	-	29,326.0	130,039.1	91,966.3	222,005.4
Subtotal Eastern States	7,192.9	150.5	159,744.6	44,953.9	-	-	-	4,290.6	166,937.5	49,395.0	216,005.4
TOTAL	7,220.7	150.5	182,019.7	46,905.1	107,736.2	60,689.0	-	33,616.6	296,976.6	141,361.3	438,337.9

Source: U.S. Dept. of the Interior, 1977b. Demonstrated Coal Base of the U.S. as of January 1, 1976. Mineral Industry Surveys, Bureau of Mines, Washington, D. C.

(a) Includes measured and indicated resource categories as defined by the USBM and USGS and represents 100% of the coal in place.
(b) Data has been rounded.
(c) Quantity undertermined (basic resource data do not provide the detail required for delineation of reserve base). 58

*Western states including Alaska

considered "low sulfur" coal. Only 13 percent of eastern coal is considered low sulfur, compared with 71 percent of western coal (see Table 2-3). Eighty-six percent of the Nation's low sulfur coal is located in the West.

Under the 1970 Clean Air Act Amendments, EPA promulgated air quality standards that established a limit on sulfur dioxide (SO_2) emissions for utilities of 1.2 pounds SO_2 per million Btu's. For typical western subbituminous coal, this standard can be met without any further treatment (notably scrubbing) if the coal has a sulfur content within or below the 0.5 to 0.7 percent range (depending on precise heat content). Under the more recent 1977 Clean Air Act Amendments, however, Congress enacted a requirement that all utilities must use "best available control technology." The U.S. Environmental Protection Agency (EPA) is in the process of promulgating final regulations to implement this requirement.

2.3 HISTORY OF NATIONAL COAL USE

Coal is the primary energy source upon which the Nation's rapid industrial and economic growth was initially based. Basic industries such as railroads, steel, and later electric power generation were developed and rapidly expanded through the production and use of the Indian's "burning rocks."

To meet the energy requirements of these and other industries, as well as rising fuel demand for space heating, the bituminous coal and lignite industry reached a 100 million ton level of production

TABLE 2-3

THE RESERVE BASE OF COALS OF THE WESTERN UNITED STATES
BY MINING METHOD AND SULFUR CONTENT
(millions of tons)

STATE	MINING METHOD	SULFUR CONTENT, WEIGHT-PERCENT				
		<1.0	1.1-3.0	>3.0	UNKNOWN	TOTAL
Alaska	Deep	4,080.8	163.3	0	0	4,246.4
Do	Strip	7,377.8	21.0	0	0	7,399.0
Arizona	do	173.2	176.7	0	0	350.0
Arkansas	Deep	43.4	310.3	29.2	19.1	402.4
Do	Strip	37.9	152.9	17.1	55.2	263.3
Coloardo	Deep	6,751.3	640.0	47.3	6,547.4	13,999.2
Do	Strip	724.2	146.2	0	0	870.0
Iowa	Deep	1.6	226.7	2,105.9	549.2	2,884.9
Kansas	Strip	0	309.3	695.6	383.2	1,388.1
Missouri	Deep	0	134.2	3,590.2	2,350.5	6,073.6
Do	Strip	0	47.8	1,635.8	1,730.0	3,413.7
Montana	Deep	63,464.4	1,939.9	456.2	0	65,834.3
Do	Strip	38,182.5	2,175.4	46.4	2,166.7	42,562.0
New Mexico	Deep	1,894.4	214.1	0.8	27.5	2,136.5
Do	Strip	1,681.1	579.4	0	0	2,258.3
North Dakota	do	5,389.0	10,325.5	268.7	15.0	16,003.0
Oklahoma	Deep	154.5	238.4	202.6	264.3	860.1
Do	Strip	120.5	88.2	38.8	186.2	434.1
Oregon	Deep	1.0	0	0	0	1.0
Do	Strip	0.5	0.3	0	0	0.9
South Dakota	do	103.1	287.9	35.9	1.0	428.0
Texas	do	659.8	1,884.7	284.1	444.0	3,271.9
Utah	Deep	1,916.2	1,397.6	6.8	460.3	3.780.5
Do	Strip	52.3	149.2	42.6	18.0	262.0
Washington	Deep	431.0	957.7	13.2	42.9	1,445.9
Do	Strip	172.5	307.7	25.8	2.2	508.1
Wyoming	Deep	20,719.1	4,535.0	1,275.6	2,955.0	29,489.8
Do	Strip	13,192.9	10,122.4	425.5	105.3	23,845.3
Total[a]	Deep	99,457.7	10,757.2	7,727.8	13,216.2	131,155.6
	Strip	67,866.8	26,774.3	3,516.3	5,106.8	103,256.8
Grand Total		167,324.5	37,531.5	11,244.1	18,323.0	234,412.4

[a] Distribution may not add to total because of individual rounding.

by 1880. By 1900, production had risen to 212 million tons. Stimulated by World War I, coal production reached 579 million tons in 1918, involving more than 8,000 mines with 615,000 workers. Coal production declined after the war (particularly during the depression), reaching a low of 310 million tons in 1932. With World War II, coal production again rose to new heights, reaching a peak shortly after the war of 631 million tons in 1947.

Once again, however, the coal industry went into decline and reached its post-war low of 392 million tons in 1954. For the next 10 years, while major year-to-year fluctuations sometimes occurred, the basic level of coal use increased only slightly. By the mid-1960's, the coal industry had begun an upward trend that by 1977 had reached an annual production level of 689 million tons, the highest ever.

For many years the major coal consumption classifications were railroads, manufacturing and mining industries, retail dealer deliveries, coke plants, and electric utilities. As late as 1944, railroads consumed 132 million tons of coal. With the introduction of diesel locomotives and electrification, however, the railroad market for coal had virtually disappeared by the early 1960's, and was dropped as a consumer classification. Also, the use of coal in ships for bunkering in foreign trade and on the Great Lakes has been displaced almost entirely by oil. Similarly, retail coal deliveries for space heating declined steadily over the years, from more than 122 million tons in 1944 to 7 million tons in 1977.

Coal used for coke plants, which was about 107 million tons in 1955, had fallen to around 77 million tons by 1977. The gradual decline in this category resulted from technological changes in the coking processes, including increased injection of supplemental fuels and modification of blast furnace practices. Nevertheless, it is expected that the demand for coking coal will be reasonably steady over the near term, with relatively small further declines resulting from technological changes.

Industrial uses, other than electric power generation, include coal used for general manufacturing and mining and for cement, steel, and rolling mills. Coal consumption in this market has declined from approximately 270 million tons in 1945 to approximately 62 million tons in 1977. Hopes for a major future expansion in National coal use depend in part on a reversal of this trend in industrial use.

As recently as 1943, coal contributed more than 50 percent of the Nation's total energy. Except for coke ovens, the declines in the U.S. domestic coal markets following World War II resulted primarily from the rapid takeover of these markets by oil and natural gas. These fuels were cheap, easy to handle, and relatively clean, and thus provided a competition that coal was unable to meet. Table 2-4 shows the historical pattern of decline of coal in these markets. The use of western coal by consumer classifications is shown on Table 2-5.

TABLE 2-4

CONSUMPTION AND EXPORTS OF BITUMINOUS COAL AND LIGNITE
BY CONSUMER CLASS IN SELECTED YEARS 1933-1977(a)
(in Thousand Short Tons)

	Electric Power Utilities	Coke Plants	Steel and Rolling Mills	Rail-roads Class II	Other Industrial: Manu-facturing and Mining(3)	Other Industrial: Total Indus-trial	Retail Dealer Deliveries	Bunker Foreign & Lake Vessel	Total U.S.	Exports	Grand Total(2)
1933	27,088	40,089	14,129	72,548	84,137	156,685	77,396	2,298	317,685	9,037	326,722
1935	30,936	50,515	16,585	77,109	98,054	175,163	80,444	2,683	356,326	9,742	366,068
1940	49,126	81,386	14,169	85,130	113,423	198,553	84,687	2,989	430,910	16,466	447,376
1945	71,603	95,349	14,241	125,120	130,765	255,885	119,297	3,192	559,567	27,956	587,523
1947	86,009	104,800	14,195	109,296	131,847	241,143	96,657	3,087	545,891	68,667	614,558
1950	88,262	103,845	10,877	60,969	103,785	164,754	84,422	2,042	454,202	25,468	479,670
1955	140,550	107,377	7,353	15,473	98,140	113,613	53,020	1,499	423,412	51,277	474,689
1960	173,882	81,015	7,378	2,101	84,703	86,804	30,405	945	380,429	36,541	416,970
1965	242,729	94,779	7,466	-	94,487(3)	94,487	19,048	655	459,164	50,181	509,345
1970	318,921	96,009	5,410	-	82,909	82,909	12,072	298	515,619	70,944	586,563
1973	386,879	93,634	6,356	-	60,837	60,837	8,200	116	556,022	52,870	608,892
1975	403,249	83,272	2,715	-	59,759	59,759	7,282	24	556,301	65,669	621,970
1976	447,021	84,324	2,743	-	57,750	57,750	6,900	12	598,750	59,406	658,156
1977	474,818	77,380	3,243	-	57,146	57,146	7,020	9	619,616	53,687	673,303

(1)Mineral Industry Reports, Bureau of Mines, Department of the Interior, 1933-1975;
Energy Data Reports, Energy Information Administration, Department of Energy, 1976, 1977

(2)Differences between the total of consumption plus exports and total production accounted for principally by coal in transit between mines and consumer facilities and coal put into stockpiles

(3)Includes cement mills, all years, and railroad fuel after 1960

TABLE 2-5

COAL PRODUCTION FROM FEDERAL LANDS IN THE SIX MAJOR COAL-PRODUCING STATES OF THE WEST IN SELECTED YEARS, 1957-1977, AND COMPARISONS WITH TOTAL U.S. AND TOTAL STATE PRODUCTION

(tons in millions)

	TOTAL U. S. PRODUCTION			TOTAL PRODUCTION SIX WESTERN STATES[(a)]				FEDERAL LANDS, SIX WESTERN STATES[(b)]				
Year	Surface	Under-ground	Total	Surface	Under-ground	Total	Percent of U.S.	Surface	Under-ground	Total	Percent of "Western"	Percent of U.S.
1957	132.1	360.6	492.7	4.6	11.1	15.7	3.2	n.a.	n.a.	4.4	28.0	0.9
1960	130.6	284.9	415.5	5.1	8.5	13.6	3.3	n.a.	n.a.	5.4	39.7	1.3
1962	140.8	281.3	422.1	6.3	7.7	14.0	3.3	n.a.	n.a.	4.9	35.0	1.2
1965	179.4	332.7	512.1	10.3	9.1	19.4	3.8	n.a.	n.a.	5.9	30.4	1.2
1967	203.5	349.1	552.6	12.6	8.6	21.2	3.8	n.a.	n.a.	6.5	30.7	1.2
1971	276.3	275.9	552.2	30.2	9.1	39.3	7.1	n.a.	n.a.	10.1	25.7	1.8
1972	291.3	304.1	595.4	35.0	9.3	44.3	7.4	n.a.	n.a.	8.8	19.9	1.5
1973	292.3	299.4	591.7	43.0	10.0	53.0	9.0	n.a.	n.a.	12.9	24.3	2.2
1974	326.1	277.3	603.4	53.9	10.2	64.1	10.8	n.a.	n.a.	21.5	33.5	3.6
1975	355.6	292.8	648.4	66.9	11.4	78.3	12.1	n.a.	n.a.	31.0	39.6	4.8
1976	383.9	294.8	678.7	82.8	12.5	95.3	14.0	31.7	6.3	38.0	40.2	5.6
1977	416.9	271.6	688.6	105.4	13.4	118.4	17.2	44.0	7.6	51.9	43.8	7.5

(a)Colorado, Montana, New Mexico, North Dakota, Utah and Wyoming.

(b)Total production from Federal lands is for "calendar" years covered; there are differences in some years from other reference data where the latter cover "fiscal" years, i.e., 4.2, 4.9, 9.1 and 10.2 million tons, respectively, in 1960, 1965, 1971, and 1972.

Sources: "Bituminous Coal Data, 1973 Edition," National Coal Association, Washington, D.C.; annual chapters "Coal - Bituminous and Lignite," Bureau of Mines, Department of the Interior; Energy Data Reports, Department of Energy; "Environmental Impact Statement, Proposed Federal Coal Leasing Program." 1975, Department of the Interior; "Projected Coal Production for Six Western Lands, 1976 and 1977, by States," Bureau of Land Management, Department of the Interior, May 1976; U.S. Department of the Interior, 1977).

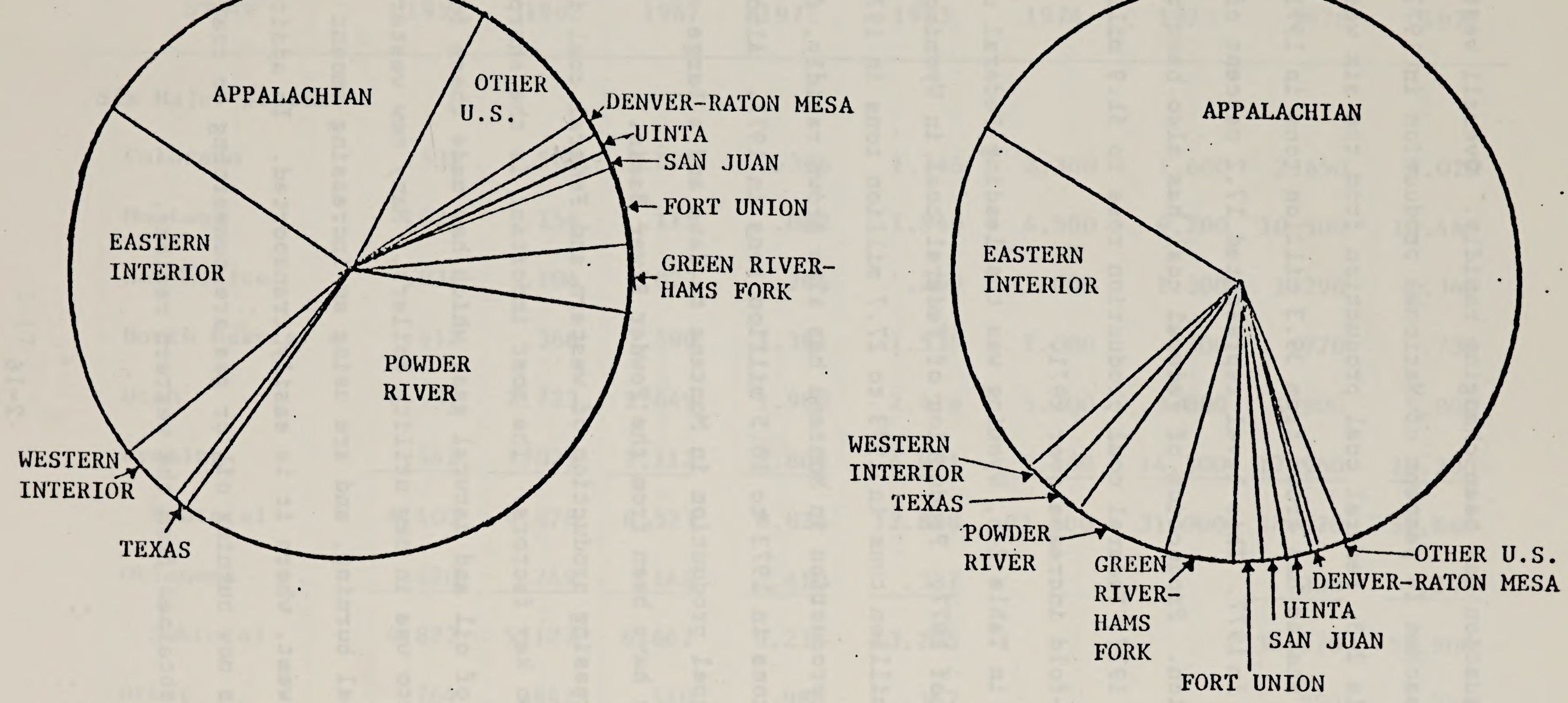
Compensating considerably for the loss or decline of its historical markets, and its exclusion from new markets by the rise of oil and gas consumption, has been the rapid growth in the use of coal for electric power generation. As recently as 1950, less than 100 million tons of coal was used by utilities. By 1977, use of coal for electric power generation reached 475 million tons.

Providing additional coal markets, particularly for coals of metallurgical quality, has been the growth since World War II of overseas coal exports, which supplement exports to Canada. In 1957, during the Suez Crisis, total exports reached more than 76 million tons. In recent years, exports generally have been in the mid-50 million ton level, but reached over 65 million tons in 1975.

2.4 THE GROWTH IN WESTERN AND FEDERAL COAL USE

Before 1972, coal production in the six western Federal coal states of Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming never exceeded 40 million tons or 7 percent of National production. In 1962, the western Federal coal states produced only 14.0 million tons, or 3.3 percent of National coal production. As seen in Figure 2-2, overall western production in 1975 was still far lower than its proportionate share of the Nation's coal reserves would have suggested.

Production of Federal coal has been even more minimal. Although 60 percent of western coal is Federally owned, in 1962 only 6 million tons of Federal coal were produced. As recently as 1975, total production of Federal coal was only 13.6 million tons.



DISTRIBUTION OF COAL RESERVE BASE

DISTRIBUTION OF COAL PRODUCTION (1976)

FIGURE 2-2
DISTRIBUTION OF THE COAL RESERVE BASE AND OF 1976 PRODUCTION AND ANTHRACITE
(EXCLUDES ALASKAN COAL)

This situation has been changing rapidly. Overall western production reached 24 percent of National production in 1977. As shown in Table 2-5, Federal coal production from the six western Federal coal states has grown from 39.3 million tons in 1971 to 118.4 million tons in 1977. This level represented 17.2 percent of National coal production. Production of Federal coal has also been rising rapidly. In 1977, Federal coal production rose to 51.9 million tons, a five-fold increase over 1971.

As seen in Table 2-6, Wyoming was the leading Federal coal producing state as of 1977. Production of Federal coal in Wyoming grew from only 5 million tons in 1973 to 27.7 million tons in 1977. Federal coal production in Montana has also grown rapidly, from 1.9 million tons in 1973 to 10.5 million tons in 1977. Almost all the Federal coal production in Montana to date and a large share of it in Wyoming have been from the Powder River Basin.

The increasing production of western and Federal coal is attributable to two key factors. The most important is the sharp rise in the price of oil and natural gas, which has made these fuels uneconomical to use in new utility boilers. Many new western power plants are coal burning, and are using an increasing amount of coal mined in the west, where it is easily transported. In addition, some western plants now burning oil or gas are converting to coal, and this coal is obtained from the western regions.

TABLE 2-6

COAL PRODUCTION FROM ALL FEDERAL LANDS IN SELECTED YEARS, 1957-1977 BY STATES

STATE	1957	1962	1967	1972	1973	1974	1975	1976	1977
Six Major States:									
Colorado	.531	.500	2.030	2.386	1.746	2.300	1.600	2.650	4.020
Montana	.026	.156	.115	.082	1.940	4.500	9.700	10.500	10.460
New Mexico	.034	.104	.027	.206	.260	1.000	1.300	1.290	2.340
North Dakota	.412	.366	.590	1.361	1.535	1.000	.300	.770	.750
Utah	2.957	2.723	1.649	1.980	2.416	3.200	3.800	4.900	5.800
Wyoming	.442	1.029	2.112	2.809	4.991	9.500	14.300	17.960	28.290
Subtotal	4.402	4.878	6.523	8.824	12.888	21.500	31.000	38.070	51.660
Oklahoma	.420	.249	.144	.410	.337			.300	.240
Subtotal	4.822	5.127	6.667	9.234	13.225			38.370	51.900
Other	.764	.842	.510	.988	.367			.250	.250
Total U.S.	5.586	5.969	7.177	10.222	13.592			38.620	52.150

Sources: Bureau of Land Management, Department of the Interior; Environmental Impact Statement, "Proposed Federal Coal Leasing Program," 1975, Department of the Interior, "Federal and Indian Lands - Mineral Production, Royalty Revenue and Related Statistics; Calendar Year 1977.

In the East, there is much greater traditional use of coal for power generation. Because transportation is a substantial portion of the overall cost of coal, eastern power plants traditionally used eastern coal. The economics of eastern power generation were significantly altered, however, by the advent of new air quality control regulations, particularly with respect to sulfur dioxide emissions. In 1971, EPA promulgated a standard of 1.2 pounds SO_2 per million Btu's. Large amounts of western reserves are low enough in sulfur content to meet this standard without use of scrubbers. Most eastern coal, however, is high in sulfur and requires expensive scrubbing. For many eastern and mid-western utilities, the added cost of building a scrubber was large enough that it became more economical to substitute western coal even if transportation costs were relatively high.

The 1977 Clean Air Act Amendments require the use of "best available control technology." This new requirement is expected to have significant effects on the relative economics of western versus eastern coal. However, since power plants coming on line until 1983 will largely be using the old standard, it will be some time before the new standard affects western production.

The use of western coal by consumer classification is shown on Table 2-7.

TABLE 2-7

COAL SHIPMENTS FROM THE WESTERN STATES IN 1976
BY CONSUMER CLASSIFICATIONS[(a)]
(In thousands of short tons)

	ELECTRIC POWER UTILITIES	COKE PLANTS	RETAIL DEALER DELIVERIES	OTHER	TOTAL
Colorado	5,984	2,583	31	806	9,404
Montana	26,038	-	-	397	26,435
New Mexico	8,516	858	-	345	9,719
No. Dakota	10,257	-	86	748	11,091
Utah	3,915	1,453	243	1,785	7,396
Wyoming	28,282	-	109	2,761	31,152
Subtotal	82,992	4,894	469	6,842	95,197
Oklahoma	2,497	491	4	319	3,311
Subtotal	85,489	5,385	473	7,161	98,508
Arizona	10,258	-	-	102	10,360
Washington	4,087	-	-	24	4,111
Subtotal	14,345	-	-	126	14,471
Grand total	99,834	5,385	473	7,287	112,979

SOURCE: U.S. Department of the Interior, Bureau of Mines

(a) "Bituminous Coal and Lignite Distribution, Calendar Year 1976," Mineral Industry Surveys.

2.5 TRENDS IN OTHER SOURCES OF ENERGY

Unlike the European nations and Japan, the United States was able to utilize largely domestic sources of oil and gas. In the post World War II period, the Nation increasingly relied on these fuels for its energy needs. However, it now appears that, although world oil and gas supplies might be adequate for some time, continued reliance on oil and gas will leave the United States very heavily dependent on foreign nations for its basic energy requirements. The undesirable national security, economic, and other implications of such heavy dependence on foreign energy sources have forced a major national reassessment of future energy directions.

The conversion of large quantities of coal into synthetic gas and liquids is expected to have considerable significance in the future. Synthetic fuels primarily will substitute for oil and gas in electric power generation, supplement domestic natural gas for heating and industrial uses that cannot be supplied by coal, and provide energy from coal conforming to prescribed clean air standards. Most importantly, synthetic fuels will help to reduce dependence on foreign energy supplies.

2.5.1 Oil Production Trends

The production of oil in the United States peaked in 1970 and, despite the stimulus of sharply increased prices over the past 5 years, there has been a continuing decline. As shown in Table 2-8,

TABLE 2-8

U.S. PETROLEUM SUPPLY AND DEMAND
(1,000 of barrels per day)

YEAR	PRODUCTION[a]	IMPORTS[b]	DEMAND[c]
1965	9014	2467	11709
1970	11297	3419	14968
1971	11156	3925	15449
1972	11185	4741	16602
1973	10946	6256	17552
1974	10462	6112	16886
1975	10007	6056	16545
1976	9736	7312	17698
1977*	9834	8708	18666

(a) Crude oil, lease condensate and natural gas liquids
(b) Crude oil and refined products
(c) May not add up due to losses, changes in stock, and exports

SOURCE: Energy Information Administration

* Preliminary

the slack in domestic production has been offset by a large increase in oil imports to meet rising demand. Although overall demand dropped in 1974 and 1975, it has again increased in the past 2 years. The rate of increase, however, is much lower than the 5 percent per year increase of the early 1970's.

The domestic production decline has been matched by a comparable decline in proven reserves. As set forth in Table 2-9, the continuing drop in reserves was only interrupted in 1970 by the discovery of the nearly 10 billion barrel Prudhoe Bay field in Alaska. But by 1977 the U.S. crude oil reserves had fallen to approximately what they had been 9 years earlier. Reserves have continued to drop despite the large increase in the number of wells drilled. There were 44,982 completed wells in 1977, the highest level since 1960.

Sustaining the existing level of domestic oil production will not be easy. At current rates, more than 25 billion barrels of oil will have to be discovered by 1985 to keep the reserves/production ratio from dropping further. While new discoveries are continuously made, oil production is more difficult and expensive as the easier finds are exhausted. Certainly, significant expansions of domestic oil production should not be counted on. Rather, there is a greater likelihood of a decline.

This decline will have fundamental national security and economic implications. Since 1973, the impact of OPEC on the world's oil

TABLE 2-9

U.S. PROVEN RESERVES OF CRUDE OIL
(billions of barrels)

YEAR END	RESERVES	RATIO RESERVES/PRODUCTION
1965	31.3	9.5
1970	39.0	9.5
1971	38.0	9.3
1972	36.3	8.9
1973	35.3	8.8
1974	34.2	8.9
1975	32.6	8.9
1976	30.9	8.7
1977	29.5	8.2

SOURCE: American Petroleum Institute, 1978 pricing structure has been dramatic. In October 1973, Saudi Arabian light crude oil, the world's standard, could be purchased for $3.53/barrel; in January 1974, the price was increased to $9.35/barrel, and by December 1977, it had been increased to $12.70/barrel. Various scenarios have been prepared to project the overall level of oil imports by 1985. One such forecast prepared by the Congressional Research Service (CRS) indicates that imports under a reasonable planning base are likely to range from 12.7 to 14.3 million barrels/day in 1985. Under more optimistic assumptions, it is projected to range from 9.2 to 10.8 million barrels/day. By 1985, national oil import costs (in 1977 dollars) for these two projections will be:

CRS Planning Base	Import Costs (1977 Dollars)
@12.7 million barrels/day	$58.9 billion
@14.3 million barrels/day	66.3 billion
CRS Optimistic Case	
@9.2 million barrels/day	42.6 billion
@10.8 million barrels/day	50.1 billion

By contrast, as shown on Table 2-10, the U.S. annual oil import bill since 1965 has shown an almost astronomical increase.

The effect of increased coal production, even of modest magnitudes, will be highly significant in terms of reducing dependence on imported oil. By increasing coal production from the 1976 level of 634.4 million tons (within the coal regions analyzed) to

TABLE 2-10

VALUE OF CRUDE OIL/PETROLEUM PRODUCT IMPORTS, 1965-77
(millions of current dollars)

	CRUDE OIL	PETROLEUM PRODUCTS	TOTAL
1965	$1,120	$ 924	$2,044
1970	1,260	1,483	2,743
1971	1,687	1,656	3,343
1972	2,369	1,989	4,358
1973	4,240	3,498	7,738
1974	15,253	11,013	26,266
1975	18,290	6,768	25,058
1976	25,456	6,646	32,102
1977 (prelim)	33,398	8,413	41,811

Source: Energy Information Administration production levels of 1.2 billion tons, the equivalent of 2.4 million barrels of oil a day or 876 million barrels a year can be realized. This production level will result in savings in import costs of more than $11 billion (based on 1977 prices of $12.70/barrel).

2.5.2 Natural Gas Production Trends

The domestic production of natural gas shown in Table 2-11 closely follows the pattern of crude oil. Output peaked in the early 1970's and has since declined. However, unlike petroleum, natural gas imports have only amounted to about 5 percent of total U.S. requirements, so there has been a drop in total consumption. This drop caused gas distributors to curtail and/or interrupt supplies to industrial customers, restrict the hook-up of new residential and commercial accounts, and limit boiler fuel usage.

The proven reserves of natural gas have similarly declined since the mid-1960's, as shown in Table 2-12. Because of declining reserves, domestic production of natural gas is expected to drop between now and 1985.

2.5.3 Nuclear Power Trends

At the end of 1977, there were 68 nuclear power plants in operation or in the startup phase with a total capacity of more than 59,000 megawatts. Nuclear plants produced 11.8 percent of the total electric power produced by all utilities in 1977. As shown in Table 2-13, 154 other nuclear plants were being built, on order, or announced with a total design capacity of approximately

TABLE 2-11

U.S. PRODUCTION AND IMPORTS OF NATURAL GAS
(billion cubic feet)

	MARKETED PRODUCTION	IMPORTS
1965	16,040	456
1970	21,921	821
1971	22,493	935
1972	22,532	1019
1973	22,648	1033
1974	21,601	959
1975	20,109	953
1976	19,952	964
1977	19,942	1009

Source: Energy Information Administration
American Gas Association

TABLE 2-12

U.S. PROVEN RESERVES OF NATURAL GAS

YEAR	RESERVES (10^9 cubic feet
1965	286.5
1970	290.7
1971	278.8
1972	266.1
1973	250.0
1974	237.1
1975	228.2
1976	216.0
1977	208.9

Source: American Gas Association

TABLE 2-13

STATUS OF NUCLEAR POWERPLANTS, END OF 1977

STATUS	NUMBER	CAPACITY (Megawatts)
In operation or startup	68	49,000
Construction Permit Granted	80	87,000
Construction started	(67)	(73,000)
No_3 construction	(13)	(14,000)
Construction permit pending	52	58,000
Order placed for plant	13	16,000
Announced	9	11,000
	222	221,000

Source: Energy Information Administration

172,000 megawatts. If all these plants were to be in operation by 1990, they would provide as much as 30 percent of expected power requirements.

Nuclear plants are currently cost competitive with coal plants and rapid expansion of nuclear power generation could significantly diminish future coal requirements. However, in recent years the expected growth rate of nuclear energy has been sharply reduced. The difficulties in achieving even lower targets have been the subject of a number of reports addressing the public's concerns with nuclear proliferation, radiation hazards, spent-fuel storage, and radioactive waste management.

2.5.4 Hydroelectric Power Trends

Hydroelectric plants in 1977 accounted for 68,300 megawatts, or 12 percent of the total electrical generating capacity of the United States. Although impressive, this was about 25 percent less than in 1974 and 1975, due primarily to drought conditions in many western states. In earlier years such as the 1930's and 1940's, hydroelectric power provided as much as 30 percent of total domestic electricity needs. Although hydroelectric power is relatively safe, nonpolluting, low in cost, and does not consume fuels, its expansion in recent years has been constrained by the lack of good new sites.

2.5.5 Nontraditional Energy Sources

A number of nontraditional energy sources - both geologic and nongeologic - are under active investigation and the subject of ongoing research. These efforts are still mostly in their infancy and nontraditional energy sources are not expected to make a major contribution to energy supplies by 1990. These sources are briefly described below.

2.5.5.1 Unconventional Sources of Gas. There are four new types of gas resources. The first is gas in geopressured zones of the Gulf Coast in the form of methane-rich waters at depths below 10,000 feet. Although estimated to encompass a vast resource base (3,000 to 50,000 trillion cubic feet), there are numerous technical and environmental problems to be resolved before gas from this resource can be utilized.

The second is gas in "tight" (impermeable) sandstone formations in the Rocky Mountain states. Again, the resource is considerable but the recovery technology has yet to be developed. The third type of gas resources is in Devonian Shales of the Appalachian states. This gas is currently being produced in localized areas and efforts are underway to enhance production from this large resource base.

Finally, extraction of methane from coal seams in advance of mining operations is technologically possible. Production of this resource would improve mine safety and make a regionally important impact on gas supply availability.

2.5.5.2 Oil Shale. Located primarily in Colorado, Utah, and Wyoming, high grade deposits of oil shale in these states may contain as much as 600 billion barrels of oil, while lower grade deposits may contain an additional 1.2 trillion barrels. Given favorable economic conditions, as much as 80 billion barrels of shale oil could be extracted from this resource. A number of optimistic production forecasts were made in the 1973-74 period; it soon became evident, however, that extractive costs were much higher than originally planned, and that developers would require a subsidy in order to be competitve even with imported oil.

2.5.5.3 Tar Sands. Although found in at least nine states, the largest known resource of bitumen-bearing rocks (tar sands) is located in Utah, encompassing a resource base roughly equivalent to 28 billion barrels of oil. Because of various constraints and high extractive costs, production from this resource is not expected to be significant in the near future.

2.5.5.4 Geothermal Energy. While it constitutes an enormous potential resource base, the heat of the earth has so far seen limited use as an energy source. Natural hot dry steam at Geysers, California, is the fuel for a 520 megawatt electricity generating plant. Hot water in Oregon, Idaho, and other western states has been used for local space heating purposes. Other plans are currently being developed to utilize hot waters for power production in certain western states and Hawaii and for space heating in several eastern states. However, there is still a great deal of uncertainty about reservoir longevity, since these hot waters are essentially nonrenewable. This feature has tended to discourage private investment thus far.

2.5.5.5 Solar Energy. Several different technologies for utilizing solar energy are technically feasible. Solar energy can be used for the heating/cooling of buildings, high temperature heating, and generation of electricity. The basic solar energy categories are solar heating and cooling of buildings, agricultural and industrial process heat, wind energy conversion, photovoltaic conversion, solar thermal conversion, ocean thermal conversion, and biomass.

Solar heating and cooling, agricultural and industrial process heat, wind energy and biomass appear to have potential for significant uses between now and 1990. Technologies need to be developed further for other solar energy sources to attain a reasonably competitive level. On an overall basis, solar energy is not expected to contribute more than 1 to 2 percent of the total space heating energy requirements by 1990. Its impact is more likely to be felt in the period between 2000 and 2020, when it has been forecast that as much as 10 percent of energy needs could be met by solar sources.

2.5.5.6 Energy from the Ocean. The renewable energy sources from the ocean include the following:

- Ocean thermal energy conversion - based on harnessing the thermal differences of at least 17°C between warm surface water and cold deep sea water (found primarily between the tropics of Cancer and Capricorn).

- o <u>Tidal energy conversion</u> - plants proposed for two potential sites in the United States, one in Maine at the Bay of Fundy and the second in Cook Inlet, Alaska. The maximum total capacity of these plants would be 3,600 megawatts and the annual energy output would represent about 1 percent of the electricity produced in the U.S.
- o Other ocean energy forms that have been the subject of limited study include wave energy, ocean current energy, ocean wind energy, and salinity gradient energy conversion.

2.5.5.7 <u>Nuclear Fusion</u>. Although it would use low cost, inexhaustible fuels and is generally considered environmentally more desirable than nuclear fission plants, there are major engineering problems to be overcome before nuclear fusion is a reality. Even if successfully resolved, this power source cannot be expected to make a major contribution for probably another 50 years.

2.5.6 Energy Conservation

There are currently 17 energy conservation programs being planned or implemented as a result of the legislative mandates embodied in the Energy Policy and Conservation Act (EPCA) and the Energy Conservation and Production Act (ECPA). These encompass economic, regulatory, and involuntary incentives covering all market sectors. The National Energy Act formally proposed by President Carter in 1977 called for additional measures such as wellhead taxes on crude oil, phased deregulation of natural gas prices, taxes on industrial use of oil and gas, mandated conversion to coal by industrial users, and selected electricity rate policies, all of which are designed to dampen energy demand and discourage wasteful energy consumption practices. However, these latter provisions have yet to be enacted by the Congress as of this writing.

Five major initiatives have been evaluated by EIA: weatherization of low income homes; Federal Energy Management Program (FEMP); new car fuel economy standards; appliance efficiency standards; and state energy conservation programs.

In comparison with the expected fuel usage in 1985 and 1990, the projected savings account for about 2 percent and 3 percent, respectively. Moreover, very little of that amount is involved in electricity generation, the principal coal use.

Other projections have been made of energy conservation savings involving a much broader range of initiatives and programs. According to the January 1978 draft report of the Market Oriented Program Planning Study (MOPPS), initiated by ERDA and continued by DOE, domestic energy demands (exclusive of metallurgical coal exports) are forecasted 92.4 quads in 1985. MOPPS projected energy conservation savings of 7.3 quads by 1985—comprised of 3.0, 1.0, and 3.3 quads from the residential/commercial, transportation, and industrial sectors, respectively. The estimated residential/commercial savings are based on installation of heat pumps and implementation of three conservation strategies. Transportation energy demands would be reduced by improvements in operating procedures, new equipment, pumping technologies, and modifications of motor vehicle engine propulsion systems. Savings in the industrial sector include three areas: waste heat utilization; industrial waste application; and process changes.

The conservation alternative as projected by MOPPS can provide meaningful results in reducing consumption, perhaps as much as 10 percent by 1990 under the thrust of major technology advances. Whether these forecasts are achievable goals is an open question. They do, however, indicate the accomplishments that are possible under optimal conditions. In addition, MOPPS indicates that potential savings in coal requirements resulting from conservation in the industrial sector will be more than offset by continued increased demand for electricity derived from coal burning.

2.6 EXPECTED FUTURE COAL USE

While the precise rate is in considerable doubt, there is little question the Nation's overall energy requirements will continue to grow. There is little likelihood of supplying that growth from domestic oil and natural gas (see discussion in section 2.5.1). New technologies and energy forms are still unproven, and cannot be relied on over the next decade or so. Nuclear power could supply large amounts of additional energy, but for the time being its future growth is inhibited by concerns about its safety. Given these circumstances, the United States is forced to deal with the problem of growing energy demands largely by a combination of three basic types of actions: (1) expand use of coal as a domestic energy source; (2) obtain increased foreign supplies of oil and gas; and (3) curb demands by greater energy conservation measures.

2.6.1 Coal in the National Energy Plan

The role of coal in the President's April 1977 National Energy Plan (NEP) was previously discussed in section 1.4.1. The National Energy Plan included a reduction in the expected level of imports of foreign oil as a prime objective. Its stated goal was to reduce foreign imports from a projected level of 11.5 million barrels per day in 1985 without the plan to 7.0 barrels with the plan. This reduction was to be achieved by adoption of additional conservation measures (2.1 million barrels) and by increased substitution of coal for oil and gas (2.4 million barrels).

Under the National Energy Plan, total coal production was expected to rise from 681 million tons per year in 1976 to 1.26 billion tons per year in 1985. This would represent an increase in coal production of about 200 million tons per year more than would have been expected without the plan.

2.6.2 Department of Energy Coal Projections

Projections of future energy production and consumption are based on many assumptions. Inevitably, these assumptions change, sometimes rapidly. Accordingly, it is necessary to use the best projections possible at a given time, but remaining ready to revise the projections as circumstances are altered.

Already, the projections in the National Energy Plan are somewhat out of date. It is clear that the Congress will not enact some of the important features of the plan. Moreover, after the plan was released, almost inevitably there were a number of criticisms made, some of which have received considerable acceptance. For example, the very rapid rate of growth projected for industrial coal use is widely regarded as too optimistic.

In preparing this coal programmatic EIS, it seemed desirable to have the most current projections of future coal production. A regional breakdown with a fairly high degree of geographic resolution was also needed for the purposes of this environmental impact statement. Hence, the Department of the Interior requested that the Department of Energy (DOE) provide a new set of coal projections especially developed for use in the preparation of this EIS. These projections were developed by DOE's Leasing Policy Development Office and submitted to the Interior Department in June 1978.

The DOE projections incorporate assumptions on future electric power requirements, oil and gas prices, nuclear power development, air quality controls, transportation costs, labor cost escalation, and other matters. Different sets of assumptions were developed for low, medium, and high projections of western coal development. As an example, for 1985 and low oil price assumption was $13 per barrel, the medium assumption $15 per barrel, and the high assumption $20 per barrel. The electric power growth rate, which is the single most important assumption, was 4.0, 4.8, and 5.8 percent for the

1985 low, medium, and high projections, respectively. Low, medium, and high projections were generated for both 1985 and 1990.

Table 2-14 shows the DOE National coal consumption projections for 1985 and 1990, broken down by type of use. Under assumptions of medium use, consumption of coal by utilities is projected to rise by 60 percent between 1977 and 1985, from 475 to 760 million tons a year. The other main increase in coal consumption is in the industrial sector, with a 98.7 million ton growth in coal use from 1977 to 1985, or 165 percent.

Total coal consumption for 1985 is projected to be 1.11 billion tons under medium level assumptions. This is a decline of about 150 million tons per year from the projected 1985 production level under the National Energy Plan, reflecting a reduced optimism especially about industrial coal use.

The medium level increase in national coal production projected between 1985 and 1990 is 37 percent. Most of this increase is due to greater use of coal by utilities. Industrial coal use has a more rapid rate of growth, but the increase is considerably less in absolute amount.

The projections for synthetic uses of coal assign them a minor role in 1985 (27 million tons). By 1990, synthetics are projected to grow by two and one-half times, but would still not be a major use of coal.

TABLE 2-14

NATIONAL COAL CONSUMPTION
(million tons)

	1977	1985			1990		
			MEDIUM			MEDIUM	
Electric Utility	475	692.4	759.5	816.1	772.4	1,007.1	1,276.7
Industrial	60	109.1	158.7	158.1	138.2	279.4	279.3
Metallurgical	77	96.1	96.2	96.2	100.0	100.0	100.1
Residential/Commercial	7	1.5	1.5	1.5	0.7	0.7	0.7
Synthetics	--	13.1	22.5	41.3	26.3	56.2	122.1
Exports	54	72.5	73.7	73.6	76.3	77.2	77.1
Total	673	984.7	1,112.1	1,186.8	1,113.9	1,520.6	1,856.0

Table 2-15 shows the regional breakdown of coal production projected by DOE. By 1985, coal production west of the Mississippi River is projected to reach 42 percent of the national total (medium assumptions). By 1990, projected western production would reach 50 percent of the national total, corresponding roughly to the percentage of reserves located in the West.

The Northern Great Plains will become the most important coal producing section of the country if the DOE projections are realized. By 1990, Northern Great Plains coal production would exceed both Appalachia and midwestern production and constitute 36 percent of national production. By comparison, in 1977 production from the Northern Great Plains was 13 percent of national production, a percentage which in fact is much higher than only a few years earlier.

In Table 2-16, DOE projections are shown for the western coal regions selected for assessment in this impact statement. As might be expected considering its huge reserves of low sulfur coal obtainable at low cost by surface mining, the Powder River Basin plays a central role in predicted western coal production. DOE projects coal production in the Powder River Basin to be 205 million tons a year in 1985 and 396 million tons per year in 1990 under its medium scenario. These amounts represent 43 and 52 percent of total western coal production projected for those years, and 18 and 26 percent of national production.

TABLE 2-15

DETAILED REGIONAL COAL PRODUCTION FORECASTS(a)
(million tons)

		1985			1990		
	1977	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Northern Appalachia	173.0	208.6	213.0	223.4	194.0	225.3	253.3
Central Appalachia	195.5	196.9	205.2	209.7	188.4	206.2	211.6
Southern Appalachia	21.2	21.4	21.4	21.4	13.8	13.8	13.8
Total	389.7	426.9	439.6	454.5	396.2	445.3	478.7
Midwest	132.7	182.7	204.4	213.4	264.2	312.3	327.3
Total	132.7	182.7	204.4	213.4	264.2	312.3	327.3
E.Northern Great Plains	12.5	20.3	21.9	25.3	23.8	22.5	36.4
W.Northern Great Plains	73.9	223.4	305.6	348.9	267.7	529.0	763.7
Total	86.4	243.7	327.5	374.2	291.5	551.5	800.1
Central West	13.7	8.9	10.6	10.9	9.6	10.3	9.6
Gulf	16.8	57.7	57.7	57.7	62.3	79.6	104.1
Rocky Mountains	20.7	38.8	43.8	44.6	43.7	53.3	53.1
Southwest	22.7	25.8	28.3	28.5	39.9	65.0	79.9
Northwest	5.0	5.6	4.4	4.4	7.0	3.7	3.7
Total	78.9	136.8	144.8	146.1	162.5	211.9	250.4
TOTAL	687.7	990.1	1,116.3	1,188.2	1,114.4	1,521.0	1,856.5

(a) Based on DOE Leasing Policy Development Office report, "Federal Coal Leasing and 1985 and 1990 Regional Coal Production Forecasts," June 1978. NOTE: The DOE estimates have been revised slightly for purposes of this environmental impact statement. See the impact methodology discussion in Chapter 5.

TABLE 2-16

DOE PRODUCTION PREDICTIONS FOR WESTERN COAL REGIONS[a]

	1985 PREDICTION (million tons/year)			1990 PREDICTION (million tons/year)		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Western Interior	8.9	10.6	10.9	9.6	10.3	9.6
Fort Union	18.4	20.0	23.4	21.9	20.6	34.5
Powder River Basin	140.4	204.6	232.1	173.7	396.1	602.9
Green River-Hams Fork	89.9	112.0	128.8	105.9	149.5	177.7
Uinta	25.7	26.4	26.3	25.1	28.3	27.9
San Juan	20.1	22.8	22.9	34.5	58.4	72.5
Denver Raton Mesa	5.3	5.3	5.2	5.4	6.8	6.6
Texas Gulf	57.7	57.7	57.7	62.3	79.6	104.1
Total	366.4	459.4	507.3	438.4	749.6	1035.8

(a) Based on DOE Leasing Policy Development Office report, "Federal Coal Leasing and 1985 and 1990 Regional Coal Production Forecasts," June 1978. NOTE: The DOE estimates have been revised slightly for purposes of this environmental impact statement. See the impact methodology discussion in Chapter 5.

(b) Excludes production from Arizona, Washington, and Alaska.

The next most important producing regions after the Powder River Basin are the Green River-Ham's Fork and San Juan Regions. Assuming medium consumption levels, production of 112 million tons a year in 1985 and 150 million tons a year in 1990 is projected for the Green River-Ham's Fork region, or 24 and 20 percent of total western production projected for those years. The San Juan Region is projected to have production of 23 million tons per year in 1985 and 58 million tons per year in 1990, or 5 and 8 percent of western production respectively.

Although not shown in Table 2-16, the great majority of the coal production projected by DOE is expected to be surface mined. In the Fort Union and Powder River Basin Regions, all the coal production is expected to be surface mined. Underground mining represents a major share of projected production only in Utah (90 percent) and Colorado (40-50 percent). Of overall western coal production projected for 1985 and 1990, only 6.9 percent and 5.9 percent, respectively, are expected by DOE to be mined underground.

The development of western coal has been stimulated by the greater ease with which low sulfur coal can meet air quality standards, creating a demand in the East for western coal. However, the most important sources of increased demand for western coal are in the West itself. In time, the West is expected to move from its traditional reliance on oil and gas and hydropower to a new use of coal fired plants for its electric power. In Table 2-17, the DOE projected distribution of

TABLE 2-17

EASTERN AND WESTERN CONSUMPTION OF WESTERN COAL[a]
(million tons)

	1985			1990		
	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Western Coal Consumed in the East	74.0	87.3	93.0	75.6	136.0	299.0
Western Coal Consumed in the West	306.4	384.7	426.9	378.2	627.3	750.4
Total Western Coal	380.4	472.0	519.9	453.8	763.3	1049.4

(a) Based on DOE Leasing Policy Development Office report, "Federal Coal Leasing and 1985 and 1990 Regional Coal Production Forecasts," June 1978. NOTE: The DOE estimates have been revised slightly for purposes of this environmental impact statement. See the impact methodology discussion in Chapter 5.

western-produced coal to eastern and western consumption regions is shown. Overall, both for 1985 and 1990 medium scenarios, only 18 percent of western production is projected to be consumed in the East and Midwest.

2.7 WESTERN COAL SUPPLY SOURCES

The DOE forecasts of future coal production were based on the assumption that Federal and non-Federal coal reserves would be fully available to meet demands for western coal. The forecasts did not address the questions of whether the reserves will actually be available, or which particular reserves will be developed.

If the DOE projections are realized, a large scale expansion in production of Federal coal seems inevitable, given the prominence of Federally-owned coal in the overall western coal reserve supplies. Expanded Federal coal production can be obtained either by increasing production from already issued Federal leases or by issuing new leases.

There are currently 534 outstanding Federal leases containing 17 billion tons of recoverable reserves. By 1977 production from these leases had reached 51.9 million tons. Substantial further increases in production can be expected from these leases by 1986, both from leases already included in mine plans and from leases that are not currently included in a mine plan.

After 1986, further expansions in production of Federal coal will have to come either through greater production from existing operations containing Federal coal or through new leasing. If existing leases are not in production by 1986, they will have to be relinquished, with a few possible exceptions, to the government for failure to meet diligent development requirements. For large western surface mines, the construction phase generally takes 3 to 5 years to get a mine fully into operation. Because of this lead period, the time is fast approaching when it will be difficult to develop a mine plan and get a mine into production by 1986 to meet the diligent development standard. There is a greater likelihood that existing leases already included in mine plans will be producing in 1986, compared to leases not yet in mine plans.

2.7.1 Existing Leases with Mine Plans

The Department has thus far received 66 mine plans, of which are approved and are pending. The Federal leases included in these mine plans contain 9.1 billion tons of recoverable reserves, representing 55 percent of the reserves in all existing Federal leases. In 1977, production from mines including Federal leases was 96.3 million tons, representing 58 percent of then current total western production. Not all of this production represents Federal coal, since the mines in some cases also include non-Federal coal.

In Table 2-18, planned production from approved and pending mine plans including Federal leases is shown. The total production planned from these mines for 1985 is 281.9 million tons. More than two thirds of the planned production is expected from the Powder River Basin,

TABLE 2-18

PLANNED 1985 PRODUCTION FROM APPROVED AND PENDING MINE PLANS INVOLVING FEDERAL LEASES (a)

	NO LEASES IN MINE PLANS	RECOVERABLE FEDERAL RESERVES IN MINE PLANS (million tons)	1985 PLANNED PRODUCTION (million tons/year)
Fort Union	4	(b)	5.9
Powder River Basin	33	5,885	199.6
Green River-Hams Fork	49	1,147	32.3
Uinta	113	1,834	39.4
San Juan	8	98	0.2
Denver-Raton Mesa	1	(b)	0
Other Regions	12	54	4.5
Total	220	9,141 (c)	281.9

(a) Estimates based on 1978 Department of the Interior review of existing Federal leases.
(b) Cannot be disclosed because of confidentiality requirements.
(c) Includes total recoverable reserves in mine plans in Fort Union and Denver-Raton Mesa Regions.

which is consistent with the distribution of existing lease reserves. Although not shown in Table 2-18, 82 percent of the total production planned in the Powder River Basin would come from Wyoming and only 18 percent from Montana.

The production planned for approved and pending mine plans may not occur. Some pending mine plans may never be approved (for example, they could be located in an alluvial valley, or require a new transportation system with unacceptable environmental impacts). Planned production may also not materialize if there is not enough demand for the coal or if other coal is cheaper to mine or higher in quality. Nevertheless, total production planned from approved and pending mine plans does provide a good indication of the production potential of these mines.

2.7.2 Existing Leases Without Mine Plans

Besides leases included in mine plans, there are an additional 314 Federal leases, representing 45 percent of existing lease reserves, for which there are as of yet no mine plans. In order to obtain an estimate of the production potential of these leases, U.S. Geological Survey (USGS) mining supervisors were requested as part of the Department's Federal coal management review to give their best judgment as to whether such leases were "more likely than not" to be in production by 1986. Of the total 7.9 billion tons of reserves in existing leases without mine plans, USGS mining supervisors estimated that leases containing 1.7 billion tons of reserves were likely to be in production by 1986 and leases containing 6.2 billion tons of reserves were not likely to be in production by 1986. Reserves in leases believed likely to be producing by 1986 are sufficient to sustain an annual production rate of 57.3 million tons a year.

In Table 2-19 the likely regional production from Federal lease reserves which are not now in mine plans but which are likely to be producing by 1986 is shown. The Uinta Region has the largest share, 41 percent of expected production.

There are many possible reasons why an existing Federal lease might not get into production by 1986. Many of the leases are small and would require additional Federal leasing or acquisition of other coal rights to form economically viable, or logical, mining units. Others are located far from transportation or in areas with environmental problems. Coal quality is poor and mining costs high in some cases. There may not be a sufficient demand for the types of coal contained in some leases.

2.7.3 Preference Right Lease Applications

Another important source of potential production of Federal coal is contained in preference right lease applications (PRLA's). Until preference right leasing was ended in the early 1970's (officially in 1976), the government issued prospecting permits in areas where coal was not known to exist in economically valuable deposits. A holder of a prospecting permit discovering a high quality deposit could obtain a lease to mine the deposit by demonstrating that it

TABLE 2-19

LIKELY PRODUCTION FROM EXISTING FEDERAL LEASES WITHOUT MINE PLANS[a]

	NO LEASES WITHOUT MINE PLANS	RECOVERABLE RESERVES IN FEDERAL LEASES WITHOUT MINE PLANS (million tons)	RECOVERABLE RESERVES IN LEASES WITHOUT MINE PLANS LIKELY TO BE PRODUCING IN 1986 (million tons)	LIKELY PRODUCTION IN 1986 FROM LEASES WITHOUT MINE PLANS (million tons/year)
Fort Union	16	(b)	(b)	(b)
Powder River Basin	36	3,997	210	7.0
Green River-Hams Fork	25	265	204	6.8
Uinta	153	2,663	700	23.3
San Juan	24	302	254	8.5
Denver-Raton	8	(b)	(b)	(b)
Other Regions	52	253	46	1.5
Total	314	7,947	1,718	57.3

(a) Estimates based on 1978 Department of the Interior review of existing Federal leases.
(b) Cannot be disclosed because of confidentiality requirements
(c) Includes total recoverable reserves in mine plans in Fort Union and Denver-Raton Mesa Regions.

contained commercially valuable coal. Such leases were called preference right leases and were issued on a noncompetitive basis. There are currently 110 outstanding applications for preference right leases remaining from prospecting permits issued mostly in the late 1960's and early 1970's.

Total recoverable reserves in PRLA's are 9.9 billion tons, 3.5 billion surface minable and 6.4 billion minable by underground methods. It is very unlikely that all these reserves will be included in producing mines in the near future. PRLA's in many cases are located outside of the areas of highest coal development potential. The government originally issued prospecting permits, which have ripened into PRLA's only in areas which were outside the known prime coal locations. Two-thirds of the reserves are for underground mining, which is expected to be a small part of western production. In addition, some PRLA holders may fail to meet all the legal requirements for processing their applications. Initial showings for some PRLA's were never made, or were made after the legal deadline had passed. Other PRLA's were improperly filed, including areas containing prior mining claims. PRLA's also may be located in areas where coal development is now considered environmentally questionable.

In Table 2-20, surface and underground reserves in PRLA's are shown by coal region. As part of the Department's coal policy review, PRLA's were examined to assess compliance with filing deadlines and

TABLE 2-20

PRODUCTION POTENTIAL FROM FEDERAL PREFERENCE RIGHT LEASE APPLICATIONS[a]
(million tons)

	TOTAL PRLA RECOVERABLE RESERVES		RECOVERABLE RESERVES WITHOUT LEGAL QUESTIONS (b)		RESERVES WITHOUT LEGAL OR ENVIRONMENTAL QUESTIONS (c)		ANNUAL PRODUCTION POTENTIAL (d)	
	SURFACE	DEEP	SURFACE	DEEP	SURFACE	DEEP	SURFACE	DEEP
Fort Union	308.0	0	308.0	0	308.0	0	10.3	0
Powder River Basin	1,594.4	4,308.3	1.594.4	4,308.3	1,454.0	4,308.3	48.5	143.6
Green River-Hams Fork	25.2	119.8	25.2	119.8	8.1	119.8	0.3	4.0
Uinta	113.9	1,173.4	116.6	375.0	94.4	360.5	3.1	12.0
San Juan	824.1	678.7	361.6	52.0	337.8	50.5	11.3	1.7
Denver-Raton Mesa	670.5	80.6	670.5	80.6	549.4	79.0	18.3	2.6
Total	3,536.2	6,360.7	3,076.4	4,935.6	2,751.7	4,918.0	91.8	163.9

(a) Estimates based on 1978 Department of the Interior review of Preference Right Lease Applications.

(b) Eliminates reserves under applications which have not met DOI procedural or legal requirements -- initial showings not made, or filed past deadline, or the PRLA was filed for land already subject to a mining claim.

(c) Eliminates both PRLA reserves with legal problems and reserves which lie in areas judged by DOI personnel to be environmentally questionable for mining.

(d) Based on estimates of reserves without legal or environmental questions. Assumes 90% recovery factor, 30 year mine life for surface coal; 50% recovery factor, 20 year mine life for underground coal.

other legal requirements, and potential environmental problems. Table 2-20 also shows reserves after excluding PRLA's for which there are legal uncertainties and PRLA's in areas that are considered environmentally questionable. Production potential from the remaining reserves is then shown.

2.7.4 Coal Owned by Indian Tribes

Indian tribes in the West own very substantial coal reserves.* These reserves represent the largest contiguous blocks of non-Federal coal and constitute a major potential source of supply for future western coal production. Coal production from Indian lands was 22.9 million tons in 1977, 13.8 percent of total western production.

The most important Indian coal owners are the Crow and Cheyenne Tribes in the Northern Powder River Basin in Montana, the Navaho Tribe in Northwest New Mexico, and the Three Affiliated Tribes in North Dakota. Except for the Cheyennes, these tribes have indicated an interest in developing their coal reserves. Coal development has the potential for generating a major infusion of income for these tribes. At present, development of the Crow coal is being delayed by a legal battle between the tribe and previous purchasers of leases and holders of prospecting permits.

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*Indian coal is considered "non-Federal" coal in this environmental impact statement. This coal is not governed by the Department's leasing program. Rather, the Department, through the Bureau of Indian Affairs, exercises trust responsibility over coal development on Indian reservations.

In Table 2-21, estimates of currently economic surface minable reserves owned by Indian tribes are shown. The 1977 production level and 1985 planned production from existing and proposed mines on Indian lands are also shown.

2.7.5 Non-Federal, Non-Indian Coal

In addition to coal owned by Indian tribes, there are other substantial holdings of non-Federal coal in the West. Railroads retain large holdings of coal in checkerboard areas which were originally railroad land grants. The Federal Government did not make it a general practice to retain coal rights in its land disposals until the early twentieth century, resulting in large-scale transfers of coal ownership to the private sector in earlier years. In Table 2-22, estimated non-Federal coal reserves and the percentage of total reserves they represent (excluding Indian coal) are shown for western coal regions. In the six key regions shown, non-Federal reserves represent only 28 percent of total reserves.

Although there are substantial non-Federal reserves, the development potential of these reserves is limited by the highly fragmented coal ownership pattern in the West. In checkerboard areas, for example, development would have to proceed one section at a time if the intervening Federal and state sections were not available. This would impose a high economic cost and would also have undesirable environmental consequences. Therefore, non-Federal coal in checkerboard areas would have a poor development potential without the addition of Federal coal (or vice-versa).

TABLE 2-21

INDIAN COAL PRODUCTION PLANS[a]

	SURFACE MINABLE RESERVES[e] (million tons)	1977 PRODUCTION	1985 PLANNED PRODUCTION FROM EXISTING AND PLANNED MINES (million tons/year)
Fort Union[b]	3,000	0	0
Powder River Basin[c]	15,000	5.5	14.0
San Juan[d]	4,000	7.0	11.1

(a) Based on DOE Leasing Policy Development Office projections of productions in 1985.
(b) Coal owned by Three Affiliated Tribes.
(c) Coal owned by Crow and Cheyenne Tribes.
(d) Coal owned by Navaho Tribe.
(e) Recoverable reserve estimates from Bureau of Indian Affairs Minerals Inventory Reports.

TABLE 2-22

ESTIMATED NONFEDERAL RESERVES[a]

	ESTIMATED NONFEDERAL RESERVES (million tons)	NONFEDERAL RESERVES AS PERCENT OF ALL RESERVES[b]
Fort Union	14,092	61%
Powder River Basin	28,505	20
Green River-Hams Fork	6,839	44
Uinta	1,014	17
San Juan	958	23
Denver-Raton	3,169	82
Total	54,577	28

(a) Estimates based on Bureau of Mines Reserve figures (see Table 2-1)

(b) Breakdown between Federal and nonfederal ownership made by examination of coal ownership rights in the six regions. Reserves are assumed to be distributed between Federal and nonfederal ownership in direct proportion to the acreages of Federal and nonfederal subsurface coal ownership within Known Recoverable Coal Resource Areas (KRCRA's) located in each region. Estimates were made under 1978 Interior Department coal policy review study of coal ownership, as shown on BLM surface-subsurface minerals ownership maps ("color quads"). Does not include Indian-owned coal.

In order to form an estimate of the maximum development potential of non-Federal reserves by themselves, a study was undertaken as part of the coal program review to classify non-Federal reserves according to three categories: (1) blocks of non-Federal coal possibly large enough by themselves to support a viable mining operation (with the minimum cutoff size set at 2,560 acres); (2) non-Federal coal in checkerboard areas and probably not developable alone; and (3) non-Federal coal in scattered parcels probably too small to support a viable mining operation (less than 2,560 acres). The distribution of non-Federal reserves among these three categories is shown in Table 2-23 for each region.

The regions with the highest percentages of non-Federal reserves in blocks of possibly developable mining size are the Fort Union, Green River - Hams Fork, and Denver-Raton Regions. The Uinta Region and the Powder River Basin have relatively much smaller proportions of non-Federal coal contained in blocks of developable size.

Because of the importance of the Powder River Basin in future coal production projections, ownership patterns in this region are particularly significant. In the Wyoming part of the Powder River Basin, the areas along the Wyodak seam, which are surface minable and which have the highest coal development potential, contain almost entirely Federally owned coal. The Montana part of the Powder River Basin is composed of a large checkerborad area and a large area of solid Federally-owned coal. Only 6.8 percent of the Powder River

TABLE 2-23

ESTIMATED DISTRIBUTION OF NONFEDERAL RESERVES BY OWNERSHIP CATEGORIES (PERCENTS)[a]

	SOLID NONFEDERAL RESERVES (POSSIBLY DEVELOPABLE)[b]	NONFEDERAL RESERVES IN CHECKERBOARD	NONFEDERAL RESERVES IN SCATTERED SMALL BLOCKS[c]	FEDERAL RESERVES
Fort Union	37.8%	21.6%	1.7%	39%
Powder River Basin	6.8	7.9	5.5	79.8
Green River-Hams Fork	23.3	13.4	7.0	56.3
Uinta	6.9	0	10.1	82.9
San Juan	14.2	0	8.5	77.3
Denver-Raton	62.8	0	19.5	17.8
Total	12.1	9.3	5.6	73.0

(a) Estimates based on the distribution of subsurface coal ownership in Known Recoverable Coal Resource Areas (KRCRA's) in the regions shown.

(b) Solid ownership was defined as reserves under nonfederal ownership in contiguous blocks greater than or equal to 2,560 acres. In Regions 2 and 3, a portion of the reserves are found in areas of checkerboard ownership, within which a number of 5-section blocks (3,200 acres) exist where the center section is state-owned and the surrounding sections are privately owned. These sections may be developable only if the center section (640 acres) is leased by the state to a private owner holding development rights to the reserves in the surrounding sections. In Region 2, at least 55 percent of the total solid nonfederal block is composed of these five-section blocks; in Region 3, at least 34 percent of the total solid nonfederal blocks fall in this category.

(c) Scattered small ownership blocks are defined as isolated sections of nonfederal coal ownership less than 2,560 acres in size, outside checkerboard areas.

Basin reserves are non-Federal and appear possibly large enough to be efficiently developed.

Most of the coal included in the "possibly developable" category is in fact not likely to be developed in the near future. The non-Federal coal owner may not be able to gain surface owner consent in those cases where there is a different surface owner. Non-Federal coal is often located in the alluvial valleys of the West, reflecting their early attractiveness for settlement, and it may not be developable for this reason. Substantial portions of the non-Federal coal are located outside of the areas believed to be most economical for mining or the areas which are believed to involve the fewest environmental problems. Even though non-Federal blocks may be of sufficient size to form a viable mining unit, these blocks may have several different non-Federal owners. There is no assurance that all owners will want their coal developed or that it will be possible to assemble the non-Federal coal into a developable package.

Planned production from mine plans that included Federal leases was shown above in Table 2-18. There are also a significant number of mine plans that do not involve any Federal coal. In 1977, excluding Indian lands, these wholly non-Federal mines produced 46.8 million tons, or 28 percent of total western coal production.

In Table 2-24, production planned for 1985 from mines that do not involve any Federal leases is shown for six western regions. Total 1985 production planned from these mines is 337 million tons.

TABLE 2-24

1985 PRODUCTION PROJECTED FROM EXISTING AND PLANNED MINING OPERATIONS INVOLVING ONLY NON-FEDERAL, NON INDIAN COAL(a)

	1985 PLANNED PRODUCTION (million tons/year)
Fort Union	15.9
Powder River Basin	3.6
Green River-Hams Fork	6.2
Uinta	3.9
San Juan	2.1
Denver-Raton	2.5
Total	34.2

(a) Based on DOE Leasing Policy Development Office projections of production in 1985.

Forty-two percent of this non-Federal production is planned in the Powder River Basin.

2.8 OVERVIEW OF THE NEED FOR NEW FEDERAL LEASING

One of the main controversies surrounding Federal leasing has been the question of the need for new leasing. It can be argued that this question need not be answered prior to initiating a coal leasing and management program. Rather, the question of whether leasing is needed and, if so, how much leasing should be undertaken, might be left to be determined through the procedures of the program adopted.

Moreover, even if new leasing is not needed immediately there is little reason for deferring the development of a program capable of undertaking leasing when it is needed. The government need not wait until leasing has become an urgent necessity before taking the steps necessary to have a leasing program in place.

Forecasts of energy supply and demand are inevitably based on uncertain assumptions. If assumptions change, what had previously appeared to be little or no need for leasing might, in a short time, appear to be a substantial need. The development and carrying out of a leasing program is not a simple matter that can be accomplished on short order. Therefore, it is desirable to have a program ready with the capacity to lease, even if little leasing is expected right away.

This programmatic environmental impact statement does not, in fact, propose any specific level of Federal leasing. The proposed action is the adoption of a program for the management of Federal coal resources, including new Federal leasing as it is determined to be needed. Procedures are specifically incorporated in the preferred Federal coal management program for determining the need for new leasing. Central to these procedures are coordination with the Department of Energy to assess the proper role of Federal coal production in meeting National energy needs; examination of available sources of coal supply including already issued leases; close consultation with states to assess the impacts of coal development on them; and analysis of the environmental consequences of different levels of Federal coal development.

Although no specific leasing level is being proposed, it is appropriate in this impact statement to give an assessment of the need for new leasing. It should be emphasized that such an assessment may be subject to substantial change as new information is gathered and assumptions are re-examined.

In Table 2-25 total 1985 planned production from (1) mine plans containing Federal leases, (2) mine plans on Indian lands, and (3) mines (non-Indian) not involving any Federal coal is shown (from Tables 2-18, 2-21, and 2-24). The DOE 1985 and 1990 medium production projections and the 1990 high projection are also shown.

For 1985, there does not appear to be any real difficulty in reaching DOE's projected medium production levels for most regions

TABLE 2-25

SUMMARY OF PLANNED AND POTENTIAL PRODUCTION
(million tons)

	TOTAL 1985 PLANNED PRODUCTION	LIKELY PRODUCTION FROM EXISTING LEASES WITHOUT MINE PLANS	PRODUCTION POTENTIAL PRLAs SURFACE RESERVES	TOTAL PRODUCTION POTENTIAL	1985 DOE MEDIUM PROJECTION	1990 DOE MEDIUM PROJECTION	1990 DOE HIGH PROJECTION
Fort Union	21.8	(a)	10.3	32.1	20.0	20.6	34.5
Powder River	217.2	7.0	48.5	272.7	204.6	396.1	602.9
Green River-Hams Fork	38.6	6.8	0.3	45.7	112.0	149.5	177.7
Uinta	43.3	23.3	3.1	69.7	26.4	28.3	27.9
San Juan	13.4	8.5	11.3	33.2	28.8	58.4	72.5
Denver-Raton	2.5	(a)	10.3	12.5	5.3	6.8	6.6
Totals	336.8	45.6	83.8	465.9	391.1	659.7	922.1

(a) Cannot be disclosed because of confidentiality requirements.

from already planned sources. There would, however, very probably be production shortfalls in 1985 in the Green River-Hams Fork Region if additional production beyond that already planned is not forthcoming.

For 1990, planned production does not appear sufficient to sustain DOE's medium level projections in the Powder River Basin, Green River-Hams Fork, San Juan, and Denver-Raton Mesa Regions. Most important, already planned production in the Powder River Basin is 178.9 million tons less than the region's projected 1990 medium level.

The addition of projected production from existing leases not yet in mine plans does not alter this conclusion (see Table 2-25). The further addition of PRLA reserves adds substantial production potential. But if only surface minable reserves are considered reasonably likely to be in production (as is the best assumption in the Powder River Basin, Green River-Hams Fork, and San Juan Regions), adding PRLA surface reserves still does not increase production enough to reach DOE 1990 projected medium levels.

Of course, additional production could be obtained in 1990 from mines using Indian coal and other non-Federal coal for which there are not yet any production plans. Moreover, if demand pressures become intense enough, currently planned mining operations could increase their output, although perhaps with some inefficiency. Therefore, it is hard to know just how severely a lack of further Federal leasing would inhibit achieving 1990 projected production levels. The Powder River Basin, for example, has little non-Federal and non-Indian coal of better quality that could be developed without adjacent Federal coal. The Crow and Cheyenne Tribes, however, have large blocks of developable coal in the Montana part of the Powder River Basin. The extent of their interest in developing this coal is uncertain.

Aside from the ability to reach specific projections, the presence of diligent development requirements creates a strong inherent reason for believing that new leasing will be needed fairly soon. Existing leases must either be in production by 1986 or be relinquished (with some possible exceptions). The level of production in 1986 will presumably not be greater than needed to meet demands in that year. Therefore, if western coal production grows after 1986, new Federal leasing will be required if Federal coal is to contribute to this growth in a significant way. With Federal coal typically a large share of total coal reserves in the western regions, it is almost inevitable that increased production of Federal coal will be needed to achieve any significant regional increases in production after 1986.

New leasing may also be desirable to promote a more competitive coal market. If utilities can purchase coal only from those coal companies that already hold Federal leases or own other coal deposits, competition could be lessened, thereby causing utilities to pay higher coal prices than otherwise necessary. The Anti-Trust Division of the Department of Justice has concluded that new Federal leasing is needed to promote greater competition.

Even if the absolute amount of Federal coal available in existing leases was large enough that it did not constrain future production, new Federal leasing might still be desirable. There is no reason to presume that existing Federal leases and planned non-Federal development involve the most economical coal to mine or are located at the least environmentally damaging sites. New leasing of Federal coal may be desirable to stimulate development of preferable mine sites, in terms of both economic and environmental features.

Given the current need for a viable program to lease Federal coal as needed, and to manage Federal coal resources, Chapter 3 presents alternatives capable of achieving these objectives.

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CHAPTER 3

This document is a preliminary working draft of the Department of the Interior's Coal Management Environmental Statement. The document is intended for internal review purposes. It will be revised in response to reviewer comments. In addition, internal analysis and revision of materials are continuing.

Chapter 3

DESCRIPTION OF THE PREFERRED COAL MANAGEMENT PROGRAM AND ALTERNATIVES

The Department of the Interior identified several issues and options for resolution in the course of conducting a review of its coal management responsibilities and past activities. The issues were originally studied by the Bureau of Land Management and the United States Geological Survey, and subsequently reviewed and consolidated by the Office of Coal Leasing, Planning, and Coordination. The result of this consolidation was a set of issue papers setting forth options for each issue. These issue papers were forwarded to the Secretary for his selection of the options he wished analyzed in this document as the preferred coal management program. Copies of the issue papers are available at no charge from BLM's Office of Coal Management (140), Washington, D.C. 20240, and from BLM's State Offices in Denver, Colorado, Billings, Montana, Santa Fe, New Mexico, Salt Lake City, Utah, Cheyenne, Wyoming, and Silver Spring, Maryland.

The issues, options, and the Secretary's preference are described below in section 3.1. The preferred coal management program, described in section 3.2, unites the Secretary's choices of options on these issues with the direction in the President's energy and environmental messages and with the requirements of the appropriate statutes, principally the Mineral Leasing Act of 1920, as amended by the Coal Leasing Amendments Act of 1975, the National Environmental Policy Act, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977.

Section 3.3 describes alternative methods to implement the preferred program and two alternative structures to the program.

3.1 ISSUES AND OPTIONS

Federal land use decisions, including those for coal management, must be made through comprehensive land use plans. Therefore, the following presentation of the key issues raised in the review of Federal coal management program should be viewed by the context of the land use planning process used in the Bureau of Land Management (BLM), the Departmental agency responsible for coal management decisions.

Structually, the BLM planning system consists of four basic elements. The first is called the Unit Resource Analysis (URA). For each BLM planning unit, a comprehensive inventory of resource problems and conditions, present uses, and existing values is prepared. This information is then analyzed to determine the existing resource situation and the management potential for resource preservation, enhancement, and development.

The URA is considered with two other system elements, the Socio-Economic Profile (SEP) and the Planning Area Analysis (PAA), in developing the land use plans or Management Framework Plans. The SEP is an information document which presents social and economic data in a systematic way. The PAA analyzes social, economic, environmental, and institutional values of significance to the management of Federal resources in a given planning area.

With this information base, land use plans termed Management Framework Plans (MFPs) are prepared in a three step process. In Step 1 of the MFP process, the maximum potential of each resource is constrained by applying laws, regulations, and the demand levels of the PAA. In Step 2, resource conflicts are identified and resolved so that final decisions can be made in Step 3. The resulting plans identify preferred land uses, or combinations of uses, for the area and serve as guides to Federal land managers. The MFPs establish the nature, extent, and objectives for future actions and programs on BLM-administered lands.

The Surface Mining Control and Reclamation Act requires that the Department review Federal lands to determine whether there are areas unsuitable for surface coal mining operations. The President in his environmental message of May 23, 1977 instructed the Secretary of the Interior to lease "only those areas where mining is environmentally acceptable and compatible with other land use". The President further directed that the Department "scruntinize existing Federal coal leases (and PRLA's) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications." As part of the Department's effort to carry out the requirements of SMCRA and the President's directives, criteria were developed which could be used for reviewing the environmental suitability of leases and PRLA's and for designating areas as unsuitable for leasing. Recommended criteria are discussed in section 3.2 below. These criteria would be applied in the MFP process to determine the environmental suitability of existing leases and PRLA's and to further define areas acceptable for further consideration for new coal leasing.

3.1.1 PROGRAM STRUCTURE ISSUES

The first issue which was forwarded to the Secretary in the review of Federal coal management authorities and activites was when in the planning process should the Department solicit information from the coal industry regarding where they would prefer to have leases offered. The options were oriented to the assumption that BLM's planning system provides the framework for making multiple resource, interdisciplinary land use decisions, including specific decisions for areas suitable for coal mining.

One option considered under this issue was to first solicit indications of areas of industry interest and then within these areas apply resource conflict analysis and unsuitability criteria, resulting in the selection tracts suitable for coal leasing. The major advantage of this option is that it allows early incorporation of industry resource and market information into the land use planning process. The major disadvantage is that it could likely eliminate consideration of some coal areas that meet the suitability criteria and have fewer resource conflicts.

A second option was not to solicit any indications of industry interest. This option would require the government to independently seek out coal resource and market information prior to application of unsuitability criteria, resource conflict resolution, and tract selection. Industry would only participate in the process at the time of lease sale. The major disadvantage is the burden placed on the government to duplicate the information which otherwise could be acquired from industry. A second disadvantage is that this option may bias the resolution of resource conflicts toward non-coal resources, because data unique to the coal industry would not enter into planning decisions.

The third option is to first use the planning process to designate areas acceptable within the planning area's coal fields and then study leasing targets using regional production projections as guidance. Resource and market information would then be solicited to aid in the tract delineation, ranking, and selection process. The Secretary selected this option (industry's tract interest would be expressed after the Department has determined acceptable areas) with the understanding that industry's comments (not nominations) would be welcomed and would be solicited concurrent with public comments in the land use planning process.

Subsequent to the Secretary's preference on industry participation in coal leasing decisions, the issue was raised as to the need for new leasing and, assuming that there are preliminary indications of need, what should be the general structure of a new Federal coal management program. The options presented to the Secretary were:

- No Federal leasing until at least 1985;
- Preference right leasing only;
- Lease bypass coal and lease to maintain existing operations;
- Lease to satisfy industry indications of need;
- Allow states to determine leasing levels;
- Lease to meet the Department of Energy (DOE) coal production projections;
- Merge DOE production goals with inputs from state and local governments, the coal industry, and other interest groups to determine leasing levels.

Over the past several years the question of the need for leasing has been a controversial focal point of the Department's efforts to manage its Federal coal resources. Considering the multi-year lead time in the development of mines to the point of production, similar time frames for planning and constructing coal-consuming power plants, and the complicating factors of competing fuels and cartel-controlled oil imports, precise determinations now of the tonnage of Federal coal which should be leased to meet the Nation's future energy requirements are not feasible. Lacking this precision, estimates of future needs are nevertheless required to avoid the speculative abuses described in Chapter 1, and to provide a rational base for future leasing decisions.

Chapter 2 of this document provides a detailed study of the Department's current estimate of the need for leasing. This analysis, together with the overriding consideration that the Department requires a coal system in place to respond to admittedly uncertain needs, is the basis for the Secretary's preference for a Federal coal management program that merges DOE production goals with advice from state and local governments, the coal industry, and other interest groups to determine leasing levels. Critical in this Departmental preference is the program component of continual reassessment of future regional coal demands in order to plan for an uncertain future.

A more thorough overview of the detailed procedures of the preferred program are presented below in section 3.2. The options not chosen are the program alternatives described in section 3.3. The entire set of options are carried forward to Chapter 4 and subsequent sections for impact analysis.

The coal management review also surfaced several issues concerning how various data would be incorporated into land use planning decisions.

It is generally assumed that DOE coal production projections consider that the difference between the projection of annual coal demand and the supply available from Federal sources (environmentally acceptable leases and PRLA's) and non-Federal sources provides an indication of the need (or lack thereof) for new Federal leasing. An issue raised was at what point would this difference enter the land use planning process. The options considered were:

- Specific targets would enter the planning process at MFP step 1 as a demand constraint. The coal demand constraint would be an element for the planning area analysis (PAA). Subsequent MFP resource conflict analyses and decisions would surface the "best" coal areas that could be developed to meet exactly the target.

- As above, except the production goal would be multiplied by a pre-specified factor (greater than one) to insure that a sufficient number of tracts would proceed through later phases of the planning system to the points of environmental analysis and tract ranking.

- Production targets would not be used in the planning process.

The Secretary preferred the last option. This preference is consistent with the previously described Departmental decision to first determine areas suitable for surface mining and then seek industry indications of need. The option also ensures that the planning system would first produce the best resource management decisions without the constraint of meeting a pre-selected production target.

Another issue raised concerning industry input was how industry indications of interest would be used in defining tract boundaries within acceptable areas. This issued must be considered in light of the Secretary's previously described preference for seeking industry indications of interest after acceptable areas have been defined.

The first option considered would have the government narrow acceptable coal areas down to a set of tracts which contain approximately the amount of coal needed to meet demand targets. This identification of the subset of "best" areas from the larger acceptable areas would place the burden on the government to independently seek out detailed resource and market information. Industry indications of interest would then be solicited and used to set final tract boundaries and to assist in tract ranking and scheduling.

The second and preferred option is to seek industry interest immediately after the land use planning process defines areas acceptable for further consideration for coal leasing. Expressions of interest and information from both industry and other sources would be used to select tracts. Tracts would then be ranked and selected for coal lease sales.

The options not preferred for these industry participation issues collectively form the substance of a coal management system alternative, further discussed below in section 3.3, designated industry determination of leasing levels. Impacts of this alternative system are presented in Chapter 4.

3.1.2 Management of Existing Leases and PRLAs

Tables 2-18, 2-19, and 2-20 indicate the current extent of Federal leases and preference right lease applications (PRLAs). The Federal coal management review included consideration of the Department's role in the possible future development of currently non-producing leases as well as consideration of processing outstanding PRLAs.

In the case of non-producing leases, the Department's preference is to apply, through BLM's planning process, the unsuitability criteria to the area of the leasehold at the time that the lessee submits a development plan. If all or part of the leasehold is found unacceptable for mining, appropriate action (e.g. purchase, exchange, condemnation, environmental stipulations, etc.) would be taken to prevent mining. The application of the unsuitability criteria to existing leases may depend on a variety of factors, including the statutory authority for each criterion and the nature of the lessee's commitments and rights.*

Outstanding PRLA's similarly would be examined for acceptability of mining, using the unsuitability criteria; however, this process would not be dependent upon applicant initiative. All PRLAs would be processed through the BLM planning system. PRLAs or portions thereof found unsuitable would be purchased, exchanged, or conditioned to protect environmental, socio-economic, or other values.

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*Issued leases that are not in production by 1986 would lapse for noncompliance with the diligent development provisions of the FCLAA.

3.1.3 Split Estate Leasing Issues - Surface Owner Consent

Under the original homestead laws, ranchers and farmers were granted both the surface and mineral rights to their land, but later homestead laws provided for the Federal government to retain the mineral estate. The majority of split estates originated out of these later homesteads. The retained mineral estate included the right to enter and mine at any time in the future. The private landowner did not have the power to prevent mining, though the landowner was guaranteed some degree of indemnification for damage.

Section 714 of SMCRA provides that in cases where Federal coal is overlain by private surface owned by a special class of owners, the Secretary will not issue a coal lease for surface mining purposes unless the owner has granted, in writing, valid consent to conduct such operations. The special class of owners (hereafter referred to as section 714 owners) is defined as a person or persons who:

- Hold legal or equitable title to the land surface;
- Have their principal place of residence on the land or personally conduct farming or ranching operations on the affected land or receive a significant portion of their income from farming or ranching on the affected lands;
- Have met these two conditions for at least 3 years prior to granting of consent.

The section further provides that valid consents granted prior to the date of the act (August 3, 1977) will be deemed sufficient for complying with the section.

In cases of leasing for underground mining or for surface mining where the surface is not owned by a section 714 owner, the consent provisions of the statute under which the surface was patented (with the coal reserved to the Federal government) would govern. The most important of these laws is the Stock-Raising HOmestead Act (30 U.S.C. 299) which states at section 9:

> ". . . Any person who has acquired from the United States the coal . . . in any such land, or the right to mine and remove the same, may reenter and occupy so much of the surface as may be required for all purposes reasonably incident to the mining or removal of the coal . . . first, upon securing the written consent . . . of the homestead . . . patentee; second, upon payment of the damages to crops or other tangible improvements . . .; or, third, . . . upon the execution of a good and sufficient bond . . . ."

Several issues were raised in considering how section 714 might affect the structure and implementation of a Federal coal management program. The questions are not trivial; of the 9.7 million acres of Federal coal rights classified as containing technically recoverable coal in six western states, six million acres are overlain by private surface (see Table 6-1). This is not to say that every acre is underlain by coal of equal quality, but rather that geologic evidence indicates that the area likely contains deposits of technically mineable coal.

The legislative history of section 714 was stormy. The measure was proposed to protect the lifestyle of farmers and ranchers who faced the risk of being moved off their land to make way for surface mining. Congress considered amendments expressly limiting compensation, and the Senate version of the Surface Mining Control and Reclamation Act empowered the Secretary to override the surface owner if leasing would be in the national interest. The provision agreed to by the Conference Committee, and signed by the President, however, included no compensation limitation or override.

SMCRA does stipulate that Federal coal underlying the private surface is to be leased in accordance with the Mineral Lands Leasing Act of 1920, as amended (MLLA). This law prohibits the government from accepting any bid which is less than the fair market value of the coal, as determined by the Secretary. According to the Department's Office of the Solicitor, ". . . the conflicts between surface owner consent and the Secretary's obligations udner the Mineral Lands Leasing Act are . . . subject to reasonable regulation under the terms of section 32 of the MLLA, 30 USC 189, which provides, 'The Secretary . . . is authorized to prescribe necessary and proper rules and regulations and to do any and all things necessary to carry out and accomplish the purposes of this (act)'." A purpose of MLLA is to receive fair market value for coal. The MLLA is interpreted as giving the Secretary the authority to regulate the leasing process to meet this purpose.

Specifically, the Secretary may monitor split estate consents to ensure their form and financial terms do not substantially affect fair market value or the competitive nature of the lease sale and, should these terms threaten the public interest, decline to proceed with that lease sale or to execute the lease.

Therefore, the guiding principal in interpreting the possible consequences of section 714 is that even if consent has been given the section does not prohibit the Secretary from exercising his discretion to lease or not to lease.

Initial questions considered by the Department were how section 714 might affect the general location of areas which may be considered for new leasing and should the Department control compensation for granting section 714 consents. The options considered were:

- Do not lease where the provisions of section 714 would apply. This option is the policy expressed by the Secretary in Louisville, Kentucky, on October 18, 1977, where he stated that "with few exceptions, it will be the Administration's policy to not lease coal in the forseeable future where the Federal Government does not own the surface above the coal . . ." The Secretary added that leasing would be permitted where the surface was owned by a coal company at the date of the passage of SMCRA, August 3, 1977;

- Do not lease where section 714 applies, but consider leasing where a coal company purchased the surface after August 3, 1977;

- Consider leasing all areas regardless of surface ownership and control compensation through regulations;
- Consider leasing all areas but do not control compensation;
- Consider leasing in all areas, control compensation by using discretion not to lease where the terms of compensation appear unfair, and use a tract selection ranking factor that states a preference to lease coal first with Federal surface and second with private surface (other factors being nearly equal).

The Department selected the last option for the preferred alternative.

A second set of section 714 questions considered were at the point in a lease tract identification process section 714 consents whould be acquired, and who should acquire consents--the Federal government or coal companies. The first question must be viewed in light of the Secretary's preference for a tract selection system that seeks industry indications of interest after areas acceptable for further considereation for leasing have been identified through the BLM's land use planning process.

These two questions are set out in a matrix of possible program choices on Table 3-1. In studying these two issues, the following factors were considered:

TABLE 3-1

MATRIX OF POSSIBLE PROGRAM CHOICES
FOR SECTION 717 SURFACE OWNER CONSENTS

WHEN?	WHO?	
	INDUSTRY	BLM
1. Contemporaneous with surface owner consultation (planning)	Not feasible	Yes, passively for those willing to volunteer
2. Adjunct to obtaining industry indication of interest	Yes, as part of interest package	Not applicable
3. Beginning with tract ranking and continuing through tract analysis	Feasible	Feasible
4. Prior to offering for sale	Feasible	Feasible
5. After sale, but before executing lease	Feasible	Not feasible

- The later in the process surface owner consent is obtained, the less the administrative costs of obtaining consent no matter who acquires it. Administrative costs are somewhat mitigated by tying them to points in the leasing process where contact must be made for reasons other than surface owner consent; that is, at the time of surface owner consultation and at the time of gathering industry indications of interest;

- The later in the process, the more information the surface owner has available and the stronger his bargaining position;

- The later in the process, the greater the risk of the government losing the time and money spent on evaluating and analyzing coal leasing tracts;

- The less direct involvement that BLM has, the lower the administrative costs and vulnerability to charges of government interference;

- The less the BLM involvement, the lower may be the government's ability to monitor compensation for the purposes of complying with MLLA.

At this time, the Department prefers a combination of options. Industry would have the responsibility of acquiring surface owner consent before a lease can be executed. Consents would have to be filed with the BLM prior to the sale announcement. The consents would be required to be transferable to any third party who successfully bids in a lease sale on a tract which contains the area to which the consent applies. Industry (as well as the states and the public) would be supplied copies of the tract ranking to provide potential bidders an indication of the liklihood certain tracts will be scheduled for sale. Industry would be encouraged to advise the BLM when consent negotiations have failed so that unnecessary site-specific analyses would not be undertaken.

If no filing of consent is made on a tract prior to the sale announcement, the tract would be removed from the sale schedule (and, if necessary, another tract substituted for it), unless the BLM determines that the tract should nevertheless be offered for lease sale. Should such a determination be made, the successful bidder on that tract in the sale would be given a period of time after the sale to obtain consent. If the bidder is successful in obtaining consent, the lease would be executed; if consent is not obtained, the sale of the lease for that tract would be voided.

A third set of issues raised in the consideration of section714 concerned compensation standards, managing pre-existing consents, and reimbursement of negotiating costs. As previously discussed, the Secretary has indicated that he prefers to monitor the levels of compensation offered for consent and to decline to lease where these levels are felt to be harmful to the public interest. These objectives may be accomplished in several ways:

- Establish an a priori method for determining acceptable levels of compensation and apply it directly to information received about consents. The method would be made public so that coal companies and surface owners would know the limits on payments that could cause the Secretary to consider implementing his option not to lease. This option would give the government the best assurances that it was receiving a fair value for its coal estate; on the other hand, it would result in an additional layer of administrative complexity;

- Exert only an indirect influence over surface owner consent. This would be done by pre-setting the level of costs allowed for surface acquisition in the computation of the fair-market value bid. Costs greater than this pre-determined amount would necessarily come from the profit computed for the coal companies in fair market value. The actual consent payment would not be reason for the Secretary to decline to offer a tract for lease;

- Do not permit any surface consent costs to enter computation of fair market value bids. All costs would be borne by coal companies and, possibly, the consumer. Coal companies either would be motivated to be extremely tough in bargaining for surface owner consent since net profit allowed for in the fair market value is tightly computed, or would refuse to participate in split estate sales altogether.

The Department prefers that a pre-set level for consent compensation costs be figured in fair market value determinations for lease tracts. Generally, the Department recognizes consent costs as a legitimate cost to the potential lessee. Prior to final decisions on the Federal coal management program, the Solicitor will review and comment on this preferred policy and the Department will undertake a study to determine the best method to determine a pre-set level for consent costs.

Pre-existing consents (i.e., those in effect prior to SMCRA) were validated under section 714 regardless of terms. Many of these consents were acquired under state laws. (Note, the Department will act to make all such consents publicly available.) SMCRA requires that the Secretary must accept these consents as written even though he may decline to lease if the consents conflict with the purposes of MLLA. Because these consents lack the transferability that would be required of consents acquired after the passage of SMCRA, they present the Department with difficulties in trying to comply with its responsibility under MLLA to only lease coal in competitive sales. With pre-existing consents and, indeed, any nontransferable consents, the competitive sale safeguard of the public interest would not be present. Intertract sales, in which the government offers several lease tracts for sale in the same auction and sells only a certain number of these tracts, offers one way around this problem. The Secretary, then, could (1) only offer tracts which are covered by nontransferable consents in intertracts sales, or (2) decline to lease pre-existing consents which are not transferable.

The Department prefers a combination of these two options. Tracts which are selected for lease sale and which include areas covered by pre-existing consents will be offered for sale if the consents are determined to be transferable. If any pre-existing consent is determined to be nontransferable, the tract would not be offered for sale unless it is included in an intertract sale.

Requiring industry to negotiate consents not only transfers the negotiation costs to industry from the government, but also imposes on one company the risk of bearing the surface owner consent costs for another's lease. The effect of this policy would be to discourage coal companies from negotiating consents except in cases where they felt they might have a strong competitive edge. This, again, is counter to the Secretary's responsibility to provide for competitive sales. Accordingly, the Department might:

- Require that the winning lessee reimburse the company that negotiated the consent for all provable costs of the consent, both direct and administrative;
- Foster the sharing of risk of losing consent costs by encouraging the development of industrial groups or consent brokers for the purpose of acquiring consent options;
- Take the position that loss of consent is a normal business risk in which the government should not be involved.

The Department would resolve this problem by requiring that a pre-sale, company-acquired surface owner consent agreement be considered transferable only if it provides that (1) the payment for the consent is to be made by the successful bidder after the lease sale in which the lease for the tract to which the consent applies is sold or (2) after the lease sale, the successful bidder is permitted to reimburse the company which first obtained the consent for the purchase price of the consent. As previously stated, except in unusual circumstances, no area would be offered for lease unless there existed a transferable consent negotiated prior to the lease sale.

3.1.4 Post Programmatic Environmental Analysis Strategy

The National Environmental Policy Act of 1969 requires that Federal agencies contemplating major actions which might significantly affect the quality of the human environment prepare a statement of the environmental impacts of that action and its reasonable alternatives. The Department, in formulating the preferred coal management program, considered which key leasing decision points could represent major Federal actions within the meaning of NEPA. The Departmental preferences on the program structure issues discussed above indicate four major decision points:

- The land use planning decision on areas acceptable for further consideration for leasing;
- The decision specifying a regional production target;

- The tract selection decision, which is made by applying the production target to the areas acceptable for further consideration for leasing;

- The decision to approve a mining and reclamation plan, once a lease is issued.

Any environmental analysis strategy must respond to potential impacts at these decision points, which range from national to site-specific in scope. Furthermore, the environmental analysis should be somewhat flexible to respond to a potentially wide degree of Federal actions among regions, depending largely on the extent and geographic pattern of Federal coal ownership. An additional goal of a policy to insure compliance with NEPA are that the concerns of the people affected by the coal management decisions be seriously considered.

As noted above, the first decision point in a Federal coal leasing process would be designation of areas acceptable for further consideration for leasing. Because these areas would likely be large relative to any lease tracts which might later be selected, and because the designations would not be constrained by demand for an area's coal, impact assessment at this point would be imprecise. Tract size and development timing would be unspecified; therefore, the number of people employed could not be estimated for socio-economic impact assessment. A further administrative constraint is that the BLM does not currently prepare EIS's at any point in its planning process, generally deferring compliance with NEPA until such time as plans for resource development are submitted by a potential resource user or plans are proposed by BLM itself. While this policy is under reconsideration, the issues involved in preparing environmental impact statements on alternative resolutions to multiple resource conflicts can not be resolved exclusively within the Federal coal management program.*

Sequentially, the next two decision points indicated above are specification of a regional production target and selection of tracts for leasing. Here there are opportunities for consolidation of impact analyses of the two decisions and for analysis of impacts ranging from site-specific to national in scope.

One option considered by the Department would be to periodically prepare a national coal sale environmental statement. Every 2 to 5 years a national lease sale schedule would be proposed by the Department. Specific and alternative tracts would be proposed, based on acceptability determinations in several planning areas and on assessment of DOE production goals, together with state and special interest group production preferences. The EIS would cover all potential site-specific, intraregional, interregional, and national impacts. The statement would assess a specific proposed and specific alternatives, rather than generalized production scenarios.

The second and preferred option is to maintain two separate levels of documents, one to consider interregional and national impacts and one to consider the site-specific and intraregional impacts.

*The BLM's Division of Planning and Environmental Coordination is currently developing regulations for comprehensive land use plans based on authorities granted in FLMPA. These regulations, if issued as proposed rules, may require BLM to prepare environmental statements at the point of resource development conflict identification.

This programmatic statement assesses the the national and interregional impacts of a Federal coal management program. If conditions change to the point where significantly different production levels appear likely, this programmatic environmental statement would be updated. Updating could also be triggered if realized impacts in a region are significantly different than those previously anticipated.

The second-level documents would be prepared in the following manner.

A regional environmental impact statement, including site-specific analyses of potential least tracts, would be prepared on a 4 year schedule of lease sales in each region delineated in the programmatic EIS. Each regional statement would include analyses of both the site-specific and intraregional cumulative impacts of the proposed leasing actions, The regional production target, tract delineation and ranking process, proposed selection of tracts to be leased, and lease sales schedules would be discussed. The tract rankings and sales schedule would be reconsidered 2 years later when the next biennial process of establishing new regional production targets is completed. If, in any region, substantial differences are found in tract ranking (because of the preparation of additional land use plans or the updating of existing plans or because of changes in environmental, social, or economic conditions), or in the regional production target which requires a change in the tracts proposed for sale, a supplement to the regional statement would be prepared. At the time of the second consecutive biennial consideration of regional production targets and ranking of tracts, new 4-year regional environmental impact statements would be prepared.

The fourth decision point indicated above is approval of mining and reclamation plans on leases issued through the preferred process. The requirement for an environmental impact statement would be judged on a case-by-case basis, depending to a large extent on the detail achieved in previous site-specific analyses of the leasing action. In any case, the impacts of the proposed and alternative plans would be examined and compared. Alternatives could include different mining sequences and scales and could include the alternative of not approving the mining plan. Environmental analysis at this stage would result in the Department's specification of detailed environmental stipulations that may have been more broadly defined at the time the lease was issued.

3.1.5 Definition of Maximum Economic Recovery

Prior to 1976, the United States Geological Survey (USGS) was responsible generally to assure conservation of coal resources during mining on Federal coal leases. Historically, USGS's role has been to prevent waste of coal by monitoring a lessee's operations and by requiring the lessee to mine all availavle coal. This was done informally and without rigid guidelines. In section 3 of the Federal Coal Leasing Amendrvent Act of 1975 (FCLAA), the Congress formalized this conservation requirement and introduced the concept of Maximum Economic Recovery (MER). Congress has indicated that MER is of considerable importance and should be treated in a consistent and formal manner. The new statute requires MER to be considered at two stages: (1) lease issuance: and (2) mine plan approval. Specifically, section 3 of FCLAA, requires that: "...Prior to issuance of a lease, the Secretary shall evaluate and compare the effects of recovering coal by deep mining, by surface mining, and by any other method to determine which method or methods or sequence of methods achieves the maximum economic recovery of the coal within the proposed leasing tract. This evaluation and comparison by the Secretary shall be in writing but shall not prohibit the issuance of a lease; however, no mining operating plan shall be approved which is not found to achieve the maximum economic recovery of the coal within the tract.. "

The issue forwarded for the Secrettary's expression of preference was what definition of MER should be adopted. Five different definitions were considered; the Secretary prefers that MER be calculated in a way that all coal seams which are collectively profitable must be mined, taking into consideration social and environmental costs. This defintion would mean that new leases would require the operator to mine successively deeper seams to the point where coal produced from the leasehold has approximately zero present value to the Federal Government. This is not to say that the government would receive zero revenues from the development of the tract. Royalities and income taxes would still accrue to the Federal treasury. For any scale of development (annual production rate), this definition would tend to minimize the area disturbed from surface mining; deeper seams would be substituted for a real expansion of operations. The Federal Government would be effectively subsidizing this minimized surface disturbance with money that, under alternative definitions, would accrue to the government from bonus bids. This definition would encourage that all technically minable coal would be developed in one pass, as opposed to re-entry to the deeper seams at a later date.

The definitions not preferred include:

- Calculate MER on a seam-by-seam basis. This definition would specify that the operator recover all seams to the point where the cost of producing the last seam would be equivalent to the revenue generated by selling coal from the seam;

- Apply either of the two previously described definitions on a case-by-case basis;

- Use engineering practices without specific economic consederations to determine MER. USGS mining supervisors would use their best technical judgment on a case-by-case basis;

- Allow the lessee to determine MER. This would require a legislative change to amend section 3 of the FCLAA.

3.1.6 End-use Considerations

Another question considered by the Secretary was whether the Department should condition new coal leases with stipulations that specify how, where, or by whom coal would be consumed. The goals of such restrictions would be:

- To more actively control the location and extent of environmental degradation;
- To promote the entry of economically and socially disadvantaged groups to the coal industry;
- To allow more active integration of Federal actions with state and local government planning, and otherwise control socioeconomic impacts;
- To encourage new energy technologies.

Coal leases have not in the past limited how a lessee could dispose of mined coal. A lessee can sell the coal for a mine-mouth power plant, ship coal short or long distances, or use the coal for gasification. Specifying the end-use of coal from new leases could give the Department greater control over the environmental and economic effects of mining and could be used to encourage new technologies; it could also infringe on other responsibilities, such as state regulation of power plant siting and EPA Clean Air Act regulations. In addition, the Department's legal authority to regulate end-use is unclear. A limited end-use requirement already exists in the Mineral Leasing Act: coal leases can be issued in favored circumstances to public bodies (non-profit companies, government agencies and rural electric associations) who would use the coal for their customers and members. (see the following discussion of public body leasing).

Options for resolution of this issue ranged from not adopting end-use stipulations (except as mandated for public bodies) to an active poliicy of conditioning leases to meet all the goals specified above. The Secretary preferred not to adopt end-use stipulations pending a Solicitor's opinion on the Department's authority for such action. The Solicitor's opinion is being developed.

3.1.7 Public Body Leasing

Section 2 of the FCLAA provides that the Department will set aside and offer for sale a reasonable number of coal lease tracts to nonprofit consumer-owned utilities, principally municipal utilities and rural electric cooperatives. This special class of lessees, hereafter referred to as public bodies, must use the coal to produce energy for their own use or for the use of their owners or customers according to a definite plan.

The statute leaves sufficient leeway for Departmental interpretation of the number of tracts which might be offered at special sales for public bodies and of the frequency of such sales. Public body leasing could play a substantial role in any new Federal coal management program as public bodies currently provide slightly over 10 percent of the Nation's electrical generating capacity.

Accordingly, options for public body leasings ranged from a program element of minimal size to a component of major porportion. The Secretary prefers to adopt a major program that actively responds to the energy needs of public bodies. An advisory committee would be established to assist in program development; however, leases to public bodies would not include any special financial incentives such as reduced royalties or lower acceptable bids at lease sales.

3.1.8 Detail of Lease Stipulations

Assuming the Federal land managing agency has identified a tract for coal leasing, a question arises as to the degree of specificity of environmental protection stipulations attached to the lease. For example, a lease stipulation regarding ground water recharge areas could take either of the following forms:

- All groundwater recharge areas within the leasehold will be restored to the original recharge capacity. Such areas and capacities will be identified by the lessee when a mining and reclamation plan is submitted;

- A groundwater recharge capacity of 20 acre-feet in the area in the southwest quarter section of the lease, above the elevation of 4,520 feet, will be restored as contemporaneously as possible with mining.

The former stipulation recognizes a general requirement for recharge capacity restoration, placing the burden for data acquisition and initial analysis on the lessee. It further imposes upon the lessee the risk that mining may not be approved in recharge areas. The later stipulation implies that the government will assume the data responsibilities and will minimize the risks of disapproval of development plans after the lease has been issued.

This example is representative of the more general issue of degree of stipulation detail. It is the Department's preference that the surface managing agency would develop sufficient information prior to leasing to answer basic environmental and economic questions (e.g., that development of the tract could proceed in compliance with the provisions of SMCRA). However, lease stipulations would not be as detailed as those that would be attached to a mining plan. Lease stipulations for environmental protection would be subject to modification for problems specified in the government's review of mining plans.

3.1.9 Other Issues

Several of the issues described above center on land use planning to manage existing leases and PRLA's and to identify new lease tracts. Successful implementation of the planning process depends to a large extent on participation of non-Federal organizations and private individuals. The Secretary's preferences on issues concerning public hearings and consultation between state governors and the Department reaffirm the Department's overall position that the preferred coal management program be continually responsive to the interests of affected organizations and individuals. Furthermore, while the Secretary does not prefer that states determine leasing levels, states would nevertheless be provided consultation opportunities at key points in the preferred program. The states' knowledge of and concerns for socio-economic factors would be critical in evaluating and disaggregating regional production targets that would guide leasing levels and influence the tract ranking process.

With respect to bidding procedures, the Department prefers to retain discretion to use either single tract or interract systems. Single tract bidding means that the bids on each tract would be compared to the government's estimate of fair market value of the coal resource; the lease would be awarded to the party whose bid most exceeds the government's estimate. Under the intertract system, more tracts would be offered for sale than are intended to be awarded. Only those tracts with the highest bids that exceed the government's fair market value estimate, and are needed to meet the leasing level target, would be awarded. The intertract system would likey introduce a degree of competition in the lease sale where individual tracts might not be equally attractive to all potential bidders. For example, an individual bidder might have a unique competitive advantage on a single tract because of control of the adjoining non-Federal coal or control of access to the tract.

The Department further would use discretion in selecting bonus, royalty, or other bidding methods. Under bonus bidding, the right to the lease would be awarded to the party who offers the highest cash amount at the lease sale. Under royalty bidding, the lease would be awarded based on the highest offer of percentage royalty to be paid to the government when coal is produced from the lease.

Finally, the Department considered whether field offices preparing MFP's should be given flexibility in the determination of specific environmental unsuitability criteria. However, at this time the Department prefers that specific criteria be adopted by the Department and then be strictly applied at the field office level. The detailed criteria are presented in section 3.2 below.

3.2 DESCRIPTION OF THE PREFERRED ALTERNATIVE*

The following describes the Secretary's preferred alternative for a Federal coal management program.

3.2.1 Background and General Policy

The basic purpose of the Department's coal management program is to carry out the President's Environmental and Energy messages to the Congress and to fulfill the mandates of the Federal Coal Leasing Amendments Act of 1975 (FCLAA), the Surface Mining Control and Reclamation Act (SMCRA), and the Federal Land Policy and Management Act (FLPMA). The principal goals of the program are to:

- Use land-use planning and effective enforcement of environmental laws to assure that Federal coal is produced in an environmentally acceptable manner that is responsive to local communities and private land owners affected by Federal coal development;
- Assure that sufficient quantities of Federal coal are produced to help meet the objectives of the National Energy Plan;
- Assure that Federal coal is produced in an economically efficient manner, with a fair economic return to the United States for all coal that is produced;

*Federal Coal Management Program example regulations are attached as Appendix A.

- Emphasize consultation and cooperation with state governments in planning the development and leasing of Federal coal.

Many of the elements of any Federal coal leasing and management program were addressed and, in some cases, required by the recent statutes. While these laws limit the Department's flexibility in shaping a program, they also have strengthened the Department's ability to address the many issues and potential problems involved in the development of Federal coal resources. To ensure that environmental and social effects of coal development are considered in leasing decisions, these laws require that coal leasing be compatible with comprehensive land use plans prepared by the Federal land management agencies in consultation with State and local governments and with full public participation.

Under these laws, no mining which disturbs the surface can be undertaken unless it meets stringent standards for protection of water and air quality, for restoration of land contours and revegetation, and for the safeguarding of other environmental and social values. The permanent program performance standards will be the subject of a separate environmental impact statement now being prepared by the Office of Surface Mining Reclamation and Enforcement on proposed regulations to implement the SMCRA. To protect the financial interests of the United States and to ensure that the Government receives a fair return for its property, the laws require that all leases must be issued after competitive bidding and upon payment of fair market value. The lessee must pay a royalty of not less than 12 1/2 percent of the value of the coal mined by surface mining methods and not less than 8 percent of the value of coal recovered from underground mining. The law restricts speculation in Federal coal by mandating that each new lease be forfeited unless production begins within ten years from the date the lease is issued. Other provisions attempt to maintain competition in the coal industry. For example, they limit the total acreage of Federal coal leases that any one company can hold and require an antitrust review by the Department of Justice before a lease is issued.

In April 1977, in conjunction with his energy message, the President released the Administration's National Energy Plan (NEP), which combines legislative, administrative and budgetary proposals to meet the Nation's energy crisis. The NEP asserts that coal must be the fuel that makes possible a reduction in the U.S. economy's energy related uses of oil and gas. The National Energy Plan sets goals for replacing oil and gas with coal and other energy alternatives. Meeting those goals will require increases in the production of coal, with the predicted added production ranging from at least 400 million more tons per year to 600 million more tons per year, or a possible doubling of 1977 annual production, by 1985.

The President also stressed that projected increases in coal production can and must take place without increasing the damage caused by traditional coal mining and burning practices. In his Environmental Message of May 23, 1977, the President said:

"The newly enacted Coal Leasing Amendments and the Federal Land Management and Policy Act provide the Secretary of the Interior with the necessary authority to carry out environmentally sound, comprehensive planning for the public lands. His duty now is to implement an affirmative program for managing coal lands and associated resources in a manner that fully protects the public interest and respects the rights of private surface owners".

Following this message, the President, by memorandum of May 24, 1977, instructed the Secretary of the Interior to "manage the coal leasing program to assure that it can respond to reasonable production goals by leasing only those areas where mining is environmentally acceptable and compatible with other land uses."

The President further directed that the Department "scrutinize existing Federal coal leases (and applications for preference right leases) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications."

The preferred alternative for a Federal coal management program would incorporate the objectives and requirements of each of these recent statutes and Presidential Messages to the Congress. The alternative includes eight major elements. First, a planning system, including environmental protection standards, to decide, in consultation with State and local governments, industry, and the public, which Federal coal reserves should be made available for production. Second, a system for evaluating the national demand for coal and determining the amount of additional production which should be stimulated by the leasing of Federal coal. Third, procedures for conducting sales and issuing leases. Fourth, post-lease enforcement of terms and conditions. Fifth, procedures for management of leases issued prior to implementation of the new program. Sixth, procedures for processing existing preference right lease applications Seventh, procedures for leasing Federal coal when the surface estate is in private ownership. Eight, a strategy to meet the environmental analysis requirements of the National Environmental Policy Act of 1969.

3.2.2 Overview of the Preferred Alternative

The following is a general overview of the eight major elements of the preferred alternative for a Federal coal management program.

3.2.2.1 Land Use and Activity Planning

During the 1970's, the Department of the Interior has been moving to integrate its comprehensive land use planning and coal leasing systems. The Federal Coal Leasing Amendments Act of 1975 requires that, before a Federal coal deposit can be offered for lease sale, the lands containing the deposit must be included in a comprehensive land use plan. The lease offering must be compatible with that plan.

The agencies principally charged with the responsibility for preparing land use plans for Federal lands which contain developable coal (i.e., coal to be mined) are the Bureau of Land Management (BLM), Department of the Interior, and the Forest Service, Department of Agriculture. Under the agencies' planning systems (required of the BLM by the Federal Land Policy and Management Act and of the Forest Service by the Multiple-Use Sustained Yield Act and the National Forest Management Act), planning is conducted on specific land areas and results in the allocation of specific land uses or combination of uses, including coal development, to each area. Resource inventories and other planning data are methodically analyzed and evaluated in light of pertinent legal requirements, policy guidance, and the existing plans of other Federal agencies, State and local governments, and private landowners to produce a multiple-use land use plan for the Federal lands and resources within the planning area. This plan is now called a Management Framework Plan (MFP) in the BLM planning system and a Unit Plan in the Forest Service planning system.

In the preferred alternative, the Department would rely on the land managing agencies' planning systems, in both the land use and activity planning stages, to provide the initiative and the forums for the making of the principal decisions in the Federal coal management program.

The critical decision during the land use planning process, under the preferred alternative, would be the delineation of areas potentially acceptable for leasing. The areas acceptable would be identified by screening out areas that:

- Are considered not to contain coal reserves of high to moderate development potential;
- Are considered unsuitable for leasing under the provisions of Section 522 of the Surface Mining Control and Reclamation Act and the President's environmental message;
- Are considered to be of higher value for other uses through the multiple-use, resource trade-off decisions;
- Are determined with reasonable certainty not to be reclaimable to their present level of productivity or higher;
- Are split estate lands where the coal would be recovered by surface mining methods and the surface owner (as defined in SMCRA) has indicated a definite preference against surface mining of his or her land.

The land use plan could also limit development levels or rates within the areas identified for further consideration. As an example, a threshold for mining employment might be established for socio-economic reasons or for wildlife populations for resource conservation reasons. The Federal land manager would not lease more coal if the additional development could be expected to push total mine employment in the planning area over, or the total population of a particular species under, the threshold level. Thresholds would be used to control impacts which depend on an overall development level rather than on site-specific effects.

Activity planning for each Federal resource in the planning area follows completion of the land use plan. Under the preferred alternative, coal resource activity planning would involve the delineation, ranking, and selection of tracts from the land identified in the land use plan as areas acceptable for further consideration for leasing. The first step in activity planning would be to delineate preliminary tracts* from within the acceptable areas. The boundaries of the preliminary tracts would be based primarily on considerations of technical coal data, resource conservation considerations, and surface ownership patterns. Readjustment of boundaries to reflect environmental or social considerations could occur as the tract selection process proceeds.

Although preliminary tract delineation would be done by the land management agencies, industry would be requested to submit indications of interest and those indications would be a critical element in the decisions on delineation and subsequent ranking of tracts.

Once the land management agency has identified preliminary tracts, it would begin analyzing the potential environmental impacts related to each tract. The agency would work closely with other Federal agencies, State and local governments, and other interested parties during this process.

As the next section details, the country has been divided into coal production regions to develop regional production targets. In cooperation with all involved surface management agencies and the affected State and local governments, the Department periodically would rank all available tracts within a production region. Selected from these ranked tracts would be those tracts to be included in a proposed lease sale schedule. The number of tracts selected and the proposed timing of their sale would be determined by considering the regional production target established by the Department, the share of the target which could be met from private or existing leases, and the analysis of the impacts related to the production target. Should the production target appear to exceed greatly the producable coal in the more highly ranked tracts, the target itself could be reevaluated and modified. These tract delineation, ranking and selection decisions would be discussed in an environmental impact statement which would consider the site specific impacts and cumulative regional impacts which would utimately result from the sale of leases for the selected tracts.

The participation of State and local governments would be sought vigorously during the tract ranking and selection process, particularly to ensure consideration of social and economic impacts and problems associated with potential coal development. The public would also be invited to participate in this process. The method for public involvement would be determined to fit the physical situation and the nature of the public interest on a region-by-region basis and to ensure the widest possible participation. In all regions, regardless of the public participation process employed, public hearings would be held on all EIS's prepared on the tract delineation, ranking, and selection process.

From among the tracts selected for lease sale, the Secretary would designate, where appropriate, specific tracts to be offered for sale only to public bodies (Federal and State agencies, municipalities, and rural electric cooperatives and similar organizations, and nonprofit corporations controlled by any of those entities) and small business. The decision on the two types of set-aside sales would be made after the Secretary reviews the information provided by public bodies through submissions of indications of interest in the activity planning process and consults with the Small Business Administration.

Stipulations would be attached to the proposed leases for the tracts selected for lease sale. These stipulations would incorporate measures to mitigate adverse environmental and social impacts that the environmental analyses of the land use planning and activity planning processes considered necessary. The leases would also require compliance with the Surface Mining Control and Reclamation Act.

Before making a final decision on which, if any, tracts to offer for lease sale, the Secretary would formally consult with the Governors of States in which tracts are being proposed for sale. Should a Governor object to the offering of any proposed tract within his State, he would be given a period of time in which to prepare and present his arguments to the Secretary. The Secretary could also schedule additional public hearings in the local area if he should determine they are needed.

The Secretary of Agriculture has the responsibility for land use planning on Forest Service lands. The FCLAA allows for adoption of State land use plans where the Federal surface ownership is minimal. Before entering any tracts recommended from other agencies into the ranking process, the Department would screen them with the unsuitability criteria mentioned earlier if the other agency has not done so.

Because of administrative resource efficiencies, the entire process could not be fully implemented for all lands bearing Federal coal during the first full cycle of decisions from land use planning through lease sale. Also, once the program is in full operation, some unexpected situations might arise to which the full planning-through-sale decision-making cycle could not respond in an appropriate time frame. To meet these situations, an emergency leasing system would be a component of the program. The system would by-pass the activity planning stage and use existing land use plans or land use analyses where appropriate. No tract would be offered that had not been the subject of an environmental assessment, including a screening against the unsuitability criteria used in the land use planning process. Emergency lease applications would be considered only in cases where hardship is involved, where Federal coal would be by-passed, and where coal is needed to continue existing production or meet existing contract requirements. Only enough reserves needed to sustain the applicant until a permanent decision could be made under the full planning-through-sale cycle of the coal management program, with some margin for error or delay, would be offered. The emergency leasing system would not be permitted to substitute for the procedures required in the full decisionmaking cycle, and should become less significant with the passage of time. Emergency applications which are not compatible with existing land use plans for the area would be rejected.

3.2.2.2 Regional Production Targets

For purposes of this program, the major coal bearing areas of the country have been divided into 12 coal productions regions; eight of these regions contain significant reserves of Federal coal. These regions would continue to play a critical role in the preferred alternative for a Federal coal management program. This role would begin with the establishment and biennial updating of national coal production targets by the Department of Energy in accordance with its responsibilities under the Department of Energy Organization Act. The targets, minus that share expected to be produced from the 4 regions not containing Federal coal reserves, would be submitted to the Department of the Interior. The Department then would review and, if necessary, adjust the portion of the national targets that apply to the eight regions containing Federal coal. Those targets would be subdivided into preliminary targets for each region in response to its own statutory policies and land management responsibilities. In considering the DOE targets, the Interior Department would review the analyses in the coal programmatic environmental impact statement and subsequent post-programmatic environmental impact statements. It would assess delineation, ranking, and selection of tracts in each region, industry surveys, and information developed by other institutions and organizations. Regional production targets would be established by the Secretary only after he has first consulted with the States, and then has offered the public and industry the opportunity to submit comments, on the preliminary targets.

Although the final regional leasing targets would not be used directly in making Federal coal leasing decisions until the tract selection process, these regional targets would enable both the Federal and State governments to set data gathering and planning priorities. These would ensure that a sufficient number of tracts are delineated and enough site-specific information is generated to make the regional tract ranking and selection process workable.

The analysis completed on the tracts available but not selected in the previous ranking and selection process for the regions would enable the Department to project cumulative impacts of any future lease sales. These impacts could then be considered when the Department again considers regional production targets. Using this process, the setting of regional production targets would supply guidance to the tract ranking and selection process which, in turn, would supply guidance for the next update of the regional production targets.

3.2.2.3 Lease Sales and Issuance of Leases

Each tract to be included in a lease sale would be analyzed to determine the appropriate fair market value and maximum economic recovery. If the determination of maximum economic recovery had not been discussed in the previous hearings on the proposed lease sale, a hearing would be held on that subject. Comments pertaining to the determination of fair market value would also be solicited before the sale.

The method for conducting the sales could vary from region to region and sale to sale. Only the specific number of tracts to be sold might be offered or more tracts might be offered with only the highest bids per ton of coal for a specific number of tracts accepted. This procedure, the intertract lease sale, is designed to encourage competition over all the tracts when competition for each tract individually may be lacking. Alternative bidding systems such as bonus, royalty, and profit-sharing could be used. In no case would bids for less than fair market value be accepted.

Particular tracts which have been set aside for public body or small business opportunities would be sold in separate sales, with only qualified public body and small business firms permitted to bid on the designated tracts. In these set-aside lease sales, no bids for less than fair market value would be accepted and no special variation in calculating fair market value would be accepted and no special variation in calculating fair market value would be used. Set aside tracts on which no successful bids are received would be released for the subsequent general sale, if one is scheduled.

The Attorney General would review all successful high bidders for antitrust implications before the leases could be issued. All leases issued would contain provisions developed by the Department of Energy to insure diligent development of the coal and continued operation of the mine.

3.2.2.4 Post-Lease Enforcement of Terms and Conditions

After a lease has been issued, the Office of Surface Mining Reclamation and Enforcement, or if a cooperative agreement has been signed with the State, the appropriate state agency, would enforce the environmental stipulations set forth in the lease and in the mining permit. The mining permit would have to be obtained by the lessee from the regulatory agency before mining operations begin. To obtain the permit, the lessee would be required to submit a mining plan for regulatory agency approval. The lessee would have to file bonds both to ensure that certain financial commitments to the Federal Government are met and to cover the cost of reclamation by the Federal land management agency should the lessee fail to meet all his reclamation requirements.

3.2.2.5 Management of Existing Leases

The Department would apply the same land use planning and unsuitability standards to existing nonproducing leases as are applied to new leases. In general, the lessee would submit a mining plan before the Department would conduct a comprehensive review of the lease.

Under this approach, the leases of lessees who do not attempt to achieve production would lapse for failure to meet diligence requirements. When a mining plan is submitted, the Department would review:

- whether the plan is consistent with Surface Mining Control and Reclamation Act reclamation standards;
- whether coal development is consistent with current planning and acceptability requirements;
- whether coal development has the potential to cause significant social and public service problems.

Should the review indicate no major problems, the Department would process the mining plan under normal procedures. If necessary, however, it would initiate negotiations for exchange or purchase of undesirable leases or reject the mining plan for failure to comply with the SMCRA.

In addition to this procedure, the Department would identify potential problem leases as it revises the land use plans to conform to the new requirements. The identification of these leases could trigger requests for exchanges or similar measures. If so, the Department would consider those requests even though a formal plan might not have been submitted.

Finally, as part of the process of determining the need for new leasing, and in setting the regional production targets, the Department has evaluated, and would continue to evaluate, the production potential from existing eases. This evaluation neither precludes subsequent review of those leases nor bars mining on those leases where the current evaluation shows mining is not expected to take place.

3.2.2.6 Processing of Preference Right Lease Applications (PRLA's)

As with existing leases, the Department would adopt a policy of applying to preference right lease applications the same environmental and planning standards as those applied to new leases. The Department would integrate the current standards into the process for determining lease entitlement and review:

- whether the lease application is consistent with the SMCRA reclamation standards;
- whether coal development is consistent with planning and acceptability requirements;
- whether coal development has the potential to cause significant potential for social and public service problems;
- whether environmental costs can be lowered and economic benefits increased by exchange.

This review would be made after the applicant submits the initial commercial quantities showing, and would be considered in the environmental assessment process. The Department would prepare impact statements on these applications to the same extent as it would do on new competitive lease sales. If the commercial quantities showing is successfully made, the

Department would issue the lease. If not, the application would be rejected, exchanged, or disposed of under other authority.

3.2.2.7 Split Estate Leasing

Tracts would be delineated and ranked regardless of the ownership of the surface. Areas may be excluded from this process that the surface owner has clearly established will not be mined In the selection of tracts for sale, a preference would be accorded tracts where the surface is federally owned in favor of tracts where the surface is in private ownership (Other factors being nearly equal).

Industry would have to acquire surface owner consent for the mining of tracts of Federal coal whenever such consent is required by section 714 of the SMCRA before a lease can be executed. Consents would have to be filed with the BLM prior to the sale announcement. The consents would be transferable to any third party who successfully bids in a lease sale on a tract that contains the area to which the consent applies. Industry (as well as the States and the public) would be supplied copies of the tract ranking to give potential bidders an indication of the likelihood certain tracts will be scheduled for sale. Industry would be encouraged to advise the BLM when consent negotiations have failed so that unnecessary site specific analysis would not be undertaken. If no filing of consent is made on a tract before the sale announcement, the tract would be removed from the sale schedule (and, if necessary, another tract substituted for it). Unless the BLM determination is made, the successful bidder on that tract in the sale would be given a period of time after the sale to obtain surface owner's consent.

If the bidder is successful in obtaining consent, the lease would be executed; if he is not, the sale of the lease for that tract would be voided.

The Secretary would exercise his discretion not to lease a tract where the surface is owned by a section 714 surface owner whenever he determines the form or the cost of surface owner consent is incompatible with the requirements of the Mineral Lands Leasing Act, including those provisions requiring that fair market value be received for the sale of the Federal coal and that the sales be competitive. A pre-set level for consent compensation costs would be required in the determination of fair market value for the lease sale.

Tracts which are selected for lease sale and which include areas covered by pre-existing consents would be offered for sale if the consents are determined to be transferable. If any pre-existing consent is determined to be non-transferable the tract would not be offered for sale unless it is included in an intertract sale.

A surface owner consent agreement would be considered transferable only if it provides that (1) the payment for the consent is to be made by the successful bidder after the lease sale or (2), after the lease sale, the successful bidder is permitted to reimburse the company that first obtained the consent for the purchase price of the consent.

3.2.2.8 Meeting the Requirements of the National Environmental Policy Act.

A regional, site specific environmental impact statement would be prepared on four year schedule of lease sales in each region identified in the programmatic environmental impact statement. Each regional statement would include analysis of both the site-specific and intraregional cumulative impacts of the proposed leasing actions. The regional production target, the tract delineation and ranking process, and the proposed selection of tracts to be leased and lease sales schedule would be discussed. The tract rankings and sales schedule would be reconsidered two years later when the next biennial process of establishing new regional production targets is completed. If, in any region, substantial differences are found in tract ranking (because of the preparation of additional land use plans or the environmental, social, or economic conditions) or if there is a new regional production target requiring a change in the tracts proposed for sale, a supplement to the regional statement would be prepared. At the time of the second consecutive biennial consideration of regional production targets and ranking of tracts, new 4-year regional environmental impact statements would be prepared. National and interregional impacts of the Federal coal management program would be analyzed in the programmatic environmental impact statement. The document would be updated when conditions change sufficiently to require new analysis of those impacts.

3.2.3 Detailed Description of Certain Aspects of the Preferred Alternative

3.2.3.1 Land Use Planning

As discussed, the BLM Planning System will be used for completing comprehensive land use plans for most public lands. The planning systems of the BLM and the Forest Service would provide the initiative and the forums for making the critical decisions in the preferred alternative. The products of these systems are the comprehensive, multiple-use land use plans for specific areas of the Federal lands. The Federal Land Policy and Management Act of 1976 established the basic planning guidelines for the BLM and the Multiple Use-Sustained Yield Act and the National Forest Management Act provided planning guidance for the Forest Service. The guidelines in the Federal Land Policy and Management Act include:

- Inventory public land, their resources and other values;
- Use multiple use and sustained yeild concepts;
- Apply an interdisciplinary approach;
- Give priority to the designation and protection of the areas of critical environmental concern;
- Consider present and potential uses of the land;
- Consider the relative scarcity of the values involved and alternative means and sites for realization of those values;

- Consider both long-term and short-term benefits;
- Provide for compliance with applicable pollution control laws;
- Coordinate inventory, planning, and management with other Federal agencies and State and local governments.

Structurally, the BLM planning system consists of four basic elements. The first is called the Unit Resource Analysis (URA). For each planning unit, a comprehensive inventory of resource problems and conditions, present uses, and existing values is prepared. This information is then analyzed to determine the existing resource situation and management potential for resource preservation, enhancement, and development.

- The URA is considered with two other system elements, Socio-Economic Profile (SEP) and Planning Area Analysis (PAA), in developing the land use plans. The SEP is an information document which presents social and economic data in a systematic way. The PAA analyzes social, economic, environmental, and institutional values of significance to the management of Federal resources in planning area.

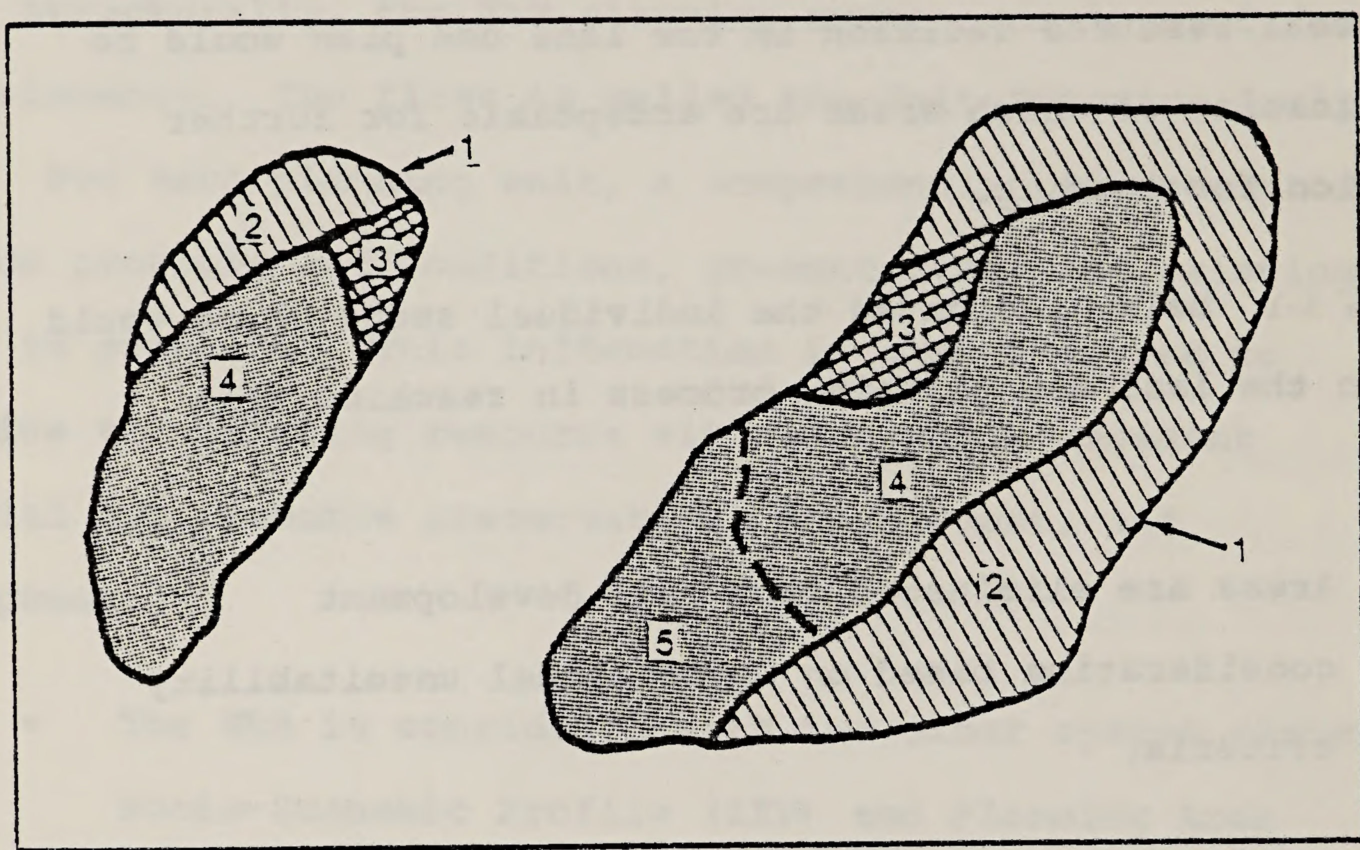
With this information base, the land use plans termed Management Framework Plans (MFPs) are prepared in a three step process. In Step 1 of the MFP the maximum potential of each resource area is constrained by applying laws, regulations, and the demand levels of the PAA. In Step 2 resource conflicts are identified and resolved so that the final decisions can be made in Step 3 of the MFP. The resulting plans identify preferred land uses, or combination of uses, for the area and serve as guides to Federal land managers. The MFP's establish the nature, extent, and objectives for future actions and programs on the BLM-administered lands.

Under The Secretary's preferred alternative, the principal coal resource decision in the land use plan would be the determination of which areas are acceptable for further consideration for leasing.

Figure 3-1 below indicates the individual steps which would be taken in the land use planning process in reaching this decision.

- Areas are eliminated from coal development consideration based on Departmental unsuitability criteria;

- Additional areas are eliminated by officially prepared plans based on multiple use values identified and analyzed during conflict resolution in MFP Step 2. The reduction would usually affect considerably less coal area than in step 2 above. The adjustment at this stage is made to accommodate unique, site specific resource values clearly superior to coal but not included in Departmental unsuitability criteria. A prime recreation site or campground might be an example. Another example



Note: Numbered items are described in the text.

FIGURE 3-1
TYPICAL MULTIPLE-USE PLANNING PROCESS

could be the strong objections of private surface owners;

- The remaining areas would be designated as areas acceptable for further consideration for coal leasing, subject to areawide constraints and multiple use coordination to guide coal program activities, such as maintenance of a minimal acreage of wildlife habitat conditions over the suitable area, or unique stipulations to be placed on any potential coal lease;

- Preferred coal leasing areas might be identified if the areas acceptable for further consideration for coal leasing clearly larger than may be needed for leasing within the land use planning cycle period before the land use plan would be updated (5 to 7 years), based on available socio-economic and demand data, and considering both coal potential and other conflicting values. Preferred area designations would be advisory only and not a plan commitment. They would assist the tract selection planning team but would not necessitate a land use plan revision if the tract selection process results in the selection of tracts in other areas.

The procedure for considering underground "minable" coal would be the same as used for surface "minable" coal. In the case of the underground coal the unsuitability criteria and resource trade-off decisions would apply only to hydrologic and surface disturbances of coal. If an underground mine would not effect the surface above it, then the surface, even if it is not acceptable for further consideration for leasing by surface mining, could be acceptable for consideration for leasing by underground mining techniques only. Where both surface minable and underground minable seams are present in the same planning unit, the distinction as to which area is acceptable for further consideration for leasing by each recovery method would be made.

A more detailed description of each of the major screening criteria is discussed below.

Unsuitability Criteria. The President, in his Environmental Message of May 23, 1977, instructed the Secretary of the Interior to lease "only those areas where mining is environmentally acceptable and compatible with other land uses." The President further directed that the Department "scrutinize existing Federal coal leases (and PRLA's) to determine whether they show prospects for timely development in an environmentally acceptable manner, taking steps as necessary to deal with nonproducing and environmentally unsatisfactory leases and applications."

In addition, in August of 1977, the President signed into law the Surface Mining Control and Reclamation Act (SMCRA). Section 522 of this Act requires the Secretary to review Federal lands to determine whether there are areas which are unsuitable for surface coal mining operations. SMCRA also contains a requirement for States to undertake a similar program if they wish to assume primary regulatory authority under the Act. A list of standards to be used by the States is identified in Section 522(a) (3) of the Act. These standards, which are also required to be applied to Federal lands (private surface lands overlying Federal coal are considered to be Federal lands for the purposes of the application of standards), include land reclaimability, fragile or historic lands, renewable resource lands including aquifers, and natural hazard lands.

Under the preferred alternative, unsuitability criteria have been developed in response to Section 522 of the Surface Mining Control and Reclamation Act and the President's directives in his evnironmental message of 1977. The Department would not lease lands unsuitable for mining without good cause. The President's environmental message requires future coal leasing to be environmentally acceptable and compatible with other land uses. The intent of these criteria is to give the Secretary assurance that would be fulfilling this responsibility in a consistent, uniform manner across all the Nation's Federal lands. They also would give him a means of judging the environmental acceptability of existing leases and lease applications.

The criteria are intended to isolate key environmental elements that should not be considered for coal production leasing. The criteria are intended for application within the planning systems of the Federal land management agencies. These criteria would be used to screen out lands that are inappropriate for further consideration because they are essential to one of several key environmental elements. These lands would be removed from the identification, ranking, and selection of tracts for lease sales.

Resource Trade-off Decisions. Although it is likely that some major tradeoffs between coal and other resources would be addressed during the application of the unsuitability criteria, other significant resource balancing decisions should remain. These other resource trade-offs would be considered and acted upon after application of the unsuitability criteria. The adjustment at this state would be made to accommodate unique, site-specific resource values clearly superior to coal but not included in the criteria. A prime recreation site or campground might be an example.

These adjustments would effect Departmental plans to develop or maintain these values on lands whose surface is managed by the Federal Government, or where the Federal Government is supporting State or local government and private surface owner's plans to develop lands under their jurisdiction or ownership, by precluding Federal coal development. The Department will not make management proposals for surface estates it does not manage unless it is actively attempting to acquire such surface rights.

Surface Owner Consultation. Section 714(d) of the Surface Mining Control and Reclamation Act of 1977 requires the Secretary, to consult during the planning process with owners of the surface estate overlying Federal coal resources being considered for leasing.

In order to minimize disturbance to surface owners from surface coal mining of Federal coal deposits, and to assist in the preparation of comprehensive land-use plans required by section 2(a) of the Mineral Lands Leasing Act of 1920, as amended, the Secretary shall consult with any surface owner whose land is proposed to be included in a leasing tract and shall ask the surface owner to state his preference for or against the offering of the deposit under his land for lease. The Secretary shall, in his discretion but to the maximum extent practicable, refrain from leasing coal deposits for development by methods other than underground mining in those areas where a significant number of surface owners have stated a preference against the offering of the deposits for lease.

Surface owner is defined in section 714(e) as an individual or majority stockowner who holds legal or equitable title to the land surface; has his principal residence on the land, or personally conducts, or receives a significant portion of his income from farming or ranching operations on the land; and has met these conditions for at least three years prior to giving his consent.

Those people qualifying as surface owners under Section 714 must also give their consent prior to the Government leasing the coal under surface. Given this veto power, the following procedure would apply under the preferred alternative.

After application of the lands unsuitable for leasing criteria and the resource trade-off decisions discussed previously, the land mangement agency would consult with all surface owners whose lands are potentially acceptable for further leasing consideration. If the surface owner indicates a definite preference against the leasing of the deposit underlying his surface, that part of the deposit would be eliminated from further consideration. Should the surface owner not wish to have the deposit eliminated from further consideration, he would still retain the right to veto leasing of the coal deposits under this surface at the time of surface owner consent is formally sought.

In addition to eliminating those tracts indicated above, the MFP would flag for special consideration any area in which a significant number of surface owners have expressed a preference against leasing. Although the area might still be designated as acceptable for further consideration, the land use plan would contain the recommendation that no leasing take place in the area unless there are no acceptable alternative areas available to meet an agreed upon needed level of leasing for the production region.

<u>Threshold</u> <u>Development</u> <u>Levels</u>. Although many land use decisions can be made on a site specific basis (ie. this location should be developed as a recreation site rather than leased for coal development) many decisions may be oriented more toward impacts dependent on levels or rates of development.

Although any one of five given potential coal development sites under consideration might have an acceptable impact by itself, the total impact to the area of developing all five could be intolerable. As an example, the critical habitat area for a particular species inhabiting the MFP land might have been eliminated from further consideration from leasing. The species does, however, use additional areas within the MFP. Reduction of the areas may adversely effect the species population. During the MFP decision process, a decision that a 10 percent decrease in the population would be an acceptable trade-off might be made. Given the protection of the critical habitat area, it might not make a difference as to what other areas would be temporarily lost to coal development as long as the total would not exceed a certain acreage or decrease the population more than the agreed upon amount. In this situation, no additional land would be removed from further consideration for leasing. A threshold constraint would be attached to specify the total level of leasing within the acceptable areas which would be consistant with the land use plan.

This threshold concept is particularly appropriate when considering social economic impact decisions. The social economic infrastructure of the planning unit might only be able to support a certain development level. Also, the rate of development might be critical. If this information is available, a recommended threshold leasing or development level and rate could be specified in the plan.

It is not necessary to specify thresholds in the MFP. The later steps in the leasing process, supply ample opportunity for the Department, others Federal agencies, State and local governments, and others to discuss and agree upon regional and subregional thresholds. If, however, the land use planning process reveals the need for a particular threshold, then it could and should be made part of the leasing system.

3.2.3.2 Activity Planning

<u>Tract identification and industry indications of interest.</u> On completion of the land use plan, preliminary tracts would be identified within the areas designated acceptable for further consideration for leasing. The land managing agencies consider the following factors:

- Technical coal data, including reserve tonnage, rank, sulfur content, seem thickness, and ratio of recoverable coal to reserves;

- Conservation considerations, including calculation of maximum economic recovery, land ownership patterns, and the formation of logical mining units;

- Expressions of interest and existing or planned operations on adjoining lands;

- Surface ownership, including the results of surface owner consultation, and the existence of surface owner consents and their terms.

Although preliminary tract delineation would be done by the land managing agencies, industry would be requested to submit indications of interest for leasing. A call for an expression of leasing interest may be made where and when areas acceptable for further consideration for leasing have been identified in the Bureau of Land Management or Forest Service land use plans.

In areas where state or other agency plans have been adopted, unsuitability criteria would be applied before a call would be made.

Any individual, business, industry, or public institution would be able to respond when the Secretary issues a call for expression of leasing interest. All calls would include a description of the kind of data required, including but not limited to location and quantities of coal desired, time needed, proposed use of coal, technical coal data, commitments with private surface and coal owners and adjacent landowners or lessees, and basic development proposals. Public inspection and copying of information submitted under this subpart would be governed by the procedures in 43 CFR Part 2.

Notice of each request for an indication of leasing interest would be published in the Federal Register and in the general circulation newspaper(s) in the affected State. This notice or request would specify the area or areas involved, information required, the period of time within which expression may be submitted, where to write for further information, and where to submit the expressions.

The fact that a specific request for indications of interest would be part of the activity planning system would not preclude industry from participating in the earlier land use planning efforts. General expressions of interest could be submitted during the planning process or whenever a mining company might wish to indicate an interest in Federal coal in a particular area. General expressions of interest would be in the form of a general letter to the Secretary. The Secretary would use this information for planning purposes or to aid in setting the regional production targets.

Tracts would not be identified as special opportunity lease sales for public bodies on small businesses during tract delineation. However, if special leasing opportunity sales are contempleted in the region, an effort to identify tracts of an appropriate size and location would be made at this stage of the process. In order to initiate Departmental action to identify potential public body tracts, interested parties qualifing as public bodies would have to submit formal indications of interest in response to appropriate request for interest indication. Although potential small business candidates would be encouraged to submit formal indications of interest, it would not be necessary to initiate tract identification. In consultation with the Small Business Administration, the Department might attempt to delineate tracts to go into the ranking process which could meet the neeeds of small business regardless of whether indications of interest for small business opportunities were submitted or not.

Regional Tract Ranking, Selection, and Scheduling. If the regional production target established for any given region suggests the need for additional Federal coal leasing, a proposed lease sale schedule would be formulated. Before the schedule is established, all available preliminary tracts within the region would be ranked by priority using such criteria as coal economics, ease of reclamation, proximity to existing transportation facilities, class of surface ownership (Federal or non-Federal), surface owner preferences, and socioeconomic and other environmental concerns. The ranked tracts would be compared with the desired level of production and a set of tracts would be selected for a proposed lease sale schedule. Since the potential environmental and social impacts resulting from development of any tracts in the same area would be cumulative, the selection of the first tract might preclude selection or lower the priority of other highly ranked tracts. Accordingly, as selections are made of individual tracts, the original rankings of the remaining tracts may be altered and the final, selected tracts would not necessarily directly correspond to the relative order in which the individual tracts were originally ranked. The number of tracts proposed would be dependent on the type of bidding system to be used (intertract or single tract bidding) and the tonnage targeted for lease. The selected tracts would be placed into a proposed lease sale schedule.

The ranking and selection process would be done by the Department in close consultation with the Governors within whose States the region is located and in consultation with representatives of all affected Federal surface managing agencies. The Secretary would invite comments and participation of the public, industry, and other interested parties before tract ranking and selection decisions are made.

A notice of intent to rank and select tracts to be included in a proposed lease sale schedule would be published in the Federal Register and selected general distribution newspapers within the region no less than 30 days before the ranking process begins. The notice would contain a description of the tracts to be ranked and procedures under which any interested parties are to be involved in the process.

The results of the process, including the tract rankings, the tracts selected, the proposed schedule, and the list of criteria used, would be published in the same publications in which the notice of intent was published after the results of the process have been accepted by the Secretary. Detailed information on each of the tracts ranked would be available for inspection in the Bureau of Land Management office in the region. Those parties interest in commenting on the results of the tract ranking and selection process would have the opportunity to do so in the environmental assessment process before any final decision by the Secretary to hold a lease sale encompassing any of the selected tracts.

The ranking and selection process would normally be repeated every two years in accordance with the updating of the National and regional production targets. The Secretary might, in consultation with the Governors of the affected States and surface managing agencies, initiate or postpone the process to respond to considerations such as major planning updates, new preliminary tract identifications, and increases or decreases in the level of leasing.

To establish planning and inventory related priorities, the Secretary might include in the ranking designated as areas acceptable for further consideration for coal leasing that have not been delineated as preliminary lease tracts. Provided all tracts subsequently identified for lease consideration would be formally entered into the ranking and selection process before they were included in a lease sale proposal, these areas could be treated informally. It would be unnecessary to include them in the notices of intent and in the results discussed above.

3.2.3.3 Setting Regional Production Targets

The major coal bearing areas of the Continental United States have been divided into 12 coal production regions as shown in Figure 2-1. Eight of these regions contain significant reserves of Federal coal. Under the preferred alternative, these eight regions would serve as the basic units both on which the assessment of desired levels of leasing would be centered and in which tracts would be ranked and lease sales conducted. The Department of Energy, pursuant to the responsibilities assigned to it by the Department of Energy Organization Act, would establish and biennially update a national coal production target. Under the preferred alternative, the DOE national production target would serve not as a goal on which to judge success or failure, but rather as a guide for judging national need for coal development against any associated adverse environmental impact. The national target would also serve as a guide to Interior in establishing a leasing rate that would not result in lowering the return per measure of coal sold to the Government.

After subtracting the production expected from the 4 regions not containing significant reserves of Federal coal from the national target, the Department would review and, if necessary, adjust the total, disaggregating it into the eight regions containing Federal coal. This review, adjustment, and disaggregation process would take into consideration statutory policies and land management requirements, the analyses in the coal programmatic environmental impact statement, and subsequent post-programmatic environmental impact statements on the delineation, ranking, and selection of tracts in each region; industry surveys; and information developed by other institutions and organizations. Regional production targets would be established by the Secretary only after the States have been consulted and the public and industry have submitted comments on the preliminary targets.

The regional production targets derived in this process would be preliminary in nature. They would be used by the Federal and State governments to set data gathering and planning priorities to ensure that a sufficient number of tracts would be delineated and that sufficient site-specific information would be available to make the regional ranking and selection process workable. These preliminary regional targets would also serve as initial guidance for the ranking and selection process. They would be flexible however, with the final targets actually being developed as part of the analysis in the ranking and selection process.

Although the regional production targets developed at this stage would be preliminary, the process would still be quite important. The regional ranking and selection process should consistantly indicate the optimum tracts for the desired level of development and lead to a thorough analysis of the impacts of alternative tract selections including the alternative of choosing a combination of tracts that would result in the lowering of the production target. The regional ranking and selection process cannot adequately analyze the possibility of trade off between regions. This must be analyzed at the time the regional targets would be set or updated. The first time the process of determining regional production targets would be conducted, the interregional analysis conducted in the coal programmatic could be used as a basis for the decisions on the targets. In the subsequent updates, scheduled to follow the biennial submission of DOE national targets, the information and analysis generated in the proceeding ranking and selection process would provide useful information for the target decisions. In the previous ranking and selection process, alternative tracts to the ones finally chosen would have been analyzed. Those highly rated but previously unselected tracts would most likely serve as the main pool of tracts for the selection of tracts to meet the new regional production targets. If the unchosen tracts remaining in one region are clearly superior to most of those remaining in another, some consideration of interregional trade-offs in the setting of the new regional production targets regional goals might be appropriate. This overall interregional marginal analysis of the tracts makes the development or update of the regional production targets at this stage quite important.

3.2.3.4 Pre-Sale And Sale

From the time a tract cleared the environmental stage until a lease could be issued, a series of actions would be required to meet various statutory and administrative requirements.

Lease Stipulations. The Department would conduct a technical examination for each proposed lease to develop lease terms and stipulations. The information on which this report would be based must be sufficiently detailed so that the Department could be satisfied that the lease would be economically and environmentally acceptable, but in less detail than would be required of a lessee at the time a mining plan would be approved.

Fair Market Value. The Federal Coal Leasing Amendments Act of 1975 (FCLAA) specifically mandates that, "No bid shall be accepted which is less than the fair market value, as determined by the Secretary, of the coal subject to the lease."

Two basic methods are currently accepted in performing tract evaluations - a comparable sales analysis and an income approach utilizing discounted cash flow analysis.

The comparable sales approach provides the best estimate of fair market value by considering recent transactions involving lands in the vicinity of that tract being considered for sale. Frequently, not enough sales have been made in the area of interest to allow reliable use of the comparable sales approach. In addition, there are few circumstances in coal resource evaluation where the tests of proximity in time, location, and similarity of resource extraction lead to true comparability between tracts. The income approach or discounted cash flow (DCF) analysis involves calculating annual costs and income resulting from the development of a property under realistic conditions. Because of the practical limitations in the comparative sales approach, only the DCF method will be discussed. The DCF method is currently being used by the Department to determine fair market value for those tracts being leased under the NRDC v. Hughes agreement.

A computer program utilizing discounted cash flow is used to calculate estimated net present values for tracts of federal land offered for competitive lease sales or preference right lease applications. The program is coded to reflect alternative mining methods which may be used. The life cycle of a mine is divided into four phases: predevelopment, development, production, and post-production. The mine life cycle is limited to a total of 60 years. The individual phases are limited as follows: the sum of the predevelopment and development phases is to be less than or equal to 10 years, the production phase is to be less than or equal to 48 years, and the post-production phase is to be less than or equal to 10 years.

Basic considerations include the following:

- The USGS (Conservation Division) resource and reserves determination procedures will be used in evaluating tracts for competitive lease sale or for potential preference right lease applications,

- Tract Resource and Development Summary Reports, or preliminary mining plans when available, reflect tract geological and environmental conditions as well as the actual manner in which the coal will be mined and the lands reclaimed;

- Developed lands will be restored to conditions representative of prior use;
- The basis for royalty collection and presale evaluation are determined from the selling price of coal at the point of shipment;
- The evaluation is based upon the project alone and disregards financing considerations and/or financial policies of any particular company;
- It is assumed that the mining operation will be conducted by a taxable corporation as a profit-making venture.

All outlays or funds over the life of the project, from predevelopment to post-production, can be grouped into five categories: capitalized expenditures, cash outlays, expense outlays, taxes, and royalties. Estimates of necessary investments, operating expenditures and income from the mining process on the tract are developed. The price of coal at point of shipment is based upon current market conditions in the area and applied to the production schedule to determine the yearly sales schedule.

These data are used in the DCF program to determine the estimated net present worth of the coal resource in the tract. The net present worth for the tract is estimated as the sum of the annual discounted cash flows. The same procedure, with minor modifications, is used to evaluate the existence of coal in commercial quantities for use in processing preference right lease applications.

Before the Secretary makes any final determination on fair market value, the public will be given the opportunity to comment on fair market value consideration for any tract being offered.

Determination of Maximum Economic Recovery (MER). Prior to a lease sale, the Department must evaluate and compare which method or methods of mining will achieve the maximum economic recovery (MER) of the coal resource. The Department would make this evaluation and comparison after tract selection but prior to lease sale and would calculate maximum economic recovery on the basis of requiring all those seams to be recovered; which could be mined at a combined overall profit on a year-to-year basis. The Department would retain the flexibility to alter the determination based on social and environmental costs.

The determination of Maximum Economic Recovery would be discussed in a hearing prior to lease sale. The hearing may deal solely with MER or cover several other presale issues along with MER.

Sale and Bidding Methods. Under the Department of Energy Organization Act, the responsibility to issue regulations on bidding systems sale and bidding methods was transferred from the Interior Department to the Department of Energy. For the preferred alternative, bidding system regulations would be kept flexible permitting the choice of sale method to be on a case-by-case basis.

Bidding could be on an individual tract where bidders compete against one another for any given tract. The Department would choose what it feels are the best tracts, both economically and environmentally, which cumulatively contain the amount of coal reserves desired for lease. The determination of the best tracts would be made using data generated in the multiple land use planning efforts and subsequent site specific environmental analysis of each tract. The highest bidder would be offered the tract provided his bid meets fair market value, passes the Attorney General's anti-trust review, and meets all other requirements of the leasing laws.

Bidding could be on an intertract basis with bidders competing between tracts as well as over individual tracts. More tracts would be offered than were intended to be awarded. The high bids for each tract would be compared and only those tracts with the highest bids needed to meet cumulatively the sale's regional production target would be awarded. The high bidder would also, of course, have to meed all necessary requirements of the law including fair market value. As under individual tract bidding the tracts selected for the sale offering would be the result of land use planning and subsequent site specific analysis.

The Department's recommendation is that the regulations reserve the authority to use either method (Note: If intertract is used for any particular sale, its use must be known prior to tract selection since more tracts must be prepared for sale than are desired to lease.)

Rents, Royalty and Diligence. These issues were not directly brought to the Secretary for consideration at this time. The authority to regulate diligence and set royalties was also transferred to the Department of Energy in the Department of Energy Organization Act unless DOE promulgates new regulations, the current requirements would remain in force.

The current regulations (43CFR3500.0-5) define diligent development for any coal lease issued after August 4, 1976, as the timely preparation for and initiation of coal production from a logical mining unit (LMU) of which the lease is a part so that the coal is actually produced at the rate of one percent of the reserves in the LMU by the end of the tenth year from the effective date of the lease. Diligent development for any lease issued prior to August 4, 1976, means the timely preparation for and initiation of coal production from the LMU so that coal is actually produced at the rate of one-fortieth of the LMU reserves before June 1, 1986. Under the regulations the period of time for the latter leases may be extended.

Regardless of whether intertract or individual tract bidding methods were used, the type of bidding method must also be determined. The department wishes to maintain flexibility at this time on this question as it is DOE's responsibility to determine the bidding method. The alternative methods being considered are:

- Bonus bidding method: the bonus bidding method requires the bidders to bid front end cash payments. The highest bidder is offered the track, provided his bid meets fair market value, passes the Attorney

General's review, and meets all other requirements of the leasing laws. The Federal Coal Lease Ammendments Act of 1975 requires that a minimum of half of all acreafe offered for lease sale be made on a deffered bonus bidding basis. Under the deffered bonus bidding method. The bonus is paid in installments with the first installment due at the award of the lease and the balance due in equal annual installments thereafter;

- Royalty Bidding Method. A royalty bidding system significantly reduces the relative importance of the cash bonus. Under this method, the Government typically fixes a nominal cash bonus and companies bid on the royalty rate. Royalty bidding reduces price and resource uncertainty but it does not reduce cost uncertainty.

Royalty bidding could lead to speculative bidding behavior. Potential bidders may overbid on tracts in hopes of receiving higher coal prices or to insure ready access to coal in the event of unplanned but favorable increases in coal demand,e.g., major breakthroughs in coal gasification and/or liquefaction. Speculation is encouraged by royalty bidding because of the lower front-end costs, especially when diligence requirements are not enforced. Nevertheless, the lower front-end costs of royalty bidding make it attractive to samller energy companies. Also, by reducing the bonus share of Government revenue, inadquate competition in a lease sale has less of an impact (relative to cash bonus bidding) on receipt of fair market value.

- Sliding Scale Royalty Method. Sliding scale royalty method adjusts the royalty rate according to the amount or value of production. This method results results in a flexible royalty rate especially when the production profile is varible. In the case of coal, the production profile for a given mine is essentially flat, once peak capacity is attained. Hence, variation in the royalty rate (based on the value of production) would essentially reflect real changes in coal prices. There would be an automatic downward adjustment in the royalty rate when real coal prices decreased and an upward adjustment when real coal prices increased. Essentially, coal operators would share more of the gains with Government in exchange for some protection against real price decreases.

For a sliding scale royalty based on either the amount or value of production, large coal deposits with high production rates would generally incur a higher royalty rate relative to a fixed royalty method. On the other hand, small coal deposits would incur lower royalty rates relative to a fixed royalty system. However, unless the long-run average cost curve for mines can be forcast over an extended time period, it is difficult to design a sliding scale method that is both equitable and consistent with maximum economic recovery. Some of these design difficulties can be alleviated by tailoring the sliding.

One drawback of the sliding royalty is its tendency to elongate the production time horizon in order to reduce the average and marginal royalty rate. This tendency is especially pronounced for linear sliding scales. Use of a non-linear scale may alleviate this problem. Coal should be less susceptible to a lengthening of the time horizon because for a given installed capacity, production rates must be maintained to satisfy supply contracts. Unlike oil or gas, once installed capacity is determined there is less flexibilty to slow down production in order to avoid a higher royalty rate. However, the time horizon could be elongated by selecting a smaller installed capacity.

- <u>Profit Sharing Methods.</u> Profit share methods have the advantage of reducing all three major types of uncertainty associated with prices, resource size, and costs of extraction. Perhaps of greater signifigance for coal is that profit share methods would extract the optimal amount of economic rents. Of course, profit share methods are more difficult to design than other contingency methods.

In general, there are two types of net profit share methods: (a) fixed profit share, bonus bidding, and (b) fixed bonus, profit share bidding. Under these two categories, several systems are being examined.

The profit share method with IRS income base uses a cash bonus as the bid variable. There are a number of ways to define net income and, hence, a number of possible kinds of profit share methods. The amount of reduction in uncertainty depends on the definition of the income base. One definition of net income, called the IRS base, is gross revenue minus operating costs and depreciation. In essence, this definition is net operating revenue in each year with an allowance for depreciation of capital investment. Using this definition,uncertainty in intial investment cost is shared only to the extent that investment capital is recovered through depreciation during the production period. This definition of net income allows no return on capital before the profit share is taken. Although the profit share methods discussed here make no allowance for loss sharing, schemes for handling loss sharing are under consideration.

As with the higher fixed royalty rate methods, there is a problem with the IRS profit share method in that the rate must be set ex ante. A rate high enough to share a sustantial portion of the risk may turn out to be too high to permit profitable development on some leases. However, early termination of production, which may exist with high rate fixed royalty methods, is not a problem for profit share methods because costs are deducted before the profit share is taken.

The annuity capital recovery share method allows for greater risk sharing in initial investment cost and is an annuity capital recovery profit share method. In this method, all of the capital investment, plus interest to the time production begins, is converted to an annuity with a pre-specified interest rate and length of capital recovery period. The amount of this annuity (plus any annuity carried forward from previous periods) is subtracted from net operating profits in each production year to obtain the profit share base. Once the investment capital is fully recovered, the Government profit share is taken from the net operating profit. Since this profit share base approximates a true economic profit share including a return to capital, the profit share rate can generally be set quite high.

The British type profit share method approximates a true economic profit share plan including a return to capital. In this method no profit share is taken by the Government until some factor times the total capital investment is recovered from net profits. The return to capital is implicit in the capital recovery factor which is multiplied by the initial investment cost. The economics of this method are essentially the same as the annuity capital recovery method described above, with the exception that the investment capital is recovered earlier and over a shorter (variable) time period.

The variable profit share method works much as the variable royalty rate except that the variation in profit share rate is normally expressed as a function of annual net profits rather than annual production or its gross value. The variable rate approach could be used with any of the profit share approaches described above. The advantage of a variable rate is that there is more flexibility in setting the rate <u>ex ante</u> than with the fixed rate methods. Of course, to the extent that annual production rates and consequently profit rates are variable for a mine, there may be a tendency to stretch out production in order to achieve a lower overall profit sharing rate.

In principle, a profit share bid method has the same drawback as the royalty bid, in that it tends to encourage speculation. However, because a profit share method inherently shares risk on both the cost and revenue side, the tendency toward speculation in such a method may be less than for royalty bid method. The extent to which this is the case would depend upon the profit share base being used.

The Department of Energy is currently considering several modifications. The modification which is currently preferred is a two phase modification. Phase No. 1 consists of (1) amending the existing regulations to require the lessee to submit a mining plan within three years after the effective date of the amendment under penalty of automatic or cause-for-lease termination (applies to existing and/or new leases), and (2) requiring the lessee (existing and/or new leases) to comply with certain milestones to indicate diligent progress with mining plan preparation. Phase 2 would require existing leases to be producing in commercial quantities within six years the effective date of the amended regulations and that all reserves in the LMU be exhausted within an additional 25 years. The above modification has no official status at this time and this or any other modification must be published in the Federal Register by the DOE before it can take effect.

Royalties would continue to be a minimum of 12 1/2 percent for surface mining and 8 percent for underground mining; higher rates are premitted either where (1) market conditions permit: or (2) they are used to facilitate bidding procedures.

Consulation with the Governors. Prior to offering a coal lease for competitive sale, the Scretary would consult the Governor of the State in which the land to be leased is located. The Secretary would give a specified period of time to comment, not less than 30 days or more than 60 days, before issuing a notice of offering. The Coal Leasing Amendments Act of 1975 provides a specific procedure for a consultation with a state when a lease proposal would permit surface mining within the boundaries of a National Forest within that state. The Governor of the State would be notified by the Secretary. If the Governor failed to object to the lease proposal in 60 days, the Secretary could issue the lease. If within the 60 day period the Governor notified the Secretary, in writing, of an objection to the lease proposal, the Secretary would not approve the lease for six months from the date the Governor objects to the lease. The Governor could, during this six-month period, submit a written statement of reasons why the lease should not be issued, and the Secretary would on the basis of this statement, reconsider the lease proposal.

3.2.3.5 State, Local, And Industry Participation.

State. The preferred alternative has been designed to give the State governments the maximum possible role in the Federal coal management process short of providing to those governments veto power over Federal decisions. The States would be offered the opportunity to sign cooperative agreements on land use planning enabling them to directly participate in the land use planning efforts. The states would be expected to participate actively in the tract ranking, selection and scheduling process. Furthermore, a special consultation step would be provided to the states in setting regional production targets. The Governor would also be formally consulted prior to any final decision to offer a tract for sale. Although the states would be expected to provide their views over the full spectrum of issues, the Department would particularly need the States comments on the interregional and cumulative regional social and economic impacts of coal development in the regional production targets setting process and on intraregional and site-specific social and economic impacts in the tract ranking and selection process.

General Public. The public would have several opportunities to participate in the process. Hearing(s) would be held on the MFP Step 2 recommendation before the final MFP Step 3 land use decisions would be made. Comments would be solicited form the public at the beginning of the regional tract ranking and selection, and sale scheduling process. The public would have the opportunity as part of the EIS on the proposed coal lease sale, to submit written comments and to participate in a hearing. If not covered in the EIS hearing, a hearing on the maximum economic recovery definition would be held prior to offering any tract for leasing. The Secretary could also hold additional hearings in the area of the proposed sale if there were general interest and any issue existed which had not been throughly discussed at previous hearings. In addition to the general public participation steps, there would be opportunities for participation concerning surface owner consultation, surface owner consent, and indications of leasing interest.

In addition to these formal public participation steps, anyone could submit general comments at any time in the process. The Department would schedule meetings for public comment any time it has reason to believe that it would serve the public's interest.

Industry Participation. Industry is a critical actor in the preferred alternative coal management program not only because it supplies the bidders in the lease sales and the technology to extract the coal, but also because it provides critical information needed in the determinations leading to the decision whether to lease the three principal sources for coal information in the United States are the Federal government, through the Geological Survey and other agencies, the state governments, through the state geological surveys or mining bureaus, and the coal industry. Industry is in a special position to make the Federal government aware of the type, quality, quantity, and location of coal which it believes should be considered for leasing.

Industry would be able to participate in the land use planning and regional production target setting process through all the formal and informal channels available to the general public. During land use planning, industry could contribute information on existing operations and on the location of resources. During the setting of regional production targets, industry could supply information on the overall demand for coal and the production potential from previously leased Federal reserves and non-Federal reserves for meeting that demand. In addition to these general participation opportunties, industry would have the opportunity to supply specific data through formal indications of interest during the tract identification process.

For coal, the activity planning step would involve the identifications and selection of "leasing tracts" within areas suitable for consideration for leasing as identified at the completion of the land use plan. In order to accomplish this objective, BLM would be required to utilize data from various sources. Detailed information derived from industry data would be required to assist in determining need and to facilitate lease tract delineations and economic evaluations. Demonstration of need would subsequently be used in determing the priority of coal activity planning areas.

To obtain this data, industry would be asked for formal expressions of interest on lands within the "areas suitable for leasing" set out in the land use plans. These expressions would be used in determining production goals and developing a tract selection and priority ranking process. The types of information requested would be:

- Written descriptions of land by legal subdivision and a map with a scale of one-half inch or larger;
- Amount of coal desired including such geologic data on the area as bed thickness, overburden depth, and thickness of coal seam(s);

- Method of mining anticipated, with proposed mining sequence and rate of production;
- Relationship, if any, between the anticipated mining operations and existing or planned mining operations, or supporting facilities on adjacent Federal or non-Federal lands;
- Anticipated method(s) of transportation and status of proposed system;
- Evidence of qualifications;
- Intention of "end use" of coal;
- Consent certification if the surface is not owned or controlled by the Federal government;
- Description of adjacent coal reserve under ownership or control of expressor of interest.

3.2.3.6 Special Leasing Opportunities

In response to the requirements in the Federal Coal Lease Amendments Act of 1975 and the Small Business Act of 1953 as amended. The Secretary would reserve and offer a reasonable number of coal lease tracts as special leasing opportunities. The special opportunities would consist of holding special sales where public bodies would bid only against other public bodies and small businesses against other small businesses. No special determinations of fair market value, maximum economic recovery or other possible financial incentive would be proposed.

A public body would be defined as a Federal agency, rural electric cooperative, or nonprofit corporation controlled by any of these entities with a definite plan for producing energy for its own use or for two of their members or customers. The Secretary would designate certain coal lease tracts for special opportunity lease sales for public bodies after the ranking and selection process, only if a public body had requested during the planning or indication of interest processes that it desired a special opportunity lease sale be held. At the time this request was submitted, the public body would have to submit evidence of its qualifications to participate in a special sale.

Small business would be required to meet the qualifying standards stated in Title 13 CFR Part 121. Essentially, to qualify a small business must be independently owned and operated, not dominant in its field, and together with its affiliates employ not more than 500 employees. Although it would be advisable and to their advantage to do so a small business would not be required to notify the Department of its desire for a special opportunity sale. The Secretary's decision to hold a small business special opportunity sale would be made in consultation with the Small Business Administration.

3.2.3.7 Emergency Leasing System

The emergency leasing system would enable the Department to meet urgent needs for Federal coal which could not be dealt with in a timely manner through the normal long range tract selection process. The emergency leasing system would differ from the normal tract selection process only with respect to (1) the method of tract identification and (2) the degree of scope requied in the planning and environmental assessment process. This system would be administered to maintain the integrity of the normal long term leasing process.

All applicants under the emergency leasing system would be required to show that either:

- The Federal coal is needed within three years to sustain an existing mining operation at the average annual level of production or new committed level of production on the date of application, as substantiated by a mining sequence plan and projected production levels; or

- In an existing mining operation, the Federal coal would be permanently bypassed for the reasonably foreseeable future and some portion of the tract would be used within three years as substantiated by a mining sequence plan and stated proposed production levels; or

- The Federal coal would be mined within three years in the process of obtaining economic access for development of private or leased coal.

In addition the applicant would have to show that:

- This is an existing mining operation which had been producing coal for at least two years before the date of application; and

- The need for coal had resulted from circumstances beyond the control of the applicant or that he could not have reasonably foreseen and planned for in time to enable the Department to respond through the normal long range tract selection process.

The tract to be offered for lease would only be so much of the lands applied for as would be necessary to meet the emergency need of the applicant without violating the integrity of the normal long term leasing process.

No coal lease would be issued unless the lands had been included in a comprehensive land use analysis including the application of the Departments unsuitability criteria. All emergency leasing decisions would have to be consistent with the appropriate land use plan or analysis.

Before a lease sale would be held in response to an application, an environmental analysis would be completed on the potential effect of such a coal lease on the resources of the area and its environment, including fish and other aquatic resources, wildlife habitats and populations, visual resources, recreation, cultural, and other resources in the affected area. If the Department determined an environmental impact statement was required, one would be completed.

The same pre-sale and sale procedures would apply as would be used in the normal long range tract selection process. The public would be able to comment on the proposed sale during the environmental analysis process and on the determination of maximum economic recovery in the MER hearings.

3.2.3.8 Start-up special Considerations

The preferred alternative is designed as a start-to-finish, pre-land use planning to post-mining use system of Federal coal management. Obviously much of the resource inventory and land use planning required under the procedures described below will have been completed or will be well begun on adoption of this alternative, should it be adopted. Assuming first that the decision is reached that a Federal coal management program is required and, second, that the program adopted is the same as, or similar to, the one presented herein, the Department proposes to integrate this program into existing plans as follows:

- For all areas on which coal-related planning has not been done, the process will begin with the selection of coal-related planning areas based on priorities established after the initial regional production targets have been established.

- For all areas on which land use plans have been completed, the land use decisions will be re-examined on areas or tracts identified as appropriate for coal development (tracts on which coal development would be consistent with the plan). The unsuitability criteria would be applied to these areas or tracts. If unsuitability for mining under the Surface Mining Control and Reclamation Act has not been determined, and if surface owner consultation has not occurred, where applicable, these steps will be taken. Those areas or tracts which are not determined unsuitable would then enter the activity planning process.

- Because of the limited number of planning areas where land use plans are or will be sufficiently completed to permit activity planning to proceed in the early years of a cool management program, the regional sale EIS's may not be able to address in detail a full four-year sale schedule.

- The emergency leasing program, the procedures for management of existing leases, and procedures for processing of preference right lease applications would go into effect as presented immediately.

3.3 ALTERNATIVES TO THE PREFERRED ACTION

In selecting the structure of the preferred Federal coal management program, the Department identified six major alternative implementation strategies. The six alternatives are:

- No leasing until at least 1985;
- Lease bypass coal and lease to maintain existing operations (emergency leasing);
- Process and lease outstanding preference right applications;
- Lease to meet the coal industry's indications of need;
- Allow State determination of leasing levels;
- Lease to meet DOE coal production goals.

These alternatives are not program components or limitations on the program structure. Rather, they are descriptions of various administrative and policy limitations which could determine the level of leasing as a general matter. Adoption of any one of these policy alternatives would likely result in regional coal production and activity levels different from those associated with the preferred program. The Department's estimate of these production and activity levels are presented in Tables 3-2 through 3-13. These estimated levels are the basis for impact assessment in Chapter 4.

TABLE 3-2

EXPECTED COAL-RELATED DEVELOPMENT: NORTHERN APPALACHIAN REGION (MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	176.0	211.6	211.7	211.8	211.7	210.4	211.5	211.1
Coal Consumption (million tons) (a)	163.0	204.1	204.1	204.1	204.1	204.1	182.8	204.1
Coal Mines: (b) Deep	-	91	98	98	98	97	98	99
Surface	-	37	32	32	32	32	32	32
Conversion Facilities: (c) Steam Generation	32	39	39	39	39	39	34	39
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	77	11	10	9	9	9	10	10
Coal Related Population (e)	694.9	907.0	907.0	907.1	907.0	905.9	861.9	906.1
		1990						
Coal Production (million tons) (a)	176.0	220.1	219.6	219.4	219.6	217.8	222.3	225.3
Coal Consumption (million tons) (a)	163.0	241.7	241.7	241.7	241.7	241.7	198.3	241.7
Coal Mines: (b) Deep	-	116	116	115	116	115	117	118
Surface	-	23	23	23	23	23	24	24
Conversion Facilities: (c) Steam Generation	32	47	47	47	47	47	39	47
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	4	4	4	4	4	3	4
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	77	9	9	9	9	9	11	11
Coal Related Population (e)	694.9	1,047.0	1,047.0	1,044.0	1,045.0	1,042.6	962.2	1,057.3

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-3

EXPECTED COAL-RELATED DEVELOPMENT: CENTRAL APPALACHIAN REGION (MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) [a]	206.8	204.4	205.4	205.6	204.9	192.5	203.4	211.0
Coal Consumption (million tons) [a]	50.7	104.5	104.6	104.6	104.6	104.6	53.4	104.6
Coal Mines: [b] Deep	-	148	149	148	148	140	147	152
Surface	-	38	38	38	38	35	37	39
Conversion Facilities: [c] Steam Generation	14	29	29	29	29	29	15	29
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads [d]	68	-	-	-	-	-	-	-
Coal Related Population [e]	496.0	638.6	640.9	640.8	639.4	617.9	524.7	650.7
		1990						
Coal Production (million tons) [a]	206.8	220.1	219.6	210.5	210.0	196.6	205.5	225.4
Coal Consumption (million tons) [a]	50.7	135.5	135.5	137.1	135.6	136.2	101.4	133.2
Coal Mines: [b] Deep	-	174	172	163	163	153	159	174
Surface	-	31	32	32	32	29	31	34
Conversion Facilities: [c] Steam Generation	14	38	38	38	38	38	28	37
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads [d]	68	-	-	-	-	-	-	-
Coal Related Population [e]	496.0	725.1	733.7	736.0	731.7	720.1	648.1	754.7

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-4

EXPECTED COAL-RELATED DEVELOPMENT: SOUTHERN APPALACHIAN REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	23.4	26.6	27.5	26.5	27.5	31.6	22.1	23.0
Coal Consumption (million tons) (a)	46.6	105.5	106.2	106.3	106.0	105.7	104.3	105.9
Coal Mines: (b) Deep	-	9	10	9	10	11	8	8
Surface	-	8	8	8	9	10	7	7
Conversion Facilities: (c) Steam Generation	11	25	25	25	25	25	25	25
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	9	-	-	-	1	1	-	-
Coal Related Population (e)	153.3	298.3	301.6	299.5	301.2	310.4	285.0	290.8
		1990						
Coal Production (million tons) (a)	23.4	25.4	26.3	26.3	26.4	30.4	14.5	14.3
Coal Consumption (million tons) (a)	46.6	119.8	119.9	121.0	119.9	120.4	118.1	118.3
Coal Mines: (b) Deep	-	11	11	11	11	13	6	6
Surface	-	6	6	6	6	7	3	3
Conversion Facilities: (c) Steam Generation	11	31	31	31	31	31	30	30
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	1	1	1	1	1	1	1
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	9	-	-	-	-	2	-	-
Coal Related Population (e)	153.3	333.2	335.5	337.8	335.5	346.7	302.6	302.6

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-5

EXPECTED COAL-RELATED DEVELOPMENT: EASTERN INTERIOR REGION (MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	136.4	209.7	206.1	206.0	207.1	196.1	203.4	213.6
Coal Consumption (million tons) (a)	107.2	154.2	154.2	154.2	154.2	155.2	150.8	153.6
Coal Mines: (b) Deep	-	72	71	71	71	67	70	75
Surface	-	33	32	32	33	31	32	33
Conversion Facilities: (c) Steam Generation	26	36	36	36	36	36	35	36
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	1	1	1	1	1	1	1
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	72	39	36	36	37	31	36	40
Coal Related Population (e)	443.4	722.4	716.2	715.9	717.8	700.3	703.2	726.7
		1990						
Coal Production (million tons) (a)	136.4	319.7	331.5	314.4	328.0	284.6	312.5	381.1
Coal Consumption (million tons) (a)	107.2	174.6	173.5	174.9	173.7	174.9	175.0	172.7
Coal Mines: (b) Deep	-	134	139	131	138	118	134	159
Surface	-	26	27	26	26	24	23	32
Conversion Facilities: (c) Steam Generation	26	39	39	39	39	39	39	39
Synthetic Liquid	-	1	1	1	1	1	1	1
Synthetic Gas (Low-Btu)	-	3	3	3	3	3	3	3
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	72	96	102	93	101	77	93	119
Coal Related Population (e)	443.4	995.5	1,013.0	983.5	1,007.5	933.4	987.6	1,100.5

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 1.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-6

EXPECTED COAL-RELATED DEVELOPMENT: WESTERN INTERIOR REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	11.5	13.6	14.2	13.7	14.2	8.2	10.8	15.8
Coal Consumption (million tons) (a)	37.1	106.0	104.4	104.5	104.9	108.7	113.6	126.5
Coal Mines: (b) Deep	-	11	11	10	11	7	9	12
Surface	-	8	9	9	9	5	7	10
Conversion Facilities: (c) Steam Generation	10	29	29	29	29	30	32	35
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	3	-	-	1	2	-	-	2
Coal Related Population (e)	114.8	282.4	279.6	279.0	280.7	282.4	294.1	330.3
		1990						
Coal Production (million tons) (a)	11.5	15.4	25.5	19.3	24.2	10.2	10.1	35.0
Coal Consumption (million tons) (a)	37.1	178.6	173.9	174.6	174.6	183.7	161.9	168.7
Coal Mines: (b) Deep	-	18	32	24	30	10	13	23
Surface	-	6	10	7	9	4	3	12
Conversion Facilities: (c) Steam Generation	10	49	48	48	48	51	45	46
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	1	1	1	1	1	1	1
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	3	1	4	2	2	-	-	6
Coal Related Population (e)	114.8	456.2	456.0	450.1	456.3	458.9	408.5	456.8

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-7

EXPECTED COAL-RELATED DEVELOPMENT: TEXAS GULF REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) [a]	14.1	66.3	64.0	63.7	64.6	50.2	57.7	78.6
Coal Consumption (million tons) [a]	165.3	139.2	137.6	137.5	138.0	136.8	137.3	141.6
Coal Mines [b]: Deep	-	-	-	-	-	-	-	-
Surface	-	9	9	9	9	7	8	11
Conversion Facilities [c]: Steam Generation	44	38	39	39	38	37	37	39
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	1	1	1	1	1	1	1
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads [d]	10	37	36	36	36	26	31	46
Coal Related Population [e] (thousands)	61.0	381.9	376.3	375.9	377.8	363.5	369.6	397.8
		1990						
Coal Production (million tons) [a]	14.1	86.1	119.4	116.4	115.8	58.9	79.6	111.0
Coal Consumption (million tons) [a]	165.3	252.2	248.3	248.1	248.8	248.6	296.6	248.9
Coal Mines [b]: Deep	-	-	-	-	-	-	-	-
Surface	-	12	17	17	17	8	11	6
Conversion Facilities [c]: Steam Generation	44	69	68	68	68	68	82	68
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	1	1	1	1	1	1	1
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads [d]	10	52	75	73	73	32	47	69
Coal Related Population [e] (thousands)	61.0	654.5	674.4	671.6	672.4	623.6	640.3	668.1

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-8

EXPECTED COAL-RELATED DEVELOPMENT: POWDER RIVER REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) [a]	37.4	205.0	204.8	205.0	205.0	225.0	183.7	204.6
Coal Consumption (million tons) [a]	6.2	16.6	16.6	16.6	16.6	17.1	14.7	16.3
Coal Mines: [b] Deep	–	–	–	–	–	–	–	–
Surface	–	29	29	29	29	33	26	26
Conversion Facilities: [c] Steam Generation	2	5	5	5	5	5	4	5
Synthetic Liquid	–	–	–	–	–	–	–	–
Synthetic Gas (Low-Btu)	–	–	–	–	–	–	–	–
Synthetic Gas (High-Btu)	–	–	–	–	–	–	–	–
Miles of New Coal Haul Roads [d]	93	420	419	420	420	477	418	366
Coal Related Population [e] (thousands)	52.6	227.0	225.9	226.0	226.3	245.9	222.1	207.9
		1990						
Coal Production (million tons) [a]	37.4	400.0	305.0	355.0	316.0	450.0	396.1	269.1
Coal Consumption (million tons) [a]	6.2	27.6	26.8	27.2	26.9	28.0	22.5	26.6
Coal Mines: [b] Deep	–	–	–	–	–	–	–	–
Surface	–	57	44	51	45	64	57	38
Conversion Facilities: [c] Steam Generation	2	5	5	5	5	5	4	5
Synthetic Liquid	–	1	1	1	1	1	1	1
Synthetic Gas (Low-Btu)	–	–	–	–	–	–	–	–
Synthetic Gas (High-Btu)	–	1	1	1	1	1	1	1
Miles of New Coal Haul Roads [d]	93	907	670	795	697	1,032	897	580
Coal Related Population [e] (thousands)	52.6	419.0	331.2	375.5	341.4	464.2	405.2	301.0

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 5.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-9
EXPECTED COAL-RELATED DEVELOPMENT: GREEN RIVER/HAMS FORK REGION (MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) [a]	25.7	80.0	76.0	77.9	77.0	112.0	112.0	57.5
Coal Consumption (million tons) [a]	8.6	18.4	17.8	17.8	18.0	19.1	20.4	18.2
Coal Mines: [b] Deep	-	4	4	4	4	4	4	4
Surface	-	19	18	19	19	27	27	13
Conversion Facilities: [c] Steam Generation	2	5	5	5	5	5	6	5
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads [d]	19	37	35	36	36	60	60	21
Coal Related Population [e] (thousands)	45.7	121.1	115.6	117.8	117.1	150.3	152.8	100.9
		1990						
Coal Production (million tons) [a]	25.7	120.0	98.7	101.0	104.2	150.0	149.5	62.8
Coal Consumption (million tons) [a]	8.6	20.0	18.0	18.4	18.2	20.7	20.1	18.3
Coal Mines: [b] Deep	-	8	8	8	8	8	8	8
Surface	-	28	23	23	24	35	35	14
Conversion Facilities: [c] Steam Generation	2	4	4	4	4	4	4	4
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	1	1	1	1	1	1	1
Miles of New Coal Haul Roads [d]	19	65	50	51	54	86	87	24
Coal Related Population [e] (thousands)	45.7	162.7	139.2	143.0	144.7	190.1	188.1	109.5

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-10
EXPECTED COAL-RELATED DEVELOPMENT: FORT UNION REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	11.4	31.9	31.9	31.9	31.9	36.9	21.9	37.4
Coal Consumption (million tons) (a)	11.6	22.1	22.1	22.2	22.1	23.3	20.3	23.4
Coal Mines: (b) Deep	-	-	-	-	-	-	-	-
Surface	-	5	5	5	5	6	3	6
Conversion Facilities: (c) Steam Generation	3	3	3	3	3	4	3	4
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	1	1	1	1	1	1	1
Miles of New Coal Haul Roads (d)	11	21	21	21	21	36	11	16
Coal Related Population (e) (Thousands)	40.2	76.7	76.6	76.7	76.7	83.4	65.0	83.6
		1990						
Coal Production (million tons) (a)	11.4	41.9	51.0	47.4	50.6	51.9	22.5	54.4
Coal Consumption (million tons) (a)	11.6	44.0	44.8	44.6	44.9	46.9	52.6	45.2
Coal Mines: (b) Deep	-	-	-	-	-	-	-	-
Surface	-	6	8	7	8	8	3	8
Conversion Facilities: (c) Steam Generation	3	7	7	7	7	8	8	7
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	2	2	2	2	2	2	2
Synthetic Gas (High-Btu)	-	5	5	5	5	6	6	6
Miles of New Coal Haul Roads (d)	11	31	40	36	40	41	12	21
Coal Related Population (e) (Thousands)	40.2	135.6	144.0	140.9	143.9	149.2	119.6	147.3

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 3.1).

TABLE 3-11
EXPECTED COAL-RELATED DEVELOPMENT: SAN JUAN REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	8.8	25.0	24.8	24.8	24.8	30.0	22.1	32.0
Coal Consumption (million tons) (a)	8.5	8.9	8.8	8.9	8.9	8.9	9.6	8.9
Coal Mines: (b) Deep	-	3	3	3	3	3	2	2
Surface	-	8	8	8	8	10	7	10
Conversion Facilities: (c) Steam Generation	2	2	2	2	2	2	3	2
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	-	-	-	-	-	-	-	-
Miles of New Coal Haul Roads (d)	6	12	12	12	12	16	10	17
Coal Related Population (e) (Thousands)	27.6	47.4	47.1	47.0	47.0	52.2	45.6	53.9
		1990						
Coal Production (million tons) (a)	8.8	50.0	59.4	54.9	58.4	60.0	57.7	63.0
Coal Consumption (million tons) (a)	8.5	1.7	1.6	1.6	1.6	1.7	15.9	1.6
Coal Mines: (b) Deep	-	4	4	3	3	3	3	3
Surface	-	16	19	18	19	19	19	20
Conversion Facilities: (c) Steam Generation	2	-	-	-	-	-	-	-
Synthetic Liquid	-	-	-	-	-	-	-	-
Synthetic Gas (Low-Btu)	-	-	-	-	-	-	-	-
Synthetic Gas (High-Btu)	6	30	36	33	35	37	35	39
Miles of New Coal Haul Roads (d) (Thousands)	27.6	68.1	76.1	72.8	75.4	77.9	102.5	80.8
Coal Related Population (e)								

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 1.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-12

EXPECTED COAL-RELATED DEVELOPMENT: UINTA REGION (MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) (a)	10.1	30.0	29.6	30.0	29.7	35.0	26.4	29.4
Coal Consumption (million tons) (a)	4.9	18.3	17.9	17.9	18.0	18.5	18.3	18.3
Coal Mines: (b) Deep	- -	25	25	25	25	29	22	25
Surface	- -	2	2	2	2	2	1	2
Conversion Facilities: (c) Steam Generation	1	5	5	5	5	5	5	5
Synthetic Liquid	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (Low-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (High-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Miles of New Coal Haul Roads (d)	2	21	21	21	21	25	18	21
Coal Related Population (e)	29.9	96.7	95.2	95.8	95.6	106.2	90.1	95.8
		1990						
Coal Production (million tons) (a)	10.1	40.4	45.0	42.0	44.8	51.0	28.3	36.8
Coal Consumption (million tons) (a)	4.9	21.7	1.6	20:5	20.7	22.0	22.2	20.9
Coal Mines: (b) Deep	- -	35	39	39	39	44	25	32
Surface	- -	2	2	2	2	2	1	2
Conversion Facilities: (c) Steam Generation	1	5	- -	5	5	5	5	5
Synthetic Liquid	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (Low-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (High-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Miles of New Coal Haul Roads (d)	2	28	32	30	32	37	20	26
Coal Related Population (e)	29.9	128.6	134.8	129.0	134.9	145.7	110.3	123.2

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 3.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

TABLE 3-13

EXPECTED COAL-RELATED DEVELOPMENT: DENVER-RATON REGION
(MID-LEVEL PROJECTION)

	1976 BASE LINE	PREFERRED LEASING POLICY	NO NEW LEASING	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		1985						
Coal Production (million tons) [a]	1.9	5.0	5.0	5.0	5.0	6.0	6.0	7.5
Coal Consumption (million tons) [a]	5.2	21.1	21.0	21.1	21.1	22.1	22.1	19.9
Coal Mines: [b] Deep	- -	6	6	6	6	7	5	7
Surface	- -	1	1	1	1	1	1	1
Conversion Facilities: [c] Steam Generation	1	5	5	5	5	5	5	5
Synthetic Liquid	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (Low-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (High-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Miles of New Coal Haul Roads [d]	1	1	1	1	2	1	1	2
Coal Related Population [e]	20.2	63.9	63.6	63.7	63.7	66.9	66.3	64.4
		1990						
Coal Production (million tons) [a]	1.9	10.0	10.7	10.5	10.6	10.0	7.5	10.3
Coal Consumption (million tons) [a]	5.2	42.1	41.4	41.5	41.5	43.0	30.8	39.7
Coal Mines: [b] Deep	- -	16	17	15	15	11	8	14
Surface	- -	1	1	1	1	2	1	1
Conversion Facilities: [c] Steam Generation	1	11	11	11	11	11	8	10
Synthetic Liquid	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (Low-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Synthetic Gas (High-Btu)	- -	- -	- -	- -	- -	- -	- -	- -
Miles of New Coal Haul Roads [d]	1	4	5	5	5	4	3	4
Coal Related Population [e]	20.2	131.2	130.0	130.9	130.4	130.3	100.0	126.0

(a) Production and consumption data from Department of Energy 1985 and 1990 coal use projections, modified to reflect coal leasing alternatives. See section 5.1 for description of projection methodology.

(b) Based upon typical mine size for eastern and western regions derived from Bureau of Mines Circulars Nos. IC-8765 and IC-8772.

(c) Assumes 3.6, 6.575, 6.575, and 2.050 million tons annual production for steam generation, synthetic liquid, high Btu synthetic gas, and low Btu synthetic gas, respectively (U.S. E.R.D.A., 1977b).

(d) Based on 45 foot roadway and 5.45 acres disturbed for each mile of new haul road (Gold and Goldstein, 1978). Data for 1985 and 1990 represents increases in coal haul roads over 1976 base year.

(e) Population (in thousands) related to direct and indirect construction and operations for workers (see section 5.1).

Procedures used for arriving at these estimates are presented in Section 5.1.

Ultimately, it would be the coal management program itself which makes choices with regard to levels of leasing, schedules, and selection of areas of leasing activity or exclusion. But it is essential to now identify and analyze a series of broad alternatives which represent potential leasing outcomes. These alternatives are treated as options here and are intended to cover a full range of leasing level and coal-related development possibilities.

The Department expects that, with minor changes, the coal management program described in section 3.2 could be used to implement four of the alternatives--no leasing, emergency leasing, process and lease outstanding preference right applications, and leasing to meet DOE production goals. The two remaining alternatives--leasing to meet industry's indications of need and State determination of leasing levels--could require the adoption of management programs substantially different from the one presented in section 3.2. In all cases, the requirments of the Mineral Land Leasing Act of 1920, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act would have to be satisfied.

The environment impact analysis in Chapter 4 compares impacts of each of the six alternatives to the impacts of the preferred program on a region-by-region basis. Note, however, that the Secretary may adopt a Federal coal management program that specifies a reasonable combination of alternatives for the study regions. For example, the no-leasing alternative may be applied to the Power River Basin Region and the emergency leasing alternative to all other regions.

Descriptions of each of the six alternatives follow.

3.3.1 No Federal Leasing

Under this alternative, no new Federal coal would be leased until at least 1985. All preference right lease applications (PRLA's) would be either rejected, not processed during this period, exchanged for other mineral leases, or purchased. There would be no leasing for bypass situations or to maintain existing operations. The supply of Federal coal available for development would consist of that coal already under lease or coal which may be leased under the consent agreement in NRDC v. Hughes.

Selection of this alternative implies that the government has decided that leasing is not needed within the planning horizon to 1985. This alternative is not necessarily inconsistent with the preferred program or the alternative of leasing to meet DOE production goals. Either of these programs could have outcomes of no leasing in one or more of the study regions.

Compared to the preferred program and other alternatives, the no leasing alternative would likely stimulate the largest number of proposals for development of existing leases that currently have no mining plans submitted. In these cases, and after the mining plan is filed, the leasehold would be examined in light of the lands unsuitability criteria presented in section 3.2. This examination would be carried out utilizing

BLM's planning system in a fashion similar to that previously described for determining areas acceptable for further consideration for leasing. Those leases that might be found unsuitable would be revoked using the appropriate legal tools: exchange, purchase, condemnation, etc. This alternative would also stimulate the largest number of proposals for development of non-Federal coal.

3.3.2 Process Outstanding Preference Right Lease Applications

Under the alternative, the Federal government would process PRLA's and issue leases for those applications that meet the commercial quantities test. However, no other Federal leasing would occur at least until 1985. The processing of PRLA's would occur as rapidly as would be administratively feasible. If it were necessary to set priorities in the processing of PRLA's, the following general guidelines would be applied:

- First, PRLA's in the least environmentally damaging areas;
- Second, PRLA's in areas where coal development needs are greatest;
- Third, PRLA's that have been on file for the longest period.

Choice of this alternative would necessitate that those PRLA's in areas where they were environmentally unacceptable, but which still met the commercial quantities test (with proper environmental stipulations applied), would either have to be purchased (through condemnation, if necessary) or acquired (through a lease exchange). As with the no leasing alternative, this alternative is not necessarily inconsistent with preferred program or with the alternative of leasing to meet DOE production projections; leasing level targets under those alternatives could be met with coal from PRLA's.

Existing leases would be managed as described under the no leasing alternative.

The surface owner consent provisions of SMCRA do not apply to PRLAs. Environmental analysis to comply with NEPA could be done on a case-by-case basis.

3.3.3 Emergency Leasing

This alternative would provide for limited competitive leasing of relatively small amounts of Federal coal to meet bypass standard needs and to maintain existing operations. Bypass will occur in small Federal ownership blocks, which, if not leased, are not likely to be mined at all. Leasing of PRLA's would be permitted only if they meet either the "bypass" or "existing operation" criteria. This limited leasing would be similar to current short term leasing criteria. As with the two previous alternatives, this alternative precludes other new competitive Federal coal leasing, at least until 1985, with a review of the need for new leasing anticipated at that time. Existing leases could be managed as described under the no leasing alternative.

The maximum amount of bypass coal eligible for lease under this alternative would be that agreed to under the NRDC v. Hughes consent agreement (i.e., 5 years of production at existing rates). Similarly, the maximum amount of coal that would be leased to maintain an existing operation would be defined by the NRDC v. Hughes agreement (8 years of production at existing rates).

To completely specify this alternative, a final restriction is necessary on the eligibility of existing operations to lease additional Federal coal to maintain their production. If mining operations could regularly plan on obtaining Federal coal needed to continue in operation, this alternative could become open-ended. Many new operations might open up by initially utilizing non-Federal coal, banking on obtaining Federal coal to continue in operation. Under this alternative, the mining operation must have been in existence at least 5 years and must not have previously obtained a new Federal lease in order to maintain the existing operations. It should be noted that this restriction in some respects is tighter than the standards under the NRDC v. Hughes agreement, wherein an operation must only have been in existence by September 1977 to be eligible to lease Federal coal. Surface owner consent would be required where appropriate.

3.3.4 Lease to Satisfy Industry's Indications of Need

This alternative is effectively the Energy Minerals Activity Recommendation System (EMARS II), as proposed by the Department in the 1975 EIS on the Federal coal leasing program. Additions would be made to bring the program into compliance with FLPMA and SMCRA.

Under this alternative, industry would first be asked to indicate those tracts that it was interested in leasing. At the same time, the public would be asked to indicate those areas where leasing would be restricted. Coal demand estimates would serve as a development restriction and would enter the planning process through the Planning Area Analysis (sec section 3.1). Such information would then be processed through the BLM planning system to determine whether the specific tracts were environmentally acceptable and whether coal development represented an efficient use of the land. Tracts that were judged acceptable would then be offered in a future sale. Each tract receiving a high bid equal to or above fair market value as determined by the Department would be leased to the high bidder.

Existing leases and PRLA's would be managed as described earlier. Note that this alternative would include procedures for emergency leasing of small tracts as described under section 3.2.2. NEPA compliance could proceed as under the preferred program. The provisions of section 714 of SMCRA would apply as described in section 3.1.3.

3.3.5 State Determination of Leasing Levels

Under this alternative, the states would have the responsibility to determine the timing and extent of new Federal leasing. There are many procedural structures that could be used to implement this alternative. States could select and rank tracts from areas acceptable for further consideration for leasing as determined through the Federal surface managing agency's planning system. States would determine a sale schedule; thereafter, the appropriate BLM state office would conduct the sale. States would have veto power over which leases would finally be issued.

A second possible structure would transfer all land use planning and environmental acceptability functions to the appropriate state planning office. The Department would retain only the responsibility to conduct lease sales and to issue leases. This structure would require Congressional action to amend the governing statutes, especially FLPMA and SMCRA.

Existing leases and PRLA's would be managed as described before, but states could have a final veto on the environmental acceptability of any area and could have responsibility for approval of mining plans for Federal mines. Furthermore, it is assumed that this alternative would include an emergency leasing provision as described in section 3.3.3. States would be delegated the responsibility to obtain appropriate surface owner consents.

To assess the comparative impacts of this alternative, it was necessary to estimate State preferences for leasing levels. The department requested each western state with substantial reserves of unleased Federal coal to specify what production level it would like to see analyzed for 1985 and 1990.

The responses from the States are presented in Table

The State of Colorado chose to specify production levels equivalent to the DOE mid-level estimates. The State of Utah preferred not to specify any production levels and indicated that the DOE estimates for Utah are extremely suspect. Therefore, the estimates in Table for Utah are the same as the levels specified under the preferred program.

3.3.6 Lease to Meet DOE Production Goals

Under this alternative, DOE regional production goals would drive the tract selection system. Although this same amount of leasing might result from some of the previously described alternatives, this alternative would focus specifically on the DOE national production projections and would not call for any adjustment in those projections. This would provide greater assurance of offering sufficient coal to achieve that production.

Areas acceptable for further consideration for leasing would be defined as under the preferred alternative. New leasing needs in a region would be calculated by first estimating for a future period the difference between DOE production estimates and currently committed coal production. Estimates would then be made of the amount of coal needed to fill potential production gaps that could be supplied from existing Federal leases and non-Federal coal. Estimates of the potential production from existing leases and non-Federal coals would take into account environmental suitability criteria and the relative costs of mining these sources of production. The remainder of the gap would then have to be met by coal production from new Federal leases.

Under this alternative, PRLA's would be processed as described under the preferred program. The amount of new competitive leasing planned for regions would be adjusted for the amount of reserves in PRLA's expected to be leased. This adjustment would take into account whether PRLA reserves were the least costly to mine, the type of coal needed, environmentally acceptable locations, and other such factors.

This alternative would include an emergency leasing component. Environmental impact statements would be prepared as under the preferred alternative. Surface owner consent would proceed as specified in section 3.1.3.

To assess the [illegible] impact [illegible] it was necessary to estimate State [illegible] The Department [illegible] with [illegible] reserves of unleased Federal coal [illegible] level it would like to see [illegible]

The responses from the States are presented in Table [illegible] The State of Colorado chose to specify production levels equivalent to the DOE [illegible] preferred not to specify any production levels [illegible] than the DOE estimates for [illegible] Therefore, the estimates in Table [illegible] the levels specified under [illegible]

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CHAPTER 4

DESCRIPTION OF REGIONAL ENVIRONMENTS

This document is a preliminary working draft of the Department of the Interior's Coal Management Environmental Statement. The document is intended for internal review purposes. It will be revised in response to reviewer comments. In addition, internal analysis and revision of materials are continuing.

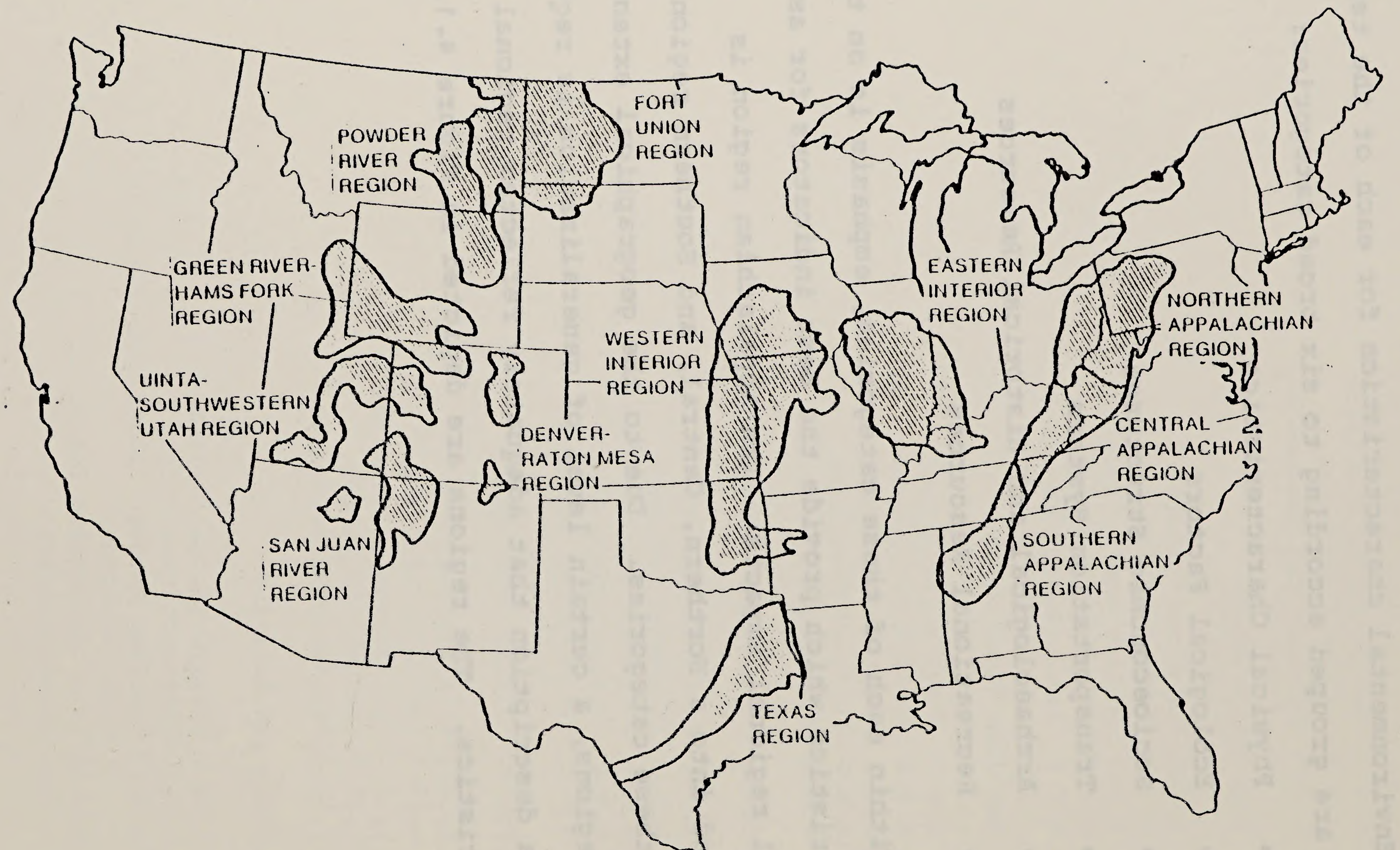
CHAPTER 4

DESCRIPTION OF REGIONAL ENVIRONMENTS

Environmental characteristics for each of the ten coal regions are grouped according to six broad categories:

- Physical Characteristics
- Ecological Factors
- Socioeconomic Structures
- Transportation Systems
- Archaeological and Historical Resources
- Recreational Resources

Within each of these categories, emphasis is on those characteristics which provide the best indicators for assessing potential regional impacts. The Appalachian region is subdivided into a Northern, Central, and Southern region for some of these categories. Due to the geographical extent of all of the regions, a certain level of generalization is required to provide a description that adequately reflectes regional characteristics. The regions are depicted in Figure 4.1.



Source: Adapted from U. S. Geological Survey Map, "Coal Fields of the United States," 1960.
NOTE: Shaded areas indicate coal regions described in this statement.

FIGURE 4-1

TEN COAL SUPPLY REGIONS OF THE UNITED STATES

4.1 APPALACHIAN REGION

4.1.1 Physical Features

4.1.1.1 Topography.

The Appalachian Region Coal Field covers a major portion of the Appalachian Plateaus physiographic province. It generally consists of steep-sided plateaus on sandstone bedrock that are 3,000 to 5,000 feet high on the eastern side, declining gradually to the west. Predominant land forms include high hills or mountains, with some tablelands in the southern portions of the region. Eastern portions of this region are included in the Valley and Ridge province which is characterized by long mountain ridges and valleys eroded on folded rock strata.

4.1.1.2 Geology.

The rocks in these provinces form a series of sandstone, shales, limestones, conglomerates, and coal beds that make up the Appalachian Basin. Folding and faulting are a common feature of the eastern formations and broad open folds are characteristic in the west. The region is defined by outcrops of coal-bearing rocks of the Pennsylvanian, Monogahela, Conemaugh, Allegheny, and Pottsville Formations with the structural variations accompanied by variations in rank of coal. The number of identified coal beds in the region ranges from 19 in Pennsylvania to 62 in West Virginia, with as many as 117 beds having been separately identified and described throughout the region.

Several features in the region have been designated as natural landmarks because they illustrate significant geological processes (U.S. Department of the Interior, 1978x). These features, located predominantly in West Virginia, Tennessee, and Kentucky, include caves, cave systems, and karst areas.

4.1.1.3 Minerals.

Coal is produced in approximately 75 percent of all counties and in nearly 90 percent of the counties in the central section of the region (U.S. Department of the Interior, 1977f). Other important minerals produced in the region include petroleum, stone, sand and gravel, cement, and clay. Another indicator of mineral production in the region is the dollar volume of this activity. Approximately 40 percent of the counties have production levels greater than $1 million and 30 percent greater than $10 million, while only 12 of the counties have no production reported (U.S. Department of the Interior, 1977f).*

4.1.1.4 Soils.

The region is characterized by a mix of soils with weakly differentiated horizons that show alteration of the parent material (i.e., calcareous sandstone and shale) and by soils that are generally low in organic matter and have subsurface horizons of clay accumulations or weathered mines (U.S. Department of the Interior, 1970). Throughout the region, the land considered as suitable for cultivation ranges from 30 to 50 percent with a variety of limitations affecting agricultural potential. In the northern and central portions of the region,

*For this and subsequent regional descriptions, the estimated dollar values of mineral production are low. Actual dollar values are often not reported to avoid disclosing individual company confidential data. This is the case for 45 percent of the counties in the Appalachian Region. In addition, all dollar figures are from the U.S. Department of the Interior (1977f) which provides figures for 1974, the latest year for which a comparable data base is available.

the major limitations to agriculture include shallowness of soil, storms, and drought. Overland erosion and shallowness are principal limitations in the southern section.

4.1.1.5 Water Resources.

The Northern Appalachian Coal Region is traversed from the northeast to the southwest by the main stem of the Ohio River and its tributaries. The average annual stream flow from the upper Ohio River basin, measured at Sewickley, Pennsylvania, is 23.3 million acre-feet (ERDA, 1977). Surface water use, which is about 1.3 million acre-feet per year, is fairly uniform throughout the year (ERDA, 1977). Flood potential is high and droughts are seldom long-lasting.

Though the average sediment load for surface waters in this region is low--about 280 mg/1--it may rise to about 2,000 mg/1 in the eastern area during periods of high runoff. Dissolved solids (TDS) are generally low--about 350 mg/1--but in some relatively small areas it may be above 1,200 mg/1. Most streams flowing through the coal-mining areas are adversely affected by acid-mine drainage.

The groundwater is generally of poor quality, particularly in the Paleozoic limestones and sandstones which are, quantitywise, the best hard-rock aquifers in the region. Well yields generally range from a few gallons per minute (gpm) to as much as 500 gpm. The best yielding aquifers, however, are the shoestring deposits of sand and gravel that commonly occupy the floodplains along the principal streams. Storage of groundwater in these aquifers is estimated to be 4.3 million acre-feet (USGS, 1974). Groundwater recharge for the area is approximately 3.2 million acre-feet per year (USGS, 1974). The water is hard to very hard, especially that from the carbonate aquifers.

Groundwater use in the region is very low, about 157,000 acre-feet per year (ERDA, 1977). For information on total domestic water and wastewater flow for this region, see Table 4-1.

The Central Appalachian Coal Region is part of the upper Ohio and upper Tennessee River Basins, where water is plentiful. Mean flow from these river basins (the Big Sandy and Kanawha Rivers) is 10.7 million acre-feet per year (ERDA, 1977). Surface water use is fairly constant throughout the year though floods are severe at times. Industry is by far the biggest user and municipal use is secondary. Their combined consumption is 1.5 million acre-feet per year (ERDA, 1977). Agricultural use is negligible. Droughts are infrequent and generally of short duration.

Quality of the surface water varies with the flow. Suspended solids levels are highest at high flow but the average is less than 280 mg/1. In the western parts of the area, dissolved solids are commonly lower than 100 mg/1, whereas in the eastern and higher parts of the region the dissolved solids range up to about 350 mg/1. Generally, the water quality is good, but industrial and municipal wastes and acid-mine drainage create local problems.

TABLE 4-1

NORTHERN APPALACHIAN REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	8017010	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd)(cc)	946
Population Density (sq. mi.) (b)	164	Total	8097	Waste Water Flow (mgd) (c)	1002
Net-Migration (1970-1971) (b)	-150905	Education	3094	Solid Waste (million tons/yr.) (c)	7.6
School Enrollments (c,d)	1683572	Highways	1050	Solid Waste (acres/yr.) (c)	801
Per Capita Income (c)	4420	Police Protection	17428	Hospital Beds (c)	28511
		Welfare	850	Year Round Housing Units (000) (e)	2586
		Health	569	Doctors-General Practice (a)	1579
		Other	2533	Doctors-Total Patient Care (b)	8244

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: U.S. Department of Commerce, 1978b; U.S. Department of Labor, 1975, 1977a; U.S. Department of Commerce, 1977d; U.S. Department of Interior, 1977d; U.S. FEA, 1977a; AMA, 1975.

Groundwater in the region is generally of poor quality but well yields are satisfactory for farm and family use. Total consumption is about 190,000 acre-feet per year (ERDA, 1977). Groundwater is generally hard and, in places, contains excessive iron and manganese. Hydrogen sulfide is troublesome in some areas.

For information on domestic water use and wastewater flow in this region, see Table 4-2.

In the Southern Appalachian Region, surface water is abundant (average annual surface flow for the region in 49.7 million acre-feet) from the Tennessee River (ERDA, 1977). Generally, the quality of the surface water is good, but there are areas of industrial and municipal use, and areas affected by acid-mine drainage where the quality is poor to unacceptable. Concentrations of dissoved solids range between 100 and 350 mg/l; sediment load in the streams ranges, in general, from 250 to 2,500 mg/l. Reservoirs of the Tennessee River system act as sediment traps.

Water use is chiefly industrial with municipal use secondary. Agricultural uses are negligible. Less than one percent of the available water is used (23,000 acre-feet per year) (ERDA, 1977). The area is flood-prone, and droughts are rare and generally of short duration.

Groundwater is abundant only in the carbonate rocks and some of the sandstones, and in the shoestring alluvial deposits along the major streams. Shallow dug or drilled wells supply rural homes and farms with yields ranging from a few gallons per

TABLE 4-2

CENTRAL APPALACHIAN REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	2095596	General Expenditures (million dollars)		Domestic Water Use (mdg)(c)	159
Population Density (sq. mi.) (b)	70	Total	1876	Waste Water Flow (mdg)(c)	262
Net-Migration (1970-1976) (b)	+90914	Education	717	Solid Waste (million tons/yr.) (c)	2.0
School Enrollments (c,d)	440075	Highways	308	Solid Waste (acres/yr.) (c)	214
Per Capita Income (b)	3783	Police Protection Employees (c, b)	4101	Hospital Beds (a)	9204
		Welfare	172	Year Round Housing Units (000) (c)	699
		Health	143	Doctors-General Practice (a)	453
		Other	526	Doctors-Total Patient Care (a)	1481

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

minute in the less permeable rocks to several hundred in the more permeable formations. The quality is generally poor. Groundwater is not greatly developed in the area (11,600 acre-feet per year) (ERDA, 1977).

For information on total domestic water use and wastewater flow for this region, see Table 4-3.

4.1.1.6 Climate.

Topographic features in the Northern Appalachian Region considerably modify major climatic controls and have extremely significant impact on regional dispersion climatology. The climate of the area is continental, typified by cold winters, humid summers, stormy springs, and fair falls. The winter cold is occasionally interrupted by invasions of warm air from the Gulf of Mexico. These events are associated with frequent windy, stormy periods that continue well into the spring. Summers are warm and humid with occasional incursions of cool air. The fall season is characterized by lengthy periods of fair weather, with warm days and cool nights.

Annual mean temperatures range from 50-58°F. All areas have experienced temperatures above 100°F and less than -10°F. Some valley locations have extreme low readings well below -20°F.

Annual precipitation is 40-50 inches. although it is slightly higher in the southern portions, the major factor in the variability is the terrain. The windward slopes and higher elevations receive higher amounts.

TABLE 4-3

SOUTHERN APPALACHIAN REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	2306668	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	198
Population Density (sq. mi.) (b)	122	total	2007	Waste Water Flow (mgd) (c)	288
Net-Migration (1970-1976) (b)	+44537	Education	757	Solid Waste (million tons/yr.) (c)	2.2
School Enrollments (c,d)	484400	Highways	240	Solid Waste (acres/yr.) (c)	233
Per Capita Income (a)	367	Police Protection Employees (c,f)	5092	Hospital Beds (a)	11472
		Welfare	198	Year Round Housing Units (000) (a)	744
		Health	245	Doctors-General Practice (a)	429
		Other	567	Doctors-total Patient Care (a)	670

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

The important meteorological parameters that effect the interchange and diffusion of airborne pollutants are the speed and direction of the wind, the persistance of the wind direction, the height variations, frequency and persistence of atmospheric inversions, and the characteristics of the mixing heights. The dominant characteristic of the entire Appalachian area is light wind speeds and the most frequent stagnation conditions of any area east of the Rocky Mountains.

Wind speeds at ridge levels, such as at the Greater Pittsburgh Airport, average about 9.5 mph. However, average wind speeds in the valleys are about 6 mph. In the valleys, wind directions are markedly channelled along directions parallel to the orientation of the valleys.

Inversions with bases below 3,000 meters occur 90 percent of the time in winter, 85 percent of the time on summer mornings, and 50 percent on summer afternoons. Surface based inversions occur 35-45 percent of the time in winter, 60-70 percent of the time on summer mornings, and 10 percent of the time on summer afternoons.

The climate in the Central Appalachian area is strongly influenced by localized topographical features. The climate of the area is continental. Winters are generally mild and damp, summers are hot and humid, springs are stormy, and falls are fair and dry. The area is far enough south so that cold air masses from the north are modified considerably before they reach the area. The winter storms also bring warmer, moist air into the region from the Gulf of Mexico. The late summers and fall are often dominated by high pressure giving lengthy periods of warm, dry weather. These situations cause the highest incidence of stagnations east of the Rocky Mountains. They also coincide with lengthy periods of drought.

Annual mean temperatures for weather reporting stations are 56-58°F. However, there is considerable variability in temperature due to the topography. All areas have experienced temperatures greater than 100°F and less than -10°F. Some valleys of West Virginia and Kentucky have reported minimum temperatures below -20°F.

Annual precipitation for the area averages 45-50 inches. However, rainfall is greatly influenced by terrain and some sheltered valleys receive less than 40 inches, while some higher elevations in Tennessee exceed 55 inches. The monthly distribution of precipitation is a distinguishing climatological feature among the three portions of the Appalachian Coal Region. The monthly variations have small amplitude but with a summer maximum in the north. In the south, the amplitude increases and a distinguishing late winter-early spring maximum and a fall minimum appear. In the Central Appalachian area, the fall minimum is apparent and a double maximum-early spring and summer occurs.

The dominant characteristic of the dispersion climatology in the entire Appalachian area is light wind speeds. The most frequent stagnation conditions of any area east of the Rocky Mountains occurs in the general area. Wind speeds at ridge levels are 8-9 mph on the annual average.

In the valleys of the area, where most human activity occurs, wind speeds average only 50-60 percent of ridge level speeds. Further, the frequency of calms is much greater and the direction is severely channelled along the orientation of the vallsys.

The Southern Appalachian Region is characterized by mild and wet winters, hot and humid summers, and dry falls. The continentality found in the northern Appalachians is no longer dominant in the southern extremity of the mountainous area. Storms which form along the Gulf Coast during the cool season result in frequent rainy periods interspersed with occasional dry periods accompanied by cold air from the mid-continent. During the warm season there is little day-to-day change. In late summer and fall, conditions that are conducive to poor dispersion are frequent.

Annual mean temperatures vary from slightly less than 60°F in the northern portions to 65°F in the "Upper Plains" Region of Western Alabama.

Annual precipitation ranges from 48 inches in some sheltered areas to 60 inches on some favorably oriented terrain features. Most areas, however, have 53-55 inches of rainfall annually. There is a pronounced spring maximum and fall minimum in the distribution with dry periods often coinciding with periods of air stagnation.

4.1.1.7 -Air Quality.

Particulate air quality in the Northern Appalachian Region varies greatly throughout those sections of the four states comprising the region.

In Pennsylvania, the Northern Appalachian Region covers all or part of four Air Quality Control Regions (AQCR's). Generally, the particulate air quality in these AQCR's is better than the national standard (75 $\mu g/m^3$ and 60 $\mu g/m^3$ annual geometric mean, primary and secondary standards, respectively). However, in the more urbanized and industrialized areas of Pennsylvania, the primary particulate standard is not being met. Ambient sulfur dioxide (SO_2) concentrations in these four AQCR's are also generally better than the national standard (80 $\mu g/m^3$ annual arithmetic mean).

In Ohio, the Northern Appalachian Region covers all or portions of eight AQCR's. Of these eight AQCR's, the worst particulate air quality occurs in the highly industrialized Steubenville-Wheeling Interstate AQCR. In the other seven AQCR's in Ohio, the existing particulate air quality is at least meeting the primary standard and, in most urban areas, the air quality is generally better than the national standard. Those Ohio counties not meeting the particulate standard are also not meeting the SO_2 standard.

In West Virgina, five AQCR's are encompassed by the northern Appalachian Region. The Steubenville-Weirton-Wheeling Interstate AQCR is the only one whose air quality does not meet the primary standard for particulates. Ambient sulfur dioxide concentrations in this portion of West Virginia are also, for the most part, better than the national standard.

Only two Maryland counties (Garrett and Allegheny) are in the Northern Appalachian Region. Except for Luke, Maryland, in Garrett County, particulate air quality and SO_2 air quality are both better than the national standard.

Although air quality in the Central Appalachian Region is generally considered good, some variation does occur. In West Virginia, the Central Appalachian Region covers essentially the southern half of the state and encompasses five Air Quality Control Regions. With the exception of two areas, the particulate air quality in these five AQCR's is better than the national standard. All West Virginia counties within the region have SO_2 air quality which is better than the national standard.

In Virginia only several counties and one AQCR (the Eastern Tennessee-Southwestern Virginia Interstate AQCR) are in the Central Appalachian Region. Particulate and SO_2 air quality in this portion of Virginia are reported to be better than the national standards.

Kentucky contains the largest portion of the Central Appalachian Region, encompassing one entire AQCR and portions of three others. Generally, particulate and sulfur dioxide air quality over this part of Kentucky is better than the national standard.

The Central Appalachian Region contains portions of two AQCR's in Tennessee. For the most part, particulate and SO_2 air quality in this area are better than the national standard.

Particulate air quality varies somewhat throughout the Southern Appalachian Region. Generally, the air quality is considered quite good though some areas in all three states (Tennessee, Georgia, and Alabama) do have areas of non-attainment. These areas will tend to be the more populated and industrialized. Sulfur dioxide air quality appears also to be good throughout the region.

4.1.2 Ecological Factors

4.1.2.1 Flora

The Appalachian Coal Region occurs within the mixed mesophytic forest section of the eastern deciduous forest biome. The percentage of total land area in forest ranges from 51% in the northern and southern sections to 57% in the central section. Principal forest types are oak and oak-mixed hardwoods extending from Pennsylvania south on both sides of the Allegheny Mountains across Tennessee and into northern Alabama (U.S. Department of Agriculture, Soil Conservation Service, 1969). A lobe of hemlock-white pine-northern hardwoods extends into the northern extreme of the region, and pines, characteristic of the oak-pine forest, become more abundant in the southern portions of the region (Braun, 1972).

Primary forest vegetation throughout the region includes oaks (chesnut, red, white), poplar, hickory, maple, sweet buckeye, and beech. Secondary forest types include associations of birch-beech-maple, white pine-hemlock, aspen-birch, and white pine-red pine.

At lower elevations and along water courses, elm-ash-cottonwood and oak-gum cypress associations are common. Principal shrub and ground cover vegetation of the higher elevations of the region include mountain laurel, rhododenron, redbud, holly, blueberry, and viburnums. Lower elevation ground cover includes spicebush, sumac, huckleberry, buttonbush, and hazelnut, and numerous grasses and other seed producing herbaceous vegetation.

Natural productivity is moderate to high, and ranges from about 8.9 tons per acre per year (primary productivity) in forested areas to about 17.8 tons per acre per year for floodplain vegetation. Recovery to natural forest cover after severe disturbance can occur within 80 to 100 years.

4.1.2.2 Fauna

The Appalachian Coal Region has a high diversity of fauna. There are 313 known species of fish (Hittman Associates, Inc., 1975), 200 species of mammals (Burt and Grossenheider, 1964), 96 species of reptiles and amphibians, and 110 bird species (Hittman Associates, Inc., 1975) that occur either as permanent residents, or as seasonal visitors.

Principal game fish species, stocked and occuring naturally, in the waters of the region include small mouth and large mouth bass, rainbow and brown trout, crappie, bluegill, northern pike, chain pickerel, muskellunge, and catfish. Non-game species common to the region's streams and rivers include carp, shad, carpsuckers, shiners, chubs, and sculpins.

Big game mammalian species include white-tailed deer, black bear, and an introduced species, the European wild boar. Common small game species include the cottontail rabbit, raccoon, opossum, and gray and fox squirrels. Fur bearing mammals of varying economic importance include gray fox, red fox, mink, muskrat, beaver, and river otter. Non-game mammals common throughout the region include several species of mice, rats, shrews, and bats.

Among the 96 known species of reptiles and amphibians in the Appalachian Region are 15 species of turtles, 7 species of lizards, 26 species of snakes, 14 species of frogs, and 34 species of salamanders (Jopson, 1971).

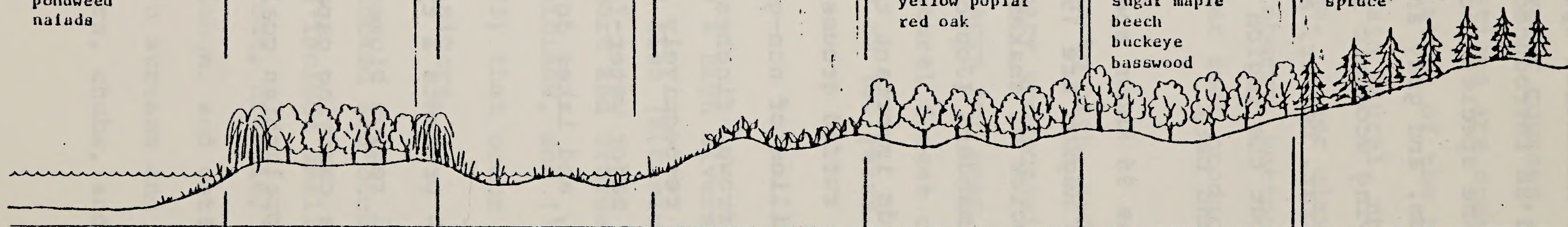
Game birds important to the region include turkey, bobwhite quail, ruffed grouse, pheasant, and mourning dove. The two largest families of non-game birds are the Fringillidae (grosbeaks, sparrows, finches) and Parulidue (warbler) with 20 and 27 species, respectively (Hubbard, 1971). While the region is not within a major water-fowl migratory corridor, the area's rivers, streams, and lakes do attract mallards, black ducks, and wood ducks.

Table 4-4 presents a typical cross section of the Appalachian coal region biomes and fauna characteristic of each. Estimates of the carrying capacities and primary productivity rates for the Appalachian coal region are presented in Appendix____.

TABLE 4-4

PROFILE OF APPALACHIAN BIOMES

ENDANGERED SPECIES watercress darter fine-rayed pigtoe pearly mussel bird wing pearly mussel Alabama lamp pearly mussel shiny pigtoe pearly mussel Appalachian monkey face pearly mussel PREDATORS mink BIRDS coots geese ducks DOMINANT VEGETATION loosestrife arrow-arum pondweed naiads	ENDANGERED SPECIES Bachman's warbler bald eagle PREDATORS bobcat gray fox BIRDS woodpecker flycatcher redstart vireo ovenbird BIG GAME white-tailed deer DOMINANT VEGETATION sycamore red maple elm river birch willow	ENDANGERED SPECIES peregrine falcon bald eagle PREDATORS mink raccoon red fox BIRDS rail bittern egret heron redwing blackbird DOMINANT VEGETATION water lilies quillwort plantain pondweeds naiads cattails	PREDATORS hawks barn owl raccoon red fox BIRDS sparrow hawk robin crow mourning dove bobwhite quail BIG GAME white-tailed deer DOMINANT VEGETATION soybeans tobacco apples pasture	ENDANGERED SPECIES gray bat Indiana bat PREDATORS great horned owl barred owl bobcat gray fox BIRDS thrush warbler vireo ovenbird wild turkey BIG GAME white-tailed deer wild boar DOMINANT VEGETATION chestnut oak white oak shagbark hickory yellow poplar red oak	ENDANGERED SPECIES gray bat Indiana bat bald eagle Eastern cougar PREDATORS great horned owl bobcat gray fox BIRDS woodpecker thrush warbler vireo wild turkey BIG GAME white-tailed deer black bear wild boar DOMINANT VEGETATION birch sugar maple beech buckeye basswood	ENDANGERED SPECIES red-cockaded woodpecker bald eagle Eastern cougar PREDATORS bobcat gray fox great horned owl BIRDS nuthatch chickadee woodpecker warblers ruffed grouse BIG GAME black bear white-tailed deer DOMINANT VEGETATION Virginia pine hemlock fir spruce



W RIVER BOTTOMLAND MARSH AGRICULTURE OAK-HICKORY BEECH-MAPLE SPRUCE-FIR E

250 miles - not to scale (for illustrative purposes only).

4.1.2.3 Protected Species.

There are 26 species of animals occuring within the Appalachian Coal Region, as permanent residents or visitors, that have protected status as endangered species under the Endangered Species Act of 1973. Among these are one species of fish, five species of birds, three species of mammals, and 17 species on invertebrates. A listing of these species and their occurrence within the coal regions is given in Appendix Table 4-5 additional information on distribution and habitats is given in Appendix Table_____. None of the 13 species of plants officially listed as endangered or threatened occurs within this coal region (U.S. Department of the Interior, 1978fff).

Golden eagles are not included on the listing of endangered species; however, they are afforded Federally protected status under the Bald and Golden Eagle Protection Act. While the golden eagle is more common in the western United States, several breeding pairs occur in the Appalachian Mountain Range (Snow, 1973).

In addition to flora and fauna protected by Federal law, each of the states within all regions have or are developing state listings of protected species.

4.1.3 Socioeconomic Structure

Socioeconomic data for the Appalachian Region are presented in Tables 4-1 through 4-3 and Tables 4-6 through 4-8

4.1.3.1 Demography

The Northern Appalachian Region had a total population of 8,017,000 in 1975 and a relatively high density of about 164 persons per square mile (U.S. Department of Commerce, 1978b). Farm population tends to be low, comprising only about 7 percent of the total. Out-migration on the order of 7 to 15 percent was typical of the 1960 decade (U.S. ERDA, 1977b) but this decreased considerably during the 1970 to 1976 period. Public school enrollments in 1975 totaled approximately 1,684,000 (U.S. Department of Commerce, 1977d).

The Central Appalachian Region is characterized by a moderate population density of 70 persons per square mile and a total population of approximately 2,096,00 (U.S. Department of Commerce, 1978b). Out-migration was quite high during the 1960's (U.S. ERDA, 1977d), but the trend reversed between 1970 and 1976. There were about 44,000 students enrolled in public schools in 1975 (U.S. Department of Commerce, 1977d).

Total population of the Southern Appalachian Region was over 2 million in 1975 with a moderate density of 122 persons per square mile (U.S. Department of Commerce, 1978b). The area experienced an out-migration rate of 6.2 percent during the 1960 decade (U.S. ERDA, 1977b). However, the region experienced a net gain of about 44,500 persons from 1970 to 1976 (U.S. Department of Commerce, 1978b). Public school enrollments

TABLE 4-6

NORTHERN APPALACHIAN COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total²
07	Agricultural Services	1,336	.06
10	Mining	60,389	2.7
12	Coal Mining Bituminous) (c)	35,573	
15	Construction	116,637	5.2
19	Manufacturing	921,525	40.8
40	Transportation/Public Utilities	128,809	5.7
50	Wholesale Trade	123,474	5.5
52	Retail Trade	423,548	18.7
60	Banking and Finance	96,674	4.3
70	Services	378,519	16.8
99	Non Classified	8,744	0.4
	TOTAL	2,259,725	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military, and railroad employment. The following breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's Scope	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.
Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal regions. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

TABLE 4-7

CENTRAL APPALACHIAN COAL REGION[1]

Major SIC Group		Sector Employment	Percent of Total[2]
07	Agricultural Services	287	0.1
10	Mining	74,409	18.2
12	Coal Mining (Nituminous)[3]	61,447	
15	Construction	19,709	4.8
19	Manufacturing	109,501	26.7
40	Transportation/Public Utilities	19,263	4.7
50	Wholesale Trade	22,501	5.5
52	Retail Trade	78,456	19.1
60	Banking and Finance	17,360	4.2
70	Services	65,752	16.0
99	Non Classified	2,690	0.7
	TOTAL	409,928	100.0

[1]Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military, and railroad employment. The following breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Patterns Scope	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

[2]May not add to 100% due to rounding.

[3]Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal regions. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

TABLE 4-8

SOUTHERN APPALACHIAN COAL REGION
MAJOR EMPLOYMENT SECTORS[1]

Major SIC Group		Sector Employment	Percent of Total[2]
07	Agricultural Services	618	0.1
10	Mining	6,797	1.0
12	Coal Mining (Bituminous)[3]	3,296	
15	Construction	47,759	7.4
19	Manufacturing	263,064	40.5
40	Transporation/Public Utilities	29,586	4.6
50	Wholesale Trade	44,171	6.8
52	Retail Trade	120,985	18.6
60	Banking and Finance	39,378	6.0
70	Services	93,801	14.4
99	Non Classified	3,635	0.6
	TOTAL	649,694	100.0

[1]Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military, and railroad employment. The following breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's Scope	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

[2]May not add to 100% due to rounding.

[3]Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal regions. Data tabulated via EMPLOY1, aMITRE employment tabulation program developed for the BLM environmental statement.

totalled approximately 484,000 in 1975 (U.S. Department of Commerce, 1977d).

4.1.3.2 Economic Base and Sectorial Employment.

Employment in the Northern Appalachian coal region is categorized in nine major classes. Total employment and percentage distribution in each class during 1974 is presented in Table 4-6.

Approximately 921,500 workers, or about 40 percent of the total regional employment, are in the manufacturing sector. Combined with 423,500 workers in the retail trade sector and 378,500 workers in the services sector, this figure represents over 75 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of65,000 persons employed in the agricultural sector in the Northern Appalachian region.

The total labor force (BLS data), expressed as a percentage of total population, provides an estimate of the labor force participation rate. This indicator is useful in that it reflects family income, regional employment opportunities, and regional unemployment rates. The estimated 1974 labor force participation rate in the Northern Appalachian Region was 30.5 percent. In comparison, the national average for 1974 was 43.0 percent.

Employment in the Central Appalachian coal region is categorized in Table 4-7. Approximately 109,500 workers, or about 26.7 percent of the total regional employment, are in the manufacturing sector. This sector combined with 74,409 workers in the mining sector and 78,500 workers in the retail sector, represents over 64 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of 42,400 persons employed in the agricultural sector in the Central Appalachian Region. The estimated 1974 labor force participation rate in the Central Appalachian Region was 63.9 percent.

Employment characteristics of the Southern Appalachian coal region are presented in Table 4-8. Approximately 263,064 workers, or about 40.5 percent of the total regional employment, is in the manufacturing sector. Combined with 121,000 workers in the retail trade sector and 93,800 workers in the service sector, these three sectors represent over 73 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of 36,600 persons employed in the agricultural sector in the Southern Appalachian Region. The estimated 1974 labor force participation rate in the Southern Appalachian region was 24.4 percent.

4.1.3.3 Agriculture.

In the Ohio and Pennsylvania portions of the Northern Appalachian Region, commercial farms with sales of over $2,500 per year represent from 30 percent to 70 percent of all farms while in the southern part of the region less than 30 percent of all farms have sales over $2,500 per year. Farms are usually small, averaging less than 160 acres except in West Virginia, along the Ohio River, where the average size is in the 160-259 range. Most are part-time farms and in many cases the operator is retired. Most operators own their own farms.

In the northern part of the Northern Appalachian Region, most of the farmland is cropland, while in the southern part farmland is mostly used as pasture. The average value of farm products sold ranges from $100-$150 per acre for some areas in both Pennsylvania and Ohio to $10-$20 per acre in the southern part of the region. Dairy farming provides the most income for the region as a whole with many counties in the northern portion of the region having over 50 percent of all farm income derived from dairy products. Generally, throughout the region, the value of crops sold represents from 10 to 30 percent of the value of farm products sold. Poultry products are also an important source of farm income in many counties throughout the region. Furthermore, fruit farms are scattered throughout the Pennsylvania and Ohio parts of the region.

Agriculture in the Central Appalachian Region involves many part-time farms. In many cases, these farms are operated by families of coal miners and retired persons and they produce food for home consumption as well as products for sales. Over 70 percent of farms in the region have less than $2,500 in sales of farm products. The land is so rough in the southern West Virginia and eastern Kentucky areas that less than 10 percent of the land is in farms and under five percent of the total land area is harvested as cropland. The average value of farm products sold per acre of land in farms ranges from under $10 per acre to $30-$50 per acre. In many areas over 25 percent of farm operators are at least 65 years old and over, compared to a national average of 16.6 percent in this category.

Agriculture in the Southern Appalachian Region is characterized by small to medium size farmss with part-time and retirement farm out-numbering commercial farms. Many farms are less than 50 acres and average farm size is less and 160 acres. The average size of farms with sales of over $2,500 is less than 160 acres in some areas, while it is as high as 260-499 acres in others. In the northern part of the region, less than 30 percent of all farms have sales of $2,500 or over and in the southern portion 30 to 40 percent of all farms have sales of over $2,500. The average value of farm products sold per acre of farmland ranges all the way from $10-$29 in the southern part of the region to over $150 per acre. The variation is due to the importance of poultry and the fact that this type of production is land intensive.

In the Southern Appalachian Region, harvested cropland as a percent of land area is less than five percent in much of the region and, in 1969, each county in the region had less than 15 percent of its land area harvested. Crops grown include hay, corn, cotton, and soybeans, with soybeans becoming increasingly important in recent years. Poultry farming is the principal agricultural activity although livestock, cash-grain, and dairy farming are also important.

4.1.4 Cultural Resources

4.1.4.1 Archaeological Resources.

Within this region, as in the other regions to be described, the evidence of man's earliest occupation is scanty and limited to scattered sites. Approximately 40 archaeological sites from this region cover various stages of early man and are included in the National Register of Historic Places (U.S. Department of the Interior, 1978hh). Although the exact date of earliest occupation is being revised by new finds, Early man was well established in the Americas by 12,000 B.C. (Dragoo, 1976). The Paleoindian occupation level of the Meadowcroft Rock Shelter site in Washington County, Pennsylvania, has been dated at 14,200 B.C. (Stuart, 1978). By 4000 B.C., these early hunters had developed into the regionally distinct groupings of the Eastern Archaic which practiced small-game hunting, fishing, and wild-plant gathering. The cultural complexes of this period included the Panhandle group in the northern part, of this region, the Indian Knoll group in the central part and the Lauderdale group in the south. The Eastern Village Farmers of the period from 100 B.C. to A.D. 500 developed maize agriculture and the beginnings of a settled village life, with burial mounds such as those of the Adena complex in Ohio being a prominent cultural feature. A great elaboration of village life developed in several areas between A.D. 500 and 1300, with most of the region being part of the Early Mississippi cultures and including regional groupings such as the Early Fort Ancient, the Harmons Creek, and the Hiwassee Island complexes. From these complexes developed the tribal groups encountered by the European explorers and settlers of the 15th and 16th centuries.

4.1.4.2 Historical Resources.

This region contains a wide variety of historical sites, over 600 of which are presently included in the National Register. These sites represent one third of all National Register sites within the 10 coal regions (U.S. Department of the Interior, 1978hh). A number of early explorers travelled through this area, including de Soto in the 1540's (U.S. Department of the Interior, 1970). During the period 1675 to 1800, many towns, camps, and forts were established along the area's post roads and trails, and between 1800 and 1820, nearly the entire area became settled. In later periods more roads were built, railroads crossed the area, and Civil War battles were fought. The National Register includes many houses, covered bridges, iron furnaces, railroad buildings, and battlefields, and such specific sites as Drake's first oil well, in Pennsylvania, and the beginning point of the U.S. Public Land Survey in Ohio.

4.1.5 Recreational Resources

As indicated in Section 1.3 above, certain land areas have been declared unsuitable for surface coal mining by the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Included in this classification are areas in the National Park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, Wild and Scenic

Rivers System, and National Recreational Areas designed by Congress.*

The Appalachian Region contains a large number of rivers presently included or under consideration for the Wild and Scenic Rivers System. Forty-five miles of the Obed River in Tennessee have been declared wild and one mile has been declared recreational. A 33-mile section of the Little Beaver River in Ohio is considered scenic. Parts of Pine Creek (Pennsylvania), Youghiogheny River (Pennsylvania-West Virginia) and Sipsey Fork River (Alabama) are currently under study for inclusion in the national system.

There are four wilderness areas totaling 47,732 acres in the Appalachian coal region. The Dolly Sods and Otter Creek National Wilderness Areas are located in the Monongahela National Forest, West Virginia. The other two areas are Beaver Creek in the Daniel Boone National Forest, Kentucky, and Sipsey, in the William B. Bankhead National Forest, Alabama (U.S. Department of Agriculture, 1977c). Three trails (North Country, Kittanning, and Potomac Heritage) that run through this region are being considered for inclusion in the National System of Trails (U.S. Department of the Interior, 1974j). There are no National Parks in the Appalachian coal region. The Erie National Wildlife Refuge in Pennsylvania is located within the region and the Wheeler Wildlife Refuge in Alabama is just outside the region.

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

U.S. Forest Service data have been used as an index of recreational activity (U.S. Department of Agriculture, 1977b). These data are aggregated for the states within each region on a per capita basis. This enables a comparison to be made of different uses within a region and gives a relative measure of the use of recreational activities by nonresidents. According to the Forest Service data, camping was the most common activity in the Appalachian Region and occurred at a rate of about one visitor-day per 1,000 people in the region. (A visitor-day is 12 person-hours in either continuous or intermittent use.) Hunting was the second most popular activity (0.60 vistor-days per 1,000 residents) with deer, turkey, and small game being the most common targets. Numerous rivers and streams in the region provide fishing for bass, blue gill, and catfish. Other recreational activities in National Forest lands include whitewater boating, spelunking, hiking, and skiing (U.S. Department of Agriculture, 1977b).

4.2 EASTERN INTERIOR REGION

The Eastern Interior Region is located in the east central portion of the United States, to the east of the Mississippi River. The majority of this 59,000 square-mile region is in Illinois, with lesser portions in Indiana and Kentucky and a small two-county section in Iowa. Nearly 70 percent of the 127 counties in this region are in Illinois, with the remainder being divided almost entirely between Indiana and Kentucky.

4.2.1 Physical Features

4.2.1.1 Topography.

The Eastern Interior Region is situated predominantly in the Central Lowland physiographic province, except for the southern portion of the region, in Kentucky, which is in the Interior Low Plateaus province (U.S. Department of the Interior, 1974h). The Central Lowland area consists mostly of low rolling landscape and nearly level plains, with local relief ranging from 100 to 300 feet. The Interior Low Plateaus include low plateaus and open hills on stratified rock, with local relief ranging from 100 to 500 feet and steep bluffs occurring along many of the rivers.

4.2.1.2 Geology.

Surficial deposits include alluvium, glacial drift, loess, and deep, residual clayey soils. Glacial deposits in Illinois and Indiana are up to 30 feet thick (Fluor Utah, 1975b). The region is underlain by extensive, nearly flat formations of Plaeozoic sandstones, limestones, conglomerates, and shales, with some rock outcroppings at the surface. The principal coal-bearing formations in most of the Eastern Interior Region are the Lower Pennsylvania, Pottsville, and Allegheny Formations (or the age equivalents of these formations which are described under a variety of local or regional names).

4.2.1.3 Minerals.

A variety of mineral commodities are produced throughout this region with only four counties reporting no production (U.S. Department of the Interior, 1977f). Coal is produced in approximately one-third of the region. Although it is the leading mineral in only one quarter of the region, it is the leading mineral in over half of those counties with mineral production valued at greater than $10 million. The other common commodities include petroleum, sand and gravel, crushed stone, and clay. Sand, gravel, and crushed stone are produced in over 80 percent of the counties of the region and are the leading value mineral in almost half of the counties. Of the half of the region's counties for which actual dollar values of production were reported, 35 percent had production valued at greater than $1 million, and 20 percent greater than $10 million.

4.2.1.4 Soils.

To a great extent, soils in the northern half of the Eastern Interior Region have derived from glacial drift and loess (windblown deposits). Deep soils (two to five feet) predominate, and approximately three quarters of the region is in cropland. These soils have a black, friable, organic rich surface layer, with some clay accumulation in the subsurface. The soils of the southern part of the region have a thinner topsoil and are derived from loess overlaying glacial till on level to gently sloping areas. These soils have a gray-brown surface layer that is medium to high in bases and often contain iron-manganese concretions. This surface soil often overlies and impermeable clay pan that produces poor internal drainage. Even with this limitation, over half of the area is in cropland and much of the soil is suitable for cultivation.

4.2.1.5 Water.

Water is generally plentiful in the Eastern Interior Coal Region with such large streams as the Mississippi-Missouri, the Ohio, and the Wabash, and a rather comprehensive network of lesser streams feeding these major ones.

Major water problems center around water distribution. The region suffers occasional damaging floods and, at times, protracted drought. Overall consumptive use of surface water is probably less than 2 million acre-feet per year (ERDA, 1977).

Water quality is generally satisfactory or can be treated for most uses. Total dissolved solids range from more than 350 mg/1 in streams in the northern and northeastern parts of the basin to about 120 mg/1 in the rest of the area. Much of this TDS content is the result of hardness, which ranges from about 240 mg/1 in the north and northeast to about 120 mg/1 in the rest of the area.

Though it is estimated that 42.3 million acre-feet of fresh to slightly saline (3,000 mg/1) groundwater is in storage in the region, some towns and cities have had difficulty obtaining wells yielding good water at reasonable costs. Over most of the region, however, fresh groundwater, at least in small to medium quantities, is generally not difficult to develop. Within the area, local overpumping has resulted since only about 4.1 million acre-feet of fresh groundwater is recharged to the system each year (USGS, 1975a) Some municipalities have found it less expensive and more satisfactory to discontinue their poor groundwater sources and develop treated surface waters. Over most of the area, the depth to saline groundwater is less than 500 feet.

For information on total domestic water use and wastewater flow in this region, see Table 4-9.

4.2.1.6 Climate.

Without the protection of natural barriers, the area experiences the full sweep of major storm systems that dominate the weather of the eastern two-thirds of the nation. The area has a classic continental climate. Storms are most frequent in the winter and spring months. Summer storms track generally north of the region and are weaker. Autumns are often dry with little storm activity which begins again in November.

The region has a large north to south variation in annual mean temperature. Northern areas average 48°F; southern areas about 60°F. Summertime temperatures above 110°F are not unknown and cold season temperatures below -20°F have been recorded.

Annual mean precipitation varies from about 33 inches in the north to 48 inches in the southeast portions. The distribution by months is likewise considerably different. In the north, the typical January minimum-June maximum of continental climates prevails. In the south, the influences of the wintertime Gulf Coast storms are evident. This circumstance contributes to the early spring floods that often plague the Ohio and lower Mississippi River areas. When a well developed

TABLE 4-9

EASTERN INTERIOR REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	5275593	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	543
Population Density (sq. mi.) (b)	85	Total	4917	Waste Water Flow (mgd) (c)	660
Net-Migration (1970-1976)	+21440	Education	2110	Solid Waste (million tons/yr.) (c)	5.1
School Enrollments (c,d)	1107875	Highways	638	Solid Waste (acres/yr.) (c)	533
Per Capita Income (b)	4872	Police Protection Employees (e, f)	11083	Hospital Beds (a)	26190
		Welfare	528	Year Round Housing Units (000) (c)	1758
		Health	353	Doctors-General Practice (a)	1247
		Other	1298	Doctors-Total Patient Care (a)	4103

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) PublicElementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

Gulf Coast storm dumps warm rain on snow cover remaining from an earlier storm, rapid runoff sometimes results.

Although dry periods occur, droughts to the extent of massive crop failures are almost unknown. The area is subject to severe local storms, particularly in the spring and early summer. In addition to wind damage, local flooding is a common occurrence. Areas affected are normally small a few tens of square miles.

Compared to most parts of the nation, the region is windy. Average speeds at the surface are 10-12 mph in the north and 9-10 mph in the southern portions. Winds are also steady and persistent in the area. Inversion conditions are accompanied by strong winds aloft 40-50 percent of the time, more frequently in summer than in winter. Surface based inversions occur about 50 percent of the time in winter and rarely in the summer. Persistent atmospheric stagnations are rare.

4.2.1.7 Air Quality.

Particulate air quality in the Eastern Interior Region varies considerably. This appears to be due in particular to many small and somewhat large dispersed and populated and industrialized areas within the region which covers portions of four states (Iowa, Illinois, Kentucky, and Indiana). Therefore, particulate air quality will generally be better in the more rural and unpopulated areas and worse in the more highly populated and/or industrialized areas. Sulfur dioxide air quality is also generally better than the national standards.

4.2.2 Ecological Factors

4.2.2.1 Flora.

The Eastern Interior Coal Region lies in a transitional area between the eastern oak-hickory forest biome (extending through southern Illionis, Indiana, and Kentucky, and along waterways) and the prairie biomes of the west. However, because of the highly agricultural nature of this region, much of the native flora has been removed and crops now dominate. About 15 percent of the region is in forest.

Where natural forests exist, dominant species include fir, white and swamp oaks, hickory, ash, poplar, and sweet gum. Ground cover associated with these forests includes shrubs such as mountain laurel, rhododendron, dogwood, wisteria, sumac, buckthorn, alder, and hawthorn, and numerous forbs and grasses such as winged pigweed, bishopcap, love grass, panic grass, and morning glory. Net primary productivity for forested areas is about 8.9 tons per acre (Rodin et al., 1975).

Relict prairie areas of Illinois are vegetated by mixed grasses, legumes, and other herbaceous species. Found within this area are big bluestem, switchgrass, and Indian grass (representative of tall grass prairie); little bluestem, needlegrass, dropseed, and western wheat-grass (representive of mid-grass prairie); and buffalo grass, blue grama, and side-oats grama (representative of short grass prairie) (Odum, 1971). There is a general tendency for the short grasses, more typical of western prairies, to push eastward onto the heavier soils of this region, and the tall grasses (typically eastern) to push westward onto the lighter soils, depending upon the amount of rainfall (Mohlenbrock et al., 1959). Net primary productivity of the prairie remaining within the Eastern Interior Coal Region is about 6 tons per acre per year (Rodin et al., 1975).

Vegetation of wetlands and along river bottom areas includes spike rush, sedges, milkweed, water primrose, cattails, pondweeds, and lizardtails. These wet areas are highly productive (17.8 tons net primary productivity per acre (Rodin et al., 1975)), and are valuable habitat to waterfowl using the Mississippi Flyway.

4.2.2.2 Fauna

Due to the proximity of forest and prairie, the diversity of wildlife within the Eastern Interior Coal Region is very high. Over 60 species of mammals (Hoffmeister, 1957), 200 breeding species of birds (Graber and Graber, 1963), 100 species or reptiles and amphibians (Conant,1975), and 200 species of fish occur within the region.

Representative mammals occurring in the forested areas of the region include white-tailed deer, cottontail rabbit, squirrel and gray fox, skunks, woodchuck, and bobcat. Species typical of the prairie areas and edge hatitat between forest and prairie include white-tailed deer, rabbit, red fox, and coyote. Small mammals, such as mice, shrews, and bats are numerous in both prairie and forest areas. Furbearers, such as mink, beaver, muskrat, and raccon occur along waterways and in marshy habitats.

Major upland game birds found in the region include ring-necked pheasant, ruffed grouse, mourning dove, bobwhite quail, and turkey. Wetlands and waterways provide habitat for waterfowl using the Mississippi Flyway, such as bluewinged and greenwinged teal, pintail, wood duck, lesser scaup, black ducks and mallards, and lesser snow and Canada Goose. Among the principal non-game birds in the region are redtailed hawk, turkey vulture, black vulture, great horned owl, and green heron.

Smaller birds include the chimney swift, cardinal, indigo bunting, mocking crow, bluejay, brown thrasher, and others (Thompson, 1972).

Among the 15 species of game fish in the region, largemouth bass is the most popular. Other gamefish of local importance include bluegills, croppie, northern pike, catfish, yellow perch, white bass, and yellow bass.

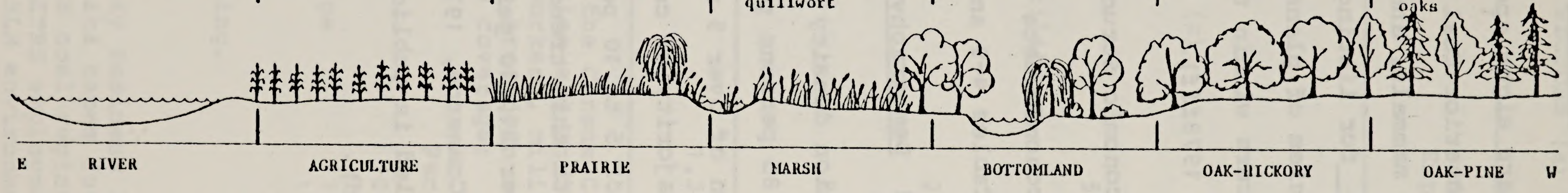
Reptiles and amphibians found within the region include box turtles, soft-shelled turtles, snapping turtles, copperhead snakes, king snakes, cricket frogs, bull frogs, leopard frogs, and a variety of lizards and salemanders. The wood frog and black nose salemander are unique to this region (Conant, 1975).

Table 4-10 presents a typical cross section of the Eastern Interior Coal Region biomes. Estimates of the wildlife carrying capacities and primary productivity rates for this region are presented in Appendix_____.

TABLE 4-10

PROFILE OF EASTERN INTERIOR COAL REGION BIOMES

RIVER	AGRICULTURE	PRAIRIE	MARSH	BOTTOMLAND	OAK-HICKORY	OAK-PINE
ENDANGERED SPECIES bald eagle tuberculated-blossom pearly mussel Sampson's pearly mussel PREDATORS mink BIRDS scaup redhead mallard black duck wood duck Canada goose FISH carp bullhead sucker crappie bluegill largemouth bass	PREDATORS coyote red fox BIRDS mourning dove bobwhite quail pheasant robin crow BIG GAME white-tailed deer DOMINANT VEGETATION tobacco pasture soybeans corn	ENDANGERED SPECIES peregrine falcon PREDATORS coyote red fox hawks BIRDS bobolink bobwhite quail song sparrow meadow lark pheasant BIG GAME white-tailed deer DOMINANT VEGETATION big bluestem little bluestem side oats gramma blazing star prairie clover	ENDANGERED SPECIES peregrine falcon bald eagle PREDATORS marsh hawk red fox raccoon mink BIRDS redwing rail bittern egrets herons BIG GAME white-tailed deer DOMINANT VEGETATION cattail swamp rose sedges spikerush quillwort	ENDANGERED SPECIES bald eagle PREDATORS bobcat gray fox BIRDS tananger cardinal peewee warblers oven bird BIG GAME white-tailed deer DOMINANT VEGETATION river birch ash cypress gum red maple swamp white oak	ENDANGERED SPECIES Indiana bat gray bat Kirtland's warbler PREDATORS bobcat gray fox BIRDS cardinal thrush warblers titmouse thrasher BIG GAME white-tailed deer DOMINANT VEGETATION hickory yellow poplar post oak white oak bur oak	ENDANGERED SPECIES Indiana bat red cockaded woodpecker PREDATORS bobcat gray fox BIRDS chickadee nuthatch cardinal titmouse warblers BIG GAME white-tailed deer DOMINANT VEGETATION red cedar white pine Virginia pine hickory oaks



225 miles - not to scale (for illustrative purposes only)

4.2.2.3 Protected Species.

There are eight species of Federally protected animals in the Eastern Interior Coal Region. Among these are four species of birds, two mammals, and three invertebrates (see Appendix Tables___and___for listings, distribution, and habitat). None of the 13 species of plants officially listed as endangered or threatened occurs within this coal region (U.S. Department of the Interior, 1978fff).

4.2.3 Socioeconomic Structure

Socioeconomic data for the Eastern Interior Region are presented in Tables 4-9 and 4-11.

4.2.3.1 Demography.

Population density in the Eastern Interior Region was approximately 85 persons per square mile relative to a total 1975 population of over 5 million (U.S. Department of Commerce, 1978b). The majority of counties within the region experienced out-migration of 5 to 10 percent during the 1960 decade (U.S. EDA, 1977b) with this trend reversing after 1970. In-migration amounted to over 21,000 persons between 1970 and 1976 (U.S. Department of Commerce, 1978b). There were over one million students enrolled in public schools in 1975 (U.S. Department of Commerce, 1977d).

TABLE 4-11

EASTERN INTERIOR COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total[2]
07	Agricultural Services	878	0.1
10	Mining	18,483	1.4
12	Coal Mining (Bituminous) (c)	6,694	
15	Construction	71,131	5.2
19	Manufacturing	505,209	37.2
40	Transportation/Public Utilities	69,430	5.1
50	Wholesale Trade	88,257	6.5
52	Retail Trade	289,465	21.3
60	Banking and Finance	64,251	4.7
70	Services	241,226	17.8
99	Non Classified	8,098	0.6
	TOTAL	1,356,428	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military, and railroad employment. The following breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Patterns Scope	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal regions. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

4.2.3.2 Economic Base and Sectorial Employment.

Total employment and percentage distribution in each employment class during 1974 is presented in Table 4-11.

Approximately 505,200 workers, or about 37.2 percent of the total regional employment, is in the manufacturing sector. This sector, in combination with 289,500 workers in the retail trade sector and 241,000 workers in the service sector, represents over 76 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of 197,000 persons employed in the agricultural sector in the Eastern Interior Region.

The total labor force (BLS data) expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Eastern Interior Region is 11.0 percent.

4.2.3.3 Agriculture.

Because of its importance to farming activity, much of the land within this region has been cleared of natural vegetation for crops and pasture. Principal crops grown in the region include corn, soybeans, wheat, and hay (U.S.D.A., 1978a). Yields for these crops are about 100 bushels of corn per acre, 33 bushels of soybeans, 39 bushels of wheat and 2.0 tons of hay (U.S.D.A., 1978a).

Agriculture in most of the region is characterized by feed-grain and livestock production. The part of the region in Kentucky and a small part of Indiana is in a general farming area. Central Illinois has a highly commercialized agricultural area and over 90 percent of all farms in that area have sales over $2500. In the southern portion of the region, the percent of farms having sales over $2500 ranges from 30-50 percent.

The average size of farms is 260-499 acres in Central Illinois and Indiana and somewhat smaller in Kentucky. In most of the region, more than 75 percent of the farmland is cropland, although in Kentucky the percent of farmland in crops is in the 50-75 percent range.

The farmland in this region is some of the finest in the world and a substantial portion of it could be classified as "prime." The productivity of much of this land has been enhanced by extensive drainage projects. The value of products sold per acre of farmland in 1969 ranged from $50-$99 in most of the region, and from $30-$49 in southern Illinois and Kentucky.

4.2.4 Cultural Resources

4.2.4.1 Archaeological Resources.

Within this region, approximately 200 sites are included in the National Register of Historic Places (U.S. Department of the Interior, 1978hh). Evidences of the Eastern Archaic period includes the Starved Rock cultural complex in the northern part of the region and the Faulkner complex in the east. The Koster Site (Greene County, Illinois) contains several occupation levels, representing various cultures from 7000 B.C. to about

1000 A.D. This coal region also includes many of the burial, effigy, and temple mounds of the Mississippi Valley, including the Cahokia Mounds and its village area (St. Claire County, Illinois) which had as many as 30,000 inhabitants at the height of its expansion.

4.2.4.2 Historical Resources.

Joliet, Marquette, La Salle, and other explorers of the 1670's and 1680's travelled the Illinois, Ohio, and Wabash Rivers in this region (U.S. Department of the Interior, 1970). By 1700, French traders frequently traveled the Ohio and Wabash Rivers; by 1800, the southereastern portion of this region, in Kentucky, was settled; and by 1835, the entire region was settled and crossed by the National Pike between Baltimore and St. Louis. The National Register includes over 200 listings within this region, primarily a large number of individual houses, banks, churches, and courthouses, and also many historic districts encompassing several buildings (U.S. Department of the Interior, 1978hh).

4.2.5 Recreational Resources

The only National Park in the Eastern Interior Region is Mammoth Cave in Kentucky. Approximately half of the 52,129-acre park is situated in this region (U.S. Department of the Interior, 1970). Other Federal lands in the region are the Crab Orchard, Meredosia, and Chautaugua National Wildlife Refuges in Illinois. These refuges include nearly 50,000 acres (U.S. Department of the Interior, 1977i).*

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

Due to the relatively small number of Federally-owned parcels of land in the region, not many of the residents utilize this land for recreation. Camping was the most popular activity (0.47 vistor-days/1,000 population) followed by boating (0.36 visitor-days/1,000 population), hunting (deer, small game, waterfowl), and fishing (both 0.26 visitor-days/1,00 population) (U.S. Department of Agriculture, 1977b).

4.3 WESTERN INTERIOR REGION

4.3.1 Physical Features

4.3.1.1 Topography

Most of the Western Interior Region is within the Central Lowland physiographic province, consisting of low rolling hills and nearly level plains (U.S. Department of the Interior, 1974h). Local relief is slight, ranging from 100 to 300 feet. Stream valleys are generally broad with steep slopes but become narrower to the east. The southern portion of the region, in eastern Oklahoma and western Arkansas, is part of the Ouachita Province with ridges and valleys eroded on upturned folded rocks. Local relief in this area may range from 500 to 1500 feet, with a maximum elevation above sea level of approximately 2,800 feet.

4.3.1.2 Geology.

The gently sloping hills of the northern portion of this region are composed of alluvium, glacial drift, and loess, underlain by a variety of sandstones, limestones, shales, and coal seams in horizontal or nearly horizontal beds with isolated faulting and gentle folding (Fluor Utah, 1975b). The east-west trending ridges and valleys of the Ouachita Province were formed during the early Paleozoic Age through extensive folding and faulting of near-surface strata and the flowage and metamorphism of lower strata. This period of geological activity occurred at the same time as similar activity in the Appalachian foldbelt (U.S. Department of the Interior, 1968). As in the Eastern Interior Region, most Western Interior coal is Pennsylvanian in age. Principal deposits include the Lower Pennsylvanian Demoines and Missouri Series which are equivalents of the coal-bearing Pottsville and Allegheny formations of the Applachian Region. The coal beds in the western Oklahoma and eastern Arkansas portion of this region were sufficiently influenced by mountain-building forces to raise their rank to the low volatile bituminous and semianthracite beds in the Hartshorne and McAlester Formations.

4.3.1.3 Minerals.

Sand, gravel, and crushed stone are produced in over 90 percent of the region's counties (U.S. Department of the Interior, 1977f). Coal is produced in 15 percent of the counties and petroleum in approximately 20 percent, principally in Oklahoma. Of those counties reporting actual dollar volumes of production (half of the region), 65 percent had production in excess of $10 million. Only five counties throughout the region reported no mineral production. For half of the counties with mineral production greater than $10 million, petroleum and natural gas were the leading minerals; in the other counties cement was the leader, with production from five counties in Kansas valued at $50 million.

4.3.1.4 Soils;

The dominant soils in the region are black, organic-rich soils that are gently to moderately sloping and often have a brown clay subsoil. These soils developed from glacial till or loess and are generally quite fertile. Although some areas are seasonally wet and require drainage, the dominant limitations are water erosion and drought.

4.3.1.5 Water.

Surface-water runoff averages about 7 inches over most of the area, ranging from about 3 inches in the northwestern part of the area in Iowa to about 30 inches in the mountains. Evapotranspiration averages about 30 inches, ranging from about 27 inches in the north to about 36 inches in the extreme south.

Numerous dams have been built on the streams in the region, and evaporation ranges from about 36 inches in the north to 54 inches in the southwest, averaging about 46 inches. Devastating floods are not uncommon, and the area has experienced severe droughts.

The quality of the surface water is generally good, especially in the east where the total dissolved solids generally range from about 120 to 350 mg/1. In the western part of the region, particularly in the northwestern and southwestern areas, the rivers not only carry a greater concentration of total dissolved solids (ranging from 350 mg/1 up) but a much heavier load of suspended solids. The Des Moines, the Iowa, the Missouri, and the Arkansas Rivers have the poorest quality of water. In some streams, oil-field wastes and other industrial and municipal wastes have created serious problems.

Groundwater conditions vary widely with respect to quantity and quality. In the Iowa and upper Missouri parts of the region, the glacial drift yields small to large quantities of water from wells generally less than 250 feet deep. Buried glacial valleys likewise offer good well supplies where they are largely filled with permeable sand and gravel; where clayey till fills these buried valleys, yields of only a few gallons a minute can be expected.

The Paleozoic dolomite and limestone bedrock aquifers may yield large quantities of water (up to 1,000 gpm or more). Valley fill alluvium in aquifers along the larger streams supply fairly large supplies of generally hard water.

Consumption of water withdrawn for use from all sources is only a very small part of the total quantity of water available.

For information on total domestic water use and wastewater flow in this region, see Table 4-12.

4.3.1.6 <u>Climate</u>.

This inland area has the classic continental climate. Most of the area is far from natural topographic barriers. Weather changes are frequent from both day-to-day and season-to-season standpoints. Ranges in temperature and

TABLE 4-12

WESTERN INTERIOR REGION: SOCIO-ECONOMIC CONDITIONS

Total Population (b)	6143999	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	750
Population Density (sq. mi.) (b)	55	total	5542	Waste Water Flow (mgd) (c)	768
Net-Migration (1970-1976) (b)	+29276	Education	2243	Solid Waste (million tons/year) (c)	5.8
School Enrollments (c,d)	1290240	Highways	817	Solid Waste (acres/yr.) (c)	616
Per Capita Income (b)	4358	Police Protection (c, f)	12462	Hospital Beds (a)	32486
		Welfare	547	Year Round Housing Units (000) (c)	2119
		Health	455	Doctors-General Practice (a)	1297
		Other	1481	Doctors-Total Patient Care (a)	6119

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

heavier load of suspended solids. The Des Moines, the Iowa, the Missouri, and the Arkansas Rivers have the poorest quality of water. In some streams, oil-field wastes and other industrial and municipal wastes have created serious problems.

Groundwater conditions vary widely with respect to quantity and quality. In the Iowa and upper Missouri parts of the region, the glacial drift yields small to large quantities of water from wells generally less than 100 feet deep. Buried glacial valleys likewise offer good well supplies where they are largely filled with permeable sand and gravel, but where clayey till fills these buried valleys, yields of only a few gallons a minute can be expected.

The Paleozoic dolomite and limestone bedrock aquifers may yield large quantities of water (up to 1,000 gpm or more). Valley fill alluvium in aquifers along the larger streams supply fairly large supplies of generally hard water.

Consumption of water withdrawn for use from all sources is only a very small part of the total quantity of water available.

For information on total domestic water use and wastewater flow in this region, see Table 4-12.

4.3.7.2 Climate.

This inland area has the classic continental climate. Most of the area is far from natural topographic barriers. Weather changes are frequent from both day-to-day and season-to-season standpoints. Ranges in temperature and precipitation are pronounced. The area tends to be dominated by cold air from the Canadian arctic in winter and, in summer, from the warm moist arid soutwest. The northern portions have cold winters and hot summers; the southern portions have milder winters but long, hot, and often humid summers.

The range of annual mean temperature is 48-62°F. This large range is a function of the latitudinal extent of the region. Summertime maximum temperatures have exceeded 110°F throughout the area. In northern portions of the region sub-zero temperatures occur on the average of more than 20 days per year.

Like the temperature, annual precipitation increases to the south. In Iowa, annual amounts average 28-30 inches, two-thirds of it in the growing season. Rainfall increases to about 44 inches in portions of eastern Oklahoma where terrain influences are minimal. In some of the mountainous parts of Arkansas, some localities receive as much as 56 inches. Throughout the area, the precipitation follows the continental pattern with a winter minimum and late spring or early summer maximum. Extended rain-free periods occur periodically and droughts occur throughout the area. The southwestern parts are most susceptible (Oklahoma, Kansas, and Missouri).

This area is generally windy. Average speeds near the ground are 11-14 mph. Windiest weather occurs in March and when precipitation has been sparse; fugitive dust and dust storms are common. Preferred wind directions are south and northwest, except where the higher terrain of Oklahoma and Arkansas influences the flow. Further, winds can be very steady and persistent throughout the area.

Surface based inversions prevail during the morning 50-60 percent of the time in winter and 70-80 percent of the time in the summer. They are more than 250 meters deep half the time. The frequency of surface based inversions is expected to be greatest in the valleys of the mountainous areas than on the plains.

The frequent snow cover and periods of frozen ground that prevail in the north contributes to the persistence of winter inversions. Nevertheless, the general storminess and variability of the weather and the strong wind speeds make the area essentially stagnation free.

4.3.1.7 <u>Air Quality.</u>

Particulate sulfur dioxide air quality in the Western Interior Region is considered to be very acceptable in most areas of the region. However, some variation does exist, particularly in highly populated and/or urbanized areas of the region.

4.3.2 Ecological Factors.

4.3.2.1 <u>Flora.</u>

The Western Interior Coal Region is similar to the Eastern Interior Coal Region in that it is also transitional between eastern deciduous forest and western prairie. Approximately 17 percent of the region is in forest. Mixed oak and hickory dominated forest are common in the eastern portion of the region, grading to oak-hickory-pine in the southeastern portion. Understory vegetation associated with these areas includes dogwood, redbud, holly, spicebush, sassafras, sumac, and numerous grasses and forbes.

Along waterways and in bottomlands, the dominant forest types are birch, willow, cottonwood, and poplar. Aquatic and semiaquatic vegetation common to the wet areas throughout the region include pondweeds, waterlily, cattails, sedges, rushes, and a wide variety of algae.

As the vegetation grades from forest to prairie, panic grass, Indian grass, little bluestem, big bluestem, and other grasses become dominant. Estimates of primary productivity range from about 18 tons per acre per year for floodplain vegetation (Rodin et al., 1972).

4.3.2.2 Fauna.

The mixture of habitat types available within the Western Interior coal region provide suitable food, shelter, and cover for a variety of wildlife. Approximately 58 species of mammals, 91 species of birds, 110 species of fish, as well as amphibians, reptiles, and numerous arthropod species are indigenous to the region (Burt and Grossenheider, 1964; Kendeigh, 1965; Shelford, 1963).

While few mammalian species develop large populations in oak-hickory forest, this type habitat is occupied by such animals as white-tailed deer, raccoon, gray fox, bobcat, eastern gray and fox squirrels, eastern cottontail rabbit, skunk, oppossum, mice, and eastern woodrat. Birds typical of these forested areas include those that prefer the upper canopy layers (vireos and warblers) and those occupying lower canopy (understory) and forest floor. Typical species of this latter group include thrushes, wood pewee, towhee, cardinal, and gamebirds such as turkey and grouse.

Wildlife typical of prairie areas and agricultural lands witin the region include white-tailed deer, cottontail rabbit, mice, voles, red fox, and coyote. Birds in these open habitats include horned lark, crow, cowbirds, grasshopper sparrows, bobwhite quail, mourning dove, pheasants, and red tailed and red shouldered hawks.

Water bodies within the region are highly productive and support a variety of fish species including bullheads, yellow perch, bluegills, large mouth bass, crappie, shiners, and minnows. Furbearers associated with these aquatic habitats include mink, muskrat, beaver, otter, and raccoon. Typical birds include red-winged blackbird, herrons, gulls, wood ducks, mallards, scaup, snow and Canada goose, and bald eagle.

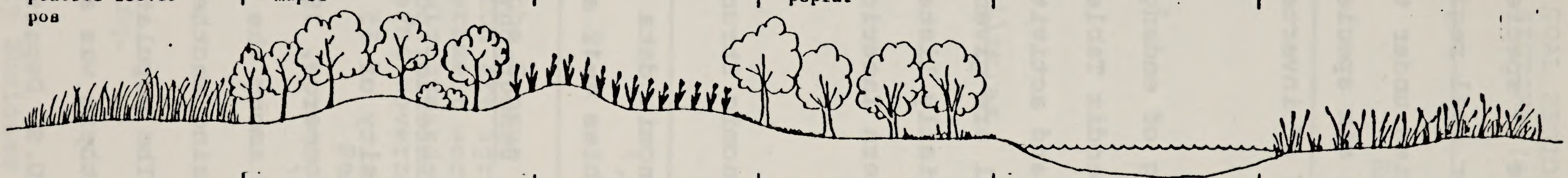
Amphibians and reptiles common to the region include cricket frog, bullfrog, collard lizard, sixlined race runner, box turtle, spiny soft-shelled turtle, ringnecked snake, kingsnake, gartersnake, and ground snake (Stebbins, 1966).

Table 4-13 presents a typical cross section of the Western Interior coal region biomes. Estimates of wildlife carrying capacities and primary production for the region are present in Appendix______.

TABLE 4-13

PROFILE OF WESTERN INTERIOR COAL REGION BIOMES

ENDANGERED SPECIES black footed ferret peregrine falcon eskimo curlew PREDATORS shorteared owl coyote red fox hawks BIRDS bobwhite quail crow song sparrow meadow lark pheasant BIG GAME white-tailed deer DOMINANT VEGETATION little bluestem big bluestem purple coneflower blazing star prairie clover poa	ENDANGERED SPECIES Indiana bat gray bat bald eagle red cockaded woodpecker PREDATORS bobcat coyote gray fox BIRDS wild turkey chickadee blue jay woodpeckers flicker BIG GAME black bear white-tailed deer DOMINANT VEGETATION oak hickory poplar maple	ENDANGERED SPECIES peregrine falcon PREDATORS red-tailed hawk raccoon red fox BIRDS meadowlark crow horned lark pheasant bobwhite quail BIG GAME white-tailed deer DOMINANT VEGETATION soybeans wheat cotton alfalfa pasture	ENDANGERED SPECIES red wolf bald eagle Bachman's warbler PREDATORS eagle coyote gray fox bobcat BIRDS rufus-sided towhee brown thrasher woodpeckers woodcock flicker BIG GAME white-tailed deer DOMINANT VEGETATION river birch mulberry willow plane tree poplar	ENDANGERED SPECIES bald eagle neosho muckett mussel PREDATORS merganser mink bald eagle raccoon BIRDS scaup wood duck mallard snow goose Canada goose FISH paddlefish walleye warmouth smallmouth bass largemouth bass	ENDANGERED SPECIES bald eagle peregrine falcon PREDATORS herons mink bald eagle raccoon BIRDS rough-winged swallow gulls belted kingfisher herons pied-billed grebe DOMINANT VEGETATION cattail pondweed canary grass sedges willow arrow arum



SW PRAIRIE UPLAND FOREST AGRICULTURE BOTTOMLAND RIVER MARSH NE

275 miles - not to scale (for illustrative purposes only)

4.3.2.3 Protected Species.

There are 11 species of animals occuring within the Western Interior coal region that have protected status as endangered species under the Endangered Species Act of 1973. Among these are six species of birds, four species of mammals, and one species of invertebrates (U.S. Department of Interior, 1977t).

A listing of endangered species occurring in the region is given in Appendix Table______. Habitat preference, distributions, and activities that pose potential threats to species survival are given in Table____. None of the 13 species of plants officially listed as threatened or endangered occur within the Western Interior Region (U.S. Department of Interior, 1978fff).

4.3.3 Socioeconomic Structure

Socioeconomic data for the Western Interior Region are presented in Tables 4-12 and 4-14.

4.3.3.1 Demography.

Western Interior population totaled over 6 million in 1975 with a density of 55 persons per square mile (U.S. Department of Commerce, 1978b). Farm populations vary from 11.3 to 28.1 percent among the counties of the region with urban dwellers comprising another 58.5 percent of the total (U.S. ERDA, 1977b). The population total was relatively stable during the 1960's and there was a slight gain (29,000 persons) between 1970 and 1976 (U.S. Department of Commerce, 1978b). Public

TABLE 4-14

WESTERN INTERIOR COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	2,293	0.1
10	Mining	11,771	0.7
12	Coal Mining (Bituminous)³	0	
15	Construction	99,465	5.9
19	Manufacturing	462,497	27.5
40	Transportation/Public Utilities	120,141	7.2
50	Wholesale Trade	147,632	8.8
52	Retail Trade	366,788	21.8
60	Banking and Finance	124,996	7.4
70	Services	335,559	20.0
99	Non Classified	10,011	0.6
	TOTAL	1,681,153	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

school enrollments were over one million in 1975 (U.S. Department of Commerce, 1977d).

4.3.3.2 Economic Base and Sectorial Employment.

Total employment in each employment class during 1974 is presented in Table 4-14 along with percentage distribution.

Approximately 462,500 workers, or about 27.5 percent of the total regional employment are in the manufacturing sector. When combined with 366,800 workers in the retail trade sector and 335,600 workers in the service sector, these three sectors represent over 69 percent of the total employment within the region. The 1974 Census of Agriculture indicates a total of 226,000 persons employed in the agricultural sector in the Western Interior region.

The total labor force (BLS data) expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Western Interior Region was 52.2 percent.

4.3.3.3 Agriculture.

Farming is a major land use within the Western Interior coal region. Principal crops include corn, soybeans, hay, wheat, and cotton. Average per acre yields for these crops are 84.6 bushels corn, 25.6 bushels soybeans, 2.0 tons hay, 29.1 bushels wheat, and 390 pounds of cotton (U.S. Department of Agricultural, 1978a).

Agriculture in the region ranges from the enormously productive feed-grain and livestock producing areas of central Iowa, to the much less productive general farming in eastern Oklahoma, and to poultry production of the Arkansas portion.

This is a large region and very heterogeneous with respect to agriculture. In central Iowa, eastern Nebraska, and northwestern Kansas, more than 50 percent of all farms have sales of farm products over $10,000. In the Kansas portion, 30-50 percent of all farms have sales over $10,00, while in the Missouri portion, 20 to 40 percent of the region, less than 20 percent of farms have sale of over $10,000.

In the northern portion of the region, over 75 percent of the land area is in cropland, and a substantial part of this area could be classified as "prime" farmland. In the Kansas portion of the region, as well as in the Missouri portion, cropland represents from 50 to 75 percent of the land area. In the Oklahoma and Arkansas portions of the region, only 15-30 percent of all land is used for crops; in these areas there is a high percentage of farm land used as pasture.

In the northern portion of the region, including Iowa and Nebraska, the value of farm products sold per acre of farmland ranges from $100-$149. In the Kansas and Missouri portions, the average value of farm products sold ranges from $30 to $100; in the Oklahoma portion, it averages $10-30 per acre.

4.3.4 Cultural Resources

4.3.4.1 Archaeological Resources. The Western Interior Region contains over 60 archaeological sites dating from various periods, that are included in the National Register of Historic Places (U.S. Department of the Interior, 1978hh). The Eastern Archaic period in this portion of the region is represented by the Nebo Hill complex in the central portion of the region and the Grove complex in the south. The period of the Eastern Village Farmers (from 1000 B.C. to 500A.D.) is well represented with an number of village sites and mounds. The final period of the Early Mississippi cultures is represented by a wider variety of regional groupings such as the Mill Creek and Nebraska complexes in the north, the Smoky Hill complex in the Central portion of the region, and the fringe areas of the Custer and Washita complexes in the south.

The latter part of the Eastern Archaic period is typified by the Spiro Mound Group in LeFlore County, Oklahoma. This group has produced many artifacts, including hundreds of pipes (many with human or animal effigies), carved cedar figures and masks, and several hundred intricately engraved conch-shell bowls (Stuart ans Stuart, 1969).

4.3.4.2 Historical Resources.

The Missouri River was the principal travel route in this region for the explorers of the 1720's and 1730's and became the standard route for the Missouri River traders travelling beteen St. Louis and the Mandan Indian Villages in the northern Great Plains during the 1780's and 1790's (U.S. Department of the

Interior, 1970). In the early 1800's, some towns and forts were established and some areas in the eastern part of the region along the Missouri became settled. By 1850, only small areas in the west and northwest remained unsettled.

At present, there are over 450 sites or districts from this region included in the National Register (U.S. Department of the Interior, 1978hh). These listings include sites similar to those in the other eastern regions (houses, churches, and courthouses), together with a range of sites associated with early travel in the area, with the new settlers, dealings with the American Indians, and with events of the Civil War. The travel-related sites include a number of stagecoach waystations, particularly those of the Butterfield Overland Mail route of Oklahoma in the 1850's. The sites associated with American Indian groups include government-run Indian agencies and missions established by various religious organizations. Approximately 20 Civil War battle sites are located in the southern half of this region.

4.3.5 Recreational Resources

Parts of six trails currently under study for the National System of Trails are in the Western Interior Region. The Oregon, Mormon-Battalion and the Santa Fe trails originate in the region while the Old Cattle, Lewis and Clark, and Mormon trails traverse it.*

Five National Wildlife Refuges are in this region. Three, the DeSoto, Squaw Creek, and Swan Lake, are located on or near the Missouri River. The other two, Flint Hills and

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

Sequoyah, are located in Kansas and Oklahoma, respectively. These areas include over 61,000 acres and are important refuges for various bird populations.

Two National Wilderness areas are located in National Forests that are partially in this region. The Wilderness areas are Caney Creek, with 14,344 acres of the Ozark National Forest, and Apper Buffalo, encompassing 10,182 acres of the Ozark National Forest (U.S. Department of Agriculture, 1977c). There are no Wild and Scenic Rivers or National Parks in the Western Interior region.

Camping was the primary recreational activity on National Forest areas in this region with 0.69 visitor-days/1,000 residents. Second in popularity was hunting (0.57 visitor-days/1,000 residents). Fishing and water sports were the next most popular activities (0.47 and 0.28 visitor-days/1,000 residents, respectively) (U.S. Department of Agriculture, 1977b).

4.4 TEXAS REGION

The Texas Region is composed of a portion of eastern Texas and small areas in northwestern Louisiana. This 37,000 square mile region includes 54 counties, predominately in Texas.

4.4.1 Physical Features

4.4.1.1 Topography.

The Texas Region is part of the Coastal Plain physiographic province. It consists of low, hilly to nearly flat terraced plains on unconsolidated sediments (U.S. Department of the Interior, 1974b). Most of the region has low relief ranging up to 250 to 300 feet. In the central part of the region, plains and hills occur in an east-west belt where local relief ranges up to 400 feet with the hills seperated by wide floodplains (Fluor Utah, 1975b). The entire region is dissected by a number of rivers that are basically parallel and flow southeast toward the Gulf of Mexico.

4.4.1.2 Geology.

The surface deposits of this region are composed primarily of unconsolidated beds of detrital sediments which get progressively older to the northwest, except for recent alluvium along the river floodplains. The deposits are basically sandy, silty, clayey residual deposits derived from deep weathering of the bedrock. The lignite of this region occurs in the Yegua Formation and the Wilcox and Jackson Groups, all of late tertiary Eocene age (Fluor Utah, 1975b). Structurally, the region has horizontal to nearly horizontal beds that dip gently to the southeast interrupted locally by faulting.

4.4.1.3 Minerals.

Although some lignite is produced in a few counties, the predominant commodity for this region is petroleum which is produced in 95 percent of the counties and is the leading value commodity in 65 percent of the counties. Five counties have aggregate production value for all minerals of over $1 billion (U.S. Department of the Interior, 1977f). Eighty-five percent of the counties in the region have mineral production valued at greater than $1 million and 45 percent at greater than $10 million.

Only four counties with productions greater than or near $10 million had a mineral other than petroleum, natural gas, or natural gas liquids as the leading commodity. In these counties the leading commodities were cement, lignite, iron, or clay. Clay is the most common mineral next to petroleum and gas in the region, being produced in 45 percent of the counties. Decreasing oil and gas reserves have increased interest in the region's lignite resources with several large strip mines in the development or planning stages, and extensive leasing and drilling occurring in the Yegua, Wilcox, and Jackson lignites (U.S. Department of the Interior, 1977f).

4.4.1.4 Soils.

The northeast part of the region is composed primarily of soils that are strongly acidic and low in organic matter, with surface textures ranging from sandy loam to silt loam and silty clay loam, and subsoils characterized by accumulations of iron and aluminum oxides. The southwestern portion of the region contains soils that range in texture from sandy loam to silty clay loam with calcium carbonate accumulations at depths of one to three feet. The other major soil grouping in the region is the alluvial soils found along the floodplains of the many rivers crossing the region. These soils have been deposited fairly recently and have not formed distinct soil horizons, but are generally characterized by a surface layer, which has some accumulation of organic matter, and lower layers which have been altered very little. Generally, the dominant soil limitations include water and wind erosion, with shallowness, slow permeability, and drought also affecting the soil's potential use.

4.4.1.5 Water.

Runoff is substantial in the eastern part of the region, but is essentially nonexistent to the southwest; it ranges from 15 in/yr to 1 in/yr. Potential evapotranspiration in the area is highest of all the coal regions, exceeding 54 in/yr in the extreme southwest. Over most of the area, however, potential evapotranspiration averages about 42 in/yr.

Numerous streams, including the Sabine, Brazos, Red, Neches, Trinity, Colorado, and Nueces Rivers, flow through the coal region. The combined flow of these rivers and their tributaries is 61.5 million acre-feet per year (WRC, 1975). Stream sediment levels decrease to the east as precipitation and runoff increase. Western portions of streams in the area may have a sediment load from over 1,900 mg/1 to as low as 270 mg/1. TDS levels increase to the east, varying from less than 350 mg/1 to greater than 1,200 mg/1. Streams in the area may carry up to

TABLE 4-15

TEXAS REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	2548171	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	100
		Total	2133	Waste Water Flow (mgd) (c)	319
Population Density (sq. mi.) (b)	71				
Net-Migration (1970-1976)	+108185	Education	841	Solid Waste (million Tons/yr.) (c)	2.5
School Enrollments (c,d)	560598	Highways	316	Solid Waste (acres/yr.) (c)	258
Per Capita Income (a)	4097	Police Protection Employees (c,f)	5588	Hospital Beds (a)	11841
		Welfare	201	Year Round Housing Units (000) (c)	849
		Health	189	Doctors-General Practice (c)	601
		Other	586	Doctors-Total Patient Care (a)	2450

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

several thousand mg/1 of total dissolved solids in areas affected by salt seeps and oil-field activities.

Of the total surface water withdrawn, 15.5 million acre-feet are consumptively used each year (WRC, 1975). The major uses of surface water in the region are irrigation and self-supplied industry.

Groundwater is abundant and of good quality. Very high yields, over 1,000 gpm, have been reported from both bedrock and alluvial aquifers. The water generally contains less than 500 mg/1 TDS, but quality deteriorates with increasing depth. In the southern part of the area, some natural groundwaters contain high levels of trace metals and fluoride. Additionally, groudwater quality has been affected in some areas by oil-field activities.

Groundwater use in the region is approximately 75,000 acre-feet per year (ERDA, 1977). The largest uses are public water supply (33,600 acre-feet) and industry (30,000 acre-feet) (ERDA, 1977). For information regarding domestic water use and wastewater flow in this region, see Table 4-15.

4.4.1.6 Climate.

The proximity of the Gulf of Mexico and the persistent southerly and southeasterly flow around the western extension of the Bermuda anticyclone produces a humid, sub-tropical climate over most of the region. The southwestern portion is less subject to air that has had a trajectory over the Gulf of Mexico and, as a consequence, is markedly drier and may be classified as semi-arid. The area is exposed to occasional outbreaks of cold air in the winter and spring and the western part receives a considerable portion of its precipitation from the showers and thunderstorms that accompany the fronts. The northeast sections receive a substantial amount of winter time precipitation from storms that develop along the Gulf Coast. During the summer, the broad humid southerly flow produces scattered showers. These three features are the major weather features of the area, although tropical storms affect the area in late summer and fall every few years.

The area has hot summers and mild winters. Mean annual temperatures vary from 64°F in the northwest sections to 70 °F in the southwest. Temperatures in excess of 100°F occur every summer. The record highs in most areas exceed 110°F.

The range of precipitation in this region is a factor of two. Some Louisiana counties receive 51 inches annually; in the southwest about 24 inches is normal. Not only does the amount vary geographically, but the seasonal pattern varies as well. In east Texas and Louisiana, precipitation amounts peak in late spring when squall-line thunderstorms are prevalent. Summertime precipitation is mostly from shower activity and amounts vary greatly in short distances. As a consequence, in most areas, a large portion of the annual precipitation occurs within short periods of time. There are two consequences of this characteristic: floods are frequent and droughts are a recurring problem. Some Texas rivers flood nearly every year.

Droughts are "normal" in Texas. A drought period may be defined as a period of time where the actual rainfall consistently falls short of the climatologically expected moisture supply. Thus, drought is a relative rather than an absolute condition. In the middle 1950's, lack of precipitation was so widespread that 94 percent of Texas counties were classified as disaster areas. However, in most years, some portions of the area are receiving less than normal while others are receiving greater than normal precipitation.

Average wind speeds at the surface are 9-12 mph. This is above average for the nation. Directions are mostly southerly and southeasterly. The outstanding characteristic is their steadiness and persistence.

Surface-based inversions occur on about 50 percent of the winter mornings and 20-60 percent of the summer mornings. The western portion of the region has the lowest frequency of morning surface-based inversions of any inland area. However, elevated inversions are frequent. They occur 80-90 percent of the time on summer mornings. Surface-based inversions occur about 10 percent of the time on winter afternoons and rarely on summer afternoons.

4.4.1.7 Air Quality.

The air quality throughout the Texas Gulf Region is quite good for both particulate and sulfur dioxide (SO_2) in all three states (Texas, Arkansas, and Louisiana) within the region.

4.4.2 Ecological Factors

4.4.2.1 Flora.

Lignite-bearing lands of the Texas Region occur principally within the oak-hickory and oak-hickory-pine communities of the deciduous forest biome. Approximately 29 percent of the total land area is in forest. Other minor communities present within the region include mesquite-savannah in the southern extreme, blackland prairie along the southern extreme and the western border, and Fayette prairie in the southeastern portion (Kuchler, 1966).

Dominant vegetation in the forested areas include poas oak, blackjack oak, shagbard hickory, and loblally, shortleaf, and long-leaf pine. In wet areas and along streams, cypress, sweetbay, maidencane, cattails, pondweeds, alligator weed, and watermilfoil are dominant. Several species of trees and flowering plants approach or reach their limit of distribution while others, such as, black tupelo, American holly, Carolina basswood, southern magnolias, box elder, and honey locust attain their largest size in this area. Estimates of primary productivity range from approximately 7.1 tons per acre per year for oak-hickory-pine forest to about 17.8 tons per acre per year for floodplains vegetation (Rodin et al., 1972).

In the mesquite-savannah community in the southern extreme of the region, mixed shrubs and grasses are dominant. Major species found in this area include mesquite, acacin, yucca, juniper, little bluestem, grama, and an occasional oak. Blackland and Fayette prairie areas contain a mixture of grasses and forbs including little bluestem, grama, wheatgrass, needlegrass, and buffalograss. Estimates of primary productivity for these communities range between 5 and 6 tons per acre per year (Rodin et al., 1972).

4.4.2.2 Fauna.

The diversity of habitat available within the Texas Region is favorable to a wide variety of animal life. Of the 64 species of mammals within the region, typical forest and forest-edge species include white-tailed deer, fox squirrel, racoons, striped skunk, eastern spotted skunk, swamp rabbit, cottontail, mice, moles, and shrews. Mammals common to the mesquite-savannah and prairie communities include white-tailed deer, pecoary, armadillo, ringtail, and cottontail. Furbearers associated with the wetter areas of the region include beaver, muskrat, otter, mink, and introduced nutria.

Birdlife within the region is also diverse. Common gamebirds associated with the forested areas and forest-edge community include turkey and bobwhite quail. Attwaters prairie chicken and the scaled quail are potential inhabitants of the prairie and mesquite-savannah communities. Waterfowl and shorebirds associated with wetlands and aquatic situations in the region include teals, canvasback, common golden-eye, mallard, wood duck, snipe, woodcock, egrets, and herons. Songbirds and warblers include those common to the forest and open areas of the southeastern United States.

Approximately 115 species of amphibians and reptiles are found in the region including alligators, American anoles, blind snakes, rattlesnakes, mud turtles, Texas terrapins, gophers, tortoises, and Texas toads (Conant, 1975).

Approximately 107 species of fish are present in the rivers, lakes, and reservoirs of the region (Hittman Associates, Inc., 1975). In addition to various species of catfish, minnows and shiners, game fish include blackbass, crappie, spotted bass, and sunfish.

Table 4-16 presents a typical cross section of the Texas Gulf Region biomes and fauna characteristics of each. Estimates of the carrying capacities and primary productivity rates are presented in Appendix____.

4.4.2.3 <u>Protected Species.</u>

There are 12 species of animals and one plant species that have protected status as endangered species (U.S. Department of the Interior, 1977t, 1978fff). Among the endangered animals are one species of fish, two amphibians, one reptile, one mammal, and seven species of birds that occur either as permanent residents or during migration. Attwater's greater prairie chicken, the fountain darter, the Houston toad, the Texas blue salamander, and Texas Wild Rice are unique to this region. A listing of endangered species occurring within this region is given in Appendix Table____. Habitat preferences, distribution, and activities associated with mining that would pose potential threats to these species are given in Appendix Table___.

TABLE 4-16

PROFILE OF TEXAS GULF COAL REGION BIOMES

PINE	OAK - PINE	OAK - HICKORY	OAK SAVANNAH	AGRICULTURE	MARSH/SWAMP	RIVER
ENDANGERED SPECIES red-cockaded woodpecker PREDATORS coyote gray fox BIRDS cardinal mourning dove bobwhite woodcock red-cockaded woodpecker BIG GAME white-tailed deer DOMINANT VEGETATION loblolly pine shortleaf pine longleaf pine slash pine	ENDANGERED SPECIES Houston toad PREDATORS coyote gray fox BIRDS flycatchers woodpeckers warblers owls BIG GAME white-tailed deer DOMINANT VEGETATION loblolly pine blackjack oak post oak	ENDANGERED SPECIES Houston toad PREDATORS coyote gray fox BIRDS woodpeckers warblers vireo snipe woodcock wild turkey BIG GAME white-tailed deer DOMINANT VEGETATION poplar post oak blackjack oak shagbark hickory	ENDANGERED SPECIES Atwater's prairie chicken peregrine falcon bald eagle Houston toad PREDATORS coyote golden eagle red fox bobcat ringtail cat BIRDS mockingbird crow cattle egret bobwhite quail BIG GAME peccari white-tailed deer DOMINANT VEGETATION short grass juniper mesquite cactus post oak blackjack oak	ENDANGERED SPECIES Atwater's prairie chicken PREDATORS coyote red fox BIRDS mourning dove mockingbird crow cattle egret bobwhite quail BIG GAME white-tailed deer DOMINANT VEGETATION sorghum cotton pasture corn wheat oats	ENDANGERED SPECIES Mexican duck ivory-billed woodpecker whooping crane peregrine falcon bald eagle red wolf alligator Bachman's warbler Texas wild rice PREDATORS red wolf coyote mink alligator BIRDS bittern rails roseate spoonbill egrets herons BIG GAME white-tailed deer DOMINANT VEGETATION cattails sawgrass maidencane water tupelo sweetbay cypress	ENDANGERED SPECIES Mexican duck fountain darter PREDATORS mink alligator FISH largemouth bass freshwater drum bluegill crappie bullhead BIRDS gallinules geese ducks coots DOMINANT VEGETATION alligator weed watermilfoil naiads pondweed

N PINE | OAK - PINE | OAK - HICKORY | OAK SAVANNAH | AGRICULTURE | MARSH/SWAMP | RIVER S

200 miles - not to scale (for illustrative purposes only)

4.4.3 Socioeconomic Structure

Socioeconomic data for the Texas Region are presented in Tables 4-15 and 4-17.

4.4.3.1 <u>Demography.</u>

Population density in the Texas Region was 71 persons per square mile in 1975 for a total regional population of approximately 2.5 million (U.S. Department of Commerce, 1978b). Out-migration rates of 6.8 to 13.2 percent were recorded during the 1960's decade (U.S. ERDA, 1977b), but this trend reversed between 1970 and 1976 when an increase of over 108,000 persons occurred in (U.S. Department of Commerce, 1978b). There were over 560,000 students enrolled in public school in 1975 (U.S. Department of Commerce, 1977d).

4.4.3.2 <u>Economic Base and Sectorial Employment.</u>

Total employment and percentage distribution in each employment class during 1974 are presented in Table 4-17.

Approximately 138,000 workers, or about 24.2 percent of the total regional employment is in the manufactoring sector. This sector, combined with 137,000 workers in the retail trade sector and 113,800 workers in the service sector, represents over 68 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of 54,100 persons employed in the agricultural sector in the Texas Gulf region.

TABLE 4-17

TEXAS GULF COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	914	0.2
10	Mining	13,170	2.3
12	Coal Mining (Bituminous) (c)		
15	Construction	52,219	9.2
19	Manufacturing	138,003	24.2
40	Transportation/Public Utilities	29,812	5.2
50	Wholesale Trade	44,877	7.9
52	Retail Trade	137,153	24.1
60	Banking and Finance	35,114	6.2
70	Services	113,792	20.0
99	Non Classified	4,174	0.6
	TOTAL	569,228	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

The total labor force (BLS data) expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Texas Gulf region was 50.6 percent.

4.4.3.3 Agriculture.

Small scale agriculture and ranching operations comprise a major part of the land use within the region. Principal crops raised include hay, wheat, cotton, and sorghum. Yields for these crops are approximately 2.3 tons of hay, 23.3 bushels wheat, 353 pounds cotton, and 11 tons sorghum per acre (U.S. Department of Agriculture, 1978a).

Ariculture in the northeastern and central portions of the region is a combination of poultry and dairy farming along with production of cattle and calves and cotton farming. Farms tend to be small to moderate in size in the east with average size increasing to the west. The average value of farm products sold is in the $10-$49 per acre range with most counties falling into the $10-$29 range. The southwestern portion the region is in the Edwards Plateau, a deeply eroded and rocky area of low but steep hills. Here, more than 60 percent of the farmlands are in woodland pasture.

4.4.4 Cultural Resources

4.4.4.1 Archaeological Resources.

At present, only a few archaeological sites from this region are included in the National Register listings (U.S. Department of the Interior, 1978hh). The Paleoindian period is represented by the Levi Rock Shelter and the Friesenhahn Cave sites to the west of this region. The Archaic period for this area includes the Trinity cultural complex in the northern part of the region. For the period from 1000 B.C. to 500 A.D. the region is divided culturally between the Eastern Village Farmers tradition of the east and the Archaic Level Bison Hunters of the Plains, with the latter tradition represented by the Late Coastal Archaic cultural complex (U.S. Department of the Interior, 1970). The final major archaeological traditions are represented by the Atto complex in the east and the Central Texas aspect of the Plains Bison Hunters and include the Davis Site in Texas and the Gahagan Site in Louisiana.

4.4.4.2 Historical Resources.

Although several explorers traveled through this region in the 1700's and early 1800's and some missions were built, few areas were settled until the fifteen-year period following 1835 when three quarters of the region became settled and the town of San Antonio was expanded (U.S. Department of the Interior, 1970). During the next few decades, the remainder of the region was settled and several main roads were established. Approximately 150 sites or areas that illustrate various aspects of the history of this area are included in the National

Register and include houses, court houses, ranches, churches, and historic districts (W.S. Department of the Interior, 1978hh).

4.4.5 Recreational Resources

The Chisholm and Old Cattle Trails, currently proposed for the National System of Trails, are the only two areas in the Texas Region being considered for inclusion in the National Systems (U.S. Department of the Interior, 1974j).*

Fishing was the most popular recreational activity in the Texas Region (0.40 visitor-days/1,000 residents). Camping and hunting were the second and third most common forms of recreation (U.S. Department of Agriculture, 1977b).

4.5 POWDER RIVER REGION

The Powder River Region covers 31,300 square miles in the northern Great Plains portion of the United States. The area extent of the region and the 14 counties within the region are divided equally between southeastern Montana and northeastern Wyoming.

4.5.1 Physical Factors

4.5.1.1 Topography.

The Powder River Region is in the northern part of the Great Plains physiographic province. It is located between the Black Hills to the east and the Big Horn Mountains of the Rocky Mountain physiographic province to the west (U.S. Department of the Interior, 1974h; Fluor Utah, 1975b). The northwestern and

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

northern portions of the region include open high hills with local relief of 500 to 1,000 feet. This terrain grades into tablelands in the south with badlands topography occurring locally. Badlands are characteristic of elevated, arid regions where occasional heavy rains produce deep gullies between tall columns and platforms (buttes) of resistant rock. Local relief in this type of terrain ranges from 100 to 600 feet (Moore, 1968).

4.5.1.2 Geology.

Surficial deposits consist primarily of the thin stoney deposits characteristic of a semi-arid area, with recent alluvial deposits and terrace gravels in the floodplains. These alluvial deposits of sand and silt with lenses of gravel usually occur in thicknesses up to 15 feet along the major rivers of the area and 10 to 15 feet along the tributaries (Fluor Utah, 1975b). The region is situated in the Powder River Basin between two areas of uplift. The curve of the basin is asymetric; strata in the east dip gently to the west while strata on the western flank of the basin dip rather steeply to the east. Coal beds of the region are thickest in the northern portion and more persistent across the gently dipping eastern and northern sides of the basin. The coal-bearing rocks are divided into the Wasatch Formation of the upper Eocene, the Fort Union Formation of the Paleocene, and the Lance Formation of the late Cretaceous (Fluor Utah, 1975b). The Wasatch Formation contains only a few important coal seams and the Lance Formation contains little economically important coal. The Tongue River Member of the Fort Union Formation contains the principal coal deposits of the region, including some of the thickest coal seams in the United States.

Two areas within the region have been designated as natural landmarks because of significant fossil deposits (U.S. Department of the Interior, 1978x). These are the Hell Creek Fossil Area of Garfield County, Wyoming, in the far northern part of the region, and the Lance Creek Fossil Area in Niobrara County, Wyoming, on the southeastern edge of the region. Renowned specimens of the carnivorous dinosaur <u>Tyrannosaurus rex</u> were uncovered at the turn of the century in the Hell Creek Fossil area (Howard, 1975).

4.5.1.3 Minerals

Although coal is produced in several of the region's counties and is the leading mineral in three, petroleum (together with natural gas) is the primary mineral of this region. It is produced in over 85 percent of the counties and is the top commodity in approximately 60 percent of the counties (U.S. Department of the Interior, 1977f). Due to petroleum production, half of the counties have mineral production greater than $10 million, and almost 80 percent have production greater than $1 million. Other mineral products of the region include sand and gravel, crushed stone, clays, and uranium.

4.5.1.4 <u>Soils.</u>

There are two dominant classes of soils in this region. One dominant category has a texture ranging from loam and silt loam to silty clay loam. It generally has a thick black surface layer that is rich in organic matter, a transitional subsoil layer, and a layer of calcium carbonate accumulation at a depth of two to four feet. These soils are used primarily for grazing and wheat production. The other dominant soil generally consists of unconsolidated sand, silt, and glacial deposits which decrease in organic matter with depth and occur on moderately to steeply sloping areas. Alluvial soils are poorly developed and occur along the floodplains of the major streams of the area. These soils are heavily used for hay, pasture, feed grains, and sugar beets. Major soil limitations vary throughout the region but they include erosion due to wind and water, shallowness, stoniness, drought, and salinity.

4.5.1.5 Water.

Surface-water runoff is low, about one-half of one inch per year. Potential evapotranspiration over about 95 percent of the area is less than 24 in/yr, but in the Yellowstone River lowlands it rises to as much as 36 in/yr.

The major streams of the Region are the Yellowstone, Big Horn, Powder, Tongue, Belle Fourch, and Mussel Shell Rivers. The average annual streamflow of the Yellowstone River Basin, which includes most of the coal mining area, is about 11 million acre-feet, most of which is derived from snowmelt (WRC, 1975). Surface reservoirs for regulation of streamflow have a combined capacity of 2.6 million acre-feet of which 370,000 acre-feet are lost annually by direct evaporation (USGS, 1975b).

Surface-water quality is variable. The Powder River and Big Horn commonly carry concentrations of saline water in excess of 1,000 mg/1 in the headwaters of the Tongue and Yellowstone

Rivers; elsewhere, TDS levels are generally in excess of 350 mg/1.

Streams of lowest sediment load are the Tongue and its upper tributaries and the Yellowstone, ranging from a low of about 270 mg/1 to a high of 1,900 mg/1. Over the remainder of the area, the sediment load generally exceeds 1,900 mg/1.

Withdrawal of surface water for consumptive use was about 8.93 million acre-feet in 1975, but only about 2.4 million acre-feet was actually consumed. The largest use was irrigation (9.88 million acre-feet) (WRC, 1975).

The occurrence of groundwater in the region is far from uniform. In the Montana part of the Powder River region, there are large areas in which shallow wells will yield only a few gpm, but wells drilled into the bedrock aquifers such as the Hell Creek and Fox Hills Formations (Cretaceous) or the Fort Union (Paleocene) may yield in excess of 50 gpm. Many wells drilled in the Powder River and the Yellowstone River Valleys flow under artesian pressure. Serious lowering of artesian pressures sometimes necessitates the use of pumps to produce water. Much of the southern and southeastern part of the area is underlain by several thousand feet of non-productive shales.

Groundwater can be produced at a rate of up to several hundred gpm from wells in permeable valley-fills along major streams. The greatest development of these alluvial deposits is along the Yellowstone River and its tributaries.

The Madison Limestone underlies the region at considerable depths, and is currently being tested by the USGS as a potential source of water supply for the coal industry. Recent studies indicate that the water is chemically suitable but the quantity available for withdrawal is questionable.

Groundwater quality is variable. Generally, at depths greater than 500 feet, all groundwater exceeds 1,000 mg/1 TDS. The amount of groundwater withdrawn in 1975 for consumptive uses was about 124,000 acre-feet, of which approximately 34,000 acre-feet was actually consumed (WRC, 1975). The largest use was for irrigation, and the second largest use for self-supplied industries (USGS, 1975b).

Groundwater in storage is low (approximately 1.4 million acre-feet) in the near surface alluvial aquifer material. Estimated reserves from the deep Madison Limestone, however, exceed 13 million acre-feet (USGS, 1975b).

For information regarding total domestic water use and wastewater flow in this region, see Table 4-18.

4.5.1.6 Climate.

The regional climate is continental in character and semi-arid. Frontal systems from the Pacific regularly cross the area, but the moisture that originally was associated with them is generally dropped on the western slopes of the Rocky Mountains. About a dozen times per year a storm that forms in the north swings through the area bringing windy and often intensely cold weather, but rarely significant moisture. These cold waves are then frequently modified by periods of milder

TABLE 4-18

POWDER RIVER REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	238088	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	36
Population Density (sq. mi.) (b)	6	Total	292	Waste Water Flow (mgd) (c)	30
Net-Migration (1970-1976)	+19285	Education	126	Solid Waste (million Tons/yr.) (c)	0.2
School Enrollments (c,d)	54760	Highways	50	Solid Waste (acres/yr.) (c)	25
Per Capita Income (a)	4449	Police Protection Employees (c,f)	552	Hospital Beds (a)	1016
		Welfare	16	Year Round Housing Units (000) (c)	82
		Health	20	Doctors-General Practice (c)	52
		Other	80	Doctors-Total Patient Care (a)	257

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates

(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

weather created by "chinook" winds. These winds, warm and dry, frequently reach 25-50 mph and may persist for several days. Spring and summer see some moisture from the upslope flow of a few storms that form to the southeast of the area, and from periods of shower activity as moisture enters the area from the southeast in conjunction with a system from the Pacific. However, the area is generally considered dry.

The average annual temperature varies little throughout the area, with most points averaging 44-46°F. Maximum temperatures occur in July when 100°F temperatures are most frequently experienced. The arctic outbreaks in winter bring extreme cold in January and February, with record lows in many areas of -50°F.

Precipitation averages 13-16 inches with at least half of it occurring during late spring and early summer, at the start of the growing season. Flooding, despite the area's aridity, is common in the spring when rapid snow melt and run-off occurs. Overall, the climate is so dry that, with the moderate temperatures, lowlow humidities and generally sunny conditions, evaporation exceeds annual precipitation by factors of 3-4. Thus, the region is always susceptible to drought.

The region is windy, with average speeds of 10-13 mph. The prevailing direction is westerly, but directions near terrain features may vary considerably.

Surface-based inversions occur on 75-85 percent of the mornings, summer and winter; and on winter afternoons, surface-based inversions occur about 35 percent of the time.

Stable conditions are prevalent in spite of generally windy conditions, and these circumstances contribute to the high summertime afternoon mixing heights. On balance, the climate is conducive to rapid dispersion with a few qualifications. However, the aridness and high average wind speed indicate potential fugitive dust problems. The frequency of chinooks, the dry, strong, persistent lee-side winds, aggravate this situation.

4.5.1.7 Air Quality.

Air quality in the Powder River Region is generally good for both particulate and sulfur dioxide (SO_2). Some variations do exist around populated areas but even more so in areas where coal strip mining is presently taking place.

In Montana, the particulate air quality is very good in most counties in this region. Exceptions to this are the Colstrip area in Rosebud County and the Billings area in Yellowstone County. The Colstrip area, where surface mining is taking place, is not meeting the primary standard for particulates. The Billings area is not meeting the secondary particulate standard. Sulfur dioxide air quality in the Powder River Region of Montana is better than the national standard.

Particulate air quality in the counties in Wyoming is better than the national standards while values of 31 $\mu g/m^3$ and 13 $\mu g/m^3$ have been reported by Converse and Weston Counties. However, in areas where substantial coal surface mining is taking place (such as Campbell and Converse Counties), the air quality in the immediate area of the mine site may not be as good. None of the counties exceed the national standard for SO_2.

4.5.2 Ecological Factors

4.5.2.1 Flora.

The Powder River Region is on the western extreme of the short grass or plains grassland biome. Although both coniferous and deciduous woodlands occur locally, the vegetation principally consists of low growing shrubs and grasses adapted to the semi-arid conditions of the region. Eight percent of the total land area of the region is in forest.

Depending upon specific site conditions, characteristic grassland species include western wheatgrass, northern needlegrass, needle-and-thread grass, blue grama, and hairey grama. In well drained areas and on uplands, shrubs such as silver sagebrush, big sagebrish, fringed sage, and soapweed are dominant. Grasses associated with these areas include grama, needlegrass, and wheatgrass and others such as sandberg bluegrass, junegrass, and indian rice-grass.

Under saline or alkaline soil conditions, shrub communities of greasewood or saltbush-greasewood are prevalent. These communities typically occur along stream channels and on floodplains periodically receiving overflow or runoff. Other shrubs and understory vegetation associated with this community include rubber rabbitbrush, inland saltgrass, fourwing and gardner saltbush, winterfat, alkali sacaton, and Nutall alkaligrass (U.S. EPA 1974e). Saltbush-greasewood communities are more prevalent on well-drained upland alkaline and saline soils. The associated vegetation is similar in composition to the greasewood dominated community, except for the absence of species that require a high soil moisture content (e.g. Nutall alkaligrass).

Coniferous forests, dominated by Ponderosa pine, are associated principally with drier upland areas and ridges where sandstone, shale, and clinker outcrops occur. Common understory species include skunkbush sumac, creeping juniper, and western snowberry, and grasses such as needlegrass, prairie junegrass, and stonehills muhly. More open stands of pine have silver sagebrush, needlegrass, and side-oats grama as major understory species.

Deciduous forests are typically associated with the floodplains of perrennial streams. The principal species is plains cottonwood, but these forests may also include lanceleaf cottonwood, sandbar willow, coyote willow, peach-leafed willow and box elder. Understory vegetation is complex and diverse and includes snowberry, wild rose, silver sagebrush, silverberry, and numerous forbs and grasses.

Primary productivity estimates for these natural communities range from approximately 1.8 tons per acre per year for sagebrush steppe to about 8.0 tons per acre per year for the coniferous forest. Depending upon specific site conditions, amount and extent of area disturbed, and upon the sereal stage that the area is to recover to, natural recovery may occur within a few years for grassland, or may take up to 50-80 years for forest.

4.5.2.2 Fauna.

Wildlife habitats within the Powder River Region are provided by grasslands, shrubs, forests, streams and lakes, and econtones or edged between these habitats. Depending upon the species, some populations may utilize only one habitat type while others may range over several different habitat types to meet all life requirements.

Grasslands and shrub communities support a variety of grazing, burrowing, and swift running mammals, ground nesting birds, reptiles, and some amphibians. Species utilizing seeds, foliage, or roots of annual and perennial grasses of the open areas include ground suirrels, pocket gopher, black-tailed prairie dog, prairie vole, western harvest mouse, mourning dove, savannah sparrow, horned lark, vesper sparrow, longspur, and Hungarian partridge. Sagebrush and other shrub communities, and mixed shrub-grassland communities provide food and cover for game animals such as pronghorn antelope, mule deer, white-tailed deer, sage grouse, sharptail grouse, cottontail rabbit, and white-tailed jackrabbit. Important non-game species include sagebrush vole, least chipmunk, sage sparrow, lark sparrow, dickcissel, and sagebrush lizard. Sagebrush is especially important to the pronghorn antelope and sagebrush grouse as critical winter habitat, providing up to 85-100 percent of their winter diet.

Deciduous forest and other vegetation typically associated with waterbodies of the region provide food, cover, nesting, or breeding sites for raccoon, mink, striped skunk, beaver, muskrat, long-tailed vole, catbird, robin, yellowthroat, black-billed magpie, garter snakes, western hognose snakes, and eastern yellow-bellied racer. Open upland pine forest and juniper breaks support elk, bushytail wood rat, porcupine, pinon jay, white-winged junco, cassins kingbird, and pygmy nuthatch.

Predators typically range over a variety of habitats depending upon the availability of prey species. Principal predators of the region include coyote, red and gray fox, bobcat, long-tailed weasel, black-footed ferret, badger, milksnake, bullsnake, and prairie rattlesnake. Among the predatory birds are great horned owl, burrowing owl, long-eared and short-eared owl, Cooper's hawk, red-tailed hawk, Swainson's hawk, marsh hawk, prairie falcon, and bald and golden eagles.

Animal life in the region, which exhibits a high to total dependence upon stream, lake, or marsh communities for existence, include snapping turtles, yellow mud turtles, bull frogs, fish and waterfowl. Naturally occurring fish include nongame species such as flathead chub, goldeye, plains minnow, carp, carp sucker, longnose, and mountain sucker. Stocked species include largemouth bass, walleye, pike, bullheads, and channel cat (U.S. EPA, 1974e). Stockponds, reservoirs, and rivers are important to waterfowl such as mallards, American widgin, green wing teal, goldeye, mergansers, and Canada geese. About half of the ducks utilizing this area for breeding are mallards and American widgin. Other birds associated with water include great blue heron, gulls, coots, snipes, upland sand piper, and lesser yellowlegs.

Table 4-19 presents a typical cross section of the Powder River Region biomes and fauna characteristic of each. Estimates of the wildlife carrying capacities and primary productivity rates are presented in Appendix ___.

4.5.2.3 Protected Species.

There are six species of animals occurring within the Powder River Region that have protected status as endangered or threatened species. A listing of these species and their occurrence within the region is given in Appendix Table ___; additional information on distribution and habitats is given in Appendix Table ___.

4.5.3 Socioeconomic Structure

Socioeconomic data for the Powder River Region are presented in Tables 4-18 and 4-20.

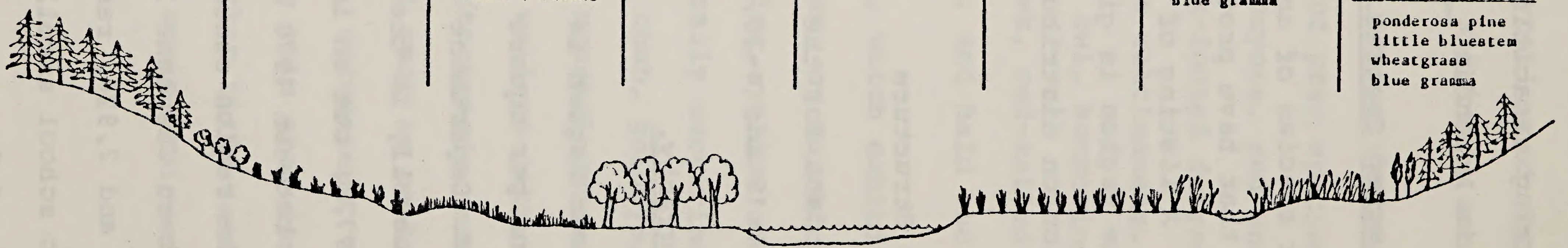
4.5.3.1 Demography.

The Powder River Region is very sparsely populated with a density of six persons per square mile; the regional population is about 238,000 (U.S. Department of Commerce, 1978b). Out-migration was generally in the 15-25 percent range in the 1960's (U.S. ERDA, 1977b) but an in-migration of over 19,000 persons was recorded between 1970 and 1976 (U.S. Department of Commerce, 1978b). The region contains the Crow Indian Reservation and Northern Cheyenne Indian Reservation with populations of 4,334 and 2,926, respectively, in 1973 (U.S. ERDA, 1977b). Public school enrollments totaled over 54,000 in 1975 (U.S. Department of Commerce, 1977d).

TABLE 4-19

PROFILE OF POWDER RIVER COAL REGION

PONDEROSA PINE	SAGEBRUSH	SHORTGRASS	BOTTOMLAND	RIVER	AGRICULTURE	MARSH	BLACK HILLS
ENDANGERED SPECIES peregrine falcon Northern Rocky Mt. wolf **PREDATORS** coyote bobcat mountain lion **BIRDS** rose-breasted grosbeak warblers red-headed woodpecker yellow-bellied sapsucker ruffed grouse **BIG GAME** mule deer **DOMINANT VEGETATION** ponderosa pine pinyon-juniper	**ENDANGERED SPECIES** peregrine falcon **PREDATORS** swift fox coyote eagles **BIRDS** mountain plover killdeer golden eagle bald eagle sage grouse sharptail grouse **BIG GAME** mule deer antelope **DOMINANT VEGETATION** greasewood bunch grasses pinyon-juniper sagebrush leadplant	**ENDANGERED SPECIES** peregrine falcon black-footed ferret **PREDATORS** swift fox coyote eagles **BIRDS** killdeer meadowlark horned lark golden eagle sage grouse greater prairie chicken **BIG GAME** mule deer **DOMINANT VEGETATION** needlegrass wheatgrass blue gramma June grass needle & thread	**PREDATORS** coyote raccoon bobcat **BIRDS** yellow-billed cuckoo greated horned owl golden eagle bald eagle **BIG GAME** mule deer white-tailed deer **VEGETATION** chokecherry mallow cottonwood willow	**ENDANGERED SPECIES** bald eagle **PREDATORS** raccoon mink **BIRDS** bald eagle pintail mallard mergansers Canada goose swans **FISH** brown trout walleye sauger black bullhead channel catfish	**PREDATORS** eagles raccoon coyote **BIRDS** meadowlark magpie crow pheasant **BIG GAME** mule deer white-tailed deer **CROPS** pasture sugarbeets wheat barley	**ENDANGERED SPECIES** peregrine falcon whooping crane **PREDATORS** coyote eagle raccoon mink **BIRDS** great blue heron bald eagle marsh hawk pintail green-wing teal mallard **BIG GAME** moose mule deer white-tailed deer **VEGETATION** cattail sedges blue gramma	**ENDANGERED SPECIES** peregrine falcon black-footed ferret **PREDATORS** coyote bobcat mountain lion **BIRDS** chukar partridge golden eagle great-horned owl pheasant sage grouse sharptail grouse ruffed grouse **BIG GAME** elk mountain goat antelope buffalo bighorn sheep mule deer **DOMINANT VEGETATION** ponderosa pine little bluestem wheatgrass blue gramma



PONDEROSA PINE | SAGEBRUSH | SHORTGRASS | BOTTOMLAND | RIVER | AGRICULTURE | MARSH | BLACK HILLS

200 miles - not to scale (for illustrative purposes only)

TABLE 4-20

POWDER RIVER COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total(b)
07	Agriculture Services	107	0.2
10	Mining	4,460	7.6
12	Coal Mining (Bituminous)[3]	199	
15	Construction	5,061	8.6
19	Manufacturing	5,961	10.1
40	Transportation/Public Utilities	4,309	7.3
50	Wholesale Trade	6,524	11.0
52	Retail Trade	16,006	27.1
60	Banking and Finance	2,980	5.0
70	Services	13,070	22.1
99	Non Classified	564	1.0
	TOTAL	59,042	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

4.5.3.2 Economic Base and Sectorial Employment

Total employment and percentage distribution in each employment class during 1974 is presented in Table 4-20.

Approximately 16,000 workers, or about 27.1 percent of the total regional employment is in the retail trade sector. This sector, combined with the service sector (13,000 workers) and the wholesale trade sector (6,500 workers), represents 43 percent of the total employment within the region. The 1974 Census of Agriculture indicates a total of 7,200 persons employed in the agricultural sector in the Powder River Region.

The total labor force (BLS data) expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Powder River Region was 39 percent.

4.5.3.3 Agriculture.

Agriculture in the region is quite homogeneous. Farms tend to be very large throughout, averaging over 2,000 acres, and typically are livestock farms. In all but one county in the region, over 50 percent of the farms have sales of over $10,000. In the Wyoming portion of the region, cropland is less than 5 percent of the land area, while in the Montana portion, cropland represents 5-15 percent of the land area. Generally, a large percentage of the harvested cropland is irrigated although extreme variations exist among counties. Pastureland represents over 75 percent of the farmland in every county in the region.

Throughout the region, the value of farm products per acre of farmland is less than $10. Estimates of yields per acre for principal crops are 1.7 tons hay, 26 bushels wheat, 43 bushels oats, and 19.5 tons sugarbeets (U.S.D.A. 1977).

4.5.4 Cultural Resources

4.5.4.1 Archaeological Resources.

Although not well documented within this region, the Paleoindian big game hunting tradition of the pre-8000 B.C. period can be characterized by sites such as Brewster and Hell Gap immediately to the east and southeast of the region. The Hell Gap site in Niobrara County, Wyoming produced evidence of several occupation levels back to approximately 9000 B.C. This region is in the transition area from the Eastern Archaic to the western Dester Culture, occupied in the pre-1000 B. C. period by the Middle Prehistoric cultural complex. The final cultural development produced the Plains Bison Hunter complex that was ancestral to the tribal groups encountered by early European explorers (U.S. Department of the Interior, 1970).

4.5.4.2 Historical Resources.

This region's historical associations basically began with the Louisiana Purchase of 1803 and the subsequent explorations by Lewis and Clark (1804-1806) which opened the area to fur traders (U.S. Department of the Interior, 1970). Development intensified during the period 1850 to 1890 when a small area along the Yellowstone became settled and the Northern Pacific Railroad traversed the area along the Yellowstone Valley. The 30 sites presently on the National Register illustrate various features of these historical periods and include houses, churches, and several Army forts and battle sites such as Fort Phil Kearny and the Custer Battlefield (U.S. Department of the Interior, 1978hh).

4.5.5 Recreational Resources

The Powder River Region includes all of the Lake Mason National Wildlife Refuge and approximately 40 percent of the 855,407 acre Charles M. Russell National Wildlife Refuge (U.S. Department of the Interior, 1977i). These areas are utilized by a variety of wildlife including sharp-tailed and sage grouse, ducks, deer, bighorn sheep, and elk. The Mormon and Lewis and Clark Trails, proposed for the National System of Trails, run through this region. The major section of the Custer National Forest is located in this area. This National Forest is unique in that it is the only one specifically declared exempt from surface mining by SMCRA.*

Camping (31.2 visitor-days/1,000 residents) was the most popular recreational activity in the Powder River Region. Fishing (several varieties of trout) and hunting (deer, moose, antelope) were the second and third most popular activities (11.5 and 10.9 visitor-days/1,000 population, respectively). Other popular activities are boating, swimming, hiking, and horseback riding (U.S. Department of Agriculture, 1977b).

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

4.6 GREEN RIVER-HAMS FORK REGION

This region is composed of two contiguous coal regions, the Green River and the Hams Fork, with the Green River Section occupying the eastern 75 percent of this study area. The region covers 37,500 square miles of Wyoming and Colorado, and small portions of Utah and Idaho, with 21 counties divided among these four states.

4.6.1 Physical Features

4.6.1.1 Topograhpy.

The Green River-Hams Fork Region consists of two physiographic provinces. The Hams Fork portion located in the western third of the region is part of the Middle Rocky Mountains province. The remainder is part of the Wyoming Basin province (U.S. Department of the Interior 1974h). The Middle Rocky Mountains province is characterized by complex mountains with many intermountain basins and plains. The area is basically a series of parallel mountain ranges and valleys. The Wyoming Basin province contains elevated plains and plateaus on sedimentary strata, with the plateaus cut in places by deep box canyons. The plateau surface has an altitude of 6,500 to 7,000 feet above sea level. Because of the semi-arid nature of this basin, common features include alkali flats, wind-produced hollows, sand and silt dunes, and badlands topography. Local relief may be as much as 2,000 feet but is more commonly less than 1,000 feet.

4.6.1.2 Geology.

The Hams Fork section is part of the geologically complex Wyoming overthrust area, a zone of thrusts faults and folded rocks that form the area's mountain ranges and valleys. This section of the region contains four coal-bearing formations: The Bear River, Frontier, and Adaville Formations of the Late-Cretaceous and the Evanston Formation of the Paleocene. The Frontier Formation is the principal coal unit. The various formations in the Green River portion are horizontal or nearly horizontal with gentle dips toward the central part of the basin. Some bed tilting and faulting occurs along the flanks of the basin. Coal-bearing rocks of this area include the Mesaverde and Lance Formations of the Late-Cretaceous, the Fort Union Formation of the Paleocene, and the Wasatch Formation of the Eocene.

The Como Bluff Fossil Area is located near the northeastern flank of the region, on the boundary line between Carbon and Albany Counties Wyoming (U.S. Department of the Interior, 1978x). This designated natural landmark is the site of the famous "Dinosaur Graveyard", where paleontological excavations since the 1870's have uncovered a great number of dinosaurs of various types (Murray, 1967; Howard, 1975). The Kemmerer area of Lincoln County, Wyoming, in the famous Petrified Fish Cut, was discovered when the Union Pacific Railroad cut through the shale hills west of Green River in the late 1860's (Murray, 1967). Middle Eocene fish fossils from this area are in museum collections throughout the world.

4.6.1.3 Minerals.

Coal is presently produced in several counties in this region, but it is the leading mineral commodity in only three counties (U.S. Department of the Interior, 1977f). Approximately two-thirds of the counties had mineral production valued at greater than $1 million, and one-third had production greater than $10 million. For those counties with mineral productions greater than $1 million, no single commodity was dominant in any great percentage of the counties. Other important commodities include coal, petroleum, phosphate rock, stone, cement, vanadium, and trona (sodium carbonate).

Sweetwater County, Wyoming, is the nation's principal source of sodium carbonate with three mines having an output of almost eight million tons. A wide variety of other mineral commodities are produced in this region, including sand and gravel, crushed stone, fluorspar, lime, pumice, clay, uranium, and iron.

4.6.1.4 Soils.

The most common soils throughout this region have a sandy loam, loam, or silty loam surface texture and a calcium carbonate accumulation at depths usually greater than four feet (Fluor Utah, 1975b). Permeability is moderate to low and, due to climatic conditions, these soils are seldom moist for three consecutive months. The soils are used mainly for range and for some irrigated crops (U.S. Department of the Interior, 1968). Shallow, poorly developed soils that are mainly rock fragments occur along the mountains of the region. Dominant soil limitations of the region are shallowness, erosion, stoniness, drought, and salinity.

4.6.1.5 Water.

Runoff from most of the area is about one inch a year, and large areas of the Red Desert produce almost no runoff.

The Green and Yampa are the largest streams in the region that flow into the Colorado River drainage. The North Platte is the largest stream in the coal basin of the Continental Divide. Average annual stream flow in the Green River Basin is 5.26 million acre-feet (WRC, 1975). The area included in this basin includes parts of the Uinta Coal Region.

Fontenelle and Flaming Gorge reservoirs are the largest in the region, but as in other parts of the arid or semi-arid west, such stored water is needed to satisfy current water rights. Total storage in the reservoirs of the region is about 4.3 million acre-feet (USGS, 1975b).

Surface-water quality is good in the higher tributaries, but, over most of the area, dissolved solids exceed 350 mg/1. During periods of high flow, the streams carry very heavy loads of sediment, sometimes exceeding 15,000 mg/1. Over most of the region, the sediment load at average rates of flow generally exceeds 1,900 mg/1. Highest sediment loads of the region occur in the Green River and its major tributaries; on the other extreme, the North Platte and its tributaries carry the lowest sediment concentrations, commonly less than 270 mg/1, but their flow rates are much lower than those of the Green River.

The amount of surface water withdrawn for use in the Green River Basin is approximately 2.5 million acre-feet per year of which about 1.1 million acre-feet is consumptively used. Irrigation is the largest use of the water (USGS, 1975b).

Groundwater quality is poor. As a result of natural groundwater quality problems, the resource is generally undeveloped. The best well-water supplies can be obtained in the valley fill deposits along the principal streams. However, if these were developed fully, that part of the base flow of the streams that is derived from these aquifers would tend to be depleted.

Information of total domestic water use and wastewater flow can be found in Table 4-21.

4.6.1.6 Climate.

The region is south of the preferred path of the storms from the Pacific Ocean that move across the Rocky Mountain area. The fronts that affect the area deposit most of this moisture on mountains further west and on the higher mountains that surround the region. In this high, dry area, radiation exchange is intense. The climate of the area is therefore primarily continental, although the air over it most of the time is of Pacific origin. The high radiation rates foster a high frequency of stagnation and inversion incidences. It ties with the Willamette Valley region as to the highest frequency of winter stagnations.

TABLE 4-21

GREEN RIVER-HAMS FORK REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	278943	General Expenditus (million dollors) (c,e)		Domestic Water Use (mgd) (c)	58
Population density (sq. mi.) (b)	7	Total	309	Waste Water Flow (mgd) (c)	35
Net-Migration (1970-1976) (b)	+33740	Education	139	Solid Waste (million tons/year (b)	0.3
School Enrollments (c,d)	66946	Highways	44	Solid Waste (acres/year) (c)	29
Per Capita Income (b)	4402	Police Protection Employees (c,1)	667	Hospital Beds (b)	1095
		Welfare	21	Year Round Housing Units (000) (c)	90
		Health	23	Doctors-General Practice (a)	84
		Other	82	Doctors-Total Patient Care (a)	208

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates

(d) Public Elementary and Secondary
(e) Direct State and Local Governments
(1) State and Local Full Time Equivalent

Sources: See Table 4-1

The average annual temperature varies from 37°F to 46°F. The variations are due mostly to differences of elevation and exposure. The coldest temperature recorded in Wyoming occurred in Teton County on the northern periphery of the region (-63°F).

The basin floor is arid. Average annual precipitation is 8-10 inches. In some areas in the foothills of the mountains, 12-15 inches occur and in the mountains themselves, 17-25 inches are received. There is a summer maxiumum on the basin floor. In the mountains the monthly precipitation amounts are more evenly distributed. The amount received from the winter snows about equals that received from summer showers. General flooding potential is not a threat. Most of it occurs as localized flash floods from intense rainfall during summer thunderstorms. Some areas in the Wasatch Range have an average of three flash floods per year. The evaporation potential far exceeds the total precipitation usually received.

Wind characteristics of the low level flow in this area of rough terrain, and intense frequent inversions are determined to a large extent by the mountain-valley circulations. The frequency of calms is high. In some areas the daily and seasonal wind direction and speed are very consistent with time. Since directions change regularly, winds tend to be less persistent in direction than in many other portions of the U.S.

The region has surface-based inversions on 85 percent of the mornings, summer and winter. They tend to be intense, but not particularly deep. Wind speed in the inversions is very low compared to most parts of the country, only 10 percent of the inversions are accompanied by wind speeds aloft greater than 5 mps. Stagnations are frequent. During a 5-year period, the region experienced 20-40 2-day episodes with mixing heights 500 meters or less and wind speeds 4 mps or less. On eight occasions, and for a total of 59 days, each of the episodes lasted five days or more.

4.6.1.7 Air Quality.

Regional air quality is, for the most part, very good for both particulate and sulfur dioxide in parts of all four states (Colorado, Wyoming, Idaho and Utah) in the region.

In the northwest area of Colorado, particulate air quality is better than the national primary and secondary standards. The only exception to this is the designated area and city limits of Craig, Colorado, in Moffat County, where the primary particulate standard is not being met. Without exception, the entire area of interest in Colorado has sulfur dioxide air quality better than the national standard.

Particulate air quality in the Wyoming counties contained in the Green River-Hams Fork Region is very good. The Trona industrial area in Sweetwater County is the only area not meeting the primary particulate standard. Sulfur dioxide air quality in Wyoming is better than the national standard.

The counties of concern in Idaho are all contained in the Eastern Idaho Intrastate Air Quality Control Region (AQCR). Particulate air quality in all counties of concern is better than the national standard except for the city of Soda Springs in Carabou County which is not meeting the primary standard.

Sulfur dioxide air quality in all counties is better than the national standard.

In the Utah counties contained in the Green River-Hams Fork Region, all have particulate and sulfur dioxide air quality which is better than the national standard.

4.6.2 Ecological Factors

4.6.2.1 Flora.

The Green River-Hams Fork Region is part of the cold desert biome, and is comprised primarily of sagebrush or salt-bush-greasewood dominated communities (Shelford, 1963). Other communities of local importance include mountain shrub, evergreen and broadleaf forest, and barren areas. Approximately 24 percent of the total regional land area is in forest.

The sagebrush community is composed of a mixture of low-growing shrubs dominated by sagebrushes with a variable understory of perennial grasses and forbs (U.S. Department of Interior, 1978d). Principal species are big sagebrush and black sagebrush. Understory vegetation includes bluebunch wheatgrass, thick weatgrass, indian ricegrass, prairie junegrass, wheatgrass biome, lupines, rabbitbrushes, broom snakeweed, and goldenweeds.

Where the salt content of the soil is relatively high, sage-brush dominated communities are replaced by saltbush-greasewood associations. Dominant species are Nuttal saltbush, shadscale saltbush, fourwing saltbush, and black greasewood. Associated understory includes Alkali sacaton, bottlebrush, squirreltail and thickspike wheatgrass in addition to many of the same understory species of the sagebrush community.

Shrub communities of the higher elevation are dominated by serviceberry-snowberry-mahogany associations with understories that include thickspike wheatgrass, prairie junegrass, bluegrasses, western yarrow, asters, and milkvetche (U.S. Department of Interior, 1978d). On well drained, poorly-developed, shallow, gravelly soils, shrub woodlands dominated by rocky mountain and utah juniper predominate. Associated species include big sagebrush, low sagebrush, rabbitbrushes, mountain mahogany, prickly pear, and a variety of grasses, phloxes and goldenweeds (U.S. Department of Interior, 1978d).

Depending upon slope, aspect, and elevation, forested mountain areas may contain associations of pinyon-juniper, spruce-douglas fir, ponderosa pine-lodgepole, or mixed evergreen-aspen. Understory species include snowberries, blueberries, mountain mahogany, pine reedgrass, lupines, mountain biome, and various grasses.

Broadleaf forest, consisting principally of willow and occasionally cottonwood, with grass understoreis are limited primarily to floodplains along perennial streams.

Barren areas associated with rock outcrops have a limited vegetative cover provided by mountain mahogany, serviceberry, wild buckwheats, big sagebrush, saltbushes, and prairie junegrasses.

Estimates of primary productivities for the major natural communities of the region range from about 1.8 tons per acre per year for sagebrush to approximately 5.4 tons per year for forested areas (Rodin et al, 1972).

4.6.2.2 Fauna.

The 63 species of mammals found in the Green River-Hams Fork Region include big game such as elk, mule deer, pronghorn antelope, moose, and Rocky Mountain bighorn sheep, and small game and non-game species such as whitetail jackrabbit, red squirrel, whitetailed prairie dog, longtail weasel, badger, coyote, and red fox.

Sagebrush dominated communities are important for providing food, shelter, habitat, and winter range for a number of the indigenous fauna. As much as 20 percent of the world's pronghorn antelope population and a major portion of the world's sage grouse population may be found within the sagebrush-grassland areas of this region (U.S. Department of Interior, 1978d). These areas also provide critical winter habitat for Wyoming's sands elk herd and mule deer, particularily in the northern part of the region.

Some boreal coniferous animals are found in the montane conferous forests of the region. The Shiras moose occurs in the conifer-aspen forest and along the willow-dominated river bottoms. Rocky Mountain bighorn sheep prefer higher elevations where the coniferous forests are broken by alpine openings. Other typical species of these areas include Canada lynx, snowshoe rabbit, red squirrel, porcupine, black bear, ruffed grouse, deer mouse, goshawk, and great horned owl.

The woodland-bushland communities (i.e., juniper, pinyon-juniper, and mountain mahogany-oak), attract species from the adjacent montane coniferous forest, and, since these areas are sometimes interspersed with grasses and shrubs, grassland or desert species may also penetrate into this community. Mule deer, mountain lion, and coyote commonly occur in the woodlands during the fall, winter, and spring, and range into adjacent habitats during summer. Rocky hillsides and cliffs within the woodland-bushland community provide habitat for bobcat, rock squirrel, cliff chipmunk, desert and bushytailed woodrats, and pinyon mouse.

Common birds of the woodland area include pinyon and scrub jay and bandtailed pigeon. Rattlesnakes, lizards, and horned toads may invade from adjacent desert areas, but are not particularly characteristic of woodland communities (U.S. Department of Interior, 1978).

A number of game and non-game fish species occur in the region's waterways. Principal game fish native to the region, include mountain whitefish, rainbow trout, and brown trout (U.S. Department of Interior, 1978d). Fish introduced into lakes of the region include walleye, pike, largemouth and smallmouth bass, and crappie. Non-game species common to the region include speckled dace, mountain sucker, Utah chub, sculpin, rednose, shiner, and longnose dace.

Pond-marsh biotic communities are limited in extent, but have local significance. The most widespread type of aquatic or semi-aquatic situation is provided by beaver ponds which are numerous on small streams throughout the province. These wet areas provide habitat for waterfowl, including mallards, pintails, teal, Barrow's goldeneye, and Great Basin Canada goose; predatory birds, such as marsh hawks, bald eagles, and osprey; and a variety of frogs, salamanders, and reptiles.

A typical cross section of the Green River-Hams Fork Region biomes and fauna characteristic of each is presented in Table 4-22. Estimates of the carrying capacities and primary productivity rates from the various ecosystems of the region are given in Appendix ___.

4.6.2.3 Protected Species.

In the Green River-Hams Fork Region, four species of fish, three species of birds, and three species of mammals are presently on the official endangered species list (U.S. Department of Interior, 1977). One of the fish species, the Kendal Warm Springs dace, is unique to the region and has been reported only from a warm spring-fed tributary to the Green River in Bridger National Forest, Wyoming (U.S. Department of Interior, 1975d). A listing of Federally protected species occurring within this region is presented in Appendix Table ___. Habitat preferences, known distributions, and activities associated with coal mining that would potentially pose a threat to these species are given in Table ___.

TABLE 4-22

PROFILE OF GREEN RIVER COAL REGION BIOMES

W RIVER	DESERT SHRUB	PINYON-JUNIPER	AGRICULTURAL/GRAZING	MOUNTAIN	SHORTGRASS E
ENDANGERED SPECIES Kendal warm springs dace greenback cutthroat trout Colorado squawfish humpback thub bald eagle	ENDANGERED SPECIES peregrine falcon Utah prairie dog	ENDANGERED SPECIES peregrine falcon	ENDANGERED SPECIES peregrine falcon Utah prairie dog	ENDANGERED SPECIES peregrine falcon Rocky Mountain wolf	ENDANGERED SPECIES peregrine falcon black-footed ferret Utah prairie dog
PREDATORS raccoon mink eagles	PREDATORS coyote fox	PREDATORS cougar fox bobcat mink	PREDATORS raccoon coyote golden eagle	PREDATORS cougar fox mink bobcat	PREDATORS red fox coyote golden eagle
FISH cutthroat trout rainbow trout brown trout pike	BIRDS sage grouse sharptail grouse	BIRDS sharptail grouse pheasant blue grouse	BIRDS pheasant sharptail grouse	BIRDS blue grouse	BIRDS sharptail grouse sage grouse
	BIG GAME mule deer antelope	VEGETATION pinyon pine juniper fir barberry	BIG GAME mule deer	BIG GAME mule deer moose bighorn sheep elf	BIG GAME buffalo antelope mule deer
	VEGETATION sagebrush blue gramma wheatgrass		VEGETATION pasture sugarbeets wheat	VEGETATION douglas fir ponderosa pine lodgepole pine spruce aspen	VEGETATION needlegrass wheatgrass blue gramma June grass needle & thread

200 miles - not to scale (for illustrative purposes only)

4.6.3 Socioeconomic Structure

Socioeconomic data for the Green River-Hams Fork Region are presented in Tables 4-21 amd 4-23.

4.6.3.1 Demography.

Counties in the Green River-Hams Fork Region are characterized by sparse population densities of about 7 persons per square mile (U.S. Department of Commerce, 1978b). Total population in the region is 279,000. The 1960 decade recorded high rates of out-migration ranging from 8.0 to 34.2 percent. This trend reversed, however, between 1970 and 1976 when over 33,000 persons migrated in (U.S. Department of Commerce, 1978b). Public school enrollments totaled approximately 67,000 students in 1975 (U.S. Department of Commerce, 1977d).

4.6.3.2 Economic Base and Sectorial Employment.

Total employment and percentage distribution in each employment class during 1974 is presented in Table 4-23.

Approximately 16,400 workers, or about 27.3 percent of the total regional employment is in the retail trade sector. This sector, when combined with 13,100 workers in the service sector and 8,300 workers in the manufacturing sector, represents over 63 percent of the total employment within the region. The 1974 Census of Agriculture indicates a total of 8,000 persons employed in the agricultural sector in the Green River-Hams Fork Region.

TABLE 4-23

GREEN RIVER-HAMS FORK COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	0	0
10	Mining	5,585	9.3
12	Coal Mining (Bituminous) [3]	588	
15	Construction	4,921	8.2
19	Manufacturing	8,335	13.9
40	Transportation/Public Utilities	3,339	5.6
50	Wholesale Trade	4,788	8.0
52	Retail Trade	16,439	27.3
60	Banking and Finance	2,861	4.8
70	Services	13,130	21.8
99	Non Classified	747	1.2
	TOTAL	60,145	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

The total labor force (BLS data) expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Green River-Hams Fork region was 47.5 percent.

4.6.3.3 Agriculture.

Agriculture in this region is limited by rainfall, which varies between 6 and 18 inches per year with 6 to 10 inches being the prevailing moisture level. In the southwestern Wyoming portion of the region, farmland is only 10-29 percent of the land area; in other areas it is higher (Colorado, 30-50 percent; South Central Wyoming, 50-70 percent). Principal crops grown in the region are corn, hay, wheat, oats, and sugarbeets. Estimates or per acre yields for these crops are 96 bushels corn, 2.2 tons hay, 23 bushels wheat, 42 bushels oats, and 18.4 ton sugarbeets per year (USDA, 1978a). Cattle ranching is the leading agricultural activity with sheep ranching also very important, especially in southern Wyoming.

Farms having sales of over $2,500 tend to be very large, averaging over 2,000 acres in all counties. Irrigated land, as a percent of farmland, varies greatly from county to county, from a high of 20-30 percent to a low of 1-4 percent. Irrigated cropland harvested as a percent of all cropland harvested is greater than 75 percent except for the area of northwestern Colorado where there is less irrigated land. The average value of farm products sold is less than $10 per acre of farmland in most areas but is $10-$29 per acre along the western boundary of the region and in the central Colorado portion of the region.

4.6.4 Cultural Resources

4.6.4.1 Archaeological Resources.

The earliest cultural traditions of this region are divided between the big-game hunting of the eastern half of the region and the gathering-hunting activities of the Desert Archaic tradition to the west (U.S. Department of the Interior, 1970). During later periods, the entire region was under the cultural influence of the Desert Culture. This culture persisted with little basic change throughout most of the region up to the historic period. Danger Cave (in Tooele County, Wyoming, to the west of the region) represents a good example of cultural persistence in this region. The cave was first occupied by Desert Culture hunter-gathers about 9,000 B.C., and by 4,000 B.C. articles such as rattles, gaming sticks, and clay effigies were being produced which would remain similar in style into the historic period (Snow, 1976).

4.6.4.2 Historical Resources.

Although some fur traders of the early 1800's passed through the northern part of this region, it was not until 1820-1835 that this area was extensively travelled (U.S. Department of the Interior, 1970). This was the era of the American fur traders, the mountain men who opended up the area of the central Rockies. Foremost of this group was Jedediah Smith who, in 1824, rediscovered the South Pass through the Rockies which was later used by the thousands of immigrants heading for Oregon and California. By 1835 the Oregon Trail was well established and the reconnaissance work of Fre'mont and other Army explorers helped to map the land west of the South Pass. By 1890, about one fourth of the area became settled, and the Pony Express, the Overland Stage, and the Union Pacific Railroad had established routes through the area.

Presently, there are approximately 50 listings from this region in the National Register (U.S. Department of the Interior, 1978hh). These sites include stage line stations, Army forts, areas of interest related to the Oregon Trail, and a variety of buildings and historic districts.

4.6.5 Recreational Resources

About five percent of Grand Teton National Park and 15 percent of Rocky Mountain National Park are located within this region (U.S. Department of the Interior, 1970). Mt. Zirkel and Rawah Wilderness Preservation Areas are within Routt and Roosevelt National Forests, respectively, that are also partly located within the region.*

Five National Wildlife Refuges, National Elk Refuge, Seedshadee, Bamforth, Hutton Lake, and Arapaho are located in the region (U.S. Department of the Interior, 1977i). Their combined area of approximately 37,600 acres provides habitat for moose, elk, pronghorns, golden eagles, shorebirds, and beavers. Sections of the Snake River are under study for the Wild and Scenic Rivers System (National Geographic Society, 1977). One National Monument, Fossil Butte, in Wyoming, is in the area. The Mormon, Oregon, and the Contential Divide Trails are under consideration for the National System of Trails (U.S. Department of the Interior, 1974j).

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

Camping was the most popular recreational activity in National Forests (28.9 visitor-days/1,000 residents) with fishing second (9.7 visitor-days/1,000 residents), and hunting third (7.7 visitor-days/1,000 residents). There are several species of trout in the region and deer, elk, and moose are some of the big game species. Winter sports, such as skiing and ice skating, are the fourth most popular activity with 7.1 visitor-days/1,000 residents (U.S. Department of Agriculture, 1977b).

4.7 FORT UNION REGION

The Fort Union Region of the northern Great Plains extends from the Canadian border to northwestern South Dakota. This 66,700 square-mile region includes major areas in North Dakota, Montana, and South Dakota, covering all or parts of 48 counties.

4.7.1 Physical Features

4.7.1.1 Topography.

The Fort Union Region is in the northern part of the Great Plains physiographic province. It is characterized by broad river plains, low plateaus, and open hills and mountains on weak, stratified sedimentary rocks (U.S. Department of the Interior, 1974h). Topographic features of the northern half of the region have been influenced by Pleistocene glacial activities. The glaciated areas adjacent to the Missouri River have well established drainage on gently rolling and terraced topography. The unglaciated areas contain numerous hilly areas, buttes, and ridges rising above the general level of the plains.

The area of the Little Missouri River and the eastern portion of Montana are badlands consisting of many low, rounded hills, deep, vertical-sided gullies, steep cliffs, pinnacles, and narrow ridges. Local relief may range up to 500 feet above the adjacent areas.

4.7.1.2 Geology.

Surface deposits of the Fort Union Region have been influenced by glacial activities. Although glacial drift may reach a thickness of 100 feet, average thicknesses over the area range from 10 to 30 feet (Fluor Utah, 1975b). The drift material is a poorly sorted mixture of unconsolidated sand and gravel, clay, and boulders that may be interbedded locally with glacial lake deposits. The unglaciated badland areas of the southern portion of the region have thin stoney surficial deposits with many areas of exposed bedrock. Alluvial deposits occur along the major streams of the area. The alluvial sand has been reworked to form sand dunes in the broad lowland along the Missouri River (U.S. Department of the Interior, 1978c). Structurally, the region occupies a broad, shallow basin in which strata dip toward the center with some local folding and faulting.

A significant geological feature of the region is the badlands topography, particularly the Little Missouri Badlands in western North Dakota. Portions of these badlands in Billings and McKenzie Counties are included in the Theodore Roosevelt National Memorial Park, and Two-Top and Big Top Mesas (Billings Co.) have been registered as natural landmarks (U.S. Department of the Interior, 1978x and 1978hh). Another geologically significant area is the Bug Creek Fossil Area, a registered natural landmark in central McCone County, Montana. Field work in the early 1960's uncovered thousands of late Cretaceous mammal teeth and jaw fragments and numerous fish, amphibian, and reptile remains, including teeth of seven species of dinosaur (Murray, 1967). These finds have been key elements in evaluating animal community changes from the Late Cretaceous into the Tertiary.

4.7.1.3 Minerals.

Coal is produced in one quarter of the counties in the region and is the leading mineral in six counties (U.S. Department of the Interior, 1977f). The major coal deposits are in the Lebo, Tongue River, and Sentinel Butte members of the Fort Union Formation. The leading mineral commodity in the region is petroleum. It is produced in half of the counties and is the leading mineral in over 40 percent of the counties. For the 80 percent of the counties reporting actual dollar values for production, 57 percent had mineral productions greater than \$1 million and approximately 22 percent had productions greater than \$10 million. Only two counties reported no mineral production. In addition to petroleum and coals, the only minerals having widespread production were sand and gravel. These are produced in 70 percent of the counties, but their value exceeded \$1 million in only a few counties.

4.7.1.4 Soils.

Soils of the Fort Union area are predominately derived from the glacial till deposits. These soils usually have a dark, organic rich surface layer and a loam, silty loam, or silty clay loam texture. This soil is generally several feet thick and used for grazing and wheat production. Shallow, poorly developed soils consisting of unconsolidated sand, silt, and glacial deposits are often associated with the richer soils. They are largely unsuited for cultivation and are used primarily for grazing. Alluvial soils with poorly developed soil characteristics are found along the floodplains of the major streams in this region. The dominant limitations to the regional soils are erosion (wind and water), drought, and salinity.

4.7.1.5 Water.

Surface water runoff is very low--less than one inch over most of the area--and the quality is poor. Total dissolved solids level exceed 350 mg/1 nearly everywhere. Hardness levels are mostly within the 180-240 mg/1 range, but in the east-central part of the area, hardness levels range between 120 and 180 mg/1. In the southwestern third of the area, hardness may exceed 240 mg/1.

Sediment loads have been greatly reduced in the Missouri River since it has been extensively dammed; each reservoir is its own sediment trap. Except for some regulated major streams, in which sediment load is less than 270 mg/1, the smaller tributaries generally carry a sediment load in excess of 1,900 mg/1.

Groundwater is available in small to moderate quantities almost everywhere, but only in large amounts locally, particularly in the alluvial valley fills along the perennial streams. The greatest potential for groundwater development in the region is from the glacial outwash sands and gravels and valley alluvium, particularly along the Missouri River and, in lesser amounts, along the Yellowstone River. Groundwater may also be developed in dependable supplies from the Fort Union Formation and the deeper Fox Hills and Hills Creek Formations. Most of these deeper groundwaters are moderately mineralized at depths of less than 500 feet.

There is a far greater demand for water in the Fort Union Coal Region than is locally available, although the Missouri River dams, chiefly the Garrison in North Dakota and the Oahe in South Dakota, have created tremendous quantities of stored water. Inasmuch as the deeper aquifers are saline, desalinization may be required if supplies are to be developed.

Specific data concerning water availability and use within the Fort Union Coal Region is limited, though it is estimated that available surface water is up to 9.8 million acre-feet per year and consumptive use less than 2.6 million acre-feet per year (WRC, 1975).

For total domestic water use and wastewater flow figures, see Table 4-24.

TABLE 4-24

FORT UNION REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	373383	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	45
Population Density (sq. mi.) (b)	4	Total	389	Waste Water Flow (mgd) (c)	48
Net-Migration (1970-1976) (b)	-3445	Education	161	Solid Waste (million tons/yr.) (c)	0.4
School Enrollments (c,d)	82144	Highways	65	Solid Waste (acres/year) (c)	38
Per Capita Income (b)	4830	Police Protection Employees (c,f)	679	Hospital Beds (c)	2556
		Welfare	30	Year Round Housing Units (000) (c)	124
		Health	18	Doctors-General Practice (c)	94
		Other	115	Doctors-Total Patient CAre (a)	263

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

4.7.1.6 Climate.

The area has a semi-arid continental climate. Winters are long and cold; summers are short and warm. Considerable frontal activity passes through the area, but being distant from major sources of moisture, precipitation is not plentiful. A dozen to 15 times a year, arctic air breaks into the region, causing, in winter, severe cold. The extreme cold is often moderated in the western and southern portions of the area by chinook winds that develop on the eastern slopes of the Rocky Mountains.

The mean annual temperature varies from 38°F in some locations in the northeast part of the region to 46°F in the southeast portion. The difference is due mostly to lower winter temperatures in the northeast. This area is closer to the mean trajectories of the anticyclones of arctic origin as they cross the Canadian-U.S. border, and further from the chinook winds that moderate the cold temperatures in the western portion of the region.

Annual precipitation varies from slightly less than 12 inches in northeastern Montana to 16 inches in the eastern portion of the region. A few points near prominent terrain features cause slight aberrations in the otherwise smooth increase in average precipitation from west to east. Most precipitation occurs in the growing season, occurring as showers or thunderstorms. Rainfall, therefore, tends to be spotty and local flooding may occur not far from places that are enduring drought.

Floods along the main stem of the Missouri River are generally caused by spring snow-melt and are aggravated by ice jams. Major rainstorms sufficient to cause wisespread flooding are rare. Drought effects usually appear in this semi-arid region soon after the precipitation drops much below the long-term mean. The windy, sunny conditions that prevail in the area indicate that evaporation exceeds normal precipitation by a factor of two or more.

The region is windy; average speeds for the year are 10-12 mph. The prevailing direction is northwest, but southerly winds are common during warm months.

Surface-based inversions occur on about 65 percent of winter mornings and 80 percent of summer mornings. Forty to 50 percent are accompanied by winds of 5 mps or more at 300 meters above the ground. On summer afternoons, surface-based inversions are rare; on winter afternoons, they occur 25-30 percent of the time. For reasons that are not obvious, morning mixing depths tend to be lowest in summer in the eastern part of the region and in the winter in the western part.

4.7.1.7 Air Quality.

The Fort Union Region's air quality is very good for both particulates and sulfur dioxide. This holds true for all portions of the three states (Montana, North Dakota, and South Dakota) included in the Region.

4.7.2 Ecological Factors

4.7.2.1 Flora.

The Fort Union Region occupies the northwestern limit of the short grass prairie or plains grassland biome. Wheatgrass-grama-needlegrass associations comprise the principal vegetation and include species such as Montana wheat grass, western wheat grass, blue bunch wheat grass, blue grama, and needle and thread grass. Interspersed with these are other grasses such as cheat grass, orchard grass, big bluestem, little bluestem, bluegrass, wild rye, and foxtail barley. Flowering plants include golden aster, blazing star, prairie coneflower, dwarf fleabone, violets, torch flower, and flowering currant. Principal shrubs are snowberry, prairie rose, fringed sage, silver sage, sumac, and buffaloberry. Other shrub communities, dominated by silver sagebrush, occur along streams, low terraces, and benches (Barker et al. 1976). Associated vegetation includes fringed sage, prairie sage, and occasionally big sagebrush and various grasses. Mixed shrub communities, dominated by buffaloberry, juneberry, chokecherry, hawthorn, and wild plum are scattered throughout the region, usually associated with draws, low terraces, swales, and the lower slopes of hillsides.

Both broadleaf and evergreen forest occur to a limited degree within the region. Cottonwood, in association with box elder, green ash, elm, peach leaf willow, and occasionally, river birch, is common along major drainages and adjacent flood plains. In draws, valleys, and on north and east facing slopes, green ash is dominant. In the Killdeer Mountains and badlands, dense homogeneous stands of bur oak, and mixed stands of bur oak, aspen birch, green ash, and elm are common depending upon moisture availability. Juniper forests, usually with little or no understory, are also typical of the Killdeer Mountains and badlands, particularly on northerly slopes.

Other forested areas within the region include shelterbelts or windbreaks planted around farms, ranches, and across croplands for aesthetics and wind protection. Commonly planted trees are green ash, American elm, Siberian elm, cottonwood, box elder, willow, Russian olive, ponderosa pine, Rocky Mountain juniper, Black Hills spruce, and scotch pine (U.S. Department of the Interior, 1978c). Only 2 percent of the total land area of the region is forested.

Aquatic and semi-aquatic vegetation, typical of the "potholes" region, shallow ponds, and reservoirs, are dependent upon water depth and availability. Areas that are seasonally flooded support such species as smartweed, barnyard grass, ball panicum, teal grass, chuba, and redroot cypress. Waterlogged soils and the shallow areas of standing water (up to about 6 inches) support numerous grasses, bulrushes, spikerushes, cattails, arrowheads, pickerelweeds, and smartweed (U.S. Department of the Interior, 1978c). Deeper water areas (up to about 10 feet) may support rooted aquatics such as bulrushes, wild rice, coontail, wild celery, waterlilies, and spatterdock, and floating plants such as duckweeds, waterweeds, and watermilfoils.

Estimates of net primary productivities for the major natural communities are approximately 6.7 tons per acre for prairie, 5.4 tons per acre for wetland vegetation, 5.8 tons per acre for broadleaf forest, and 8 tons per acre for evergeen forest (Rodin, 1972). Recovery rates of these communities vary with the type and degree of disturbance and upon the sereal stage to which the area is to be returned. Recovery may occur within a few years in moderately disturbed prairie, or may take up to 50 years for forested areas.

4.7.2.2 Fauna.

Wildlife occurring in the Fort Union Coal Region is similar in composition to that of the Powder River Region. The various habitats support approximately 70 species of mammals, 200 species of birds, 87 species of fish, and 20 species of amphibian and reptiles, as well as numerous insects and other invertebrates.

Principal big game animals include mule deer, white-tailed deer, and pronghorn antelope. While ranges may occasionally overlap, each is associated with preferred habitat. Primary mule deer habitat is provided by the rough breaks and badlands where browse species such as buckbrush, skunkbrush, yucca, chokecherry, and mixed grasses occur. White-tailed deer, while widespread throughout the region, prefer river bottoms and other areas where dense vegetation provides adequate cover. Preferred food items include buckbrush, chokecherry, rose, cottonwood, willow, aspen, and green ash (U.S. Department of the Interior, 1978c). Prime pronghorn antelope range occurs on the rolling or broken grasslands interspersed with large sagebrush flats. Where available, big sagebrush and silver sagebrush provide critical winter browse.

Principal small game animals within the region include eastern cottontail, desert cottontail, snowshoe hare, gray squirrel, and fox squirrel. The eastern cottontail is widely dispersed through the area, while the desert cottontail prefers shrubland habitat. Snowshoe hare and fox and gray squirrels are typically associated with woodlands.

Furbearers and other small mammals associated with this region include typical grassland species such as Richardson ground squirrel, thirteen-lined ground squirrel, black tailed prairie dog, western harvest mouse, deer mouse, meadow vole, prairie vole, and blackfooted ferret; woodlands and shrubland species such as gray fox, raccoon, badger, skunk, bobcat, opossum, woodchuck, least chipmunk, wood rat, and southern red backed vole; and wetland and semi-aquatic species such as beaver, mink, and muskrat.

Gamebirds of the region include sharp-tailed grouse, ring-necked pheasant, Hungarian partridge, and wild turkey. Both sharp-tailed grouse and the introduced pheasant prefer large expanses of undisturbed native grasslands interspersed with brush for food, cover, and nesting. The Hungarian partridge is widely dispersed but prefers areas of limited agriculture where shelterbelts are available for cover. Wild turkey are more limited in distribution and tend to be associated with river bottom woodlands, or around ranches and farms where they have become semi-domesticated (U.S. Department of the Interior, 1978c).

Wetlands, occurring primarily as scattered potholes along the Missouri River and other drainages within the region, are of primary value as nesting and feeding habitat for waterfowl of the Central Flyway. Breeding species include mallards, green-winged and blue-winged teal, pintail, redhead, canvasback, gadwall, American widgeon, shoveler, and wood duck. Shorebirds and other non-game birds associated with these wet areas include cranes, grebes, sandpipers, terns, and gulls.

The large areas of open terrain found throughout much of this region provide both seasonal and year round habitat for a variety of predator birds. These include golden and bald eagels, osprey, marsh hawk, sharp-shinned hawk, rough-legged hawk, Swainson's hawk, Cooper's hawk, red-tailed hawk, prairie and peregrine falcon, barn owl, long-eared and short-eared owl, burrowing owl, and great horned owl (U.S. Department of the Interior, 1978c).

Open areas, woodlands, and edges are utilized by a wide variety of song birds, warblers, and woodpeckers. At least 145 species of non-game birds occur within the region, including black-billed cuckoo, belted kingfisher, red-headed and red-bellied woodpeckers, catbird, robin, eastern and mountain bluebird, yellow warbler, tree and chipping sparrow, cowbird, and cardinals.

Most of the 87 species of fish reported from North Dakota would be expected to occur within the rivers, streams, and lakes of the entire region. Principal species of game fish stocked in reservoirs and lakes include walleye, sanger, northern pike, white bass, yellow perch, largemouth bass, channel catfish, and black bullheads. Non-game species common to most streams and rivers include a variety of minnows, shiners, and suckers.

About 20 species of amphibians and reptiles are known from this region. Typical species found in wet areas include tiger salamander, leopard frog, chows frog, snapping turtle, painted turtle, and smooth softshelled turtle. Grassland and shrub species include plains spadefoot frog, western hognose snake, plains garter snake, and prairie rattlesnake.

Table 4-25 presents a typical cross section of the Fort Union Coal Region biomes and characteristic fauna. Estimates of the wildlife carrying capacities and primary productivity rates are presented in Appendix ___.

4.7.2.3 Protected Species.

There are six species of endangered animals that occur or have been reported from the region, including three species of birds and three species of mammals. The Northern kit Fox is not believed to be a permanent resident of the region nor to have any established population within the region. Individuals which have been reported are believed to have wandered into the region from Canada (U.S. Department of Interior, 1978c).

In addition to those with endangered species status, there is also one species with threatened status (Tule White-fronted Goose) and one species with undetermined status (northern greater prairie chicken). A listing of these Federally protected species is presented in Appendix Table ___. Habitat preferences, known distributions and activities associated with coal mining that would potentially pose a threat

TABLE 2-25

PROFILE OF FORT UNION COAL REGION BIOMES

	W SHORTGRASS PRAIRIE	MARSH/POTHOLE	AGRICULTURE	SAGE/SALTBRUSH	BADLANDS	TRANSITION PRAIRIE	BOTTOMLANDS	RIVER E
ENDANGERED SPECIES	black-footed ferret peregrine falcon Northern kit fox	peregrine falcon whooping crane		peregrine falcon	black-footed ferret peregrine falcon	black-footed ferret peregrine falcon	peregrine falcon	Tule white-fronted goose bald eagle
PREDATORS	red fox rattlesnake coyote	snapping turtle mink coyote	red fox hawks coyote	red fox golden eagle hawks coyote	red fox golden eagle coyote mountain lion	red fox rattlesnake coyote	owls bobcat eagle coyote	mink bald eagle
BIRDS	horned lark meadowlark sparrow hawk sage grouse sharp-tailed grouse	marsh hawk gadwall blue-winged teal shoveler pintail mallard	Franklin's gull meadowlark crow Hungarian partridge pheasant	gray jay magpie golden eagle sharp-tailed grouse sage grouse	bald eagle golden eagle magpie sharp-tailed grouse	horned lark meadowlark sparrow hawk sage grouse sharp-tailed grouse	woodpecker wood thrush warblers vireo pheasant	gadwall scaup shoveler pintail mallard
BIG GAME	buffalo antelope	white-tailed deer mule deer	white-tailed deer	mule deer antelope	mule deer antelope	buffalo antelope	white-tailed deer	
FISH								suckers catfish carp smallmouth bass sauger
DOMINANT VEGETATION	buffalo grass needle & thread June grass blue gramma	cattail sedges spikerush wild celery	pasture wheat barley hay	wheatgrass saltbush bluestem sagebrush	dwarf juniper cottonweed cedar sand cherry	buffalo grass needle & thread June grass blue gramma	Sycamore choke cherry elder cottonwood willow	

225 miles - not to scale (for illustrative purposes only)

to these species are given in Appendix Table ___ (U.S. Department of the Interior, 1978fff).

4.7.3 Socioeconomic Structure

Socioeconomic data for the Fort Union Region are presented in Tables 4-24 and 4-26.

4.7.3.1 Demography.

The total 1975 population of about 373,000 was sparsely settled in the Fort Union Region at four persons per square mile (U.S. Department of Commerce, 1978b). Farm population is quite high, reaching 30-40 percent in some areas; out-migration was high during the 1960's (U.S. ERDA, 1977b). Although out-migration still persists, it decreased to 3445 persons between 1970 and 1976 (U.S. Department of Commerce, 1978b). The Fort Peck Indian Reservation in Montana and the Fort Berthold Reservation in North Dakota are composed of 6202 and 2775 Indians, respectively (U.S. ERDA 1977).

4.7.3.2 Economic Base and Sectorial Employment.

Total employment and percentage distribution in each employment class during 1974 are presented in Table 4-26.

Approximately 19,212 workers, or about 30.6 percent of the total regional employment, is in the retail trade sector. This sector, combined with 17,200 workers in the service sector and 7,600 workers in the wholesale trade sector, represents over 70 percent of total employment within the region. The 1974 Census of Argiculture indicates a total of 28,700 persons employed in the agricultural sector in the Fort Union Region.

TABLE 4-26

FORT UNION COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	24	0
10	Mining	1,728	2.8
12	Coal Mining (Bituminous)[3]	174	
15	Construction	4,063	6.5
19	Manufacturing	4,619	7.4
40	Transportation/Public Utilities	4,136	7.2
50	Wholesale Trade	7,574	12.1
52	Retail Trade	19,212	30.6
60	Banking and Finance	3,842	6.1
70	Services	17,252	27.5
99	Non Classified	232 -	0.4
	TOTAL	62,682	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

The total labor force (BLS data) expressed as a percentage of the total population provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Fort Union Region was 43.3 percent.

4.7.3.3 Agriculture.

Agriculture in this region consists primarily of spring wheat farming in the northern and eastern portions, and cattle ranching with some irrigated crop production in the southern and western portions. Farms tend to be large, averaging over 2000 acres in Montana and South Dakota, and over 1000 acres in commercial wheat growing areas in the region.

Cropland represents over 75 percent of the total land area along the northeastern boarder of the region down to under 5 percent in the southern portion (Montana and South Dakota). Irrigated cropland represents less than 1 percent of the farmland over most of the region, with some counties in Montana and North Dakota having from 1-4 percent of cropland irrigated.

Principal agricultural crops grown within the region include soybean, hay, wheat, oats, and sugarbeets. Yields per acre for these crops are 17.3 bushels for soybeans, 1.4 tons for hay, 24.6 bushels for wheat, 42.1 bushels for oats, and 19.3 tons for sugarbeets (U.S.D.A., 1977).

The average value of farm products sold per acre of farmland is $10-$29 in the northern and eastern portions of the region, principally North Dakota and several counties in northern Montana. In all other counties in the region, the value of farm products sold is less than $10 per acre of farmland. Cash-grain farms, along with livestock farms and general farms, are found in the northern and eastern portions of the region, while livestock farms predominate in the other areas of the basin.

4.7.4 Cultural Resources

4.7.4.1 Archaeological Resources.

Although represented by archaeological sites specific to this region, the cultural development within this region is the same as that described above for the Powder River Region.

4.7.4.2 Historical Resources.

During the 1780's and 1790's, the Missouri River traders established routes between St. Louis and the Mandan Indian Villages of the upper Missouri River (U.S. Department of the Interior, 1970). During later years, historical development in this region paralleled that described above for the Powder River Region after the Lewis and Clark explorations. By 1890, small areas along the Yellowstone and Missouri Rivers and around Bismark, North Dakota, were settled. The 45 listings on the National Register of Historic Sites include houses, churches, Army forts, and other locations illustrating various aspects of this region's history (U.S. Department of the Interior, 1978hh).

4.7.5 Recreational Resources. One major distinction of the Fort Union Region is the 15 National Wildlife Refuges that are wholely

or partly within the region. There are 13 refuges in North Dakota ranging in size from the 32,092-acre Upper Souris Refuge to the 313-acre Canfield Lake Refuge. These are used mostly by migratory waterfowl. Medicine Lake and about 10 percent of Charles M. Russel National Wildlife Refuge, Montana, are also within the region (U.S. Department of the Interior, 1977i).*

Small sections of Custer National Forest, which is exempted from surface mining activities, are within the region. The Little Missouri River in North Dakota is currently protected by state law from dam construction and other laterations that could be initiated for industrial purposes (U.S. Department of the Interior, 1978c). The North Country and Lewis and Clark Trails are currently under consideration for the National System of Trails (U.S. Department of the Interior, 1974).

Camping (8.9 visitor-days/1,000 residents), hunting (3.8 visitor-days/1,000 residents), and fishing (3.5 visitor-days/1,000 residents) are the most common recreational activities (U.S. Department of Agriculture, 1977b). The region is in the Central Flyway of numerous migratory bird species, some which, along with pronghorn antelope, are major game species.

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*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

4.8 SAN JUAN RIVER REGION

The San Juan River Region in the Four Corners area of the southwest consists of two geographically separated coal areas: the main portion of the region and the Black Mesa Field approximately 50 miles to the west. The entire region covers 27,300 square miles with the Black Mesa Field accounting for 14 percent of the total area. The region occupies portions of four states--New Mexico, Colorado, Arizona, and Utah-- and all or parts of 17 counties.

4.8.1 Physical Features

4.8.1.1 Topography.

The San Juan River Region is part of the Colorado Plateau physiographic province with high plateaus of stratified rock that are cut by deep canyons (U.S. Department of the Interior, 1974h). The southern portion of the region (the San Juan Basin area) is characterized by mesas, rolling plains, badlands, localized dune areas, and canyons having a local relief of 3,000 to 5,000 feet. The northern portion is characterized by gently sloping plateaus and mesas cut by deep canyons and narrow stream valleys. Some strongly sloping mountains in the area may reach elevations greater than 14,000 feet.

4.8.1.2 Geology.

Surface deposits in the region consist of alluvium along the valleys of the area and colluvium (material that has accumulated on the steep slopes or at the foot of cliffs) that is characteristic of sandy and shaley desert deposits (Fluor

Utah, 1975b). Structurally, the region is a large basin-shaped depression in which strata in the central and southern areas dip gently toward the center of the basin. In other portions of the region, strata dip more steeply, either along the San Juan and Nacimiento Mountains in the north and east, or along fold areas in the west. Coal-bearing rocks of the area include the early Cretaceous Dakota Sandstone, the late Cretaceous Crevasse Canyon, Menafee, and Cliff House Sandstone Formations of the Mesaverde group, the late Cretaceous Fruitland Formation, and the Eocene-age Nacimiento Formation. The thickest coal seams in the region occurs in the Mesaverde group and the Fruitland Formation.

Several geologically significant areas near this region have been incorporated into the National Park system. Within the region, Ship Rock, in northwestern San Juan County (New Mexico), has been designated a natural landmark as a significant example of a volcanic neck (U.S. Department of the Interior, 1978x).

4.8.1.3

<u>Minerals.</u> Coal is produced in five counties in the region but is the leading mineral in only one county (U.S. Department of the Interior, 1977f). Mineral production in the area consists predominately of petroleum, sand and gravel, and a wide variety of metallic minerals. Approximately 80 percent of the counties had mineral production valued at greater than $1 million, and over half of the counties had production valued at greater than $10 million. The most commonly produced minerals were sand, gravel, and crushed stone, which were produced in

over 80 percent of the counties. The predominant leading-value minerals were petroleum, natural gas, and natural gas liquids, the leading commodity in almost half of the counties. Major metallic minerals produced in the area included gold, silver, copper, lead, zinc, vanadium, and uranium. The major non-metallics, other than sand, gravel, and stone, were clay and pumice.

4.8.1.4 Soils.

The soils in the southern part of the region are generally sandy loams to silty clay loams, with a calcium carbonate zone at one to three feet (Fluor Utah, 1975b). Permeability is slow to moderate and the soils are used primarily for grazing. The soils in the northern portion of the area have a sandy loam, loam, or silty loam surface texture and a calcium carbonate zone at depths greater than four feet. These soils are used primarily for range land. The Black Mesa area soils are generally poorly developed, shallow soils consisting mainly of rock fragments. Rich alluvial soils occur along the floodplains and alluvial fans of the area, but these soils make up only a small percentage of the region. The major limitations to area soils are shallowness and erosion.

4.8.1.5 Water.

This area is the headwaters of the San Juan River, the only stream in the region that receives flow from outside the area. Potential evapotranspiration ranges from less than 24 in/yr to about 35 in/yr and averages about 28 in/yr.

Major streams draining the area are the San Juan, of the Upper Colorado River Basin, and the Little Colorado, of the Lower Colorado Basin. Runoff in the higher, upper part of the San Juan Basin, in Colorado, ranges from about 10 to 20 in, with most of the water derived from spring snowmelt. Runoff in the Little Colorado and its numerous "dry washes" is one in/yr or less. Summer thunderstorms and spring snowmelt often create floods of damaging proportions that carry tremendous loads of sediment. Average annual streamflow for the Four Corners Region measured at the confluence of the San Juan and Colorado Rivers is approximately 2.6 million acre-feet (WRC, 1975). Surface reservoirs of the region store 27.1 million acre-feet of water (USGS, 1975b).

Only in the upper reaches of the higher tributaries of the San Juan, in Colorado, is the sediment concentration low or medium, ranging from less than 270 mg/1 to about 1,900 mg/1. Over most of the San Juan Basin and the Black Mesa, the sediment concentration exceeds 1,000 mg/1. Hardness of the surface water throughout most of the coal region exceeds 240 mg/1, and over the remainder it ranges from about 180 to 340 mg/1. Acid-mine drainage is widespread wherever coal is mined. With respect to salinity, all the major streams (Colorado, Little Colorado, and the San Juan Rivers) average at least 1,000 mg/1 TDS.

Approximately 1 million acre-feet of surface water is withdrawn each year for consumptive use but only about one-half of this is actually consumed. The major use of surface water is for irrigation (WRC, 1975).

TABLE 4-27

SAN JUAN RIVER REGION

Total Population (b)	461014	General Expenditures (c,e) (million dollars)		Domestic Water Use (mgd) (c)	100
Population Density (sq. mi.) (b)	9	Total	473	Waste Water Flow (mgd) (c)	58
Net-Migration (1970-1976)	+55035	Education	220	Solid Waste (million Tons/yr.) (c)	0.5
School Enrollments	110643	Highways	53	Solid Waste (acres/yr.) (c)	48
Per Capita Income (c,d)	4135	Welfare	35	Year Round Houding Units (000) (c)	144
		Health	32	Doctors-General Practice (a)	95
		Other	135	Doctors-Total Patient Care (a)	235
		Police Protection Employees (c,f)	1191	Hospital Beds (a)	1077

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1.

Groundwater is generally of very poor to fair quality where it is available. TDS ranges from about 300 to 40,000 mg/1, and hardness generally exceeds 350 mg/1 except in the eastern third of the San Juan Basin, where wells developed in riverine deposits or in sandstone aquifers deliver 50 to 500 gpm of groundwater ranging in hardness between 120 and 350 mg/1.

Most groundwater pumpage in the Black Mesa and Little Colorado Basin is mainly from fine-grained sandstone, alluvium, and basalt flows. Groundwater use is chiefly for domestic and stock supply; there is little groundwater used for irrigation or industrial purposes.

The heaviest pumping is in the Gallup, New Mexico, part of the Little Colorado drainage. There, pumpage to meet the demands of industry associated with coal and uranium have created a condition in which more water is pumped from the aquifers than naturally can be replaced. Groundwater withdrawals for consumptive use in the region are approximately 50,000 acre-feet per year (USGS, 1975b).

For information regarding total domestic water use and wastewater flow, see Table 4-27.

4.8.1.6 Climate.

The San Juan River Region encompasses the high plateau of northwestern New Mexico and southwest Colorado and small portions of the Four Corners area of Utah and Arizona. This high plateau is south of the major track of storms from the Pacific Ocean that move across the Rocky Mountain area. The Pacific fronts that trail across the region have deposited most of the associated moisture on the mountains to the west. They still cause light snow falls on the higher terrain but have little impact at lower levels except for causing increases in cloudiness and windiness and causing occasional showers. In the colder season, a low latitude storm development off southern California moves through the area once or twice each year and produces, some precipitation, again mostly on higher terrain as snow. A major cold weather feature is the "Basin High." This area is the preferred position for a major quasi-stationary anticyclone which often shunts storms to the north of the area or minimizes this impact on the area. During the summer, the area is subtropical in nature. Widely scattered showers and thunderstorms are prevalent.

Annual mean temperatures are 48°-52°F, although some mountainous areas are a bit lower. Temperatures exceeding 100°F occur throughout the area, but are not frequent except at places below 5000 feet MSL. Sub-zero temperatures are uncommon except in the mountains. A distinctive feature of the climate is the large range in daily temperatures.

Annual precipitation averages less than 10 inches for most of the region. However, some elevated points in northern New Mexico and southwestern Colorado receive 20 inches or more. At lower elevations, about half the precipitation falls in May-August. At higher elevations, a greater proportion is received from the winter storms and monthly precipitation amounts do not vary greatly throughout the year. Summer rainfall is mostly from frequently intense thunderstorms. They may deposit several inches to small areas in a short period of time. These storms frequently cause flash floods because the rough terrain and sparse vegetation facilitate quick runoff. Floods from snow melt may occasionally occur. Potential evaporation exceeds normal precipitation by a factor of 6-10 or more. Because of the showery nature of much of the rainfall, parts of the region may not receive substantial rainfall for several months. Drought is a continual threat.

Winds tend to be light to moderate and variable in direction. During the winter and spring, relatively strong winds occasionally accompany frontal activity. Blowing dust often develops in these situations.

Surface-based inversions occur 80-90 percent of the mornings throughout the year. During afternoons, surface-based inversions are uncommon, occurring only about 10 percent of the time in winter. Stagnations are very prevalent. The region has experienced 12-20 2-day episodes in a 5-year period with mixing heights of 500 meters or less, and wind speeds 4 mps or less and almost as many 5-day periods with mixing heights of 1500 meters or less and wind speeds 6 mps or less.

4.8.1.7 Air Quality.

The San Jan River Region's air quality varies somewhat throughout the four states (Arizona, New Mexico, Colorado, and Utah) it encompasses. For the most part, the air quality is considered good and better than the national standards.

The San Juan River Region covers three counties in Arizona. Particulate air quality in Coconino County is not meeting the national primary particulate standard. Navajo and Apache Counties similarly are not meeting the secondary particulate standard; however, they are meeting the primary standard.

The northwest section of New Mexico includes portions of four Air Quality Control Regions (AQCR's). The particulate air quality over these AQCR's is generally better than the national standards. Certain portions of San Juan County, in the Four Corners Interstate AQCR, are an exception where the primary standard is not being met. Sulfur dioxide air quality is also better than the national standard in the areas of concern in New Mexico except in certain portions of San Juan County.

A small section of the southwest corner of Colorado is also contained in the San Juan River Region. Particulate and sulfur dioxide qir quality in this region is better than the national standard.

San Juan County is the only Utah county included in the region. Both particulate and sulfur dioxide air quality in this county are better than the respective national standards.

4.8.2 Ecological Factors

4.8.2.1 Flora.

Dominant vegetation in the San Juan River Region includes ponderosa pine-inland Douglas fir of the montane coniferous forest biome, pinyon-juniper of the woodland-bushland biome, and galletu and grama grass areas of the grassland biome. Approximately 44 percent of the regional land area is in forest.

In mountainous areas, coniferous forests comprised of ponderosa pine, Douglas fir, lodgepole pine, Engelmann spruce, and alpine fir, form the major overstory vegetation. Understory vegetation includes a mixture of shrubs such as juniper, snowberry, barberry, elderberry, and numerous lichens, liverworts, and mosses. Where forests are more open, wild strawberry, brome grass, and twin flower occur. Mountain meadows contain clover, knotweeds, and a variety of grasses (Shelford, 1963).

Pinyon-juniper associations predominate at middle altitudes (5,000 to 7,000 feet). These forested areas are generally open and include a variety of understory vegetation such as creeping barberry, rabbitbrush, elderberry, currants, and ocean spray. At lower elevations, sagebrush, shadscale, and rabbitbrush, as well as grasses, form the principal understory. Other shrubs and small trees occurring occasionally through this association include various scrub oaks, sumac, serviceberry, squawberry, and chokecherry.

The grassland biome is dominated by blue grama in the northern temperate portions of the region, and by mixed grama-galletu or grama-galletu-sagebrush in other areas.

Productivity estimates for areas of natural vegetation are 1.8 tons per acre for sagebrush steppe, 4.5 tons per acre for grassland, and 8.0 tons per acre for evergreen forest (Rodin et al, 1975).

4.8.2.2 Fauna.

Wildlife within the San Juan region includes at least 100 species of mammals (Burt and Grossenheider, 1964), 116 species of birds (Kendeigh, 1961, 1965), and 28 species of amphibians (Conant, 1975). Several, species such as Apache pocket mouse, Great Basin kangaroo rat, canyon mouse, Utah prairie dog, and canyon tree frog, are unique to this region.

Grassland and grassland-shrub associations within the region provide habitat, feed, and cover for a variety of wildlife. Common inhabitants of these areas include pronghorn antelope, black-tailed jackrabbit, desert cottontail, sagebrush vole, northern grasshopper mouse, Ord's kangaroo rat, Great Basin kangaroo rat, Utah prairie dog, badger, coyote, and western spotted skunk. Bird life in open areas includes gambel's quail, sage grouse, mourning dove, loggerhead shrike, sage thrasher, sage sparrow, Brewer's sparrow, red-tailed hawk, ferruginous hawk, and great horned owl. Reptiles, particularly lizards and snakes, are well represented. Common species include sagebrush lizard, leopard lizard, side-blotched lizard, short-horned lizard, bullsnake, plateau whiptail, racer, and western rattlesnake.

The woodland-bushland community includes fauna from grassland and grassland-shrub associations, as well as characteristic species such as rock squirrel, cliff chipmunk, desert woodrat, pinyon mouse, bushytailed woodrat, and bobcat. Birds include the ash-throated flycatcher, scrub jay, pinyon jay, blue-gray gnatcatcher, western bluebird, and acorn woodpecker (U.S. Department of Interior, 1975d).

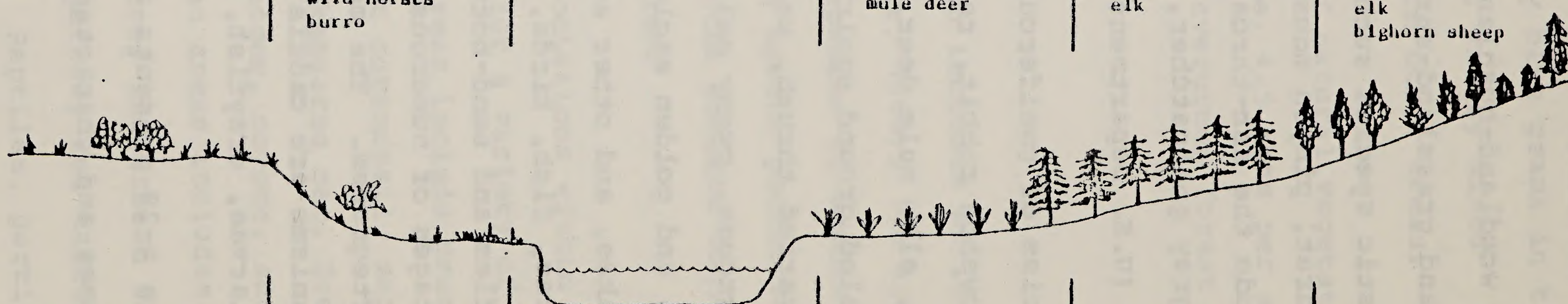
Species of coniferous forest and forest edge communities include snowshoe rabbit, red squirrel, deer mouse, porcupine, black bear, elk, mule deer, bobcat, mountain lion, marten, and golden mantled ground squirrel. Birds include the mountain bluebird, varied thrush, western tanager, common raven, gray jay, blue grouse, pygmy owl, flomulated owl, saw-whet owl, great horned owl, and golden eagle. •tap;11 Wildlife associated with streams, lakes, and other aquatic habitats include invertebrates, fish, birds, mammals, reptiles, and amphibians. Stream riffles and sand-bottom pools provide habitat for the immature stages of numerous aquatic insects, snails, fish, and other invertegrates. The most characteristic and abundant stream organisms are caddisfly larvae, mayfly nymphs, stonefly nymp, fly larvae, crayfish, snails, freshwater clams, and fish.

Table 4-28 presents a typical cross section of the regions biomes and characteristic fauna.

TABLE 4-28

PROFILE OF SAN JUAN COAL REGION BIOMES

ENDANGERED SPECIES peregrine **PREDATORS** coyote fox (swift & kit) **BIRDS** gambels quail valley quail road runner sage grouse **VEGETATION** sagebrush rabbitbrush bitterbrush **BIG GAME** antelope desert bighorn	**ENDANGERED SPECIES** peregrine falcon **PREDATORS** coyote golden eagle raccoon fox (swift & kit) **BIRDS** sage grouse gambels quail valley quail **VEGETATION** winter fat galleta wild rye gramma **BIG GAME** antelope wild horses burro	**ENDANGERED SPECIES** Arizona (apache) trout Mexican duck bald eagle **PREDATORS** raptors raccoon **BIRDS** valley quail waterfowl **FISH** cutthroat golden brook rainbow trout bass	**ENDANGERED SPECIES** bald eagle **PREDATORS** coyote eagles raccoon fox (swift & kit) **BIRDS** sage grouse gambels quail valley quail **VEGETATION** pasture grass cotton lettuce hay **BIG GAME** antelope mule deer	**ENDANGERED SPECIES** peregrine falcon bald eagle gray wolf **PREDATORS** cougar fox (swift & kit) bobcat raccoon **BIRDS** wild turkey **VEGETATION** pinyon pine juniper ponderosa pine **BIG GAME** mule deer black bear elk	**ENDANGERED SPECIES** peregrine falcon bald eagle gray wolf **PREDATORS** cougar fox (swift & kit) bobcat raccoon **BIRDS** wild turkey **VEGETATION** lodgepole pine douglas fir spruce **BIG GAME** mule deer black bear elk bighorn sheep



SW DESERT SHRUB	GRAZING LAND	RIVER & LEDGE	AGRICULTURE	CONIFER	MOUNTAINS NE

250 miles - not to scale (for illustrative purposes only)

4.8.2.3 Protected Species.

There are seven species of animals occurring within the San Juan Region that have protected status as endangered or threatened species under the Endangered Species Act of 1973. Arizona (apach) trout (threatened status) and thick-billed parrot (endangered status) are unique to this region. A listing of protected species and their occurrence within the region is given in Appendix Table __; additional information on distribution and habitats is given in Appendix Table __.

4.8.3 Socioeconomic Structure

Socioeconomic data for the San Juan River Region are presented in Tables 4-27 and 4-29.

4.8.3.1 Demography.

Population density in the San Juan River Region was about nine persons per square mile in 1975, with a total population of approximately 461,000 (U.S. Department of Commerce, 1978b). Out-migration rates ranged up to 25 percent during the 1960 decade (U.S. ERDA, 1977b), but the net figure between 1970 and 1976 showed a gain in population of about 55,000 (U.S. Department of Commerce 1978b). There are about 175,000 Indians in the region, primarily of the Navajo tribe (U.S. ERDA, 1977b). Over 110,000 students were enrolled in public schools in 1975 (U.S. Department of Commerce, 1977d).

TABLE 4-29

SAN JUAN RIVER COAL REGION
MAJOR EMPLOYMENT SECTORS(a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	0	0
10	Mining	7,193	10.8
12	Coal Mining (Bituminous) (c)		
15	Construction	4,101	6.2
19	Manufacturing	8,894	13.4
40	Transportation/Public Utilities	4,164	6.3
50	Wholesale Trade	3,258	4.9
52	Retail Trade	20,281	30.5
60	Banking and Finance	2,864	4.3
70	Services	15,256	23.0
99	Non Classified	400	0.6
	TOTAL	66,411	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

4.8.3.2 Economic Base and Sectorial Employment.

Total employment and percentage distribution in each employment class during 1974 are presented in Table 4-29.

Approximately 20,300 workers, or about 30.5 percent of the total regional employment, are in the Retail Trade sector. When combined with 15,300 workers in the Service sector and 8,900 workers in the manufacturing sector, these sectors represent over 67 percent of the total employment within the region. The 1974 Census of Agriculture indicates a total of 7100 persons employed in the agricultural sector of the San Juan River Region.

The total labor force (BLS data) expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the San Juan River region was 32.1 percent.

4.8.3.3 Agriculture.

Agriculture in this area consists of irrigated farming along water courses and the grazing of cattle and sheep. There is extreme variation from county to county because of differences in topography and water availability. Dryland farming is important locally, especially in the Colorado portion of the basin, whereas, in other areas, irrigated cropland harvested accounts for over 75 percent of harvested cropland. In the Utah portion of the region, less than 10 percent of the land area has been utilized for farms. In the region's counties in New Mexico, the percent of farmlands varies from over 90 percent in McKinley County to between 10 and 30 percent in Sandoval County. Cropland is less than 5 percent of the land area throughout the region except for Montezuma, La Plata, and Montrose Counties where cropland total is in the 5-14 percent range. The value of farm products sold is less than $10 per acre of farmland throughout the region; most income is derived from sales of cattle and sheep.

Principal agricultural crops grown within the region include corn, hay, wheat, cotton, and sugarbeets. Yields per acre for these crops are 96.6 bushels for corn, 3.6 tons for hay, 35.8 bushels for wheat, 720.5 pounds for cotton, and 17.8 tons for sugarbeets (U.S.D.A., 1977).

4.8.4 Cultural Resources

4.8.4.1 Archaeological Resources.

This region is rich in known archaeological resources, particularly for the period from 500 A.D. to historic times. Approximately 60 of the known sites are included in the National Register (U.S. Department of the Interior, 1978hh). The early inhabitants of this area were part of the Desert Archaic cultural complex with a later development into the San Jose tradition of the desert culture. The period from 1000 B.C. to 500 A.D. saw the development of the Early Southwestern Farmers tradition in the southwest, with the Basket Maker and Atrisco subcultures predominant in this region. Following 500 A.D., the Main Southwestern Farmer tradition thrived with Mesoamerican-derived crops and increasing populations, eventually developing into the distinctive southwestern Pueblo

Indian culture. Within this region, the Anasazi culture developed and flourished in the Four Corners area until forced to abandon the area about 1300 A.D. after a series of disastrous droughts (Snow, 1976).

4.8.4.2 Historical Resources.

This region was the focus of many Spanish explorers coming from Mexico between 1540 and 1600 (U.S. Department of the Interior, 1970). Following these initial explorations, attention and later development shifted to the east of this region, centering on Santa Fe. During the period between 1850 and 1890, Army explorations extensively mapped the region, forts were established, and the Atlantic and Pacific Railroad crossed the southern portion of the region, and by 1890 about one-fourth of the area was settled. At present, there are approximately 20 historical listings in the National Register for this region, many associated with the Indian tribes of the area (U.S. Department of the Interior, 1978hh).

4.8.5 Recreational Resources.

Four rivers in Colorado, the Delores, Los Pinos, Piedra, and Conejos, are under consideration for the Wild and Scenic Rivers System. There are six National Monuments ranging in size from the 35,253-acre Wupatki National Monument to the 10-acre Yucca House National Monument (U.S. Department of the Interior, 1970). Two National Wilderness areas, the Weminuche Park (completely) and San Pedro Park (partially) are located in the region. The Continental Divide Trail has been proposed for inclusion in the National System of Trails (U.S. Department of the Interior, 1974j).*

The most popular recreational activity in this region is camping (17.6 visitor-day/1,000 residents), followed by fishing (4.7), picnicking (3.7), and hunting (3.6) (U.S. Department of Agriculture, 1977b).

4.9 UINTA-SOUTHWESTERN UTAH REGION

4.9.1 Physical Features

4.9.1.1 Topography.

The Uinta-southwestern Utah Region is part of the Uinta Basin and High Plateaus sections of the Colorado Plateau physiographic province (Hunt, 1974). The Uinta Basin section is a dissected plateau with strong relief, and the High Plateau section consists of terraced plateaus and high-block plateaus that are partially lava capped. Local relief generally ranges from 1,000 to greater than 3,000 feet, with several mountains in the region having an elevation of 11,000 to 13,000 feet.

4.9.1.2 Geology.

The Unita portion of this region is a structural basin with rocks on the southern flanks of the basin dipping gently toward the center. Rocks on the northern and northeastern flanks are steeply dipping with overturned beds and major faults. The Southwestern Utah section of the region includes a series of plateaus in a shallow structural basin. Many of these areas are sepa- rated by a series of major faults, including the Hurricane, Sevier, and Paunsaugunt Faults (Hunt, 1974). A

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

number of geologically significant areas within this region have been included in the National Park System as parts of Zion, Bryce Canyon, and Capitol Reef National Parks, and Cedar Breaks National Monument (U.S. Department of the Interior, 1968).

4.9.1.3 Minerals.

Coal is produced in almost half the region's counties and is the leading value mineral in six of them (U.S. Department of the Interior, 1977f). Of those counties reporting actual dollar volume of production, 60 percent had total production valued at greater than $1 million, and 45 percent had values greater than $10 million. Petroleum, natural gas, and natural gas liquids were produced in half of the counties and were the leading commodities in one-quarter of the counties, including two counties that had a total mineral production of $340 million. Although sand and gravel was the most common mineral in the region, being produced in 95 percent of the counties, production value was low, accounting, for example, for only one percent of Utah's total mineral production. A wide variety of metalic minerals were produced in the region with the most common being uranium (produced in one-quarter of the region). Other metallic minerals included copper, zinc, lead, vanadium, gold, silver, and iron. In addition to sand and gravel, the nonmetallic minerals produced in the region included crushed stone, clay, gypsum, lime, potassium salts, and salt.

4.9.1.4 Soils.

The soils of the eastern part of the region generally have a sandy loam, loam, or silty loam surface texture with a calcium carbonate accumulation usually occurring at depths greater than four feet (Fluor Utah, 1975b; U.S. Department of the Interior, 1968). The soils of the central portion of the region are generally steep, shallow , poorly developed soils, often with many rock fragments. In the southern portion of the region, the soils are a mix of the rocky soils, found in the central part of the region, and soils with sandy loam to silty clay loam texture and a calcium carbonate zone at one to three feet. The major limitations for soils of this region include severe to very severe erosion, shallowness, steep slopes, active gullies, and rock outcropping.

4.9.1.5 Water.

The principal streams of the area are the Green River and its two main tributaries, the Strawberry, in Utah, and the White coming out of Colorado, and the Colorado River and its tributaries. Though stream flows and surface water use have not been quantified for this region specifically, flows are probably less than 6 million acre-feet per year (WRC, 1975).

Dissolved solids in streams of the region range from 120 to 350 mg/1 in the western base of the Wasatch Mountains, and tributaries to the upper Strawberry, which drain the south face of the Uinta Mountains. Over the remainder of the region, TDS values are greater than 350 mg/1. Sediment concentrations are mixed, but are greater than 1,900 mg/1 in the larger perennial rivers and less than 270 mg/1 in the higher tributaries of the region.

The region is underlain by low permeability rocks that generally yield less than 50 gpm to wells. However, in some of the alluvial valley fills, particularly those containing gravels and sands, yields of several hundred gallons a minute can be obtained. The quality of bedrock water supplies is generally poor.

For information regarding total domestic water use and wastewater flow, see Table 4-30.

4.9.1.6 Climate.

General climatic conditions are similar to those described for the San Juan River Region. The rugged topography, with its great changes in elevation and orientation of the major features causes great variations in temperature in short distances. Where data are collected, the annual mean falls between 43°-53°F. Most areas on the plateau experience 100°F temperatures; sub-zero temperatures are common.

The annual precipitation on the plateau averages 5-10 inches. In mountainous areas, 15 inches is common and a few spots approach 20 inches. On the average, precipitation is uniformly distributed throughout the year. The few cold season frontal systems contribute about as much moisture as the scattered summertime thundershowers. Much of the precipitation occurs within a short period of time. Some areas will experience several consecutive summers (or winters) without

TABLE 4-30

UINTA-SOUTHWESTERN UTAH REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	419032	General Expenditures (c,e) (million dollars)		Domeestic Water Use (mgd) (c)	96
Population Density (sq. mi.) (b)	7	Total	436	Waste Water Flow (mgd) (c)	52
Net-Migration (1970-1976) (b)	+43931	Education	211	Solid Waste (million tons/yr.) (c)	0.4
School Enrollments (c,d)	100568	Highways	45	Solid Waste (acres/yr.) (c)	43
Per Capita Income (a)	4270	Police Protection Employees (c,f)	1005	Hospital Beds (a)	1429
		Welfare	37	Year Round Housing Units (000) (c)	131
		Health	29	Doctors-General Practice (a)	129
		Other	114	Doctors-Total Patient Care (a)	300

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

precipitation, then have one or two storms that provide a few to several inches. Flash flooding is common.

The surface wind patterns are profoundly affected by the orientations and height of the terrain features with respect to the prevailing synoptic-scale air flow and by the effect of the terrain in creating local anomalous circulations. Many of these flows are very regular by season or time of day. Some of the wind flows created by these factors can be quite strong. As a rule, their persistence is not great.

Surface-based inversions occur 80-90 percent of the mornings throughout the year. During afternoons, surface-based inversions are uncommon, occurring only about 10 percent of the time in winter. Stagnations are very prevalent. The region has experienced 12-20 2-day episodes in a 5-year period with mixing heights 500 meters or less and wind speeds 4 mps or less, and almost as many 5-day periods with mixing heights 1500 meters or less and wind speeds 6 mps or less.

4.9.1.7 <u>Air Quality.</u>

Most of the Uinta-Southwestern Utah Region is located in Utah with a slight extension into Western Colorado. Air quality is generally very good.

4.9.2 Ecological Factors

4.9.2.1 Flora.

The Uinta-Southwestern Utah Region has varied vegetative cover ranging from low desert shrub-sagebrush of the cold desert biome, through pinyon-juniper and mahogany-oak, to coniferous forest-alpine meadow of the montane coniferous forest biome. Approximately 32 percent of the regional land area is in forest.

Sagebrush, either dominant or codominant with shadscale and rabbitbrush, is the major component over much of the cold desert biome. Grasses regularly present as understory include bluebunch wheatgrass, Sandberg bluegrass, porcupine grass, squirreltail, foxtail barley, indian rice grass, and alkali sacaton (Shelford, 1963).

At high elevations, the sagebrush dominated community gives way to larger shrubs and small trees of the pinyon-juniper woodlands. Typical overstory vegetation includes Utah juniper, pinyon pine, mountain mahogany, and various scrub oak. Understory may include big sagebrush, indian grass, rabbitbrush, and shadscale where the cold desert grades into the woodlands, and cliff rose, serviceberry, broomweed, creeping barberry, and currants in middle and upper altitude woodlands.

As the woodland grades into montane forest, aspen and ponderosa pine form the overstory. Other common tree types associated with the higher elevation forest include inland Douglas fir, lodgepole pine, and spruce. Understory vegetation includes a mix of shrubs and grasses.

Alpine meadows are interspersed throughout the upper elevations of the montane forest area and are vegetated principally by grasses and flowering species such as clover, knotweed, wild strawberry, biome grass, and twin flower.

Productivity estimates for the natural vegetation within the region range from a low of 1.8 tons per acre of sagebrush, to 5.8 tons per acre for woodlands, and approximately 8.0 tons per acre for evergreen forest.

4.9.2.2 Fauna.

A large variety of wildlife, characteristic of the various biomes, is found in the region. Approximately 90 species of mammals, 270 species of birds, 26 species of reptiles, and 9 species of amphibians occur within the Uinta coal region.

Wildlife associated with montane coniferous forest areas include small mammals such as snowshoe rabbit, red squirrel, flying squirrel and porcupine; game species such as elk, black bear, mule deer (summer range); and predators such as bobcat, cougar, and marten. Bird species characteristic of this biome include Clark's nutcracker, grayheaded junco, mountain bluebird, mountain chickadee, hairy woodpecker, ruffed grouse, blue grouse, goshawk, great horned owl, pygmy owl, and flomulated owl (U.S. Department of the Interior, 1975d).

Typical mammals of woodland-bushland communities include rock squirrel, cliff chipmunk, desert woodrat, pinon mouse, bobcat, and bushy-tailed woodrat. Birds include the ash-throated flycatcher, gray flycatcher, pinon jay, plains titmouse, western bluebird, and the black-throated gray warbler. In cold desert communities, typical mammals are the black-tailed jack rabbit, desert cottontail, Nuttall's cottontail, desert woodrat, least chipmunk, the Greak Basin pocket mouse, Ord's kangaroo rat, northern grasshopper mouse, pronghorn antelope, coyote, kit fox, western spotted skunk, and desert bighorn sheep. Characteristic reptiles are the leopard lizard, sagebrush lizard, side-blotched lizard, short-horned lizard, bullsnake, plateau whiptail racer, and western rattlesnake. Birds include red-tailed hawk, Gambel's quail, sage grouse, mourning dove, great-horned owl, loggerhead shrike, sage thrasher, sage sparrow, and Brewer's sparrow.

The Uinta-Southwestern Utah Region is primarily within the Colorado River drainage area. The cutthroat trout and the mountain whitefish are the only game fish native to this area. These fish have been supplemented and, in the case of the cutthroat trout, largely replaced by introduced species. Rainbow trout are the most numerous newcomers and are stocked in large numbers each year (Scott, 1971). Other introduced game fish are brown trout, Yellowstone cutthroat trout, brook trout, and arctic grayling in the colder waters, and channel catfish, black bullhead, and yellow perch in warmer waters. Characteristic nongame fish are carp, Utah chub, roundtail, bonytail, humpback chub, leatherside chub, redside shiner, Colorado squawfish, speckled dace, fathead minnow, flannelmouth sucker, mountain sucker, bluehead sucker, humpback sucker, and the mottled sculpin (Baxter and Simon, 1970; Scott, 1971; Sigler and Miller, 1963).

TABLE 4-31 TO BE PROVIDED

BIOME TABLE

TABLE 4-32

UNITA-SOUTHEWESTERN UTAH COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	78	0.0
10	Mining	5,540	6.2
12	Coal Mining (Bituminous) (c)	268	0.3
15	Construction	5,965	6.6
19	Manufacturing	16,302	18.2
40	Transportation/Public Utilities	3,954	4.4
50	Wholesale Trade	4,707	5.2
52	Retail Trade	23,434	26.1
60	Banking and Finance	3,758	4.2
70	Services	25,334	28.2
99	Non Classified	698	0.8
	TOTAL	89,770	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation developed for the BLM environmental statement.

A variety of mammals and birds are closely associated with, and at least partially dependent upon, stream communities. Bald eagles, kingfishers, and great blue herons feed on fish. Water ouzels dive for aquatic insects. Muskrats, beavers, mink, raccoons, water shrews, river otters, and others are links in the food chains of stream ecosystems.

Table 4-31 represents a typical cross section of the Uinta coal region biomes and characteristic fauna. Estimates of the wildlife carrying capacities and primary productivity rates are presented in Appendix __.

4.9.2.3 Protected Species

There are nine species of animals and one plant species occurring within the Uinta Coal Region that have protected status as endangered species under the Endangered Species Act. The Yuma Clapper Rail (endangered status) is unique to this region. A listing of protected species and their occurrence within the region is given in Appendix Table __; additional information on distribution and habitats is given in Appendix Table __.

4.9.3 Socioeconomic Structure

Socieconomic data for the Uinta-Southwestern Utah Region are presented in Tables 4-30 and 4-32.

4.9.3.1 Demography.

Total population for the Uinta-Southwestern Utah Region was approximately 419,000 in 1975, with a density of seven persons per square mile. Forty-four thousand persons migrated into the region between 1970 and 1976 (U.S. Department of Commerce, 1978b). Public school enrollments totaled over 100,000 students in 1975 (U.S. Department of Commerce, 1977d).

4.9.3.2 Economic Base and Sectorial Employment.

Total employment and percentage distribution by employment class during 1974 is presented in Table 4-32.

Approximately 25,300 workers, or about 28.2 percent of the total regional employment, are in the Service sector. Combined with 23,400 workers in the retail trade sector and 16,300 workers in the manufacturing sector, these three sectors represent over 72 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of 19,200 persons employed in the agricultural sector in the Uinta-Southwestern region.

The total labor force (BLS data), expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Uinta-Southwest region was 42.9 percent.

4.9.3.3 Agriculture.

Agriculture in this region is limited by rainfall and topography. Thus, a relatively low percentage of the land has been used for farms, less than 30 percent in most areas of the region. Farms are moderate in size and are principally involved with raising cattle and sheep; dairy farming is important in scattered areas. Cropland accounts for less than 5 percent of the land area, while pastureland represents more than 75 percent of farmlands. Over 75 percent of harvested cropland is irrigated. In some counties, as much as 20-29 percent of the total farmland and most of the irrigated land was used for the production of hay to support livestock operations. The value of farm products sold was less than $10 per acre in southern and eastern Utah and in the $10-$49 range in the other portions of the region.

Cultivated crops produced within the region include hay, wheat, sugarbeets, and corn. Average yields per acre for these crops are 2.5 tons for hay, 23.3 bushels for wheat, 18 tons for sugarbeets, and 96 bushels for corn (U.S. Department of Agriculture, 1977).

4.9.4 Cultural Resources

4.9.4.1 Archaeological Resources.

The early cultural development in this region is similar to that in the San Juan and Green River-Hams Fork Regions, with the Desert Archaic culture evolving into the Desert Culture and its major subcomponent within this region, the Uncompagre complex. The Desert Culture persisted with little basic change throughout most of the region up to the historic period.

4.9.4.2 Historical Resources.

Early Indian traders established routes through this area and in the 1770's the Spanish explorer Escalante traveled the northern part of the region (U.S. Department of the Interior, 1970). In the first half of the nineteenth century, explorers like Jedediah Smith and Fremont travelled this area. By 1890, the Denver and Rio Grande Railroad had been constructed and about one fourth of the area was settled. The National Register presently includes about 70 sites from this region including houses, ranches, and other historical features particularly of the period after 1870 (U.S. Department of the Interior, 1978hh).

4.9.5 Recreational Resources

Ten National Parks and Monuments are located in this region, including approximately 90 percent of Zion National Park's 146,500 acres and 70 percent of the 39,000-acre Bryce Canyon National Park. About half of the Capitor Reef National Park, 10 percent of Dinosaur National Monument, and all of Cedar Breaks National Monument are also in the area (U.S. Department of the Interior, 1970). West Elk Wilderness Preservation Area and Ouray National Wildlife Refuge Area, a haven for Canada geese, ducks, and shorebirds, are also in the Uinta Region.*

Major recreational activities include camping (22.6 visitor-days/1,000 residents), fishing (7.0 visitor-days/1,000 residents), winter sports (5.8 visitor-days/1,000 residents), and hunting (4.4 visitor-days/1,000 residents). Opportunities

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

for wildlife and scenic photography abound. Other popular activities are hiking, backpacking, picnicing, and boating (U.S. Department of Agriculture, 1977b).

4.10 DENVER-RATON MESA REGION

4.10.1 Physical Features

4.10.1.1 Topography.

The Denver-Raton Mesa Region is on the western edge of the Great Plains physiographic province, just east of the Southern Rocky Mountains province (U.S. Department of the Interior, 1974h). The Denver portion of this region is in the Colorado Piedmont Section of the physiographic province. This area is an old plain from which most of its older alluvial cover has been removed, causing it to have lower elevations than the High Plains section to the east (Thornbury, 1965). Local relief generally ranges from 100 to 500 feet, the areas of higher relief being in the southern portions of the section (U.S. Department of the Interior, 1968). The Raton Mesa section of the region is in the Raton section of the Great Plains, characterized by relatively higher elevations, deep canyons, and high mesas or plateaus capped by Tertiary lava flows (Hunt, 1974).

4.10.1.2 Geology.

The Denver section of this region occupies a north-south trending structural basin (the Denver Basin) where, at its deepest part, as much as 4,500 feet of strata down folding has taken place (Thornbury, 1965). The basin is characterized by gently dipping strata on its east flank and steeply-dipping upturned beds along the Rocky Mountain foothills to the west. The primary coal in the area occurs in the Upper Cretaceous Larmie Formation with the Denver Formation containing extensive beds of Late Cretaceous and Paleocene lignite.

The Raton Mesa section of this region commonly contains lava-capped mesas that give evidence of repeated basalt and andesite extrusions. Structurally, there are four general subdivisions of this area: a foothill belt with tightly compressed rock; a basin or trough (Raton Basin) to the east of this belt; a broad uplift east of this basin; and another uplift area to the northwest of the broad uplift (Thornbury, 1965). A variety of other volcanic phenomena occur in addition to the basalt flows, including many volcanic plugs, sills, and dikes.

On Raton Mesa, one of the highest basalt-capped mesas, a total of eleven separate lava flows can be identified with the flows varying in thickness from 100 to 500 feet. This mesa, six miles southeast of Trinidad, Colorado, has been designated a natural landmark because its form, composition, and structure constitute a significant record of geological history in the western marginal zone of the Great Plains (U.S. Department of the Interior, 1967 and 1978x). Another designated natural landmark in the Raton Mesa section of the region is the Spanish Peaks area, approximately 40 miles northwest of the Raton Mesa landmark. Within the Denver section of this region, two geologically significant features have been designated as natural landmarks: the Garden of the Gods area in El Paso

County to the northwest of Colorado Springs, and the Morrison Fossil Area in Jefferson County to the west of Denver.

4.10.1.3 Minerals.

Coal is produced in only three of the region's counties, two in the Raton Mesa section and one in the Denver section (U.S. Department of the Interior, 1977f). Approximately 70 percent of the region's counties had mineral productions valued at greater than $1 million and 55 percent had productions valued at greater than $10 million. Although the leading minerals in counties with high value productions included petroleum, coal, sand and gravel, and cement, the primary commodity was petroleum, the leading mineral in 40 percent of the counties. The most commonly produced minerals were crushed stone, and sand and gravel. Crushed stone was produced in 70 percent of the counties and sand and gravel in all of the counties in the region. Production of sand and gravel was much greater than that of crushed stone, with the production from one Colorado county in the region nearly equal to the crushed stone production in the entire state. Other minerals produced in the region include clay, lime, uranium, gold, and tungsten.

4.10.1.4 Soils

Within the Denver section of this region, the soils generally have an organic-rich surface horizon and are high in bases (U.S. Department of the Interior, 1968). These gently sloping soils usually have a thin clay accumulation in the subsurface horizon and are intermittently dry for long periods during the summer. The predominant soils of the Raton Mesa section have a grey to brown surface horizon with a subsurface accumulation of clay, and are medium to high in bases. These soils are usually moist but have steep slopes and many areas with rock outcrops. Soil limitations in this region include erosion, shallowness, and slope.

4.10.1.5 Water.

The coal region is part of three major drainage basins: the Upper Missouri, the Upper Arkansas-Red, and the Western Gulf. The major rivers draining the area include the South Platte River and its tributaries, tributaries to the Arkansas River, and tributaries to the Rio Grande River. Average annual runoff over most of the area is less than 1 in/yr., but increases to about 10 in/yr in the Raton Mesa area. Over the eastern half of the area, sediment loads in the major streams exceed 1,900 mg/1, though some tributaries to the South Platte may carry sediment loads of less than 270 mg/1.

Surface-water quality is quite variable, but generally, dissolved solids levels exceed 350 mg/1. In the southern portion of the area, however, TDS levels may exceed 1,800 mg/1. Although the salinity of surface water may be high, total hardness levels are generally less than 180 mg/1.

Surface-water flow in the region is approximately 5.4 million acre-feet per year of which over 4.5 million acre-feet is consumptively used. Irrigated agriculture and self supplied industry are the largest uses (WRC, 1975).

The region includes most of the major population centers of Colorado. Due to a shortage of available water to meet the industrial, municipal, and irrigation needs of the area, extensive importation of water from the western slopes of the Rocky Mountains has been undertaken (See Table 4-33).

Groundwater is generally scarce except in the alluvial deposits along the South Platte River and some bedrock aquifers in the Denver area. Water quality is variable but generally acceptable for use as domestic and agricultural water supplies. Wells in the alluvial deposits will generally yield more than 50 gpm.

4.10.1.6 Climate.

Prevailing storm tracks across the region are west-to-east. The storms provide little moisture to the area, however, because most of it is deposited on the western slopes of the adjacent mountains as the storms traverse the area. Similarly, storms from the north that bring some of the coldest weather are rarely accompanied by significant precipitation. In spring, when there is a tendency for storms to develop in the panhandle of Texas and Oklahoma, incursions of moisture on the eastern slopes of the mountains take place and the area receives the heaviest and most general rains. This situation tapers off to shower and thunderstorm activity in the summer period.

The mean annual temperature varies between 48° and 52°F. The daily range in temperature averages 27-39°F, indicative of the high, semi-arid nature of the area and climate.

TABLE 4-33

DENVER-RATON MESA REGION: SOCIO-ECONOMIC CHARACTERISTICS

Total Population (b)	1863752	General Expenditures (million dollars) (c,e)		Domestic Water Use (mgd) (c)	358
Population Density (sq. mi.) (b)	78	Total	1974	Waste Water Flow (mgd) (c)	233
Net-Migration (1970-1976)	+162581	Education	904	Solid Waste (million tons/yr.) (c)	1.8
School Enrollments (c,d)	428663	Highways	227	Solid Waste (acres/yr.) (c)	189
Per Capita Income (b)	4875	Police Protection Employees (c,f)	5065	Hospital Beds (a)	7482
		Welfare	173	Year Round Housing Units (00) (c)	601
		Health	132	Doctors-General Practice (a)	367
		Other	540	doctors-Total Patient Care (a)	3071

(a) 1974 Data
(b) 1975 Data
(c) 1975 Estimates
(d) Public Elementary and Secondary
(e) Direct State and Local Government
(f) State and Local Full Time Equivalent

Sources: See Table 4-1

Average annual precipitation is about 15 inches, with a range of 11-20 inches. Over half the annual amount falls in the April-July period, mostly as showers and thunderstorms.

Mean annual surface wind speeds are 9-10 mph. However, winds through the vertical mixing zone are less than average for the nation as a whole. The wind characteristics are much influenced by the terrain and the considerable daily range in temperature. These factors tend to create local valley-mountain circulations of a diurnal nature. Hence, winds are not very persistent in direction in this area, except when the chinooks occur, compared to the central portion of the county. There is a tendency for reversals of flow on a regular basis, however, a situation which is not conducive for dispersing pollutants from an area. A high frequency of night time surface-based inversions and relatively high afternoon mixing heights is a prevalent feature of the area.

4.10.1.7 Air Quality.

Regional air quality is generally quite good. However, areas do exist in this region which are not meeting certain air quality standards. These areas normally tend to be the more populated and industrialized.

4.10.2 Ecological Factors

4.10.2.1 Flora.

The Denver portion of the region is on the western edge of the prairie biome and is primarily vegetated by buffalo grass and blue grama. Associated vegetation includes yucca, western wheatgrass, needlegrass, fringed sage, and prairie globemallow. Other plants of local importance include four-wing saltbush along drainage systems, inaldn saltgrass on saline or alkaline soils, and sand sage, prairie sand reed, and plains prickly pear in sandy areas. Along the southwestern border of this region, vegetation grades to coniferous forest comprised of pines mixed with Douglas fir.

In the Raton Mesa portion of the region, the principal vegetation is montane coniferous forest. Dominant species include inland Douglas fir, Ponderosa pine, and Englemann spruce. Associated vegetation includes aspen, mountain ash, ninebark, bearberry, and squashberry.

At lower altitudes and below the montane coniferous forest, woodland-brushland, dominated by pinyon pine and juniper, is prevalent. Associated understory includes barberry, edlerberry, sagebrush, and various grasses. Short-grass prairie occupies a small portion of this area and is composed of many species that occur in the Denver portion of the region. Deciduous forests occur primarily along streams, and are comprised of various willows, aspen, box elder, and cottonwood.

Primary productivity estimates for these major communities range from approximately 1.8 tons per acre for mixed grass and sagebrush to 5.4 tons per acre of pinyon-juniper, 5.9 tons for deciduous forest, 7.6 tons for prairie, and 8 tons per acre for montane evergreen forest (Rodin et al., 1975).

4.10.2.2 Fauna.

Wildlife within the Denver-Raton Mesa region includes representatives of prairie, shrub, and forest biomes. Mammals associated with prairie and prairie-shrub habitats include blacktailed jackrabbit, desert cottontail, black-tail prairie dog, ground squirrels, northern pocket gopher, plains pocket gopher, meadow vole, coyote, swift fox, long-tailed weasel, black-footed ferret, badger, prairie spotted skunk, and pronghorn antelope. Birds include ferruginous hawk, prairie chicken, sharptailed grouse, mountain plover, burrowing owl, horned lark, western meadowlark, Lark bunting, and savannah grasshopper, and vesper sparrow. Reptiles include prairie rattlesnake and the eastern short-horned lizard.

Montane coniferous forest and forest edge mammals include yellow-bellied marmot, golden-mantled ground squirrel, least chipmunk, red squirrel, bushy-tailed woodrat, boreal redback vole, bobcat, mule deer, elk, and porcupine. Birds include golden eagle, western flycatcher, Clark's nutcracker, mountain chickadee, mountain bluebird, and pygmy nuthatch.

The deciduous forest-edge community (riparian woodland) includes the red fox, fox squirrel, eastern cottontail, striped skunk, and raccon; blue racer, milk snake, and red-spotted garter snake; turkey vulture, sharp-shinned hawk, Cooper's hawk, red-tailed haw, Swainson's hawk, mourning dove, common nighthawk, red-shafted flicker, violet-green swallow, common crow, black-billed magpie, loggerhead shrike, and Brewer's blackbird.

Aquatic wildlife includes a variety of invertebrates, fishes, birds, mammals, reptiles, and amphibians associated with the stream, lake, and pond-marsh biotic communities.

Stream riffles and sand-bottom pools are characterized by caddisfly larvae, mayfly naiads, stonefly naiads, crayfish, and snails. Characteristic stream fish include the plains minnow, longnose dace, flathead chub, goldeye, fathead minnow, river carpsucker, black bullhead, channel catfish, stonecat, plains topminnow, plains killfish, and white sucker (Baxter and Simon, 1970; Brown, 1971; Costello, 1964; U.S. Fish and Wildlife Service, 1952). Rainbow trout and brown trout are found in suitable larger streams. Other stream-associated wildlife include tiger salamander, plains spadefoot toad, great plains toad, leopard frog, snapping turtle, belted kingfisher, muskrats, and beaver.

Table 4-34 presents a typical cross section of the Denver-Raton Mesa coal region biomes and characteristic fauna. Estimates of the carrying capacities and primary productivity rates for the region are presented in Appendix __.

TABLE 4-34 TO BE PROVIDED

DENVER - RATON MESA

BIOME TABLE

4.10.2.3 Protected Species.

There are five species of animals occuring within the Denver-Raton Mesa Region that have protected status as endangered species under the Endangered Species Act of 1973. A listing of the protected animals and their occurrence within the region is given in Appendix Table __; additional information on distribution and habitats is given in Appendix Table __.

4.10.3 Socioeconomic Structure

Socioeconomic data for the Denver-Raton Mesa Region are presented in Tables 4-33 and 4-35.

4.10.3.1 Demography.

Overall population density was about 78 persons per square mile in the Denver-Raton Mesa Region in 1975 (U.S. Department of Commerce, 1978b). This varies considerably, however, from the metropolitan centers like Denver to the more isolated areas of the region. Net migration between 1970 and 1976 was highly positive at over 162,000 people. Public school enrollments totaled over 428,000 in 1975 (U.S. Department of Commerce, 1977d).

4.10.3.2 Economic Base and Sectorial Employment.

Total employment and percentage distribution by major employment class during 1974 is presented in Table 4-35.

Approximately 134,900 workers, or about 22.8 percent of the total regional employment, is in the retail trade sector. Combined with 130,000 workers in the service sector and 112,200

TABLE 4-35

DENVER_RATON MESA COAL REGION
MAJOR EMPLOYMENT SECTORS (a)

Major SIC Group		Sector Employment	Percent of Total (b)
07	Agriculture Services	1,496	0.2
10	Mining	6,677	1.1
12	Coal Mining (Bituminous) (c)		
15	Construction	57,000	9.6
19	Manufacturing	112,214	18.9
40	Transportation/Public Utilities	50,271	8.5
50	Wholesale Trade	47,895	8.1
52	Retail Trade	134,910	22.8
60	Banking and Finance	44,888	7.6
70	Services	130,073	22.0
99	Non Classified	6,827	1.2
	TOTAL	592,251	100.0

(a) Employment covered by Bureau of the Census County Business Patterns. Excluded from consideration are agricultural workers, self-employed workers, government workers, military and railroad employment. The followig breakdown indicates the breadth of County Business Patterns coverage:

Employment Group	Percent
Total Employment	100.0
Covered by Social Security	90.5
In County Business Pattern's	76.5
Not in Scope	14.0
Not Covered by Social Security	9.5

(b) May not add to 100% due to rounding.

(c) Included in SIC 10 - Mining.

Source: Bureau of the Census, County Business Patterns, 1974. Data taken from computer data tapes for all counties specified as in the various coal region. Data tabulated via EMPLOY1, a MITRE employment tabulation program developed for the BLM environmental statement.

workers in the manufacturing sector, this represents over 63 percent of total employment within the region. The 1974 Census of Agriculture indicates a total of 23,000 persons employed in the agricultural sector of the Denver-Raton Mesa region.

The total labor force (BLS data), expressed as a percentage of total population, provides an estimate of the labor force participation rate. The estimated 1974 labor force participation rate in the Denver-Raton Mesa region was 39 percent.

4.10.3.3 Agriculture.

This region contains three very different types of agriculture. In northern Colorado, there is substantial irrigation along the South Platte River, along with production of livestock products, principally beef. In this area, the value of farm products sold is $50-$150 per acre of farmland. South of this area is principally dryland farming because of the shortage of irrigation water. About half of the farms in this area are cash-grain farms (wheat is the leading cash-crop) and about one-half are livestock farms.

In this area, the value of farm products sold per acre of farmland is $10-$29. Finally, there is the Raton area, where agricultural resources are extremely meager and the main activities are grazing cattle and sheep. In this area the average value of farm products equals less than $10 per acre of farmland.

Principal crops grown within the region include wheat, hay, corn, sugarbeets, and cotton. Yields per acre for these crops are approximately 23 bushels wheat, 3 tons hay, 101 bushels corn, 19 tons sugarbeets, and 380 pounds of cotton (U.S. Department of Agriculture, 1977).

4.10.4 Cultural Resources

4.10.4.1 Archaeological Resources.

Both sections of this region are associated with important Paleoindian sites. Directly east of the Raton Mesa section is the Folsom site in Colfax County, New Mexico, the first site to be positively identified as Paleoindian (Snow, 1976). Folsom points, a particular style of projective points, were found in direct association with the remains of an extinct species of bison (Snow, 1976; Willey, 1974). Immediately north of the Denver section is the Lindenmeier site, in Larimer County, Colorado. Extensive excavations of this site uncovered over 20,000 artifacts, primarily stone blades and projectile points, and helped to produce a better understanding of Paleoindian life (Stuart and Stuart, 1969). Cultural developments following this period included the San Jose complex of the Desert Culture in the Raton Mesa section and a transition phase between the Archaic and Desert Cultures in the Denver section (U.S. Department of the Interior, 1970). Further developments continued to divide the two sections between eastern and western cultural influences. By the period following 500 A.D., the Denver section was within the cultural sphere of the Plains Bison Hunters, and the Raton Mesa section was part of the Anasazi complex of the southwestern Farmers Tradition.

4.10.4.2 Historical Resources.

A few explorers from the Spanish settlements around Santa Fe travelled through the Raton Mesa section of this region between 1700 and 1740, using the Raton Pass as an entry way to areas to the north (U.S. Department of the Interior, 1970). (Present-day Interstate I-25 follows this same route between New Mexico and Colorado.) By 1835, some explorers had travelled through the Denver section but the Raton Mesa area had received considerable attention as several groups of explorers travelled the Raton Pass on trips between Santa Fe and the Arkansas River. By 1850, Fremont had passed through the Denver section on two of his expeditions, stopping at Fort St. Vrain, and the Santa Fe Trail had been established through the Raton Mesa section. By 1890, almost the entire area of both sections had been settled and the areas were crossed first by stage lines and then by railroads. Of the 110 listings presently on the National Register, half are in the city of Denver (U.S. Department of the Interior, 1978hh). The listings include houses, churches, hotels, schools, and several historic districts illustrating various aspects of this region's history. The historical associations of the Raton Pass led to its designation as a National Historic Landmark and early inclusion in the National Register.

4.10.5 Recreational Resources

The only area within this region considered unsuitable under SMCRA is the Maxwell National Wildlife Refuge which is utilized by waterfowl and bald eagles (U.S. Department of the Interior, 1977i). There are no National Systems, rivers, parks, or wilderness areas in the region. *

The most popular recreational activities within the region were camping (14.0 visitor-days/1,000 residents), followed by fishing (3.8 visitor-days/1,000 residents), hunting (3.4 visitor-days/1000 residents), and picnicking (3.0 visitor-days/1,000 residents) (U.S. Department of Agriculture, 1977b). The city of Denver lies within this region and is the largest metropolitan area in any of the western coal areas.

*Acreage and attendance figures for State park systems in this region can be found in Appendix Table .

was part of the cultural complex of the southwestern Apache Tradition.

A few explorers from the Spanish settlements [illegible] Fe traveled through the Raton Pass area [illegible] between 1700 and 1740, using the [illegible] areas to the north (U.S. Department of the Interior, 1979). (Fremont-[illegible] follows [illegible] between New Mexico and Colorado.) By 1820, some explorers had traveled through the Denver section but the Raton Pass area had received considerable attention as several groups of explorers traveled the Raton Pass on trips between Santa Fe and the [illegible]. By 1850, Fremont had passed through the Denver section on two of his expeditions, stopping at Fort St. Vrain, and the Santa Fe Trail had been established through the Raton Pass section. By 1890, almost the entire area of both sections had been settled and the areas were crossed first by stage lines and then by railroads. Of the [illegible] listings presently on the National Register, half are in the city of Denver (U.S. Department of the Interior, 1978bb). The listings include houses, churches, hotels, schools, and several historic districts illustrating various aspects of this region's history. The historical associations of the Raton Pass led to its designation as a National Historic Landmark and early inclusion in the National Register.

4.11 PLANS AND POLICIES

This section reviews broad policy areas at the Federal, regional, and state level which may have an effect on coal development. This section begins with an overview of the national and regional transportation system. This is followed by a discussion of current transportation policy with identification of significant issues. Water policy is then discussed.

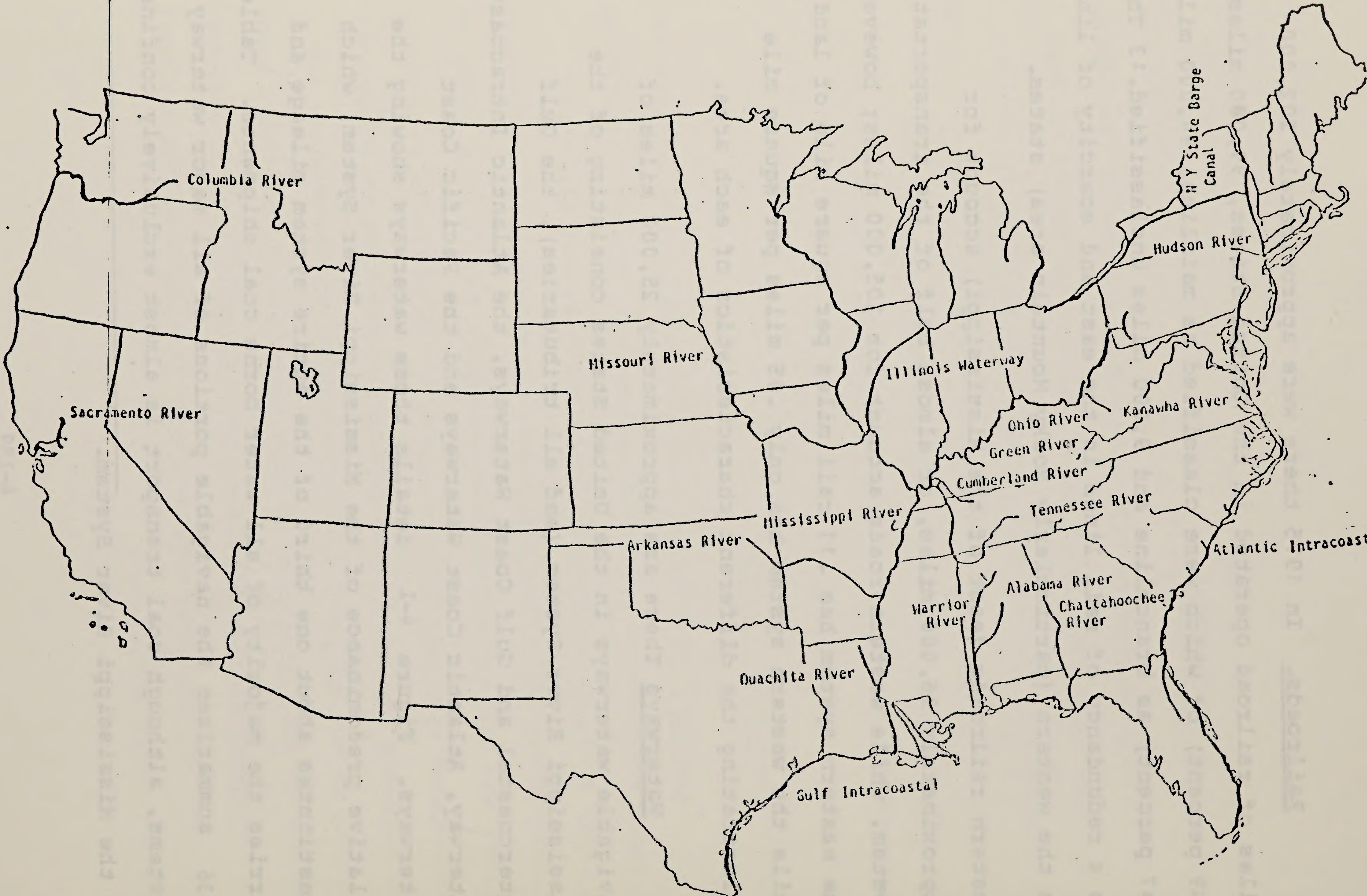
4.11.1 Transportation Systems

General. The United States transportation network is a diverse and complex system consisting of roadways, interstate highway systems, waterways, locks and dams and railroad rights-of-way utilizing pipelines, motor vehicles, locomotives, barges and equipment needed to transport the diverse range of commodities consumed in this country. An accurate assessment of the nation's transportation network is required to determine whether or not adequate facilities exist to accommodate the amounts of coal projected to move from western consuming states. The following section considers the physical miles of waterway, highways, and railroad rights-of-way that make up the national transportation system.

Railroads. In 1975 there were approximately 202,000 miles of railroad operated in the United States, 99,000 miles (49 percent) of which were classified as mainline, 94,000 miles (47 percent) as branchline and 9,000 miles unclassified.[13] There is a redundancy of rail lines in the east and scarcity of lines in the western (particularly Rocky Mountain area) states.

Eastern railroads (east of the Mississippi) account for approximately 96,000 miles, or almost half of the transportation system, while western roads account for 105,000 miles; however the eastern system has .11 rail miles per square mile of land while the western system has only .05 miles per square mile illustrating the different characteristics of each area.

Waterways There are approximately 25,000 miles of navigable waterways in the United States consisting of the Mississippi River System (and all tributaries), the Gulf Intercoastal and Gulf Coast Waterways, the Atlantic Intracoastal Waterway, Atlantic Coast Waterways and the Pacific Coast Waterways. Figure 4-1 details those waterways showing the relative predominance of the Mississippi River System, which constitutes about one third of the entire system mileage and carries the majority of all water borne coal shipments. Table 4-36 summarizes the navigable portions of all major waterway systems, although coal transport is almost exclusively confined to the Mississippi River System.



MAJOR WATERWAYS OF THE UNITED STATES

FIGURE 4-1

TABLE 4.36

NAVIGABLE WATERWAYS OF THE UNITED STATES

Group	Under 6 Feet	6 to 9 Feet	9 to 12 Feet	12 to 14 Feet	14 Feet and Over	Total	Percent of Total
Mississippi River System	2,020	969	4,957	740	268	8,954	36%
Gulf Intracoastal Waterway and Gulf Coast Waterway	2,055	647	1,133	1,216	378	5,429	22
Subtotal	4,075	1,616	6,090	1,956	646	14,383	58%
Atlantic Intracoastal Waterway and Atlantic Coast Waterways	1,426	1,306	649	2,042	1,581	7,004	28
Pacific Coast Waterway	730	498	237	26	2,084	3,575	14
Total Mileage	6,231	3,420	6,976	4,024	4,311	24,962	100%

Source: Waterways of the United States, 1973, American Waterways Operators, Inc. Compiled from information supplied by Corps of Engineers.

In order of coal volume transported, the following table details the most important river systems and their respective tonnages for the year 1976:

TABLE 4-37

River	Tons of Coal Handled
Ohio	181,274,784
Mississippi	62,127,103
Monongahela	29,845,521
Green	13,600,319
Tennessee	9,320,919
Kanawha	6,682,114
Illinois	6,590,415
Black Warrior	6,394,600

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., 1976.

Highway Systems

In 1977 the Federal Highway Administration estimated there were 42,580 miles of interstate highway in use in the United States with only about 2,000 miles yet to be completed. Figure 4-2 details the Federal Interstate system in the United States. Roads and streets other than the Interstate system reached 3,857 miles in 1977. Of that 3.85 million miles, 648,331 miles, or 17 percent, are municipal roads and the bulk (3,209,020 miles) represent rural roads. Growth in the rural-municipal system has been minimal over last seven years, growing less than 16 percent since 1970. Most of the impact of coal related traffic hauled by motor carrier would be on the local/municipal road systems in the major coal producing states. Judging the aqequacy of local highway systems to handle increases in coal traffic will require detailed local studies.

Coal Slurry Pipelines

There is currently only one commercial slurry operation; the 278 mile Black Mesa Pipeline which has an annual capacity of approximately five million tons. The major coal slurry lines are currently being considered, as detailed in Table 4-38 and Fiquure 4-

FIGURE 4-2

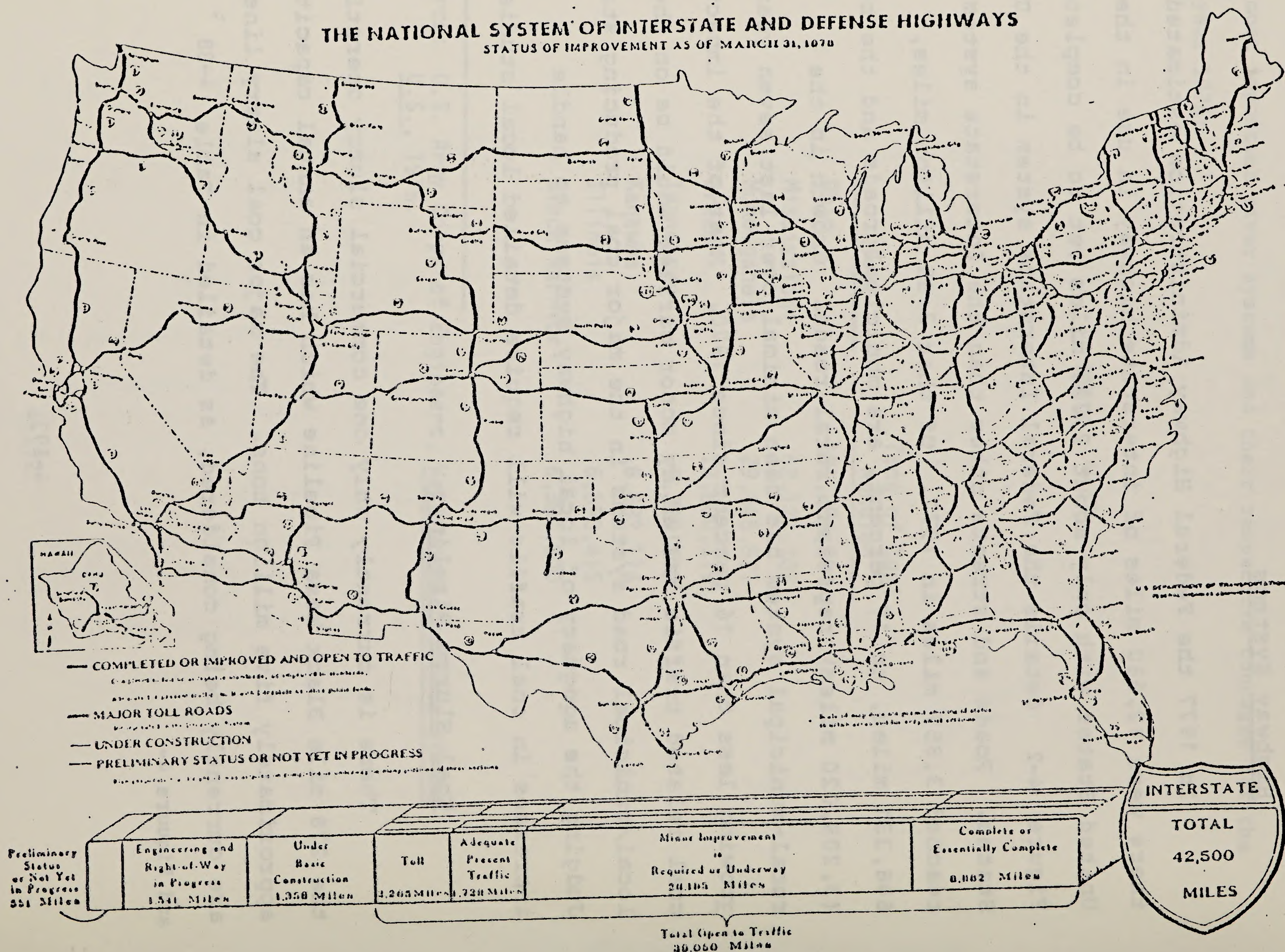

THE NATIONAL SYSTEM OF INTERSTATE AND DEFENSE HIGHWAYS
STATUS OF IMPROVEMENT AS OF MARCH 31,
COMPLETED OR IMPROVED AND OPEN TO TRAFFIC
MAJOR TOLL ROADS
UNDER CONSTRUCTION
PRELIMINARY STATUS OR NOT YET IN PROGRESS
HAWAII
Preliminary Status or Not Yet in Progress 551 Miles
Engineering and Right-of-Way in Progress 1,541 Miles
Under Basic Construction 1,358 Miles
Toll
Adequate Present Traffic
Minor Improvement is Required or Underway
Complete or Essentially Complete
Total Open to Traffic
INTERSTATE
TOTAL
42,500
MILES

TABLE 4-38

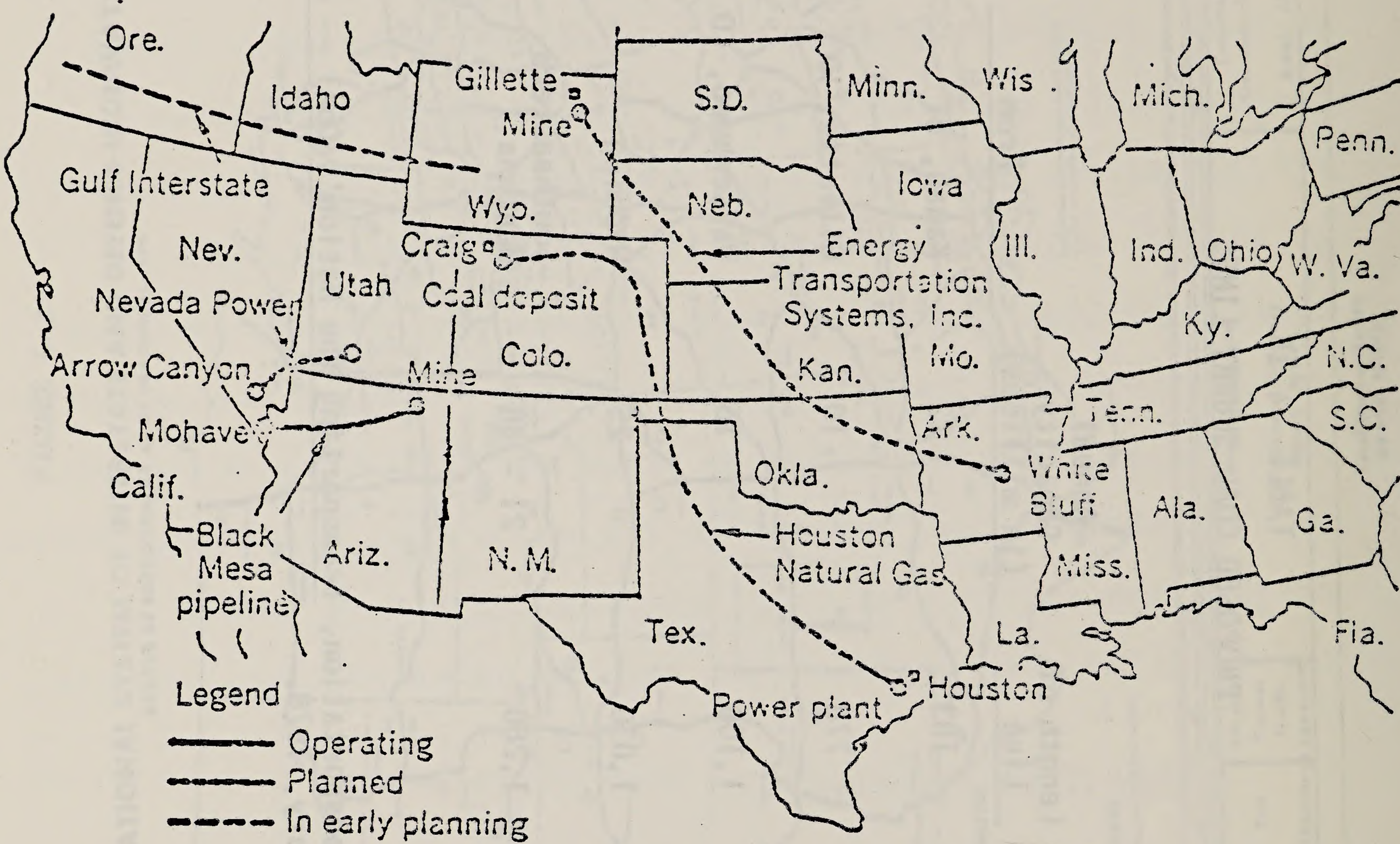
PROPOSED COAL SLURRY LINES

Firm	Length of Line	Annual Capacity (in millions)	From	To
Nevada Power Co.	183	12	Kanab, UT	Nevada
Gulf Interstate N.W. Pipeline Corportation	778	10	Gillette, WY	Oregon
Houston Natural Gas Corporation	1,100	15	Walsenburo, CO	Angleton, TX
Energy Transportation Systems, Inc.	1,030	25	Wyoming	Arkansas
Texas Eastern Transmission	1,260	21 - 38	Southeastern Montana	Texas

Source: Department of Transportation, Transporting the Nation's Coal -- A Preliminary Assessment, January, 1978.

FIGURE 4-3

COAL SLURRY PIPELINES



Note: Proposed Texas Eastern Transmission Pipeline in Table not shown.

Source: Bureau of Mines, Information Circular 8690, Long-Distance Coal Transport: Unit Trains or Slurry Pipelines, 1975

Transportation networks, like all complex systems, have weak links and must be examined in detatil to fully understand their attributes and shortcomings. Table 4.39 is a breakdown of the transportation systems just discussed. In order to ascertain the adquacy of each state's transportation system one needs one relative measure of the adquacy of the system. For each system (waterway, pipeline, railroad and highway) an index of the system per square mile of state land area has been constructed. The last column includes the total transportation system (waterway miles, highway miles, rail miles and pipeline miles) per square mile of land area within each state or complex of states. Values for the index range from .37 miles per square mile in Wyoming to 4.17 miles per square mile for the Connecticut, Massachusetts, Rhode Island area. The lower the value, obviously, the less dense the transportation network per square mile of land. One must bear in mind, however, such an index useful at a comparative level only; it isn't an indicator of potential problem areas, since capacity problems in transportation systems are complex issues not soley related to the size of the physical plant.

TABLE 4-39

INVENTORY OF TRANSPORTATION SYSTEMS

State	Square Miles per State	Waterway Miles	Waterway Miles per Sq. Mile	Pipeline Miles	Pipeline Miles per Sq. Mile	Railroad Miles Main	Railroad Miles Branch	Railroad Miles Total	Railroad Miles per Sq. Mile	Highway Miles Interstate	Highway Miles All Others	Highway Miles Total	Highway Miles per Sq. Mile	Number of Problem Links	All Modes Miles per Sq. Mile
AL	51,609	755	.0146			2,502	2,031	4,533	.09	886	86,675	87,561	1.70		1.80
AZ	113,909			278	.0024	1,953	1,589	3,542	.03	1,205	55,746	56,951	.50		.53
AR	53,104	700	.0132	130*	.0024	1,538	582	2,120	.04	521	77,451	77,972	1.47		1.53
CA	158,693					4,038	3,292	7,330	.05	2,315	172,841	175,156	1.10		1.15
CO	104,247			100*	.0010	2,155	1,291	3,446	.03	959	86,106	87,065	.84	1	.87
CT/MA/RI	14,480					649	1,431	2,080	.14	976	57,448	58,424	4.03		4.17
DE/NJ	9,893					641	670	1,311	.13	399	38,370	38,769	3.92		4.05
FL	58,560					2,063	2,163	4,226	.07	1,542	98,094	99,636	1.70		1.77
GA	58,876					2,927	2,592	5,519	.09	1,192	102,826	104,018	1.77		1.85
ID	83,557			300*	.0036	937	1,723	2,660	.03	612	57,788	58,400	.70		.73
IL	56,400	1,300	.0230			6,845	4,255	11,100	.20	1,760	133,559	135,319	2.40		2.62
IN	36,291	400	.0110			3,937	2,524	6,461	.18	1,132	91,662	92,794	2.56		2.75
IA	56,290	685	.0122			3,239	4,546	7,785	.14	804	112,460	113,264	2.01		2.16
KS	82,264			355*	.0043	3,455	4,329	7,784	.09	808	134,621	135,429	1.65		1.75
KY	40,395	1,311	.0325			2,339	1,226	3,565	.09	715	69,706	70,421	1.74		1.86
LA	48,523	500	.0103			1,991	1,815	3,806	.08	665	54,814	55,479	1.14		1.23
ME/NH/VT	52,123					857	2,308	3,165	.06	826	50,912	51,738	.99		1.05
MD	10,577					521	513	1,034	.10	398	26,113	26,511	2.51		2.61
MI	58,216					1,795	4,222	6,017	.10	1,151	118,998	120,149	2.05		2.15
MN/WI	140,222	650	.0046			4,766	8,526	13,292	.09	1,493	233,976	235,469	1.68		1.77
MS	47,716	460	.0096			1,758	1,856	3,614	.08	673	67,708	68,381	1.43		1.52
MO	69,686	1,020	.0146			3,654	2,390	6,044	.09	1,114	117,223	118,337	1.70		1.80
MT	147,138	125	.0008	50*	.0003	2,657	2,274	4,931	.03	1,193	77,902	79,095	.54		.57
NE	77,227	75	.0010	315*	.0041	2,163	3,351	5,514	.07	480	96,894	97,374	1.26		1.34
NV	110,540			83*	.0008	1,094	480	1,574	.01	540	50,063	50,603	.46		.47
NM	121,666					1,780	501	2,281	.02	999	70,358	71,357	.59		.61
NY	49,576					2,313	2,804	5,117	.10	1,458	109,419	110,877	2.24		2.34
NC/SC	83,641					3,606	3,603	7,209	.09	1,635	152,481	154,116	1.84		1.93
ND	70,665	300	.0042			1,377	3,751	5,128	.07	571	106,430	107,001	1.51		1.53
OH	41,222	520	.0126			4,639	2,805	7,444	.18	1,541	110,620	112,161	2.72		2.91
OK	69,919	350	.0050	345*	.0049	2,340	2,575	4,915	.07	811	109,606	110,417	1.58		1.66
OR/WA	165,173	1,330	.0081	273*	.0017	3,010	5,114	8,124	.05	1,351	192,604	193,955	1.17		1.23
PA	45,333	765	.0169			3,664	3,827	7,491	.17	1,510	116,880	118,390	2.61		2.80
SD	77,047	400	.0052	185*	.0024	307	3,210	3,517	.05	691	82,426	83,117	1.08	1	1.14
TN	42,244	1,105	.0262			1,778	1,487	3,265	.08	990	81,567	82,557	1.95	1	2.06
TX	267,338			1,600*	.0060	7,966	5,462	13,428	.05	3,237	257,649	260,886	.98		1.04
UT	84,916			100*	.0012	1,124	597	1,721	.02	944	48,501	49,445	.58		.60
VA	40,817					2,259	1,709	3,968	.10	1,041	63,430	64,471	1.58		1.63
WV	24,181	372	.0154			1,526	1,638	3,164	.13	462	37,244	37,706	1.56		1.71
WY	97,914			525*	.0054	1,314	665	1,979	.02	910	32,854	33,764	.34	2	.37

*Proposed

Sources: Federal Railway Administration, Network Planning Model Output.
Federal Highway Administration, Forms MI and FMI, 1976.
U.S. Department of Transportation, Transporting the Nation's Coal - A Preliminary Assessment, 1978.
U.S. Army Corps of Engineers, Water Resources and Development (Various States).
U.S. Department of Commerce, Statistical Abstract, 1976.
Newspaper Enterprise Association, Inc., The World Almanac and Book of Facts 1979.

Tables 4-40 and 4.41 present a detailed inventory on transporation systems for the most important western coal producing states as well as data on links in the transportation system that may prove inadequate at peak production levels. Also included in each summary is an index designating the total transportation system (miles) per square mile of land area.

4.11.2 Transportation Policy

Federal and state laws and policies have always had a strong impact on transportation services. Through the Interstate Commerce Commission, the Department of Transportation, the Federal Power Commission, Federal Maritime Administration, and the Coast Guard, the Federal government controls most aspects of surface transportation. Additionally, most areas of Federal jusirdiction also have state counterparts that review rates, mandate safety requirements, and generally protect the public interest. When considering energy products transportation, Federal impact on the transport section is enormous. Federal policies impact transportation modes in three rather broad areas:

- Energy. Determines availability and costs of fuels used by transport section, and determines types and quantities of fuels used by consumers.
- Environmental. Determines types of fuels that may be used according to pollutant levels, possibly changing the transport mix.

TABLE 4-40

WESTERN STATES TRANSPORTATION FACILITY INVENTORY

ITEM	UNIT	WYOMING	COLORADO	N. DAKOTA	MONTANA	S. DAKOTA	ARIZONA	N. MEXICO	TEXAS	UTAH
Railroads										
Main lines	mi.	1,314	2,155	1,377	2,657	307	1,953	1,780	7,966	1,124
Branch lines	mi.	665	1,291	3,751	2,274	3,210	1,589	501	5,462	597
Rail miles	sq. mi.	0.02	0.03	0.07	0.03	0.05	0.03	0.02	0.05	0.02
Roads										
Interstate highways	mi.	910	959	571	1,193	691	1,205	999	3,237	944
All other roads	mi.	32,854	86,106	106,430	77,902	82,426	55,746	70,858	257,649	48,501
Waterways	mi.	0	0	300	125	400	0	0	0	0
Pipelines (slurry)										
Actual	mi.	0	0	0	0	0	278	0	0	0
Proposed	mi.	525	100	0	50	185	0	0	1,600	100

TABLE 4-41

INDEX OF TRANSPORTATION SYSTEMS

Class	Designation
I	0 - .49 miles/square mile
II	.50 - .99 miles/square mile
III	1.00 - 1.49 miles/square mile
IV	1.50 - 1.99 miles/square mile
V	2.00 - 2.99 miles/square mile
VI	3.00 - 4.99 miles/square mile

- Regulatory: Determines the entry, service, rates, and other basic operations of transportation companies.

The single most important Federal body affecting transportation is the Interstate Commerce Commission (I.C.C.). The I.C.C. has jurisdiction over a wide range of areas including:

- Rates. The I.C.C. has authority to approve or disapprove rates. Rates must meet many tests but principally they must be lawful and reasonable and in the public interest while furthering the goals of the National Transportation Policy as stated in the Interstate Commerce Act.

- Entry/Service. The I.C.C. has the authority to approve or disapprove entry of a carrier into the regulated transport sector. The carrier must be able to show that there is a need for the services which it intends to provide, that it can serve the location specified, and that minimal service levels can and will be met.

- Abandonment/Merger. The agency has sole authority to allow railroads the right to abandon lines and also has joint authority over proposed mergers between regulated railroad common carriers.

Table 4-42 summarizes Federal regulatory agencies having control over the transportation sector.

The Federal sector has another important impact on transportation in the form of expentitures. In 1974, the U.S. Department of Transportation spent over $20 billion on highway expansion and maintenance. Corps of Engineers obligations were over $130 million in 1974 for waterways, and aid to railroads under the Railroad Revitalization and Regulators Reform Act of 1976 (4RACT) is at an authorized level of over $6 billion. State and local impact in the expenditure areas is considerable as well. Non-Federal agencies provide approximately 73 percent of all highway funds and about 9 percent of waterway expenditures.

Perhaps of more importance than direct expenditures and regulatory authority are the present and potential issues that will impact on the transportation industry, particularly the coal transportation area. Some of the more important issues are summarized below.

<u>Rates on Coal.</u> It is probable that the I.C.C. will closely scrutinize all future coal rate increase requests by railroads. The recent I.C.C. decision and its wording in <u>Ex</u>

TABLE 4-42

FEDERAL TRANSPORTATION REGULATION AUTHORITY[(a)]

	RATES	ENTRY	ABANDONMENT	MERGER	SERVICE
Motor Carrier	ICC	ICC	- -	ICC	ICC/DOT
Water Carrier	ICC/FMC	ICC/FMC	- -	ICC/FMC	ICC/FMC/ USCG
Railroads	ICC	ICC	ICC	ICC/DOT	ICC/DOT
Oil Pipelines	ICC	- -	- -	- -	ICC
Gas Pipelines	FPC	FPC	FPC	FPC	FPC
Electricity Transmission Lines	- -	FPC[(b)]	- -	FPC	FPC

<u>LEGEND</u>

ICC = Interstate Commerce Commission

FMC = Federal Maritime Commission

USCG = United States Coast Guard

DOT = Department of Transportation

FPC = Federal Power Commission

(a) Source: Ernst & Ernst, <u>The Transportation of Energy Commodities for the Appalchian Region</u>, April 1978.

(b) This authority is limited to facilities used for the import or export of electricity.

Parte 349 provides reasonable insight into the Commissio.'s probable direction concerning its role in the transportation of energy products. In this proceeding, a proposed increase of 7 percent on the transportation rate for coal was not justified. The I.C.C., while favoring selective increases,did not believe that, in an across-the-board general increase, one commodity should be singled out for disproportionate treatment, absent compelling circumstances. Such a showing was not made in the mentioned proceeding. The I.C.C. further noted that coal is a basic energy source and a rate increase not fully justified, even if later ordered cancelled, would have an inflationary impact.

In a broader sense, the I.C.C. is currently assessing what the rate structure for the movement of western coal should be. The need for this study was heightened in response to recent regulatory proceedings involving long distance, unit train operations. Utility companies and line-haul railroads entered into preliminary negotiations regarding minimum coal columes and a per-ton rate structure. Based on these negotiations, commitments were made to expand electrical generating capacity. However, when actual tariffs for initial coal movements were filed with the I.C.C., the rates were considerably higher than anticipated. These higher rates lead to a reassessment of the economic justification of continued long-haul western coal movements and of on-going efforts to emphasize coal-fired over gas or oil-fired boilers. In the long term, an inordinately high rate structure could influence the geographic location and intensity of future coal resource development. It could also improve the competitive advantage of alternative transport modes, such as coal slurry lines.

<u>Waterway User Charges.</u> Unlike rail and motor transport, waterway traffic now bears no direct burden for right-of-way upkeep. The controversy over rebuilding Lock and Dam 26 surely may the basis for some form of compromise on waterway user charges. At present, waterway rates are about 20 percent below rail rates at comparable distances. It seems apparent from published reprts that unless a user charger is enacted, there will be little change in modal traffic divisions or in barge rates.

<u>Eminent Domain and Slurry Pipelines.</u> The question of coal slurry pipelines with the Federal power of eminent domain is no longer active in the current session of Congress. If the railroads, particularly those in the Western District, persist in their efforts to recapitalize their plant and equipment

through heavy dependence upon coal traffic,a revival of Congressional interests in slurry pipelines to restrain railroad rates is likely. It is doubtful that railroads will be any less hostile toward future legislation. One proposal under consideration was that slurry pipelines be treated as common carriers under the authority of the I.C.C.

A related issue is water usage for slurry pipelines. Current thoughts are that the Federal Gevernment would meet fierce resistance from Western states if it attempted to impose a water resources plan. From this and recent events, one can expect continued and protracted local legal intervention in any slurry pipeline proposal.

Deregulation. Most of the thrust of current deregulation proposals is toward the airline and trucking industries neither of which handles substantial quantities of energy products. Since most trucking movements are local in nature, deregulation would have little impact on transported coal products. In the rail area, the emphasis is on regulatory reform rather than outright deregulation.

Railroad Rationalization. No single railroad currently provides single line service between the east and west coats. Rail shipments are generally interchanged at major mid-west rail centers, such as Chicago. This lack of continuous through service has lead in part to increased competitionm from trucking companies and perhaps to higher rates for long-haul movements. The proposed merger of the Burlington Northern and the St. Louis, San Francisco (FRISCO) Railroads would for the first time provide a direct link between the Northern Great Plains coal fields and Gulf of Mexico ports. If authorized by the I.C.C., the merger could improve prospects for greater eastern penetration of western coal and provide greater opportunities for export of coal.

4.11.3 Existing Federal, State, and Regional Water Policies

Federal, state, and regional water supply policy in regard to coal mining concerns: (1) allocation of water resources and (2) control of water pollution. Federal authority applies primarily to navigable waters of the nation and water based on federal lands. State authority applies to other water resources , especially ground water. In addition, administrative authority for many federal pollution control programs is being and in some states has been delegated to state governments.

Federal Level Controls In the United States, a theory of federal-state sovereignty has been used in the development of water law. Historically, federal water law has been subordinate to individual state water laws. Therefore, federal agencies have generally observed applicable state water laws in states where federal projects are being undertaken.

In 1963, however, a different concept of water rights was introduced by the U.S. Supreme Court. In Arizona vs. California (1963), the Court acknowledged superceding federal water rights when land is withdrawn from private use for certain beneficial purposes. This position was further extended to justify a Federal Power Commission license for a privately-owned power generation dam on a non-navigable river. The new concept has drawn the federal and state governments into direct conflict with regard to state protection of private property.

Numerous federal acts have been directly or indirectly concerned with control of water pollution from mining activities: the Federal Coal Leasing Amendments Act of 1975 and the Mineral Leasing Act of 1920, the Federal Water Pollution Control Act (FWPCA) Amendments of 1972, the Safe Drinking Water Act of 1975, and the Surface Mining Control and Reclamation Act of 1977.

The Federal Leasing Amendments Act of 1975 requires the Secretary of Interior or the Secretary of Agriculture, if national forests are involved, to prepare a comprehensive land use plan that includes water resources issues. A coal lease may not be denied based on the plan, but the leasee must have an approved operation and reclamation plan that takes into account the water resources.

Under the Mineral Leasing Act of 1920, the Department of Interior issues rules and regulations controlling the issuance of leases and operation of mines. In addition, the federal government controls subsurface mineral rights. The Department of Interior has proposed to apply existing state regulations that provide protection of environmental quality at least as strong as the federal law.

Under the FWPCA, Section 402 establishes a National Pollutant Discharge Elimination Systems (NPDES) that requires permits for point source discharges, including coal-mining activities. Section 208 of FWPCA requires area-wide water-quality management plans include a method to identify and control, where feasible, non-point source pollutants including surface and underground mine runoff.

The Safe Drinking Water Act of 1975 contains a provision for protection of aquifers that serve as the sole-source water supply for an area. All proposed federal activities in a designated sole-source area must be evaluated to assure protection of the water supply. Sole-source aquifers have been identified in New York, Washington, Idaho, Texas and California.

To prevent significant environmental harm to water resources, the Surface Mining Control and Reclamation Act of 1977 requires development of performance standards that apply to coal-mining activities. These standards apply to mining waste disposal activities as well as disruptions of the hydrologic system resulting from mining and reclamation.

<u>State</u> <u>Level</u> <u>Controls</u> <u>In</u> general, there are two legal concepts of state water allocation: (1) "riparian doctrine" in the eastern United States, and (2) "prior appropriation doctrine" in the western United States. The riparian doctrine reconizes the coequal right of every landowner adjacent to water to use that water, without unreasonably interferring with the rights of other upstream or downstream landowners. The prior appropriation doctrine reconizes that water rights acquired earlier in time has a priority over water rights acquired later in time. A water right can be acquired only if there is available water and if it is to be diverted for a beneficial use. Water that is not needed to satisfy existing water rights is considered unappropriated and thus subject to future appropriation. This process may continue until all available water is appropriated to competing users.

In most western state, a water right may be sold as real property and the type and location of the water right use may be transferred. This allows the transfer of water from low value uses in areas of water abundance to high values in areas of limited water availability. For example, municipal and industrial uses of water are considered to be of high value whereas agricultural uses are considered to be of low value. Traditional economic principles dictate the reallocation of water resource. This transfer process does not operate smoothly, however, because of legal and institutional barriers, some of which included outdated state water rights records, confusion in transfer procedures, and legal restraints to transfers.

There are three basic types of state statutes concerned with control of water pollution from mining activities. They are: reclamation statues, mine sealing statutes, and water pollution control statutes.

Most reclamation statutes are directed to surface mining and vary in stringency. For example, the West Virginia Surface Mining and Reclamation Chapter requires protection of private property, soil, and water resources. A drainage system is required during the period of mining. Other reclamation requirements included control of runoff, revegetation and prevention of seepage and soil erosion. Mine operators are required to post bond to ensure fulfillment of reclamation plans.

Mine sealing statutes are directed to deep mines and are designed to prevent public entry and prevent water pollution. In the Commonwealth of Pennsylvania, the sealing statute is specifically designed to prevent water pollution. Mine sealing prevents air and surface-water flow into mines. The mixing of water, air, and minerals could form acid that can leach into ground water or be released to surface-water bodies.

Most state water pollution control statutes follow federal statutes and contain general language that can be applied to coal mining activities. . However, few state have a specific permit system to prevent the discharge into or pollution of waters of state by coal mining.

Regional Level Controls Controls on the regional level are generally based on the distinct needs of geographic areas, whether intrastate or interstate. For example, in example, water pollution, a river basin may form a more appropriate boundary than the political boundary of a county of state.

An example of an interstate water compact concerned primarily with water allocation is the Colorado River Basin Compact (1922) which is designed to divide the water of the Colorado River Basin among competing users in different states. The Tri-State Compact (1935) is an example of an interstate pollution control compact that was designed to address water quality problems in New York Harbor. Since the creation of that compact, other states have entered into similar pollution control compacts. Pollution control compacts have specific objectives that are carried out by appointed administrative agencies. These agencies have authority that ranges from study and advisory powers to broad water-quality standard setting and enforcement powers.

4.11.4 Water Allocation Issues

The major water allocation issues involve clarification of Indian water rights, federal water rights, and the rights guaranteed by water compacts and treaties. The Indian rights issue is the most volatile because it involves large amounts of water that in most cases are already appropriated.

In the western United States, the prior approriation doctrine has been used to give early acquired water rights priority over later acquired water rights, especially during times of water shortage. Indian water rights, however, are covered under federal law and exist independent of state water laws. An Indian water right comes into being at least upon creation of a reservation, and is not contingent on use of the water. In addition, where land is owned by Indians, the water right could exist from time immemorial. Therefore, application to appropriate water need not be made to the state to acquire an Indian water right.

This principle of Indian water rights is based on a U.S. Supreme Court decision in the case of Winters vs. the United States (1908). Surface water was being diverted upstream from a reservation in Montana under a state-authorized permit that had been issued prior to any substantial use of the water on the reservation. The Court decided that the federal government could reserve a water right for the Reservation. During the next 50 years, the Winters doctrine was given little attention as the water resources of the western

United States were developed by the federal government for use by the non-Indian population. In 1963, the Supreme Court reaffirmed the Winters doctrine in the case of Arizona vs. California. In this decision, the Court quantified Indian water rights to include that amount of water necessary to irrigate all practically irrigable acreage on the Reservation.

This Court decision creates a conflict between the Indians, who have not used their prior water rights to a maximum extent, and non-Indians who have benefited from federal water projects using the same water supply. Factors involved in this conflict concern the right of the Indian nation to develop their water resources and the tremendous capital investment of the federal government and the non-Indian population in the same water resources. Development of coal resources in the western states may be contingent on resolution of the Indian water rights conflicts. Specifically, the Indians have laid claim to water resources of the northern Great Plains and the Colorado River Basins. These two basins contain the Powder River, Fort Union, Green River-Hams Fork, Unita-Southwest Utah, and San Juan-Black Mesa Coal Regions described in this Environmental Impact Statement.

Earlier Court decisions appear to support only agricultural uses for the Indian water rights, however, it has been argued that the purpose of the Indian water right is to create an economic base for the Reservation. Therefore, the water could be used for beneficial use, including coal development and energy conversion. The legality of the non-irrigation use of the Indian water is being litigated and will be judicially determined.

The Federal government is involved in major projects that require large quantities of water thus affecting regional water availability. Recent court decisions have limited the application of state law to certain federal projects. In Arizona vs. California (1931), the court held that water could be reserved for federal projects on public land that had widespread benefits, even though a single state was inconvenienced. Application of this right of the federal government to benefit the nation by producing coal from federal lands could force present users of the water resources to lose or at least diminish their water rights. Such a situation would certainly produce intense public opposition.

There are many water compacts between states and regions and treaties with other countries that guarantee water of specific quality and quantity. These compacts and treaties could affect the amount of water available for mining operations. For example, the Colorado River Basin Compact (1922) divides the Colorado River Basin at Lee's Ferry, Arizona, into the Upper and Lower Basins. The compact requires the Upper Basin states to allow a minimum flow of 75 million acre-feet per any 10-year period of flow into the Lower Basin. In 1948, water allocations were granted under the Compact to the member states including Arizona, New Mexico, Utah, Colorado, and Wyoming. Arizona was granted 50,000 acre-feet per year, and the other states were granted varying percentages of the remaining water, ranging between 11 and 52 percent.

Mean natural stream flow in the Upper Basin, measured by the U.S. Geological Survey at Lee's Ferry, Arizona has fluctuated greatly. Through 1970 the average annual flow is 14.86 million acre-feet per year, with approximately 8 million acre-feet or less five percent of the time. However, a mean flow of 12.9 acre-feet per year was recorded between the years 1931 and 1964 and a mean flow of 18 million acre-feet was calculated in 1922. A difficulty has therefore arisen with regard to the volume of water available for allocation.

In 1964 the U.S. Supreme Court ruled in Arizona vs. California that Arizona was entitled to an additional 2.8 million acre-feet per year above the agreements of the Compact. Arizona's right to Colorado River Basin water is presently completely allocated. Further, with the completion of the Navajo Indian Irrigiation Project in New Mexico, total water use in that state will be slightly above the mean state allocation of the Upper Colorado River Basin Compact (1948).

In 1950, the Yellowstone River Compact was approved by Montana, North Dakota and Wyoming to regulate distribution of appropriative water rights in the Yellowstone River Basin. All water rights acquired prior to 1950, however, are not subject to the terms of the compact. In addition, the compact forbids member states from adversely affecting Indian and Federal rights to the Yellowstone River Basin waters.

In 1973, the Montana Water Use Act was amended to allow the State or any political subdivision or agency to apply to the Board of Natural Resources for a reservation of waters for existing or future beneficial uses, or to maintain a minimum flow, level or quality of water for any period of time. Under this Act the Montana Department of Fish and Game applied to reserve the right to 8.2 million acre-feet of Yellowstone River water to protect the biota of the river.

Due to huge competing claims to Yellowstone River water allocated to Montana, the Yellowstone Moratorium was enacted in 1975 to allow the Montana Board of Natural Resources to quantify water rights and determine the amount of water available. The moratorium was envisioned to end in 1977 but has been extended indefinitely. Thus, applications for water rights from several state agencies including the Department of Fish and Game and large industries are pending. The outcome of this moratorium and the pending applications could affect water availability and coal development in the area.

The Mexican Treaty (1944) requires the United States to discharge 1.5 million acre-feet of Colorado River water each year to Mexico. Due to development of water resources in the basin, the quality and quantity of Colorado River water has declined. The federal government has assumed financial responsibility to upgrade the quality and quantity of Colorado River water in fulfillment of the requirements of the Mexican Treaty. Water is being transferred into the basin and desalination projects are being undertaken to assure water rights of existing users.

Many other treaties and compacts place similar restrictions on water availability and quality. Increased coal mining, expecially in the western United States, may significantly threaten the viability of these agreements.

Both the federal government and the states have developed programs to protect water quality. Both water-quality standards for rivers and streams and effluent discharge standards for industry have been promulgated. Development of such standards has brought the Federal and state governments into direct conflict with each other as well as into conflict with industry, environmentalists, and the public.

Increased coal mining will mean increased threats of water pollution. Consequently, additional regulation will be needed, setting into motion the problems inherent in the policy-making process. This issue will be evident in all potential coal-mining regions.

4.11.5 State Policies

State policy must be considered when the overall environmental impacts of a Federal coal management program are addressed. In recent years, the states have assumed more responsibilities in the formulation of national programs through a policy of coordinating Federal, state, and local government actions. This policy was set into motion by the U.S. Office of Management and Budget through issuance of the A-95 Circular. This White House Circular provides for creation of a state clearinghouse system to coordinate Federal funding and program operations. This system has been especially effective in Western coal states as a means of broadening and strengthening surveillance of Federal mineral leasing activities.

Individual state policies relating to coal leasing and development activities in Western coal states are presented in Appendix K. A brief description of the roles of the Federal Regional Council (FRC) and the Council of Government (COG) in this system is also presented in Appendix K.

The eight states discussed include those where public land ownership is most significant and where the largest deposits and production of coal are found, namely, Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming. In addition, Arizona and South Dakota are included for analysis, although coal deposits in these states are small and located largely on Indian reservations.

CHAPTER 5

ALTERNATIVE LEASING STRATEGIES AND THEIR IMPACTS ON REGIONS

This document is a preliminary working draft of the Department of the Interior's Coal Management Environmental Statement. The document is intended for internal review purposes. It will be revised in response to reviewer comments. In addition, internal analysis and revision of materials are continuing.

CHAPTER 5

ALTERNATIVE LEASING STRATEGIES AND THEIR IMPACTS ON REGIONS

This chapter describes the major impacts that are likely to occur as a result of implementation of a Federal coal management program. The first section presents a discussion of the various methodologies used for the determination and analysis of impacts. Generic discussions of various categories of impacts including socioeconomic, transportation, ecological, and cultural, follows. Section 5.3 discusses the impacts as they apply more specifically to the preferred program and each of the six alternatives. A brief comparative summary analysis completes this chapter. Included is discussion of interregional impacts, comparison of impacts as they relate to low, medium, and high production scenarios, and cumulative environmental impacts of the preferred program and the six alternatives.

5.1 METHODOLOGY OF IMPACT ANALYSIS

5.1.1 Activity Analysis

Activity analysis highlights the potential environmental impacts which could result from construction and operation of various facilities located at nodes of the coal cycle. Estimates of the activities producing such impacts are the key to this analytical approach. Assumptions are made as to average mine size, average coal consumption of various energy conversion facilities and average levels of support facilities necessary to extract and convert given levels of energy resources. Impacts estimated using this approach rely upon identification of characteristics of specific nodes in the coal cycle. For example, the average mine in a region might produce 3 million tons, employ 300 people and have 25 miles of spur railroad track linking it to mainline rail facilities. Given regional coal production estimates, estimates of total production per mine, number of mines, people employed, roads built, royalties paid, etc. can be made. Since regional constraints and characteristics can influence energy resource developmental levels, estimates of activity analysis are presented on the basis of both geographic regions and specific leasing alternatives analyzed. Tables 3-2 through 3-12 present these activity estimates for 1985 and 1990.

5.1.2 Production Scenarios - High, Medium, and Low

This coal management programmatic environmental statement provides analyses of impacts projected to accompany a range of alternate leasing policies. Because there are inherently many uncertainties as to the coal production levels in specific western regions, several levels are analyzed for both the preferred action and no leasing alternatives. By evaluating three production levels (high, medium and low), a broad range of assumptions concerning factors such as the price of energy substitutes, the extent of regulatory constraints, mining and transportation costs, and growth rates in the electric power industry (nuclear and non-nuclear) are incorporated in the analysis. The production levels specified for high, medium and low levels for the preferred alternative and the no new leasing alternative are not derived from any specific projection model or procedure, but rather, represent a bracketing of reasonable production possibilities as determined by examining:

- o Department of Energy (DOE) projections;
- o Preliminary Department of Interior regional environmental impact statements;
- o Coal industry and government forecasts;
- o Approved and pending mine plans;
- o Current production levels;
- o Contractually obligated production;
- o Other pertinent factors available.

The high, medium and low levels of regional productions for the preferred alternative and the now new leasing are presented in Table 5-1. The preferred leasing alternative (a combination of leasing to meet DOE national production projections as modified by industry, state, local and other imputs) is capable of meeting all levels specified, although the medium level is considered more likely to occur than either the high or low levels.

Similarly, the no new leasing alternative incorporates many of the assumptions made in the preferred alternative production levels. If the same institutional constraints exist in the event of adoption of a "no new leasing" policy, privately controlled coal resources will be called on to meet projected increases in demand. Based upon conditions similar to those hypothesized for the preferred action, three levels of production are presented in Table 5-1 for the no new leasing alternative. Further support for an analysis of high, medium and low production levels under the no new leasing alternative is that it represents a major departure from the proposed action. As such, it could involve substantial differences in the receptors of impacts produced.

Alternative 2 (PRLA leasing only) and alternative 3 (short-term leasing only) were considered to be similar to the no new leasing alternative in their impacts. To provide a measure of the impact of each alternative, a medium production level is analyzed. Table 5-2 presents medium production level estimates for alternatives 2, 3, 4, 5 and 6 for the western coal regions. The impacts of the low and high production levels for alternatives 2 and 3 would be similar to the impacts of comparable production levels for the no new leasing alternative.

TABLE 5-1

PROJECTED PRODUCTION LEVELS,
PREFERRED PROGRAM AND NO NEW LEASING ALTERNATIVE
1985 and 1990
(million tons)

REGION	PREFERRED LEASING POLICY			NO NEW LEASING		
1985	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Fort Union	16.9	31.9	51.9	16.9	31.9	51.9
Powder River	150.0	205.0	300.0	150.0	204.8	275.0
Green River	40.0	80.0	130.0	40.0	76.0	99.6
Uinta	15.0	30.0	45.0	15.0	29.6	44.5
Denver-Raton	2.0	5.0	10.0	2.0	5.0	10.0
San Juan	15.0	25.0	40.0	15.0	24.8	39.7
1990	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
Fort Union	21.9	41.9	81.9	21.9	51.0	94.9
Powder River	175.0	400.0	600.0	175.0	305.0	335.0
Green River	70.0	120.0	175.0	66.5	98.7	119.0
Uinta	20.0	40.0	60.0	19.8	45.0	65.0
Denver-Raton	5.0	10.0	15.0	5.0	10.7	15.0
San Juan	25.0	50.0	75.0	25.0	59.4	77.3

TABLE 5-2

PRODUCTION LEVELS, MID LEVEL ALTERNATIVES
1985 and 1990
(million tons)

REGION	PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	STATE DETER-MINATION	MEET DOE TARGETS
1985	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Fort Union	31.9	31.9	36.9	37.4	21.9
Powder River	205.0	205.0	225.0	183.7	204.6
Green River	77.9	77.0	112.0	57.5	112.0
Uinta	30.0	29.7	35.0	29.4	26.4
Denver-Raton	5.0	5.0	6.0	7.5	6.0
San Juan	24.8	24.8	30.0	32.0	22.1
1990	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Fort Union	47.4	50.6	51.9	54.4	22.5
Powder River	355.0	316.0	450.0	269.1	396.1
Green River	101.0	104.2	150.0	62.8	149.5
Uinta	42.0	44.8	51.0	36.8	28.3
Denver-Raton	10.5	10.6	10.0	10.3	7.5
San Juan	54.9	58.4	60.0	63.0	57.2

Projection under the high, medium, and low scenarios for alternatives 4, 5, and 6 are similar to comparable scenarios for the preferred alternative. For ease fo analysis, only the mid-level impacts are estimated for the former alternatives.

5.1.3 Impact Estimation Methodology

The social, economic, and ecological effects of coal production, preparation, transportation, and consumption are estimated for the seven leasing alternatives at two discrete points in time. Detailed impact estimates are presented for the no new leasing and preferred leasing alternatives. Estimates of impacts accompanying other leasing alternatives are presented in tabular form.

The overall methodological approach utilized in impact estimation relies on concepts embodied in a network coal flow allocation model, a regional residual estimating model, and a series of environmental loading factors applied to coal flows. These loading factors (multipliers) identify specific residuals generated per 100,000 tons of coal mined, processed, transported, or consumed. Residuals are the result of economic activity. They occur because no production or resource use activity transforms all activity inputs into desired products or services. The remaining flows of materials and/or energy from the activity are termed "nonproduct outputs." If a nonproduct output has no value in existing markets or has a value less than the cost of collecting, processing, and transporting for use or reuse or another activity, the nonproduct output is termed a residual.

Interrelationships Among Residuals. It is critical to recognize the interrelationships among residuals. One form of material residual can be transformed into one or more other forms, usually by the addition of materials and energy, as in the modification of sewage in a municipal treatment plant.

These interrelationships can be illustrated by considering a power plant using coal as the fuel for electric energy generation. The particulates formed in combustion can be discharged to the atmosphere in the exhaust gas stream, i.e., a gaseous residual. If there are constraints on such discharge, a wet scrubber could be installed to wash the particulates out of the gas stream, and thereby tranform the gaseous residual into a liquid residual, i.e., suspended solids, which could then be discharged to an adjacent water body. Such discharge might adversely affect water quality, with consequent damage to fish. To prevent such an impact, a settling basin could be installed to settle out the suspended solids in the liquid residual, thereby yielding a solid residual for ultimate disposal (Bower, 1977).

Estimates of residuals occurring in the coal cycle are generated by combining environmental loading factors and specific coal flows at individual points (nodes) in the coal cycle. Due to the broad geographic scope, number of alternatives considered, number of periods analyzed both absolutely and incrementally, and number of impacts to be considered, it was determined that a computerized residual estimating model would be a necessity.

Figure 5-1 presents a schematic diagram of the approach utilized to estimate residuals and, utimately, impacts. A more exhaustive description of the residuals model, environmental loading factors and geographic region utilized in the impact estimating process can be found in Appendix .

Environmental Loading Factors. The concept of environmental loading factors was incorporated in the residuals model. These loading factors, or multipliers, relate levels of coal flow at specific nodes in the coal cycle to specific types of impacts. Loading factors were developed for the following major impact categories:

- o Air pollution;
- o Water pollution;
- o Land disturbed;
- o Solid waste;
- o Accidents/fatalities;
- o Operating energy;
- o Direct workers.

Within each of the areas listed above, multipliers were developed for the following nodes:

- o Mining
  - underground
  - surface
- o Coal preparation
  - mechanical cleaning
  - nonmechanical cleaning
- o Transportation
  - rail
  - truck
  - barge
  - slurry pipeline

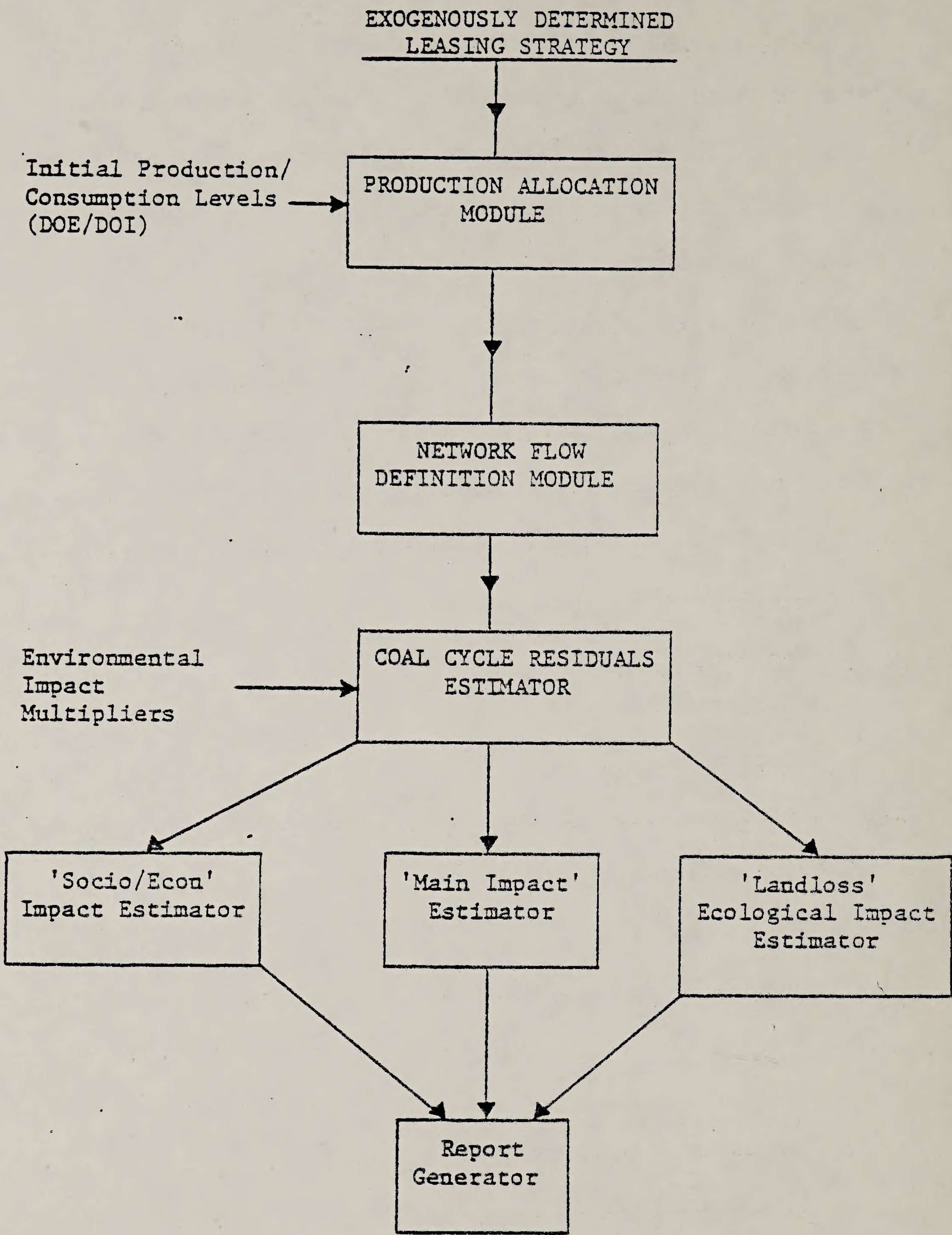

EXOGENOUSLY DETERMINED LEASING STRATEGY
Initial Production/ Consumption Levels (DOE/DOI)
PRODUCTION ALLOCATION MODULE
NETWORK FLOW DEFINITION MODULE
Environmental Impact Multipliers
COAL CYCLE RESIDUALS ESTIMATOR
'Socio/Econ' Impact Estimator
'Main Impact' Estimator
'Landloss' Ecological Impact Estimator
Report Generator

FIGURE 1

o Conversion

steam generation
metallurgical coal
synthesis including
synthetic conversion
high Btu gasification
low Btu gasification
liquefaction

The multipliers were applied to projected flows of coal to produce estimates of residuals. These residual estimates were then characterized and analyzed in terms of their impact on the social, economic, and ecologic systems affected. The following sections present more detailed discussions of the multipliers, residuals, and impacts resulting from projected coal flows.

Socioeconomic Impact Methodology

The broad area of social and economic impact analysis is primarily based on levels of employment related to various nodes of the coal cycle. Indirect or induced employment resulting from increased employment directly related to coal production and use can then be considered.

Once estimates of total construction employment, total operational employment and total induced employment are made, assumptions concerning number of dependents can be applied to projected employment levels to produce estimates of total coal cycle-related population. Having once produced coal-related population estimates, levels of infrastructure demand are then equated to specific populations. Other studies evaluating the socioeconomic impact of western energy resource development such as studies by Gilmore and Duff (1974,75,76), Doran (1974) and others provided a broad base of information upon which this methodological approach can be based. Once estimates of absolute and additional infrastructure requirements are determined, the next step in the analysis is to combine estimates of infrastructure costs with the incremental and absolute estimates of infrastructure demand. The resulting levels of additional demand on public fiscal resources provide insight into the level of financing that will be required to alleviate problems such as inadequate roads, substandard or insufficient education and health facilities, and public safety needs. The estimates of additional fiscal needs also enter the planning process and could negate arguments in favor of massive energy extraction and conversion facilities for a specific community or subregional area.

Ecological Impact Assessment Methodology

The ecological impact analysis is based upon estimates of land committed or disturbed due to mining and related development under the various alternatives. Since actual sites were not considered in this analysis, acres disturbed were assigned the same ratio as current land use. Percent allocated to each land use category was determined by Howes (1978) based on data from states within each region. It was assumed that mining and development of related energy facilities would not occur in either urban areas or in limited sensitive ecosystems, but would be located in common types of vacant land areas.

Once acreages were determined and assigned to respective land use categories, natural and agricultural biomass productivities per acre or animal unit were calculated to give estimates of potential ecosystem losses due to development. Natural ecosystem types and biomes were determined from Braun (1972), Shelford (1963) and Kuchler (1966). Most common crops for each region were determined from U.S. Department of Agriculture (1977a).

Productivity rates for natural communities are given on an annual basis, predicated on data reported by Olson (1974), Miller et al (1976), and Rodin et al (1972). Harvestable crop productivities are from U.S. Department of Agriculture (1977a). Forest productivities are based on state net timber production records and on the assumption that 30 cubic feet of green wood equals one ton (White and Hook, 1975).

Population densities for wildlife are based on Allen (1962), Kendiegh (1961), U.S. Department of Interior (1974), U.S. Department of Interior (1978d), and Taylor (1969). If natural and farmland acreages are converted to mining or related development, carrying capacity of habitat would be reduced. Although wildlife might not be killed directly, over the years competition for food, cover, habitat, or other limiting factors would lower populations. It was assumed that animals could not move into new habitats successfully because all ecological niches in adjacent habitats would be filled.

Analysis of short-term commitments of land are based on the assumption that during the initial phases of development all candidate acreages would be disturbed (short-term). Long-term land commitments include land that is converted to hard surfaces, buildings, and other uses that would not undergo reclamation or natural revegetation.

An attempt has been made to quantify impacts where possible so that regional comparisons can be made. In areas where data are not available, or the analysis must be site specific before impact can be determined, a qualitative discussion is presented.

5.2 GENERIC IMPACTS

There are certain impacts associated with the various nodes of the coal development cycle that can best be described generically. These are impacts that cannot be quantified on a regional basis and are independent of time of action and lease strategy; they are dependent on site-specific activities. The impact categories that are addressed generically in this section include fiscal demands, accidents and fatalities, topography, geology, minerals, soils, archeology, historical sites, ecology, and recreation. Following this generic treatment, section 5.3 describes impacts that are regionally quantifiable as a function of leasing strategy (preferred program and six alternatives), time frame (1985, 1990), and coal production levels (low, medium, high).

5.2.1 Socioeconomic Impacts

Socioeconomic impact in this analysis is addressed quantitatively for the twelve coal producing regions in Section 5.3 . It is important to note, however, that data aggregated for these very large and often diverse regions provide only broad insights into potential impacts of the coal management program. Actual socioeconomic impact is a more localized phenomenon which will ultimately be determined by a variety of factors related to individual community characteristics. For example, the size and location of a specific community will play an important role. An area with a large indigenous population can more likely supply the types of labor required for development and thereby reduce the number of workers and their families that must be imported. Proximity of even relatively small communities to urbanized areas with well developed highway networks will facilitate worker communtation and also reduce population influx. Most importantly, larger communities with highly developed infrastructures are better able to absorb a given level of population increase than a small, rural community. (U.S. ERDA, 1977b).

Basically, the degree of impact is often directly related to the incremental growth of the area. Communities in semirural areas can generally absorb a five percent annual growth rate without experiencing severe strain. However, rapid urban growth or "hyper-urbanization" appears to occur when average annual increases approach the seven to ten percent range resulting in boom-town development

(U.S. ERDA, 1977b). Population above that level would require detailed advance planning and possible considerations of new town design.

High or even moderate growth in areas with relatively undeveloped infrastructures generally creates severe adverse socioeconomic impact. Rather than create new towns where none exist, existing social and economic institutions would have to be altered significantly to accommodate change (U.S. ERDA, 1977b). Local workers would be attracted to higher paying jobs in mining or related industries creating shortages in other sectors of the economy. Wage and salary levels would increase raising the overall cost of living and adversely affecting those on fixed incomes.

Housing shortages could be severe resulting in the rapid establishment of mobile home parks in areas with inadequate zoning regulations. This often leads to haphazard growth, substandard living conditions and a general deterioration of the social structure. In more severe cases, there could be an increase in violent and property crime, alcoholism, prostitution, and drug abuse. Lack of a full array of recreational, educational, social services, and cultural opportunities for personal enrichment may become evident. Divisive political struggles for control of local government and the feeling of loss of community control could develop (U.S. ERDA, 1977c).

Long term planning problems are also likely to occur in the public sector (U.S. ERDA, 1977b). Demand for public facilities and services would rise rapidly once development begins. Population increases would require expansion of educational institutions, health care systems, water and sewer distribution networks and public safety personnel and equipment. However, tax bases in local communities are rarely adequate to finance such rapid expansion. Tax revenues anticipated from new development are generally not available to communities until the projects reach the operational stage, often long after the major impacts of the construction phase have occurred. Even then they may not be directed to the political jurisdiction experiencing severe socioeconomic impact. Overcrowded schools and health care facilities would result along with an increase in social problems and deterioration of the quality of life.

Expansion or upgrading of highway networks would be necessary to handle the larger traffic volumes. Since these are paid for by the public sector, increased tax burdens would be incurred by area residents. New highways would open up previously inaccessible areas with a potential impact on scenic areas, recreational facilities, and cultural patterns and values of relatively isolated communities.

Special problems could result in areas where new towns are designed. Expectations of employment opportunities often attract more workers than can be accommodated by new development. High unemployment rates can result in placing severe strain in the welfare system which is supported by area residents. Substandard living conditions could develop as result of haphazard growth beyond the boundaries of the zoned areas of the planned community. Proximity to older communities could also have an affect on the quality of life of the earlier residents (U.S. ERDA, 1977b). The quiet, relatively rural lifestyle of the past may intensify quite rapidly and lead to a way of life which is more hectic involving change and uncertainties never before experienced by small local communities. In these cases, economic growth and higher standards of living may provide inadequate compensation for local residents experiencing radical changes in their day-to-day living.

5.2.1.1 Fiscal Impacts

Public Sector Effects

The level of demand for public goods and services generated by coal-induced population change will be a direct function of the existing level of infrastructure development. In areas such as Denver, small percentage increases in population and accordingly, public services, will result in relatively minor demands for additional fiscal resources. Conversely, in a sparsely-populated region such as the Powder River area, identical fiscal demands may prove unmanageable. Other examples of impacts associated with fiscal demands include increased demand for water and sewage facilities. Existing sewage systems may become overloaded, resulting in the pollution of local streams and aquifers. Existing facilities are likely to become overloaded and prone to failure if facilities are not expanded.

Expanded police services will be needed to cope with the increased population and resulting crime and traffic problems. Fire protection services will also have to be expanded. Because existing medical facilities within the area may be meager, they must be expanded. As with many rural communities, it may be very costly or difficult to increase rapidly the availability of medical services. Coal development companies may themselves supply such services to employees and their families.

Because the age structure of the new work force differs from that of the area population before development, school enrollments are likely to grow even faster than the population. During the early stages of coal development and the construction of conversion facilities, revenues generated by coal-related activities will not yet be available for financing the expansion of public education. However, the growth in the demand for public schools will begin during the early stages, particularly in those communities near the sites of conversion facility construction. This would have the effect of at least partially internalizing these external costs of coal development. However, it should be borne in mind that higher wages, training costs, and outlays for public service provision will internalize only those external costs borne by industry workers, unless others also enjoy the benefits of coal industry-sponsored public service improvements. To the extent that others suffer a net decrease in the quality of services available, the external costs will not be internalized.

Private Sector Effects

With the increase in population and disposable income, there will be corresponding increases in the levels of demand for goods and services. The demand for housing will also increase sharply. To meet this demand, mobile homes are apt to be used extensively because they are, in the short run, less costly. These are likely to be clustered into trailer camps with lower quality water and sewage facilities, streets and less open space. Mobile home developments for operating employees will probably be of higher quality, as they will be designed for a more permanent population. With a sharp increase in demand for housing generating substantial increases in housing prices, the market may turn to less costly, and therefore lower quality substitutes in the short term.

5.2.1.2 Tax Lead Time Impacts

Development of western coal resources will result in the generation of significant fiscal impacts on local, state, and Federal entities. These impacts have at least two significant aspects:

(1) A temporal imbalance between revenues to provide for the needs of an expanding population and the generation of additional revenues from resource extraction and conversion facilities.

(2) A spatial imbalance of revenues among communities producing the impact and those receiving them.

The temporal imbalance problem results from the arrival of new, transitory households during mine and conversion plant construction. Their needs for housing, health, and safety place severe strains on the local infrastructure at a time when increased revenues are minimal. The spatial imbalance problem occurs because the facility will be built in one taxing jurisdiction while the new residents, induced to the area by the facility, settle in another. Under normal (i.e., low population growth rate conditions) the fiscal resources necessary to provide these services would be generated simultaneously with demand. However, large increases in tax revenues are not anticipated until several years after commencement of energy-related construction projects. Once completed, the tax base expands, energy resource production increases, and sufficient tax revenues are generated.

After a period of five to eight years, those facilities will produce excesses of tax revenue over tax expenditures. Capital improvement funds are the critical need in the early growth years.

Thereafter, the key fiscal concerns will be operations, maintenance, and depreciation of public facilities and previously assumed debt financing costs.

The problem of equitable distribution to cities and school districts of revenues generated from coal resources development and conversion facilities remains unsolved. It is obvious that some governmental entities will be severely impacted when no industrial development occurs within their taxing jurisdictions, but residential development does.

Concomitant with the need for sound fiscal planning prior to population increases, is the need for enlightened land use planning. If nonrestrictive policies are adopted with regard to the location of subdivisions, individual residences, and mobile home parks, the community may face high costs for busing students to central school sites as school populations increase. The tax bill for such busing services can be avoided if people not connected with ranching or farming are encouraged to cluster in service areas large enough to support urban-type facilities, such as schools.

5.2.1.3 Accidents and Fatalities

Accidents and fatalities can occur at all steps in the coal cycle. They can be caused by human error, structural or mechanical failure, and natural phenomena. These accidents cause environmental damage, economic losses, fatalities, injuries, and health impairment. Accidents associated with coal-related activities can be generic hazards (arising from participation in a particular activity in which the accident rate is generally independent of the coal fuel cycle, e.g., heavy equipment operation) or specifically coal-related hazards (an activity where accident rates for the coal fuel cycle are different from the industry-wide average, e.g., underground coal mining).

Underground coal mining is significantly more hazardous than underground mining of other substances; both are more hazardous than an all-industry average. The frequency of injuries in underground coal mines is more than one and half times the average for underground mining of other materials. The severity of underground coal mining injuries is almost eight times the all-industry average and about 25 percent higher than underground mining per se (excluding coal).

Mine roof and rib falls (cave-ins) account for 40 to 50 percent of annual coal mine fatalities. Haulage related accidents account for another 15 to 20 percent. While gas or dust explosions may cause many deaths during a single incident, they only account for 10 percent or less of the annual underground coal mining fatalities. Surface activities associated with underground coal mining and surface coal mining account for approximately 20 percent of annual coal mining fatalities during the past 10 years. Significant health or environmental impacts also may result from collapse of a mine tailing dam or from land subsidence associated with coal extraction.

While the frequency of injury and death at surface mines is significantly less than at underground mines, the number of accidents occurring at surface mines has been growing as surface mining increases.

Other hazards associated with the coal fuel cycle are generic in nature. Accidents occur during transportation and distribution of coal via rail, truck, or ship. The accidents occurring in the coal transportation sector are principally those involving motor vehicles and trains. The greatest number of fatalities result from motor vehicle accidents. Most rail accidents causing fatalities are attributable to servicing and other non-train operations. Estimated rail accident rates involving some form of coal transport are 0.2135 fatal injuries and 9663 nonfatal accidents for every billion ton miles. Trucking rates are estimated at 47.2 fatalities and 434.4 nonfatal injuries per billion ton miles.

In fossil fueled power plants, electricity currently is generated by boiler fired or gas turbine plants. Major accidents in these systems result from explosion in a boiler, turbine or generator. Explosion and fire generally occur because of fuel mishandling or component failure. Power failure may result from explosions from electrical malfunctions, breakdowns, circuit overloads, or human error, and from accidents involving transmission and distribution of electricity.

The coking of coal has been carried out since the turn of the century. Although there have been incidents of coke ovens or batteries exploding, the frequency of occurrence has been low. An accidental shift in operating conditions may cause an increase in fugitive emissions, some of which are known or suspected carcinogens.

Coal processing facilities (e.g., cleaning, sizing, drying operations) are less hazardous than other elements in the coal fuel cycle. Advanced processes involving coal liquefaction or gasification generally are in the developmental stage; no operating data exist to quantify accident situations. The rapid, explosive release of coal conversion reactants or by-products may include polycyclic aromatic hydrocarbons, or combustible gases. Some process steps such as rapid depressurization or volatilization are inherently dangerous. Although accident data for these processes are not available, accident histories in other industries, e.g., oil refining, may be similar.

5.2.2 Transportation Impacts

Rail, barge, and truck transport of coal will have significant impacts on communities in coal producing, consuming, and intermediate transit regions. Since these modes are all classified as "surface transportation," it is apparent that some community disturbances will result with significantly increased levels of utilization of any or all of these modes. Those impacts to be examined here are:

- o Noise;
- o Traffic Delays;
- o Accidents and Fatalities.

Of the many "costs" associated with increased traffic levels, the physical effects of noise and vibration intrusion are the most elusive and pervasive. Most freight train noise levels vary between 90 and 110 dBA (annoyance sound level in decibels) at 100 feet. In comparison, EPA automobile traffic noise criteria require that traffic noise levels are not to exceed 70 dBA 10 percent of the time (URS, 1976). There is little difference between the noise levels associated with trucks vis-a-vis railroads, as indicated by the following data.

RAIL AND TRUCK NOISE LEVELS

Vehicle	Noise Level dBA 50 ft. from Source*
Trucks	
Light	70 - 85
Medium	80 - 89
Heavy Duty	85 - 95
Railroads	
Diesel, Electric, Locomotives	88 - 98
Freight Cars	80 - 94
Passenger Cars	80 - 90

Source: Kerber, Matthew J., 1973-74, Your Government and the Environment--A Supplemental Environmental Reference, Vol. 2-S. Output Systems Corporation.

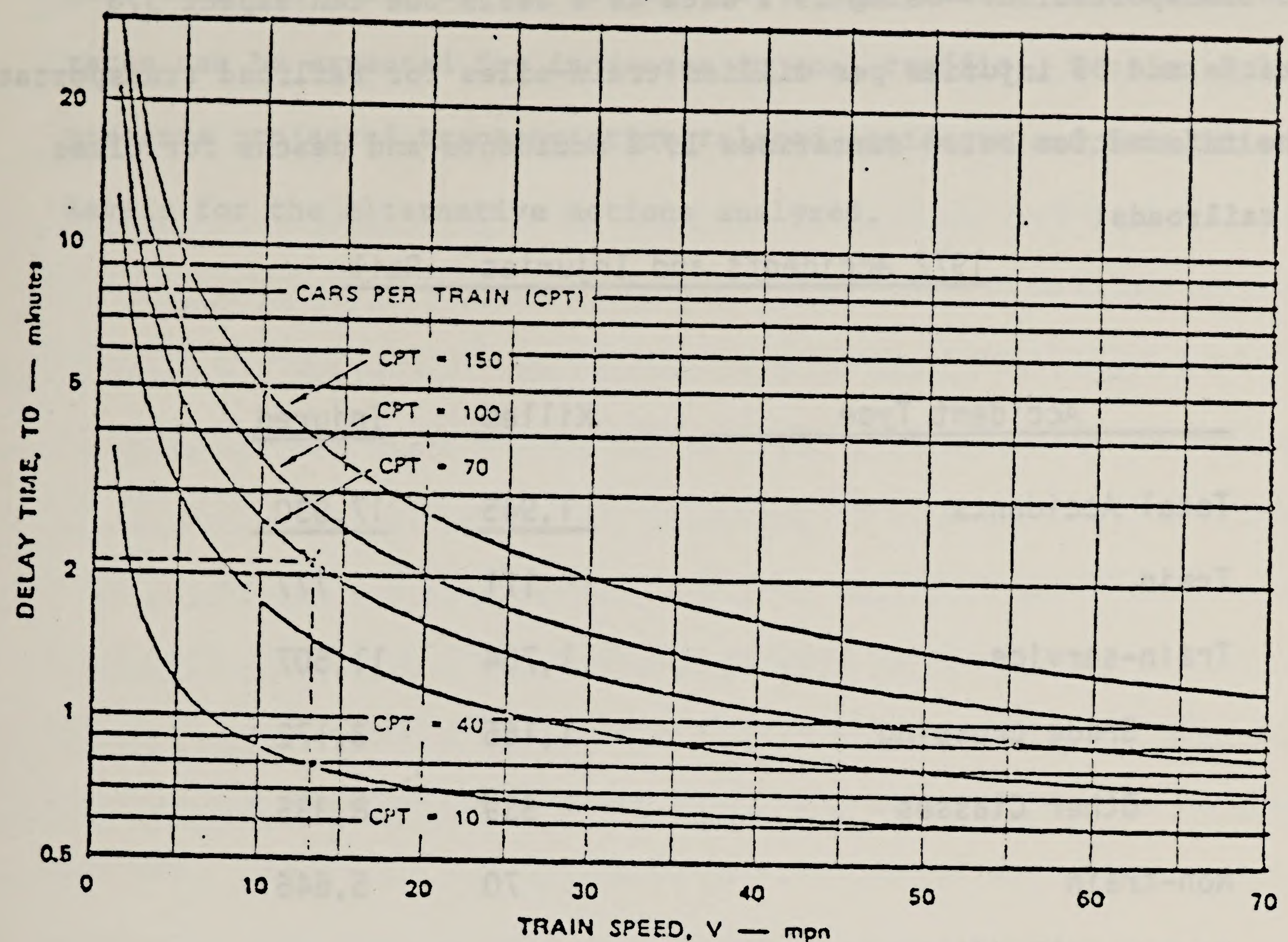
* The source is the vehicle measured.

Current noise emission standards are based on the best available technology for rail and motor carriers. Results from several studies indicate that rail traffic noise levels fall well within the EPA guidelines for railroads. This will, however, probably not reduce complaints stemming from significantly increased frequency of coal train operations. There are very little data available on noise impacts of waterway traffic. Since most residential communities are located far from the audible effects of waterway operations, detrimental impacts on communities from increased waterway traffic are unlikely.

Disruption of local traffic patterns by surface transportation is also a by-product of increased traffic levels. Increased traffic levels can create "economic barriers" that may divide towns, and prevent customers on one side of town from visiting retail locations on the other side. Increased traffic (truck or rail) may also hinder municipal services such as police and fire protection. Good examples of transportation-induced delays are unit trains that may be hauling large loads of coal at very low speeds. Figure 5-2 presents estimates of the average delay time (in minutes) at rail crossings for various combinations of train length and speed.

FIGURE 5-2

Delays v. Train Size and Speed



Source: DOT Research Report No. RP-31 (1974)

Increased levels of surface freight transport will in all probability result in higher levels of injuries and deaths related to transportation. Using 1972 data as a basis one can expect 3.8 deaths and 35 injuries per million train-miles for railroad transportation. The information below summarizes 1972 accidents and deaths for Class I railroads:

1972 Accidents and Injuries - Rail

Accident Type	Killed	Injured
Total Accidents	1,945	17,930
Train	171	777
Train-service	1,704	11,507
Grade crossing	1,165	3,172
Other Classes	539	8,335
Non-train	70	5,646
Number killed/injured per million train-miles*	3.8	35

* Total train-miles for 1972 was 512 million in transportation service, Class I railroads.

Source: Congressional Research Service, prepared for the Committee on Energy and Natural Resources, Henry Jackson, Chairman, National Energy Transportation Volume III, March, 1978.

The truck accident mortality rate (deaths) is 250 deaths per million vehicle-miles. However, since most coal movements will be less than 100 miles and at low speeds, significantly reduced death rates can be expected for increases in coal traffic. Section 5.3 presents projected transportation related accidents and fatalities levels for the alternative actions analyzed.

5.2.3 Physical Impacts

5.2.3.1 Topography

There is an impact on the topography of an area when there is a permanent change in the general configuration of the land surface. The concept of permanent change is a key factor in determining the topographic impacts of surface mining under the provisions of SMCRA. The environmental protection performance standards of this Act (Section 515) operate to mitigate the significance of topographic changes based upon those occurring under conditions of no control.

During early phases of coal development, topographic changes would be limited to the grading required for access roads and the preparation of the drill sites used to determine the overburden and coal-deposit dimensions. The (outline) drilling program requires that holes be drilled at about quarter-mile intervals; this involves approximately 35 holes per 1000 acres of leasehold. Except in very rugged terrain, grading for access roads and drilling would involve a negligible portion of the leasehold.

Topographic impacts would occur during pre-mining site preparation and facilities construction. Cuts and fills may be required for coal haul roads, and some surface grading may be needed for mine-support facilities such as offices, warehouses, shops, and equipment parking or storage areas. The amount of such changes would be highly dependent on the characteristics of a particular site. However, the topographic changes produced by these activities would not generally be extensive enough to produce a significant impact on an area's topography.

The extent of topographic disturbance due to coal-extraction operations differs considerably between surface mining and underground mining, the far greater disturbance being associated with surface mining. Surface mining basically involves the removal (or stripping) of the overburden and the extraction of the exposed coal seam or seams. The primary impact of this action is the lowering of the surface in the area mined to depths that vary from a few feet to hundreds of feet, depending on the combination of overburden depth and coal thickness that allows economic recovery of the coal. If left in its stripped form, the area mined would suffer a significant topographic impact. However, SMCRA requires that all overburden material be backfilled and graded to restore the approximate original contour of the land. Additional provisions in SMCRA cover instances where insufficient or excess overburden does not allow restoration of original contours. The geological nature of the overburden and the ratio of overburden thickness to coal seam thickness are measures that indicate whether there is excess or insufficient overburden. During excavation, the overburden material is broken up and a volumetric expansion or bulking occurs which is predominantly related to the geological nature of the material. This overburden bulking usually ranges from 10 to 20 percent and can vary between regions, within regions, and even within a particular leasehold depending on the geological materials encountered. If a 20-foot coal seam were to be mined in an area that required the removal of 200 feet of overburden material that had a 10 percent bulking factor, backfilling and grading of the overburden could restore the approximate original contour of the land with all highwalls, spoil piles and depressions eliminated. If the overburden to coal seam thickness ratio is greater than the percent of overburden bulking, there will be excess overburden that would form a hill. Conversely, if the overburden to coal ratio is less than the percent of bulking, there will be insufficient overburden and a depression will remain after mining reclamation. The conditions of hill or depression formation are both covered under SMCRA which requires that the overburden material be backfilled, graded, and compacted (where advisable) to the lowest practicable grade but not more than the angle of repose. Another area of topographic impact resulting from surface mining operations involves the general shape of the restored land. Regardless of whether the restored area is at the same elevation, elevated, or depressed relative to the original elevations of the area, the landforms resulting from restoration activities would have more smoothly contoured surfaces than the original landscape; most of the microrelief features, such as small ledges, rock outcrops, and steep banks would be eliminated. Since areas with thick coal seams are also the more economically attractive areas, they exhibit the greatest amount of surface lowering. Among the various coal regions, the Powder River Coal Region, with its 26-foot average seam thickness, would have a much higher proportion of lowered topography than the other regions. Surface lowerings of 25 to 40 feet have been experienced at some present mining operations in this region involving coal seams up to 70 feet thick with overburden thicknesses averaging 150 to 250 feet.

Underground mining can impact surface topography through deformation of the geologic strata above the coal extraction area. This can lead to surface lowerings, tension cracks, or compression bulges. These types of impacts can play a major role in future use of the land surface above the mine workings. The type and magnitude of such surface changes is highly site-specific and cannot be generalized for any region. Conditions which affect subsidence involve the lithology, structure, and thickness of the overburden; the geometry of mine workings; coal-bed thickness and the rate of mining; and the direction of dip of the coal bed relative to its outcrop (Dunrud, 1978). Underground mining activities can be designed to mitigate those factors which influence subsidence processes. New techniques, such as the use of remote sensing imagery, are being developed to provide better information for evaluating mine ground stability and potential impacts of subsidence (Dunrud, 1976; Rinkenberger, 1978).

Other activity phases associated with coal development such as plant construction, utility and transportation corridor construction and worker-related factors also produce topographic change. New roads or rail lines may require cuts and fills; coal-conversion and electric-generation facilities would require some site preparation in the form of surface grading; and community-development activities (housing, utilities, and so on) associated with coal development may also involve a certain amount of surface grading. Although these changes would also be site dependent, the magnitude of such changes from a topographical basis would not be significant.

5.2.3.2 Geology

The mining phase of the coal development cycle is the only phase in which significant geological impacts occur. Although coal processing, transport, conversion, and use may produce minor topographic changes, the impacts of such changes would not be of a magnitude to significantly alter the geologic character of an area.

In the mining phase, surface mining operations produce significantly greater geologic impacts than do underground operations. The exact extent of surface mining impacts is directly related to the geological characteristics and thickness of the overburden, and cannot be generalized for a particular region. When overburden is broken up, removed, and later replaced as spoil, the geological structure and natural stratification of the overburden is destroyed and its physical and chemical properties are altered. Although structural alterations would prevent any future scientific study of the original nature and structure of the overburden, much of the needed information would be collected during earlier development activities. As discussed further in Appendix A, A.1.2 Mining Technology, exploratory drilling includes the collection of core samples for mineralogical, physical, and chemical testing and also includes bore hole testing to collect data on the seismic, gravimetric, and magnetic characteristics of the different underground strata.

Paleontological resources would be affected by the disturbance, destruction, or removal of fossil material from overburden during stripping and backfilling operations. The exposure of fossiliferous rocks in an area could also lead to losses due to unauthorized fossil collecting and vandalism. The significance of impacts on paleontological resources due to stripping operations cannot be meaningfully assessed without data and evaluatory criteria. The BLM and the Geological Survey are currently developing a memorandum of understanding relating to the protection of paleontological resources on Federal lands. These agencies are also developing technical guidelines to define these resources and to provide evaluatory criteria and measures for protection. When applied to any leasehold, the provisions of these documents will serve as a basis for the management and protection of paleotological resources.

Another category of potential geological impacts involves the Department of the Interior's Natural Landmarks Program. The objective of this program is to assist the preservation of the various categories of significant natural areas which would illustrate the diversity of the country's natural history. The types of nationally-significant geological features that could qualify for natural landmark designation are outstanding formations significantly illustrating geologic processes, significant fossil evidence of the development of life on earth, and examples of the scenic grandeur of our natural heritage (U.S. Department of the Interior, 1978x). Efforts to inventory significant landmarks of all the natural regions are continuing through a variety of natural-region theme studies. It is not possible at present to determine the magnitude of potential impacts on these landmarks without being site specific. As a matter of fact, the nature of the landmark would be a factor in determining whether coal development activities would cause a significant impact. For example, a landmark which owed part of its significance to the ability to view it from a particular vantage point could be impacted by the visual intrusion of man-made structures or terrain alterations while a significant fossil area could remain unaffected by such activities so long as they did not physically disrupt the fossil formations.

In general, all of the phases of coal mine development contain elements which could possibly affect natural landmarks. However, surface mining activities present the highest probability of potential impacts. Thirteen landmarks currently included on the National Registry have been reported to be threatened by various types of surface mining (U.S. Department of the Interior, Office of the Secretary, 1978). (Only one of these sites specifically involved coal mining.) Coal development activities could also alter a site so as to preclude its possible designation as a natural landmark. Other activities which have potential for landmark impacts include uncontrolled fossil collecting due to mine-related population increases and community developments which could preempt the designation of an area as a natural landmark.

5.2.3.3 Minerals. Mineral resources are impacted by their extraction, by the establishment of conditions which preempt any future development, or by conditions which delay their development. The major mineral impacts of any coal leasing program would be the permanent depletion of a nonrenewable resource through the production and consumption of the tonnages of coal associated with each of the alternatives.

Additional minor impacts would occur through the use of sand and gravel or other minerals for road-base material and as construction aggregate. These materials would be required in varying quantities in all phases of coal development and in any community development that would occur due to coal development. Although the requirements are not known at this time, regionally significant impacts would not be expected because of the widespread nature of the resources.

Both surface and underground mining have the potential to preempt future development of other mineral resources. The magnitude of any preemption cannot be estimated at the programmatic level due to the site-specific nature of the factors affecting such preemption. These factors include the mineral-resource character of surface mine overburden and the location of any deep coal bed relative to other mineral commodities above or below the coal deposit. An example of potential preemption due to surface mining operations can be illustrated by the Wasatch and Fort Union Formations in the Powder River Coal Region in Wyoming. Uranium and coal have been found in both of these formations. The stripping of overburden to reach a coal seam would intermix any uranium with the rest of the overburden and eliminate the possibility of any future uranium extraction. The uranium occurring under such conditions usually consists of deposits that are presently uneconomical to recover. However, if future uranium market conditions or uranium extraction technology were to change to make recovery of this deposit economically attractive, such recovery would have been preempted by the intermixing with the rest of the overburden. The extent to which this might occur for uranium or other minerals cannot be projected for any of the coal regions since it is dependent on the site-specific characteristics of individual leaseholds. Mineral development preemption may also occur with the development of new communities or the expansion of existing communities if such development were to occur above mineral deposits.

Coal mining operations may also conflict with oil and gas recovery operations, either by preempting development or by delaying development for the life of the coal mining project. In various regions, coal deposits may occur below, on the same horizon, or above a commercial oil or gas deposit. Simultaneous operation of a coal mine and a producing oil or gas field may present unreconcilable difficulties. Oil drill holes may interfere with underground coal operations if the coal seams are not properly sealed off. If not properly sealed, hydrocarbon vapors could penetrate the coal seam and create safety problems (U.S. Department of the Interior, 1978iii). The potential resolution of this type of resource conflict can only be determined on a site-specific basis.

Often it becomes necessary to extract one resource prior to extracting the other. However, this can create potential problems for the second resource extractor. For example, drilling for oil or gas resources may be made difficult due to loss of drill fluid into abandoned workings. Maps of abandoned underground mines would have to be thoroughly analyzed to prevent inadvertent drilling into the underground workings. In the reverse case, where a mining operation is to follow extraction of petroleum products, the location of oil and gas wells would have to be determined by the mining company in order to leave safety pillars around the wells. It should be noted that in cases requiring sequential extraction, it is generally more prudent, for technological reasons, to extract the coal resource before the oil and gas resource.

5.2.3.4 Soils. Under conditions of no control, coal development activities could cause soil impacts ranging from minor, short-term disturbances to significantly adverse, long-term alteration of soil charcteristics.

Stripping or grading operations can drastically alter soil characteristics through the mixing of the soil with the subsoil and underlying rock material. Horizons within the topsoil would be destroyed and various soil types would be combined resulting in a potential lowering of soil productivity, i.e., the natural soil structure would be broken up, soil compaction would cause lower permeability, soil microorganisms would be buried, and nutrient cycling and established soil climate relationship would be completely altered. Overburden removal could also bring to the surface and mix with the soil those elements that are either toxic to plant growth or toxic to animal life that feed on the plants.

All land disturbances would result in the exposure of a range of soil materials of varying size to the action of wind and water. Soil productivity, permeability, and infiltration rates would be reduced, increasing runoff, soil erosion, and sedimentation. Wind action, which is variable both among the regions and within a single region, would cause fine soil, silt, and clay particles to be lifted into the atmosphere, reducing air quality and increasing soil loss. However, estimates of impacts on soils can only be made on a site-specific basis after haul roads, plant facilities, utility corridors, and other mine development activities have been identified.

Because of the provisions of SMCRA that pertain specifically to topsoil handling and restoration, potential adverse soil impacts can be minimized. The mining and reclamation plan for a particular leasehold must include soil surveys provided by the lessee. Such surveys identify physical and chemical characteristics together with the geographic extent of the leasehold soils to provide the basis for an effective reclamation plan. (The wide variability of soil types is well illustrated by the proposed mining and reclamation plan for a Powder River Coal Region coal mine. This plan included a soil survey that identified nearly 30 different soil types within a 5,800-acre leasehold (U.S. Department of the Interior, 1978jjjj)).

5.2.3.5 Potential Air Quality Impacts

There are no established classifications of mining operations. In estimating the total dust emissions from a coal mine, it is preferable, when possible, to identify the dust-producing activities present and estimate emissions from each activity separately rather than to use a single emission factor for the entire mine. This allows direct determination of the major source areas and their contribution to the overall emissions from the mine. Thus, those operations most requiring control can be isolated and so to the effect of control on the overall emissions from the mine.

Table 5-3 presents a list of operations oriented toward isolation of specific dust-producing activities found at coal mines. All operations are not always found at every mine or type of mine. For example, of those particulate sources listed in Table 5-3, only conveying and transfer, access road, storage, crushing, waste disposal, and possibly a few short haul roads are normally found at underground mines.

TABLE 5-3

POTENTIAL DUST-PRODUCING OPERATIONS

IN THE COAL MINING INDUSTRY

1.	Overburden removal (i.e. dragline)
2.	Haul roads
3.	Access roads
4.	Topsoil removal
5.	Reclamation
6.	Storage (open storage)
7.	Shovel/truck loading
8.	Transfer and conveying
9.	Truck dumping
10.	Drilling (overburden and/or coal)
11.	Blasting (overburden and/or coal)
12.	Front-end loading
13.	Crushing (coal)
14.	Train loading
15.	Waste disposal
16.	Cleaning (coal)
17.	Fly-ash dump (mine mouth plants only)
18.	Coal fires
19.	Exposed areas (wind erosion)

Recent studies have shown that of the sources listed in Table 5-3 haul roads and access roads are most often the largest contributors to ambient particulate concentrations at and near the mine site. Other major sources of particulate are wind erosion from exposed areas and topsoil and overburden removal.

The impact of mining operations to the existing particulate air quality at and in the vicinity of an active mine depends on a number of variables: climatology, type of dust-producing operations at the mine site, degree of control applied to dust-producing operations, and size of the mine. Any one of these factors can greatly add to or reduce emissions from a mine site. For example, a small underground mine may contribute greatly to the ambient particulate concentration in the surrounding area because of an extremely long unpaved access road leading to the mine which mine employees travel every day.

The impact to particulate air quality is always greatest at the mine site where generation of airborne particulate is taking place and in areas closely surrounding the mine site. The particulate air quality impact from the mining operation generally decreases rapidly with respect to distance from the mine site. Figures 5-3, 5-4, and 5-5 are hypothetical isopleth maps which show typical air quality impact

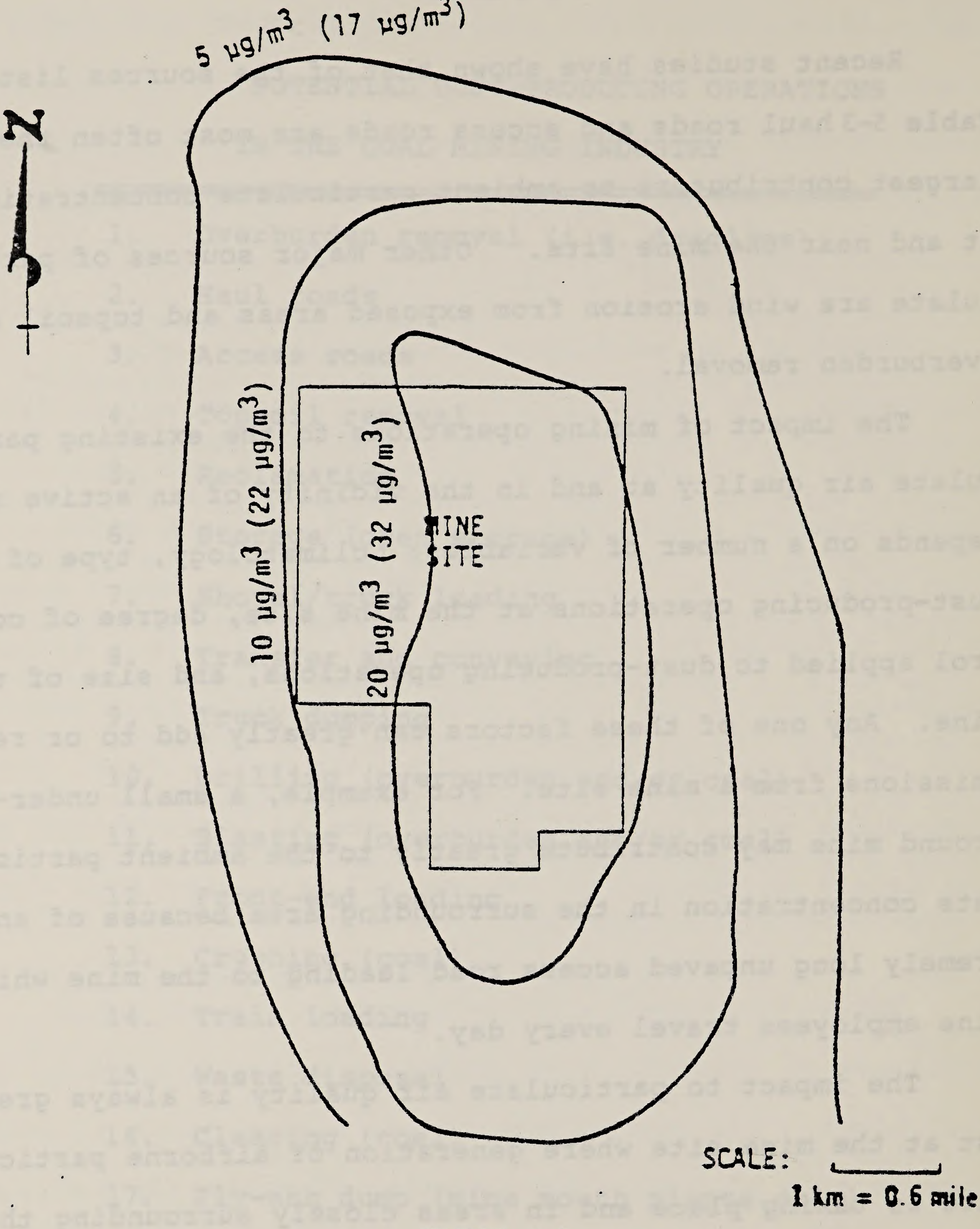


FIGURE 5-3

Hypothetical isopleth map showing predicted particulate air quality impact from a 4,000,000 ton per year surface mine.

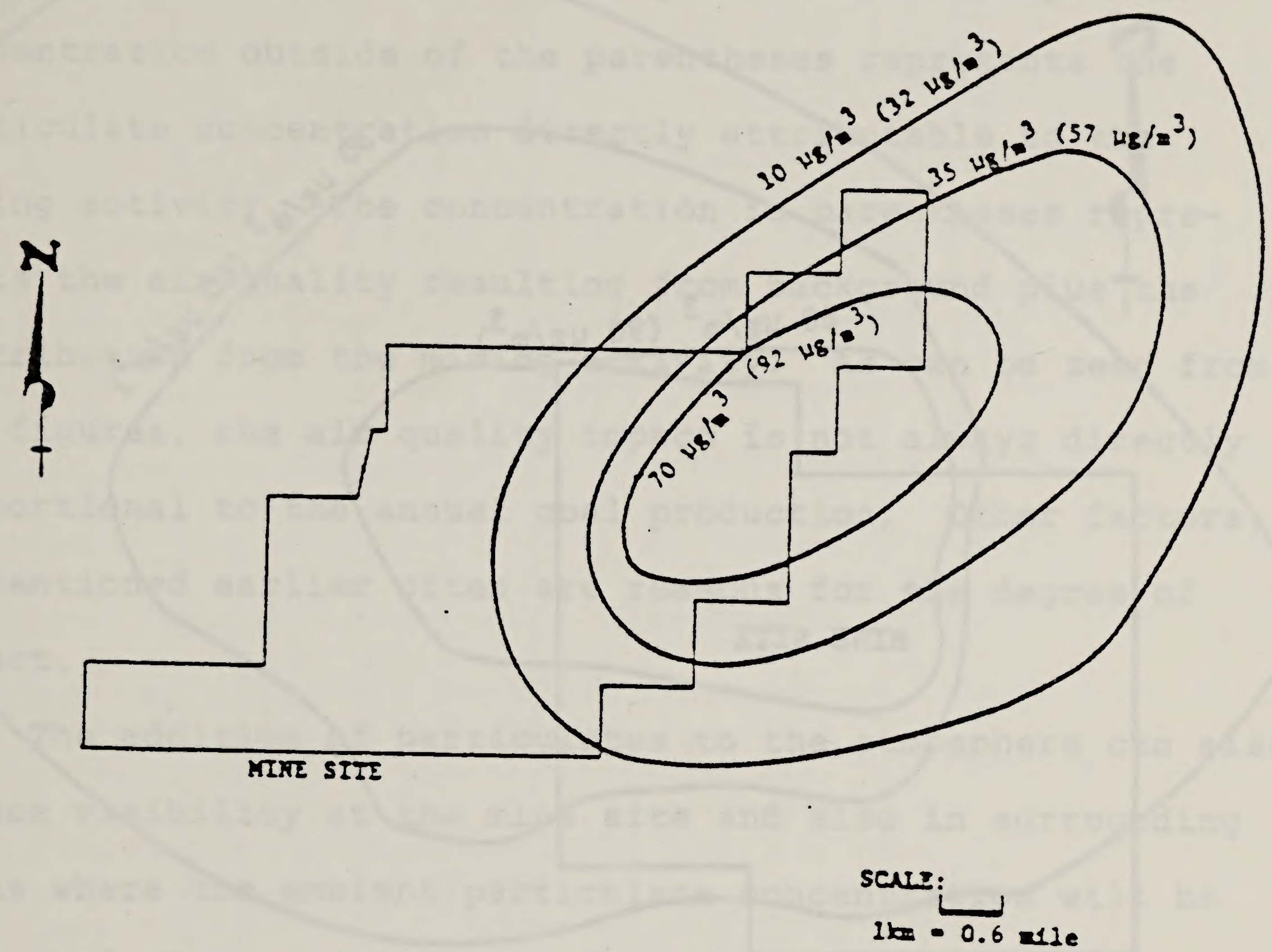


FIGURE 5-4

Hypothetical isopleth map showing predicted particulate air quality impact from a 2,000,000 ton per year surface mine.

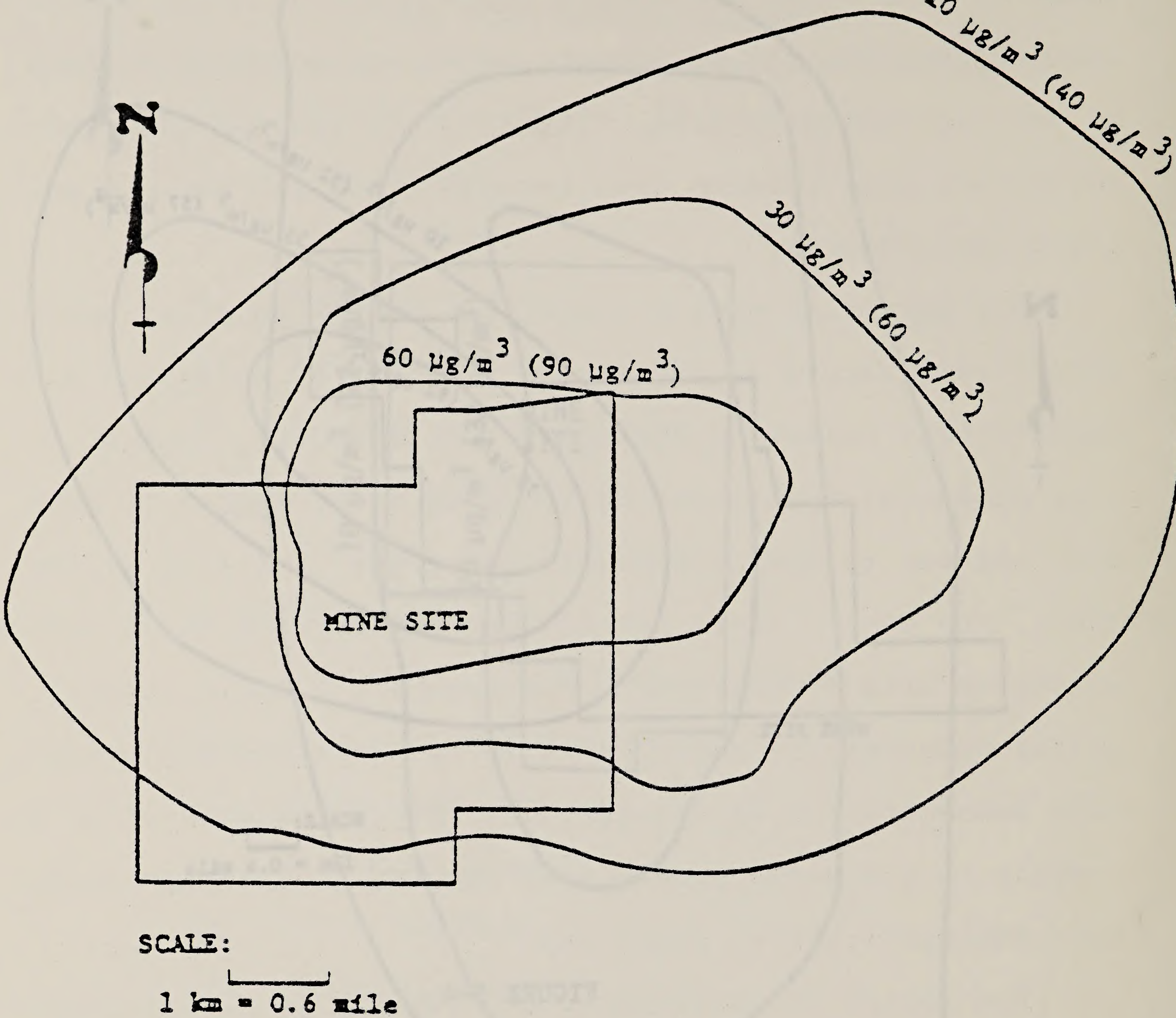


FIGURE 5-5

Hypothetical isopleth map showing predicted particulate air quality impact from a 500,000 ton per year surface mine.

from western surface strip mines. The figures represent mines which would produce about 4,000,000, 2,000,000, and 500,000 tons per year, respectively. The concentration outside of the parentheses represents the particulate concentration directly attributable to the mining activity. The concentration in parentheses represents the air quality resulting from background plus the contribution from the mining activity. As can be seen from the figures, the air quality impact is not always directly proportional to the annual coal production. Other factors, as mentioned earlier often are reasons for the degree of impact.

The addition of particulates to the atmosphere can also reduce visibility at the mine site and also in surrounding areas where the ambient particulate concentration will be increased above the background concentration. Table 5-4 presents four examples of visibility reduction as a result of increased TSP. It should be noted that the examples in Table account for TSP only and not other natural climatological factors such as fog, haze, snow, and rain which can also reduce visibility.

The only other potential air pollution sources identified at coal mines are exhaust emissions from employees' motor vehicles and diesel-powered haul trucks. The major

TABLE 5-4

EXPECTED VISIBILITY AT FOUR DIFFERENT TOTAL SUSPENDED PARTICULATE CONCENTRATIONS

Example	Background[b] TSP Concentration ($\mu g/m^3$)	Background[c] Visibility (miles)	Additional[d] Particulate from the Mine ($\mu g/m^3$)	Resultant[e] Ambient Concentration ($\mu g/m^3$)	Resultant[f] Visibility (miles)	Reduction[g] in Average Visibility (miles)
1	25	45	5	30	40	5
2	25	45	15	40	32	13
3	25	45	30	55	25	20
4	25	45	60	85	18	27

[a] Expected visibility for the hypothetical situations presented in this table were calculated from the formula presented in Ettinger and Royen, 1972.

[b] Represents a hypothetical annual average ambient particulate concentration that would exist without the mining activity.

[c] Represents a hypothetical annual average visibility that would exist without the mining activity.

[d] That additional portion of the ambient particulate concentration that would be contributed to the TSP as a result of mining activity. Note that the higher contributions; such as, 60 and 30 $\mu g/m^3$, would normally occur in very close proximity to the mine site.

[e] The TSP concentration that would result from the background concentration plus the contribution from the mining activity.

[f] The average visibility that would result from the resultant ambient concentration.

[g] The reduction in visibility that is directly attributable to the additional particulates from the mining activity.

gaseous emissions from these vehicles are carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), and sulfur oxides (SO_x). The amount of these pollutants generated at even the larger coal mines is usually insignificant. Recent studies of the impact of vehicle emissions associated with western coal mines estimate the probable range of impact to be insignificant.

Particulate Air Quality Impact from Mining Activities

It is very difficult to accurately predict the particulate air quality impact or even the relative magnitude of impact in each of the coal regions. In order to predict the degree of impact with any degree of accuracy dispersion modeling must be performed in all the areas likely to be affected by any mining activity(s) and/or subsequent handling and useage of the coal. Dispersion modeling generally requires the following detailed and precise source data input: source locations (both point and fugitive sources); source emission rates; locations where ground level pollutant concentrations are desired; and very detailed climatological data on wind directions, wind speeds, and stability classes. It is very important that information concerning fugitive dust sources is available for dispersion modeling of mining activities since fugitive emissions can account for 95 percent or more of the particulate emissions from the mining activities. In addition (as explained in the previous description) the quantity of fugitive emissions from a coal mine is often not directly related to the annual coal production from a coal mine. The emissions model accounts for point source particulate emissions only. Therefore neither regional or site specific dispersion modeling and the resulting predicted air quality impact is a feasible option.

Air quality impact from mining activities tend to decrease rapidly with distance from the mine since particles from coal mining operations tend to be rather large and fall out quickly. The most therefore that could be predicted is that air quality impact from mining operations is likely to be greatest in the very near vicinity of the mine site.

Particulate Air Quality Impact from Transport and End Uses

The emissions model also predicts particulate emissions for point sources associated with transport of the coal as well as final end uses of the coal (e.g. combustion emissions). In cases of transport and end uses such as steam generation, point sources account for the majority of the particulate emissions. Again, without dispersion modeling little can be interpreted in reference to particulate air quality impact. However, since point source emissions make up the majority of the emissions, the following limited predictions can be reasoned with respect to potential particulate air quality impact. Under the preferred leasing policy for all levels of action (low, medium, and high), for both 1985 and 1990 the Northern Appalachian, Eastern Interior, Western Interior, and Texas Gulf Regions will generate the largest amounts of particulate from point sources. Almost 80 percent of these particulates will be from steam generation. Thus, the greatest particulate air quality impact is likely to be in the vicinity of these steam plants. Beyond this, impacts from other point sources would be expected to be minimal compared to steam generation sources.

Gaseous Air Quality Impact

The gaseous emissions (hydrocarbons, carbon monoxide, sulfur oxides, and nitrogen oxides) from coal mining activities, coal transport, and end uses of coal almost always result from some type of combustion or heat treatment. Coal mine haul trucks, railroad and barge transport modes (as shown by the emissions model) all produce these emissions from combustion of gasoline or diesel fuel which is used to power them. These sources are in a real sense mobile sources as opposed to stationary point sources. The gaseous emissions from transport vehicles are spread over extremely long distances. Only coal mine haul trucks tend to emit all their gaseous emissions in a designated area, that being the actual mine site. As was discussed earlier, recent studies have shown no significant air quality impact with regards to these gaseous emissions. Therefore it is even more unlikely that truck, rail, or barge transport, which emit pollutants over extreme distances, would have any decernable impact on air quality.

The emissions model predicts that steam generation will account for well over 95 percent of the gaseous emission production with sulfur and nitrogen oxides being emitted in the largest quantities. It also appears that the eastern coal regions will receive the largest impact. The real extent of the air quality impact cannot be stated without dispersion modeling. However, past experience has shown that power plants can have a detrimental impact on air quality in areas around the plants, particularly in reference to sulfur oxides air quality.

5.2.4 Ecological Impacts

5.2.4.1 Regionally - Independent Impacts

Ecosystems in each coal region would be subject to a number of similar impacts associated with various aspects of coal developments, including exploration, construction (access routes, transportation routes and facilities, mine support facilities, user facilities, etc.), extraction or production, beneficiation, utilization, and site rehabilitation.

While the degree of impact would vary according to the amount of land committed, characteristics of the site, extent and type of activity, and methods used, the general kinds of impact associated with any of these steps would be common to all regions. These impacts include:

- o Disturbance and destruction of vegetation;
- o Loss of habitat;
- o Disturbance and destruction of wildlife;
- o Temporary or permanent land use changes;
- o Introduction of hazards into the environment.

In addition, secondary impacts resulting from induced growth, community change, and from ecosystem adjustment, would also occur. Disturbances and modifications of habitats adjacent to the areas of principle impacts would vary in degree primarily as a function of distance. This "area of influence" could encompass as much as five times the area directly disturbed, depending upon species effected and type of impact (U.S. Department of the Interior, 1978d).

Off-road vehicles (ORV's) are frequently used during the exploration phase of coal development. Use of off road vehicles for recreation by the public sector has gained in popularity and would be expected to increase in the coal regions as a result of the increased population. Impacts related to ORV use are dependent upon frequency of travel over the same route, inherent properties of the soils, and the area crossed. The immediate impact of ORV travel is to the surface where low growing vegetation is injured and destroyed. Repeated travel over the same route can result in soil compaction, decreased water infiltration, and interference with root growth (Geological Society of America, 1977). Increased runoff resulting from a reduced capacity of the compacted soils to absorb rainfall can lead to erosion, rut formation and increased sediment loadings in adjacent waterways. Concentrated ORV travel and frequent disturbance (noise and man's presence) in a given area may affect wintering big game, upset breeding behavior of animals and birds, and result in direct loss of some wildlife. Energy required for winter survival may be expended by wildlife in avoidance efforts.

Transportation routes and facilities, access roads, mine support facilities, and the actual mining itself will require commitments of large amounts of land. Community development to support workers and families, and industrial development to utilize the coal produced will take additional acreage. All of these activities will require clearing, grading or other site preparation techniques at some point and will result in direct and indirect impacts to the environment. Similarily, once construction activities have been completed and use of the facilities (operation) has begun, changes in land use, emissions from facilities, etc., will continue to impact the environment. Areas not committed to permanent structures or to continued and frequent use would, over a period of time, recover in ecological value. This recovery could be naturally from adjacent undisturbed seedstock, or man-induced by reseeding of various species. However, the habitat and consequently the compostition of wildlife following such recovery might be quite dissimilar from that existing prior to development.

Major direct impacts will occur principally during mine development and construction of plant facilities. Vegetation removal will result in total loss of site productivity, loss of habitat, and loss of usefulness for wildlife. Indirect or secondary impacts resulting from site preparation include an increase in the potential for site erosion, sedimentation, and introduction of pollutants into adjacent waterways, and disturbance of adjacent vegetation, habitat, and wildlife. Losses of animal life would be restricted principally to soil micro- and macroorganisms, insects and other anthropods directly associated with the vegetation removed, slowly moving forms (reptiles, amhpibians and other invertebrates), and burrowing mammals and ground nesting birds. While direct mortality of larger, more mobile wildlife species would be rare, destruction of habitat would cause increase competition for food, cover, nesting sites, territory, etc., and an ultimate lowering of populations over time due to reduced carrying capacity. (Carrying capacity is defined as the number of animals that an area will support over time at a proper use level within boundaries set by competition with other animals, unusable areas, and restricting habitat requirements (Taylor, 1975)).

Ecosystems beyond the development area would be temporarily or permanently disturbed by noise, air, and water emission from community expansion, human presence, and activity, and plant and mine operations. For example, the loss of sagebrush in the western coal regions due to salt drift from cooling towers would affect species such as the sage grouse, mule deer, and antelope, which are dependent upon sagebrush areas for food and shelter. Most species tolerate human intrusion only to a certain point. Others, such as pronghorn antelope and elk, are quite intolerant of human presence. The extent of these impacts will be dependent on the tolerance of a given species.

Lands committed to coal development would decrease the total area available for wildlife and, initially, create overcrowding of adjacent habitats. The impact from the destruction of habitat may be further compounded by the fact that some animals occupy different habitats at different times of the year and, in some cases, at different times of the day. Consequently, the destruction of habitat in one area may obviate the use of habitat in another area. In the West, for example, winter range tends to limit the deer population. Ranges which are available to deer the rest of the year are not completely used because winter range limits population size. If development were to reduce habitats presently limiting the size of a particular wildlife population, that population would also be reduced in other habitat areas. Further secondary impacts could then be felt by predators, prey, or other links in the food chain of that species.

Coal developments would also result in the introduction of additional hazards into the environment. Air and water emissions would directly affect both aquatic and terrestrial species and would indirectly affect them through impacts on vegetation. Fences constructed along rights-of-way, areas under construction, areas under rehabilitation, etc., would take a toll of animals, such as deer and antelope (U.S. Department of the Interior, 1974). Transmission and distribution lines could electrocute or injure and kill birds striking the lines. Increased ground vehicle traffic would result in higher numbers of road-kills. The presence of mining operations and support facilities can be expected to change migration patterns and grazing movements through changes in the quantity and quality of forage and water, as well as physically restricting movement by erecting impassable barriers, tall fences, deep ditches, and heavily trafficked roadways.

Protected Species. The Endangered Species Act of 1973 protects listed species (both vegetation and animals) and their critical habitat. All of the regions under consideration have species which fall under this category. Provided that all requirements are met under the law, no direct impacts to protected species are anticipated. Indirect impacts resulting from coal developments which may effect endangered or protected species are presented in Table _____ in Appendix __.

5.2.4.2 Regionally-Dependent Impacts

Land requirements are used as the basic criterion in the ecological analysis. For all production levels examined for the preferred program and the six alternatives, major commitments of land would be required in both 1985 and 1990 in the Appalachian Coal Region (Northern, Central and Southern), the Eastern and Western Interior Coal Regions, and the Texas, Powder River, Green River-Hams Fork, and Fort Union Coal Regions. Coal consuming industries (steam generation, metallurgy, conversion, etc.) would account for over 50 percent of this land in these regions. Coal production and mining activities would account for over 50 percent of the land commitment in the western regions. Quantitative data are presented in Sections 5.3 through 5.9 below.

Based on the land use scenario developed for each of the respective coal regions, land committed to coal development would result in major potential productivity losses from the following general land use categories.

Region	Productivity Loss		
	Agriculture	Forest	Range
Appalachian	√	√	
Eastern Interior	√		
Western Interior	√		
Texas	√		√
Powder River	√		√
Fort Union	√		√
Green River-Hams Fork		√	√
Uinta-Southwestern Utah		√	√
San Juan River		√	√
Denver-Raton Mesa		√	√

Animal life which was dependent upon the vegetation disturbed would be adversely affected by losses of food, cover, and habitat. Removal of habitat would have the greatest initial impact on soil micro- and macro-organisms, arthropods, small mammals, birds, amphibians, and reptiles in all regions. However, due to the relatively rapid population turnovers and high reproductive rates, these groups of animals would likely be the first to repopulate recovered areas. Small mammals such as mice, rabbits, shrews, and woodchucks have been reported to return to stripped land within 15 years (de Capita and Bookhout, 1975). Insects and other arthropods would repopulate disturbed areas soon after vegetation began to return. Diversity of species may be lower than before development, however (de Capita and Bookhout, 1975).

Comparatively speaking, few predators and large game mammals would be affected by habitat loss due primarily to their larger territory requirements. The losses that did occur would tend to be more long term due to slower population turnovers and lower reproductive rates. White-tailed deer (found in all regions except Green River-Hams Fork, San Juan, Uinta, and Denver-Raton Mesa) would be the major large game species affected in the eastern coal regions. Initial increases in density of white-tailed deer in adjacent habitats would create more hunter success (man and predator) followed by an "apparent" decrease in deer as the population returned to normal carrying capacity. Creation of edge habitat between developed and natural areas would result in a benefit to this species.

Major impacts would occur to species dependent upon specific seasonal habitats if disturbances removed or reduced these habitats. Removal or reduction of sagebrush habitat would have a major affect on wintering herds of pronghorn antelope and sage grouse in Green River-Hams Fork, Powder River, Fort Union, and San Juan Coal Regions. Sage grouse, for example, are dependent upon soft materials for food because they lack a muscular gizzard containing stones, and are solely dependent upon sagebrush for food from October through April (Braun et al, 1977). Sagebrush provides up to 90 percent or more of the winter browse for pronghorn antelope (Cole, 1956), and individuals of the species tend to congregate in sagebrush areas during winter. As much as 20 percent of the world's pronghorn population and a major portion of the world sage grouse population occurs in the sagebrush-grasslands of the Green River-Hams Fork Region (U.S. Department of Interior, 1978d).

Removal or disturbances of the numerous "potholes" found in the Fort Union Coal Region would have major direct and long term effects on central flyway waterfowl that use these areas for nesting and breeding.

Fish and other aquatic organisms have, like all organisms, ranges of tolerance to the physical and chemical parameters of their environment. The most commonly recognized factors that limit the distribution of aquatic organisms are temperature, turbidity, pH, water velocity, oxygen supply, and conductivity. Any one of these factors could be changed in local streams and downstream rivers by effluents, accidental spills, impoundments, and/or erosion. For instance, sufficient amounts of leached substances and saline groundwater released to surface waters from excavations, overburden piles, or spent shale piles could cause a shift in pH and conductivity into a range that would interfere with the vital functions of aquatic organisms. Acid drainage is a potential problem particularly in the Eastern Coal Regions (Appalachia, Eastern Interior and Western Interior) while salinity poses more of a problem in the Western Coal Region.

Sediment introduced into surface waters by runoff could affect aquatic life in many ways; it could clog fish gills, bury eggs of both fish and insects, bury food sources, and smother aquatic vegetation. In addition to direct effects, there are many indirect ways in which sediment could disrupt an aquatic system. For example, turbidity would decrease light penetration, thereby decreasing photosynthetic activity of aquatic plants and phytoplankton. This effect, in turn, could result in a reduction of dissolved oxygen concentrations.

Development activities near surface water systems may affect aquatic life through the introduction of various materials into the water body by overland runoff. The primary constituents of such runoff would be clay and silt particles which are eroded by the runoff as it crosses areas cleared in the construction of the right-of-way, access, roads or staging areas. Material transported from these areas frequently contains inorganic and organic matter originating from decayed vegetation and from the soil itself. Overland runoff may also leach minerals from the exposed soils or may carry residues (oils, grease, pesticides, etc.) used during the construction period or which are resident in the soil. The exact quantities of the various pollutants that would enter a given water body depend, to some extent, on the care taken to minimize their entry.

Any change in the physical characteristics of the stream substratum may result in extensive alteration in benthic composition. Species dependent upon running water for food supply and for hard attachment surfaces for position maintenance (e.g., attached algae, stoneflies, caddisflies, several species of mayflies, etc.) may be replaced by organisms which typically live in the substratum rather than on it (e.g., oligochaete worms, dipteran larvae, and rooted vegetation). Also, alteration of benthic composition would affect species dependent on benthic organisms as a food source. Species diversity of the benthos of an impounded pool is usually substantially lower than in its former unimpounded, free-flowing status (Warner, et al., 1974).

The extent and severity of the effects of the above-described changes depend upon the particular habitat and species affected and the composition and volumes of polluting substances. Unless carefully controlled, such discharges could significantly reduce the aquatic population of streams and their riparian fauna. These communities are diverse and include trout, suckers, catfish, minnows, herons, geese, ducks, rails, cormorant, bitterns, killdeer, song birds, beaver, muskrat, mink, and stream bottom invertebrates.

5.2.5 Cultural Impacts

5.2.5.1 Archaeological Resources. It is not possible, at present, to estimate the extent of potential archaeological resource impacts due to various levels of coal development. Present levels of archaeological site information are based, primarily, on localized general surveys or on surveys performed prior to specific construction projects (e.g., highways or power plants) and the concept of site density for a particular region cannot be used to determine potential sites except in a very general sense. The potential for impacts is dependent on the exact location of a particular leasehold and of the activities associated with coal development in the leasehold.

The whole range of the activities of coal development that produce surface disturbances may effect archaeological resources. In general, archaeological sites may be affected by the disturbance of surface indications of a subsurface site, by the disturbance of artifacts or other evidence of a surface site, by grading or excavation that destroys a subsurface site, by destruction of site integrity through alteration of the adjacent landscape setting, or by the exposure of a site to vandalism and pothunting. It is not only the massive excavations of surface mining that can potentially affect a site but also such lesser activities as vehicle parking or open storage of materials. Vehicle movement in an ungraded, unsurfaced parking area could easily disturb surface evidence or destroy a surface site. Similarly, the excavation and reclamation of a 6,000 acre surface mine may not encounter and, thus, not distrub any archaeological sites while a cut for a short section of 40-foot wide, employee-access road leading to this mine could completely destroy a site. A site-specific survey is absolutely necessary to determine any potential archaeological impacts due to coal development.

A 1976 amendment to the National Historic Preservation Act of 1966 (16 USC 470 et seq.) now requires that a Federal agency take into account the potential impact of an undertaking not only on sites included in the National Register but also on sites eligible for inclusion in the Register, and an executive order of 1971 (E.O. 11593, 16 USC 470) direct Federal agencies to locate, inventory, and nominate to the National Register properties under their jurisdiction or control. The National Register criterion used in determining the eligibility of archaeological sites is any site that has yielded or may be likely to yield information important in prehistory or history (36 CFR 800.10).

A site survey is the first step in the required process of identification, evaluation, eligibility determination, and impact analysis.

The above cited legislation together with the other laws which establish a national policy concerning cultural resources provide a sufficient regulatory framework within which the destruction of significant elements of this resource base can be prevented while allowing the coal development necessary for the nation's needs. However, the promulgation of inflexible regulations which require greater than necessary restrictions on coal mining would almost certainly lead to conditions that produce or allow significant levels of impacts to archaeological sites rather than the original intent of such regulations to prevent or minimize such impacts. For example, if all areas with archaeological sites were to be completely excluded from surface mining, these areas would be so great as to severely limit or preclude most mining. This would most likely lead to attempts at avoiding identification of sites which might meet National Register criteria, to political and economic pressure to weaken or remove these National Register criteria, or even to the destruction of sites to avoid having an area closed to mining. Such inflexible and over stringent regulations would either not allow the mining necessary to meet the nation's energy needs or would not in fact preserve important cultural resources. However, both mining and resource protection can occur under the existing regulatory framework for cultural resources.

Certain aspects of archaeological surveys or survey procedures contain elements that might relate to potential archaeological impacts. Although access to the data collected in a survey should be provided for scientific study, great care should be taken to prevent the survey reports from turning into hunting guides for site looters or pothunters. For example, the pothunter problem has made it necessary to remove detailed site maps or site-location descriptions from public copies of university doctoral dissertation (Stuart, 1978). Similar provisions may be necessary for any of the survey reports developed in connection with coal mining.

Recent studies have been directed toward development of predictive models for archaeological site location. While this new archaeological tool may be able to provide data that could aid in the development of a survey program and program budget, these models are not yet sufficiently developed to be able to replace a good ground survey in precisely locating archaeological sites (Bridges, 1978; Reeves, 1978). Although this kind of model may be able to identify the type or types of sites most likely to be found in a particular environmental zone of a region, it cannot determine with the degree of certainty required that no sites exist within a specific location.

Another important aspect of a survey involves its time frame relative to coal-mine development. Since a survey requires on-ground inspection and since the areas to be surveyed would be snow-covered or frozen for several months a year, particularly in the western coal regions, sufficient calendar time should be allotted to accommodate the project time estimated for a survey. It generally requires approximately two years after a lease issuance for development of the mining and reclamation plan and another year and a half after plan approval for site preparation prior to actual coal extraction. Provided there is early initiation of the archaeological survey, this time frame would be sufficient for a good survey. Such a survey would allow early identification of potential conflicts and also provide sufficient time for resolution of such conflicts. For example, if an archaeological site that required time for excavation was discovered in the area through which the access road would pass, early site identification would allow the access road to be designed to bypass this site.

If coal-development activities are accomplished within the existing regulatory framework for cultural resources, there is little likelihood that these activities would result in a significant loss of archaeological resources. Although every possible site would not necessarily be found by even the best of surveys, the data developed through these surveys would provide the basis for the preservation of important sites and thus protect this fragile, non-renewable portion of the total environment.

5.2.5.2 Historical Resources. Although the number of historical sites presently on the National Register is far greater than the number of archaeological sites, there is still a need for protection of important historical sites, particularly certain types of sites from the western areas. Historical sites and certain architectural styles are not as well represented in the West as in the East, with ranch styles and windmills particularly needing added representation (Luce, 1978).

The regulatory framework described in the preceeding section applies to all cultural resources whether archaeological or historical in nature and if development occurs within the requirements of this framework coal mining or mining related activities should not produce significant impacts for historical resources. It is essential that any cultural resources survey include professionals not only from the field of archaeology but also from the fields of history and architecture. Any community changes that occur due to coal development could affect the older, historic core of existing communities. Representative architectural styles as well as building of local historical significance could be lost to make room for new structures. The historical integrity of a group of structures could similarly be affected by new construction. Although some impacts to historical resources would occur, it is not possible to estimate the extent or magnitude of such potential impacts at the programmatic level because of the site specific nature of the sites or districts that could be affected by coal development.

5.2.6 Recreational Impacts

The greatest impact on recreation facilities will be the increase in the demand for recreation caused by the addition to the workforce while at the same time preventing use of minded land for recreation purposes. Overcrowding and overuse of existing facilities, a decrease in the quality of recreation experiences requiring facilities or solitude, increased administrative and enforcement costs, and increased vandalism would likely result (U.S. Department of the Interior, 1978c). Another significant impact would be the consequences of lax regulations of reclamation of areas where exploration may occur without proceeding with additional mining operations (Lyons, 1978). The increased demand for recreation facilities would also cause more conflicts between private land owners and people using the land for recreation. The increased number of people going to the country would reduce the quality of areas used for primitive recreation.

While the Surface Mining Control and Reclamation Act of 1977 (SMCRA) prohibits new surface mining on recreational land areas mentioned in the Recreation Description section or within 300 feet of any public park, these areas can be adversely affected by nearby mining operations. The impacts from visual disturbance, noise and air pollution can be mitigated by avoiding mining within three miles of national and state parks, wildlife refuges, game management areas and local and private recreation facilities (U.S. Department of the Interior, 1978c).

A greater problem to outdoor recreation than the mining itself would be the increased population and consequent overcrowding of existing facilities. Wildlife for hunting and viewing would be displaced by increased urbanization of open space. The increased hunting pressure could necessitate reductions in hunting seasons and bag limits. Demand already exceeds supply for deer and elk in parts of western Colorado, lowering the quality of hunting in that section of the Uinta region (U.S. Department of the Interior, 1978iii). The increased fishing pressure would reduce the present capabilities of many areas to attract and sustain fishing use. It is estimated that by 1990, an additional 605,000 catchable cold-water fish and 33,000 catchable warm-water fish will have to be added to the lakes and rivers of the Colorado portions of the Uinta and Green River regions just to meet the increased demand (U.S. Department of the Interior, 1978z).

Many of the new recreation facilities, such as swimming pools, tennis courts, and bowling alleys, will be built with private or municipal funds. Conflicts may occur between newcomers and long-time residents over the type or even the need for new facilities. The incoming population will tend to be younger and desiring more recreational opportunities than the permanent residents in many of the rural areas where mining is likely to occur (U.S. Department of the Interior, 1978c). Much of the population influx will be due to the construction of power plants and transmission facilities. If long-term recreation facilities are built for this peak population, these facilities will be underused and may become a tax burden once construction is completed and the workers leave.

Expansion of coal mining could also have some beneficial impacts on recreation. Part of the greater tax revenue generated by the increased population could be used to help alleviate pressure on existing municipal facilities. Mining operations could open up new roads, trails and barren slopes to sustain off-road-vehicle (ORV's) (U.S. Department of the Interior, 1978z). Successful reclamation efforts on disturbed land may increase winter season wildlife viewing opportunities that would occur adjacent to right-of-way where snowfall is regularly removed. Recontouring and replanting of land during reclamation can sometimes increase habitat for small game, waterfowl and migratory birds.

5.3 IMPACTS OF PREFERRED PROGRAM AND PROGRAM ALTERNATIVES

5.3.1 Impacts of Preferred Program

5.3.1.1 Socioeconomic Impacts

Socioeconomic characteristics related to the preferred leasing alternative are presented in Tables __ to __ of Appendix __ for the three production scenarios and two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeconomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total* increases over those two time intervals related to production level changes. Examination of the description of methodology in section 5-1 will provide a more thorough understanding of the significance of those data. Also, a generic description of socioeconomic impact is presented in section 5.2 to provide further insight into the meaning of the various population increases discussed in this section.

High Level Production Scenario

Socioeconomic impact for the high production scenario is greatest in the Powder River Region at both the 1985 and 1990 levels. Population approximately doubles in this region over the 1975 baseline population for the 1985 case with an additional 73 percent increase at the

*Total population related to direct and indirect construction and operation workers.

1990 level. This represents a total population increase of about 412,000 for the combined time periods or a total of 173 percent between the base year and 1990.

School enrollments would be two times greater than baseline levels for the 1990 level alone. This is in addition to the 38,000 related to the 1985 case. It also means an increase of about 133,000 housing units, 56,000 more than the number of year round dwelling recorded in the base year when the combined production levels are considered. Another indication of the magnitude of impact is the demand placed upon law enforcement and health care systems. While there were only 250 patient care doctors in the entire region in the 1975 base year, the 1985 level would require 170 new physicians and an additional 240 doctors for the 1990 case. Combined production years would add over 850 police officers to the base force of 550.

It is evident that "hyperurbanization" is likely to occur when these data are considered over the respective time periods. This represents a significant socioeconomic impact in the Powder River Region for both the 1985 and 1990 production level scenarios. It should be noted that while a large part of this impact is related to surface mining, considerable population increase can also be attributed to non-mechanical cleaning (see Section 5.2 for generic discussion of impact).

The only other region to exceed a twenty percent increase is the Green River-Hams Fork Region under the 1985 production level. The 75,000 people for that time period represents a manageable growth rate at about 27 percent over the base population. The 1990 case would add another 17 percent to the base figure for a total increase of 44 percent. Other socioeconomic characteristics increase at comparable levels ranging from about one-third to one-half of that recorded in the base year. Notable contributions to these increases are surface mining and non-mechanical cleaning with some development in underground mining and steam generation.

While some of the other regions reflect rather large absolute population numbers, the percentage increases range only from a high of 16 percent in the Uinta-Southwestern Utah Region to only one percent in Central Appalachia at the 1985 high scenario.

Mid-Level Production Scenario

Powder River is again the region most affected at both the 1985 and 1990 production levels. The 113,000 and 162,000 population figures for the respective years represent a total increase of approximately 115 percent over the 1975 base year. Demand for housing, physicians and law enforeement officers is about twice that of baseline when the two production years are combined. While these numbers are considerably lower than those related to the high scenario, they still approach levels of unacceptable growth rates and represent a potential for significant socioeconomic impact in the Powder River Region.

The only other regions which exceed a 10 percent population increase at mid-level production are Green River-Hams Fork and

Fort Union. They are well within manageable levels. Green River-Hams Fork records an 18 and 13 percent increase for the 1985 and 1990 cases respectively. Fort Union numbers represent a 13 percent increase over base for the 1990 scenario. All other regions range only from 10 percent in the Uinta-Southwestern Utah Region to one percent in the Denver-Raton Mesa Region and Southern Appalachia. Numbers for other socioeocnomic characteristics within this range are not significantly greater than base year data when considered over the two time periods.

Low-Level Production Scenario

The only notable increase in population at the low level production scenario is again in the Powder River Region in the 1985 case. However, the 84,000 people represent only about 35 percent over the base population. Considering this over that time period suggests that it is within the range of manageable growth rates. The only other regions to be noted at this production level are Northern and Southern Appalachia which experience a slight decline in population for the 1990 case. This decrease is slight, however, representing more of a stabilization than any serious impact from a "bust" economy. All other regions reflect a slight positive growth ranging from one to eleven percent.

Fiscal Demands

The fiscal demand categories considered in this section include:

Educational facilities

Health facilities

Housing

Drinking water

Wastewater treatment

Solid waste disposal

Public safety

The individually estimated demands have been aggregated for each of the coal regions. Estimates of total and incremental fiscal demands for the 1985, 1990 and 1976-85, 1985-90 are presented in Appendix ___.

Increased production of western coal under the preferred alternative results in significant incremental fiscal demands attributable to the coal cycle during the period 1976-1985. These demands range from $1.6 billion for the low production level to $4.2 billion for the high production level. The additional demands represent a 34.0 and 50.0 cumulative percent increase, respectively, of estimated coal cycle related infrastructure investment by 1985. Under the preferred action, the most significantly affected western regions are:

Powder River - estimated additional coal cycle related fiscal demands range from 800 million to $1.7 billion by 1985.

Uinta - The Uinta Coal Region is projected to have total additional infrastructure fiscal demands ranging from $200 million to $650 million by 1985.

In the Eastern Coal Regions, increased coal production will result in the generation of significant additional coal cycle related fiscal demands. These demands are projected to range between $6.1 billion under the low production alternative and $7.7 billion under the medium production alternative. These additional demands represent 21.7 and 24.9 percent increase, respectively, of cumulative estimated 1985 coal cycle related fiscal investments. The estimated total incremental 1976-85 coal cycle related fiscal demands in the Eastern Coal Regions are also projected to be significant. Estimates of additional demand range between $6.1 billion under the low production alternative and $7.7 billion under the medium alternative.

The most significantly affected regions in the eastern coal areas are:

Northern Appalachia - cumulative demands of \$1.4 to \$1.8 billion dollars. These projected levels are anticipated under the low and high production level, respectively.

Eastern Interior - cumulative fiscal demands are expected to range between \$1.7 and \$1.8 billion dollars by 1985 for the low, medium and high production levels projected.

Between 1985 and 1990, additional coal cycle related fiscal demands are projected to range between $1.2 billion (low production level) and $4.7 billion (high production level) in the Western Coal Regions.

The regions most significantly affected include:

Powder River - projected additional demands of from $257 million to $2.3 billion between 1985 and 1990.

Fort Union - projected additional demands of from $97 million to $482 million between 1985 and 1990.

Denver Raton - projected additional demands of from $238 million to $573 million between 1985 and 1990.

In the Eastern Coal Regions, the total additional projected coal-cycle related fiscal demands between 1985 and 1990 are projected to range between $2.4 billion and $14.8 billion.

The Appalachian (N,C,S) and Texas Gulf Coal Regions will generate a substantial (>50%) amount of these total additional demands.

5.3.1.2 Transportation Impacts

Regionally dependent transportation impacts that will occur as a result of increased coal production under all leasing alternatives considered are presented on Figure 5-6 . The areas indicated have been identified as transportation capacity bottlenecks.

Area A - Rail lines between Gilette, Wyoming, and the South Dakota border at Clifton will represent an obstacle to Powder River Region and Green River Region coal moving to midwestern destinations. This transit capacity limitation has been described as severe.

Area B - Rail lines running north-south in Wyoming, between Frannie Junction (north) and Cheyenne (south). This transportation constraint will affect shipments of coal from Powder River and Green River to south and southwestern destinations. It has been characterized as severe.

Area C - Rail capacity between Glenwood Springs, Colorado, and Denver. This constraint will affect coal flows from the Green River and Uinta coal regions to destinations in eastern Colorado and in the Midwest. Due to the relative magnitude of flows, this limitation on coal transit capacity has been characterized as moderate.

Area D - Rail capacity between Aberdeen, South Dakota, and Jefferson, South Dakota. This north-south rail link will limit the flows of Fort Union and Powder River coal to destinations such as Nebraska, Kansas, Arkansas and Oklahoma. It has been characterized as moderate.

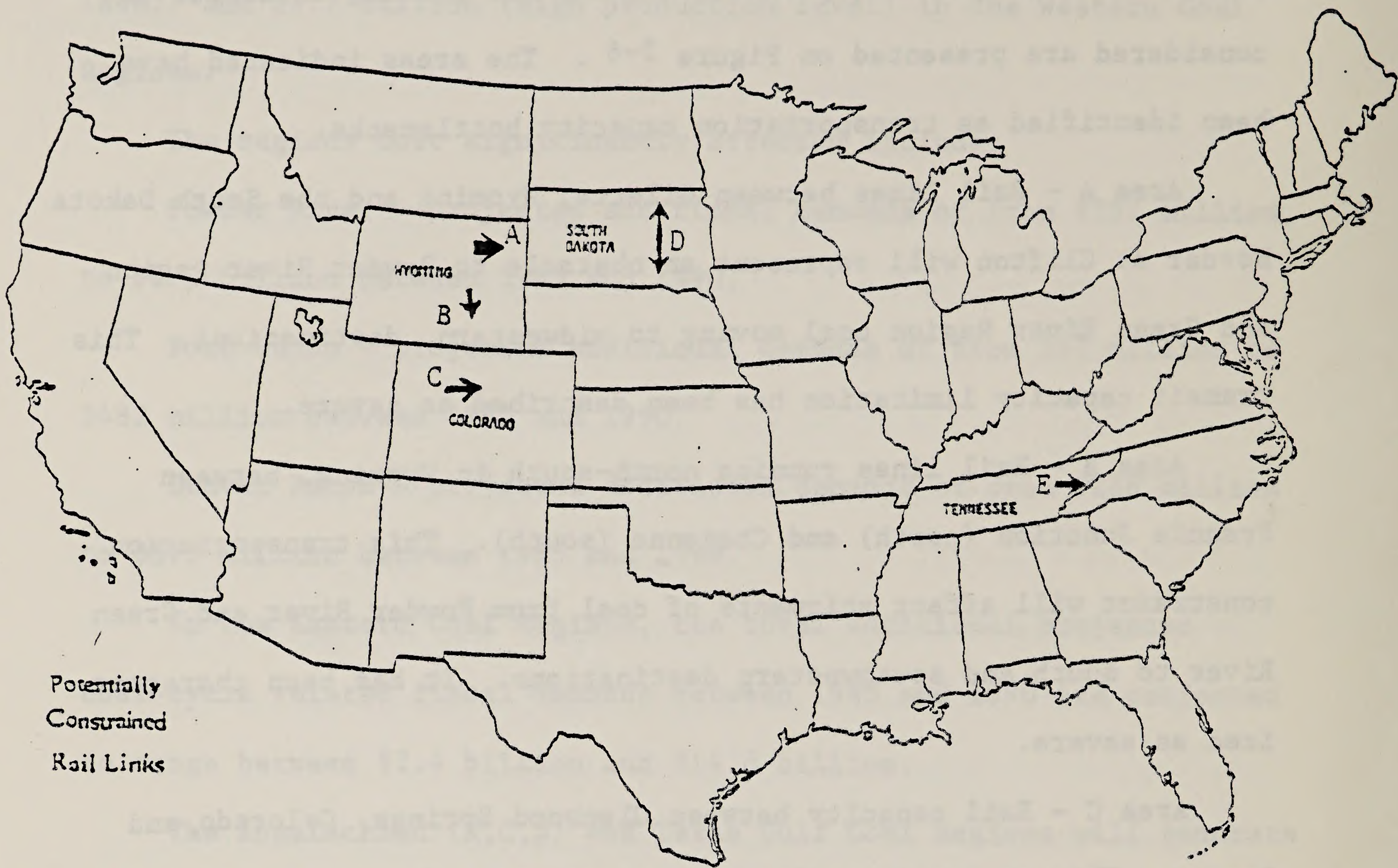


FIGURE 5-6

COAL TRANSPORTATION FLOWS

Area E - Area E is the only eastern coal route that will result in limitations on projected coal flows. These flows will originate in the southern and central Appalachian coal region and will have destinations primarily in the South Atlantic and Mid-Atlantic states. Due to the relative magnitude of these flows, the constraint can be considered moderate.

5.3.1.3 Ecological Parameters

Regional summaries of potential losses in plant productivity and in wildlife populations due to losses of habitat for the preferred alternative high, mid, and low level production, for 1976-1985 and 1985-1990, are given in Appendix G. Land commitments associated with mining activities and coal plant construction are in Table 5-5.

TABLE 5-5

LAND COMMITMENTS FOR MINING ACTIVITIES AND COAL PLANT CONSTRUCTION

High Level

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Applachian	221,000	74	193,000	86
Central Applachian	121,000	64	103,000	74
Southern Applachian	137,000	87	103,000	93
Eastern Interior	200,000	78	128,000	81
Western Interior	159,000	90	139,000	96
Texas	174,000	86	184,000	82
Western Regions				
Powder River	68,000	58	67,000	62
Green River-Hams Fork	90,000	73	60,000	75
Fort Union	48,000	63	31,000	58
San Juan River	26,000	53	26,000	55
Uinta-Southwestern Utah	26,000	78	18,000	79
Denver-Raton Mesa	29,000	81	24,000	83

TABLE 5-5 (Continued)

Mid Level

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	206,000	73	128,000	81
Central Appalachian	143,000	64	93,000	73
Southern Appalachian	136,000	91	75,000	94
Eastern Interior	185,000	70	104,000	74
Western Interior	146,000	90	122,000	95
Texas	188,000	78	171,000	83
Western Regions	45,000	53	44,000	57
Green River-Hams Fork	54,000	63	40,000	69
Fort Union	28,000	62	29,000	72
San Juan River	17,000	54	17,000	81
Uinta-Southwestern Utah	24,000	83	13,000	79
Denver-Raton Mesa	27,000	89	27,000	89

TABLE 5-5 (Concluded)

Low Level

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Applachian	210,000	73	107,000	78
Central Applachian	135,000	63	80,000	71
Southern Applachian	102,000	91	51,000	94
Eastern Interior	177,000	68	99,000	75
Western Interior	117,000	86	65,000	93
Texas	122,000	71	79,000	73
Western Regions				
Powder River	33,000	46	19,000	45
Green River-Hams Fork	26,000	52	23,000	61
Fort Union	35,000	79	20,000	77
San Juan River	12,000	52	80,000	48
Uinta-Southwestern Utah	23,000	90	15,000	87
Denver-Raton Mesa	21,000	94	15,000	87

The major commitments of land in Powder River and Green River Coal Regions under all production levels in both 1985 and 1990 would be to mining and mine related activities. In San Juan Coal Region, mining would also require the major portion of land developed under the high and mid-level alternatives (1985 and 1990). Under the low level production alternative 52 percent of the land committed in 1985 would be for using industry. In 1990, 48 percent in San Juan would be for mining.

Based on the land use scenario, major losses of forest productivity would occur in Appalachia (Northern, Central, and Southern) and Texas under all production levels for both 1985 and 1990. Major loss of agricultural production (grain) would occur in Eastern Interior and Western Interior. Loss of potential corn production in Eastern Interior, for example, would be as high as 13.5 million bushels by 1990 under the low coal production level, 13.9 million under medium and 14.3 million under high. Loss of range would be greatest in the western regions (Powder River, Green River-Hams Fork, Fort Union, Denver-Raton Mesa) and in Texas.

Wildlife dependent on lands committed to coal development would be affected by habitat loss. In Northern Appalachia, for example, habitat capable of supporting approximately 4 million small mammals would be lost by 1990 under the low production level. Under mid and high production levels, habitat for approximately 4.6 and 5.2 million small mammals would be removed by 1990.

5.3.1.4 Recreational Impacts

Appalachian Region

Figures on the additional Federal and State recreation acreages projected for 1985 and 1990 for high, meduim, and low production scenarios for this alternative appear in Table __ in Appendix__. These increases would be necessary to maintain the same number of areas of recreation facilities per resident that existed in 1975. National forests were not included in these figures because they tend to be very large in size, but not heavily used for recreation. They do have great potential as recreation sites, and are therefore mentioned later when they are adjacent areas that are likely to have future coal mining.

The acreages available for recreational purposes in all three sections of this region are fairly small compared to those in the western regions. Since this region is located near many densely populated areas, the recreation facilities are used heavily already. Any further increase in demand in these areas could cause a greater impact than a similar demand in the western regions (Lyons, 1978).

The Warrior Basin area in Alabama is the most likely area in the Appalachian Region to be impacted by mining of Federal coal. The Talladega National Forest lies approximately 20 miles south of the Warrior Basin area. Lake Lurleen State Park, located 12 miles northwest of Tuscaloosa is about 10 miles from the area of known coal reserves.

Eastern Interior and Western Interior

Figures on the additional Federal and State recreation acreages in these regions projected for 1985 and 1990 for high, medium, and low production scenarios for this alternative appear in Table __ in the Appendix. The lower population density in and around these regions means the public parklands are less intensively used than those in the Appalachian region. Any coal mining would therefore cause less detrimental impacts than comparable mining in the Appalachian region (Lyons, 1978).

Texas Gulf Region

Figures on the additional Federal and State recreation acreages projected for 1985 and 1990 for high, medium, and low production scenarios for this alternative appear in Table _ in the Appendix.

Powder River Region

This region will suffer the greatest impact on recreation facilities of any region under this alternative. In 1985, an additional 171,695 Federal recreation acres and 3,000 acres of State recreation facilities will have to be added to maintain the 1975 population-recreation acreage ratio under the medium scenario (Appendix, Table -). By 1990, another 246,247 acres will be needed in the Federal systems and 4,303 in the State systems.

The Grass Creek and Powder River Basin Known Recoverable Coal Resource Areas (KRCRA's) in Wyoming are within 15 miles of the Shoshone National Forest and the Bighorn National Forest respectively. The Powder River Basin KRCRA also includes 400,000 acres of Custer National Forest which is exempt from mining under SMCRA, but could still be adversely affected by any nearby mining (U.S. Department of the Interior, 1978tt). Other recreation facilities within 25 miles of current leases are the Lake Mason National Wildlife Refuge, Montana, Fort Phil Kearny and Sheridan Inn National Historical Landmarks and Fort Fretterman in Wyoming.

Green River Region

This region would require the second greatest increase in recreation facilities to offset the expected increase in population under this alternative (Appendix, Table__). Of the eight KRCRA's either totally or partially within the region, four are within several miles of recreation facilities. McCallum KRCRA, Colorado includes a portion of Arapahoe National Wildlife Refuge and is adjacent to sections of the Colorado State Forest and Roosevelt National Forest. Hanna and Carbon Basins KRCRA, Wyoming, border Seminole State Park which is heavily used for fishing and boating. Fossil Butte National Monument lies five miles from the Kemmerer KRCRA, Wyoming. Flaming Gorge National Recreation Area is several miles southwest of the Rock Springs KRCRA, Wyoming (U.S. Department of the Interior, 1978tt).

Additional recreation sites within 25 miles of areas currently leased include Fort Steele, Fort Bridger and Piedmont Charcoal Kilns historical sites in Wyoming and Steamboat Lake State Park and Routt National Forest in Colorado. Due to the increased sewage discharge rates resulting from the expected rapid growth of the region's communities, damage is likely to occur to the recreation opportunities along the Yampa and White Rivers (U.S. Department of the Interior, 1978z).

Fort Union Region

Figures on the additional Federal and State recreation acreages projected for 1985 and 1990 for high, medium and low production scenarios for this alternative appear in Table _ in Appendix _. Half of the 14 KRCRA's in this region are located near recreation facilities. Burns Creek - Thirteen Mile Creek KRCRA is just south of the Fox Lake State Waterfowl Project. Wibaux Beach KRCRA is located two miles from Lame Steer National Wildlife Refuge in Montana. Bowman - Gascoyne and Dickinson KRCRA's in North Dakota are adjacent to the Little Missouri Badlands and Theodore Roosevelt National Memorial Park, respectively. Activities at Lake Ilo National Wildlife Refuge, North Dakota, are likely to be adversely affected by the expected development of the Knife River KRCRA. A proposed coal gasification plant for this area would not only affect activities at Lake Ilo, but the emissions would be detrimental to the watching of falcons and eagles nesting nearby on Horse Nose Butte and Ziner Butte (U.S. Department of the Interior, 1978c). The Niobe KRCRA is two miles from the Des Lacs National Wildlife Refuge and the Williston - Avoca KRCRA borders state wildlife lands in Williams County, North Dakota (U.S. Department of the Interior, 1978tt).

San Juan River Region

Figures on the additional Federal and State recreation acreages necessary to maintain the 1975 population-recreation facility ratio in 1985 and 1990 for this alternative appear in Table __ in the Appendix. Of the seven KRCRA's in the region, five are near recreation areas. Cimarron Ridge KRCRA is within one mile of a 1,700 acre State Wildlife Area and the Uncompahgre National Forest on the north. The Los Pinos River, which is under consideration for the Wild and Scenic Rivers System, runs north to south through the potential coal leasing area. La Ventura KRCRA is bordered on the east by Sante Fe National Forest and is 15 miles from Chaco Canyon National Monument. Small sections of the San Juan KRCRA are in the Sante Fe National Forest and the Tsaya KRCRA is due west of Chaco Canyon National Monument (U.S. Department of the Interior, 1978tt). Other recreation facilities within 25 miles of existing leases include Glen Canyon National Recreation Area, Utah, and Aztec Ruins National Monument, Navajo Lake, Coronado State Park and Jemez State Monument, New Mexico.

Uinta Region

Figures on the additional Federal and State recreation acreages projected for 1985 and 1990 for this alternative appear in Table__ in the Appendix. Six of the eight KRCRA's in the region are near recreation facilities. The southern border of Dinosaur National Park is ten miles from the northern border of the Lower White River KRCRA. Parts of Grand Mesa National Forest and Gunnison National Forest including the West Elk Wilderness area are in the Paonia - Somerset KRCRA. The Alton - Kanab KRCRA is bordered by Bryce Canyon National Park and includes portions of Dixie National Forest. A section of Henry Mountain KRCRA is bounded by and slightly overlaps Capital Reef National Park. Kaiparowits Plateau KRCRA is bounded by Bryce Canyon National Park on the west, Glen Canyon National Recreation Area to the southeast and Dixie National Forest on the north. Most of the Wasatch Plateau KRCRA is in the Wasatch National Forest (U.S. Department of the Interior, 1978tt).

Other recreation facilities within 25 miles of current leases include Zion National Park, Fishlake and Manti-La Sal National Forests, Scofield Lake, Huntington Lake and Palisade Lake State Recreation Area, Millsite Lake State Beach, Escalante Petrified Forest and Kodachrome Basin State Reserve in Utah. Recreation areas that might be impacted in Colorado include Paonia, Highline, Sweitzer Lake, Crawford and Vega State Recreation areas. In many sections of the region, recreation and tourism are the biggest industries, so even minor impacts to the environment could have serious effects to the economy.

Denver - Raton Mesa

Figures on the additional Federal and State recreation acreages necessary to maintain the 1975 population-recreation facility ratio in 1985 and 1990 for this alternative appear in Table__ in the Appendix. This area has the smallest amount of developed recreation facilities of all the coal regions.

Only 50 acres of new Federal recreation acreage and 331 acres of State recreation would be added to the present systems by 1985 for the medium scenario. By 1990, another 108 acres will be needed in the Federal systems and 709 acres in State recreation land.

Recreation areas within 25 miles of current leases include San Isabel National Forest and Ramah and Trinidad State Recreation Areas in Colorado. Maxwell National Wildlife Refuge is near current leases in New Mexico.

5.3.1.5 Water Impacts

The total yearly water-use requirements of the coal leasing program will range from 2.7 million acre-feet (ac-ft) to 3.2 million ac-ft in 1985; by 1990, the range will be from 3.1 million ac-ft to 5.2 million ac-ft. Water-use requirements in the 12 regions reflect the degree of coal development in each region (Table 5.5a).

Both water availability and water quality will be affected by the coal leasing program. Water to meet mining, cleaning, and conversion needs will be drawn from available surface-water and ground-water sources. Dependent upon local conditions, these water sources may or may not be adequate to support the mining program. Following its use, a volume of water will be discharged to the environment. The quality of this fluid will have been changed during its utilization. Such quality changes may include the addition of total dissolved solids, including heavy and trace metals as well as the common cations and anions; the lowering of ph; and the addition of heat.

The analysis of the impact of the coal leasing program on water availability was based on surface-water flow data compiled for watersheds by the U.S. Water Resources Council. To ease the task of analysis, it was necessary to choose watersheds which most closely overlap the coal regions.

Table 5-5a

Total Regional Water Use Requirements
(Preferred Action Program)
(1000's Acre-Feet/Year)

Region	1985			1990		
	Low	Medium	High	Low	Medium	High
Northern Appalachian	633.2	630.2	656.1	641.7	746.1	1,080.5
Central Appalachian	353.3	377.0	316.0	416.7	483.5	536.3
Southern Appalachian	264.7	353.6	359.9	270.0	397.8	528.5
Eastern Interior	498.5	516.6	545.2	555.8	581.4	771.6
Western Interior	295.6	364.2	400.0	322.8	608.2	688.5
Texas Gulf	313.8	476.2	439.4	399.3	865.1	925.0
San Juan	30.7	32.6	51.9	39.1	98.4	91.6
Uinta	58.8	63.5	72.5	78.5	74.3	100.8
Green River	55.2	68.6	64.7	66.7	65.8	78.0
Powder River	77.6	71.6	87.7	92.8	98.5	122.5
Fort Union	82.6	63.4	116.8	93.5	137.5	148.5
Denver-Raton	54.3	70.4	77.7	78.4	141.9	141.3

In some cases, it was necessary to use a watershed that includes two or more coal regions (Table 5-5b).

The available surface-water supply in the Upper Ohio and Tennessee River Basins will be sufficient to support the coal leasing program in the Northern, Central, and Southern Appalachian Coal Regions. The combined 1985 water demand for these coal regions is 1.33 million ac-ft (high option), which is 1.3 percent of the mean flow (96.5 million ac-ft) and only 2.1 percent of the extreme low flow (5 percent flow or once every 20 years on the average) of the watershed (62.8 million ac-ft). The 20-year low flow for October is 1.4 million ac-ft, which will support a mean monthly water demand of 110,000 ac-ft. The 1990 water demand will increase to 2.1 million ac-ft, but this is far less than the mean flow in the river basins. Increased water demands in 1990 will not produce difficulty during periods of low flow. The 20-year low flow for October (1.4 million ac-ft) is much greater than the projected mean monthly demand for 1990 (180,000 ac-ft).

Over 80 percent (1.1.million ac-ft) of all water used in the Appalachian coal regions will be consumptively used (Table 5-5c). The remainder (230,000 ac-ft) will be discharged as waste fluid to surface water. Without adherence to

Table 5-5b

Coal Regions and Corresponding Watersheds

Coal Region	Watershed
Northern, Central, and Southern Appalachian	Upper Ohio and Upper Tennessee
Eastern Interior and Appalachian	Upper Mississippi and Ohio
Western Interior, Powder River, Fort Union, and Denver-Raton	Missouri and Arkansas
Texas Gulf	Texas Gulf
Powder River	Yellowstone
Fort Union and Powder River	Upper Missouri
Green River	Green River
Uinta and Green River	Upper Colorado and Green
San Juan, Uinta, and Green	Upper Colorado at Lee's Ferry
Denver-Raton	Upper Platte and Upper Arkansas

Table 5-5c

Total Regional Water Consumption
(1000's of Acre-Feet/Year)
(Preferred Program)

Region	1985			1990		
	Low	Medium	High	Low	Medium	High
Northern Appalachian	491.6	480.8	509.3	498.0	581.1	877.1
Central Appalachian	311.1	333.5	278.6	368.6	428.2	474.2
Southern Appalachian	277.3	307.9	311.4	231.1	345.2	461.1
Eastern Interior	412.7	429.2	456.1	458.2	478.0	581.3
Western Interior	266.1	327.5	360.1	290.2	546.2	617.0
Texas Gulf	280.1	426.0	393.3	356.7	776.5	828.9
San Juan	27.6	29.1	46.4	34.8	80.6	81.6
Uinta	52.5	54.8	60.5	69.9	62.3	85.4
Green River	49.3	61.2	57.4	59.4	56.6	68.8
Powder River	69.1	63.3	76.6	82.6	82.2	105.7
Fort Union	72.6	54.4	103.2	82.2	120.9	130.0
Denver-Raton	46.7	61.2	66.8	68.0	124.3	100.8

effluent guidelines mandated by the Federal government and the states, some local pollution problems may occur. During most of the year, however, stream flows will remain sufficiently high to dilute the pollution potential.

The 1985 water demand (high option) of the Eastern Interior Coal Region is 545,000 ac-ft, or less than 1 percent of the available surface-water flow (214 million ac-ft mean annual) of the Upper Mississippi and Ohio River Basins. The 20-year low flow for October is 2.1 million ac-ft, which will support the projected mean monthly use requirements of 45,000 ac-ft. Some local problems, however, may occur where stream flow of individual rivers may not be able to support the coal mining demands. Large supplies of ground water are available to meet these localized demands, but ground-water quality may not be adequate for some uses, especially for steam conversion. High consumptive use of the water (456,000 ac-ft) will result in relatively low effluent discharge. Some pollution problems may, however, exist in smaller streams.

The stream flows of the Missouri and Arkansas River Basins are adequate to support the water requirements of the Western Interior Coal Region. The upper reaches of these river basins also support the water requirements of the Powder River, Fort Union, and Denver-Raton Coal Regions. If it is assumed that no water leaves these upper coal-mining reaches, the mean annual flow available to the

Western Interior Coal Region is 45 million ac-ft. The 1985 water demand (high option) for the coal region is 400,000 ac-ft (approximately 10 percent of the flow). Major seasonal problems may occur, however. The 20-year low flow in July, August, and September may not be sufficient to support coal mining in 1985. If all upstream uses were reduced during this period, coal mining could be supported in the Western Interior Coal Region. Similar low flow problems will also be evident in 1990.

Consumptive use in the Western Interior Coal Region is 360,000 ac-ft (high option) in 1985, increasing to 617,000 ac-ft in 1990. Effluent discharges following use of the water may not be sufficient to support normal low-flow water-quality conditions in many local areas.

Several rivers, including the Lower Red, Sabine, Neches, Trinity, Brazos, Colorado, and Nueces Rivers can be used to support the water demands of the Texas Gulf Region. Even though the mean annual flow of these rivers (46.7 million ac-ft) is sufficient to meet the yearly 1985 water demand of 439,999 ac-ft (high option), 5 percent of the time the 20-year low flow will not be able to support the mean monthly water demand (37,000 ac-ft) during 4 months of the year. Doubling water demands by 1990 will not increase the number of months in which there will be a deficiency of surface-water supplies. Overall, there is abundant ground water available to support coal mining in the region; however, ground-water mining is presently occuring in some areas of the coal region. Water-pollution problems similar to those indicated for the Western Interior Coal Region will occur in the Texas Gulf Region.

The Yellowstone River will provide most of the surface water to meet the coal demands of the Powder River Coal Region. The 1985 water demand (high option) for the coal region is 87,700 ac-ft, or approximately 25 percent of the 20-year low flow (3.7 million ac-ft). In 1990 the water demand will increase to 33 percent (122,500 ac-ft) of the 20-year low flow. Mean monthly water demands will exceed monthly 20-year low flows during the summer months. Many of the tributaries in the watershed have only intermittent flow during much of the year. Therefore, even though it appears water is regionally available during most of the year, serious local problems may occur during parts of the year. Current water rights problems associated with the Yellowstone River may limit the amount of available water accessible to the coal industry. Existing water users consumptively use approximately 97 percent of the 20-year low flow, thus effectively removing all available surface water during these periods.

Ground water is available in the Powder River Coal Region from a shallow aquifer system and a deep aquifer system, the Madison Limestone. It appears that present ground-water use is sufficiently low to allow the increased use by the coal industry. Ground-water mining, however, may result in some areas. Additionally, other energy demands for water, including uranium mining, will stress the ground-water system.

The Fort Union Coal Region will require 116,800 ac-ft of water by 1985 to meet the high option water demands. The Upper Missouri River Basin will supply the water for this region. The 1985 water demand is 2.5 percent of the mean 20-year low flow (4.7 million ac-ft). At no time is the monthly 20-year low flow less than the monthly water requirement for coal mining. Local water-availability and water-quality problems may exist, however. Because the Western Interior Coal Region will be somewhat dependent on water leaving the watershed, it may be necessary to support some minimum levels of outflow from the watershed.

The Upper Colorado River Basin, which includes the Green River, Uinta, and San Juan Coal Regions, is highly regulated by compacts and treaties. It has been estimated that only 400,000 ac-ft are potentially available for use by the coal-mining industry (ERDA, 1977). A 1985 water demand (high option) of 189,000 ac-ft has been estimated. By 1990 the water demand will increase to 270,000 ac-ft. This leasing program, therefore, can be met from available supplies. Extreme low-flow problems may, however, occur.

If it is assumed that the available 20-year low flow is approximately 135,00 ac-ft (34 percent of 400,00 ac-ft based on low-flow relationships for the entire Upper Colorado flow), the water demand exceeds the 20-year low flow for all levels of leasing.

Ground water is available in the Upper Colorado Basin. It has been estimated that 4 million ac-ft of ground water are recharged to the system each year (Price, 1974). The recoverability of this recharge is unknown. In addition, it is estimated that there are 115 million ac-ft of recoverable ground water in storage. Use of this ground water will, however, result in local ground-water mining.

Consumptive use of the water requirements will be 164,000 ac-ft in 1985. The resulting effluent flow (25,000 ac-ft) will be discharged to surface water, where some local pollution problems may occur.

In 1985 it is projected that the high option water demand for the Denver-Raton Coal Region will be 77,300 ac-ft. The Upper Platte and Upper Arkansas River Basins will be the primary sources of supply for the region. The 1985 demand will 7.5 percent of the 20-year low flow; the 1990 demand (141,300 ac-ft) will be 14 percent of the 20-year low flow. As with other western coal mining regions, the monthly average water demand exceeds the montly 20-year low flow. In local areas the available surface water may not support coal mining during extended periods of time.

Extensive importation of water is currently being undertaken to meet existing water demands. Increased coal development in the region will require increased importation or extensive ground-water development.

An additional impact of coal mining on water availability could affect all regions. Surface mining activities could result in the removal of aquifer systems and/or the disruption of recharge areas, thus effectively removing an unknown volume of ground water from potential use. Some mining operations will require dewatering processes to support the mining. This water could be used to meet some water demands, thereby lessening the demand on other sources.

5.3.2 Impacts of No New Leasing (Up to 1985) Program Alternative

5.3.2.1 Socioeconomic Impacts

Socioeconomic characteristics related to the no new federal leasing alternative are presented in Tables ____ to _____ of Appendix ___ for the three production scenarios and two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeocnomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeocnomic characteristics discussed here refer to total increases related to these production level changes. Examination of the description of methodology in section _ will provide a more thorough understanding of the significance of these data. Also, a generic description of socioeconomic impact is presented in section _ to provide further insight into the meaning of the various growth rates.

High Level Production Scenario

Socioeconomic impact related to the no new leasing alternative is also concentrated in the Powder River Region for the high production scenario. While population increases are not as large as those for the preferred action, they are at levels approaching impact significance.

For example, the 1985 production level results in a regional population increase of approximately 156,000 or 66 percent of the base year. Adding the 1990 scenario increase of about 600,000 people results in a total increment of around 90 percent over the 1976 base. While this increase does not represent a doubling of the socioeconomic baseline data, the combined incremental demand for such things as physicians, law enforcement officers and school enrollments approach levels which existed in the base year. Concentration of this increase in any one area could therefore have a potential for considerable socioeconomic impact as described in the generic Section 5.2. Again, most of this increase can be attributed to surface mining and non-mechanical cleaning with a small percentage related to steam generation.

Increases in all other regions appear to be within manageable ranges with the Green River-Hams Fork Region experiencing about a 20 percent increase for the 1985 case. With the exception of a 16 percent figure in the Uinta-Southwestern Utah Region, data range from 13 percent in Fort Union to one percent increases in parts of Appalachia.

Mid-Level Production Scenario

Data of most significance at the mid-level production scenario relates to the Powder River Region for the 1990 case. The approximately 90,000 people or 38 percent increase over the base year is higher for this mid level case than the increase for the high level scenario in the same year. Although the production level is lower, there is considerable development in other nodes of the cycle. For example, non-mechanical cleaning, high Btu gasification and liquefaction account for about 70 percent of the population increase. Consequently, while coal production for this scenario may be lower, population increases are at levels which could potentially lead to "hyperurbanization" as was the case in the Powder River Region for the preferred alternative high scenario. Effects on related socioeocnomic characteristics are therefore approaching those discussed under the high production scenario (see Section 5.2 for generic discussion of impact).

All other increases for the mid-level scenario appear to be within a manageable range of about 16 percent in Green River-Hams Fork to one percent in Southern Appalachia.

Low Level Production Scenario

While the population figures for the 1985 low level reflect about a 35 percent increase in Powder River, the 1990 production scenario drops to about an eleven percent increment. This considerable reduction can be attributed to a fairly consistent drop in the rate of increase across all nodes of the cycle. Consequently, all regions for both time periods appear to experience slight to moderate population increases within manageable levels of growth rates. With the exception of Powder River, they range from 9 percent in Green River-Hams Fork to a slight decrease in Northern Appalachia. This decrease is only slight, however, and does not reflect a significant decline in the economy.

Fiscal Impacts - No New Leasing

Fiscal impacts anticipated to occur under the No New Leasing Alternative closely parallel the fiscal impacts that accompany the proposed action and are described in Section 5.3.1.1. The No New Leasing fiscal impacts are presented in tabular form in Appendix __.

5.3.2.2 Transportation Impacts

Transportation impacts were previously addressed in Section 5.3.1.2.

5.3.2.3 Ecological Parameters

Ecological summaries of potential losses in plant productivity and in wildlife population due to losses of habitat for the No New Leasing Alternative, high, mid and low level production are given in Appendix G for 1976-1985 and 1986-1990. Land commitments associated with mining activities and coal plant construction for the three production levels are shown in Table 5-6.

The major commitments of land in Powder River, Green River, and San Juan Coal Regions under high, medium and low production levels would be to mining and mine-related activities. The remaining regions would have major land commitments to coal-using industry and coal cleaning facilities.

TABLE 5-6

LAND COMMITMENTS FOR MINING ACTIVITIES
AND COAL PLANT CONSTRUCTION

HIGH LEVEL

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	218,000	73	134,000	83
Central Appalachian	119,000	63	93,000	74
Southern Appalachian	136,000	86	78,000	90
Eastern Interior	199,000	77	100,000	75
Western Interior	156,000	90	120,000	91
Texas	176,000	82	167,000	81
Western Regions				
Powder River	60,000	55	37,000	54
Green River-Hams Fork	68,000	70	40,000	70
Fort Union	47,000	63	32,000	55
San Juan River	26,000	54	27,000	84
Uinta-Southwestern Utah	25,000	78	13,000	71
Denver-Raton Mesa	29,000	80	27,000	85

TABLE 5-6 (Continued)

MID-LEVEL

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	206,000	73	128,000	81
Central Appalachian	143,000	64	92,000	72
Southern Appalachian	136,000	90	76,000	93
Eastern Interior	184,000	70	103,000	73
Western Interior	143,000	89	118,000	92
Texas	187,000	79	169,000	78
Western Regions				
Powder River	46,000	54	34,000	54
Green River-Hams Fork	52,000	63	33,000	68
Fort Union	28,000	62	30,000	68
San Juan River	17,000	54	21,000	83
Uinta-Southwestern Utah	23,000	83	13,000	77
Denver-Raton Mesa	27,000	88	27,000	89

LOW LEVEL

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	210,000	73	107,000	78
Central Appalachian	135,000	63	80,000	71
Southern Appalachian	100,000	91	51,000	94
Eastern Interior	177,000	68	99,000	75
Western Interior	118,000	86	65,000	93
Texas	122,000	71	79,000	73
Western Regions				
Powder River	33,000	46	19,000	46
Green River-Hams Fork	26,000	52	22,000	60
Fort Union	35,000	90	20,000	77
San Juan River	12,000	52	8,500	49
Uinta-Southwestern Utah	23,000	90	15,000	87
Denver-Raton Mesa	20,000	91	15,000	87

Based on the land use scenario, major losses of forest productivity would occur in Northern, Central, and Southern Appalachian and Texas (Table ___). Major losses in grain production would occur in Eastern Interior and Western Interior. By 1990 approximately 13.5 million bushels of corn production would be lost under the low and high levels of production. Approximately 14 million bushels would be lost under the medium level. Loss of range would be greatest in the Powder River, Green River-Hams Fork, Fort Union, Denver-Raton Mesa and Texas Regions.

Wildlife dependent upon lands committed to coal development would be effected by habitat loss. Small and game mammals, birds, amphibians, reptiles, and predators would be effected in all regions based principally on the acres of habitat disturbed. By 1990, habitat capable of supporting 4.8 million small mammals would be removed from Green River-Hams Fork under the low production level. Under mid and high production levels by 1990, potential losses could be as high as 7.1 million and 8.5 million, respectively. White-tailed deer would be the major large game animal effected in eastern regions while mule deer, pronghorn elk, moose and white-tailed deer would be effected in the West. Habitat capable of supporting as many as 111,000 white-tailed deer (low level by 1990); 122,000 (mid-level by 1990); and 129,000 (high level by 1990) would be removed. Loss of habitat in the western regions would affect less numbers of large game animals, but more species would potentially be affected.

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5.3.2.4 Recreation Impacts

Figures on the additional Federal and State recreation acreages projected for 1985 and 1990 for high, medium, and low production scenarios for this alternative appear in Table ___ in Appendix ___. Under this alternative, the Powder River region receives the greatest impact, Uinta - Southwest Utah the second greatest and Denver-Raton Mesa the least. Refer to the Recreation Impacts, Preferred Alternative section for a discussion of the recreational facilities in each region likely to be impacted by further coal production.

5.3.2.5 Water Impacts

Table 5-6a summarizes the water use demands of the no new leasing alternative for the years 1985 and 1990. As can be seen by comparison with Table 5-56 the 1985 water demands of this alternative are not significantly different from the 1985 water demands of the preferred leasing alternative. The water availability and quality impacts discussed in conjunction with that alternative apply here. The 1990 water demands for the no new leasing alternative are also similar to the preferred alternative except under the high option scenario. By comparison, the 1990 high-option national water demand of the preferred alternative is 5.2 million ac-ft.

whereas the 1990 no new leasing alternative is 4.2 million ac-ft. Eastern coal regions including the Northern, Eastern, and Southern Appalachian Regions, and the Eastern Interior Coal Region will account for almost 70 percent (690 thousand ac-ft) of this decreased water demand. As these coal regions have sufficient available water supply to meet the higher preferred alternative levels, the lower water demands of the no new leasing alternative have no real significant impact.

In the western coal regions where seasonal or even yearly water deficiences exist, the water demand will be reduced 310 thousand ac-ft under the no new leasing alternative. This decrease in demand will not greatly alleviate the potential water problems associated with coal mining in these areas. On the average, the decrease in demand is approximately 4,500 ac-ft per year in all regions except San Juan, where water demand is decreased by 79,000 ac-ft. Such a reduction in the San Juan Coal Region will allow available surface water to support coal mining and its related activities.

Table 5-6a

Total Regional Water Use Requirements
(No New Leasing)
(1000's Acre-Feet/Year)

Region	1985			1990		
	Low	Medium	High	Low	Medium	High
Northern Appalachian	633.2	630.2	656.2	641.7	754.1	760.3
Central Appalachian	353.2	377.8	315.6	416.7	484.0	481.7
Southern Appalachian	264.7	355.6	358.1	270.0	398.3	402.8
Eastern Interior	498.5	515.9	542.8	555.3	579.1	558.1
Western Interior	295.6	358.8	390.1	322.2	592.2	598.4
Texas Gulf	313.8	470.6	443.2	400.0	853.8	833.5
San Juan	30.7	32.6	51.6	39.1	10.2	12.0
Uinta	58.8	62.1	70.9	78.1	70.7	73.3
Green River	55.2	66.0	60.0	66.2	58.6	70.4
Powder River	77.6	71.6	84.4	92.4	90.0	110.0
Fort Union	82.6	63.4	115.2	93.2	141.6	154.9
Denver-Raton	54.3	70.0	75.7	78.3	139.6	133.7

5.3.3 Impacts of Preference Right Leasing Alternative

5.3.3.1 Socioeconomic Impacts

Socioeconomic characteristics related to the preference right leasing alternative are presented in Tables ___ and ___ of Appendix __ for the two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeconomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total* increases related to these production level changes. Examination of the description of methodology in section 5.1 will provide a more thorough understanding of the significance of those

*Total population related to direct and indirect construction and operation workers.

5.3.2.4 Recreation Impacts

Figures on the additional Federal and State recreation acreages projected for 1985 and 1990 for high, medium, and low production scenarios for this alternative appear in Table__ in Appendix__. Under this alternative, the Powder River region receives the greatest impact, Uinta - Southwest Utah the second greatest and Denver - Raton Mesa the least. Refer to the Recreation Impacts, Preferred Alternative section for a discussion of the recreational facilities in each region likely to be impacted by further coal production.

5.3.3 Impacts of Preference Right Leasing Alternative

5.3.3.1 Socioeconomic Impacts

Socioeocnomic characteristics related to the preference right leasing alternative are presented in Tables and of Appendix for the two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeocnomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total* increases related to these production level changes. Examination of the description of methodology in Section 5.1 will provide a more thorough understanding of the significance of those data. Also, a generic description of socioeocnomic impact is presented in Section 5.2 to provide further insight into the meaning of the various growth rates.

Socioeconomic impact of the preference right leasing alternative is similar to the preferred action in that it is concentrated in the Powder River Region. While population increases only approach impact levels for the 1985 scenario, they are clearly in the "hyperurbanization" range for the 1990 case which reflects an increase of about 53 percent over the 1975 baseline. Significance of this increase on related socioeconomic characteristics is similar to that discussed for the preferred action high level alternative presented in Section 5.2.1 and will not be repeated here.

All other regions are within a manageable growth range with Green River-Hams Fork and Fort Union reflecting the highest increases of 17 percent and 14 percent respectively. Other increases range from one to ten percent.

Fiscal Impacts - PRLA Leasing

Fiscal impacts anticipated to occur under the PRLA Leasing Alternative (Alternative 2) closely parallel the level of impacts projected under the medium production level of the preferred leasing alternative as described in Section 5.3.1.1. Final Impacts of the PRLA Leasing Alternative are presented in tabular form in Appendix __ as Tables ___ through ___. These tables are summarized in Section 5.4.

5.3.3.2 Ecological Parameters

Regional summaries of potential losses in plant production and in wildlife populations due to losses of habitat for the Preference Right Leasing Alternative, mid-level production, are given in Appendix G for 1976-1985 and 1986-1990. Land commitments associated with mining activities and coal plant construction are summarized in Table 5-7.

The major commitment of land in Powder River, Green River, and San Juan River coal regions would be to mining and mine-related actvity. The remaining regions would have major land commitments to coal using industry and coal cleaning facilities.

Based on the land use scenario, major losses of forest production would occur in Northern, Central and Southern Appalachia and Texas (Table 5.7). Major losses in grain production (corn and wheat) could occur in Eastern Interior and Western Interior. Corn production could be reduced by as much as nine million bushels by 1985 and an additional 5 million bushels by 1990 in Eastern Interior if lands disturbed followed the scenario. Cotton production could be reduced by 10 million tons in Texas by 1990. Loss of range would be greatest in the Powder River, Green River-Hams Fork, Fort Union, Denver-Raton Mesa, and Texas Regions.

Wildlife dependent upon lands committed to coal development would be affected by habitat loss. Small and game mammals, birds, amphibians, reptiles, and predators would be affected in all regions based principally on the acres of habitat disturbed. Habitat capable of supporting up to seven million small mammals could be lost in Green River-Hams Fork by 1990. Song bird populations in Appalachian (Northern, Central, and Southern) could be reduced by approximately 3.5 million by 1990.

TABLE 5-7

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	206,000	73	128,000	81
Central Appalachian	143,000	64	94,000	73
Southern Appalachian	137,000	91	77,000	93
Eastern Interior	184,000	70	104,000	74
Western Interior	142,000	89	120,000	94
Texas	187,000	79	170,000	79
Western Regions				
Powder River	46,000	54	39,000	56
Green River-Hams Fork	52,000	63	33,000	68
Fort Union	28,000	62	29,000	70
San Juan River	17,000	54	19,000	82
Uinta-Southwestern Utah	23,000	82	13,000	77
Denver-Raton Mesa	27,000	88	27,000	88

White-tailed deer would be the major large game animal affected in eastern regions while mule deer, pronghorn elk, moose and white-tailed deer would be affected in western regions.

5.3.3.3 Water Impacts

Tables 5-7a and 5-7b present and mid-level water use requirements for preference right leasing and all other alternatives. Because the water use requirements are not sufficiently different in relationship to the preferred alternative and the no new leasing alternative, the impacts of the other five alternatives will not be significantly different. The national water use requirements for each alternative (1985) are:

PRLA's	-	3.07 million ac-ft
Short Term	-	3.08 million ac-ft
Industry Needs	-	3.10 million ac-ft
DOE Target	-	2.85 million ac-ft
State Needs	-	3.16 million ac-ft

This compares with a preferred alternative mid-level water use (1985) of 3.09 million ac-ft and a no new leasing mid-level water use (1985) of 3.07 million ac-ft. Specific regional impacts may vary with each alternative, but the primary coal regions where significant water use differences were determined are those that have an abundance of available water.

Table 5-7a

Total Mid-level Water Use Requirements
All Other Alternatives in 1985
(1000's of Acre-Feet/Year)

Region	Alternative				
	PRLA's	Short-Term Leasing	Industry Needs	DOE Target	State Needs
Northern Appalachian	630.2	630.2	630.1	563.5	630.1
Central Appalachian	377.5	377.2	376.1	201.6	377.6
Southern Appalachian	355.8	354.9	354.4	348.5	354.4
Eastern Interior	515.9	516.0	517.9	503.7	514.6
Western Interior	359.0	360.6	373.2	390.0	434.9
Texas Gulf	470.3	472.1	467.0	469.2	484.9
San Juan	32.4	32.4	32.8	34.7	33.0
Uinta	62.0	62.5	64.5	63.2	63.2
Green River	66.2	66.9	72.7	77.2	66.1
Powder River	71.6	71.6	74.6	65.1	69.1
Fort Union	63.4	67.4	67.9	56.4	68.1
Denver-Raton	70.2	70.2	73.6	73.7	66.7

TABLE 5-7b

Total Mid-level Water Use Requirements
All Other Alternatives in 1990
(1000's Acre-Feet/Year)

Region	Alternative				
	PRLA's	Short-Term Leasing	Industry Needs	DOE Target	State Needs
Northern Appalachian	746.1	746.1	745.9	615.3	746.6
Central Appalachian	489.3	484.0	485.7	366.5	477.4
Southern Appalachian	401.9	398.3	400.3	391.5	391.8
Eastern Interior	581.6	579.4	578.8	582.3	581.7
Western Interior	550.0	595.1	624.9	550.6	575.9
Texas Gulf	853.0	855.2	851.3	853.5	855.2
San Juan	10.0	10.2	10.5	48.5	10.7
Unita	70.6	71.2	76.0	75.1	71.4
Green River	59.9	59.6	69.7	67.9	57.0
Powder River	94.7	91.1	103.1	84.4	86.7
Fort Union	140.3	141.8	147.7	131.0	143.3
Denver-Raton	140.0	140.1	145.0	103.0	133.9

5.3.4 Impacts of Short Term Leasing Alternative

5.3.4.1 Socioeconomic Impacts

Socioeconomic characteristics related to the short-term leasing alternative are presented in Tables ____ and ____ of Appendix ___. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeocnomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total increases related to these production level changes.

Socioeconomic impact of the bypass leasing alternative is similar to the preferred action in that it is concentrated in the Powder River Region. While population increases only approach impact levels for the 1985 scenario, they reach "hyperurbanization" levels for the 1990 case which reflects an increase of approximatley 41 percent over the 1975 baseline. Significance of this increase on related socioeconomic characteristics is similar to that discussed for the preferred action high level alternative presented in Section 5.2.1 and will not be repeated here.

All other regions are within a manageable growth range with Green River-Hams Fork and Fort Union recording the highest increases of 17 percent and 15 percent respectively. Other increases range from one to ten percent.

Fiscal Impacts - Short Term Leasing

Fiscal impacts anticipated to occur under the Short Term Leasing Alternative (Alternative 3) closely parallel the level of impact projected under the medium production level of the preferred leasing alternative as described in Section 5.3.1.1. Final Impacts of the Short Term Leasing Alternative are presented in tabular form in Appendix __ as Tables ___ through ___. These tables are summarized in Section 5.4.

5.3.4.2 Ecological Parameters

Regional summaries of potential losses in plant productivity and in wildlife populations due to losses of habitat for the short-term leasing alternative mid-level production, are given in Appendix G for 1976-1985 and 1986-1990. Land commitments associated with mining activities and coal plant construction are summarized in Table 5-8.

The major commitment of land in Powder River, Green River, and San Juan River coal regions would be to mining and mine-related activity. The remaining regions would have major land commitments to coal using industry and coal cleaning facilities.

Based on the land use scenario, major losses of forest productivity would occur in Northern, Central and Southern Appalachian and Texas (Table ___). Major losses in grain production (corn and wheat) could

TABLE 5-8

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	206,000	73	128,000	81
Central Appalachian	143,000	64	93,000	73
Southern Appalachian	136,000	90	76,000	93
Eastern Interior	184,000	70	103,000	73
Western Interior	143,000	89	120,000	93
Texas	188,000	79	170,000	79
Western Regions				
Powder River	45,000	53	35,000	54
Green River-Hams Fork	52,000	63	34,000	68
Fort Union	28,000	62	29,000	68
San Juan River	17,000	54	20,000	82
Uinta-Southwestern Utah	23,000	83	13,000	77
Denver-Raton Mesa	27,000	88	27,000	89

occur in Eastern Interior and Western Interior. Corn production could be reduced by as much as nine million bushels by 1985 and an additional 5 million bushels by 1990 in Eastern Interior if lands disturbed followed the scenario. Cotton production could be reduced by 10 million tons in Texas by 1990. Loss of range would be greatest in the Powder River, Green River-Hams Fork, Fort Union, Denver-Raton Mesa, and Texas Regions.

Wildlife dependent upon lands committed to coal development would be effected by habitat loss. Small and game mammals, birds, amphibians, reptiles, and predators would be effected in all regions based principally on the acres of habitat disturbed. Habitat capable of supporting up to five million small mammals could be lost in Green River-Hams Fork by 1990. Song bird populations in Appalachian (Northern, Central, Southern) could be reduced by approximately 3.5 million by 1990. White-tailed deer would be the major large game animal effected in eastern regions while mule deer, pronghorn elk, moose and white-tailed deer would be effected in western regions.

5.3.5 Impacts of Leasing to Meet Industry Needs Alternative

5.3.5.1 Socioeconomic Impacts

Socioeocnomic characteristics related to the lease to satisfy industry need alternative are presented in Appendix G.

for the two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeconomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total increases related to these production level changes. Examination of the description of methodology in section 5.1 provides a more thorough understanding of the significance of those data. Also, a generic description of socioeconomic impact is presented in section 5.2.1 to provide further insight into the meaning of the various growth rates.

Socioeconomic impact of the lease to meet industry need alternative is similar to the preferred action in that it is concentrated in the Powder River Region. While population increases exceed manageable levels only slightly for the 1985 scenario, they go well beyond "hyperurbanization" levels for the 1990 case which relfects an increase of about 77 percent over the 1975 baseline. Significance of this increase on related socioeconomic characteristics is similar to that discussed for the preferred action high level alternative presented in Section 5.2.1 and will not be repeated here.

All other regions are within a manageable growth range with Green River-Hams Fork and Fort Union recording the highest increases of 24 percent and 15 percent respectively. Other increases range from two to twelve percent.

Fiscal impacts anticipated to occur under the Industry Needs Leasing Alternative (Alternative 4) closely parallel the level of impact projected under the medium production level of the preferred leasing alternative as described in Section 5.3.1.1. Final Impacts of the Industry Needs Leasing Alternative are presented in tabular form in Appendix __ as Tables ___ through ___. These tables are summarized in Section 5.4.

5.3.5.2 Ecological Parameters

Regional summaries of potential losses in plant productivity and in wildlife populations due to losses of habitat for the Meet Industry Needs Alternative, mid-level production, are given in Appendix G for the 1976-1985 and 1986-1990. Land commitments associated with mining activities and coal plant construction are summarized in Table 5-9.

The major commitment of land in Powder River, Green River, and San Juan River coal regions would be to mining and mine-related activity. The remaining regions would have major land commitment to coal using industry and coal cleaning facilities.

Based on the land use scenario, major losses of forest productivity would occur in Northern, Central and Southern Appalachia and Texas (Table). Major losses in grain production (corn and wheat) would occur in Eastern Interior and Western Interior. Corn production could be reduced by as much as nine million bushels by 1985 and an additional five million bushels by 1990 in Eastern Interior if lands disturbed followed the scenario. Cotton production could be reduced by ten

TABLE 5-9

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	206,000	73	127,000	81
Central Appalachian	144,000	66	93,000	73
Southern Appalachian	136,000	89	77,000	93
Eastern Interior	185,000	71	103,000	76
Western Interior	149,000	94	126,000	97
Texas	184,000	82	170,000	88
Western Regions				
Powder River	49,000	54	49,000	58
Green River-Hams Fork	76,000	68	50,000	72
Fort Union	30,000	60	31,000	69
San Juan River	20,000	58	21,000	83
Uinta-Southwestern Utah	24,000	80	13,000	76
Denver-Raton Mesa	28,000	83	28,000	87

million tons in Texas by 1990. Loss of range would be greatest in the Powder River, Green River-Hams Fork, Fort Union, Denver-Raton Mesa and Texas Regions.

Wildlife dependent upon lands commited to coal development would be affected by habitat loss. Small and game mammals, birds, amphibians, reptiles, and predators would be affected in all regions based principally on the acres of habitat disturbed. Habitat capable of supporting up to ten million small mammals could be lost in Green River-Hams Fork by 1990. Song bird populations in Appalachia (Northern, Central and Southern) could be reduced by approximately 3.2 million by 1990. White-tailed deer would be the major large game animal affected in eastern regions while mule deer, pronghorn elk, moose and white-tailed deer would be affected in western regions. Habitat for up to 130,000 white-tailed deer would be removed from eastern regions by 1990, while habitat for approximately 16,000 mule deer, antelope, elk, and white-tailed deer would be removed from western regions.

5.3.6 Leasing to Meet DOE Production Target Alternative

5.3.6.1 Socioeconomic Impacts

Socioeconomic characteristics related to the DOE production goals leasing alternative are presented in Appendix for the two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeconomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total increases related to these production level changes. Examination of the description of methodology in Section will provide a more thorough understanding of the significance of those data. Also, a generic description of socioeocnomic impact is presented in Section to provide further insight into the meaning of the various growth rates.

Socioeconomic impact of the DOE production goals alternative is similar to the preferred action in that it is concentrated in the Powder River Region. While population increases appear to be within manageable levels for the 1985 scenario, they go well beyond "hyper-urbanization" levels for the 1990 case which reflects an increase of about 65 percent over the 1975 baseline. Significance of this increase on related socioeconomic characteristics is similar to that discussed for the preferred action high level alternative presented in Section 5.2.1 and will not be repeated here.

All other regions appear to be within a manageable growth range with Green River-Hams Fork and Fort Union recording the highest increases of 25 percent and 12 percent respectively. Other increases range from one to eleven percent.

Fiscal impacts anticipated to occur under the DOE Target Leasing Alternative (Alternative 6) closely parallel the level of impacts projected under the medium production level of the preferred leasing alternative as described in Section 5.3.1.1. Final Impacts of the DOE Leasing Alternative are presented in tabular form in Appendix ___.

5.3.6.2 Ecological Parameters

Regional summaries of potential losses in plant productivity and in wildlife populations due to losses of habitat are given in Appendix G. In Table 5-9a, land commitments associated with mining activities and coal plant construction are presented.

The major commitment of land in Powder River, Green River, and San Juan River coal regions would be to mining and mine-related activity. The remaining regions would have major land commitments to coal using industry and coal cleaning facilities.

Based on the land use scenario, major losses of forest productivity would occur in Northern, Central and Southern Appalachia and Texas (Table). Major losses in grain production (corn and wheat) would occur in Eastern Interior and Western Interior. Corn production could be reduced by as much as nine million bushels by 1985 and an additional 5 million bushels by 1990 in Eastern Interior if lands disturbed followed the scenario. Cotton production could be reduced by 9.5 million tons in Texas by 1990. Loss of range would lie greatest in the Powder River, Green River-Ham's Fork, Fort Union, Denver-Raton Mesa, and Texas Regions.

TABLE 5-9A

	Land Commitment			
	1985		1990	
	Acres	%	Acres	%
Eastern Regions				
Northern Appalachian	181,000	70	104,000	77
Central Appalachian	73,000	48	69,000	67
Southern Appalachian	134,000	92	75,000	96
Eastern Interior	180,000	70	103,000	75
Western Interior	155,000	92	111,000	97
Texas	185,000	80	169,000	84
Western Regions				
Powder River	45,000	55	43,000	59
Green River-Hams Fork	76,000	67	51,000	73
Fort Union	25,000	68	29,000	83
San Juan River	15,000	50	20,000	60
Uinta-Southwestern Utah	24,000	84	14,000	83
Denver-Raton Mesa	28,000	84	20,000	85

Wildlife dependent upon lands committed to coal development would be effected by habitat loss. Small and game mammals, birds, amphibians, reptiles, and predators would be effected in all regions based principally on the acres of habitat disturbed. Habitat capable of supporting up to ten million small mammals could be lost in Green River-Ham's Fork by 1990. Song bird populations in Appalachia (Northern, Central and Southern) could be reduced by approximately 3 million by 1990. White-tailed deer would be the major large game animal effected in eastern regions while mule deer, pronghorn elk, moose and white-tailed deer would be effected in western regions. Habitat for over 60,000 white-tailed deer would be lost from Northern, Central and Southern Appalachia by 1990.

5.3.7 Impacts of State Leasing Determinations Alternative

5.3.7.1 Socioeconomic Impacts

Socioeconomic characteristics related to the state determination leasing alternative are presented in Appendix for the two time periods. The discussion in this section will highlight significant findings in the data as they pertain to specific coal producing regions and changes over time. However, tabular data in the appendix describe each socioeocnomic characteristic in detail for each region. It should be noted that reference to the 1985 production level in the text represents the change over time between 1976 and 1985. The 1990 data relates to change from 1985 to 1990. Increases in population and associated socioeconomic characteristics discussed here refer to total increases related to these production level changes. Examination of the description of methodology in Section will provide a more thorough understanding of the significance of those data. Also, a generic description of socioeconomic impact is presented in Section to provide further insight into the meaning of the various growth rate.

Socioeconomic impact of the state determination alterntive is similar to the preferred action in that it is concentrated in the Powder River Region. While population increases appear to be within manageable levels for the 1985 scenario, they approach "hyperurbanization" levels for the 1990 case which relfects an increase of approximately 33 percent over the 1975 baseline. Significance of this increase on related socioeoc̲nomic characteristics would be similar to that discussed for the preferred action high level alternative presented in Section 5.2.1 and will not be repeated here.

All other regions are within a manageable growth range with Fort Union and Green River-Hams Fort recording the highest increases of 14 percent and 13 percent, respectively. Other increases range from less than one percent to ten percent.

Fiscal impacts anticipated to occur under the State Determined Leasing Alternative (Alternative 5) closely parallel the level of impacts projected under the medium production level of the preferred leasing alternative as described in Section 5.3.1.1. Final Impacts of the State Determined Leasing Alternative are presented in tabular form in Appendix __

5.3.5.2 Ecological Parameters

Regional summaries of potential losses in plant productivity and in wildlife populations due to losses of habitat for the State Determination alternative, mid-level production, are given in Appendix G for 1976-1985 and 1986-1990. Table 5-10 presents commitments associated with mining activities and coal plant construction.

The major commitment of land in Powder River, Green River, and San Juan River coal regions would be to mining and mine-related activity. The remaining regions would have major land commitments to coal using industry and coal cleaning facilities.

Based on the land use scenario, major losses of forest productivity would occur in Northern, Central and Southern Appalachian and Texas (Table ___). Major losses in grain production (corn and wheat) could occur in Eastern Interior and Western Interior. Corn production could be reduced by as much as nine million bushels by 1985 and an additional 5 million bushels by 1990 in Eastern Interior if lands disturbed followed the scenario. Cotton production could be reduced by over 10 million tons in Texas by 1990. Loss of range would be greatest in the Powder River, Green River-Hams Fork, Fort Union, Denver-Raton Mesa and Texas Regions.

Wildlife dependent upon lands committed to coal development would be effected by habitat loss. Small and game mammals, birds, amphibians, reptiles, and predators would be effected in all regions based principally on the acres of habitat disturbed. Habitat capable of supporting up to five million small mammals could be lost in Green

TABLE 5-10

	Land Commitment			
	1985		1990	
Eastern Regions	Acres	%	Acres	%
Northern Appalachian	206,000	73	127,000	80
Central Appalachian	143,000	63	90,000	70
Southern Appalachian	136,000	92	75,000	96
Eastern Interior	185,000	70	102,000	69
Western Interior	173,000	90	115,000	90
Texas	190,000	75	169,000	79
Western Regions				
Powder River	49,000	52	50,000	52
Green River-Hams Fork	76,000	56	50,000	57
Fort Union	29,000	59	30,000	67
San Juan River	21,000	60	21,000	82
Uinta-Southwestern Utah	24,000	83	13,000	79
Denver-Raton Mesa	25,000	82	26,000	88

River-Hams Fork by 1990. Song bird populations in Appalachian (Northern, Central and Southern) could be reduced by approximately 3.5 million by 1990. White-tailed deer would be the major large game animal effected in eastern regions while mule deer, pronghorn elk, moose and white-tailed deer would be effected in western regions. Habitat for as many as 134,000 white-tailed deer would be removed from the Appalachian, Eastern and Western Interior, and Texas Regions by 1990. Habitat for approximately 11,000 mule deer, elk, antelope, and white-tailed deer would be removed from the western regions.

5.4 Comparison of Preferred Program and Alternatives

Prior sections in this chapter assessed the environmental impacts of the preferred and alternative coal management programs on a generic and regional basis. This section provides a comparison of alternative programs based on the following:

- o Coal production;
- o Coal consumption;
- o Coal-related population growth;
- o Distribution of surface and underground mines;
- o Emissions of air pollutants;
- o Water makeup requirements;
- o Land disturbance;
- o Forest productivity loss;
- o Animal population losses

The comparative analysis is in two forms. Figures 5-7 through 5-19 compare impacts on an east versus west basis for 1985 and 1990 at the medium production level. Tables 5-11 through 5-24 provide a comparison on a regional basis for 1985 and 1990 for all production levels considered.

5.4.1 Coal Production

As shown in Figure 5-7, production in the western regions would increase substantially in 1985 and 1990 over the 1976 baseline for all program alternatives. The "Meet Industry Needs" alternative indicates the greatest increases (four-fold increase in 1985 and an eight-fold increase in 1990). Production levels in the

FIGURE 5-7

COMPARISON OF IMPACTS OF COAL PRODUCTION
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(100,000 TONS)

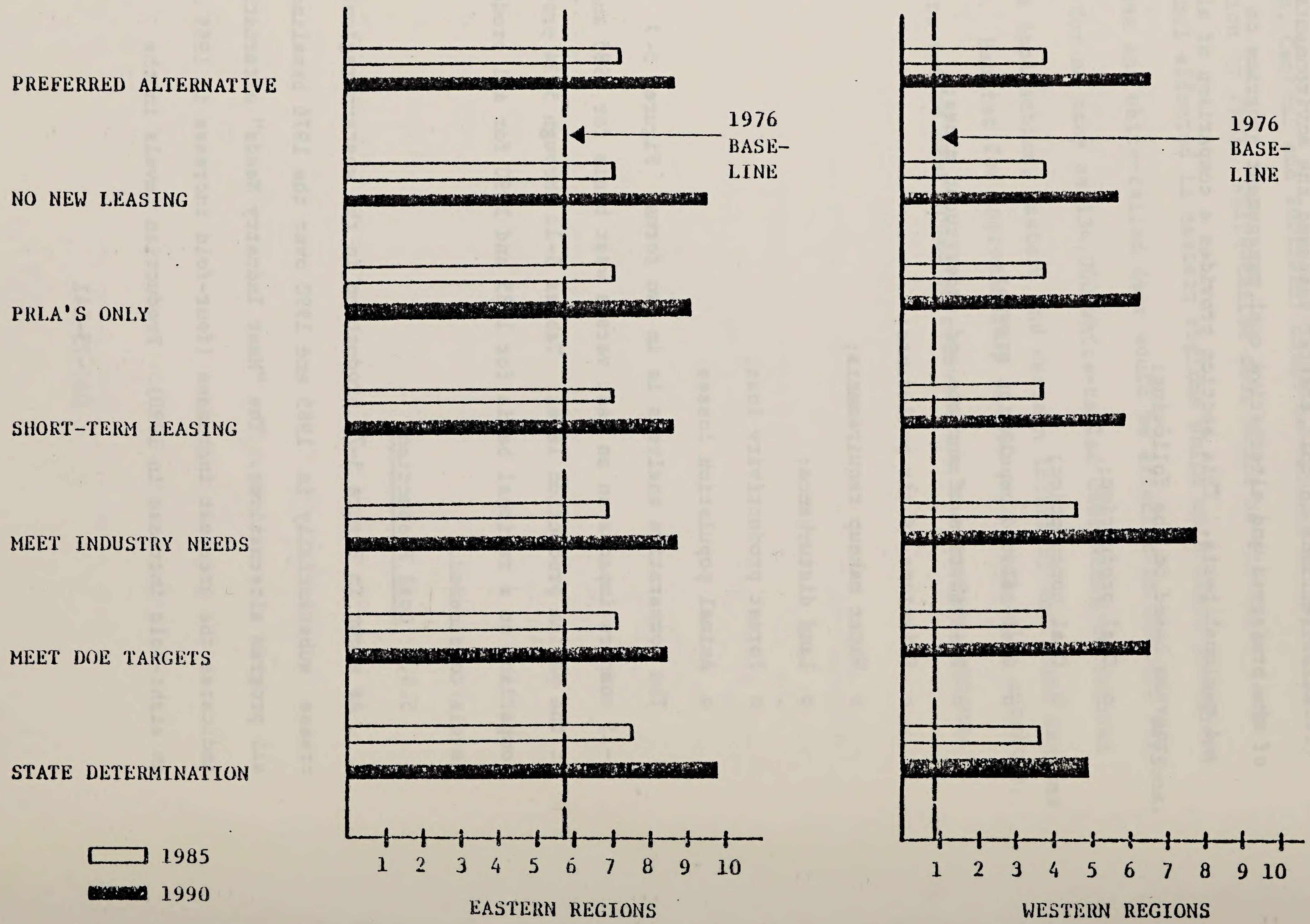

FIGURE 5-8

COMPARISON OF IMPACTS OF COAL CONSUMPTION
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(100,000 TONS)

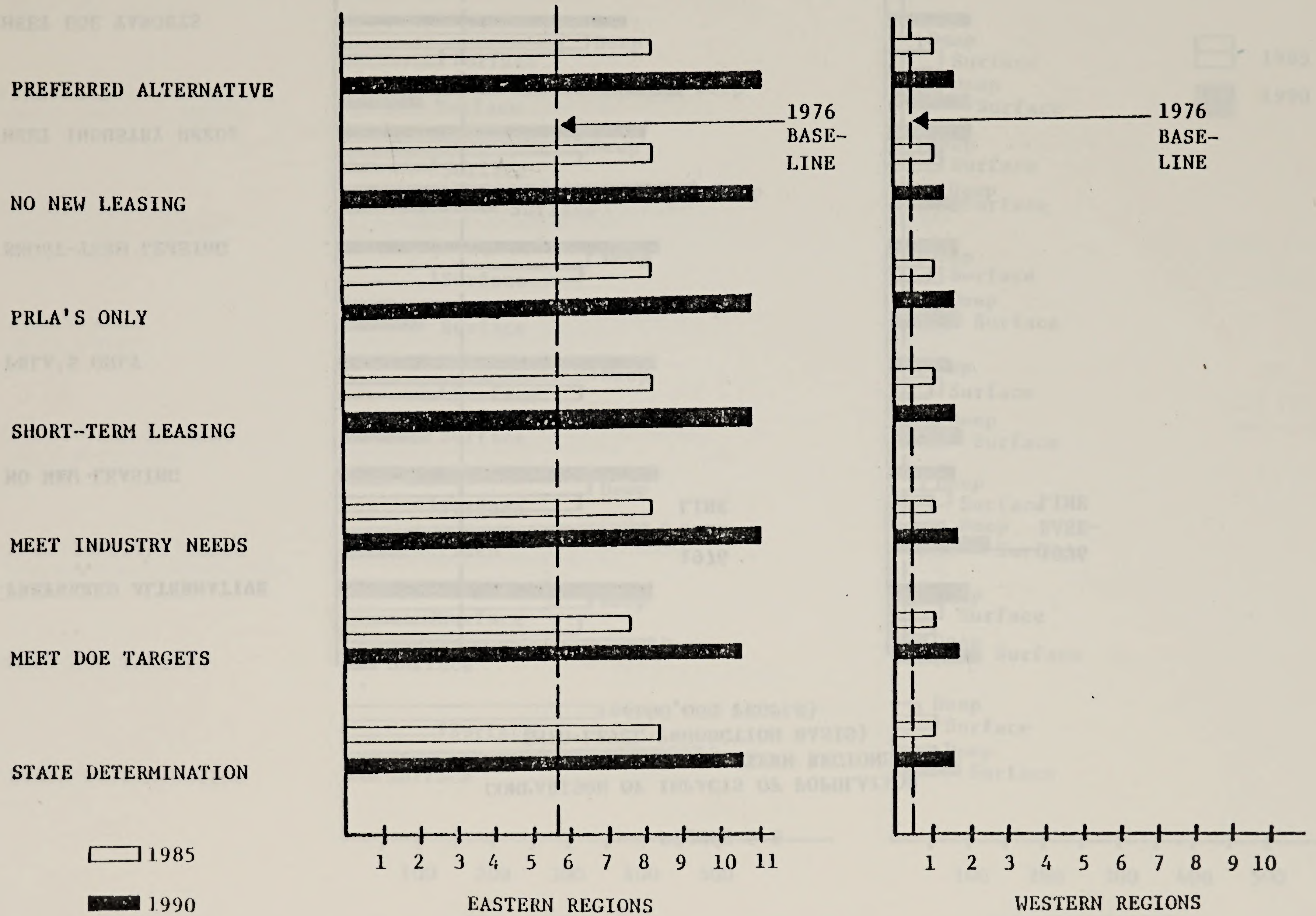

FIGURE 5-9

COMPARISON OF IMPACTS OF POPULATION
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(100,000 PEOPLE)

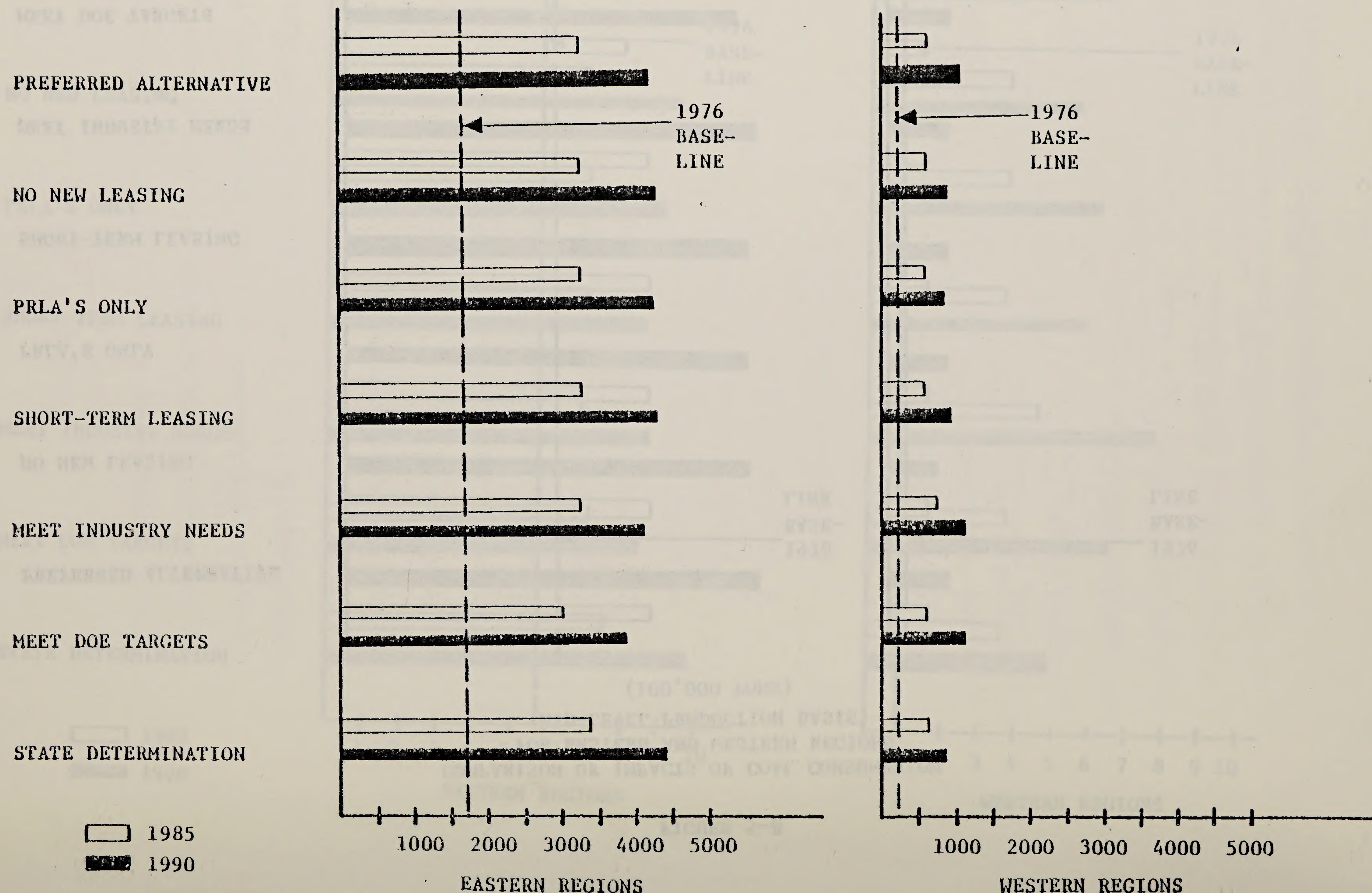

FIGURE 5-10

COMPARISON OF NUMBER OF MINES
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)

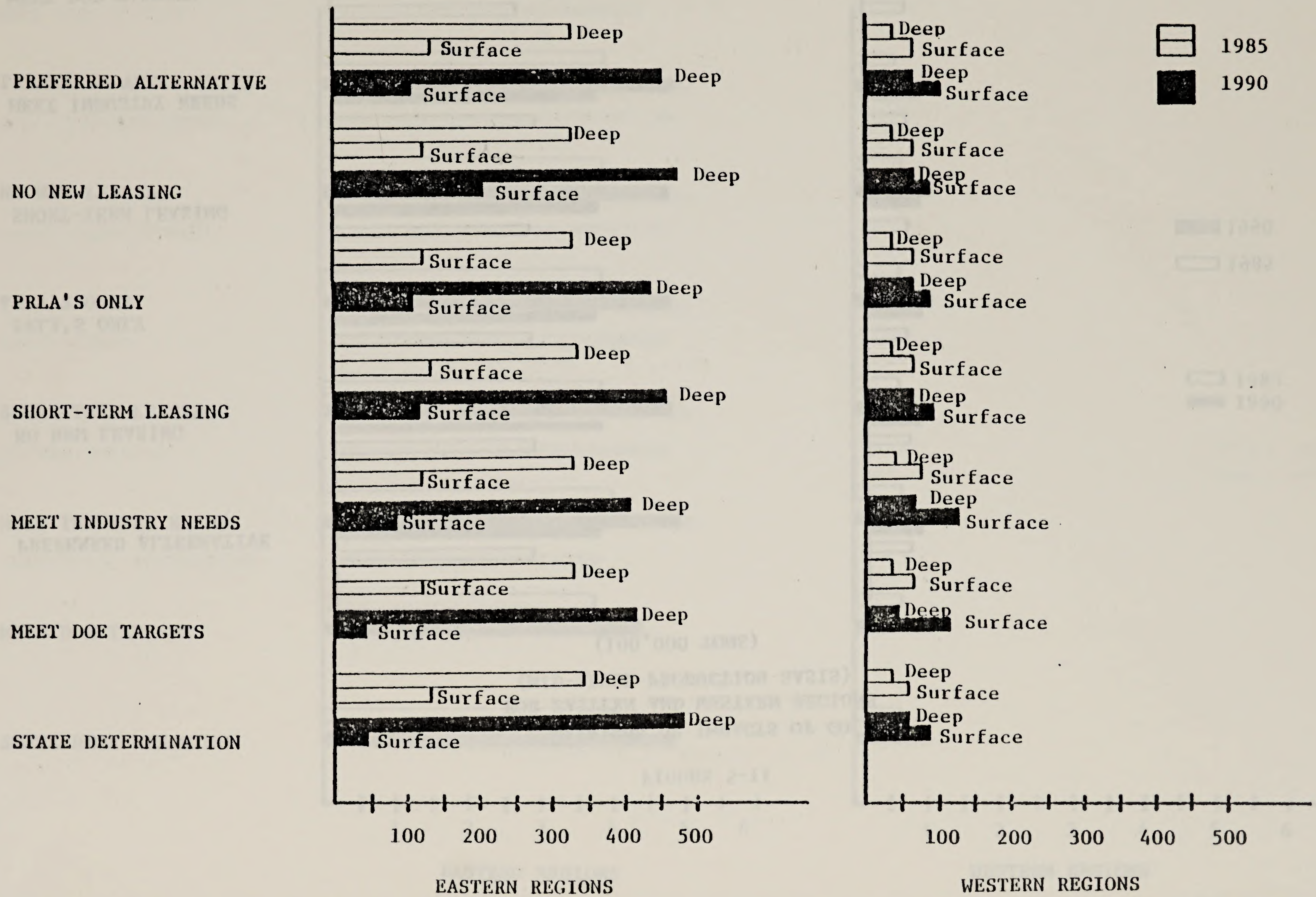

FIGURE 5-11

COMPARISON OF IMPACTS OF CO
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)

(100,000 TONS)

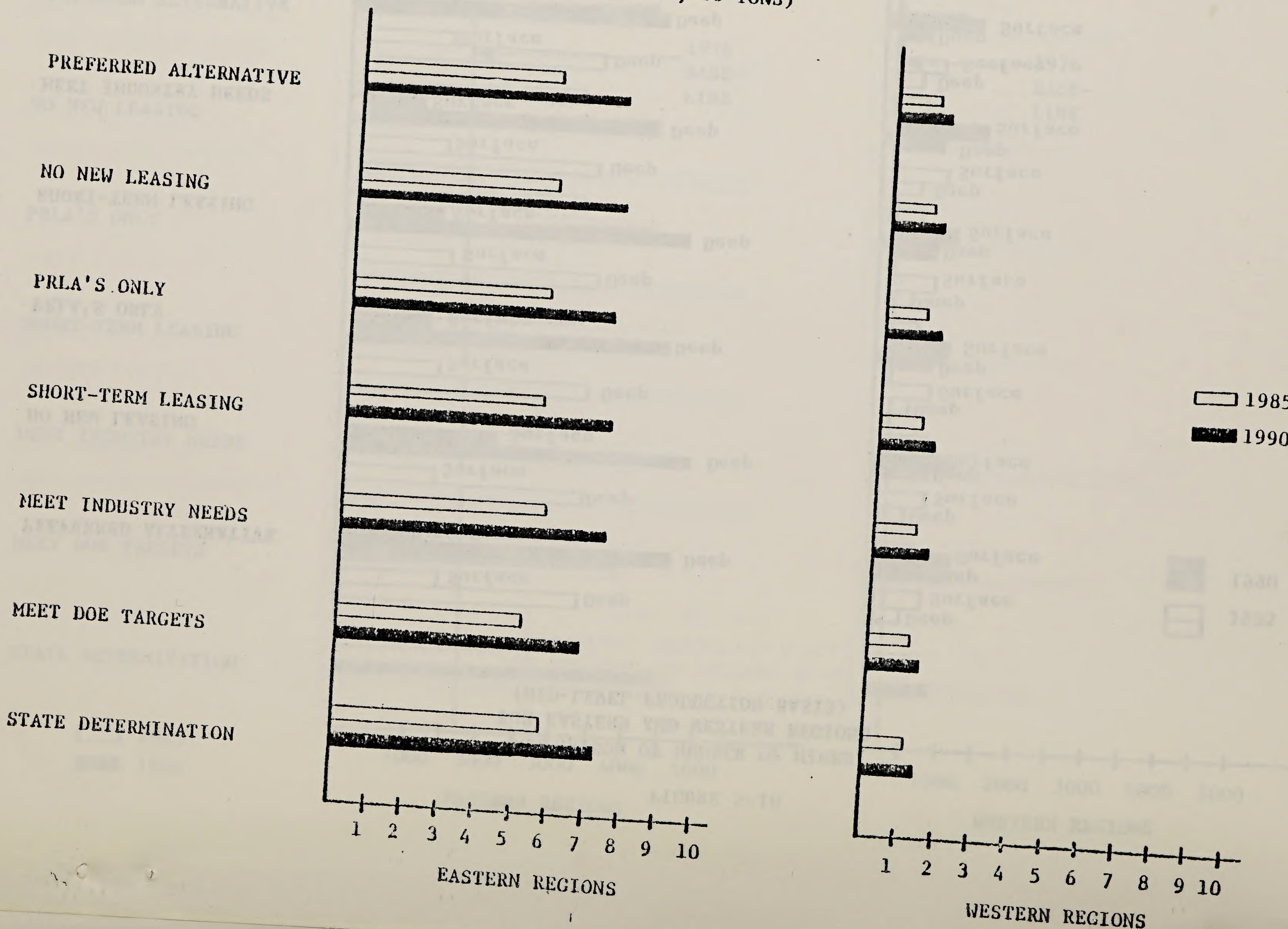

FIGURE 5-12

COMPARISON OF IMPACTS OF HC
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)

(100,000 TONS)

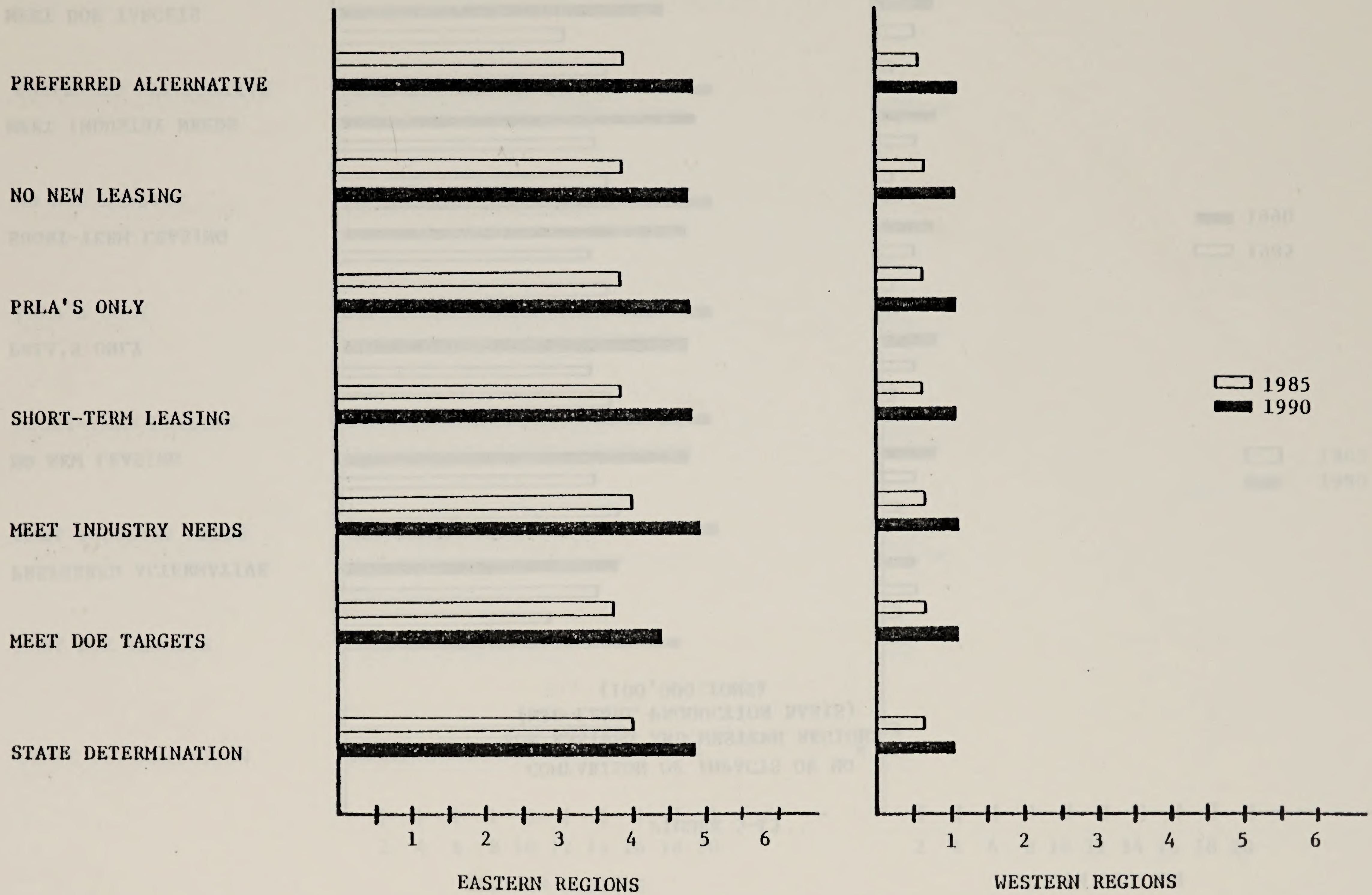

FIGURE 5-13

COMPARISON OF IMPACTS OF NO_x
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(100,000 TONS)

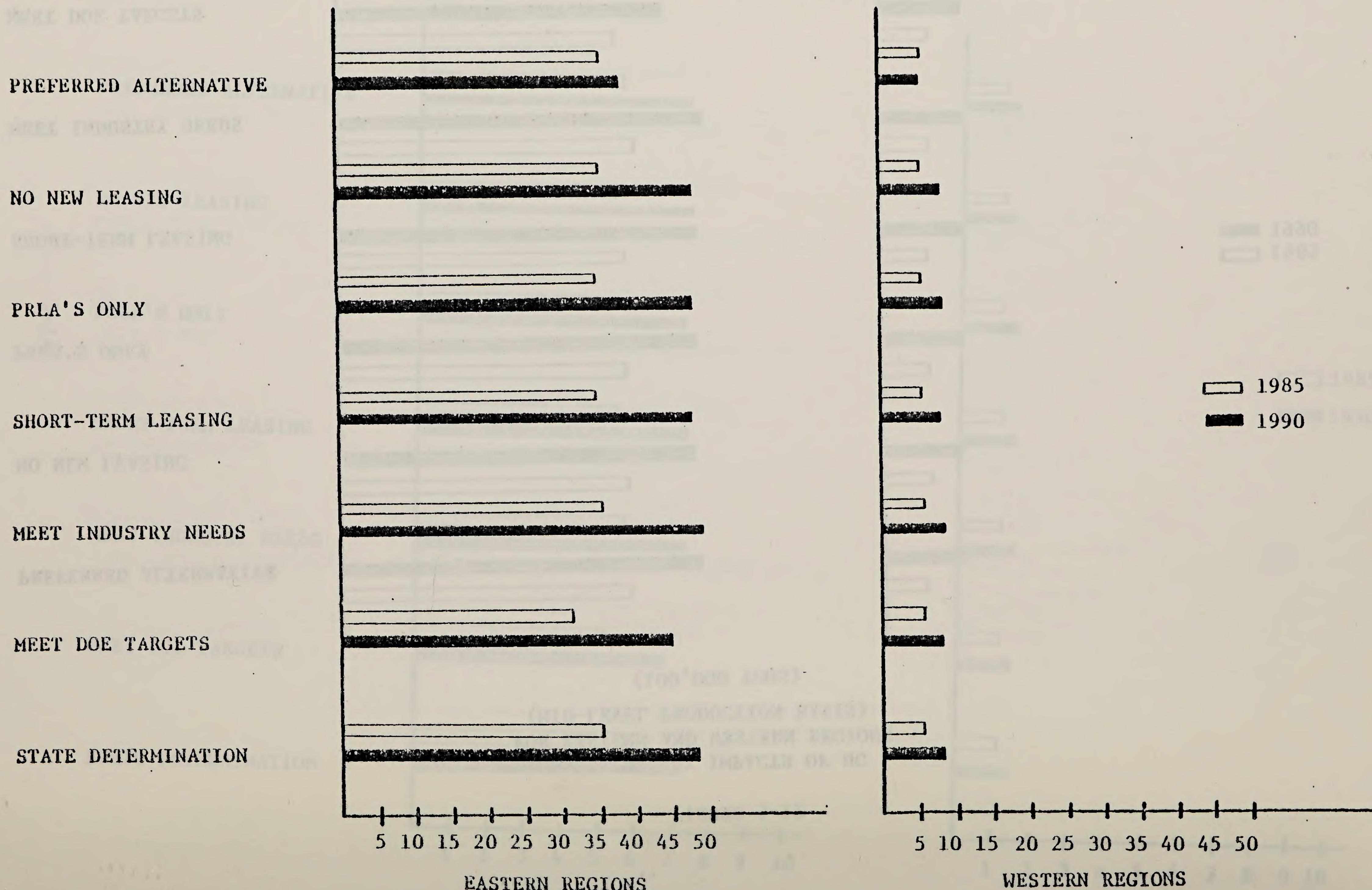

FIGURE 5-14

COMPARISON OF IMPACTS OF SO_x
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(100,000 TONS)

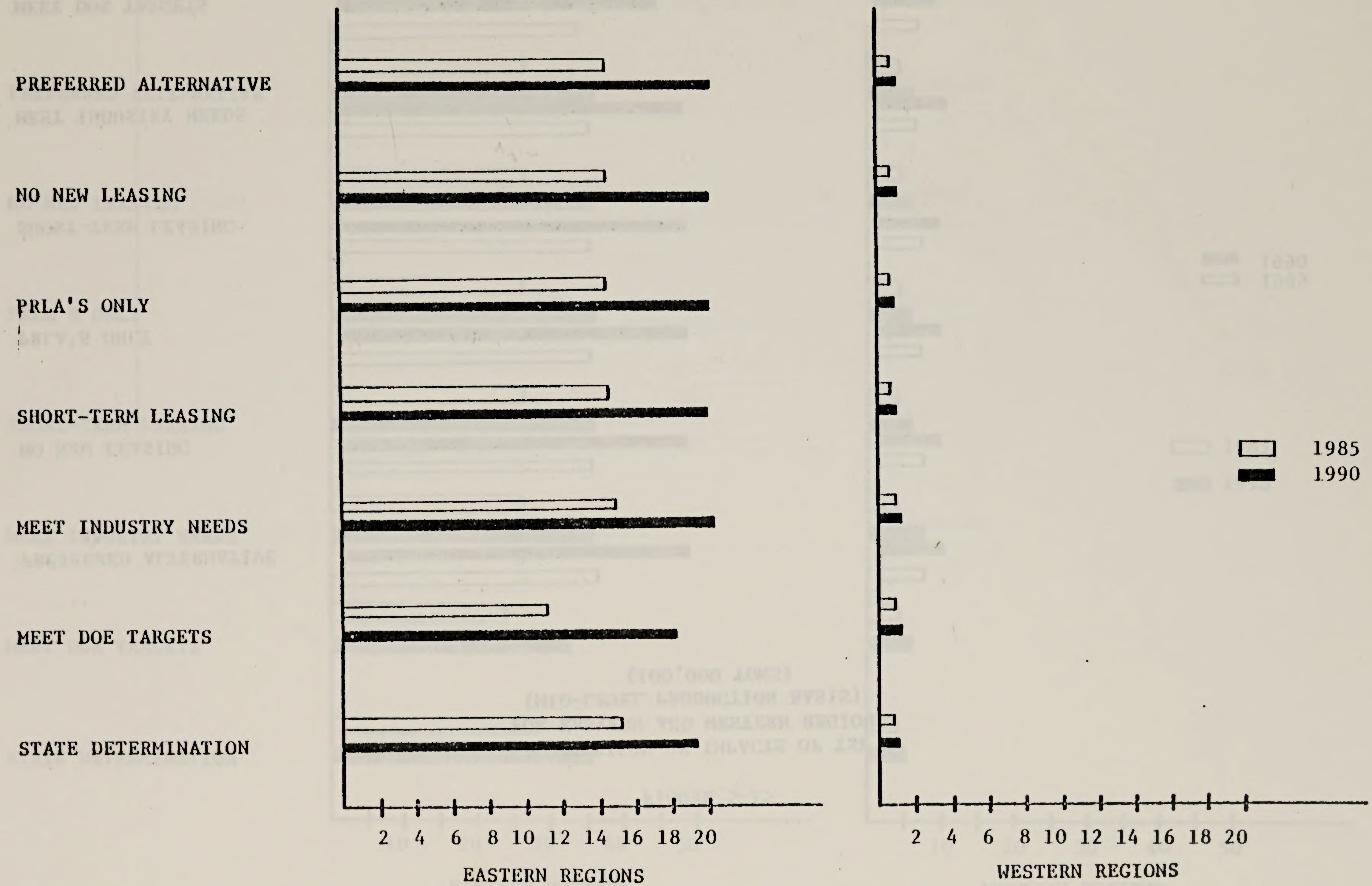

FIGURE 5-15

COMPARISON OF IMPACTS OF TSP
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(100,000 TONS)

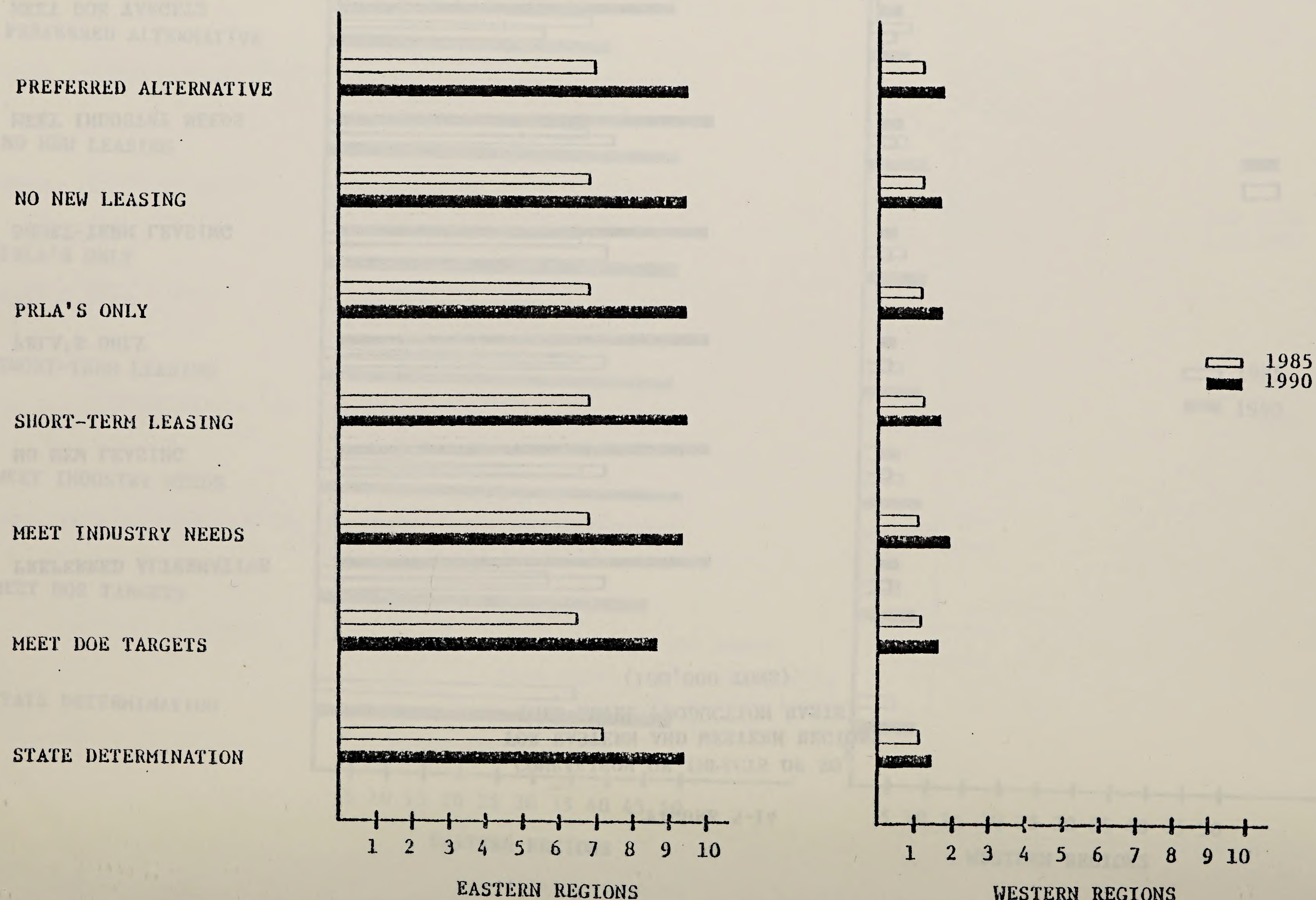

FIGURE 5-16

COMPARISON OF IMPACTS OF WATER MAKEUP
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)

(100,000 ACRE FEET)

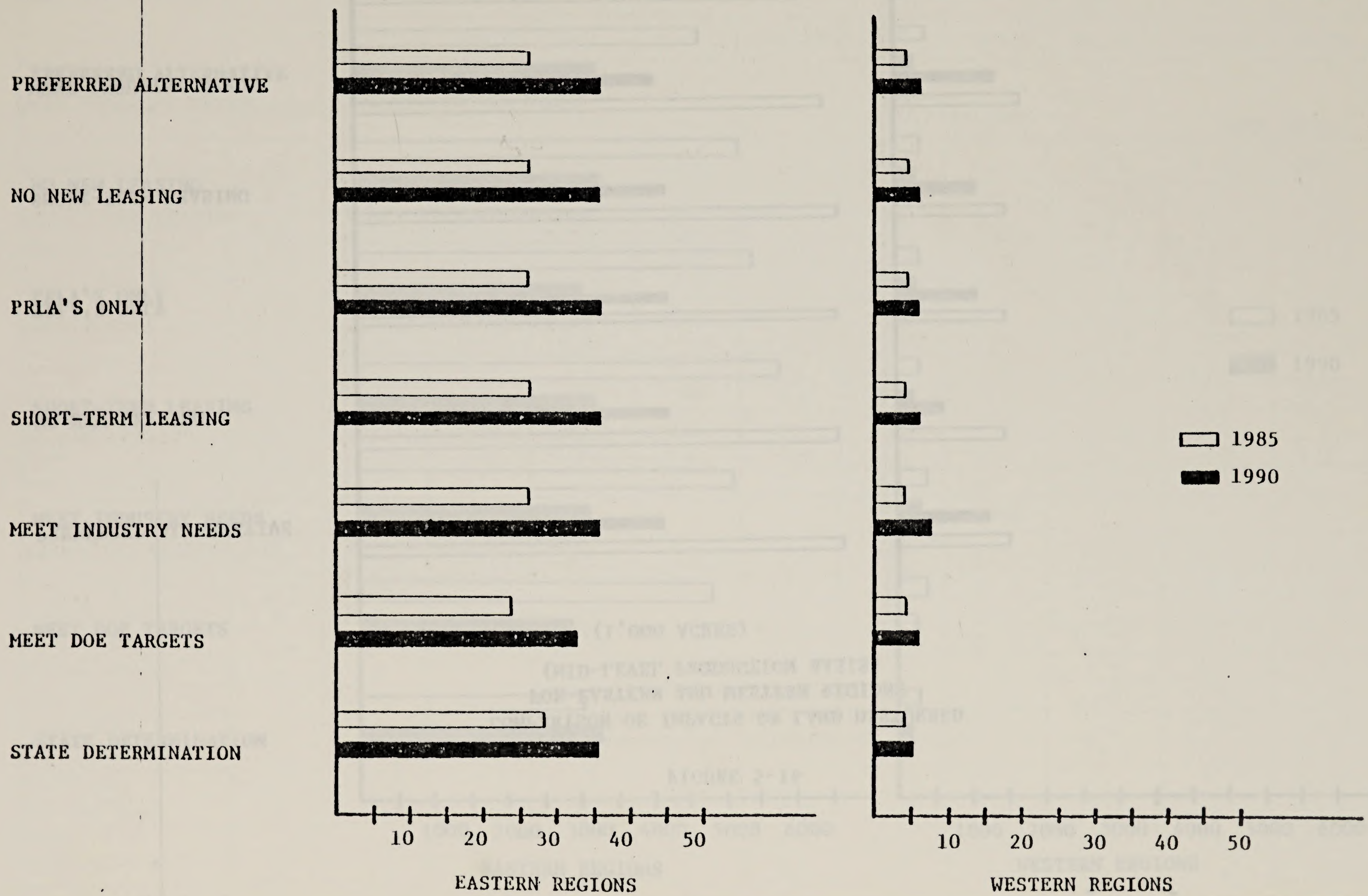

FIGURE 5-16

COMPARISON OF IMPACTS OF LAND DISTURBED
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)

(1,000 ACRES)

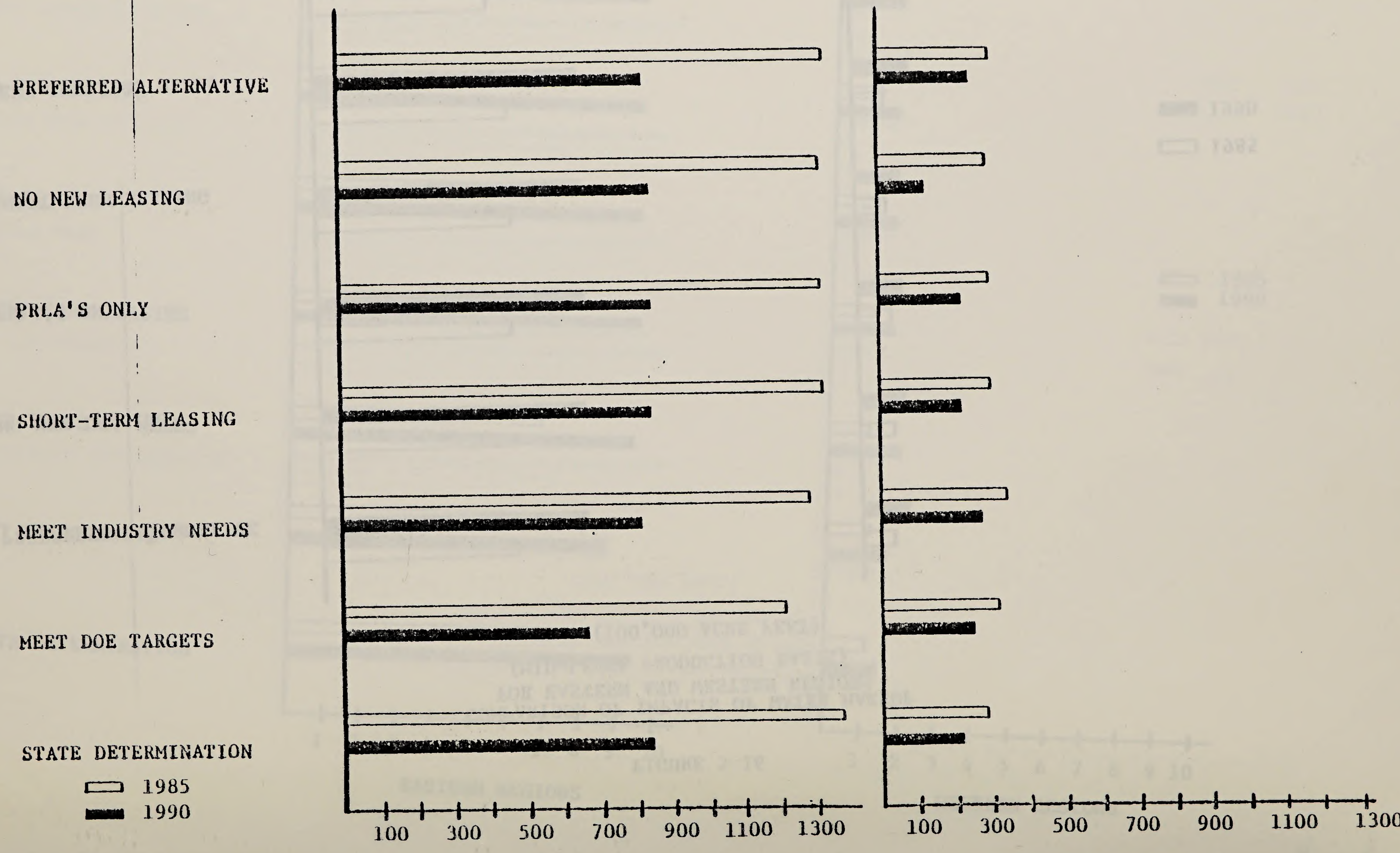

FIGURE 5-18

COMPARISON OF IMPACTS OF FOREST PRODUCTIVITY LOSS
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(TONS)

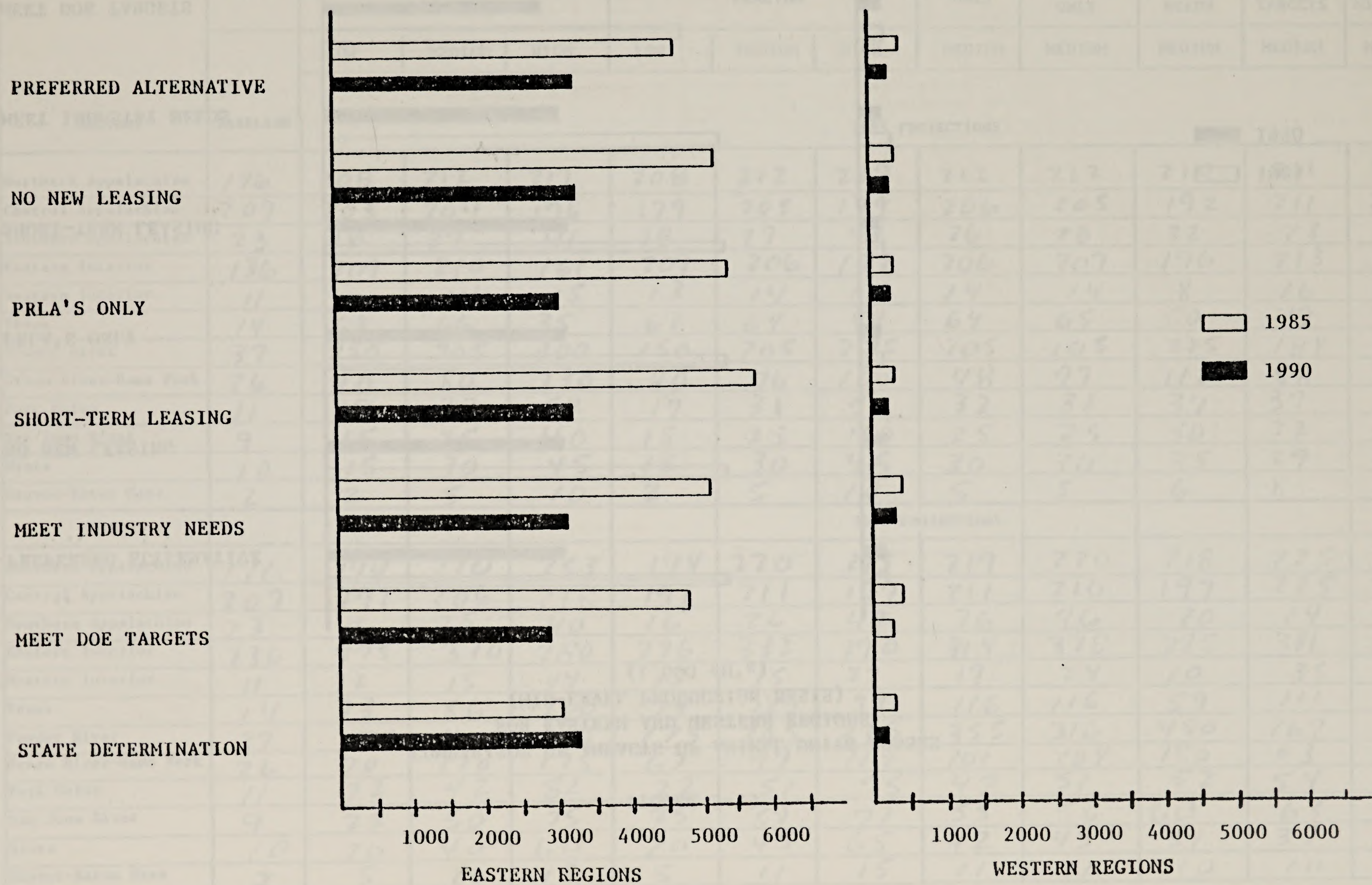

FIGURE 5-19

COMPARISON OF IMPACTS OF ANIMAL UNITS LOSSES
FOR EASTERN AND WESTERN REGIONS
(MID-LEVEL PRODUCTION BASIS)
(1,000 AU's)

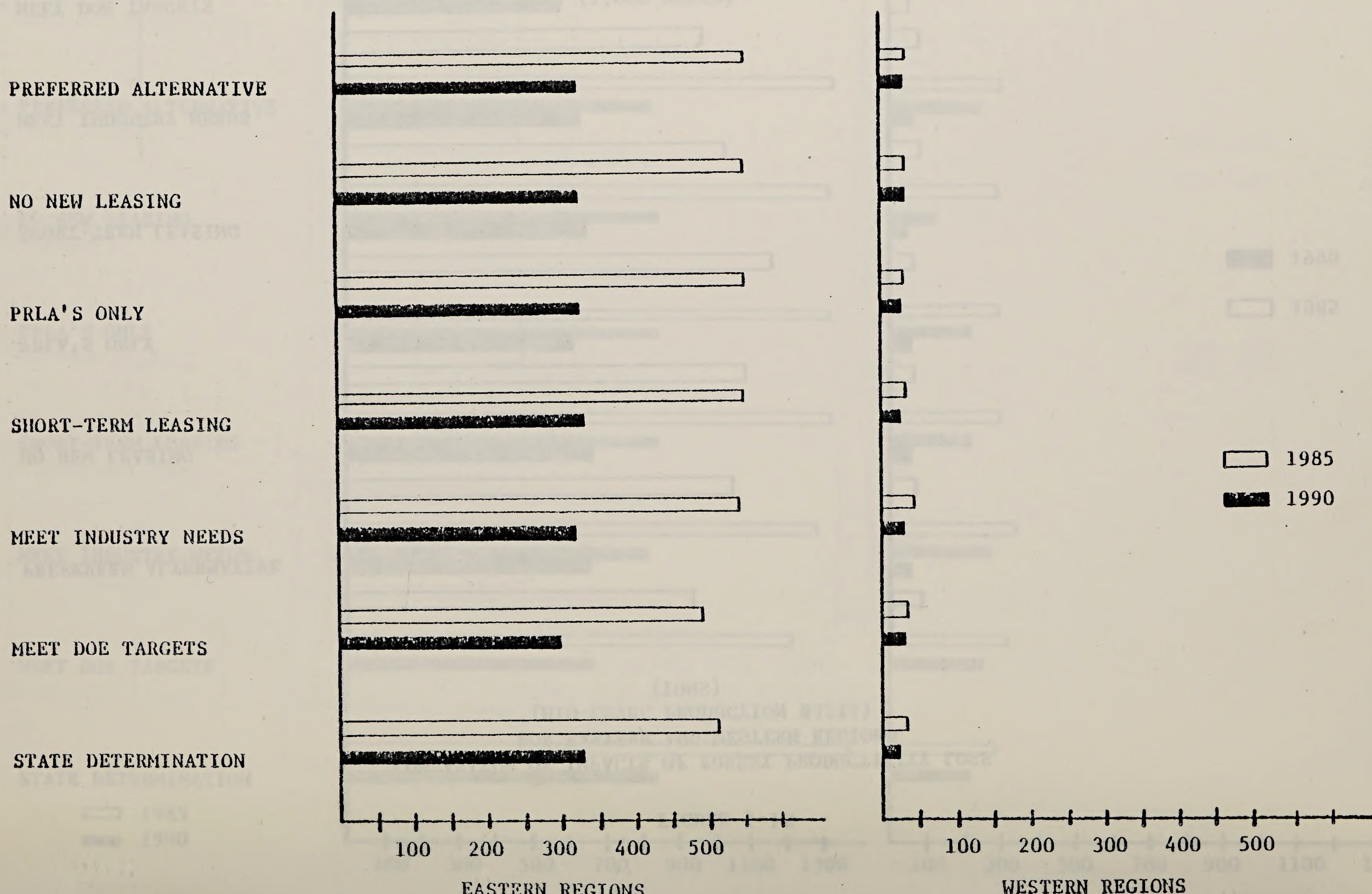

TABLE 5-11

COAL PRODUCTION SUMMARY COMPARISON
(millions of tons)

REGIONS	1976	PREFERRED LEASING POLICY			NO NEW LEASING			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
	BASELINE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	176	208	212	217	208	212	217	212	212	210	211	212
Central Appalachian	207	203	204	176	179	205	179	206	205	192	211	203
Southern Appalachian	23	18	27	41	18	27	43	26	28	32	23	22
Eastern Interior	136	209	210	161	209	206	172	206	207	196	213	203
Western Interior	11	—	14	15	13	14	14	14	14	8	16	11
Texas	14	63	66	35	62	64	49	64	65	50	77	58
Powder River	37	150	205	300	150	205	275	205	205	225	184	205
Green River-Hams Fork	76	40	80	130	40	76	100	78	77	112	58	112
Fort Union	11	17	32	52	17	31	52	32	32	37	37	72
San Juan River	9	15	25	40	15	25	40	25	25	30	32	22
Uinta	10	15	30	45	15	30	45	30	30	35	29	26
Denver-Raton Mesa	2	2	5	10	2	5	10	5	5	6	8	6
REGIONS						1990 PROJECTIONS						
Northern Appalachian	176	194	220	253	194	220	213	219	220	218	225	222
Central Appalachian	207	191	206	218	191	211	197	211	210	197	225	206
Southern Appalachian	23	16	25	40	16	26	42	26	26	30	14	15
Eastern Interior	136	275	370	280	276	332	270	314	328	285	381	313
Western Interior	11	12	15	14	13	25	27	19	24	10	35	10
Texas	14	73	86	100	74	119	99	116	116	59	111	80
Powder River	37	175	400	600	175	305	335	355	316	450	267	396
Green River-Hams Fork	26	70	120	175	67	99	119	101	104	150	63	150
Fort Union	11	22	42	82	22	51	95	47	51	52	54	23
San Juan River	9	25	50	75	25	59	77	55	58	60	63	58
Uinta	10	20	40	60	20	45	65	42	45	51	37	28
Denver-Raton Mesa	2	5	10	15	5	11	15	11	11	10	10	8

TABLE 5-12

COAL CONSUMPTION SUMMARY COMPARISON
(millions of tons)

REGIONS	1976 BASELINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETER-MINATION MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	163	202	204	211	202	204	211	204	204	204	204	183
Central Appalachian	51	98	104	88	98	105	87	105	105	105	105	53
Southern Appalachian	47	82	106	108	80	106	107	106	106	106	106	104
Eastern Interior	107	151	154	167	149	154	166	154	154	155	154	151
stern Interior	37	86	106	116	86	104	113	104	105	109	127	114
xas	17	91	139	129	91	138	130	138	138	137	142	137
uder River	6	19	17	21	19	17	20	17	17	17	16	15
een River-Hams Fork	9	15	18	16	15	18	16	18	18	19	18	20
Fort Union	12	27	22	36	27	22	35	22	22	23	23	20
San Juan River	9	9	9	14	9	9	14	9	9	9	9	10
Uinta	5	17	18	21	17	18	21	18	18	18	18	18
Denver-Raton Mesa	5	17	21	23	17	21	23	21	21	22	20	22
REGIONS		1990 PROJECTIONS										
Northern Appalachian	163	206	242	345	206	242	242	242	242	242	242	198
Central Appalachian	51	151	136	151	116	136	136	137	136	136	133	101
Southern Appalachian	47	82	120	159	82	112	120	121	120	120	118	118
Eastern Interior	107	165	175	215	165	174	173	175	174	175	173	175
Western Interior	37	94	179	205	94	174	177	175	175	184	169	162
Texas	17	117	252	272	117	248	245	248	249	249	249	297
Powder River	6	23	28	25	23	27	27	27	27	28	27	23
Green River-Hams Fork	9	18	20	19	18	18	18	18	18	21	18	20
Fort Union	12	30	44	47	30	45	49	45	45	47	45	53
San Juan River	9	11	2	25	11	2	2	2	2	2	2	16
Uinta	5	22	22	29	11	2	2	21	21	22	21	22
Denver-Raton Mesa	5	23	42	35	23	41	42	41	42	43	40	31

TABLE 5-13

COAL-RELATED POPULATION SUMMARY COMPARISON
(THOUSANDS)

REGIONS	1976	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETERMINATION MEDIUM
						1985 PROJECTIONS						
Northern Appalachian	695		907			907		907	907	906	862	906
Central Appalachian	496		639			641		641	639	618	525	651
Southern Appalachian	153		298			302		300	301	310	285	291
Eastern Interior	443		722			716		716	718	700	703	727
Western Interior	115		282			280		279	281	282	294	330
Texas	61		382			376		376	378	364	370	398
Powder River	53		227			226		226	226	246	222	208
Green River-Hams Fork	46		121			116		118	117	150	153	101
Fort Union	40		77			77		77	77	83	65	84
San Juan River	28		47			47		47	47	52	46	54
Uinta	30		97			95		96	96	106	90	96
Denver-Raton Mesa	20		64			64		64	64	67	66	64
						1990 PROJECTIONS						
REGIONS												
Northern Appalachian	695		1,047			1,045		1,045	1,045	1,043	762	1,057
Central Appalachian	496		725			734		736	732	720	648	755
Southern Appalachian	153		333			336		338	336	347	303	303
Eastern Interior	443		946			1,013		984	1,008	933	988	1,101
Western Interior	115		456			456		450	456	459	409	457
Texas	61		655			674		672	672	624	640	668
Powder River	53		419			331		376	341	464	405	301
Green River-Hams Fork	46		163			139		143	145	190	188	110
Fort Union	40		136			144		141	144	149	120	147
San Juan River	28		68			76		73	75	78	103	81
Uinta	30		129			135		129	135	146	110	123
Denver-Raton Mesa	20		131			130		131	130	130	106	126

TABLE 5-14

SURFACE COAL MINES SUMMARY COMPARISON

REGIONS	1976 BASELINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETERMINATION MEDIUM
						1985 PROJECTIONS						
Northern Appalachian			37			32		32	32	32	32	32
Central Appalachian			38			38		38	38	35	37	31
Southern Appalachian			8			8		8	9	10	7	7
Eastern Interior			33			33		22	33	31	32	33
Western Interior			8			9		9	9	5	7	10
Texas			9			9		9	9	7	8	11
Powder River			29			29		29	29	33	26	26
Green River-Hams Fork			19			18		19	19	27	27	13
Fort Union			5			5		5	5	6	3	6
San Juan River			8			8		8	8	10	7	10
Uinta			2			2		2	2	2	1	2
Denver-Raton Mesa			1			1		1	1	1	1	1
REGIONS						**1990 PROJECTIONS**						
Northern Appalachian			23			23		23	23	23	24	24
Central Appalachian			31			32		32	32	29	31	34
Southern Appalachian			6			6		6	6	7	3	3
Eastern Interior			26			27		26	26	24	23	32
Western Interior			6			10		7	9	4	3	12
Texas			12			17		17	17	8	11	16
Powder River			57			44		51	45	64	57	38
Green River-Hams Fork			28			23		23	24	35	35	14
Fort Union			6			8		7	8	8	3	8
San Juan River			16			19		18	19	19	19	20
Uinta			2			2		2	2	2	1	7
Denver-Raton Mesa			1			1		1	1	2	1	1

TABLE 5-15

UNDERGROUND COAL MINES SUMMARY COMPARISON

REGIONS	1976	PREFERRED LEASING POLICY			NO NEW LEASING			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETERMINATION
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
REGIONS	BASELINE	1985 PROJECTIONS										
Northern Appalachian			91			98		98	98	97	98	99
Central Appalachian			148			149		148	148	140	147	152
Southern Appalachian			9			10		9	10	11	8	8
Eastern Interior			72			71		71	71	67	70	75
Western Interior			11			11		10	11	7	9	12
Texas			—									
Powder River			—									
Green River-Hams Fork			4			4		4	4	4	4	4
Fort Union			—									
San Juan River			3			3		3	3	3	2	2
Uinta			25			25		25	25	29	22	25
Denver-Raton Mesa			6			6		6	6	7	5	7
REGIONS		1990 PROJECTIONS										
Northern Appalachian			116			116		115	116	115	117	118
Central Appalachian			174			172		163	163	153	159	174
Southern Appalachian			11			11		11	11	13	6	6
Eastern Interior			134			139		131	138	118	134	159
Western Interior			18			32		24	30	10	13	23
Texas			—									
Powder River			—									
Green River-Hams Fork			8			8		8	8	8	8	8
Fort Union			—									
San Juan River			4			4		3	3	3	3	3
Uinta			35			39		39	37	44	25	32
Denver-Raton Mesa			16			17		15	15	11	8	14

TABLE 5-16

CARBON MONOXIDE EMISSIONS SUMMARY COMPARISON
(THOUSANDS OF TONS PER YEAR)

REGIONS	1976 BASE-LINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETER-MINATION MEDIUM
		1985 PROJECTIONS										
Northern Appalachian		126	130	133	126	130	133	130	130	130	118	130
Central Appalachian		64	70	62	64	70	62	69	69	70	43	70
Southern Appalachian		56	70	72	55	70	72	70	70	71	69	70
Eastern Interior		94	98	103	94	98	102	98	98	99	96	98
Western Interior		86	102	111	86	101	109	101	101	105	104	113
Texas		59	85	86	59	84	81	84	84	84	83	86
Powder River		23	25	29	24	25	28	25	25	26	23	24
Green River-Hams Fork		16	20	20	16	19	19	19	19	21	21	19
Fort Union		24	22	32	24	22	31	22	22	24	21	23
San Juan River		6	6	9	6	6	9	6	6	6	7	6
Uinta		11	12	14	11	12	13	12	12	12	12	12
Denver-Raton Mesa		23	28	30	23	27	29	27	27	29	28	27
REGIONS		1990 PROJECTIONS										
Northern Appalachian		130	152	206	129	152	149	152	152	152	129	151
Central Appalachian		75	91	103	75	90	91	91	91	91	73	89
Southern Appalachian		58	83	107	58	83	83	83	83	83	81	81
Eastern Interior		102	111	162	102	110	106	111	110	111	110	110
Western Interior		95	156	183	95	152	155	153	153	159	145	150
Texas		73	147	160	73	145	142	145	145	145	144	145
Powder River		27	34	45	27	31	36	33	32	35	31	30
Green River-Hams Fork		19	22	28	19	21	24	21	21	23	22	20
Fort Union		27	37	45	27	39	42	39	39	40	36	39
San Juan River		7	4	16	7	4	4	4	4	4	9	4
Uinta		13	15	19	13	14	14	14	14	15	15	14
Denver-Raton Mesa		28	45	55	29	44	42	44	44	45	38	43

TABLE 5-17

HYDROCARBON EMISSIONS SUMMARY COMPARISON
(THOUSANDS OF TONS PER YEAR)

REGIONS	1976	PREFERRED LEASING POLICY			NO NEW LEASING			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER-MINATION
	BASE-LINE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian		160	165	158	151	165	158	165	165	165	153	165
Central Appalachian		25	27	25	25	27	25	27	27	27	19	27
Southern Appalachian		40	42	46	38	42	46	42	42	43	42	42
Eastern Interior		76	77	80	76	77	80	77	77	78	77	77
Western Interior		44	52	55	44	51	54	51	51	53	52	55
Texas		26	35	33	26	34	34	34	34	35	34	35
Powder River		11	12	15	11	12	14	12	12	12	11	12
Green River-Hams Fork		8	9	10	8	9	9	9	9	10	9	9
Fort Union		16	18	19	16	18	19	18	18	18	17	18
San Juan River		2	2	3	2	2	3	2	2	2	2	2
Uinta		4	7	10	4	7	10	7	7	7	7	7
Denver-Raton Mesa		16	9	21	16	18	20	18	18	19	19	18
REGIONS		1990 PROJECTIONS										
Northern Appalachian		155	179	201	155	179	148	178	179	179	150	179
Central Appalachian		29	36	43	27	36	38	36	36	36	30	35
Southern Appalachian		41	53	64	41	52	49	53	53	53	51	52
Eastern Interior		82	89	215	82	88	88	89	88	89	89	88
Western Interior		50	78	96	49	76	79	77	76	79	73	75
Texas		31	55	64	31	54	56	54	54	55	54	54
Powder River		12	25	23	12	24	19	24	24	26	23	24
Green River-Hams Fork		9	15	14	9	14	12	15	14	16	15	14
Fort Union		18	26	31	18	25	27	25	25	26	28	25
San Juan River		2	2	5	3	2	2	2	2	2	8	2
Uinta		5	10	[illegible]	5	10	9	10	10	11	10	10
Denver-Raton Mesa		19	28	69	19	27	30	28	28	28	26	27

TABLE 5-18

NITROGEN OXIDES EMISSIONS SUMMARY COMPARISON
(THOUSANDS OF TONS PER YEAR)

REGIONS	1976 BASE-LINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETER-MINATION MEDIUM
1985 PROJECTIONS												
Northern Appalachian		698	682	728	698	682	728	682	682	684	605	683
Central Appalachian		478	514	441	478	515	439	515	515	516	283	515
Southern Appalachian		369	485	491	362	487	488	487	486	487	477	486
Eastern Interior		609	637	677	609	636	672	636	636	642	619	634
Western Interior		508	614	672	509	606	657	607	609	631	643	707
Texas		437	652	609	437	644	612	644	646	642	642	663
Powder River		122	115	129	122	115	126	115	115	119	105	113
Green River-Hams Fork		91	110	105	91	107	99	107	108	115	119	108
Fort Union		132	107	182	132	106	180	106	106	113	97	113
San Juan River		42	44	69	42	44	68	44	44	44	47	44
Uinta		81	83	90	81	81	88	81	82	84	83	83
Denver-Raton Mesa		108	135	147	109	135	144	135	135	141	137	131
1990 PROJECTIONS												
Northern Appalachian		712	836	127	712	835	891	836	836	837	692	835
Central Appalachian		567	670	747	567	669	665	676	669	674	514	659
Southern Appalachian		372	553	734	372	553	563	558	553	557	545	546
Eastern Interior		669	705	826	668	700	669	706	701	707	703	697
Western Interior		557	982	1,126	556	957	964	963	962	1,007	899	934
Texas		550	118	1,259	551	1,158	1,127	1,158	1,160	1,160	1,159	1,160
Powder River		144	130	177	144	124	165	127	125	133	113	121
Green River-Hams Fork		108	104	135	107	96	120	98	97	108	104	96
Fort Union		149	217	238	149	221	234	220	221	230	199	223
San Juan River		52	13	120	52	13	14	13	13	13	53	13
Uinta		106	95	129	106	90	92	90	91	96	96	91
Denver-Raton Mesa		144	24	205	144	240	225	241	241	249	191	233

TABLE 5-19

SULFUR OXIDES EMISSIONS SUMMARY COMPARISON
(THOUSANDS OF TONS PER YEAR)

	1976	PREFERRED LEASING POLICY			NO NEW LEASING			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER-MINATION
REGIONS	BASE-LINE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
		1985 PROJECTIONS										
Northern Appalachian		247	241	257	247	241	257	241	241	242	214	242
Central Appalachian		209	225	190	209	225	189	225	225	225	118	225
Southern Appalachian		84	110	111	82	110	111	111	110	110	108	110
Eastern Interior		342	357	380	342	357	378	357	357	359	347	355
Western Interior		361	443	487	361	436	475	437	438	454	472	525
Texas		73	110	102	73	108	103	108	109	108	108	111
Powder River		14	14	15	14	14	15	14	14	14	12	13
Green River-Hams Fork		12	15	14	12	14	13	14	14	15	16	14
Fort Union		15	13	19	15	13	19	13	13	14	12	14
San Juan River		7	7	11	7	7	11	7	7	7	8	7
Uinta		17	17	19	17	17	18	17	17	18	17	17
Denver-Raton Mesa		11	13	14	11	13	14	13	13	14	13	13
REGIONS		1990 PROJECTIONS										
Northern Appalachian		252	293	450	252	293	315	293	293	293	241	293
Central Appalachian		249	292	323	249	292	290	295	292	294	220	287
Southern Appalachian		84	125	166	84	125	127	126	125	126	123	123
Eastern Interior		378	392	457	377	389	370	392	390	393	392	387
Western Interior		393	728	819	392	708	710	713	712	749	661	689
Texas		93	198	212	93	195	190	195	195	195	195	195
Powder River		17	18	21	17	17	20	17	17	18	16	16
Green River-Hams Fork		14	15	18	14	14	16	14	14	15	15	14
Fort Union		16	24	27	16	24	25	24	24	25	23	24
San Juan River		8	2	20	8	2	2	2	2	2	9	2
Uinta		22	20	27	22	19	19	19	19	20	20	19
Denver-Raton Mesa		14	22	24	14	21	22	22	21	22	18	21

TABLE 5-20

TOTAL SUSPENDED PARTICULATES EMISSIONS SUMMARY COMPARISON
(THOUSANDS OF TONS PER YEAR)

REGIONS	1976 BASELINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETERMINATION MEDIUM
		1985 PROJECTIONS										
Northern Appalachian		148	145	153	148	145	153	145	145	145	132	145
Central Appalachian		92	97	82	92	97	83	97	97	96	64	98
Southern Appalachian		58	77	80	57	78	80	78	77	78	75	77
Eastern Interior		146	151	150	146	150	151	150	150	149	146	151
Western Interior		99	121	133	99	119	129	119	120	123	128	142
Texas		74	109	98	74	107	100	107	108	105	106	112
Powder River		38	44	60	38	45	56	45	45	47	42	40
Green River-Hams Fork		14	22	30	14	21	24	21	21	28	28	18
Fort Union		16	13	25	16	13	24	13	13	15	11	15
San Juan River		8	16	16	8	10	16	10	10	11	10	11
Uinta		13	16	19	13	15	19	16	16	17	15	16
Denver-Raton Mesa		10	13	15	10	13	15	13	13	14	14	13
REGIONS		1990 PROJECTIONS										
Northern Appalachian		148	172	250	148	171	180	171	171	171	146	172
Central Appalachian		103	118	129	103	118	116	119	118	118	96	119
Southern Appalachian		58	86	116	58	86	90	87	87	87	84	84
Eastern Interior		168	179	195	168	179	166	178	179	174	178	186
Western Interior		108	197	222	107	193	194	193	193	202	178	188
Texas		93	193	207	93	195	187	194	195	188	190	194
Powder River		45	70	103	45	58	69	66	59	77	67	51
Green River-Hams Fork		20	28	39	19	23	29	24	24	33	32	17
Fort Union		18	27	33	18	29	34	28	29	30	23	29
San Juan River		13	10	31	13	11	14	11	11	12	17	12
Uinta		19	20	27	19	20	22	19	20	21	19	19
Denver-Raton Mesa		16	27	22	16	26	24	26	26	27	21	25

TABLE 5-21

WATER MAKEUP SUMMARY COMPARISON
(THOUSANDS OF ACRE FEET PER YEAR)

	1976	PREFERRED LEASING POLICY			NO NEW LEASING			PRLA's ONLY	SHORT-TERM LEASING ONLY	MEET INDUSTRY NEEDS	MEET DOE TARGETS	STATE DETER-MINATION
	BASE-LINE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
REGIONS		1985 PROJECTIONS										
Northern Appalachian		633	630	656	633	630	656	630	630	630	563	630
Central Appalachian		353	377	316	353	378	316	377	377	376	202	378
Southern Appalachian		271	354	360	265	356	358	356	355	354	349	354
Eastern Interior		499	517	545	499	516	543	516	516	518	504	515
Western Interior		296	364	400	296	359	390	359	361	373	390	435
Texas		314	476	439	314	471	443	470	472	467	469	485
Powder River		78	72	88	78	72	84	72	72	75	65	70
Green River-Hams Fork		55	69	65	55	66	60	66	67	73	77	66
Fort Union		83	63	117	83	63	115	63	63	68	56	68
San Juan River		31	33	52	31	33	52	32	32	33	35	33
Uinta		59	63	73	59	62	71	62	63	65	63	63
Denver-Raton Mesa		54	70	77	54	70	76	70	70	74	74	67
REGIONS		1990 PROJECTIONS										
Northern Appalachian		642	746	1,081	642	746	760	746	746	746	615	747
Central Appalachian		417	484	536	417	484	482	489	484	486	367	477
Southern Appalachian		270	398	529	270	398	403	402	398	400	392	392
Eastern Interior		556	581	772	555	579	558	582	579	579	582	582
Western Interior		323	608	689	322	592	598	595	595	625	551	576
Texas		399	865	925	400	854	833	853	855	851	853	855
Powder River		93	98	122	92	90	110	95	91	103	84	87
Green River-Hams Fork		67	66	78	66	59	70	60	60	70	68	57
Fort Union		93	137	148	93	142	155	140	142	148	131	143
San Juan River		39	10	92	39	10	12	10	10	11	48	11
Uinta		78	74	101	78	71	73	71	71	76	75	71
Denver-Raton Mesa		78	142	141	78	140	133	140	140	145	103	134

TABLE 5-22

TOTAL LAND DISTURBED SUMMARY COMPARISON
(MINE, PLANT, HAUL ROADS, RAIL ROADS)
(THOUSANDS OF ACRES)

REGIONS	1976 BASE-LINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETER-MINATION MEDIUM
		1985 PROJECTIONS										
Northern Appalachian		288	282	298	288	283	298	282	283	282	259	282
Central Appalachian		214	223	188	214	224	189	224	224	218	153	226
Southern Appalachian		112	150	158	110	151	158	150	151	152	145	148
Eastern Interior		261	265	256	261	263	26	263	263	261	257	264
Western Interior		137	162	177	137	160	173	160	161	158	169	193
Texas		172	241	202	172	237	214	237	238	225	232	254
Powder River		72	84	118	72	84	109	84	84	91	82	78
Green River-Hams Fork		50	86	123	50	82	98	83	83	112	114	68
Fort Union		44	45	76	44	45	75	45	45	49	37	50
San Juan River		23	31	49	23	31	49	31	31	35	30	37
Uinta		26	29	33	26	28	32	28	28	30	28	29
Denver-Raton Mesa		22	30	36	22	30	36	30	30	34	34	31

REGIONS	1976 BASE-LINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETER-MINATION MEDIUM
		1990 PROJECTIONS										
Northern Appalachian		137	158	225	137	157	162	157	157	157	135	158
Central Appalachian		112	127	140	112	128	125	129	128	128	104	129
Southern Appalachian		54	80	110	54	82	86	82	82	83	78	78
Eastern Interior		131	140	158	131	141	134	141	141	136	138	148
Western Interior		69	128	145	69	128	132	127	129	130	114	128
Texas		108	206	224	108	216	205	215	215	193	201	213
Powder River		42	77	107	42	62	168	70	64	85	73	57
Green River-Hams Fork		38	57	80	37	48	57	49	50	70	69	34
Fort Union		26	40	53	26	43	58	47	43	45	35	44
San Juan River		17	21	47	17	25	32	23	24	25	33	26
Uinta		18	17	23	17	16	18	16	16	18	16	11
Denver-Raton Mesa		17	31	29	17	30	32	30	30	32	23	[illegible]

TABLE 5-23

FOREST PRODUCTIVITY LOSS SUMMARY COMPARISON

(THOUSANDS OF TONS)

REGIONS	1976 BASELINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETERMINATION MEDIUM
		1985 PROJECTIONS										
Northern Appalachian	—	1526	1498	1581	1526	1499	1583	1499	1498	1496	1371	150
Central Appalachian		1179	1233	1040	1179	1237	1045	1237	2733	1204	844	125
Southern Appalachian		598	81	840	586	804	842	802	80	812	774	790
Eastern Interior		606	614	595	605	610	600	691	141	606	596	614
Western Interior		332	393	430	332	389	420	388	391	385	409	468
Texas		59	788	696	592	814	736	813	818	723	796	872
Powder River		22	25	36	22	25	33	25	25	27	25	23
Green River-Hams Fork		67	116	166	67	110	132	112	112	151	182	91
Fort Union		13	13	22	13	13	22	13	13	14	11	14
San Juan River		84	115	181	84	114	18	114	114	129	111	135
Uinta		59	67	77	6	65	76	66	66	69	65	66
Denver-Raton Mesa		37	52	62	37	52	61	52	52	57	57	53
REGIONS		1990 PROJECTIONS										
Northern Appalachian		724	836	1173	724	835	858	835	835	801	715	840
Central Appalachian		620	702	707	620	707	692	713	706	705	572	713
Southern Appalachian		58	434	589	288	436	460	406	436	442	418	417
Eastern Interior		305	326	367	305	328	311	190	327	315	320	342
Western Interior		168	312	352	168	312	118	308	312	315	777	310
Texas		370	707	770	377	744	705	739	740	662	691	733
Powder River		12	23	32	13	19	21	21	19	26	22	22
Green River-Hams Fork		52	72	110	50	65	72	66	68	94	93	45
Fort Union		7	12	15	7	12	12	12	12	13	10	13
San Juan River		64	78	172	64	91	117	85	90	91	122	19
Uinta		41	39	54	41	38	42	38	39	41	38	37
Denver-Raton Mesa		29	52	49	29	51	54	52	52	55	39	50

TABLE 5-24

ANIMAL UNITS LOSS SUMMARY COMPARISON
(THOUSANDS)

REGIONS	1976 BASELINE	PREFERRED LEASING POLICY LOW	PREFERRED LEASING POLICY MEDIUM	PREFERRED LEASING POLICY HIGH	NO NEW LEASING LOW	NO NEW LEASING MEDIUM	NO NEW LEASING HIGH	PRLA's ONLY MEDIUM	SHORT-TERM LEASING ONLY MEDIUM	MEET INDUSTRY NEEDS MEDIUM	MEET DOE TARGETS MEDIUM	STATE DETERMINATION MEDIUM
						1985 PROJECTIONS						
Northern Appalachian		131	129	136	131	129	136	129	129	129	118	129
Central Appalachian		98	102	86	98	102	86	102	102	100	62	103
Southern Appalachian		51	68	72	50	69	72	69	69	70	66	68
Eastern Interior		153	156	151	153	154	152	154	155	154	151	155
Western Interior		53	62	68	53	62	67	61	62	61	65	74
Texas		26	37	31	26	36	32	36	36	34	35	38
Powder River		5	5	8	5	5	7	5	5	6	5	5
Green River-Hams Fork		5	9	13	5	9	11	9	9	12	12	7
Fort Union		5	5	9	5	5	9	6	6	6	5	6
San Juan River		2	3	4	2	3	4	3	3	3	3	3
Uinta		3	3	4	3	3	4	3	3	4	3	3
Denver-Raton Mesa		1	2	2	1	2	2	2	2	2	2	2
REGIONS						1990 PROJECTIONS						
Northern Appalachian		62	72	103	62	72	74	72	72	71	62	72
Central Appalachian		51	58	64	51	58	57	59	58	58	47	59
Southern Appalachian		25	37	50	25	37	40	38	37	38	36	36
Eastern Interior		77	83	93	77	83	78	83	83	80	81	87
Western Interior		27	49	56	27	49	51	49	49	50	44	49
Texas		16	31	34	16	33	31	33	33	29	31	32
Powder River		3	5	7	3	4	4	5	4	5	5	4
Green River-Hams Fork		4	6	9	4	5	6	5	5	7	8	4
Fort Union		3	5	6	3	5	7	5	5	5	4	5
San Juan River		2	2	4	2	2	3	2	2	2	3	2
Uinta		2	2	3	2	2	2	2	2	2	2	2
Denver-Raton Mesa		1	2	2	1	2	2	2	2	2	2	2

eastern regions for all alternatives show a more modest growth (about 25 percent in 1985 and 40 percent in 1990 relative to the 1976 baseline).

Table 5- disaggragates production levels to the ten coal regions. Production from eastern regions is relatively constant regardless of the alternative, while production from the western regions is much more variable, although the preferred program shows little change from the new leasing alternative.

5.4.2 Coal Consumption

Figure 5-8 indicates the majority of coal produced would be consumed in the eastern regions on a fairly uniform level regardless of alternative management program employed. By 1990, projected consumption in these regions would be twice that of the 1976 baseline. Consumption in the western regions was low in 1976 and will continue to be low through 1990. Western production will continue to be slated for eastern region consumers.

On a regional basis, Table 5-12 indicates the relative constancy of consumption in the eastern regions across the alternatives.

5.4.3 Coal-Related Population Growth

Consistent with the relatively large consumption forecasts in the eastern regions, Figure 5-9 indicates a correspondingly large increase in coal-related population growth in these regions. The increases in western regional growth reflects increased production in those areas.

As shown in Table 5-13 , regional populations remain fairly constant for all management alternatives. However, western regions exhibit a substantial overall population increase from the 1976 baseline to 1990 (an almost 400 percent gain in 14 years).

5.4.4 Number and Type of Coal Mines

Figure 5-10 shows that all alternatives entail an emphasis on surface mining in the western regions through 1990 whereas underground mining is emphasized in the eastern regions. These differences can be explained on the basis of economics. Eastern coal deposits have already been extensively stripped so that operators have to go underground; in the west, many surface deposits still remain unmined. Underground mining being more costly, operators will mine the surface coal first.

5.4.5 Criteria Air Pollutants

Carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides, and total suspended particulates estimates were made as a function of the following major activities in the coal cycle: recovery and extraction, refining and processing, transportation, conversion, and delivery by pipelines.

As shown in Figures 5-11 to 5-15, the amounts of the criteria pollutants emitted per year do not vary much (±5 percent) as a function of alternative employed. The effects of increased demand for coal in 1990 are manifested in the increases in emissions over 1985. Due to the low sulfur characteristics of western coal, sulfur oxides emissions are markedly lower in the western regions. Tables 5-16 to 5-20 present the air emissions on a regional basis. It must be recognized that emissions themselves do not indicate whether air quality in a given region would be seriously degraded. That kind of determination can only be made on a site specific basis in terms of climate, terrain features, and activity operating characteristics.

5.4.6 Water Makeup Requirements

These requirements are significantly higher in the eastern regions as shown in Figure 5-16. Water availability is a key issue in the western states. The increased requirements shown in the period 1985 to 1990 could create an impediment to western coal production. Table 5-17 presents this same data on a coal region basis.

5.4.7 Land Disturbance

Figure 5-17 compares land disturbance estimates for the eastern and western regions. Surface mining involves substantial disturbance because of the need to remove overburden (see Appendix F for a description of mining methods). Land disturbance estimates are shown to diminish with time in the eastern regions as operators are forced to mine underground coal deposits with increasing frequency. Table 5-22 presents the land disturbance estimates on a regional basis.

5.4.8 Forest Productivity Loss

The fact that much of the western coal underlies non-forest land is shown in Figure 5-18 where little forest productivity loss is estimated for those regions to 1990. The decrease in productivity loss in the eastern regions can be attributed to the increasing emphasis on deep mining as opposed to surface mining. Table 5-23 indicates how productivity loss varies on a regional basis for the seven alternative programs.

5.4.9 Animal Population Losses

Little difference in animal unit losses is shown in Figure 5-19 for the various alternatives. The losses projected for the eastern regions diminish with time reflecting the trend toward deep mining. Those projected for the western regions indicate slight change, the trend is the same although not as pronounced.