CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter discusses the environmental consequences (impacts) of implementing the alternatives to form a Resource Management Plan (RMP). The impacts are discussed, by alternative, at a level commensurate with the degree or severity of impact. Laws regulating impacts to cultural resources and endangered and threatened plant species would be the same regardless of which alternative is implemented. Therefore, impacts to these resources are discussed only in the General Impacts section of this chapter.

Three terms frequently occur within this chapter:

Interrelated impacts refers to impacts which exist as the result of: (A) previous BLM project commitments, or (B) impacts resulting from State and private projects over which BLM has no authority. Implementation of the Book Cliffs Resource Management Plan would not change any of the interrelated impacts. Interrelated impacts are specifically identified only if they are significant or have the possibility of being significant when combined with BLM actions related to implementation of the RMP. Also, because they do not vary between alternatives, they are discussed only in the Current Management Alternative.

The term **BLM impacts** refers to any impacts which would occur as the result of BLM implementing the Book Cliffs Resource Management Plan (RMP).

Cumulative impacts refers to the total impacts created by combining the BLM impacts (impacts resulting from implementing the RMP) and the interrelated impacts (impacts resulting from State, private, and previously committed BLM projects).

ANALYSIS ASSUMPTIONS AND GUIDELINES

For the purpose of analyzing the impacts of implementation of each alternative, the following assumptions were made. Note that assumptions were not made for all of the identified issues.

GENERAL ASSUMPTIONS

To facilitate preparation of this final EIS, landownership was assumed to remain unchanged from August 1, 1983.

The management actions and mitigating measures would be implemented.

All actions would conform with existing laws, including protection of cultural resources and endangered and threatened species.

Management actions would only involve public lands except where exchange-of-use agreements exist with non-Federal land owners.

The White River Dam will be built.

Minerals Assumptions

Generally, multiple mineral developments could occur in the same geographical area and could be compatible with each other, provided the initial development is mitigated for by any subsequent developments. For example, underground oil shale development could occur in the same vicinity as oil and gas development. However, in some cases, development of certain minerals could be delayed, some recovery rates reduced, or a mineral may not be developed at all.

Oil and Gas

Regardless of the alternative selected, approximately 40 to 80 wells would be drilled within the BCRA annually; 28 to 56 wells would be producible and would remain in existence at least 10 years. The remaining 12 to 24 wells would be nonproducing and the surface disturbance would be reclaimed.

Surface disturbances required for drilling and development would include access roads, powerlines, drill pads and well sites, flow lines, storage tank batteries, storage ponds, distribution pipelines and other projects.

Total surface disturbance for a particular well site and access road would average four to six acres with the majority of the disturbance occurring during the drilling phase.

Oil wells are generally spaced at one well per quarter section (four wells per section), and gas wells are spaced at one well per section, although spacings may vary from these figures.

The effects of oil and gas production would not differ from those that have been analyzed in the Vernal District Oil and Gas Leasing Environmental Assessment. Appropriate mitigating measures would be continued as part of the leasing program (BLM 1976).

Oil Shale

The estimated barrels per day operations and resulting acreage disturbances for the conceptual development within future oil shale tracts are shown in Tables 4-1 (Oil Shale Magnitude of Conceptual Development in Barrels Per Day), 4-2 (Underground Oil Shale Mining-Magnitude of Conceptual Development in Acreage Disturbance), and 4-3 (In Situ Oil Shale Development-Magnitude of Development in Acreage Disturbance During Full Production). These assumptions are based on the best available data (Cashion 1967, Smith 1981, Trudell et al. 1983, BLM 1982b, BLM 1983a, Bechtel Petroleum, Inc. 1981).

Although room-and-pillar mining methods are antici-

TABLE 4-1
Oil Shale Magnitude of Conceptual
Development in Barrels Per Day

Probable Mining Method	Total Area Available For Lease (Acres)	Total Reserves* (Millions of Barrels)		Potential Future Lease Tracts		Recoverable Barrels Within Tracts (Rich Zone Only)			Length of Mining Operation	Barrels Per Day	Barrels Per Day (Rounded)
		Mahogany Zone	Rich Zone	No.	Acres	Total (Millions)	Recovery (PCT)	Recovery (Millions of Barrels)	(Years)	(Thousands)	(Thousands)
COMMODITY PRODUCTION ALTERNATIVE											
Underground	84,000	12,000	8,000	3-4**	15,450-20,600	1,500-2,000	65	980-1,300	20	131-178	130-180
In Situ	14,000	1,500	780	0-1**	0-5,150	300	50	150	20	20.5	20
BALANCED USE ALTERNATIVE											
Underground	42,000	6,400	3,700	2-4**	10,300-20,600	900-1,800	65	600-1,200	20	82-164	80-160
In Situ	6,000	650	310	0-1**	0-5,150	270	50	135	20	18.5	20
RESOURCE PROTECTION ALTERNATIVE											
Underground Only	18,000	2,500	1,500	2	10,300	860	65	560	20	76.7	80

*Kerogen
**No more than 4 total tracts would be leased regardless of the mining method employed.

TABLE 4-2
Underground Oil Shale Mining-Magnitude of Conceptual Development in Acreage Disturbance

Total Area Available for Lease	Total Area With Potential For Tract Delineation	Acreage Disturbance: Spent Shale Disposal: Annual Acres Disturbed* (1%)	Spent Shale Disposal: Annual Acres Reclaimed** (.5%)	'Permanent' (Includes Plant and Mine Facilities, Storage Facilities, Retention Dams, etc.): Acres Disturbed (One Time) (4%)	Acres Reclaimed (1%)	Other (Includes Rights-of-Way and Construction Camps): Acres Disturbed (One Time) (5%)	Acres Reclaimed (4%)	Average Total Disturbance***: Disturbed 8%	Under Rehabilitation 3%
COMMODITY PRODUCTION ALTERNATIVE									
84,000	15,450-20,600 (3-4 tracts)	150-200	75-100	600-800	150-200	750-1,000	600-800	1,200-1,600	500-600
BALANCED USE ALTERNATIVE									
42,000	10,300-20,600 (2-4 tracts)	100-200	50-100	400-800	100-200	500-1,000	400-800	800-1,600	300-600
RESOURCE PROTECTION ALTERNATIVE									
18,000	10,300 (0-2 tracts)	100	50	400	100	500	400	800	300

*A 2% initial disturbance would occur.
**Reclaimed refers to contoured and seeded areas. Three additional years would be required for adequate forage development. Disposal areas would be disturbed more rapidly than rehabilitation would occur for several years. Spent shale reclaimed areas would not be available for forage consumption through the life of the project.
***Through a 10-year period at a given time.

TABLE 4-3
In Situ Oil Shale Development-Magnitude of Development in Acreage Disturbance During Full Production*

Total Available Acres	Total Potential Tract Acres	Project Life	'Permanent' Disturbances** (5%)	New Annual Disturbance (5%)	Area Undergoing Rehabilitation*** (15%)	Total Of All Disturbances (25%)
COMMODITY PRODUCTION ALTERNATIVE						
14,000	0-5,150	20 years	0-250	0-250	0-750	0-1,250
BALANCED USE ALTERNATIVE						
6,000	0-5,150	20 years	0-250	0-250	0-750	0-1,250

*In situ oil shale development is not considered likely in the areas that could be leased under the Resource Protection Alternative.
**Includes plant site, storage facilities, etc.
***Reseeded and fenced.

pated, modified in situ methods could also be used. Shallow oil shale deposits would be developed by true in situ methods and would be similar in appearance and impacts to the ongoing Geokinetics oil shale project. A detailed description of the project is being prepared and should be available through the Division of Oil, Gas, and Mining, State of Utah.

Based upon current legislation, no off-site disposal of spent oil shale would be authorized.

Tar Sand

Combined Hydrocarbon Lease Applications received prior to November 16, 1983 will be analyzed in separate environmental documents. Tracts leased competitively will also be analyzed in separate environmental documents.

The estimated barrels per day operations and estimated acreage disturbances for conceptual tar sand development in the PR Spring STSA are presented in Tables 4-4 (Tar Sands-Magnitude of Conceptual Development in Barrels Per Day, for the PR Spring STSA) and 4-5 (Tar Sands-Magnitude of Conceptual Development in Acreage Disturbance for the PR Spring STSA). These estimates differ slightly from the Utah Combined Hydrocarbon Regional Draft EIS, because of improved data. The following comments relate to those tables:

- All assumed tar sand developments were within the central and southern portion of the PR Spring STSA. The levels of development in PR Spring STSA are within the scope of development predicted in the Utah Combined Hydrocarbon EIS (BLM 1983f).
- Based upon a more recent, detailed evaluation of data, most tar sand deposits would likely be developed by an in situ, thermal combustion process because the depth of overburden is too great for economical surface mining (Hubbard 1983). The area suitable for surface mining of tar sand (strip ratio of 1:1 or less) is much smaller than was previously estimated in the Utah Combined Hydrocarbon Regional EIS (BLM 1983f). A thermal combustion process was assumed instead of a steam process for two reasons. The relatively thin overburden (less than 350 feet) is considered insufficient for a steam process, and the amount of water necessary for the steam process may not be readily available (BLM 1983f, Kruuskraa 1978).
- Within the limited areas where surface mining could be employed, development was assumed to be similar to a coal strip mine. Generally, after a unit area would be mined, it would be backfilled with the material from a subsequent mine unit. For example, a mined out unit would be backfilled with spent sand, overburden, and covered with topsoil from the adjacent unit. This is a refinement of the prediction made within the Utah Combined Hydrocarbon Leasing EIS that surface mining would be open pit with little or no backfilling into the mine area.
- Development of the Hill Creek and Raven Ridge-Rim Rock STSAs was assumed to be consistent with the high level scenario of the Utah Combined Hydrocarbon Leasing EIS which predicted limited development.

Gilsonite

Approximately one to five miles of currently unleased gilsonite veins would be leased and subsequently developed in the next 10 years. Mine staging areas, which include a head frame, haul house, access roads and storage areas would be laid out in intervals of 600 to 1,200 feet along a vein. Each staging area, including access roads, would disturb approximately three acres. Each staging area would remain in existence up to ten years.

Sand and Gravel

Sand and gravel pits are usually granted in 40-acre parcels. Within these parcels, one to five acres may be used for equipment, set up, and stock piles, and one to two acres may be used for topsoil storage. The rest of the area could be available for mining. The length of activity could vary, but generally, the life of the pit would be one to two years with another one to two years required for reclamation. In some locations, small quantities of water may be required.

Conceptual disturbance from potential sand and gravel developments is shown in Table 4-6 (Sand and Gravel-Magnitude of Development in Acreage Disturbance).

Right-of-Way Corridors Assumptions

Common oil and gas pipelines, roads related to oil and gas development, and roads related to large overhead powerlines, generally disturb a 30-foot wide area, although up to 100 feet could be disturbed by larger projects. This would result in 3 to 12 acres of disturbance per linear mile. In some instances, maintenance roads to powerlines could negate total reclamation.

Forage Assumptions

1. Analysis of forage-related impacts is based on expectations of near normal annual climate conditions. Severe climate variations could drastically alter vegetation responses.
2. The proposed vegetation manipulations would be implemented over a 10-year period.

TABLE 4-4
Tar Sand-Magnitude of Conceptual Development in Barrels Per Day for the PR Spring STSA

Assumed Development (Acres)	Total Recoverable Barrels* (Millions)	Probable Mining Method	Total Area With Potential for Development	Total Recoverable Barrels By Mining Type (Millions)	Amount of Resource Recovered (PCT)	Amount of Resource Recovered (Millions of Barrels)	Length of Mining Operations	Barrels Per Day Operations	Barrels Per Day Operations, All Developments	Barrels Per Day Rounded to Nearest 5,000
COMMODITY PRODUCTION ALTERNATIVE										
89,000	700	In Situ	44,500-62,300	385-540	30-50	115-270	20 years	15,750-37,000	25,050-58,250	25,000-60,000
		Surface	8,900-17,800	75-155	90-100	68-155	20 years	9,300-21,250		
BALANCED USE ALTERNATIVE										
23,500	300	In Situ	11,750-16,450	165-230	30-50	50-115	20 years	6,850-15,750	12,700-25,750	15,000-25,000
		Surface	2,350-4,700	35-65	90-100	32-65	15 years	5,850-10,000		
RESOURCE PROTECTION ALTERNATIVE										
4,200	55	In Situ	2,100-2,940	30-42	30-50	9-21	10 years	2,450-5,750	5,200-12,350	5,000-10,000
		Surface	420-840	6-12	90-100	5-12	5 years	2,750-6,600		

*All development was assumed to occur in the central and southern part of PR Spring STSA.

TABLE 4-5
Tar Sand-Magnitude of Conceptual Development in Acreage Disturbance for the PR Spring STSA*

Assumed Development (Acres)	Probable Mining Method	Assumed Development By Mining Type (PCT)	Assumed Development By Mining Type (Acres)	Assumed Project Life	Permanent Facilities (Plant Site Storage Facilities, etc.) (PCT)	Annual Mining Disturbance (PCT)	Area Undergoing Rehabilitation (Reseeded and Fenced) (PCT)	Additional Area in Disturbance (Waste and Tailings Piles) (PCT)	Total of All Disturbances (PCT)	Total of All Disturbances (Acres)	Total of All Disturbances (All Mining Methods) Rounded to Nearest 100 Acres
COMMODITY PRODUCTION ALTERNATIVE											
89,000	In Situ	50-70	44,500-62,300	20 yrs.	5	5	15	0	25	11,125-15,575	13,400-22,700
	Surface	10-20	8,900-17,800	20 yrs.	5	5	15	0-15	25-40	2,225-7,120	
BALANCED USE ALTERNATIVE											
23,500	In Situ	50-70	11,750-16,450	20 yrs.	5	5	15	0	25	2,950-4,110	3,800-6,600
	Surface	10-20	2,350-4,700	15 yrs.	5	7	20	0-20	32-52	750-2,450	
RESOURCE PROTECTION ALTERNATIVE											
4,200	In Situ	50-70	2,100-2,950	10 yrs.	5	10	30	0	45	950-1,330	1,400-2,200
	Surface	10-20	420-840	5 yrs.	5	20	60	15	100	420-840	

*All developments were assumed to occur in the central and southern portions of the PR Spring STSA.

TABLE 4-6
Sand and Gravel-Magnitude of
Conceptual Development in Acreage Disturbance

Total Area (Acres)	Anticipated Demand (acres) (Annual)	Anticipated Demand (acres) (10-Year)	Rehabilitated Area (Percent) (10 Years)	Total Disturbance (Acres) (10 Years)	Total Disturbance* (Acres) (10 Years)
CURRENT MANAGEMENT ALTERNATIVE					
8,500	Unquantifiable		Unknown	Unknown	Unknown
RESOURCE PROTECTION ALTERNATIVE					
0	10-15	100-150	N/A**	N/A**	N/A*
COMMODITY PRODUCTION ALTERNATIVE					
12,500	50-110	500-1,100	50	500-1,100	250-550
BALANCED USE ALTERNATIVE					
8,500	20-50	200-500	50	200-500	100-250

*Includes rehabilitation.
**Not applicable as no development would occur under this alternative.

3. The difference between initial and projected livestock use levels would be based on site potentials, the level of interacting use demands, and the level and direction of management.
4. Livestock operators will have up to five years to adjust ranching operations to coincide with any final adjusted livestock utilization levels.
5. Range data are sufficient to indicate current ecological condition and trend.
6. Noncompetitive use for forage between livestock and wildlife was not taken into consideration in the original allocation process. This would amount to an unknown quantity of additional forage that would be available for wildlife and livestock.
7. Forage which would be available for wildlife, on State and private lands, has not been included in allocating forage for wildlife.
8. The forage inventories and forage adjudications (AUMs) completed in the early 1960's are accurate with respect to total forage production and total utilization levels by livestock and wildlife. However, due to the kind and intensity of inventory conducted and the limited number of elk and wild horses at the time of adjudication, the following criteria were not fully considered (Oldroyd 1984):
   a. Noncompetitive livestock/wildlife forage utilization,
   b. Suitability, including distance from water,
   c. Forage adjudication for wild horses,
   d. Forage adjudication for elk.

Mitigation for forage actions are incorporated within the alternatives. See forage section in Chapter 2 and Appendix 8, Mitigating Measures for Land Treatments.

Wildlife and Wild Horse Assumptions

There will be an unquantifiable loss in crucial big game range on State and private land. The loss would increase the big game forage demand on other State and Federal land.

Threatened and Endangered Plant Assumptions

In any of the locations identified as having potential habitat for threatened and endangered plant species, clearance of the area will be required, as prescribed by law, and prior to initiating any surface disturbing activity, such as range improvement work, minerals development, watershed protection, etc.

Woodland Assumptions

Productive timberland (Douglas fir) would be harvested on a 150-year rotation, woodland on a 150-year rotation for medium production sites, and a 125-year rotation for high production sites (pinyon-juniper), and cottonwood on a 65-year rotation. No live aspen or ponderosa pine would be harvested.

In calculating the allowable cut, the woodland resource for the Winter Ridge WSA is not included in the Current Management Alternative. The interim management policy does not permit commercial harvest of woodland products. However, for the other three alternatives, the forest resource is included in the allowable cut and would become available for harvest, if the area is determined to be unsuitable for wilderness.

Recreation Assumptions

Flows of less than 250 cfs in the White River would be insufficient for floatboating.

Visual Resources Assumptions

Many projects would have short-term visual impacts (three to five years) that may exceed the management objectives for a particular VRM class. However, these impacts would not be considered significant providing the projects conform to management objectives in the long term (10 to 20 years) following implementation.

Water Use Assumptions

1. Water use under Current Management includes:

   -28,000 acre-feet for White River Shale Oil Corporation (tracts U-a and U-b),

   -77,000 acre-feet for the high-level scenario projected in the Uintah Basin Synfuels Development EIS (37,000 for eight synfuels projects, 20,000 for municipal or industrial use and 20,000 for agricultural use),

   -An estimated 62,000 acre-feet for the unresolved Ute Tribe entitlements,

   -For a total of 167,000 acre-feet of water.
2. Because of the many uncertainties regarding development technology, no attempt is made to quantify water needs for tar sand development.
3. All water needed for oil shale development would come from the White River.

4. The amounts of water needed to develop two oil shale tracts would be the same as for developing tracts U-a and U-b (28,000 acre-feet).

5. ***Capacity of the White River Dam is 109,000 acre-feet.***

Water Quality Assumptions

All waste water from oil shale development would be confined and recycled so it would not reach surface or ground water.

Land Tenure Adjustment Assumptions

Where valuable minerals can be identified, all mineral rights would be reserved on land identified for disposal, unless the land is exchanged for other land having equal value.

Air Quality Assumptions

1. The potential impacts to air quality from additional mineral leasing are based upon the probable production levels and mining and processing methods discussed previously in the minerals assumptions.
2. This air quality analysis was developed using several previously completed air quality analyses including the Uintah Basin Synfuels (UBS) Development analysis (Systems Applications 1983), the Combined Hydrocarbon Leasing EIS (BLM 1983f; Aerocomp 1984), and the Federal Oil Shale Management Program EIS (BLM 1983b; Dietrich et al. 1983). The analysis is based on the assumption that the high production level scenario of the Uintah Basin Synfuels Development EIS would occur over the next decade (BLM 1982b). This would represent the worst case analysis; however, eventual development may be somewhat less. The UBS analysis also considered the impact of the Bonanza Power Plant and the Plateau Oil Refinery as point sources.
3. The criteria for determination of the significance of impacts to air quality are related to the regulatory limitations set on air quality by the Prevention of Significant Deterioration (PSD) Regulations and the National Ambient Air Quality Standards (NAAQS) (Appendix 13).

Socioeconomic Assumptions

A Denver Research Institute study identified a 10 percent annual population growth as being a general threshold level at which a government's ability to meet increased service demands often breaks down. This level was used in determining the abilities of communities in this document to accommodate increased growth.

The economic and social analyses were based on the assumption that certain interrelated projects outside the scope of this document would be constructed. The projects include those discussed in the high production level scenario of the Uintah Basin Synfuels Development EIS (BLM 1982b).

GENERAL IMPACTS

MINERALS

Concurrent development of separate mineral resources, such as oil shale, tar sand, and oil and gas, in the same vicinity, could result in delays to one or the other of the developments. Cooperation between individual developers working in multiple-lease areas would be necessary to avoid or minimize resource loss.

In certain areas, oil and gas and combined hydrocarbon leases would be subject to special mitigating measures which may be perceived as being unduly restrictive by certain people or organizations. These special mitigating measures (reflected by the category system) would be of particular concern in areas with higher potential for oil and gas and tar sand resources. Table 4-7 compares category designations against favorable areas for oil and gas and tar sand resources ***by alternatives.*** On the other hand, any development in these same areas may be considered to be unduly destructive by certain other people or organizations.

Approximately 12,000 acres of tar sand within the Hill Creek STSA overlaps with the NOSR II (Figure 2-10). The tar sands within this area would be in Category 4, no lease under all alternatives, as required by Executive Order dated December 6, 1916. Development of the energy resources in this area would be delayed indefinitely.

Right-of-Way Corridors

A variety of developments ranging from oil and gas pipelines to roads and powerlines could be located within a designated corridor. An individual project could cause a surface disturbance from 30 to 100 feet or three to twelve acres per mile. Although, theoretically, a mile wide corridor could contain more than one hundred rights-of-way, current undesignated corridors contain a maximum of three. The types of impacts which could be expected from road construction would be similar to those previously described in the environmental assessment for the proposed highway from Bonanza to Vernal, Utah (BLM 1981a). Impacts of pipelines and electrical transmission lines would be

similar to those described in environmental impact statements for Mapco's Rocky Mountain Liquid Hydrocarbons Pipeline (BLM 1980b) and the Moon Lake Power Plant Project (BLM 1981b).

Corridor designation would reduce anticipated environmental impacts from random or unplanned right-of-way networks by avoiding sensitive resource areas. Surface and visual disturbances associated with rights-of-way development would be confined to corridor areas. In some cases, costs to companies constructing the projects may increase an unquantified amount due to an increase in miles necessary to remain within the corridor. Processing of applications would be expedited through simplified environmental review.

Although environmental consideration is a criterion used in selecting corridor routes, not all resource conflicts could be resolved. Conflicts with important resource values are shown by alternative for each corridor segment (Appendix 9, Utility Corridor Segments by Alternative).

Forage

This general section contains facts and impacts that are common to more than one locality or alternative. The facts and impacts are discussed in detail in this section and are merely referred to in the rest of the text.

The basic unit affected by the actions proposed under the respective alternatives is the ecological site. For purposes of analysis and application of management, the natural environment has been classified into sites. Each site is characterized by a particular climate, specific soils, a defined mix of plants, and a certain production potential. Elevation, aspect, and parent material have a direct bearing on these characterizing elements. Grazing animals (livestock, wildlife, wild horses) can have a significant effect on the plant mix or vegetation. Soils may also be affected but less directly. The degree of livestock grazing impact is directly related to the site. For instance, a desert site generally has lighter colored, less fertile soils and sparser vegetation than a mountain site. Hence, the impact of a given stocking level would be much greater on a desert site than on a mountain site.

The practice of allocating a portion of the annual forage production, (an amount in balance with plant needs) to consumptive use by livestock, is termed "proper use stocking". The concept of proper use allows the maintenance of plant food reserves, resists invasion of undesirable and unproductive plants, and allows for the increase of desirable plants and ground water supplies by improving ground cover and infiltration (Dyksterhuis 1951). Harvest of a portion of the annual plant production tends to stimulate growth and plant vigor, thus ensuring sustained yield by the plant. The level of use needed to attain sustained use is relative to the specific plant, the site, and the season of harvest. Proper use of major forage plants is usually set at 50 percent (BLM 1983g). However, it has been found that light use (21 to 40 percent) is generally more conducive to range improvement than moderate use (41 to 60 percent) (BLM 1983g).

Heavy grazing can have excessive impact on the root system of plants. Approximately one third of the root system must be replaced annually. Under heavy use, replacement cannot take place: hence, root volume and plant vigor decreases. The plant's ability to compete with less desirable plants, often weedy annuals, is reduced. The result is a decline in site condition (Hormay 1970, Dietz 1975). If excessive use of the vegetative cover occurs over a prolonged period, significant soil loss could occur. The basic site could be altered and long-term productivity reduced.

Hormay also pointed out that it is unrealistic to assume plants will be grazed at proper use levels simply by adjusting stocking levels. Livestock graze selectively both by plant species and by areas. This can result in over-use of preferred plants and accessible areas, especially floodplains, riparian zones, water service areas, trails, bedgrounds, sheltering areas, etc. Selective grazing under constant stocking levels combined with wide, natural variability in annual production, can result in severe use of preferred plants and grazing areas, particularly during dry years.

It has been determined that grazing during the spring growth period has the greatest impact on a plant's ability to maintain adequate levels of root reserves. As much as 75 percent of a plant's stored carbohydrates are required to initiate the first 10 percent of new growth (Stoddard and Smith 1955). Grazing during any part of the growth period reduces the plant's carbohydrate reserves (Cook 1966).

Plant reproduction is a critical element in maintaining or improving desirable range conditions (Hormay 1970). Periodic deferment to allow production of seed and seedling establishment is vital for key plants which reproduce through seed.

Grazing practices, such as continuous grazing, which do not take into account the physiological requirements of the plant, would have a detrimental impact on site condition. The extent and intensity of the impact would relate to the stocking level.

Reductions in livestock numbers do not necessarily result in improvement of site conditions. If the selective pattern of grazing is not changed, the plant's physiological requirements still may not be met.

Complete deferment of grazing during the critical plant growth period (from plant beginning to the peak

flowering stage) of key plants, on an annual basis, is the single most effective treatment in restoring and maintaining plant vigor. Systems which provide periodic deferment will also result in improvement, but on a more long-term basis.

Conversely, deferment of grazing during the critical spring growth period can impose hardships to livestock operations (see economic section, Resource Protection Alternative).

Winter grazing generally has less impact than other seasons of use because plants are dormant and carbohydrate reserves are least affected (Cook 1966, Hutchings and Stewart 1953). This is particularly true where grasses and forbs, which store food reserves in the roots, are key management species.

Where shrubs are key forage plants, adverse impacts can occur when more than the current year's growth is harvested, since food reserves are stored in both the roots and twigs. Heavy winter grazing can result in depletion or loss of black sage, winter fat, or other species depending on the kind of grazing animal and intensity of use (Holmgren and Hutchings 1974).

The concept of rest rotation grazing comes closest to satisfying plant physiological requirements since systematic deferment is provided to maintain or improve plant carbohydrate reserves, seed production and seedling establishment. Under this system, livestock are also afforded periodic maximum use of the forage.

Impacts to the grazing animals can be somewhat different than plant response. In some instances rotation grazing can increase livestock stress and reduce animal gains. Yearling gains were higher under continuous grazing than under deferred grazing according to (Hormay 1970). However, where the ecologic range condition is poor or fair and the pasture overgrazed, livestock gains would be low but would increase as forage conditions improved (Hormay 1970). Where conditions were good, rotation grazing would reduce individual animal gains, but total production would increase due to greater carrying capacity and livestock numbers (Smoliak 1960).

The manner in which the livestock are handled and the time allowed for pasture moves are important factors in animal stress (BLM 1983g). The degree of negative impact, resulting from a grazing system, relates to the arrangement and number of pastures and the increase in AUMs derived from following the grazing system. Where grazing systems are simple (having a minimal number of pastures and well-arranged moves), and a substantial increase in AUMs from the grazing system is gained, there is no net negative impact (BLM 1983g).

Some beneficial affects can accrue to livestock under rotation grazing. Early use can be made of rest pastures. Old growth can provide shelter to calves and can reduce incidences of grass tetany and scours. The impact of rest required for pastures (one and one-half to three years) in conjunction with vegetative treatment can be lessened, if the required rest can be scheduled with the normal rest treatment (Hormay 1970). Breeding success can be increased by subdividing large areas into pastures. Cows are concentrated and more available to bulls.

Ecologic condition and forage production can be improved through vegetative treatment. Prescribed burning of dense (25 percent or greater canopy), big sagebrush would greatly reduce canopy of big sagebrush. Grass cover would increase resulting in at least a doubling of forage production (Ralfs and Busby 1979). The longevity of the effects depend on the grazing practices applied and moisture patterns.

Chemical treatment to control sagebrush has resulted in similar increases in production. Doubled yields were reported on study plots receiving 10 to 13 inches of annual precipitation (Nielson and Hinckley 1975). On sites where sagebrush was intermingled with browse species, damage occurred to aspen, chokecherry, serviceberry, snowberry, and bitterbrush (Blaisdell and Mueggler 1956). However, a large proportion of these species resprouted abundantly. Bitterbrush was consistently killed if sprayed when plants were less than 12 inches tall (Nielson and Hinkley 1975). Plants over 12 inches were only slightly damaged if spraying occurred prior to, or at the time of leaf origin.

Significant increases in bitterbrush density can occur following chemical treatment. Forbs are generally reduced when treated with the herbicide 2-4-D (Nielson and Hinkley 1975). Of 38 species studied, 13 were moderately or severely damaged. Among them were balsam root milk vetch, bluebell, and lupine (Blaisdell and Mueggler 1956).

Chaining pinyon and juniper allows release of understory forage or seeded species and can result in production of 200 to 700 pounds per acre (Valentine 1971). The debris and disturbance resulting from chaining can have an adverse effect on the aesthetics of the area. In areas with woodland value, it can also greatly reduce the value of woodland products. It has also been observed that the incidence of fire is greater in chained areas (Smith 1984).

Cultural Resources

Construction and land modification activities could cause disturbance and modification to cultural resources that occur within the affected area. Impacts could include destruction or alteration of the resource base (sites, artifact and feature relationships, artifact displacement; removal, destruction and alteration of the surrounding environment) and the introduction of visual, audible and atmospheric elements out of character with

the present environment. These impacts would result in a loss of scientific, educational and recreational values in a site or region and a loss of a portion of the resource base for future research or use. The loss of any information could have a significant impact on efforts to reconstruct the prehistory and history of the region, including data pertinent to many other types of anthropological studies and related disciplines. The majority of site disturbance could be avoided by proper placement of facilities. Where avoidance is not possible, data recovery by salvage excavation would mitigate most adverse effects. The total number and significance of the affected sites is unknown.

The loss of these values, on the other hand, would be partially offset by information gained from overall excavation and salvage programs. Such information would add to the growing data base for cultural resources in Utah and enhance our knowledge of prehistoric resource utilization and settlement patterns.

Indirect impacts would increase as a result of greater accessibility and local population increases. Recreational activities of two types, those intentional illegal activities associated with artifact collection and treasure hunting, and unintentional recreational use (hiking, hunting, off-road vehicles), could ***cause*** irreparable site damage. Both scientific and aesthetic site values would be lost as a result of these indirect impacts.

Site specific effects would be assessed when project specific locations, applied technologies, ***and right-of-way locations*** are determined (BLM 1981b).

Paleontology

The primary concentration of hydrocarbon development would occur in the Green River and Uinta Formations which are known to contain important fossils of fish, reptile, bird and mammal species. Construction activities could also provide new paleontological information.

An unknown amount of paleontological resources would be destroyed by ground-disturbing activities. Large scale mining activities could destroy or reveal buried paleontological resources. Those projects which disturb only the soil layer would have the least probability of destroying or discovering paleontological remains.

Collection and removal of fossils from known fossil areas would result from the anticipated population increase, resultant increase of people in known fossil areas, and the exposure of fossils by project construction. An unquantifiable amount of paleontological resources which have scientific and educational values would be lost.

Endangered, Threatened, and Sensitive Plant Species

Surface-disturbing activities proposed for each alternative would have the potential to adversely affect endangered, threatened, and sensitive plant species and their habitats. Impacts could include destruction of individual plants and destruction or degradation of occupied and potential habitats.

Mitigating measures requiring survey and clearance prior to proposed surface disturbing actions would reduce the potential for significant endangered and threatened plant or habitat loss. In some areas, resource development could not occur due to the presence of endangered or threatened species.