

UTAH COMBINED

HYDROCARBON



88045451

LEASING

REGIONAL

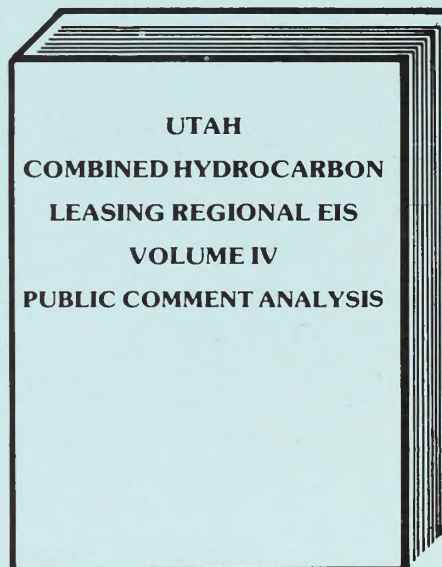
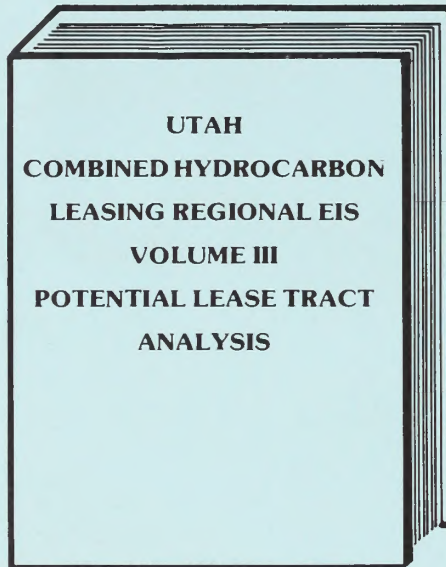
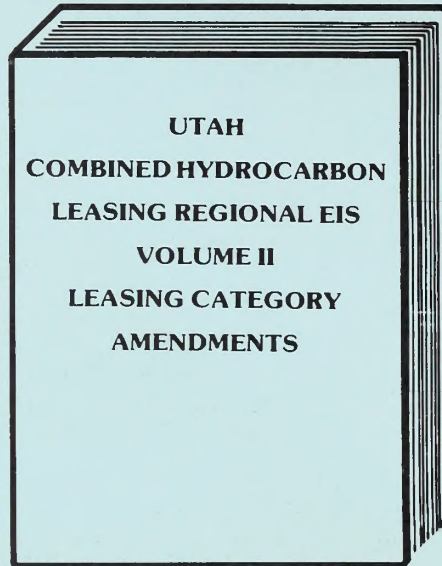
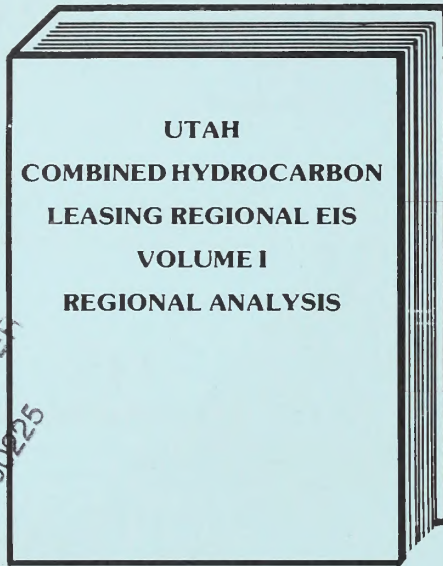
FINAL

EIS



VOLUME I: REGIONAL ANALYSES

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225



Why Is This EIS Divided into Four Volumes?

This EIS is divided for ease of handling the volume of data involved and to clearly separate three levels of analyses plus public comment received on the Draft EIS. The first three volumes address a separate proposal and analyses, along with specific major Federal actions, required to implement the Combined Hydrocarbon Leasing Program in Utah.

What Does Each Volume of this EIS Contain?

Volume I contains the regional assessment for implementation of the Bureau of Land Management's Combined Hydrocarbon Leasing Program for Utah. This analysis examines high and low production levels and no action at various periods of time during a 20-year time frame. This volume serves as the regional assessment for all required site-specific Combined Hydrocarbon Lease EISs in Utah.

Volume II contains proposed planning amendments to update BLM's land use plans. These updates propose categories for issuing new leases or converting existing oil and gas leases to Combined Hydrocarbon Leases.

Volume III contains the site-specific assessment for issuing Combined Hydrocarbon Leases on potential tracts within Special Tar Sand Areas.

Volume IV contains public comments made on the Draft EIS, along with BLM responses to those comments.

ID 88045451

TD
195
.595
U87
1984
v.1



United States Department of the Interior

BUREAU OF LAND MANAGEMENT

Utah State Office
136 East South Temple
Salt Lake City, Utah 84111

IN REPLY
REFER TO:

1792
(U-933)

June 1, 1984

Dear Reader:

Enclosed is the Utah Combined Hydrocarbon Leasing Regional Final EIS, Volumes I-IV. This document was prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 and is in accordance with the Council of Environmental Quality's regulations (40 CFR 1500-1508).

This Regional Final EIS is a revised, complete edition of the Utah Combined Hydrocarbon Leasing Regional Draft EIS. Before preparation of this Final EIS, all written comments and oral testimony from the public hearings held for the Draft EIS were reviewed. Comments that presented new data, questioned facts and/or analyses, and raised issues bearing directly on the Draft EIS are responded to in Volume IV of this Final EIS. Text changes made to the Draft as a result of these comments appear in italicized print in Volumes I-III of this final document.

There is a 30-day period to comment on this Final EIS. Those interested should send their comments to:

Roland G. Robison, Utah State Director
Bureau of Land Management
Utah State Office
University Club Building
136 East South Temple
Salt Lake City, Utah 84111

A formal Record of Decision stating the selected alternative for Volumes II and III will be issued following the 30-day comment period. It should be noted that decisions on leasing within Special Tar Sand Areas will not be based solely on data presented in this Final EIS.

Sincerely,

Roland G. Robison
State Director

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

UTAH COMBINED HYDROCARBON LEASING

REGIONAL FINAL EIS

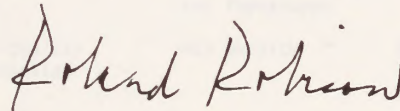
UTAH
.36
FES

Volume I

v.1

Regional Analyses

Prepared By:
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
RICHFIELD DISTRICT



**State Director
Utah State Office**

Cooperating Agency: State of Utah and National Park Service

Counties That Could Be Directly Affected: Carbon, Duchesne, Emery, Garfield, Grand, San Juan, Uintah, *Utah*, Wasatch, and Wayne, all in the State of Utah.

ABSTRACT: The Bureau of Land Management, under the Combined Hydrocarbon Leasing Act, is examining potential development alternatives for Special Tar Sand Areas in Utah. This volume (I) provides an analysis of regional impacts resulting from three alternatives: High Commercial Production, Low Commercial Production, and No Action (No commercial production from Federal tar sand). The major impacts or concerns are air quality, water supply, endangered species habitat, restoration of large disturbed areas, split estates (land ownership), and socioeconomics. In addition to an overview of cumulative impacts resulting from various levels of potential tar sand development, this volume also provides an analysis for each STSA.

For Further Information, Contact: Alan Partridge, EIS Team Leader, Richfield District Office, Bureau of Land Management, 150 East 900 North, Richfield, Utah 84701, or call Commercial: (801) 896-8221 or FTS: 584-8011.

Comments on the Final EIS must be received within 30 days after filing this document with the Environmental Protection Agency

Bureau of Land Management
Library
Bldg. 50, Denver Federal Center
Denver, CO 80225

LIST OF PREPARERS

EIS Team	Title	Assignment	Education	Years of Professional Experience
Don Pendleton	District Manager	Supervision and Management	B.S. Wildlife	28
Carl Thurgood	Project Manager	Organization, Support, and Quality Control	B.S. Range Management	21
Alan Partridge	Environmental Specialist	Team Leader	B.S. Botany	22
Ferris Clegg	Environmental Specialist	Technical Coordinator, Aquatic Animals, and T&E Species	B.S., M.A. Biological Science	20
Dee Ritchie	Environmental Specialist	Quality Control	B.S., M.S. Range, Forestry, and Wildlife Management	23
Roger Twitchell	Environmental Specialist	Vegetation, T&E Plants, Livestock Grazing, and Wild Horses and Burros	B.S. Botany	6
Richard Felthousen	Wildlife Biologist	Terrestrial Animals and T&E Animal Species	B.S. Natural Resource Development M.S. Wildlife Biology	8
John Branch	Geologist	Minerals, Geology, and Topography	B.S. Geology	5
Hal Hubbard	Geologist	Minerals, Geology, and Topography	B.S. Geology	31
Mark Green	Air Quality Specialist	Air Quality	B.S. Atmospheric and Oceanic Sciences M.S. Meteorology	6
LaRell Chappell	Soil Scientist	Soil and Water Resources	B.S. Agronomy	16
Wayne Kammerer	Outdoor Recreation Planner	Recreation, Visual Resources, and Wilderness	B.S., M.S. Forestry, Ed.M. Human Services	5
Craig Harmon	Archaeologist	Cultural Resources	M.A. Anthropology	12
Duane DePaepe	Environmental Specialist	Climate, Air Quality, Geography, Social Issues, and Land Use Plans and Controls	B.A., M.A. Geography	16
David Hillier	Economist	Economics	B.A. Economics	8
Elaine Larsen	Editor	Editorial and Publication	A.D. Business	7
Shirley Taft	Clerical	Typing and Proofing		12
Bert Hart	Public Information Specialist	Public Information and Participation	B. S. Range Management	10
Coordination and Quality Control Team				
Lorin Nielson	Utah State Department of Natural Resources and Energy	Paul Carter	BLM, Cedar City District	
Joel Pickelner	National Park Service	Jim Piani	BLM, Utah State Office	
Rich Aiken	BLM, Washington Office	Earl Hindley	BLM, Utah State Office	
Chuck Horsburgh	BLM, Richfield District	Thomas Slater	BLM, Utah State Office	
Brad Palmer	BLM, Vernal District	Alan Partridge	BLM, Richfield District	
Lynn Jackson	BLM, Moab District	Ron Bolander	BLM, Utah State Office	

LIST OF AGENCIES AND ORGANIZATIONS REQUESTED TO COMMENT ON THE *FINAL* EIS

BLM is requesting comments on this *Final* EIS from the agencies and organizations listed below. Comments from companies who expressed interest in leasing or applied for lease conversions are requested. All other interested and/or affected individuals, private groups, and agencies are also invited to comment.

Federal Agencies

Army Corps of Engineers
Department of Energy
Environmental Protection Agency
Federal Energy Regulatory Commission
U.S. Department of Agriculture
Forest Service
Soil Conservation Service
U.S. Department of the Interior
Bureau of Indian Affairs
Bureau of Mines
Bureau of Reclamation
Fish and Wildlife Service
Geological Survey
National Park Service
Office of Surface Mining

Utah State Agencies

Clearinghouse
Department of Community and Economic Development
Department of Transportation
Department of Natural Resources and Energy
Division of Environmental Health
Division of Lands
Division of Oil, Gas, and Mining
Division of State History
Division of Water Resources
Division of Wildlife Resources
Geological and Mineral Survey
Office of the State Planning Coordinator

Local Government Agencies

Carbon County Commission
Duchesne County Commissioners
Garfield County Commission
Roosevelt Chamber of Commerce
Six County Economic Development District
Six County Organization of Governments
Southeastern Association of Governments
Uinta Basin Association of Governments
Uintah County Commissioners
Utah County Commission
Wasatch County Commission
Wayne County Commission

Nongovernment Agencies

American Fisheries Society
Archaeological Society of Utah
Council on Utah Resources
Defenders of the Outdoor Heritage
Friends of the Earth

ISSUE

National Parks and Conservation Association
National Woolgrowers Association
Natural Resources Defense Council
Rocky Mountain Oil and Gas Association

Sierra Club

SOURCE

Utah Audubon Society
Utah Cattlemen's Association
Utah Geological Association
Utah Mining Association
Utah Nature Study Association
Utah Water Resources Council
Utah Wildlife Federation
Ute Indian Tribe
Wild and Scenic Rivers
Wilderness Society
WHOA!

EIS Availability

Copies of this *Final* EIS will be available for public inspection at the BLM offices listed below:

Washington Office of Public Affairs

18th and C Street, N.W.
Washington, D.C. 20240
Phone: (202) 343-4151

Utah State Office

University Club Building
136 East South Temple
Salt Lake City, Utah 84111
Phone: (801) 524-4227

Richfield District Office

150 East 900 North
Richfield, Utah 84701
Phone: (801) 896-8221

Moab District Office

125 West 200 South
Moab, Utah 84532
Phone: (801) 259-6111

Cedar City District Office

1579 North Main
Cedar City, Utah 84720
Phone: (801) 586-2401

Vernal District Office

170 South 500 East
Vernal, Utah 84078
Phone: (801) 789-1362

Copies of this *Final* EIS may also be requested from the Utah State Office and the Richfield District Office at the above-listed addresses.

TABLE OF CONTENTS

ABSTRACT	iii
LIST OF EIS PREPARERS	v
LIST OF AGENCIES REQUESTED TO COMMENT ON THE DRAFT EIS	vi
SUMMARY	
Introduction	1
Purpose and Need	1
The Setting	1
Scoping and Issue Identification	1
Alternative Energy Sources	1
Description of Alternatives	2
Mitigating Measures	2
Alternative 1: High Commercial Production	2
Alternative 2: Low Commercial Production	2
Alternative 3: No Action	2
Summary of Major Environmental Consequences	2
Alternative 1: High Commercial Production	2
Alternative 2: Low Commercial Production	2
Alternative 3: No Action	2
Summary of Major Environmental Consequences	2
Alternative 1: High Commercial Production	2
Alternative 2: Low Commercial Production	5
Alternative 3: No Action	8
Unresolved Issues	8
CHAPTER 1: INTRODUCTION	
Purpose and Need	11
The Setting	11
Planning and Leasing Processes	12
Pre-EIS Planning and Leasing Processes	12
Post-EIS Planning and Leasing Processes	14
Scoping Process	14
Interrelationships With Other Proposed Tar Sand Projects and Energy Sources	14
Energy Efficiency	14
CHAPTER 2: DESCRIPTION OF ALTERNATIVES AND TAR SAND RESOURCES	
Introduction	17
Description of Tar Sand Resources	17
Tar Sand Deposits Within Utah	17
Tar Sand Recovery Methods	19
Description of Alternatives	24
Mitigating Measures	24
Alternative 1: High Commercial Production	24
Alternative 2: Low Commercial Production	24
Alternative 3: No Action	24
Energy Conservation and Alternative Energy Sources	27
Summary of Unavoidable Adverse Impacts, Irreversible/Irretrievable Commitments of Resources, and the Relationship of Short-Term Use of the Man's Environment to Maintenance and Enhancement of Long-Term Productivity	31
CHAPTER 3: AFFECTED ENVIRONMENT	
Introduction	35
Air Quality and Climate	35

TABLE OF CONTENTS

Water Resources	39
Water Quantity	39
Water Quality	39
Water Requirements and Future Effects on the Colorado River System	39
Groundwater	39
Water Rights	39
Soils	39
Topography, Tar Sand, and Other Minerals	46
Vegetation	55
Animal Life	57
Terrestrial Animals	57
Aquatic Species	59
Wild Horses and Burros	59
Recreation	59
Wilderness	64
Visual Resources	66
Scenic Quality	66
Land Uses	68
<i>Federal, State and Local Land Use Plans, Programs, and Controls</i>	68
Cultural Resources	68
Livestock Grazing	70
Socioeconomics	74
Regional Overview	74
Infrastructure	77
Attitudes and Lifestyles	93
Transportation	93

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Introduction	95
Analyses Assumptions and Guidelines	95
Threatened, Endangered, and Sensitive Plant and Animal Species	96
Alternative 1: High Commercial Production	97
Regional Overview	97
Air Quality	97
Water Resources	105
Soils	107
Topography, Tar Sand, and Other Minerals	110
Vegetation	112
Animal Life	113
Recreation	116
Wilderness	116
Visual Resources	118
Cultural Resources	118
Livestock Grazing	118
Socioeconomics	119
Attitudes and Lifestyles	126
Transportation	126
Analysis of STSAs	128
Argyle Canyon/Willow Creek STSA	128
Asphalt Ridge/White Rocks STSA	129
Circle Cliffs STSA	131
Hill Creek STSA	133
P. R. Spring STSA	135
Raven Ridge/Rim Rock STSA	137
San Rafael Swell STSA	138
Sunnyside STSA	140
Tar Sand Triangle STSA	143
Alternative 2: Low Commercial Production	146
Regional Overview	146
Air Quality	146
Water Resources	152
Soils	152
Topography, Tar Sand, and Other Minerals	152
Vegetation	155
Animal Life	156
Recreation	158
Wilderness	158

TABLE OF CONTENTS

Visual Resources	160
Cultural Resources	160
Livestock Grazing	160
Socioeconomics	160
Attitudes and Lifestyles	165
Specific Analysis of STSAs	169
Asphalt Ridge/White Rocks STSA	169
Circle Cliffs STSA	171
P. R. Spring STSA	173
San Rafael Swell STSA	175
Sunnyside STSA	176
Tar Sand Triangle STSA	179
Alternative 3: No Action	181
Air Quality	181
Water Resources	181
Socioeconomics	181
Population Projections	185
Employment Projections	192
Personal Income Projections	192
Infrastructure	196
APPENDIX 1: RATIONALE AND DATA SOURCES FOR DETERMINING ALTERNATIVE PRODUCTION LEVELS FOR STSAS IN UTAH.....	207
APPENDIX 2: GENERAL POLICY GUIDELINES FOR OIL AND GAS LEASING	215
APPENDIX 3: PROJECTED WATER SUPPLY AND DEPLETIONS, UPPER COLORADO RIVER BASIN.....	223
APPENDIX 4: FISH AND WILDLIFE SERVICE LIST OF THREATENED, ENDANGERED, AND SENSITIVE SPECIES WITHIN OR NEAR STSAS	229
APPENDIX 5: AIR QUALITY IMPACT SIGNIFICANCE CRITERIA AND ANALYSIS METHODOLOGY	235
APPENDIX 6: CULTURAL RESOURCES MEMORANDUM OF UNDERSTANDING	243
APPENDIX 7: ALTERNATIVE 1, COUNTY SOCIOECONOMIC ANALYSIS	245
APPENDIX 8: ALTERNATIVE 2, COUNTY SOCIOECONOMIC ANALYSIS	271
APPENDIX 9: BASELINE EMPLOYMENT PROJECTIONS BY COUNTY	297
APPENDIX 10: PROJECTIONS OF ENERGY-RELATED PROJECTS	307
LIST OF ABBREVIATIONS	315
GLOSSARY	317

TABLE OF CONTENTS

BIBLIOGRAPHY 321

INDEX 327

LIST OF TABLES

1-1: BLM-Administered Land Within STSAs	13
2-1: Acreage, Location, and Leasing Data for STSAs Within Utah.....	18
2-2: Alternative 1, Estimated Reserves, Production, Water Requirements, and Work Force.....	25
2-3: Alternative 2, Estimated Reserves, Water Requirements, and Work Force	26
2-4: Summary of Major Environmental Consequences, Irreversible/Irretrievable Commitments of Resources, and the Relationship of Short-Term Use of Man's Environment to Maintenance and Enhancement of Long-Term Productivity	33
3-1: Ambient Air Quality Within STSAs	36
3-2: NAAQS for National Levels, Colorado, and Utah.....	37
3-3: Allowable PSD Standards	38
3-4: Background Median Visual Range at Each STSA	38
3-5: Surface Water Resources Within or Near STSAs	41
3-6: Groundwater Resources Within or Near STSAs	43
3-7: Current and Baseline Projected Water Depletions Within or Near STSAs.....	45
3-8: Soil Types and Characteristics For STSAs Within Utah	47
3-9: Sediment Yield and Salinity Classes Within STSAs	48
3-10: Quantification of Tar Sand Deposits Within Utah.....	49
3-11: Threatened, Endangered, and Sensitive Plant Species Within STSAs	56
3-12: Summary of Significant Wildlife Resources Within STSAs.....	58
3-13: Fisheries Within STSAs	60
3-14: Potential Water Sources of Fisheries Outside STSA Boundaries	61
3-15: River Segments on the Nationwide Rivers Inventory.....	62
3-16: County Land Use Plans Encompassing STSAs	62
3-17: Livestock Grazing Within STSAs.....	71
3-18: Historical Population Levels of Potentially Affected Counties and Communities (1970 and 1980)	75
3-19: Summary of Demographic Characteristics of Potentially Affected Counties (1980)	76
3-20: Historical County Employment Levels for Potentially Affected Counties (1970-1980)	78
3-21: Average Nonagricultural Wages and Yearly Rate of Change for Potentially Affected Counties (1975-1980)	80
3-22: County PCPI and PCPI Ratio of County PCPI To Utah (1970-1980)	81
3-23: Existing Housing Units in Potentially Affected Communities and Counties (1980).....	83
3-24: Student Enrollment, School Capacity, and Staffing Statistics of Potentially Affected Counties (1982).....	84
3-25: Sewage Disposal Systems of Potentially Affected Communities and Counties	89
3-26: Solid Waste Disposal Systems for Potentially Affected Communities and Counties	90
3-27: Summary of Water System Characteristics for Potentially Affected Communities and Counties	91
3-28: Summary of Fiscal Conditions for Potentially Affected Communities and Counties.....	92
3-29: Average ADT Levels	94
4-1: Alternative 1, Air Quality Impacts Within STSAs	98
4-2: Alternative 1, Comparison of Maximum Increased Pollutant Concentrations With PSD Incremental Limitations	99
4-3: Alternative 1, Comparison of Maximum Increased Pollutant Concentrations With NAAQS.....	102
4-4: Alternative 1, Water Sources and Estimated Depletions	106
4-5: Alternative 1, Current and Projected Water Depletions Within or Near STSAs	108
4-6: Alternative 1, Estimated Bitumen Productions and Acreages Developed and Disturbed	111
4-7: Alternative 1, Summary of Impacts to Wildlife.....	114
4-8: Alternative 1, Potential Wilderness Areas Affected.....	117
4-9: Alternative 1, Summary of Regional Socioeconomic Impacts	120
4-10: Alternative 1, Summary of Population and Household Impact Projections.....	122
4-11: Alternative 1, Employment Growth Projections.....	124
4-12: Alternative 1, Wage and Personal Income Projections	125
4-13: Alternative 1, Annual ADT Projections	127
4-14: Alternative 2, Summary of Air Quality Impacts Within STSAs	147
4-15: Alternative 2, Comparison of Maximum Increased Pollutant Concentrations With PSD Incremental Limitations	148

TABLE OF CONTENTS

4-16: Alternative 2, Comparison of Maximum Increased Pollutant Concentrations With NAAQS.....	150
4-17: Alternative 2, Water Sources and Estimated Depletions.....	153
4-18: Alternative 2, Estimated Bitumen Productions and Acreages Developed and Disturbed.....	154
4-19: Alternative 2, Summary of Impacts to Wildlife.....	157
4-20: Alternative 2, Potential Wilderness Areas Affected.....	159
4-21: Alternative 2, Summary of Regional Socioeconomic Impacts.....	161
4-22: Alternative 2, Summary of Population and Household Impact Projections.....	163
4-23: Alternative 2, Employment Growth Projections.....	166
4-24: Alternative 2, Total Personal Income and Per Capita Income Projections.....	167
4-25: Alternative 2, Wage and Personal Income Impact Projections.....	168
4-26: Alternative 2, Annual ADT Projections.....	170
4-27: Alternative 3, Comparison of Concentration Levels to NAAQS.....	182
4-28: Alternative 3, Summary of Population Projections.....	186
4-29: Alternative 3, Summary of Household Projections.....	188
4-30: Alternative 3, Personal Growth Projections.....	191
4-31: Alternative 3, Housing Demand Projections.....	194
4-32: Alternative 3, Educational Service Projections.....	197
4-33: Alternative 3, Health Care Service Projections.....	198
4-34: Alternative 3, Public Safety Requirements by County and Year.....	201
4-35: Alternative 3, Utility Service Demands.....	204

LIST OF FIGURES

Summary Figure 1: Special Tar Sand Areas in Utah.....	3
Summary Figure 2: Regional Population Projections by Alternative.....	6
Summary Figure 3: Work Force Requirement Profiles for Alternative 1: High Commercial Production.....	7
Summary Figure 4: Work Force Requirement Profiles for Alternative 2: Low Commercial Production.....	9
2-1: Channel Deposits of a River System.....	20
2-2: Conceptual Tar Sand Process Plant.....	22
3-1: Water Drainages Within STSAs.....	40
3-2: Geologic Formations Within STSAs.....	50
3-3: Generalized Distribution of Tar Sand Thickness.....	53
3-4: Projections of Total Personal Income by County (1970-1980).....	82
4-1: Alternative 1, Predicted Salinity Changes at Imperial Dam.....	109
4-2: Alternative 1, Projection of County Population Increases.....	121
4-3: Alternative 1, Projection of County Employment Levels.....	123
4-4: Alternative 2, Projection of County Population Increases.....	162
4-5: Alternative 2, Projection of County Employment Levels.....	164
4-6: Alternative 3, Projection of County Population Increases.....	190
4-7: Alternative 3, Projection of County Employment Levels.....	193
4-8: Alternative 3, Projection of Total Personal Income by County.....	195
Appendix Figure 5-1.....	239

SUMMARY

INTRODUCTION

The Combined Hydrocarbon Leasing Act (Public Law 97-78), which amended the Mineral Leasing Act of 1920, was enacted in 1981 "to facilitate and encourage the production of oil from tar sand and other hydrocarbon deposits (Ninety-Seventh Congress, 1981)."

This volume of the *Final* Environmental Impact Statement (EIS) provides an analysis of regional impacts resulting from implementation of *two* different development levels, and *no action* (*no development of tar sand resources*). This volume is an overview and cumulative impact analysis of potential tar sand development. It also serves as the regional tier, as explained in the Council of Environmental Quality's (CEQ) regulations implementing the National Environmental Policy Act (NEPA).

PURPOSE AND NEED

The main features of the Combined Hydrocarbon Lease Act: (1) redefine oil to include tar sand; (2) provide for conversion of existing oil and gas leases and certain valid mining claims to Combined Hydrocarbon Leases (CHLs) on areas identified by the Secretary of the Interior (conversion CHLs); and (3) provide for issuance of new CHLs on a competitive basis (potential lease tracts). These CHLs would be offered in areas designated by Congress as Special Tar Sand Areas (STSAs). All 11 STSAs referred to in the Act are located in Utah.

This EIS is needed to comply with NEPA regulations related to Federal actions. The EIS evaluates the impacts of implementing the entire CHL program. Issuance and possible development of potential lease tracts and amendments to leasing categories within certain Bureau of Land Management (BLM) land use plans (Management Framework Plans [MFPs]) are analyzed in the other two volumes. The EIS provides public disclosure of significant impacts, provides the public an opportunity to comment, and is a tool that will be used in conjunction with other documents for decision-making.

THE SETTING

Figure 1 shows locations of STSAs. (A pocket map, which is located in the back of this volume, is an enlarged map of the STSAs showing land ownership.) All of the STSAs are located within the Colorado Plateau physiographic province and range in elevations from 5,000 to 10,000 feet. STSAs are concentrated in Carbon, Duchesne, Grand, and Uintah counties but extend to Emery, Garfield, San Juan, and Wayne counties. The region is generally semi-arid and is characterized by low relative humidity, abundant sunshine, low to moderate precipitation, warm summers, and cold winters.

SCOPING AND ISSUE IDENTIFICATION

Consultation has been maintained throughout the development of this EIS with the State of Utah, National Park Service (NPS), Bureau of Indian Affairs (BIA), Department of Energy, Ute Indian Tribe, county planning offices, and other affected and/or interested agencies and individuals.

Public scoping and identification of potential lease tracts began in March 1982 when a public meeting was held to explain the CHL program. In July 1982, another public meeting was held, and BLM called for Expressions of Interest for development on unleased Federal lands and notice of intent to amend land use plans. A *Federal Register* notice on February 10, 1983 invited public participation at meetings held in Vernal (March 8, 1983), Price (March 9, 1983), and Salt Lake City (March 15, 1983). These meetings were held to identify significant issues resulting from tar sand development.

Based on information from public meetings and other sources, the following issues were identified as significant: air quality, water quality and use, wildlife, recreation, wilderness, visual resources, socioeconomic impacts, and transportation development.

ALTERNATIVE ENERGY SOURCES

Potential development of other energy sources in Utah, as well as non-Federal tar sand development, could interfere with Federal tar sand development analyzed in this EIS. In the Carbon County area, coal development could preclude some tar sand development; oil and gas production development in Uintah and Duchesne counties could also compete with tar sand development. Water use, available work force, lack of housing and service facilities, and air quality degradation could also be limiting factors.

Energy conservation and use of other energy sources was considered as a potential alternative, but was dropped from consideration because of the legal requirements, etc. However, conservation and other energy sources could influence the need for tar sand development. Energy conservation in the residential, commercial, and industrial sectors could account for over 5 million barrels of oil per day. The electric utility industry could switch from oil to coal or other sources. Transportation usage could be lessened by improving mileage standards. Rail transport and commercial air travel efficiency could also be improved. Gasohol (a gasoline alcohol fuel mixture) could also reduce dependence on oil. Improvements in telecommunications could replace the need for oil because information would travel rather than vehicles.

SUMMARY

DESCRIPTION OF ALTERNATIVES

Three alternatives are analyzed in this volume of the EIS: High Commercial Production, Low Commercial Production, and No Action. Each alternative analyzes specific levels of production for Federal combined hydrocarbon leasing on different STSAs. A higher production level assuming maximum development of STSAs was considered but dropped from analysis because the production was considered too extensive. A pilot level production was also considered but dropped because the Low Commercial Alternative would encompass similar impacts.

Mitigating Measures

Any lease or lease conversion would include standard stipulations (category 1) or standard and special stipulations (category 2) that would require mitigation for site-specific projects.

Alternative 1: High Commercial Production

During the 20-year planning period, a level of 365,000 barrels/day would be produced from development of Federal tar sand. This production level would anticipate production from nine STSAs (i.e., Argyle Canyon/Willow Creek, Asphalt Ridge/White Rocks, Circle Cliffs, Hill Creek, P. R. Spring, Raven Ridge/Rim Rock, San Rafael Swell, Sunnyside, and Tar Sand Triangle) of the eleven STSAs. About 190,000 barrels/day would be produced from surface mining, while about 175,000 barrels/day would be produced from in-situ processes. Assuming that no water reuse occurred, 88,295 acre-feet of water per year would be required by the year 2005. The largest work force would be required during 1995, with about 7,000 construction workers and 4,500 operation workers.

Alternative 2: Low Commercial Production

Total tar sand production would reach 83,000 barrels/day by the year 2005. Only six STSAs (i.e., Asphalt Ridge/White Rocks, Circle Cliffs, P. R. Spring, San Rafael Swell, Sunnyside, and Tar Sand Triangle) of the 11 STSAs would be developed. Fifty-three thousand barrels/day would be produced by surface mining and 30,000 barrels/day would be produced by in-situ processes. Predicted water use would be about 22,200 acre-feet/year, which would peak by 2005. The estimated construction work force would peak in the year 2000 at about 5,500 construction workers, while the maximum operation work force (3,100 workers) would be reached at the end of the planning period in 2005.

Alternative 3: No Action

This alternative would allow only oil and gas leases on STSAs. No conversions to CHLs would be approved nor would new Federal leases be issued. However, there could be some tar sand development on State and private lands.

SUMMARY OF MAJOR ENVIRONMENTAL CONSEQUENCES

Major environmental impacts resulting from implementation of each of the three proposed alternatives are described below.

Alternative 1: High Commercial Production

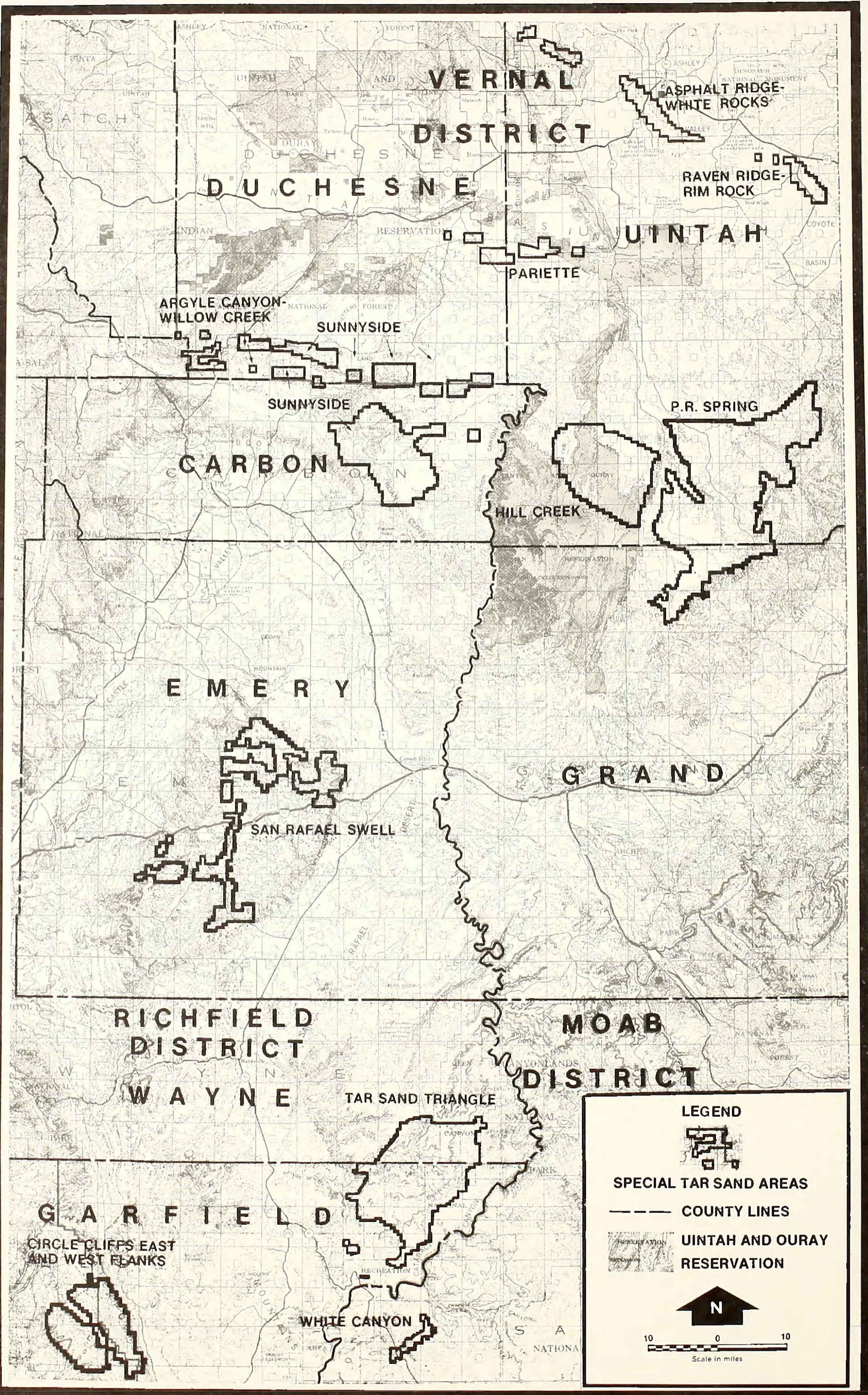
Air quality modeling shows that annual total suspended particulate (TSP) concentrations would exceed the National Ambient Air Quality Standards (NAAQS) in about six STSAs. Also, TSP concentrations from fugitive emissions could exceed 24-hour standards in and near many STSAs. No NAAQS sulfur dioxide (SO₂) violations would occur, but Prevention of Significant Deterioration (PSD) incremental limitations could be exceeded in or near several STSAs. Class I PSD increments for SO₂ could be exceeded at Capitol Reef and Canyonlands national parks. Nitrogen dioxide (NO₂) could exceed the NAAQS for only a small area near the Town of Sunnyside. No significant impacts would be expected from ozone and carbon monoxide (CO). Visibility impacts (atmospheric discoloration) would be expected to occur at Canyonlands National Park (a Federal Class I area), Colorado National Monument, and the Uintah and Ouray Indian Reservation. Estimated visibility impairment would be close to the threshold of perceptibility at Arches National Park and Capitol Reef National Park, both of which are Class I areas.

Increase in consumptive water use, increases in sedimentation and salinity of streams, and possible water quality alterations from mining wastes and transfers in water right allocations would result from development of tar sand. The depletion of water for all STSAs would be about 84,000 acre-feet/year, and changes in salinity levels at Imperial Dam, California would be less than 2 milligrams per liter (mg/l), costing \$1,080,000 annually.

Soil would be disturbed by mining, construction, storage, sediment ponds, and extreme amounts of overburden removal in some areas. Soil losses from disturbed areas would occur until reclamation was completed and soils were stabilized on nine STSAs.

Major impacts and changes in geology and topography would occur at the STSAs having the thickest tar sand deposits. This would include Asphalt Ridge/White Rocks, P. R. Spring, Sunnyside, and Tar Sand Triangle STSAs.

Vegetation could be removed on approximately 51,300 acres disturbed by surface and in-situ hydrocarbon recovery operations. Impacts to riparian, aspen, spruce-fir, and mountain brush communities on Argyle Canyon/Willow Creek, Hill Creek, P. R. Spring, and Sunnyside STSAs



**SUMMARY FIGURE 1
 SPECIAL TAR SAND AREAS IN UTAH**

SUMMARY

would be the most important vegetation losses. Individuals, populations, and habitat of Wright's fishhook cactus (*Sclerocactus wrightiae*) would be lost to tar sand development in the San Rafael Swell STSA. No other Federally listed threatened and endangered plant species are known to exist in other STSAs.

Mule deer summer range could be destroyed from surface disturbance, causing a decline in deer populations. Crucial elk summer and winter ranges could be destroyed with tar sand development. Elk populations would decline, especially on the 43,000 acres disturbed. Bighorn sheep substantial value range (4,980 acres) could be lost because of tar sand development. Thirty-seven thousand six hundred acres of small game species habitat could also be lost. Nine sage grouse strutting grounds, 13,141 acres of nesting habitat and 5,264 acres of yearlong habitat could be destroyed by surface-disturbing activities.

Four golden eagle nest sites and 3,180 acres of nesting habitat could be destroyed. Raptor foraging habitat could be disrupted on 49,500 acres. Raptors dependent on this habitat would probably be displaced or lost.

Fish habitat would be impacted by altering stream channels and degrading water, which would reduce the quality of fish or eliminate the fisheries habitat. Water depletions could adversely affect the habitat for two endangered species, Colorado squawfish and humpback chub.

Recreation uses and values would be eliminated in the STSAs where tar sand development occurred. In addition, population increases associated with development would increase use of other recreation sites, resulting in overutilization of some local resources. Tar sand development in STSAs contiguous to proposed Wilderness Study Areas (WSAs) could degrade wilderness values by visual intrusions, odor, and noise associated with development and operation. Visual resource management (VRM) objectives in areas subject to in-situ processes or surface-mining development would not be met.

Tar sand development could damage or destroy cultural resources. Secondary impacts could also be expected through vandalism and increased human activity.

Livestock grazing use would have to be discontinued for up to 20 years on many of the allotments affected by tar sand development. A total of 3,192 Animal Unit Months (AUMs) could be lost by a loss of forage from surface-disturbing activities.

Site-specific EISs or Environmental Assessments (EAs) would be prepared prior to the development of specific lease tracts. Through this process, critical soil erosion areas, vegetation, and wildlife habitats could be avoided or impacts to them mitigated. Hydrocarbon recovery operations would be conducted in phases. Rehabilitation of disturbed areas could begin as soon as development operations were completed in the affected areas, thus minimizing the effects of development on the environment.

Human population would increase by 45,681 in 2005 over the baseline (i.e., the projected population [including growth] without tar sand development). (Summary Figure 2

shows projected populations for each alternative.) The year 1995 would show the greatest population increase for most counties. Total regional tar sand employment is also projected to grow rapidly over the 1985-2005 years by 73 percent annually. (Summary Figure 3 shows work force requirements for each STSA for Alternative 1.) Hospitals, doctors, dentists, nurses, public health nurses, clinical psychologists, and mental health workers would be needed in addition to baseline projections. Public safety and utility services would also need to increase. Ninety-two police officers and their equipment, emergency medical technicians, jails, and juvenile holding cells would need to increase. There would be considerable need for new and improved water systems and sewage disposal systems. Public parks and library space would have to increase at an annual rate of 74 percent between 1985 and 1995. The greatest growth would occur in Carbon County. Sixty percent of the regional growth would occur in that county by 2005. Total monthly personal income would grow from \$0.3 million in 1985 to \$75.8 million in 1995. Wages would account for 80 percent of the change.

The extent of quality of life impacts cannot be quantified; however, small-town way of life values would be interrupted in most communities, and there would be a decrease in cultural homogeneity. Attitudes and lifestyles would change and environmental problems (i.e., degraded air and water) would result. Trespassing, overcrowding, and other social problems could occur as development increased in the STSAs.

On all affected regional highways, significant increases in high tonnage truck traffic would result in an unquantifiable amount of damage to road surfaces.

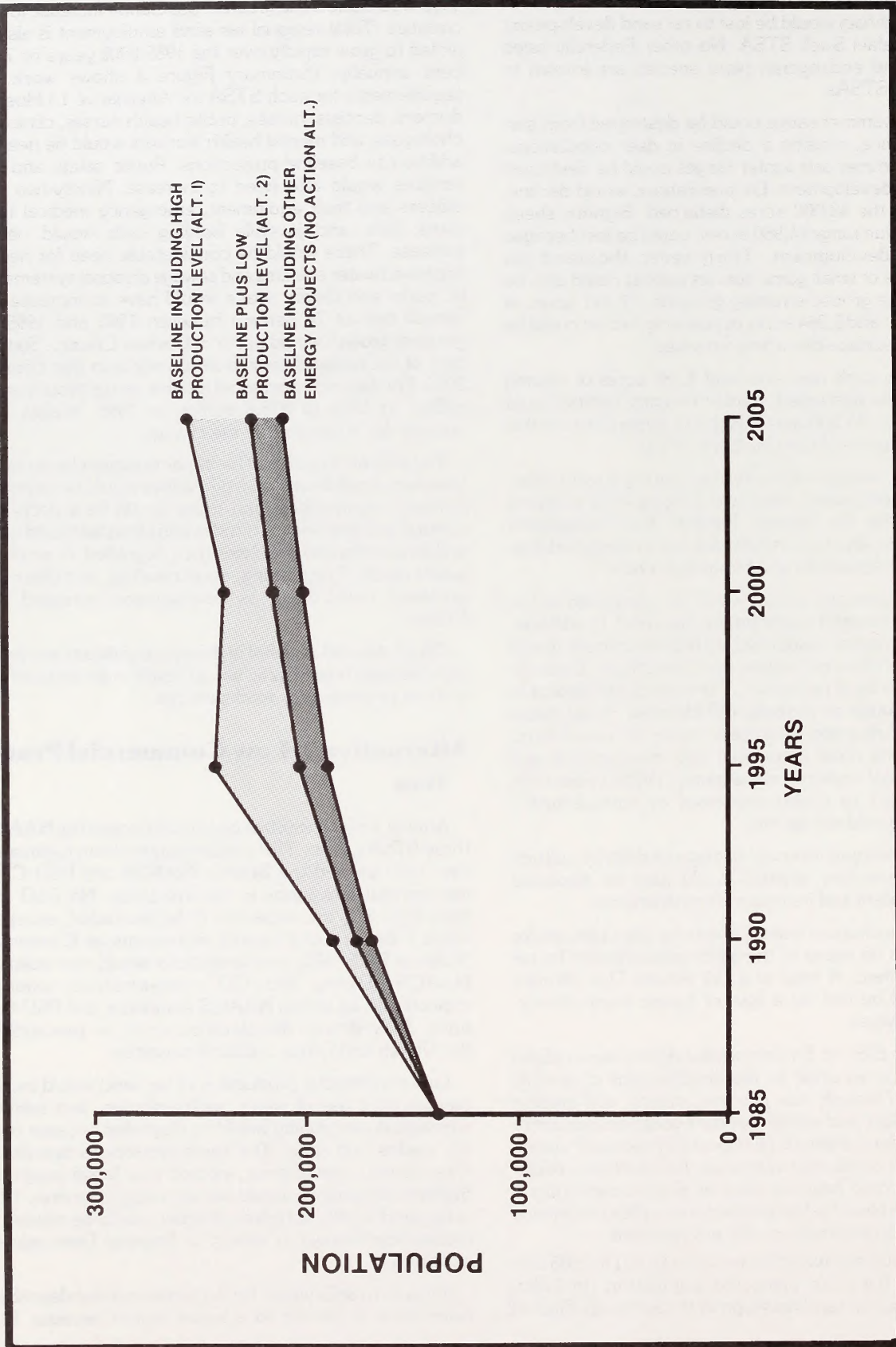
Alternative 2: Low Commercial Production

Annual TSP concentrations could exceed the NAAQS in three STSAs. Also, TSP concentrations from fugitive sources could exceed the 24-hour NAAQS and PSD Class II incremental limitations in several areas. No PSD increments for SO₂ are expected to be exceeded, except the Class I 24-hour and annual increments at Canyonlands National Park. NO₂ concentrations would not violate the NAAQS. Ozone and CO concentrations would be expected to be within NAAQS standards and PSD limitations. Atmospheric discoloration could be perceptible at the Uintah and Ouray Indian Reservation.

Low commercial production of tar sand would increase consumptive use of water, sedimentation, and salinity of streams. Water quality would be degraded because of mining wastes and spills. The same impacts as described in Alternative 1 would exist, except to a lesser magnitude. Surface disturbance would occur on approximately 13,950 acres, and 17,000 acre-feet of water would be needed. No measurable change in salinity at Imperial Dam would be expected.

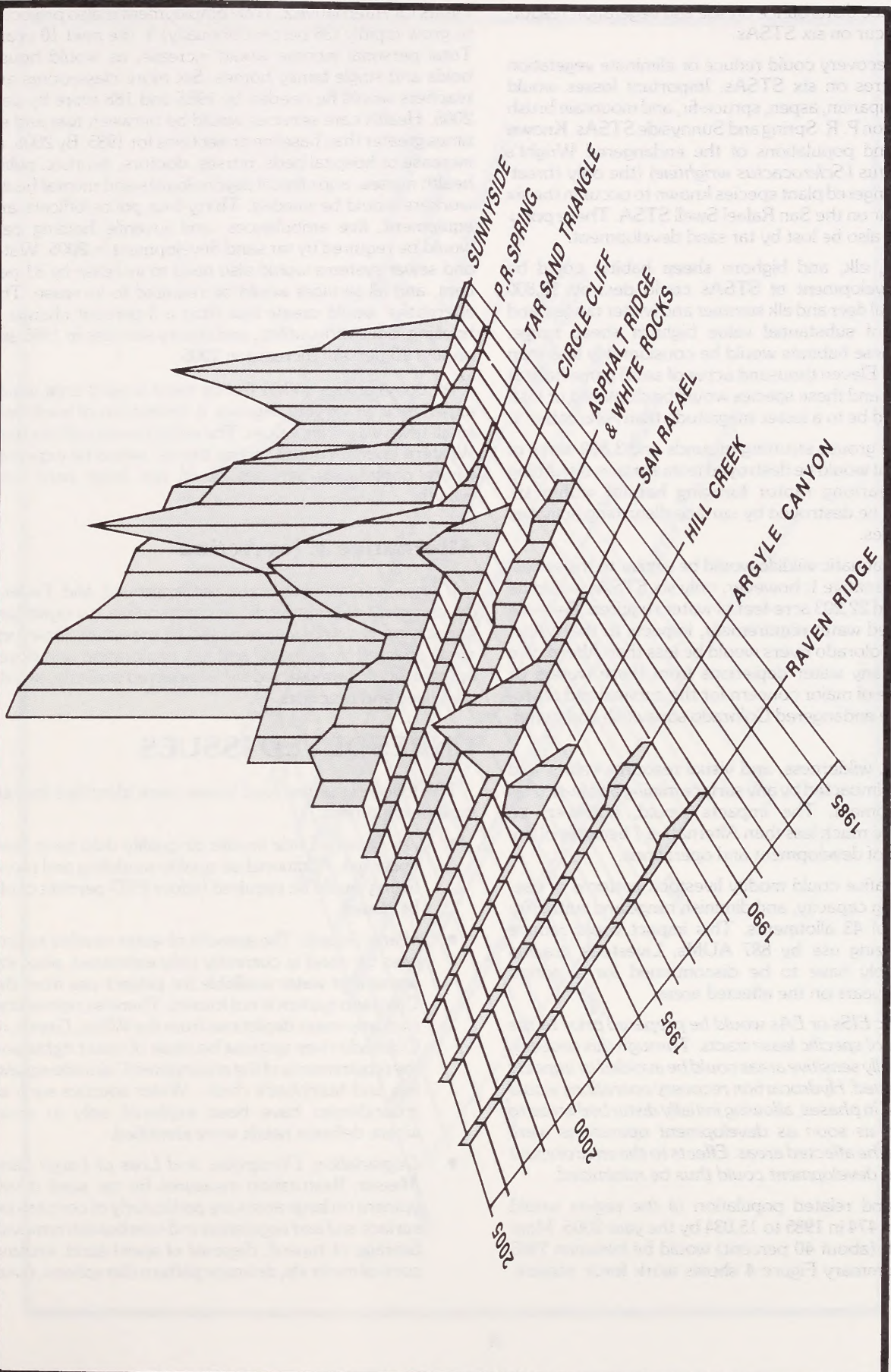
Impacts to soils would be the same as those described in Alternative 1, except to a lesser extent because 13,950

SUMMARY
SUMMARY



SUMMARY FIGURE 2
REGIONAL POPULATION PROJECTIONS BY ALTERNATIVE

SUMMARY



SUMMARY FIGURE 3
**WORK FORCE REQUIREMENT PROFILES FOR ALTERNATIVE 1:
 HIGH COMMERCIAL PRODUCTION**

SUMMARY

acres of surface disturbance on soil and vegetation resources would occur on six STSAs.

Tar sand recovery could reduce or eliminate vegetation on 11,300 acres on six STSAs. Important losses would occur to the riparian, aspen, spruce-fir, and mountain brush communities on P. R. Spring and Sunnyside STSAs. Known individuals and populations of the endangered Wright's fishhook cactus (*Sclerocactus wrightiae*) (the only threatened or endangered plant species known to occur in the six STSAs) occur on the San Rafael Swell STSA. These populations could also be lost by tar sand development.

Mule deer, elk, and bighorn sheep habitat could be reduced. Development of STSAs could destroy 12,800 acres of crucial deer and elk summer and winter ranges, and 1,150 acres of substantial value bighorn sheep range. Impacts to these habitats would be considerably less than Alternative 1. Eleven thousand acres of small game habitat could be lost, and these species would be displaced or lost. Impacts would be to a lesser magnitude than Alternative 1.

Three sage grouse strutting grounds and 3,800 acres of nesting habitat would be destroyed from surface-disturbing activities. Yearlong raptor foraging habitat within six STSAs could be destroyed by surface-disturbing activities on 13,450 acres.

Impacts to aquatic wildlife would be similar to those described in Alternative 1; however, only six STSAs would be developed and 22,203 acre-feet of water required. Because of this reduced water requirement, impacts to the White, Green, and Colorado rivers would be less than Alternative 1. However, any water depletions from these waters or tributaries are of major concern for the survival and reproduction of the endangered Colorado squawfish and humpback chub.

Recreation, wilderness, and visual resource values and uses could be impacted by any surface mining and in-situ tar sand development. The impacts would, however, be expected to be much less than Alternative 1 because of the smaller scale of development and operations.

This alternative could modify livestock patterns of use, reduce grazing capacity, and diminish rangeland suitability on portions of 43 allotments. This impact could reduce livestock grazing use by 887 AUMs. Livestock grazing would probably have to be discontinued for a period exceeding 20 years on the affected areas.

Site-specific EISs or EAs would be prepared prior to the development of specific lease tracts. Through this process, environmentally sensitive areas could be avoided or impacts to them mitigated. Hydrocarbon recovery operations would be conducted in phases, allowing initially disturbed areas to be reclaimed as soon as development operations were completed in the affected areas. Effects to the environment from tar sand development could thus be minimized.

The tar sand related population of the region would increase from 474 in 1985 to 15,034 by the year 2005. Most of the growth (about 40 percent) would be between 1985 and 1995. Summary Figure 4 shows work force require-

ments for Alternative 2. Total employment is also projected to grow rapidly (38 percent annually) in the next 10 years. Total personal income would increase, as would households and single family homes. Six more classrooms and teachers would be needed by 1985 and 188 more by year 2005. Health care services would be between two and six times greater than baseline projections for 1985. By 2005, an increase of hospital beds, nurses, doctors, dentists, public health nurses, and clinical psychologists and mental health workers would be needed. Thirty-four police officers and equipment, five ambulances, and juvenile holding cells would be required by tar sand development in 2005. Water and sewer systems would also need to increase by 31 percent, and all services would be required to increase. This alternative would create less than a 3-percent change in housing, education, utility, and library services in 1985 and up to a 20-percent increase in 2005.

All communities within the tar sand project area would experience, in varying degrees, a diminution of traditional small-town way of life values. The social consequences from Western energy-related "boom towns" would be expected where community services could not keep pace with growth.

Alternative 3: No Action

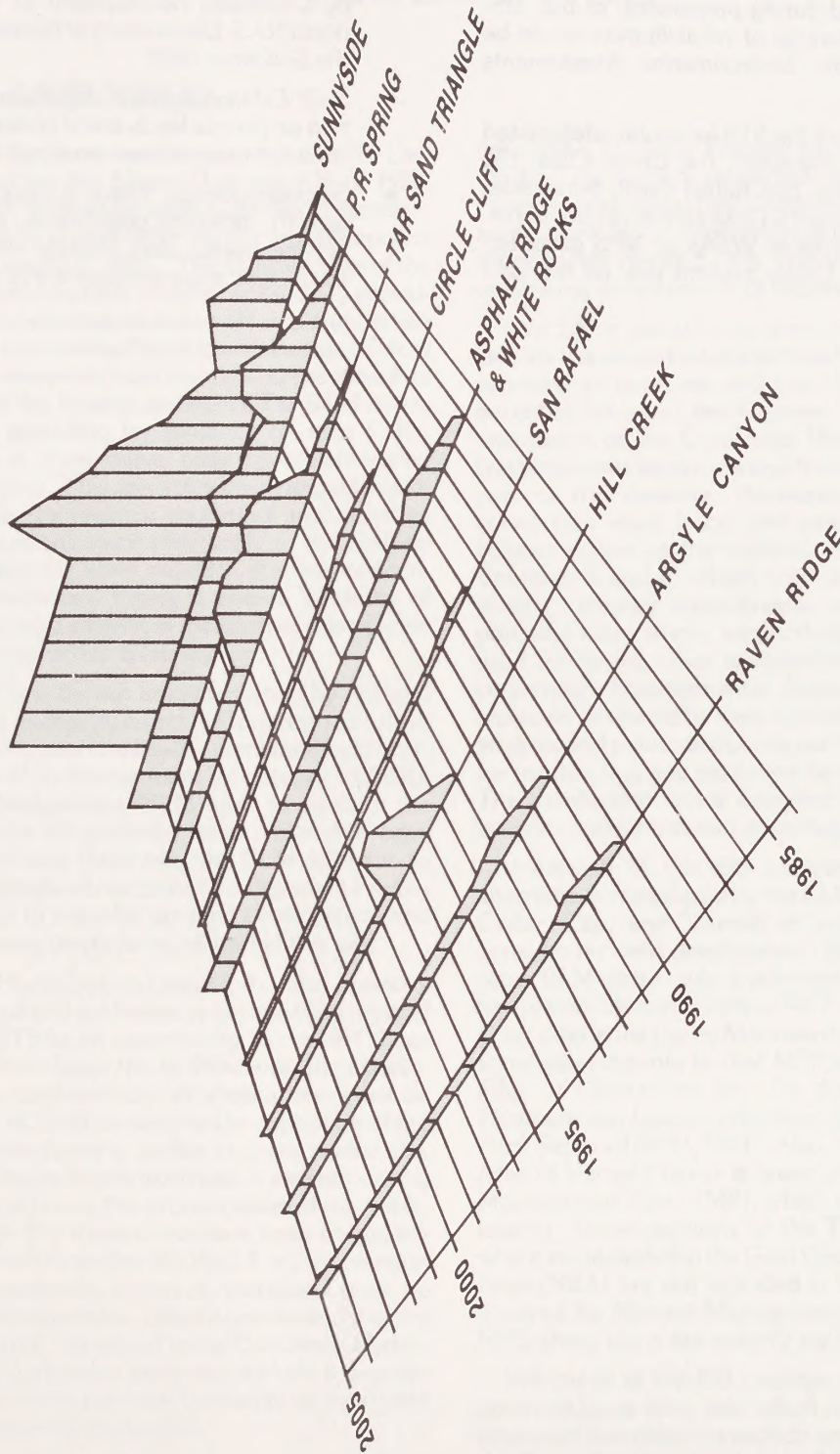
If lease conversions were not approved and Federal development of tar sand did not materialize, no significant impacts on resource values would be expected. However, areas affected by some oil and gas exploration and development would be expected to be impacted similarly, as with past uses and practices.

UNRESOLVED ISSUES

The following unresolved issues were identified for tar-sand development:

- *Air Quality:* Little on-site air quality data have been collected. Additional air quality modeling and monitoring would be required before PSD permits could be issued.
- *Water Supply:* The amount of water needed to process tar sand is currently only estimated; also, the amount of water available for project use from the Colorado system is not known. There is controversy over any water depletions from the White, Green, or Colorado river systems because of water rights and the requirements of the endangered Colorado squawfish and humpback chub. Water sources such as groundwater have been explored only in areas where definite needs were identified.
- *Degradation, Disruption, and Loss of Large Land Masses:* Restoration measures for tar sand development on large areas are particularly of concern for surface *soil and vegetation* and overburden removal. Storage of topsoil, disposal of spent sand, erosion control methods, drainage pattern disruptions, over-

SUMMARY



SUMMARY FIGURE 4
**WORK FORCE REQUIREMENT PROFILES FOR ALTERNATIVE 2:
LOW COMMERCIAL PRODUCTION**

SUMMARY

burden redistribution, *vegetation*, and complete disruption of natural ecosystems are of a large magnitude. The extent of rehabilitation cannot be predicted because planning and mitigation could not be completely defined during preparation of this EIS. More complete analysis of rehabilitation would be outlined in specific Environmental Assessments (EAs) or EISs.

- *Wilderness*: None of the STSAs contain designated wilderness areas. However, the Circle Cliffs, Hill Creek, P. R. Spring, San Rafael Swell, Sunnyside, and Tar Sand Triangle STSAs contain or are immediately adjacent to BLM WSAs or NPS proposed wilderness areas. Under present law, no tar sand

development could occur inside WSAs and proposed wilderness areas because development measures could not meet nonimpairment standards. However, if the WSAs are not designated wilderness by Congress, development of these areas could occur (U.S. Department of Interior [USDI], Office of the Solicitor, 1983).

- *Split Estates*: Surface disturbance and compensation on private lands are of concern. Surface values versus tar sand values have not been resolved.
- *Socioeconomics*: There is concern over potential growth, including populations, income, and public service needs; also, lifestyle changes and "boom-town" type environments are of concern.

CHAPTER 1

INTRODUCTION

PURPOSE AND NEED

The Combined Hydrocarbon Leasing Act (Public Law 97-78), which amended the Mineral Leasing Act of 1920, was enacted in 1981 'to facilitate and encourage the production of oil from tar sand and other hydrocarbon deposits (Ninety-Seventh Congress, 1981). The main features of the Act include: (1) redefining oil to include tar sand; (2) providing for conversion of existing oil and gas leases and certain valid mining claims to combined hydrocarbon leases (CHLs) (hereafter called conversion lease tracts) in areas identified by the Secretary of the Interior as Special Tar Sand Areas (STSAs); and (3) providing for issuance on new CHLs within STSAs on a competitive basis (hereafter called potential lease tracts). This environmental impact statement (EIS) analyzes the regional impacts of implementing these last two provisions since they apply to the Federal government's richest tar sand deposits and are concentrated in Utah. (Summary Figure 1 shows locations of STSAs; the pocket map located in the back of this volume shows land ownership within STSAs.)

Within these STSAs (which are established by law and cannot be modified except by an act of Congress) all future leasing of oil, gas, or tar sand will be by combined hydrocarbon leasing. The U.S. Department of Interior (USDI), Bureau of Land Management (BLM) plan to conduct the first competitive sale on potential lease tracts *has been postponed*. Prior to that lease sale, the BLM will have to amend certain existing land use plans (Management Framework Plans [MFPs]) to consider tar sand development and identify potential lease tracts to be offered in this sale.

The Combined Hydrocarbon Leasing Act also provides holders of existing oil and gas leases or certain valid mineral claims within the STSAs an opportunity to convert these holdings to conversion lease tracts. However, the conversion provision is limited because all applications must be filed by November 15, 1983, or prior to the expiration of the oil and gas lease, whichever is earlier. A grace period was allowed for those leases which would have expired during the enactment of the law or the promulgation of the implementing regulations. For these conversion lease tracts, the deadline for filing was December 23, 1982. For a conversion application to be approved, a plan of operations must be presented which demonstrates "diligent development of the hydrocarbon resource" (as stated in the Combined Hydrocarbon Leasing Act); the plan must also include a description of enhanced recovery methods (primarily tar sand) and reasonable environmental protection.

The Act requires a Federal decision on these applications within 15 months of receipt of each complete proposal. Site-specific EISs are being produced concurrent with this EIS. These EISs cover conversion applications received to

date in the Tar Sand Triangle STSA. *Asphalt Ridge/White Rocks STSA*, and *Sunnyside STSA*. *The Ashley National Forest is performing the site-specific environmental assessment work on a conversion application in the Asphalt Ridge/White Rocks STSA*. This EIS evaluates the impacts of allowing development of Federal tar sands within Utah.

This EIS is divided into three volumes to more clearly identify the major Federal actions being analyzed. Volume I provides an overview and cumulative impact analysis of potential tar sand development in Utah resulting from enactment of the Combined Hydrocarbon Leasing Act. Developments on private and State lands are considered as part of the baseline. Development would result from conversion lease tracts and potential lease tracts. This volume serves as the regional analyses on which to tier Volumes II and III which consider land use plan (MFP) leasing category amendments and proposed leasing of potential lease tracts, respectively. Volume I will also be used for tiering other environmental documents such as conversion Environmental Assessments (EAs) or EISs. However, it should be kept in mind that Volume I is only for analysis and public disclosure purposes and will not be used for establishing any particular target or production levels. The production levels analyzed in this volume include possible conversion and potential lease tracts.

Volume II of this EIS analyzes the leasing category alternatives considered by the BLM District Offices (Moab, Cedar City, and Vernal) in amending their MFPs to consider tar sand development. Richfield District, the only other BLM district which administers lands within a STSA, had previously completed an MFP which considered leasing of tar sand in the Henry Mountain Resource Area. However, some amendments to that MFP are proposed in the *Unit Plan of Operations for Tar Sand Triangle Combined Hydrocarbon Lease Conversion Draft EIS* (USDI, *National Park Service* [NPS], 1984). Also, the Book Cliffs Resource Area of Vernal District is presently developing a Resource Management Plan (RMP), which will also analyze tar sand leasing. Those portions of the Tar Sand Triangle STSA which are included in the Glen Canyon National Recreation Area (NRA) are not included in Volume II since they are covered by Mineral Management Plans prepared by the NPS; these plans are roughly equivalent to a BLM MFP.

Volume III of this EIS analyzes impacts of the proposed potential lease tract sale *which has been postponed*. The proposed sale does not include any potential lease tracts in the Book Cliffs Resource Area (Vernal District). However, additional potential lease tracts could be identified in the Book Cliffs RMP. If tracts are identified in this RMP, a separate lease sale on those tracts would be scheduled.

THE SETTING

The STSAs are located in east-central Utah, and include Carbon, Uintah, Duchesne, Grand, San Juan, Garfield, Wayne, and Emery counties. Summary Figure 1 shows the location and comparative size of the STSAs. All of the STSAs except Asphalt Ridge/White Rocks are located in sparsely populated or unpopulated areas. The Asphalt Ridge portion of this STSA is located within 1 mile of Vernal. The Sunnyside STSA is located 5 miles from the towns of Sunnyside and East Carbon.

Most of the STSAs are located on land administered by BLM with intermittent State and private land. However, Asphalt Ridge/White Rocks, Hill Creek, and Pariette STSAs each include lands on the Uintah and Ouray Indian Reservation; Asphalt Ridge/White Rocks and Argyle Canyon/Willow Creek STSAs contain National Forest land; and Circle Cliffs and Tar Sand Triangle STSAs each include land administered by NPS. Table 1-1 indicates the acreages of land ownership of each STSA. The pocket map, located at the back of this volume, visually depicts land ownership within STSAs.

Seven of the STSAs (Asphalt Ridge/White Rocks, Argyle Canyon/Willow Creek, Hill Creek, P. R. Spring, Pariette, Raven Ridge/Rim Rock, and the northern portion of Sunnyside) are in the Vernal BLM District. San Rafael Swell, White Canyon and the southern portion of Sunnyside are in the Moab BLM District. Tar Sand Triangle is in the Richfield BLM District, and Circle Cliffs is in the Cedar City BLM District.

PLANNING AND LEASING PROCESSES

The following discussion of the planning and leasing processes are divided into pre- and post-EIS phases.

Pre-EIS Planning and Leasing Processes

Following the passage of the Combined Hydrocarbon Leasing Act, the Washington Office of the BLM began preparation of the two sets of implementing regulations for combined hydrocarbon development (Combined Hydrocarbon Leasing; Conversion of Existing Oil and Gas Leases and Valid Mining Claims Based Upon Mineral Locations [43 CFR 3140] and Combined Hydrocarbon Leasing; and Procedures for Leasing of Combined Hydrocarbon Resources [43, CFR 3141]). EAs were completed for both sets of regulations. These EAs dealt only with the development of regulations, not with the implementation of the program. This orientation was necessary because the program was geographically limited and, therefore, impacts were better analyzed at the regional level. To comply with Executive Order 12291, a Regulatory Impact Analysis and Flexibility Analysis were completed, covering the economic impacts of implementing the conversion leasing regulations and determining the impacts on small businesses. Because the competitive leasing regulations were determined not to

result in a major economic impact nor any impacts on small businesses, no Regulatory Impact Analysis or Flexibility Analysis was performed.

The proposed regulations for converting and leasing conversion lease tracts were printed in the *Federal Register*. Public meetings were held in Salt Lake City on March 18 and July 15, 1982 to explain the CHL program, receive comments, and call for Expressions of Interest. The regulations became final in May 1982. Final regulations are:

- CFR Part 3140--Combined Hydrocarbon Leasing; Conversion of Existing Oil and Gas Leases and Valid Mining Claims Based on Mineral Locations; Final Rulemaking (*Federal Register*, Vol. 47, No. 100, May 24, 1982).
- CFR Part 3141--Combined Hydrocarbon Leasing; Procedures for the Leasing of Combined Hydrocarbon Resources (*Federal Register*, Vol. 48, No. 35, February 18, 1983).

A formal Notice of Intent to prepare land use plan (MFP) leasing category amendments and a regional EIS and a notice of additional public scoping meetings were published in the *Federal Register* on February 10, 1983. That notice invited public participation in meetings held in Vernal, Price, and Salt Lake City.

This EIS analyzes the CHL program within the STSAs required by the Combined Hydrocarbon Leasing Act. This EIS analyzes all 11 STSAs. All of the STSAs are located in Utah. Current and related environmental analyses documents which specifically address tar sand include:

Utah Combined Hydrocarbon Leasing Regional Draft EIS

Volume 1: Regional Analysis

Volume 2: Leasing Category Amendments

Volume 3: Potential Lease Tracts Analysis

Unit Plan of Operations for Tar Sand Triangle Combined Hydrocarbon Lease Conversion Draft EIS

Sunnyside Combined Hydrocarbon Lease Conversion Draft EIS

In December 1982, NPS issued a Notice of Intent to Prepare an EIS covering the site-specific impacts of the applications for conversion lease tracts in Glen Canyon NRA lands adjoining BLM lands. That EIS is being prepared on a joint-lead basis by NPS and BLM. On February 15, 1983, BLM issued a Notice of Intent to prepare an EIS covering the site-specific impacts of the applications for conversion lease tracts on the Sunnyside STSA.

Other documents which may be added to this series depending on lease conversion applications (which were received by BLM prior to November 15, 1983) would be site-specific EAs or EISs for lease tracts in the following STSAs: Asphalt Ridge/White Rocks, Circle Cliffs, P. R. Spring, Raven Ridge/Rim Rock, San Rafael Swell, and Tar Sand Triangle. These STSAs are among those covered by production alternatives analyzed in this volume of the EIS.

CHAP. 1: INTRODUCTION

TABLE 1-1
Approximate Acreage and Land Ownership in STSAs

STSA	BLM	Forest Service	National Park Service	Private	Utah and Ouray Reservation	State	Total Acres
Argyle Canyon/Willow Creek	9,837	3,040	--	5,786	--	3,200	21,863
Asphalt Ridge/White Rocks	13,169	1,600	--	13,826	4,320	8,480	41,395
Circle Cliffs	50,760	--	29,120	--	--	11,200	91,080
Hill Creek	57,932	--	--	8,160	38,597	2,560	107,249
Pariette	12,312	--	--	6,239	2,560	960	22,071
P. R. Spring	183,346	--	--	48,844	--	41,760	273,950
Raven Ridge/Rim Rock	12,950	--	--	1,388	--	1,920	16,258
San Rafael Swell	115,233	--	--	2,720	--	12,738	130,691
Sunnyside Southern	55,562 ^a	--	--	91,624	--	3,200	169,734
Northern	19,348 ^b 33,043	--	--	19,446	--	4,320	56,809
Tar Sand Triangle	83,400	--	58,419	--	--	15,520	157,339
White Canyon	8,085	--	--	291	--	2,160	10,536
Total	654,977	8,640	87,539	198,324	45,477	108,018	1,098,975

Source: USDI, BLM, 1983f.

^aBLM administers the entire mineral estate on these lands.

^bBLM does not control the tar sand resource on these lands.

Post-EIS Planning and Leasing Processes

Following circulation of *this* Final EIS and the appropriate 30 day public review period, decisions on competitive leasing of potential tracts and BLM's leasing category amendments will be made in land use plans (NFPs), as explained in Volumes II and III of this EIS. Other decisions on conversion lease tracts will be issued separately.

No decisions will be made specifically as a result of Volume I of this EIS; decisions will be made on a case-by-case basis on conversion applications and plans of operations and will additionally consider site-specific EAs or EISs. The initial potential lease tract sale *has been postponed*. That sale will be prefaced by a 2-month consultation period with the Governor of Utah (and his designated agency representative[s]).

Prior to the initiation of development on any new leases, a plan of operations (as outlined in 30 CFR 231) will be required. This plan would outline in detail any exploration or production activities on the tract. An appropriate environmental review will be completed at that time. *Following completion of that site-specific EA or EIS, which would ensure that the plan of operations did not violate the current land use plan, a lease containing the prescribed stipulations would be granted (see Mitigating Measures section, page 24).* As modifications to those initial plans of operations are received, the appropriate NEPA documents will be updated.

SCOPING PROCESS

Scoping uses public participation and consultation with other agencies to identify significant issues requiring analysis in an EIS. Consultation has been maintained throughout the planning and EIS process with the State of Utah, NPS, Bureau of Indian Affairs (BIA), Department of Energy, Ute Indian Tribe, county planning offices, and other affected and/or interested agencies and individuals.

Scoping for this EIS was initiated at public meetings explaining the CHL program held in Salt Lake City, Utah, on March 18, 1982. This meeting was followed by a meeting held in July 15, 1982 to call for Expressions of Interest in the new leasing and Notices of Intent to amend leasing categories in land use plans (MFPs).

A formal Notice of Intent to prepare leasing category amendments in land use plans (MFPs), an EIS, and a notice of additional public scoping meetings were published in the *Federal Register* on February 10, 1983. That notice invited public participation at meetings held in Vernal (March 8, 1983), Price (March 9, 1983), and Salt Lake City (March 15, 1983). Before these meetings were held, scenarios for different levels of tar sand development were developed by BLM, in cooperation with affected and/or interested oil and gas companies. Based on these scenarios and other information on combined hydrocarbon leasing, agencies and individuals identified the following issues as significant: air quality, water quality and use, wildlife, visual resources, socioeconomic impacts, and transportation development.

INTERRELATIONSHIPS WITH OTHER PROPOSED TAR SAND PROJECTS AND ENERGY SOURCES

Two tar sand proposals in Utah outside Federal jurisdiction are discussed in this EIS as interrelated developments. The Chevron and Great National Corporation proposals on private lands in the Sunnyside area involve no Federal decisions for tar sand development. The Standard of Ohio proposal on Asphalt Ridge is on lands included in mining claims currently filed under the 1872 Mining Law. In the near future it is unlikely that tar sand development in the Standard of Ohio proposal will be undertaken on lands under the leasing provisions of the Combined Hydrocarbon Leasing Act. Both the Chevron and the Standard of Ohio projects are included in the baseline for impact analyses purposes in this EIS.

Other possible energy development in Utah could interact with tar sand development. Coal development in the Carbon County area, oil and gas development in Uintah and Duchesne counties, and oil shale development in Uintah County could compete with tar sand development. Water use, work force requirements, lack of housing and service facilities, and air quality degradation could be limiting factors for tar sand development. Also, the cost of developing tar sand could be a factor when considering comparatively lower costs of developing other energy sources.

ENERGY EFFICIENCY

Energy efficiency is defined as the net energy output divided by the net energy input times 100. Net energy outputs are basically the British thermal units (Btus) contained in the products and by-products. Net energy inputs are more complex, but they can be separated into components, each of which can be dealt with separately and combined in various ways as needed. These components are:

1. Mining the tar sand.
2. Transporting the tar sand and other needed material, such as water, to the processing plant.
3. Processing and extracting the tar sand and upgrading the resultant product.
4. Transporting the products, by-products, and waste products.

Indirect energy would be needed to operate the plant and necessary equipment. Infrastructure energy (which includes energy used by the employees of the project, their families, and secondary industries [including social services]) would also be required.

Data on net energy requirements for tar sand projects are not specifically available in literature. Consequently, the net energy analyses summarized here are only approximations

CHAP. 1: INTRODUCTION

of the efficiency that could be expected from the applicants' projects. Depending on the length of ancillary facilities (i.e., roads, water, and project pipelines), the efficiency of a particular project could vary.

The overall energy efficiency for bitumen production from tar sand by surface-mining methods is estimated at 50 to 65 percent. In-situ process energy efficiencies are not available; however, it can be assumed that the percentage of recovery of in-place oil would be fair to good and that the above-ground processing efficiencies would be about the same for the other processes. With this in mind, the overall in-situ energy efficiency would be an estimated 25 to 30 percent.

The following chart is a comparison of energy efficiency for production from tar sand and other energy sources.

Type	Percent Efficiency
Oil From Tar Sand in-Situ	20 to 30
Shale Oil from an Underground Mine	30 to 40
Crude Oil to Petroleum Products	30 to 40
Electrical Power from Coal Strip Mines	33 to 43
Underground Mines	31 to 41
Uranium to Electricity	17 to 27
Electrical Power from Natural Gas	35 to 45
Oil from Tar Sand Strip Mines	45 to 55

USDA, BLM, 1982c.

CHAPTER 2

DESCRIPTION OF ALTERNATIVES AND TAR SAND RESOURCES

INTRODUCTION

Two production levels (High Commercial Production and Low Commercial Production) and No Action are the three alternatives analyzed in this volume of the environmental impact statement (EIS). Each alternative analyzes specific levels of production for proposed and potential Combined Hydrocarbon Leases (CHLs). *Alternative 3, No Action, establishes the baseline on which the other two alternatives are analyzed (Chapter 3 describes the existing environment). Thus, Alternatives 1 and 2 are cumulative assessments of two different production levels.*

In-place reserves and mining methods for CHLs were identified by Bureau of Land Management (BLM) geologists and from applicants for conversion lease tracts. Appendix 1 presents the assumptions and data used in developing the two production alternatives. While most professionals from involved agencies and some industry officials believe these scenarios are too high, none have suggested that these figures are not within the realm of future possibility. A higher scenario allowing maximum development of STSAs was considered but dropped from analysis because the production was considered too extreme. A pilot level scenario was also considered but dropped because the Low Commercial Production Alternative would encompass the same impacts, although the time frame involved could be different.

Conservation and other energy alternatives are addressed in this chapter. However, because such alternatives are rather generic in nature and are not directly geographically comparable to Utah tar sand deposits nor to the enabling legislation for tar sand development, the discussion of these alternatives is not carried into Chapters 3 and 4.

DESCRIPTION OF TAR SAND RESOURCES

Tar sand is sedimentary rock containing bitumens (residues of lighter crude oils). *The tar sand deposit may be divided into two major types, including breached petroleum reservoirs and large oil seeps. The breached reservoirs may have been formed as heavy crude oils, precursors of bitumen, accumulated in conventional petroleum reservoirs. These reservoirs were near the land surface, allowing streams to cut through their cap rocks. This resulted in gas and other fluid components of the bitumen to escape from the reservoirs. An example of this type of deposit would be the Tar Sand Triangle.*

The large oil seeps differ from the breached petroleum reservoirs in that the crude oil migrated from the point of origin through fractures and faults and has accumulated in favorable environments near the surface. Thus, a conventional petroleum reservoir may never have been created. This type of deposit has been referred to as an oil seep (Ritzma, 1984). Examples of this type of deposit would include those located in the vicinity of the Uinta Basin. In both types of deposits, the less fluid components of the bitumen remained in the deposit and have been altered by contact with air, bacteria, and groundwater.

Tar sand deposits are not homogeneous (i.e., of uniform structure or distribution). Bitumen distribution in a deposit varies, depending on the permeability and porosity of the sedimentary rock. Therefore, deposit properties are estimated from descriptions and samples from widely spaced locations on outcrops and widely spaced drill holes. The estimates of the quantities of bitumen and the thicknesses of bitumen are uncertain by as much as factors of 10 (U.S. Department of Interior [USDI], Minerals Management Service [MMS], 1982).

Tar Sand Deposits Within Utah

More than 50 tar sand deposits occur in Utah. Data on the size of these deposits are sparse and, therefore, are based on estimates. Deposits range in size from major (containing more than 500 million barrels of in-place bitumen) to minor (containing less than 0.5 million barrels of in-place bitumen) (Ritzma, 1979). However, it is known that nearly all of the bitumen occurs in a few major deposits. The largest deposits occur within 11 Special Tar Sand Areas (STSAs). (Table 2-1 lists acreage figures and leasing data for each of these 11 STSAs.) Of all deposits, Tar Sand Triangle STSA contains about half of the total tar sand resource in Utah; six large deposits (including the Tar Sand Triangle) contain more than 96 percent of the total tar sand resource (Campbell and Ritzma, 1979). The largest deposits are, in order of size, Tar Sand Triangle, P. R. Spring, Sunnyside, Hill Creek, Circle Cliffs, and Asphalt Ridge/White Rocks.

GEOLOGIC DISTRIBUTION OF TAR SAND DEPOSITS

Uinta Basin

The deposits within seven STSAs (i.e., Argyle Canyon/Willow Creek, Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, Pariette, Raven Ridge/Rim Rock, and Sunnyside)

CHAP. 2: ALTERNATIVES AND TAR SAND RESOURCES

TABLE 2-1
Acreage, Location, and Leasing Data for STSAs Within Utah

STSA	Total Acreage	Federal Acreage	Federal Acreage		Percent Leased	Percent Unleased	Expressions of Interest Received (Acres) ^b	Operation Plans With Intention to Convert	BLM District	BLM Resource Area
			Leased for O&G ^a	Unleased for O&G						
Argyle Canyon/ Willow Creek	21,863	12,877	9,237	3,340	72	28	0		Vernal/Salt Lake	Diamond Mountain, Pony Express
Asphalt Ridge/ White Rocks	41,395	13,169	9,472	1,457	72 ^c	11 ^c	yes ^d		Vernal	Diamond Mountain
Circle Cliffs	91,080	81,480	47,767	2,502	95	5	0	yes	Cedar City/ Richfield	Escalante, Henry Mountain
BLM NPS		50,760 30,720		2,400 102						
Hill Creek	107,249	57,932	46,812	11,120	81	19	e	yes ^f	Vernal	Book Cliffs
P. R. Spring	273,950	183,346	126,746	43,120	69	24	e	yes ^f	Vernal/Moab	Book Cliffs, Grand
Pariette	22,071	12,213	7,379	4,834	60	40	3,042.24		Vernal	Diamond Mountain
Raven Ridge/Rim Rock	16,258	12,950	9,690	3,260	75	25	e	yes	Vernal	Book Cliffs
San Rafael Swell	130,292	111,266	67,946	43,320	61	39	880.00	yes	Moab	San Rafael, Price River
Sunnyside	157,445	107,952	80,272	23,200	75 ^c	21 ^c	14,812.97	yes	Moab/Vernal	Price River, Diamond Mountain
Tar Sand Triangle	157,339	140,856	118,064	22,792	84	16	3,169.00	yes	Richfield	Henry Mountain
BLM		83,400	77,460	9,480		6.7				
NPS		57,456	41,506	13,312 ^g		9.4				
White Canyon	10,469	7,931	400	7,531	5	95	0		Moab	San Juan
Total	1,029,411									

Source: USDI, BLM, 1982a, 1982b, 1983f.

^aO&G = oil and gas.

^bAn expression of interest is a submittal by a company informing BLM that they are interested in leasing a tract of land for oil and gas or mineral development.

^cPart of the Federal surface has privately owned oil and gas or tar sand.

^dThis plan involves U.S. Forest Service land in the Ashley National Forest.

^eNew invitations for Expressions of Interest will be issued by the Vernal District for these areas.

^fPlan anticipated but not received as of September 15, 1983.

^gDoes not include NPS land in a "No Lease Area".

CHAP 2--ALTERNATIVES AND TAR SAND RESOURCES

occur in the Uinta Basin. All but one of these deposits occur in sedimentary rocks of Tertiary age. *The White Rocks deposit is contained in the Navajo Sandstone of Jurassic age. The Asphalt Ridge deposits occur in the Mesa Verde Formation of Cretaceous age and the Duchesne River and Uinta formations of Eocene and Oligocene ages.* Most bitumen impregnations occur in sandstones, but minor bitumen impregnations occur in limestones in the northwestern part of the Basin (Ritzma, 1979). Most of the sediments were deposited as part of stream complexes, although some were deposited in large lakes. Stream-deposited sediments include sands deposited in stream channels, and silts and finer sands deposited on the valley floors adjacent to the stream (see Figure 2-1). The channel deposits are lenticular (see Glossary): these lenses of coarser sediments are the most porous and permeable rocks, so the bitumen is largely concentrated there (USDI, MMS, 1980).

Southeastern-Central Utah

The four STSAs in southeastern-central Utah (i.e., Circle Cliffs, San Rafael Swell, Tar Sand Triangle, and White Canyon) include rocks of Permian and Triassic ages. The largest deposit, Tar Sand Triangle STSA, occurs in the White Rim Sandstone of Permian age. Geologists do not agree on the environment which deposited these cross-bedded sandstones. Some believe that it was a sand dune complex; others believe that it was deposited in shallow marine water (Campbell and Ritzma, 1979). Considerable variations in permeability occur in the White Rim Sandstone, reflected by the variations in bitumen concentrations throughout this STSA.

Deposits for the other three STSAs occur in sandstones of Triassic age. The Circle Cliffs and San Rafael Swell deposits occur in fine- to medium-grained, moderately well-sorted sandstones of the lower part of the Moenkopi Formation, which was deposited as a huge delta in a shallow sea. The White Canyon deposit occurs in the Hoskininni Formation, which underlies the Moenkopi. The Hoskininni is a sandstone that probably was deposited in shallow marine water (USDI, MMS, 1980).

Tar Sand Recovery Methods

Bitumen in tar sand can be extracted by in-situ or surface-mining methods. Bitumen may be extracted by surface mining where deposits are near the surface or by in-situ extraction where deposits are more deeply buried. In-situ methods are similar but more intensive than those used for tertiary production from conventional crude oil reservoirs. Most of the deposits in the STSAs cannot be mined by surface-mining methods because the overburden is too thick. Other deposits may not be suited to in-situ extraction because the bitumen saturation, permeability, thicknesses of impregnated intervals, or continuities of impregnated intervals are inadequate.

The STSAs that appear most favorable for development in the near future are Asphalt Ridge/White Rocks, P. R. Spring, and Sunnyside. These deposits contain thick intervals of sand richly impregnated with bitumen. The STSAs

that appear to be least favorable for development are Argyle Canyon/Willow Creek, Pariette and White Canyon because bitumen concentrations and deposits are small, and impregnations are discontinuous. Other characteristics such as viscosity, carbon-hydrogen ratio, sulfur content, permeability, and porosity are unknown.

SURFACE-MINING METHODS

Surface-mining methods could occur where bitumen impregnations were thick and overlying barren rock was thinner than the bitumen-impregnated rock. The Asphalt Ridge/White Rocks, P. R. Spring, and Sunnyside STSAs contain the most suitable deposits for surface mining. If any of these deposits were developed by surface-mining methods, the scale of mining operations would compare to that of a large, open-pit mine.

Based on the information provided in the current conversion lease plans of operations, surface mining would require conventional types of earth-moving or mining equipment to excavate the tar sand and overlying barren rock. Actual mining would begin after access roads and support facilities were constructed. Major mining activities would include: (1) stripping and stockpiling of topsoil; (2) removing and disposing of overburden; (3) excavating of tar sand; and (4) reclaiming of the area after mining. Topsoil would be stockpiled and protected from erosion after it was removed. Later, topsoil would be used for reclamation.

Non-bituminous rock overlying the tar sand would be removed separately from tar sand. During early mining stages, overburden would be used to fill the upper parts of valleys. It would first be placed in valley bottoms and built upward in layers instead of just being dumped into valley heads. Depositing overburden in layers would slow runoff and reduce erosion. After the full depth of the mine was attained, overburden could backfill the pit where tar sand was completely removed. Because the volume of disturbed overburden would increase in volume when bedrock was broken up, it could more than fill the pit.

On the average, approximately 80 percent of a given lease underlain by surface minable deposits could be disturbed due to actual mining operations (Marchant, 1984). The actual amount of surface area disturbed is expected to be 100 percent due to ancillary facilities and the storage of topsoil and waste sand. Tar sand would be sent to a processing plant by conveyors, scrapers, or trucks, depending on the distance to the processing plant and the nature of the terrain (Enercor, 1982).

Reclamation would proceed as mining progressed. Fill could be graded to the final rounded contours, covered with topsoil, and reseeded. The restored landscape would have more rounded slopes than surrounding undisturbed landscape; also, elevations of restored landscapes would be lower than the original elevations unless waste sand from the processing plant were added to the pit. If enough waste sand were added, elevations of restored landscapes would be higher than original elevations. The recovery of tar sand from surface mining is estimated at 90 percent.

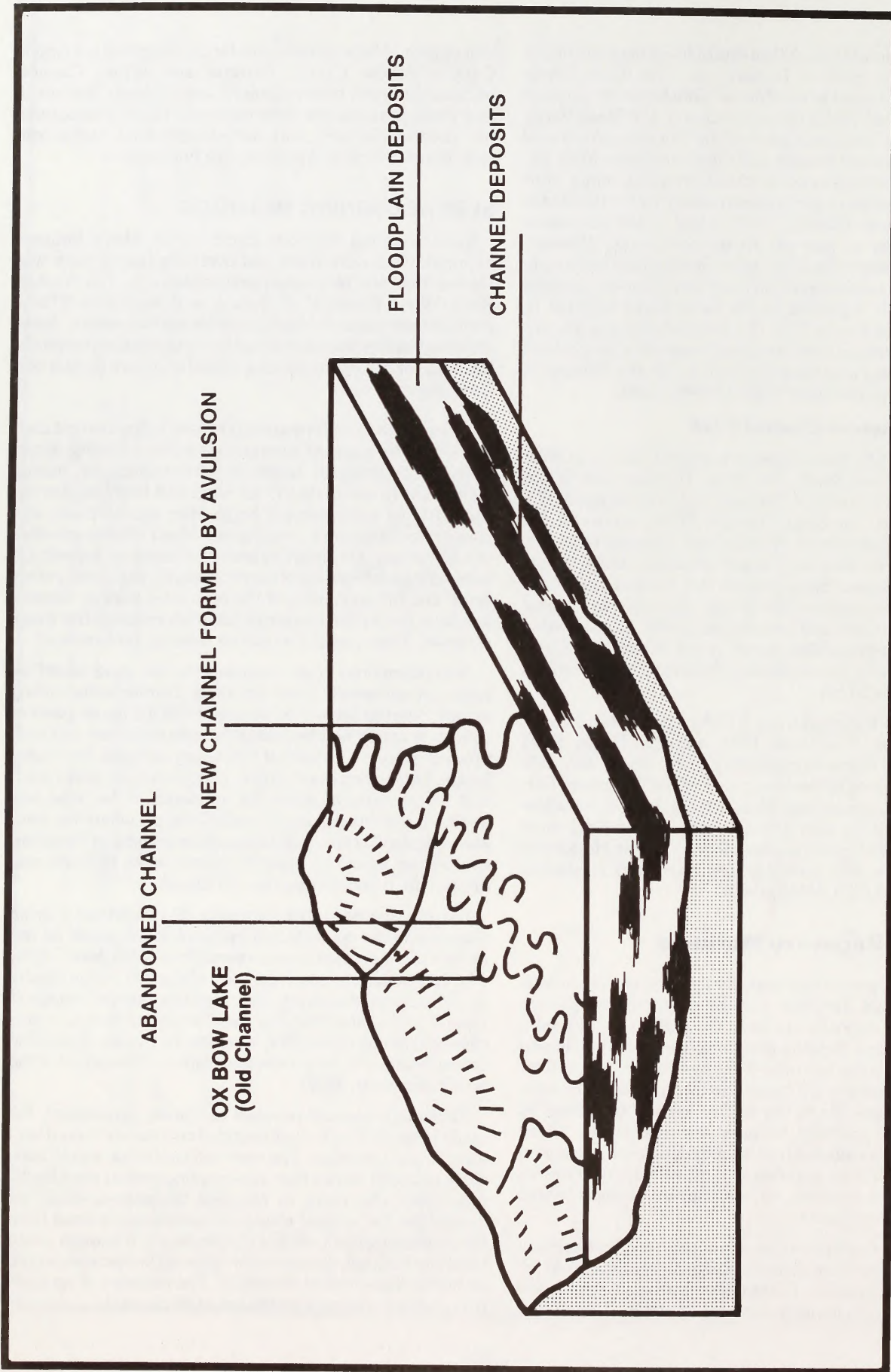


FIGURE 2-1
CHANNEL DEPOSITS OF A RIVER SYSTEM

CHAP 2--ALTERNATIVES AND TAR SAND RESOURCES

Description of Bitumen Recovery Process

A plant could be used to separate bitumen from tar sand and to upgrade the bitumen to a commercial product. The plant, associated storage areas, disposal area for spent sand, and other facilities could occupy about 50 percent of the proposed project area. The mill would be located either as a mine mouth facility or on suitable terrain at lower valley elevations.

Many concepts of an extraction processing plan exist: a conceptual diagram of a flow process is shown in Figure 2-2. This figure shows the major stages needed to process tar sand, although other methods could be used at any one stage to achieve the same final results. Major stages for bitumen recovery are:

- Crushing the tar sand.
- Separating the bitumen from sand, which involves mixing the crushed ore with hot water to release the bitumen, and floating this mixture to concentrate the bitumen. The bitumen concentrate, from hot water processing, is then treated with a solvent to separate the bitumen, water, and sand.
- Upgrading bitumen to a marketable product.

The cleaned crude bitumen would be upgraded in a delayed coking unit. Products would be sold to refineries as synthetic crude oils. Any gas and coke produced during the product upgrading process could be used for fuel in the plant: these would be burned to produce steam for operating the mill. Any excess coke could be sold.

Disposal of Waste Sand (Tailings)

Disposal of waste sand would be a major consideration in a surface-mining project because huge amounts of waste sand would be produced. For example, a proposed 2,000-acre project would require between 500 and 1,000 acres for disposal of waste sand if disposal in the mine were not feasible (Enercor, 1982). This sand could include as much as 5 percent of bitumen, although this amount could vary at each site.

Waste sand could be disposed of *using three methods: (1) backfilling the mined area; (2) filling gullies near the plant; and (3) tailing ponds.* Usually tailing ponds would be located in canyons or valleys near a plant, although such ponds could be constructed using dikes on level terrain. Tailings ponds must be designed: (1) to keep the tailings from sliding; (2) to ensure that subsurface runoff from sources outside the ponds does not enter and overflow the dam holding tailings; and (3) to control water seepage through the tailings and prevent possible rupture of the dam.

IN-SITU MINING METHODS

In-situ recovery methods presently used for crude oil are referred to as "tertiary." This method is proposed for bitumen recovery because bitumen must be heated before it can move through and be pumped from the deposits. However, this technology is not well established for tar sand and would be subject to considerable experimentation and test-

ing. Different sites could also cause considerable variations in the efficiency of bitumen extraction.

Bitumen coats the sand grains in the deposit but does not completely fill the pore spaces in most impregnated rock. These "oil wet" sands differ from the Canadian tar sands which are "water wet." In water wet sands, water films coat the sand grains, and the bitumen occupies part or all of the remaining pore spaces. Consequently, the technique developed in Canada may not be applicable to Utah's tar sand.

Description of Bitumen Recovery Process

Under laboratory conditions, 40 to 50 percent of the bitumen could be recovered. However, in the field, much less is generally expected. The oversweep efficiency of a fire front rarely exceeds 30 to 40 percent of the volume, but some bitumen comes from the part of the zone not burned (Latil et al., 1980).

Any process that extracts bitumen from tar sand deposits should do three things: (1) establish communication of air or fluids between injection and production wells; (2) reduce the viscosity of the bitumen; and (3) maintain the flow of bitumen after flow has been started. Bitumen recovery requires that the following elements be met:

1. The rock of a tar sand deposit should be permeable or of such a nature that it could become permeable by artificial fracturing.
2. The bitumen's viscosity should be reduced by heating or the bitumen should be dissolved by solvents. Heat could be supplied either from steam developed from boilers located at the surface or from the burning of part of the bitumen.
3. The rock should have fairly uniform bitumen saturation. Saturated rock should be at least 10 feet thick, and the enclosing rock should be stable. Sand grains of many tar sands are cemented by bitumen; the sand would be compacted and rock permeability increased as bitumen was removed (Herbeck et al., 1977).

Six in-situ recovery methods are potentially usable for extracting bitumen from tar sand: (1) in-place forward combustion; (2) reverse combustion; (3) steam drive; (4) cyclic steam injection; (5) hot water and gas injection; and (6) solvent extraction (Spencer et al., 1970).

The upgrading facilities for bitumen produced from in-situ recovery would largely depend upon the type of recovery process used. If in-place forward or reverse combustion recovery processes were used, upgrading facilities could be required to reduce the viscosity of the bitumen before transportation. If steam drive, cyclic steam injection, or hot water and gas injection were used, a circuit would need to be added to separate the steam from the oil as well as a circuit to reduce viscosity of the bitumen. If solvent extraction were used, a solvent-bitumen separator would need to be added in addition to the viscosity reduction circuit.

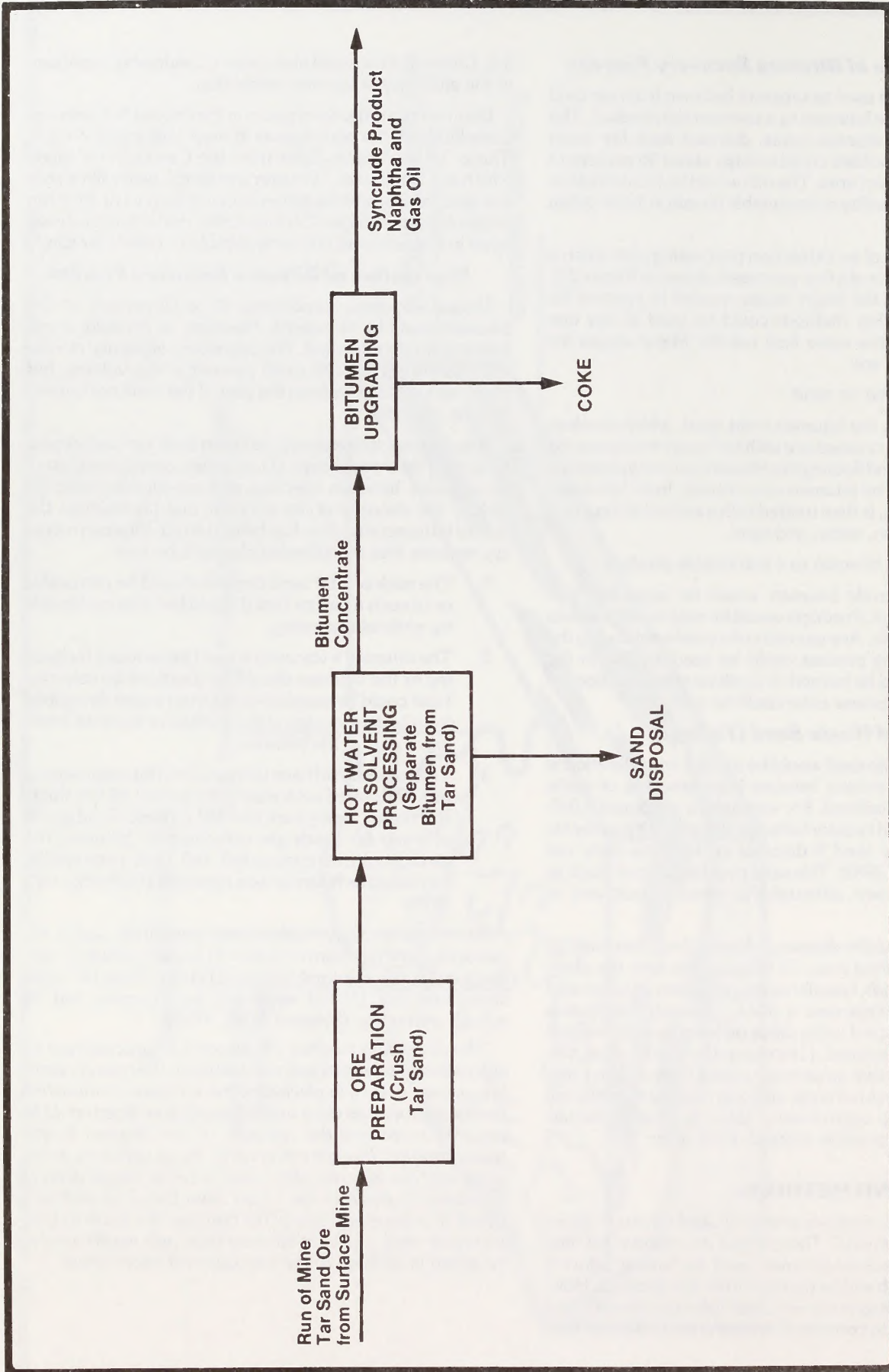


FIGURE 2-2
CONCEPTUAL TAR SAND PROCESS PLANT

CHAP 2--ALTERNATIVES AND TAR SAND RESOURCES

Details concerning any upgrading facilities which may be needed will be provided when a recovery method is decided upon and the characteristics of the produced bitumen are evaluated. This decision may not be made until after the exploration and pilot plant phases are complete. Impacts associated with these facilities will be analyzed in site-specific EAs or EISs prepared for each plan of operations.

At the present time, no one method has been proven better than the others for extracting bitumen from tar sand in all situations (Marchant, 1984). Each recovery method is described briefly below.

In-Place Forward Combustion

Bitumen would be heated by convection with heated air, which would be pumped down injection holes and escape from production holes. After air flow began, a fire would be started at one or more injection holes. As fire heated the bitumen, the lighter fractions would vaporize. The vaporized portion of bitumen, together with steam formed by combustion, would move from the fire into cooler parts of the deposit where they would condense into liquids that could be pumped from the deposit. The heavier portion of bitumen would be left behind as a heavy residual coke or carbon deposit. This residual portion would serve as fuel for the fire: the fire would move forward only as rapidly as the residual portion were burned. In this process, flame front would move in the same direction as the air. Maximum temperatures would be about 900°F.

For in-place forward combustion, about 80 percent of the heat developed during combustion would remain behind the advancing front of the fire and would be lost to the rock above and below the tar sand. Variations have been proposed to improve the effectiveness of this process. For example, water could be injected with air: this would vaporize to steam, which would flow through the fire and add heat to the unburned deposit. If a large enough amount of water were added, the flame would be partially quenched. Then the flame front would move forward before all of the residual coke fraction was burned and would reduce the amount of air needed to be pumped into the deposit to allow the fire to sweep the deposit (Herbeck et al., 1977).

Reverse Combustion

The reverse combustion process would be similar to forward combustion except the direction of the fire movement would be different in relation to air flow. With this process, a fire would be started with air injection into a well that later produced bitumen. Bitumen heated at the flame front would move through the heated zone to the producing well.

Very viscous bitumen could be liquified only by reverse combustion, although the process would not be very efficient. Part of the light hydrocarbons would be burned, and sometimes very large amounts of air would have to be pumped into the deposit; also, the deposit would require adequate air permeability for the process to work (Herbeck et al., 1977).

Steam Drive

Steam formed in boilers at the surface would be pumped into the deposit through one or more injection wells; bitumen and water would be recovered from other wells. Steam would heat the bitumen in the deposit, which would reduce the bitumen's viscosity: the steam-heated bitumen would be driven to one or more production wells. Wells could be constructed in parallel rows or could form a ring around a well located in the center of the ring. Steam drive would use large quantities of water (Spencer et al., 1970). A ratio of bitumen to water could be as much as 1 to 10, but is usually considered to be 1 to 5.

Cyclic Steam Injection

Steam would be injected into a well for days, weeks, or months. After the steam heated the bitumen until it became fluid, it would be pumped from the well. The same well could be used as an injection well and a production well during different times. Best results would occur for deposits more than 50 feet thick and less than 3,000 feet deep, with viscosity ranging from 1,500 to 11,000 centipoises (see Glossary). Very permeable rock would be desirable. Saturation would have to be at least 1,000 barrels of bitumen per acre-foot of rock. Overall recovery of in-place bitumen would be small because only the bitumen very near the wellbore would be heated enough for removal (Spencer et al., 1970).

Hot Water and Hot Gas Injections

Hot water and hot gas drives would resemble steam, but they would be less efficient because each would have less heat-carrying capacity. However, hot water and hot gas have been used to recover bitumen from tar sand in combination with other methods (Spencer et al., 1970).

Solvent Extraction

Generally, solvent extraction is similar to the steam-drive in-situ process. Solvents have been used at the Athabasca deposit in Canada. In the solvent extraction process, a solvent or an emulsifying solution is introduced in bitumen-impregnated rock through injection wells. The fluid dissolves or emulsifies bitumen as it flows through permeable rock. Then, the bitumen and fluid are pumped to the surface through production wells. At the surface, the bitumen is separated from the fluid, and the fluid is recycled. In-situ solvent extraction has not been used in Utah.

IN-SITU EQUIPMENT AND FACILITY REQUIREMENTS

In-situ development of tar sand would include exploration, drilling of production wells, installation of production equipment, production of bitumen, removal of equipment, and reclamation of sites.

Exploration would be needed to determine the major physical properties of the deposit. Information would be collected by geophysical surveys and by core and geophysical data from widely spaced drill holes.

For in-situ production, closely spaced holes would be drilled and used as injection and production wells. The production wells for a tar sand project probably would be no

CHAP 2--ALTERNATIVES AND TAR SAND RESOURCES

farther apart than 500 feet, and most could be closer spaced.

The surface equipment needed to extract bitumen would include drilling rigs, compressors, pumps, production pipes, storage tanks, and pits. For in-situ production by steam injection, boilers and steam pipes also would be required. Additional required facilities would include shops, warehouses, office buildings, outside storage areas, fuel storage, housing, and roads. Much of the ground surface would be disturbed during the installation of production facilities, although disturbance would differ from place to place. Although most of the disturbance would result from soil compaction, it would also occur from construction of roads, drill pads, and facility foundations.

Only part of the tar sand deposit would be developed at a time. After the bitumen was removed from one part of the deposit, the production equipment would be moved to another part, and the land over the depleted part of the deposit would be reclaimed.

Estimates for the amount of surface disturbance which could result from in-situ recovery methods range from a low of 10 percent using directional drilling techniques (Marchant, 1984) to as high as 60 percent, depending on topography and characteristics of the bitumen and reservoir rocks. On a statewide basis, however, approximately 40 percent of the area developed by in-situ methods would be disturbed by some form of surface-disturbing activity (Weber, 1983). Surface disturbance is expected to be similar regardless of the type of in-situ development method used (Marchant, 1984).

DESCRIPTION OF ALTERNATIVES

A 20-year period is considered for analysis purposes in this EIS. However, should development occur, facilities would probably last longer, and production would probably continue past this period. The following discussion provides three potential tar sand production levels. Given the developmental nature of the tar sand industry and the current fluctuation in world oil prices, there is much uncertainty concerning the level of production that can be expected from new CHLs. Therefore, these three alternatives were developed to provide an idea of the range of impacts that might be expected from the implementation of CHLs. These alternatives are for analysis and disclosure purposes only, and no decision will be based solely on them.

Mitigating Measures

To determine leasing activities for oil, gas, and tar sand, four categories are used, based on potential for development, other resource uses, and protection of sensitive resource values. Category 1 opens all public lands to leasing with standard stipulations (see Appendix 2). Category 2 allows leasing with standard and special stipulations to protect sensitive resource values. Category 3 allows leasing

with no right of surface occupancy: recovery methods must not disturb the surface. Category 4 closes lands to leasing.

Any potential lease or lease conversion tracts would include either standard or special stipulations that would provide required mitigating measures for site-specific projects. Generally, the analysis in Chapter 4 considered these stipulations to determine impacts to individual resources.

Alternative 1: High Commercial Production

This alternative assumes that all lease conversions would be approved, new Federal leases would be issued, and economic conditions would be sufficiently improved to allow development on a high level. Federal tar sand would be developed to a level of 365,000 barrels/day during the 20-year planning period. This production level would anticipate production from nine of the eleven STSAs within Utah, as shown in Table 2-2. That table also shows estimated water and work force requirements. About 190,000 barrels/day would be produced from surface mining, and about 175,000 barrels/day would be produced from in-situ processes. Assuming that no water reuse occurred, 88,295 acre-feet/year would be required by the year 2005. Table 2-2 does not show the length of work periods or years worked; however, the largest work force would be required during 1995, with about 7,000 construction workers and 4,500 operation workers.

Alternative 2: Low Commercial Production

This alternative also assumes that conversion lease applications would be approved and new leases would be issued. However, unlike Alternative 1, it assumes that economic conditions would not have improved sufficiently to encourage individual companies to develop their resource on a large scale. Production would reach 83,000 barrels/day by the year 2005 (see Table 2-3). At this level of production, only six of the STSAs would be developed for tar sand. Fifty-three thousand barrels/day would be produced from surface mining and 30,000 barrels/day from in-situ mining. Predicted water use would be about 22,200 acre-feet/year and would peak by the year 2005. The estimated construction work force would peak at the year 2000 to about 5,500 workers, while the maximum operation work force of 3,141 would be reached at the end of the analyses period (2005).

Alternative 3: No Action

This alternative assumes no tar sand development would be allowed on Federal land on the STSAs. No conversions to CHLs would be approved nor would new leases be issued. However, there could be some tar sand development from State and private lands. Other activities in the region would continue to affect air quality, water resources,

CHAP 2--ALTERNATIVES AND TAR SAND RESOURCES

TABLE 2-2

Alternative 1
Estimated Reserves, Production, Water Requirements, and Work Force

Special Tar Sand Area	Estimated In-Place Reserves (Barrels)	Mining Method	Estimated Production (Barrels/Day)	Estimated Water Requirements (Acre-Feet/Year)	Estimated Work Force	
					Construction	Operation
<u>Argyle Canyon/Willow Creek</u>	60-90 million					
Projected ^c		Surface	5,000	1,250	200	130
<u>Asphalt Ridge/White Rocks</u>	1.22-1.31 billion					
Rocky Mountain		Surface	5,000	^b 4,521	200	263
Projected		Surface	5,000	1,250	200	130
Sohio ^a		Surface	(15,000)	(3,620)	(19,900)	(770)
Total		Surface	10,000	5,771	400	406
<u>Circle Cliffs</u>	1-3 billion					
Projected		In-situ	20,000	4,600	1,400	360
<u>Hill Creek</u>	1-16 billion					
Projected		In-situ	10,000	2,300	700	120
<u>P. R. Spring</u>	4-4.5 billion					
Mobil		Surface	30,000	4,800	1,200	780
Projected		Surface	20,000	5,000	800	520
Projected		In-situ	50,000	11,500	3,500	600
Enercor ^a		Surface	(5,000)	(5,000)	(350)	(275)
Total		Surface and In-situ	100,000	21,300	5,500	1,900
<u>Pariette</u>	12-15 million					
No Production			0	0	0	0
Projected						
<u>Raven Ridge/Rim Rock</u>	101-131 million					
Projected		Surface	5,000	1,250	200	130
<u>San Rafael Swell</u>	445-545 million					
Projected		In-situ	20,000	4,600	1,400	240
<u>Sunnyside</u>	3.5-4 billion					
Mono Power		Surface	30,000	9,345	2,450	650
AMOCO		Surface	50,000	12,000	1,050	2,630
Enercor		Surface	20,000	5,000	2,500	800
Chevron-GNC ^a		Surface	(10,000)	(4,500)	(1,000)	(650)
Projected		Surface	10,000	2,500	400	260
Sabine		Surface	5,000	1,150	350	60
Projected		In-situ	5,000	5,000	60	35
Projected		In-situ	5,000	1,150	350	60
Total		Surface and In-situ	125,000	36,145	7,160	4,495
<u>Tar Sand Triangle</u>	12.5-16 billion					
Santa Fe/Altex et al.		In-situ	30,000	1,679	2,200	400
Projected		In-situ	30,000	6,900	2,100	360
Projected		Surface	10,000	2,500	400	260
Total		In-situ and Surface	70,000	11,079	4,700	1,020
<u>White Canyon</u>	12-15 million					
No Projection			0	0	0	0
<u>Subtotals</u>		Surface	190,000	49,416	9,600	6,566
		In-situ	175,000	38,879	12,060	2,235
TOTALS			365,000	88,295	21,660	8,801

Source: USDI, BLM, 1983a.

^aNumbers in parentheses are not included in totals because project would be located on private lands.

^bUnderground water source.

^cProjected new leasing or possible new conversions.

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

TABLE 2-3
Alternative 2
Estimated Reserves, Production, Water Requirements, and Work Force

Special Tar Sand Area	Estimated In-Place Reserves (Barrels)	Mining Method	Estimated Production (Barrels/Day)	Water Requirements (Acre-Feet/Year)	Estimated Construction	Estimated Work Force Operation
<u>Asphalt Ridge/White Rocks</u>	1.22-1.31 billion					
Rocky Mountain Sohio ^a		Surface	5,000	4,521	200	263
Total		Surface	(5,000)	(905)	(475)	(175)
		Surface	5,000	4,521	200	276
<u>Circle Cliffs</u>	1-3 billion					
Projected ^c		In-situ	2,000	460	140	30
<u>P. R. Spring</u>	4-4.5 billion					
Mobil		Surface	10,000	1,600	400	260
Projected		Surface	10,000	2,500	400	260
Projected		In-situ	5,000	1,150	350	60
Enercor		Surface	(5,000)	(1,150)	(350)	(275)
Total		Surface and In-situ	25,000	5,250	1,150	580
<u>San Rafael Swell</u>	445 - 545 million					
Projected		In-situ	1,000	230	70	20
<u>Sunnyside</u>	3.5 - 4 billion					
Projected		In-situ	1,000	230	70	15
Projected		Surface	2,500	625	100	65
Mono Power		Surface	10,000	3,112	625	425
AMOCO		Surface	8,000	2,000	1,050	1,200
Enercor		Surface	5,000	1,250	500	200
Chevron-GNC ^a		Surface	()	()	()	()
Projected		Surface	2,500	625	100	65
Sabine		In-situ	1,000	1,000	30	25
Total		Surface and In-situ	30,000	8,842	2,475	1,995
<u>Tar Sand Triangle</u>	12.5 - 16 billion					
Santa Fe/Altex et al.		In-situ	10,000	600	700	120
Projected		In-situ	10,000	2,300	700	120
Total		In-situ	20,000	2,900	1,400	240
<u>Subtotals</u>		Surface	53,000	16,233	3,375	2,751
<u>TOTALS</u>		In-situ	30,000	5,970	2,060	390
			83,000	22,203	5,435	3,141

Source: USDI BLM, 1983a.

^aNumbers in parentheses are not included in totals because project would be located on private lands.

^bUnderground water source.

^cProjected new leasing or possible new conversions.

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

and socioeconomics, as described in this volume under Chapter 4, No Action Alternative section.

This alternative is the baseline for all tar sand development and serves as the basis for the cumulative analyses completed for Alternatives 1 and 2.

ENERGY CONSERVATION AND ALTERNATIVE ENERGY SOURCES

This discussion describes how energy conservation and use of other energy sources could influence the need for tar sand development. Much of the information presented below is derived from a 1981 report prepared by Solar Energy Research Institute (SERI). Under the stipulations of the Combined Hydrocarbon Leasing Act, conversion applications cannot be denied based upon the ability to meet anticipated energy needs from non tar sand sources. However, company decisions on the pace of their development and Federal decisions on new leasing could be affected by the ability to meet that demand from other sources.

Energy Conservation

Opportunities for conservation of liquid fossil fuels exist in stationary uses. This section outlines the technical potential for saving energy by the use of conservation and using renewable energy resources.

RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL ENERGY USAGES

Total residential and commercial energy usages have fallen steadily since 1976. Energy consumption in 1981 was below 1970 levels. These two sectors account for slightly more than 33 percent of the United States direct energy use. The efforts have mostly been made by individual homeowners and businesses. Despite the massive subsidies to conventional energy sources, residential and commercial customers have contributed to energy supply through active conservation during the past few years. These investments have reduced fuel bills in the U.S. by 10 percent since 1973. Total liquid fuel usage in the residential sector also has decreased. Between 1979 and 1981, fuel oil and kerosene usages in residential dwellings decreased by 16 percent (U.S. Department of Commerce [USDC], Bureau of the Census, 1983).

For residential areas, research identifies savings potential for new homes and for retrofitting of existing homes. Between 1980 and 2000, nearly 29 million new fuel-heated homes are expected to be built. SERI (1981) estimates that furnace efficiency improvements, added attic insulation, reduced infiltration, building shell improvements, and a combination of passive solar design and domestic hot-water heating can substantially reduce residential use by the year 2000. The potential for oil savings via cost-effective home design is roughly 265,000 barrels/day. These savings are

roughly 34 percent of 1981 oil use in household dwellings. Another approach to new home design is the superinsulated home. Known as the Saskatchewan Conservation House and Lo-Cal design, these homes are 10 to 100 times more energy efficient than the average 1978 U.S. home (SERI, 1981).

Existing residential dwellings pose a difficult challenge because of the diversity in design and construction. By the year 2000, SERI (1981) estimates that 52.2 million homes built before 1980 will still exist. The U.S. stock of residential dwellings is thermally inefficient when compared to other countries and with successful retrofit projects in this country. The average U.S. house has air leakage area equivalent to 1 square yard. There is clearly great potential for fuel savings.

The application of conservation and solar strategies to reduce fuel use depends upon the condition of the house and the amount of conservation and solar design previously built in. In its report to Congress, SERI (1981) identifies basic characteristics of categories of homes (which are expected to last until the year 2000) based upon the age of the house. It found that approximately 41 percent of existing fuel-heated homes are without insulation.

The uninsulated pre-1976 stock of homes offers a high potential for fuel savings. SERI (1981) estimates that average use per home can be reduced by 85 percent to 25.2 million British thermal units (Btu)/year. Fuel oil savings, by the year 2000, are roughly 335,000 barrels/day.

There are expected to be 30.3 million partially insulated pre-1976 homes intact by the year 2000. Energy usage in these homes can be reduced by 72 percent to 23.7 million Btu/year through the various solar and conservation technologies. Approximately 315,000 barrels/day could be conserved by the year 2000.

Responding to changes in regulatory and economic climates, U.S. electric and gas utilities have begun to actively promote energy conservation. Legislative action has also catalyzed utility involvement in conservation programs. The U.S. Congress has directed the Department of Energy (DOE) to develop the Residential Conservation Service which sets guidelines for utility-sponsored programs providing financial and installation of conservation and solar retrofit measures (U.S. Congressional Budget Office, 1980 and 1982). Many major electric utilities have instituted conservation programs designed especially for existing homes. Interest-free loans are also offered for conservation measures.

Given the incentives for utility investment in energy conservation programs and the progress already realized by individual homeowners, substantial energy savings can be achieved over the next 20 years. Based on the SERI model, it is estimated that, for oil alone, approximately 937,000 barrels/day can be saved by the year 2000.

Energy-saving opportunities for the commercial sector have been widely documented and have received a great deal of attention during the 1970s and 1980s. Despite the difficulty in determining its magnitude, the trend towards

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

energy conservation in the commercial sector quite clearly is growing. In 1981, oil usage in the commercial sector, primarily dedicated to space and water heating, was approximately 1.56 quads or 780,000 barrels/day.

The results of the Building Energy Performance Standards research indicates that, for new commercial office buildings, energy reductions of 60 to 65 percent are feasible utilizing existing technology (U.S. Department of Energy, Buildings Division, 1981). According to the American Institute of Architects Research Corporation (1979), designs can reduce fuel requirements for newly constructed commercial buildings by 50 percent over the next 10 years. Based upon design standards, improved building design would save approximately 25,000 barrels/day by 1993.

Existing commercial buildings offer a challenging opportunity for fossil-fuel energy savings. Several sources have reported many successful retrofit programs. For example, SERI (1981) estimates that 1.6 quads of fuel energy savings can be achieved in a two-phase program. Of these savings, it is estimated that 304,000 barrels/day of direct oil savings are feasible.

Both the new and existing commercial buildings offer opportunities for liquid fossil-fuel savings. A variety of cost-effective building designs, conservation, and solar technologies are presently available to actualize oil savings potential. It is estimated that approximately 329,000 barrels/day could be displaced by the year 2000, using a coherent conservation strategy.

The industrial sector uses the largest amount of energy in U.S. economy. Next to transportation, American industry consumes the highest amount of petroleum. In 1981, this sector alone utilized 4,100,000 barrels/day. This rate is slightly more than half the rate of our 1981 imported petroleum products (U.S. Department of Energy, Energy Information Administration, 1982 and 1983).

Energy consumption in the industrial sector has steadily decreased since 1970. Between 1972 and 1979, the ten most energy-intensive industries decreased their energy consumption per unit of product by an average of more than 15 percent. Conservation technologies, technological efficiency improvements, and energy management practices can be cited as significant contributors to this trend (U.S. Department of Energy, Energy Information Administration, 1982 and 1983).

Potential Reductions in Oil Usage

The section addresses legislative efforts to reduce oil usage in utility boilers and reviews savings realized through different oil backout programs.

Considering fossil-fuel efficiency and investment strategies, three types of conservation projects are discussed in literature: cogeneration of electricity, upgrading efficiency of industrial boilers, and basic process changes (SERI, 1981).

There are two basic forms of cogeneration. The first is to utilize waste heat from industrial processes to generate

electricity. The second form uses steam before it enters the industrial process to generate electricity. There are many studies which have favorably reviewed the technical feasibility of industrial cogeneration (Federal Energy Administration, 1980). One of the most notable experiences has been Dow Chemical Corporation's investment in cogeneration technology. Dow successfully generates 75 percent of its electrical needs. Their study estimates that American industry could generate 33 percent of its electricity, thereby displacing 680,000 barrels/day and deferring utility capital requirements by \$4.1 billion (Federal Energy Administration, 1980).

The industrial sector is diverse. Use of conservation technologies, energy management strategies, and renewable resources have already affected usage trends in this area. Based upon the previously mentioned studies, savings potential still exists. A national effort to improve energy utilization could displace the need for synthetic fuels, bolster local economies, and improve the competitive nature of the manufacturing industry through lower prices attributable to reduced energy consumption per unit of product.

A significant member of the industrial sector is the electric utility industry. Beginning in the mid-1970s, a concerted effort was set forth to reduce the use of petroleum in this industry. Two significant legislative bills were enacted during this period. The Energy Supply and Environmental Coordination Act of 1974 authorized the Federal Energy Administration to prohibit certain existing powerplants and some large industrial fuel-burning installations from using petroleum and natural gas. In addition, this Act allowed the Federal government to order new powerplants and major industrial petroleum customers to design and construct new facilities which would utilize coal as the primary energy source. Another relevant and important legislative act is the Powerplant and Industrial Fuel Use Act of 1978, which prohibits the use of petroleum and natural gas in new electric powerplants and large industrial installations.

Institutional and financial barriers have limited the successfulness of the Powerplant and Industrial Fuel Use Act. The Powerplant Fuel Conservation Act of 1980 was introduced to Congress to overcome these impediments. It was expected that Phase I of this legislation would save 400,000 barrels of oil/day by 1985; Phase II would displace an additional 600,000 barrels of oil/day by 1990. The Powerplant Fuel Conservation Act was not enacted by Congress; however, some utilities have proceeded with an oil backout program.

There has been considerable success in the industry with regard to load management techniques. For many utilities, peak demands are met by oil-fired turbines or oil-fired thermal generation. By reducing periods of high usage, utilities can save petroleum fuels.

A wide range of technical efficiency improvement exists which can save fossil fuel. These energy-saving measures are cost effective, they do not impinge upon the level of human comfort, and they maintain, if not improve, the quality of the natural environment.

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

FOSSIL-FUEL SAVINGS IN MOBILE PETROLEUM USES

Transportation usage is considered here since well over 50 percent of the petroleum used in the U.S. is for transportation needs.

In 1981, the transportation sector consumed 26 percent of U.S. primary energy demand. Ninety-seven percent of the primary energy was supplied by petroleum, which is an amount equivalent to all petroleum imports (USDC, Bureau of the Census, 1983). Clearly, a program to reduce oil demand in this sector could have a significant impact on the need for new supplies of petroleum.

Although substantial progress in reducing fuel consumption has been made since the early 1970s, the full potential for oil savings in the transportation sector has not been fully realized. Alternatives for improvement of overall transportation efficiency have focused on a wide range of options including an upgrade of vehicle fleets, changes in urban transportation configurations, transportation infrastructure improvements, and use of renewable resources (on a decentralized basis) for fuels production.

Automobiles

Over the past 10 years, the automobile industry has made steady progress in improving mileage standards. It has been noted that the average imported car was more than twice as fuel efficient in 1982 as the present American fleet. A Congressional Budget Office study (Lovins and Lovins, 1982) concluded that improvements in automobile efficiency standards will continue, estimating that the 40 miles per gallon (mpg) level will be achievable by the year 1995. Reasons given for this progress reflect manufacturers' willingness and ability to apply fuel efficient technologies and continued market shifts toward smaller, more efficient cars. The study further points out that by the year 2005 (or 10 years at a 40-mpg standard) 1.1 million barrels of oil/day would be saved relative to the 1985 (27.5 mpg) fleet.

Other recent studies confirm the trend which the Congressional Budget Office study (Lovins and Lovins, 1982) describes. For example, in an article published in *Scientific American*, Gray and Von Hippel (1981) describe the technical feasibility of producing energy-efficient automobiles which consider demographic changes as well as improved automobile design by using best technologies available over the next two decades. They suggest that a 60-mpg vehicle fleet is possible by 1995 without major technological advances. By the year 2000, fuel consumption would be about 66 percent of that in 1980, or approximately 2 million barrels/day. These fuel savings would be roughly more than twice the energy delivered by the Trans-Alaska Pipeline.

Urban Transportation

One area of particular importance in considering petroleum savings is urban transportation. Obviously, the preferred options are to increase bus and vanpool ridership in urban areas.

Vehicle occupancy is an important issue in designing urban transportation systems which will reduce dependency on petroleum. The average car in 1976 was designed to carry four to six passengers; however, load factors for that time period show that an average vehicle occupancy was 2.4 for intercity driving, 1.4 for intracity driving, and 1.2 for rush hour commuting. In that same year, 56 percent of all commuters drove alone, 26 percent shared driving with others, 14 percent used public transport, and 4 percent walked, bicycled, or used other means (Hayes, 1976). Clearly, the potential exists for improvement in designing systems which move people more efficiently in urban areas than conventional passenger vehicles.

Vanpooling is a very attractive urban transportation option. It is estimated that 24,000 commuter vans carry 0.25 million people to work each day. The most successful vanpooling arrangements are in areas with poor mass transit. The potential for vanpooling is evident when one considers that 18 percent of the entire United States work force is employed in the top 500 industries (Wall Street Journal, 1983).

In addition to improving vanpooling and bus arrangements, attention should be given to small commuter or mini-cars which seat two people as a means of saving petroleum.

Trucking

The potential for increasing fuel efficiency in heavy trucks is an important way of affecting petroleum savings. Trucks haul less than one-fifth of all freight and use one-half of all fuel. One short-term method of reducing fuel consumption in heavy trucks is to increase the use of radial tires. It is estimated that fuel can be reduced up to 8 percent in urban areas and 4 to 14 percent in intercity driving. Advanced radial tire designs, which are expected on the market sometime in 1983, are estimated to improve the previous figures by 2 to 3 percent and 4 to 5 percent, respectively. Currently, radial tires of any design have only captured 8 percent of the truck tire market (U.S. Congressional Budget Office, 1980).

Efficient diesel engines in 1978 were used in 80 percent of the heavy trucks, but only 40 percent of the medium trucks. A way of improving fuel efficiency would be to increase the number of efficient diesel engines entering the new truck fleet.

Railroad and Shipping

A major area of fuel savings would be the improvement of our present rail system and the encouragement of a shift from freight transport to rail transport. It is estimated that rail transport takes 0.25 percent of the energy requirements of truck transport. In addition, railroad facilities in Europe and Japan have proved to be far more advanced than railroads in the U.S., indicating that the technology exists for improvements in our present rail system.

Air Transport

Commercial air travel consumes 90 percent of the aviation fuel used by the U.S. Since 1972 the energy use/pas-

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

senger mile for domestic aircraft has been reduced by about 5 percent. Overall fuel efficiency increased from 17.5-air passenger mpg in 1933 to 25-passenger mpg in 1979. A variety of relatively simple measures can be employed to help improve energy efficiency in the air transportation sector. These include increasing the number of passengers on each plane, better operation (i.e., reduced cruising speeds, reduced holding times, more efficient climb rates, better maintenance), and increased use of wide-bodied jets. The more long-term improvements in technical potential in air transport include changes in engine design, active control technology, and material substitution. The percentage of improved fuel economy ranges from 0 to 20 percent per measure. It is expected that, by the year 2000, average fuel efficiency will be 28.8-air passenger mpg.

FUEL FROM RENEWABLE RESOURCES

Much discussion has focused on creation of fuels from renewable resources. These fuels use agricultural feedstocks (wood, crops, organic waste) as the raw materials in creating fuel. Ethanol is typically made from biomass-derived sugars and starches. In the U.S., the supply of methanol is potentially greater than that of ethanol since this fuel can be made from biofeedstocks, peat, coal, and natural gas.

There are costs and benefits for alcohol-derived fuels. The advantages of these fuels are that they have higher octane ratings, and thus, greater thermal efficiency and reduced vehicle emissions. However, because the energy of the fuel is lower, a larger tank is required (SERI, 1981).

Gasohol, a gasoline alcohol fuel mixture, can also reduce dependence on petroleum. Again, it has a higher octane rating and reduces vehicle emissions. Use of gasohol increased steadily through 1981, although this fuel only captured a small percentage of the motor fuel oil market. Most new cars produced in the United States are warranted for gasohol use.

Since alcohol fuels are, for the most part, derived from biofeedstocks, a real potential exists for development in the agricultural sector. Farm vehicles which require large fuel inputs could benefit greatly from this energy source. It is estimated that the potential for petroleum displacement from methanol and ethanol produced from wood, grass, and crop residues is 0.4-5.5 quads or approximately 30 percent of the total national demand for transportation fuel.

Telecommunications

It has been suggested that improvements in telecommunications can also displace quantities of petroleum since information moves rather than vehicles. The types of telecommunication systems having the greatest impact on transport patterns include teleconferencing, high-speed data links, mailings and couriers, and home computers to replace some shopping. Some have indicated that 20 to 35 percent of business trips would not be needed if adequate videoconferencing facilities existed. Quantification of how

much petroleum expanded telecommunications could save is a difficult determination to make.

Alternative Energy Sources

COAL

Coal is one of the most commonly used fossil fuels in the world and is used extensively as a fuel for electrical generating plants and as a source of hydrocarbons to produce synfuels in the U.S. Coal is abundant in the U.S. and is encouraged for use as powerplant fuel to alleviate the heavy use of fuel oil and other oil products. Its disadvantages are primarily from air pollution.

COAL GASIFICATION

The gasification of coal is a chemical-heat process of converting coal to low-Btu gas, while removing environmentally harmful sulfur and ash from the natural system. The gas produced is then suitable for use in industrial complexes and can readily replace the use of natural gas, fuel oil, etc., in many industries. There are high capital and operating costs to convert coal to gas and, at present-day costs, these limit production and development. Costs of conventional oil and gas drilling and production are still less than the cost of converting coal to gas products.

GEOHERMAL

All geothermal energy so far exploited or known to be economically exploitable consists of heat contained in water and steam trapped in pockets within the upper part of the earth's crust (Cook, 1976). Pockets of trapped steam or water of sufficient quality and temperature are known to exist in California, Utah, Colorado, Wyoming, Idaho, and Nevada.

A possible commercial geothermal field is currently being developed at the Roosevelt Hot Springs unit near Milford, Utah. According to estimates made by Phillips Petroleum Company and the University of Utah, Department of Geology and Geophysical Sciences, this geothermal field might contribute a total of 300 megawatts. Such a geothermal development could replace some of the nation's energy needs.

The application of a commercial solar powerplant to meet base energy requirements is still in the development stages. The Department of Energy has devised a program plan and schedule aimed at the eventual commercialization of solar powerplants. This program began in 1975, and the first commercial demonstration plant is scheduled for 1985. Solar plants for large-scale applications are not sufficiently tested and developed to consider a solar plant as a viable alternative for meeting mid-1980s base energy demands.

WIND

The intermittent nature of wind and the wide geographical and seasonal variations in the availability of this energy

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

source require either supplementary energy storage capability or inerties of wind energy conversion systems with conventional energy systems. The variable nature of both of these, at best, could supplement energy sources. Also, the size of wind generation systems is still on a small scale and could not feasibly supply the total energy needed.

FUEL CELL GENERATION

Fuel cells convert chemical energy of high cost hydrogen-rich fuel into direct current electricity. The direct current is then converted to alternating current for utility power supply. Fuel cells have been and are being tested for small-scale generation projects. However, the technology has not been tested on a large scale, and therefore, this is not considered a reliable and viable energy source.

NATURAL GAS

Natural gas, which mainly consists of methane, is both an efficient and largely pollution-free industrial fuel. The estimated recoverable natural gas reserves in the U.S. are limited, so much so that the Federal government has established the Industrial Fuel Use Act regulations restricting the use of natural gas, primarily to use as a domestic heating fuel. As a result, natural gas can be considered as a reliable fuel alternative only in the cumulative sense (Burns and McDonald, 1980).

OIL SHALE

Oil shale contains a solid bituminous material called kerogen which, when heated to a high temperature, will yield a substitute crude oil that can be refined and treated much like petroleum (Cook, 1976). The largest oil shale deposits occur in Colorado, Wyoming, and Utah. However, oil from oil shale is not considered at this time because it is experimental, uses new technologies, and development includes hidden costs. Furthermore, oil shale processing is more difficult and complicated than tar sand processing.

HYDROELECTRIC

Although the most efficient and cleanest major energy source yet developed by man, hydroelectric energy (on a large scale) is greatly limited by the availability of good sites. Good sites are those with high head (height of water fall), large discharge (the rate at which the water flows), large storage capacity, and near to population centers (Cook, 1976). Few good sites remain in the United States nor are there enough small hydroelectric developments under construction or being planned which could collectively provide for future requirements. Some additional hydroelectric power is, however, a reasonable method of power generation for the future.

NUCLEAR

Another energy source is in the nucleus of the atom. When this source can be managed properly, enough energy

would be available to supply most of the nation's energy needs. Proper management has been a problem, and less emphasis has been placed on developing the nuclear energy source because of the controversies. Nuclear energy has some advantages such as reduced sulfur dioxide, nitrogen oxides, particulates, coal piles, and dust. The problems associated with nuclear energy development are human hazards, reactor production of more fissionable material than is used up in the reactions, the nuclear waste areas, excess heat, and associated cooling requirements.

IMPACTS OF ALTERNATIVE ENERGY DEVELOPMENT

Even though there are opportunities to develop some of the alternative energy sources and some benefits can be realized, the adverse impacts of increasing and expanding the energy exploitation of the above-mentioned energy sources should be recognized. Development can be divided into three phases: production, processing, and utilization. In production, land is disrupted by coal, oil, and uranium mining. Mine wastes degrade surface and groundwaters. Solar grids covering large tracts of land would make that land unusable for agriculture or other production of forage. Hydroelectric installations induce filling of river channels. Oil spills are a continual hazard, especially for offshore drilling and transport. In the processing phase, disposal of waste products is of major concern. Depending upon the physical and chemical properties of the effluents, they can exert environmental consequences of varying degrees of significance and extent. In the utilization phase of energy development, pollutants are emitted into the atmosphere by the combustion of fossil fuels, water is polluted by raise of water temperatures, and local areas may be affected by concentrations of air pollutants. These and other impacts associated with production, processing, and utilization may be limiting factors in alternative energy development.

The implementation of this alternative would involve a reordering of energy priorities and policies of regulatory authorities and the personal attitudes of the public to support such policies in each of the respective energy sources mentioned. New legislation, which would further mandate or provide incentives for the conservation of energy and the development of alternative energy sources, would have to be enacted on Federal, State, and local levels.

SUMMARY OF UNAVOIDABLE ADVERSE IMPACTS, IRREVERSIBLE/IRRETRIEVABLE COMMITMENTS OF RESOURCES, AND THE RELATIONSHIP OF SHORT-TERM USE OF THE ENVIRONMENT TO MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

CHAP. 2: ALTERNATIVES AND TAR SAND RESOURCES

Table 2-4 summarizes and compares the unavoidable adverse impacts discussed in Chapter 4. The comparison is by alternative and environmental element and includes impacts on regional and STSA bases. This table does not list impacts of low significance, short duration, or those that are readily mitigated.

Table 2-4 also indicates whether the adverse impact is irreversible or irretrievable. Actions committing future generations to continue a similar course are considered

irreversible. Irretrievable is defined as irrecoverable, not retrievable; once used, not replaceable.

The relationship between short-term uses of the environment to maintenance and enhancement of long-term productivity is briefly discussed for each alternative and resource and completes the table. Short term is generally the project's life (20 years). Long term is the period beyond the project's predicted life.

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

TABLE 2-4
Summary of Major Environmental Consequences, Irreversible/Irrecoverable Commitments of Resources, and the Relationship of Short-Term Use of Man's Environment to Maintenance and Enhancement of Long-Term Productivity

Environmental Element	Unavoidable Adverse Impacts			Commitment of Resource	Project Life	Relationship of Short-Term Use of Man's Environment to Long-Term Productivity
	Alternative 1	Alternative 2	Alternative 3			
	High Commercial Production	Low Commercial Production	No Action			
Air Quality						
PSD Class I Standards Exceeded for SO ₂	2 STSAs	1 STSA	None	No	Yes	Tar sand development would release pollutants into the atmosphere, but degradation would cease at project completion. Because of the use of air quality increments for tar sand development, other air polluting projects in the area could be limited.
PSD Class II Standards Exceeded for SO ₂	5 STSAs	4 STSAs	9 Places	No	Yes	
MAAQs Exceeded for TSP	6 STSAs	3 STSAs	3 STSAs	No	Yes	
for NOx	1 STSAs	None	None	No	Yes	
Visibility Reduction on Sensitive Areas	3 STSAs	None	None	No	Yes	
Water Resources						
Water Depletion (maximum)	84,000 ac.-ft./yr.	17,000 ac.-ft./yr.	1,283,000 gal.-ft./yr ^a	No	Yes	Water quantity would revert to existing levels except for other possible projects at the completion of the project. There would be some lag time between the end of the project and rehabilitation in which water quality would be degraded.
Increase Salinity Level (Imperial Dam)	<2 mg/l	Unmeasurable	1,089 mg/l	No	Yes	There would be a permanent loss of some soil and soil productivity would be altered.
Cost of Salinity (Increase)	\$1,080,000		None	No	Yes	Even with rehabilitation, the existing contours would not be reestablished.
Increased Sedimentation and Water Flow	9 STSAs	6 STSAs	None	Yes	Yes	These sites could not be restored to native vegetation or vegetation condition for many years. The endangered cactus habitat would be altered.
Soils						
Soil Disturbed (to 20 years)	51,300 acres	13,950 acres	None	No	Yes	
Increase Erosion	9 STSAs	6 STSAs	None	No	Yes	
Changing Soil Texture	51,300 acres	13,950 acres	None	Yes	Yes	
Topography, Tar Sand, and Other Minerals						
Topography Modified	6 STSAs (43,000 ac)	3 STSAs (13,950 ac)	None	No	Yes	
Tar Sand Removed	47,400 acres	9,200 acres	None (on Federal land)	Yes	Yes	
Vegetation						
Removal of Vegetation (to 20 years)	51,300 acres	13,950 acres	None	Yes	Yes	
Invasion of Weeds	9 STSAs	6 STSAs	None	No	Yes	
Wrights Fishhook Cactus (Endangered Plant)	1 STSA (1,100 ac)	1 STSA (50 ac)	None	No	Yes	
Habitat Could Be Lost						
Animal Life						
Human Harassment	9 STSAs	6 STSAs	None	No	Yes	Some reduction in herd size would be anticipated; however, some rehabilitated areas would contain improved forage for some of the species involved. If endangered fish were lost, restoration would be required, which would be costly. The response of wild horses and burros would vary; however, but in general, they would change their patterns of use and would return to restored areas following completion of the project.
Loss of:						
Elk and Deer Habitat	43,000 acres	12,800 acres	None	No	Yes	
Desert Bighorn Sheep	4,980 acres	1,150 acres	None	No	Yes	
Sage Grouse Strutting Grounds	9 sites (3 STSAs)	6 sites (3 STSAs)	None	No	Yes	
Golden Eagle Nest Sites	4 sites (3 STSAs)	2 sites (2 STSAs)	None	No	Yes	
Yearlong Raptor Foraging Habitat	49,500 acres	13,950 acres	None	No	Yes	
Degrading of Fish Habitat	9 STSAs	6 STSAs	None	No	Yes	
Loss of Wild Horse or Burro Range	3 STSAs	3 STSAs	None	No	Yes	
Recreation						
Loss of Recreation Values	9 STSAs	6 STSAs	None	No	Yes	Even though the project would degrade the recreation value, the increased population could cause increased use and overcrowding of the surrounding area, and the quality of recreation use would decline.
Impact Waters of Nationwide River Inventory	6 Rivers or Streams	6 Rivers or Streams	6 Rivers or Streams	No	Yes	

CHAP. 2--ALTERNATIVES AND TAR SAND RESOURCES

TABLE 2-4 (concluded)

Environmental Element	Unavoidable Adverse Impacts			Commitment of Resource	Relationship of Short-Term Use of Man's Environment to Long-Term Productivity
	Alternative 1 High Commercial Production	Alternative 2 Low Commercial Production	Alternative 3 No Action		
<u>Wilderness</u> WSA and ISA Within STSA	17 in 6 STSAs	17 in 5 STSAs	None	No	Degradation of WSAs is not allowed and tar sand could not be developed until or unless the wilderness status is dropped.
<u>Visual Resources</u> Loss of Visual Resources	9 STSAs	6 STSAs	None	No	When an area was disturbed, the visual resources could be degraded until restoration occurs. In some cases, it is doubtful this would occur.
<u>Cultural Resources</u> Inadvertent Resource Loss	9 STSAs	6 STSAs	None	No	
<u>Livestock Grazing</u> Loss of Livestock Grazing	3,192 ADMs	887 ADMs	None	No	Some immediate reduction in available forage would require reduction in cattle use. Because the area is revegetated, forage values could be increased in some places, but generally would not change much from the existing forage.
<u>Socioeconomics</u> Peak Population School-age Population Employment Number of Highways Affected	53,901 13,255 19,236 11 highways	15,034 4,615 6,111 6 highways	210,931 ^c 64,728 ^c 75,125 ^c None	Yes	The immediate population increases would change community situations. Even after the project was disbanded, the existing lifestyle and living conditions would never revert to those of the present time.

^aThis number represents the projected water depletions for all Utah projects on the Colorado River system to year 2010 not including tar sand development.

^bEstimated number for year 2010.

^cThese numbers represent projections for the year 2005 from other projects with no tar sand development. Cumulative figures may be found by adding the figures in the No Action Alternative to the alternatives.

CHAPTER 3

AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes the environment which would be affected by tar sand development and contains other pertinent data required to understand the environmental aspects of the affected area.

No tar sand development is currently expected to occur on Pariette or White Canyon Special Tar Sand Areas (STSAs). However, these STSAs are discussed in this chapter because future development could be proposed. In that case, descriptions in this chapter could be used for tiering purposes.

AIR QUALITY AND CLIMATE

All of the STSAs are located within the landforms of the Colorado Plateau physiographic province at elevations ranging from 5,000 to 10,000 feet. These landforms are within the Colorado River watershed.

Utah's climatic variations significantly correlate to differences in elevation. The region is generally semi-arid, characterized by low relative humidity, abundant sunshine, low to moderate precipitation, warm summers, and cold winters. Lower-elevation STSAs are characterized by lack of moisture, having 8 or less inches of precipitation per year. Higher-elevation STSAs receive 30 or more inches of precipitation per year. Seasonal and daily temperature variations can be extreme. Average January Fahrenheit (F) temperatures range from the teens at higher elevations to the upper 20s in valleys. Average July temperatures range in the high 50s in the mountains to the low 80s along the Colorado River. The mean length of the frost-free season ranges from 30 days at the highest elevations to 180 days at lower elevations.

Regional airsheds encompassing STSAs have been based on confinement of air movement, topographic barriers, and meteorology. Table 3-1 indicates ambient air quality for STSAs. These airsheds are topographically bounded on the west by the Wasatch Plateau and on the north and east by the Uinta and Rocky mountains. These topographic features significantly limit airflow out of this regional basin.

Ambient air quality is regulated by provisions of the Federal Clean Air Act and its amendments of 1970. Two sets of ambient air quality standards apply to the region: the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) incremental limitations. NAAQS are uniform minimum national standards for air quality. Primary NAAQS are designed to protect human health whereas secondary NAAQS are designed to protect human welfare and include such con-

cerns as crop loss. PSD limitations provide additional protection to air quality and related values in areas where existing air quality is better than the minimum required, such as is typical of STSAs. Individual states may also establish air quality objectives if these standards do not allow pollutant levels above the national minimum limits. Both Utah and Colorado have ambient air quality standards equal to the NAAQS (see Table 3-2).

Areas with PSD incremental limitations which would be affected by tar sand development are divided into two classes:

Class I: Applies to areas in which practically any air quality deterioration would be considered significant, thus allowing little or no major energy or industrial development.

Class II: Applies to areas in which deterioration normally accompanying moderate, well-controlled growth would not be considered significant.

All STSAs are located within designated Class II areas except that part of Circle Cliffs which is located in Capitol Reef National Park and a small portion of the Tar Sand Triangle located in Canyonlands National Park. These areas are Class I. Utah national parks (Arches, Canyonlands, and Capitol Reef) located close to and in STSAs are mandatory Class I areas. The portion of Dinosaur National Monument within Colorado and Colorado National Monument near Grand Junction are Colorado Category I areas, having sulfur dioxide (SO₂) standards similar to Federal Class I. *Dinosaur and Colorado national monuments have been recommended by the U.S. Department of the Interior (USDI) for Class I redesignation.* Table 3-3 lists Class I and II allowable increments for SO₂ and total suspended particulates (TSP).

Most STSAs are in rural areas which are not close to major pollution sources. Table 3-1 shows ambient air quality for each STSA. Table 3-4 shows background median visual ranges at each STSA. Regional visibility is usually good, ranging from 119 miles at Circle Cliffs STSA to 109 miles at San Rafael Swell STSA.

The landscapes encompassing all STSAs, as well as those of the Rocky Mountain ranges to the east, are considered highly sensitive for acid deposition because of chemical composition of soils, climatic patterns, and types of vegetation (Environmental Protection Agency [EPA], 1977). Currently, there is no EPA-recommended guideline or procedure for determining potential impacts from acid deposition to sensitive ecosystems. Based on the existing sulfur deposition values from monitoring sites in the Western states mountain region, the background sulfur deposition flux is

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-1

Ambient Air Quality Within Airsheds

Pollutant	White River Airshed ^a ($\mu\text{g}/\text{m}^3$) ^c	Colorado River Airshed ^b ($\mu\text{g}/\text{m}^3$)
<u>Total Suspended Particulates</u>		
24-hr max.	53-127	90
Annual	13-25	19
<u>Sulfur Dioxide</u>		
24-hr max.	0-14	< 13
Annual	0-3	< 13
<u>Nitrogen Dioxide</u>		
Annual	0-6	0-6
<u>Carbon Monoxide</u>		
1-hr max.	700-7400	NA ^d
8-hr max.	400-4500	NA ^d
<u>Ozone</u>		
1-hr max.	137-160	132

Source: Aerocomp, Inc., 1983a.

^aIncludes the following STSAs:
 Argyle Canyon/Willow Creek
 Asphalt Ridge/White Rocks
 Hill Creek
 P. R. Spring
 Pariette
 Raven Ridge/Rim Rock
 Sunnyside

^bIncludes the following STSAs:
 Circle Cliffs
 San Rafael Swell
 Tar Sand Triangle
 White Canyon

^cConcentrations given in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

^dConcentrations not established.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-2

NAAQS for National Levels and Colorado and Utah

Pollutant	Averaging Time	Primary ($\mu\text{g}/\text{m}^3$) ^a	Secondary ($\mu\text{g}/\text{m}^3$) ^b
Ozone	1 hour ^c	235	d
Carbon monoxide	8 hour	10,000 ^e	d
	1 hour	40,000 ^e	d
Nitrogen dioxide	Annual Arithmetic Mean	100	d
Sulfur dioxide	Annual Arithmetic Mean	80	NA ^f
	24 hour	365	NA ^f
	3 hour	NA ^f	1,300
Total suspended particulates	Annual Geometric Mean	75	60
	24 hour	260	150
Lead	Calendar Quarter	1.5	d

Source: Aerocomp, Inc., 1983a.

Note: National standards, other than for ozone or those based on annual average: these standards are not to be exceeded more than once per year.

^aAir quality levels which affect human health.

^bAir quality levels which affect human welfare (e.g., crops, cropland, other vegetation, and animal life).

^cThe number of days during a calendar year in which one or more hourly values could equal or exceed the ozone standard must be less than or equal to 1.

^dSame as primary standard.

^eMilligram/meter³.

^fStandard not established.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-3

PSD Incremental Limitations

Pollutant	Averaging Time	Maximum Allowable Concentration ($\mu\text{g}/\text{m}^3$)	
		Class I	Class II
Sulfur dioxide	Annual	2	20
	24-hour	5	91
	3-hour	25	512
Total suspended particulate matter	Annual	5	19
	24-hour	10	37

Source: Aerocomp, Inc., 1983a.

TABLE 3-4

Background Median Visual Range at Each STSA

STSA	Background Median Visual Range (miles)	Monitoring Station
Argyle Canyon/Willow Creek	123	Dinosaur N.M. ^a
Asphalt Ridge/White Rocks	123	Dinosaur N.M.
Circle Cliffs	119	Capitol Reef N.P. ^b
Hill Creek	123	Dinosaur N.M.
P. R. Spring	123	Dinosaur N.M.
Pariette	123	^c
Raven Ridge/Rim Rock	123	Dinosaur N.M.
San Rafael Swell	129	Cedar Mountain
Sunnyside	123	Dinosaur N.M.
Tar Sand Triangle	121	Canyonlands N.P.
White Canyon	121	^c

Source: Aerocomp, Inc., 1983a.

^aN.M. = National Monument.

^bN.P. = National Park.

^cBackground median visual range based on air quality data derived from a similar STSA.

0.28 grams per square meter per year ($\text{g}/\text{m}^2/\text{yr}$). The Environmental Defense Fund (Oppenheimer, 1982) suggested that sulfur deposition rates below $0.5 \text{ g}/\text{m}^2/\text{yr}$ would not lead to acidification of sensitive lakes.

WATER RESOURCES

The 11 STSAs are in the Upper Colorado River Basin in Utah. Most streamflow originates at altitudes above 8,000 feet. Flow is typically perennial in the higher altitudes (i.e., Argyle Canyon/Willow Creek and Sunnyside STSAs) where normal annual precipitation exceeds 30 inches. As the smaller streams flow through areas receiving less than 10 inches of precipitation annually, they become intermittent and, ultimately, ephemeral. Normal annual precipitation in most of the areas below 5,000 feet is less than 8 inches; precipitation is less than 6 inches near the San Rafael Swell STSA.

Major tributaries to the Colorado and Green rivers in and near the 11 STSAs are the Dirty Devil, Duchesne, Escalante, Price, San Rafael, and White rivers. Most of these rivers drain to the Green River, and ultimately all drain to the Colorado River and Lake Powell (See Figure 3-1). Much of the variations in annual precipitation and resulting runoff in and near the 11 STSAs reflect differences in altitude.

Most of the data concerning water quantity and quality are taken from a report prepared for the BLM by the USDI, Geological Survey (GS) (1983).

Water Quantity

Surface and groundwater resources in or near the STSAs are shown in Tables 3-5 and 3-6, respectively. Streamflow varies from one location to another and also varies seasonally and yearly at each location, depending on the amount and intensity of precipitation and the rate of snowmelt.

Water Quality

Water quality for STSAs is also shown in Tables 3-5 and 3-6. Chemical qualities of streamflow and groundwater are strongly influenced by the nature of rocks over which the water passes. Increased concentration of dissolved solids are also attributed to return flow from irrigation, discharge from mines, and increased concentrations as flow is depleted by evapotranspiration. Groundwater quality in shallower formations is generally of better quality than formations at greater depths.

Effluent would be limited to no higher than 10 milligrams per liter (mg/ℓ) tar and grease, 1000 lbs. total dissolved solids (TDS) on a daily average, and a maximum of 35 mg/ℓ biochemical oxygen demand weekly average. In all cases State water quality class standards must be met for the area (Nelson, 1984).

Water Requirements and Future Effects on the Colorado River System

The Colorado River Simulation System, a computerized model of the Colorado River, was used to simulate flows from 1983 to 2025, and to estimate salinity of the Colorado River and its tributaries considering a tar sand industry (Konwinski, 1983).

According to the projected water supply and depletions shown in Appendix 3, current depletions in the Colorado River basin are projected to leave available 348,000 acre-feet for the upper basin and 48,000 acre-feet for Utah in the year 2000 (159,000 acre-feet/year of the upper basin allocation and 39,000 acre-feet/year of Utah's allocation would still be available by the year 2010). All available water would be used by the year 2040. Current depletions (1983) and projected baseline depletions to the year 2005 are shown in Table 3-7. These depletions are shown for the following measuring points: Duchesne River at the Green River; White River at the Green River; San Rafael River at Green River, Utah; Green River at Green River, Utah; and inflow to Lake Powell. The sources of the water use are shown in Appendix 3.

Groundwater

The most important known groundwater sources are shown in Table 3-6. Recharge to aquifers occurs from precipitation, streamflow, and subsurface inflow. The amount of recharge is dependent upon precipitation; recharge is sporadic and infrequent, depending upon the intensity of precipitation and the rate of snowmelt and thickness of snowcover (Hood, 1977).

Water Rights

Water rights in the STSAs are fully appropriated by existing rights or applications for rights. Uses include irrigation, municipal, industrial, domestic, and livestock (USDI, GS, 1983).

SOILS

Soils data for the 11 STSAs were compiled from different sources varying in level of detail. All STSAs are located in eastern Utah in the Uinta Basin and Canyonlands sections of the Colorado Plateau Physiographic Province. This province is distinguished by its generally high elevation and its numerous canyons (Wilson et al., 1975).

Because of variations in parent material, climate, topography, and vegetation, the STSAs have a wide variety and combination of soils. Soils vary from moist, dark, and light soils of the mountains and plateaus to dry, light-colored soils of the valleys, terraces, and mesas. Soils are generally derived from sandstones, shales, and siltstones. Sandy soils are common, particularly near ridgelines, with clayey soils generally occurring on or near shale outcrops. Alluvial fans

CHAP 3--AFFECTED ENVIRONMENT

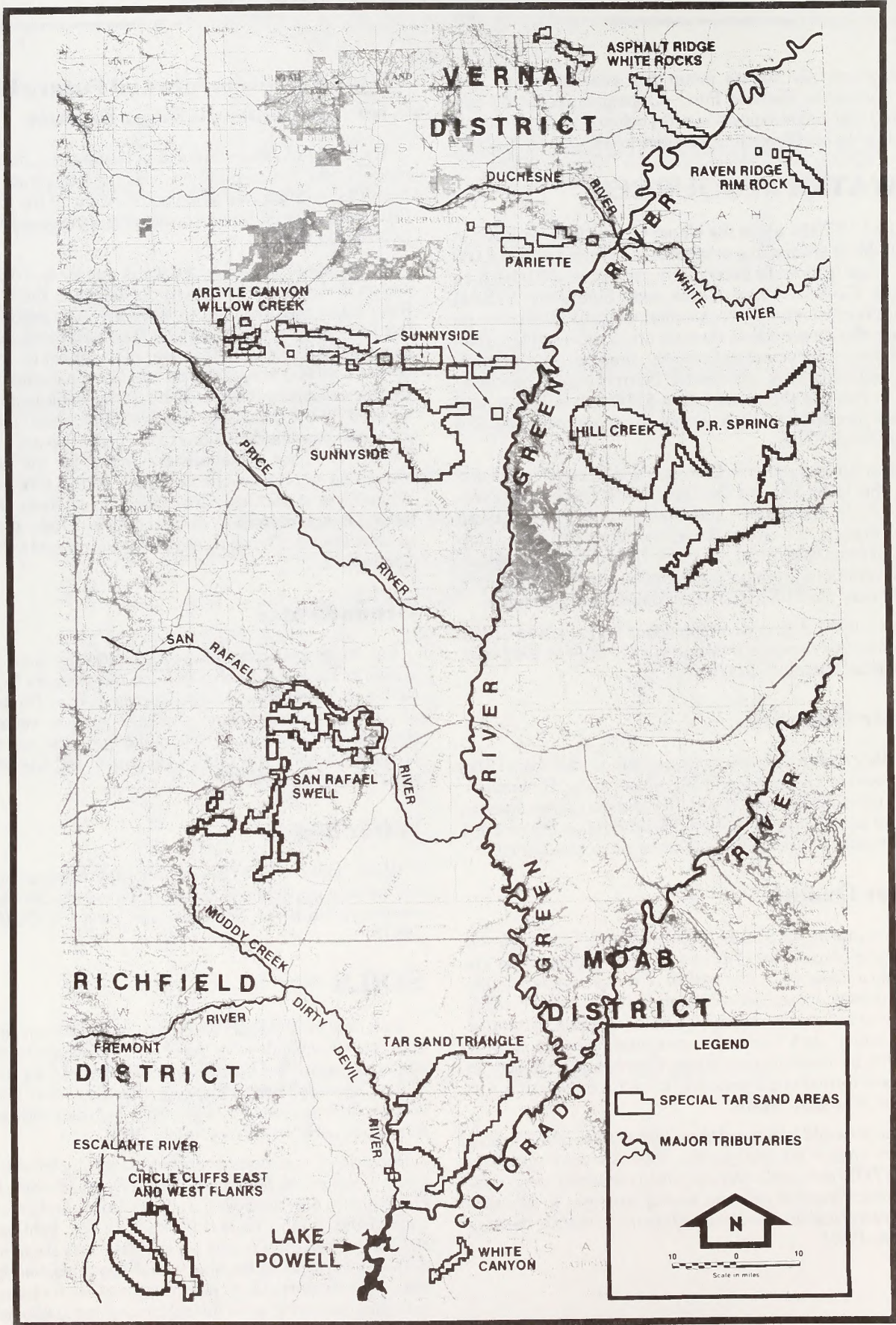


FIGURE 3-1
WATER DRAINAGES WITHIN STSAs

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-5

Surface Water Resources Within or Near STSAs

STSA	Streams	Quantity ^a Average Annual Flow (Acre-Feet)	Quality ^{a,b} Maximum TDS (mg/l)	Uses
Argyle Canyon/ Willow Creek and Sunnyside	Green River	--	--	Irrigation, livestock, domestic and boiler water for Town of Sunnyside, culinary water for Price and Helper cities.
	Strawberry River	90,560	548	
	Duchesne River	398,500	3,330	
	West Fork of Avintaquin Creek	10,430	413	
	Nine Mile Creek	--	--	
	Minnie Maud Creek	3,640 to 14,770	511 to 1,000	
	Argyle Creek	--	--	
	Range Creek	--	--	
	Price River	43,220 to 81,140	200 to 7,060	
	Willow Creek	5,900	536 to 814	
	Grassy Trail Creek	2,500	1,810 to 2,510	
	Icelandier Creek	--	6,080	
Whitmore Canyon	--	658		
Asphalt Ridge/ White Rocks	Uinta River	250,000 ^c	279	Irrigation, domestic, municipal, and industrial.
	White Rocks River		38 to 67	
	Ashley Creek		40 to 4,440	
	Dry Fork Creek		--	
	Green River	3,200,000	600	
Circle Cliffs	Escalante River	62,000 at mouth	--	Irrigation in Upper Escalante River Basin. Spring flow used for livestock.
	Hall's Creek	--	--	
Hill Creek and P. R. Spring	Bitter Creek	3,000	412 to 15,500	Irrigation, Bonanza gilsonite mine, livestock, and oil development.
	Hill Creek	6,000	--	
	Willow Creek	15,000	3,650	
	Towave and Weaver Reservoirs	2,000	--	
	White River	500,000	1,400	
Green River	4,100,000	3,400		
Pariette	Pariette Draw (near Ouray)	14,780	4,190	Minimal use.
Raven Ridge/ Rim Rock	Green River	3,600,000 ^d	73 to	Minimal use: livestock, some oil development.
	White River		1,400	
	Coyote Wash	2,620	--	

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-5 (concluded)

STSA	Streams	Quantity ^a Average Annual Flow (Acre-Feet)	Quality ^{a,b} Maximum TDS (mg/ℓ)	Uses
San Rafael Swell	San Rafael River	75,300 to	6,030 to	Domestic irrigation and Huntington power plant. Major diversions (April to November) nearly deplete streamflow in these streams. Reser- voirs used for irriga- tion and Utah Power and Light Company.
	Upper Muddy Creek	105,100	6,530	
	Eight reservoirs	27,020	4,860	
	west of STSA	115,000		
Tar Sand Triangle and White Canyon	Green River	4,152,000	3,440	Livestock, mining, and public supply for tourists. 510 acres irrigated near Hanksville approximately 45 miles northwest of Tar Sand Triangle STSA.
	Dirty Devil River	69,770	3,460	
	Fremont	48,690	3,010	
	North Wash	869	--	
	White Canyon	3,690	--	
	Colorado River at Hite	9,775,000	1,530	

Source: U.S. Department of Interior (USDI), Geological Survey (GS), 1983.

^aWhere two figures are shown, they represent measurements or samples taken at separate locations.

^bThe terms used to classify water according to the concentrations of dissolved solids, in milligrams per liter (mg/ℓ), are as follows:

Fresh	Less than 1,000
Slightly Saline	1,000 to 3,000
Moderately Saline	3,000 to 10,000
Very Saline	10,000 to 35,000
Briny	More than 35,000

^cCombined flow of Uintah River, White Rocks River, Ashley Creek, and Dry Fork Creek.

^dCombined flow of Green River and White River.

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-6

Groundwater Resources Within or Near STSAs

STSA	Source	Quantity Gallons Per Minute (gpm)	Quality ^{a,b} Range of TDS (mg/ℓ)	Formations and Other Characteristics
Argyle Canyon/ Willow Creek and Sunnyside	Wells Springs	<1-350	190-67,800	Unconsolidated deposits, Green River, Flagstaff, Blackhawk, Price River, North Horn, Ferron, and Uinta.
Asphalt Ridge/ White Rocks	Ashley Valley aquifer	0.1-503	149-2,420	Shallow aquifer of Ashley Valley has an estimated 50,000-75,000 acre-feet of recoverable groundwater (Hood, 1977).
	Duchesne River Formation	0.1-40	505-1,400	
	Dakota Sandstone, Morrison	3-20	No data	
	Nugget Sandstone			
	Shallow wells	1-100	336-721	
	Deep wells (6,000')	--	1,870	
	Gartra Grit member of Chinle	2	--	
	Spring from Chinle Springs	45	742	
	36-83,250	69-742		
Circle Cliffs	Wells	--	188-8,510	Little data available.
	Mine sump	--	8,510	
Hill Creek and P. R. Spring	Springs	<50 gpm most are <10gpm.	297-6,110	Quaternary alluvium, Birds Nest aquifer, and Douglas Creek aquifer
Pariette	Wells	3-60	116-4,480	Recharge is from irriga- tion water. Uinta Formation.
Raven Ridge/ Rim Rock	Wells	0.1-200	221-118,000	Uinta, Green River, Wasatch, Park City, Mesa Verde Group, Nugget Sandstone, Entrada Sandstone, Weber Sand- stone.
San Rafael Swell	Wells	2.8-200	--	Entrada, Navajo, Wingate, Coconino sandstone, Moenkopi, Mississippian-age rocks. Highest yields from Navajo and Moenkopi.
	Springs	<1-200	--	

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-6 (concluded)

STSA	Source	Quantity Gallons Per Minute (gpm)	Quality ^{a,b} Range of TDS (mg/l)	Formations and Other Characteristics
Tar Sand Triangle and White Canyon	Wells Springs	70 (maximum) Generally <50 Two springs have 360 and 450 gpm.	318-85,500 179-6,530. Generally <2,400.	Navajo, Wingate, Coconino Sandstone.

Source: USDI, GS, 1983.

^aWhere two figures are shown, they represent measurements or samples taken at separate locations.

^bThe terms used to classify water according to the concentrations of dissolved solids, in milligrams per liter (mg/l), are as follows:

Fresh	Less than 1,000
Slightly Saline	1,000 to 3,000
Moderately Saline	3,000 to 10,000
Very Saline	10,000 to 35,000
Briny	More than 35,000

^cCombined flow of Uintah River, White Rocks River, Ashley Creek, and Dry Fork Creek.

^dCombined flow of Green River and White River.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-7

Current and Projected Baseline Water Depletions
Within or Near STSAs

Tar Sand Industry Water Source	Measuring Points	Depletion Schedule ^a					
		1983	1985	1990	1995	2000	2005
White Rocks River	Duchesne River at Green River	448	467	538	591	668	668
White River	White River at the Green River	42	42	133	156	210	210
San Rafael River	San Rafael River at Green River, Utah	84	84	99	99	99	99
Green, Price, and Escalante Rivers	Green River at Green River, Utah	155	155	168	168	205	205
Dirty Devil River	Inflow to Lake Powell	34	34	50	50	50	50

Source: Konwinski, 1983.

^aFigures expressed in thousands of acre-feet.

CHAP 3--AFFECTED ENVIRONMENT

are loamy and very stony and bouldery. Some soils near washes and on the lower slopes have accumulated soluble salts in some part of their profile. Table 3-8 shows types and characteristics for soils within the STSAs.

Sediment yield classes and salinity classes for each STSA are shown in Table 3-9. Because sediment yield data were taken from map overlays showing only general distribution of sediment yield classes (USDI, Bureau of Reclamation, 1975), these data should be used only for general planning purposes. None of the STSAs had sediment yield rates in either Class 1 (extremely high) or in Class 6 (very low). Of the 11 STSAs, most of the area is in Class 4, moderate, followed by Class 3, high.

The four salinity classes shown in Table 3-9 are determined by electrical conductivity of soil extracts and are expressed in millimhos per centimeter (mmhos) (see Glossary). Class 1, non-saline, has less than 4 mmhos in the soil profile. Class 2, slightly saline, has less than 4 mmhos above 8 inches and 4-16 mmhos below 8 inches. Class 3, moderately saline, has 4-16 mmhos above 20 inches and greater than 16 mmhos below 20 inches. Class 4, strongly saline, has greater than 16 mmhos throughout the soil profile.

TOPOGRAPHY, TAR SAND, AND OTHER MINERALS

Table 3-10 provides data for tar sand deposits in all STSAs. The following discussion is divided by STSAs.

Argyle Canyon/Willow Creek STSA

TOPOGRAPHY

The deposits are located on areas of steep-sided valleys in the dissected West Tavaputs Plateau north of the Roan Cliffs. These deposits are found at elevations ranging from about 7,400 to 8,700 feet. The area is dissected by intermittent and perennial streams, which have created rugged terrain of high relief ranging from 700 to 1,300 feet. Figure 3-2 shows the geologic formations of the area.

TAR SAND

Bitumen impregnations occur in lenticular limestones and sandstones of the Green River Formation. Rocks dip gently to the northeast (USDI, Minerals Management Service [MMS], 1980). Figure 3-2 shows geologic formations occurring within the STSAs.

Bitumen impregnations occur in three to five principal zones: the total thickness of all the zones ranges from 15 to 60 feet. No data are available to describe the thicknesses of individual layers or to estimate distribution of bitumen (USDI, MMS, 1980).

Tar sand on and near outcrops would be recovered by surface mining where slopes were not too steep. The sparse data available suggest that the thickness, continuity, and

concentration of bitumen are limited. Other areas could be developed by in-situ methods.

OTHER MINERALS

Oil and gas may occur in the rocks underlying the STSA, but the possibility of occurrence is small.

Asphalt Ridge/White Rocks STSA

TOPOGRAPHY

Asphalt Ridge is a cuesta or asymmetrical ridge. The western part of the STSA is a dissected plain. At White Rocks, a ridge is cut by the White Rocks River. Figure 3-2 shows the geologic formations of the area. Elevations in the STSA range from 4,700 to about 7,000 feet.

TAR SAND

Principal bitumen impregnations at Asphalt Ridge occur in sandstones of the Mesa Verde Group (see Figure 3-2). Minor impregnations also occur in sandstones of the Duchense River Formation. At White Rocks, the bitumen impregnations occur in the Navajo Sandstone, which is about 1,000 feet thick, and dips at about 70°.

Bitumen impregnations form lenticular (lens-shaped) layers, and continuity of layers differs from place to place. For Asphalt Ridge, the greatest thicknesses and continuity of bitumen impregnation occur at the north end, where the composite thickness of the bitumen-impregnated beds averages about 90 feet. The average thickness farther south is about 50 feet. For White Rocks, the average thickness is about 1,000 feet. The bitumen impregnations extend to depths of 500 to 730 feet and to at least 1.5 miles along the strike (USDI, MMS, 1980).

Bitumen could be extracted by surface-mining methods along a narrow strip of Asphalt Ridge and at White Rock Canyon. In other parts of the STSA, extraction by in-situ methods could occur where bitumen had sufficient thickness, continuity, and concentration (USDI, MMS, 1980).

OTHER MINERALS

The area has a low potential for oil and gas because it is on the edge of the Uinta Basin, where potential reservoirs are thin or absent. Poor quality coal may occur beneath the tar sand.

Circle Cliffs STSA

TOPOGRAPHY

The interior of the STSA is a gently domed surface with mesas and buttes. Locally, canyons incise the domed surface. Geologic formations are shown in Figure 3-2. Elevations range from 7,000 to 7,300 feet on the mesa tops to 5,700 feet in the canyon bottoms.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-8
Soil Types and Characteristics Within STSAs

STSA	Soil Unit/Landform	Depth	Erosion Hazard	Dominant Slope (Percent)	Dominant Textures	Other Characteristics
Argyle Canyon/ Willow Creek	65% Midfork, GT, JS, ET, Adel, and Podo. 35% minor soils, rock outcrops, and badland	Midfork, JS = V deep Adel = sandstone at 50". GT, ET = shale at 36". Podo = shale at 8"	Midford: water - high wind - none. Adel: water - slight wind - moderate. Podo: water - slight wind - moderate.	15-75	Gravelly loams and clay loams.	Reclamation potential: Moderate slopes = fair to good. Steep slopes = poor.
Asphalt Ridge/ White Rocks	75% Rencot	18"	Water - moderate-high Wind - none	8-25	Gravelly sandy loam and loam	Poor
	Brownsto	60"	Water - slightly moderate Wind - none			Fair
	Luhon	60"	Water - slight Wind - moderate.			Good
	25% rock outcrop, bad- lands, and minor soils					
Circle Cliffs	Highly dissected mesas, benches, rolling, steep hills, and associated fans and floodplains	Dominantly shallow, some deep	70-80% moderate-severe 20-30% slight-moderate		Loams and gravelly loams.	
Hill Creek	33% Atchee 20% Walknolls 12% Gerst	14"	Approx. 30 percent of STSA is in critical erosion condition.	4-25	Channery sandy loam Channery loam Channery and shaly loam.	
		16"		2-25		
		13"		4-25		
P. R. Spring	25% Atchee 13% Castner 7% Haverdad	14"	Approx. 4 percent of STSA is in critical erosion condition.	4-25	Channery sandy loam Very gravelly loam Loam	
		18"		3-8		
		60+"		0-8		
Pariette	Motto	Shallow	Water - moderate Wind - none	2-8	Sandy loam over clay loam.	
	Muff	Moderately deep	Water - slight Wind - moderate			
	Uffens	Very deep	Water - slight Wind - moderate			
	Badland, rock outcrops, and minor soils					
Raven Ridge/ Rim Rock	20% Atchee 25% Haverdad 7% Walknolls	14"	Approx. 5 percent of STSA is in critical erosion condition.	4-25	Channery sandy loam Loam Channery loam.	
		60+"		0-8		
		13"		2-25		
San Rafael Swell	Mesas, structural benches, and cuestas	Generally shallow, others moderately deep to deep	High, when existing vegetation is removed, especially shales and steep slopes		Sandy to clayey	Soluble salts near washes and on alluvial fans.
Sunnyside	Floodplains, terraces, alluvial fans, and high terraces.	Deep	Water - slight to moderate	1-8 sloping to strongly sloping.	Loam and sandy loam	
	Mesas, mountains, ridge- top plateaus, mountain sideslopes.	Shallow to deep	Water - slight to moderate			
	Mountain sideslopes, canyon walls, and mesa escarpments	Very shallow to moderately deep	Water - high	Very steep	Loamy-skeletal Sandy-skeletal	
Tar Sand Triangle	Mellenthin-Mido-Begay Farb-Moenkopie-Pennell Rock outcrops Arches-moenkopie Travesilla-Yarts-Shedado Rizozo-Chipeta-Begay	Shallow to very deep	Water - slight-moderate Wind - moderate-high for sandy soils.	4-30	Fine sandy loams and loamy fine sands.	
White Canyon	Canyons, mesas, alluvial fans, and rock outcrops.	Over 60 percent of area is <20" deep.	Moderate	<15	Sandy loam and sandy clay loam.	
		20 percent of area is 20-60" deep.	20% = severe 20% = slight	30-70	V. stony sandy loam and sandy clay loam.	
		Less than 20 percent of area is >40" deep.	Water erosion = slight Eolian soils subject to severe wind erosion when disturbed	1-8	Fine sandy loam.	

Sources: Wilson et al., 1975; US Department of Agriculture (USDA), Soil Conservation Service (SCS) et al., 1979; USDI, BLM, 1979, 1982a, 1982b, 1983a; and Earth Environmental Consultants, Inc., 1980.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-9
Sediment Yield and Salinity Classes Within STSAs

STSA	Sediment Yield Classes (Yield Rate--Acre-Feet/Square Mile/Year)										Salinity Classes					
	2-Very High 1.0-3.0	3-High 0.5-1.0	4-Moderate 0.2-0.5	5-Low 0.1-0.2	1-Not Saline	2-Slightly Saline	3-Moderately Saline	4-Strongly Saline	Total Acres	3-High 0.5-1.0	4-Moderate 0.2-0.5	5-Low 0.1-0.2	1-Not Saline	2-Slightly Saline	3-Moderately Saline	4-Strongly Saline
Argyle Canyon/ Willow Creek	--	--	--	3,160	14%	18,703	86%	21,863	100%	--	--	--	--	--	--	--
Asphalt Ridge/ White Rocks	--	26,675	64%	8,800	22%	5,920	14%	12,800	31%	26,195	63%	1,600	4%	800	2%	
Circle Cliffs	2,240	3%	32,160	35%	56,680	62%	--	90,900	99%	180	<1%	--	--	--	--	
Hill Creek	--	50,119	47%	56,480	53%	650	<1%	107,249	100%	--	--	--	--	--	--	
P. R. Spring	--	60,300	22%	213,650	78%	--	--	263,710	96%	10,240	4%	--	--	--	--	
Pariette	--	11,171	51%	3,800	17%	7,100	32%	--	--	14,871	67%	7,200	33%	--	--	
Raven Ridge/ Rim Rock	--	1,000	6%	15,258	94%	--	--	15,698	97%	560	3%	--	--	--	--	
San Rafael Swell	23,400	18%	23,700	18%	83,192	64%	--	40,000	31%	90,292	69%	--	--	--	--	
Sunnyside	--	15,800	10%	44,200	28%	97,445	62%	157,445	100%	--	--	--	--	--	--	
Tar Sand Triangle	1,600	1%	125,839	80%	28,600	18%	1,300	92,139	59%	65,200	41%	--	--	--	--	
White Canyon	--	10,469	100%	--	--	--	--	6,000	57%	4,469	43%	--	--	--	--	
Totals	1,029,411	27,240	2% 357,233	35% 513,820	50%	131,118	13%	807,804	78%	212,007	21%	8,800	1	800		

Source: USDI, Bureau of Reclamation, 1975.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-10

Quantification of Tar Sand Deposits for STSAs Within Utah

Deposit	Area Extent (Square Miles)	Number of Principal Bitumen Zones	Gross Thickness of Resource (feet)	Overburden Thickness (feet)	Gross In-Place Bitumen (Barrels)
Uinta Basin					
Argyle Canyon/ Willow Creek	7 - 15	3 to 5	15 - 60	0 - 500+	70-75 million
Asphalt Ridge/ White Rocks	25 - 35	2 to 5	10 - 135	0 - 500+	1.1 billion
Circle Cliffs	28	1 to 3	5 - 310	0 - 500+	1.3 billion
Hill Creek	115 - 125	1 to 3	5 - 35	0 - 500+	1.16 billion
P. R. Spring	240 - 270	2 to 6	10 - 80	0 - 500+	4.0-4.5 billion
Pariette	1.2 - 1.4	1 or 2	5 - 32	0 - 300	12-15 million
Raven Ridge/ Rim Rock	22 - 30	1 to 4	5 - 95	0 - 500+	100-130 million
San Rafael Swell	15 - 30	2	20 - 40		500 million
Sunnyside	35 - 90	3 to 12	15 - 550	0 - 500+	3.5-4.0 billion
Tar Sand Triangle	200 - 230	1 or 2	5 - 300+	0 - 500+	16 billion
White Canyon	16	1	0 - 480		12-15 million

Source: Campbell and Ritzma, 1979.

CHAP 3--AFFECTED ENVIRONMENT

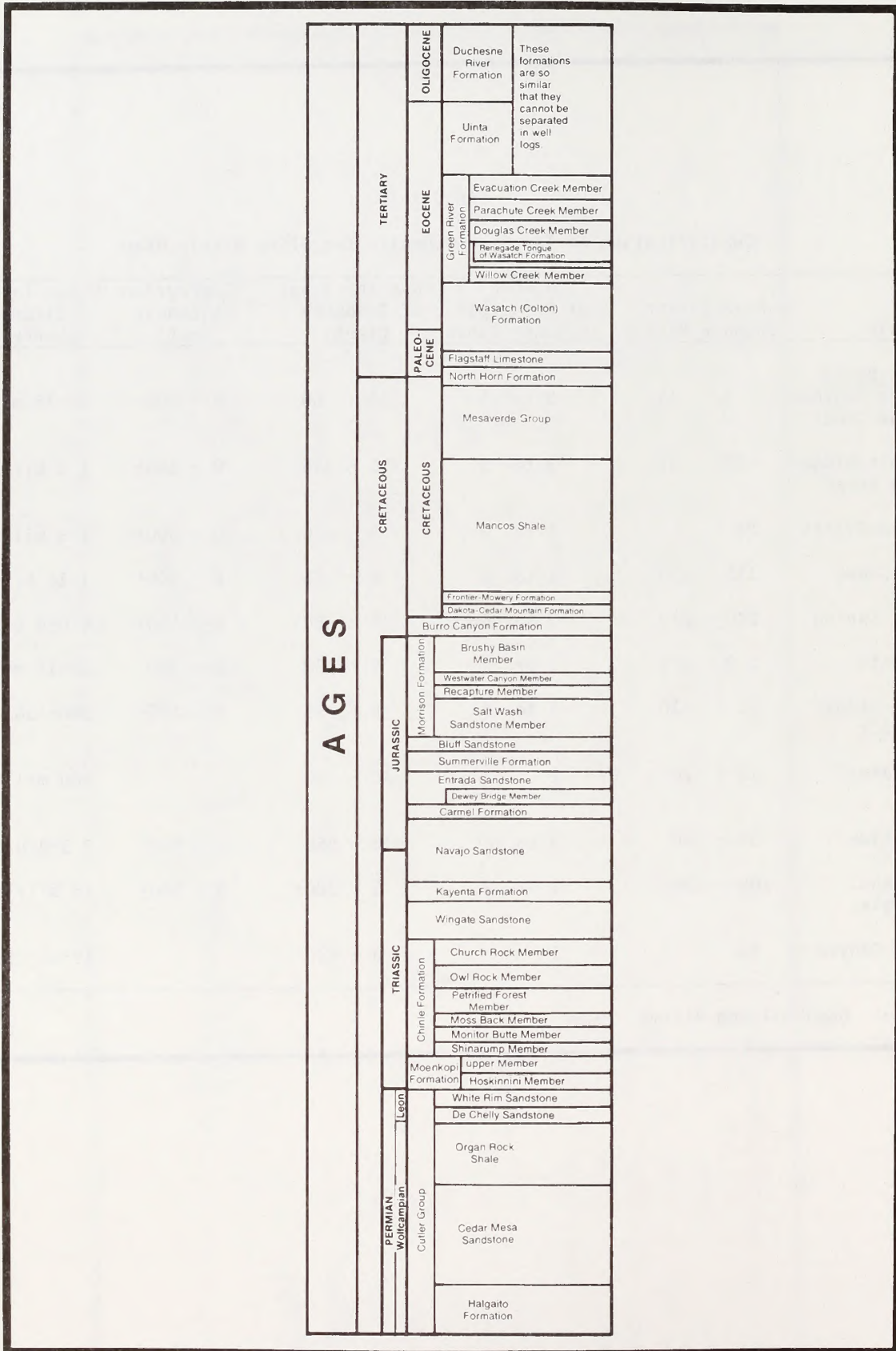


FIGURE 3-2
GEOLOGIC FORMATIONS WITHIN STSAs

CHAP 3--AFFECTED ENVIRONMENT

TAR SAND

Bitumen impregnations occur in moderately well-sorted sandstones near the base of the Moenkopi Formation (see Figure 3-2), which is a giant fossil delta. The bitumen-impregnated Moenkopi has been eroded from the central part of the Circle Cliffs anticline. The beds on the west side dip westward at 2° to 3°; those on the east side dip eastward at a few degrees in the west to more than 25° in the east (USDI, MMS, 1980).

Tar sand ranges in thickness from 5 feet to 310 feet. The lower part of the Moenkopi Formation contains impregnations over a large area, although data on distribution, continuity, and saturation of bitumen impregnations are limited (Davidson, 1967; and Campbell and Ritzma, 1979).

Bitumen extraction by either surface mining or in-situ methods would be limited by the rugged topography and overburden thickness. Generally, tar sand is too deeply buried for surface-mining methods to be practical. About 8,200 acres have been identified as having some potential for surface mining and 18,000 acres as having some potential for in-situ extraction (USDI, MMS 1980).

OTHER MINERALS

The area has a low potential for oil and gas. The structural dome is a potential trap for oil and gas, and a small gas field occurs southeast of the Circle Cliffs structure. Uranium deposits occur locally in the Shinarump Conglomerate, which overlies the Moenkopi Formation.

Hill Creek STSA

TOPOGRAPHY

The area occurs in the east Tavaputs Plateau. Topography ranges from the deeply dissected edge of the plateau in the south to a slightly dissected plain in the north. Formations slope (dip) northward, and the surface slopes northward less steeply than the formations slope, causing more overburden to the north. Elevations range from 7,500 feet in the south to 5,700 in the north. Figure 3-2 shows the geologic formations within the STSA. Elevations within the Hill Creek deposit range from 7,500 feet in the south to 5,700 feet in the north.

TAR SAND

The bitumen impregnations occur in the Douglas Creek and Parachute Creek members of the Green River Formation (see Figure 3-2). Limited data indicate that the deposit has a gross thickness of 5 to 35 feet and that, at any one place, the bitumen occurs in one to three zones. The overburden ranges from 0 feet at outcrops in the south to more than 500 feet at 1/4 mile from the outcrop, and even deeper to the north. The concentration of bitumen generally is less than it is at the P. R. Spring STSA to the east (USDI, MMS, 1980).

Surface mining would not be feasible in nearly all of the STSA because the overburden is too thick. The sparse data show that the net thickness of bitumen zones averages only 7.3 feet, and the average content of bitumen is less than 10 percent (USDI, MMS, 1980).

OTHER MINERALS

The area is favorable for oil and gas. Coal in Cretaceous rocks may underlie the STSA. Oil shale overlies tar sand deposits in the northern portion of the STSA.

P. R. Spring STSA

TOPOGRAPHY

The area occurs on the southern margin of the East Tavaputs Plateau. The plateau slopes gently northward and is deeply and closely dissected in the southern part of the area. The terrain is not rough in the vicinity of the principal impregnations of bitumen, except for the deep canyons which cut the plateau. Elevations range from 8,400 feet in the south to 5,600 feet in the north, with a relief of 2,800 feet. Figure 3-2 shows the geologic formations within the STSA.

TAR SAND

The bitumen impregnations occur in the upper part of the Douglas Creek Member of the Green River Formation (see Figure 3-2). Impregnations are concentrated in five zones, but generally only one zone contains substantial deposits at any single location. The cumulative net thickness of all zones varies from 10 to 80 feet and averages about 35 feet (USDI, MMS, 1980). The average thickness of the most favorable zone is generally less than 20 feet.

The overburden is too thick for surface mining to be practical, except in the southern part of the STSA. The STSA is one of the most favorable areas for in-situ extraction of bitumen in Utah because of the relative thickness, good continuity, and amount of saturation of the bitumen impregnations (USDI, MMS, 1980).

OTHER MINERALS

The area is very favorable for oil and gas. Producing gas wells occur within and near the STSA. Coal may occur in Cretaceous rocks beneath the STSA. Oil shale overlies tar sand deposits in the north portion of the STSA.

Pariette STSA

TOPOGRAPHY

The area is a gently sloping plain that includes dissected areas including low mesas and buttes. The maximum local relief is about 350 feet, and the average local relief generally is less than 100 feet. Figure 3-2 shows the geologic forma-

CHAP 3--AFFECTED ENVIRONMENT

tions of the area. Elevations in the vicinity of the deposits range from about 4,800 to 5,400 feet.

TAR SAND

The bitumen impregnations occur in lenticular stream channel sandstones in the fluvial sediments of the Uinta Formation of Tertiary age. The beds dip northeasterly at about 1° to 3° (USDI, MMS, 1980).

Limited data (Ritzma, 1979) indicate that 1 or 2 principal bitumen-impregnated zones occur in the STSA. Thickness ranges from 5 to 32 feet, and total extent is estimated at less than 1.4 square miles. The location of impregnated layers cannot be determined from available data.

Because of the small size and thickness and probable discontinuous nature of the tar sand, bitumen probably could not be extracted on a commercial scale in the foreseeable future because the overburden is generally too thick for surface mining. The bitumen impregnation may be too discontinuous, thin, and low grade for in-situ extraction (USDI, MMS, 1980).

OTHER MINERALS

The area is very favorable for oil and gas, and producing wells occur in and near the STSA. Oil shale occurs beneath the STSA.

Raven Ridge/Rim Rock STSA

TOPOGRAPHY

A series of northwest-trending low hogback ridges comprise most of the STSA. The southwest portion is a slightly dissected plain. The elevation ranges from 6,000 to 6,200 feet. Figure 3-2 shows the geologic formations of the STSA.

TAR SAND

Bitumen impregnations occur in sandstones of the Green River Formation of Tertiary age (see Figure 3-2). Rocks dip southwesterly at 10° to 33° (USDI, MMS, 1980).

Bitumen impregnations occur in discontinuous layers. At different locations, significant impregnations occur within one to four layers in the STSA. The gross thickness of bitumen ranges from 5 to 95 feet, but no data are available to describe the net thicknesses or other characteristics of the bitumen-impregnated layers (USDI, MMS, 1980).

A narrow band of bitumen-impregnated rock occurring along Raven Ridge could be extracted by surface-mining methods. Bitumen in the remainder of the deposit is too deeply buried to be extracted by surface-mining methods, but could potentially be extracted by in-situ methods.

Available data do not adequately describe the bitumen concentrations in pore spaces in the rock or the number and thickness of bitumen-impregnated layers. The deposit

has only modest probability of commercial extraction within the foreseeable future (USDI, MMS, 1980).

OTHER MINERALS

The STSA is favorable for oil and gas; a major field occurs west of the STSA. Oil shale also underlies the STSA. The Mahogany oil shale zone occurs above the tar sand deposit.

San Rafael Swell STSA

TOPOGRAPHY

The San Rafael Swell is a huge northwest-trending breached, elongated dome. The interior is an open-domed plain that contains numerous mesas and buttes, especially in the east, which is incised by canyons. Figure 3-2 shows the geologic formations of the STSA. Elevations range from about 4,500 feet to more than 7,000 feet.

TAR SAND

Principal bitumen impregnations occur in sedimentary rocks of the Black Dragon Member of the Moenkopi Formation (see Figure 3-2). The Black Dragon Member, which occurs of fine-grained, moderately well-sorted sandstone deposited as part of a large delta during Triassic time. Minor impregnations occur in the Sinbad Limestone Member, which overlies the Black Dragon. The overlying clastic rocks of the Moenkopi Formation, which are finer grained and less permeable than rocks of the Black Dragon Member, contain minor bitumen impregnations (Blakey, et.al., 1977).

The most significant bitumen impregnations occur in the lower and middle parts of the Black Dragon Member, although isolated spots of bitumen occur in the upper portion and the overlying Sinbad Limestone Member (USDI, MMS, 1980).

Bitumen impregnations are commonly 20 to 40 feet thick and of relatively small concentration. Impregnations are more than 60 feet thick near Mexican Mountain, and the concentration of bitumen is moderate. The thickness of overburden exceeds the thickness of bitumen-impregnated sandstone.

There is only a limited development potential. The deposit would be better suited for in-situ production than surface mining because the thickness of overburden exceeds that of the impregnated rock.

OTHER MINERALS

The STSA has a poor potential for oil and gas. Locally, uranium occurs in the Temple Mountain Formation which overlies the bitumen-impregnated rocks in some places. Copper mineralization occurs in some places in the Chinle Formation and Navajo Sandstone.

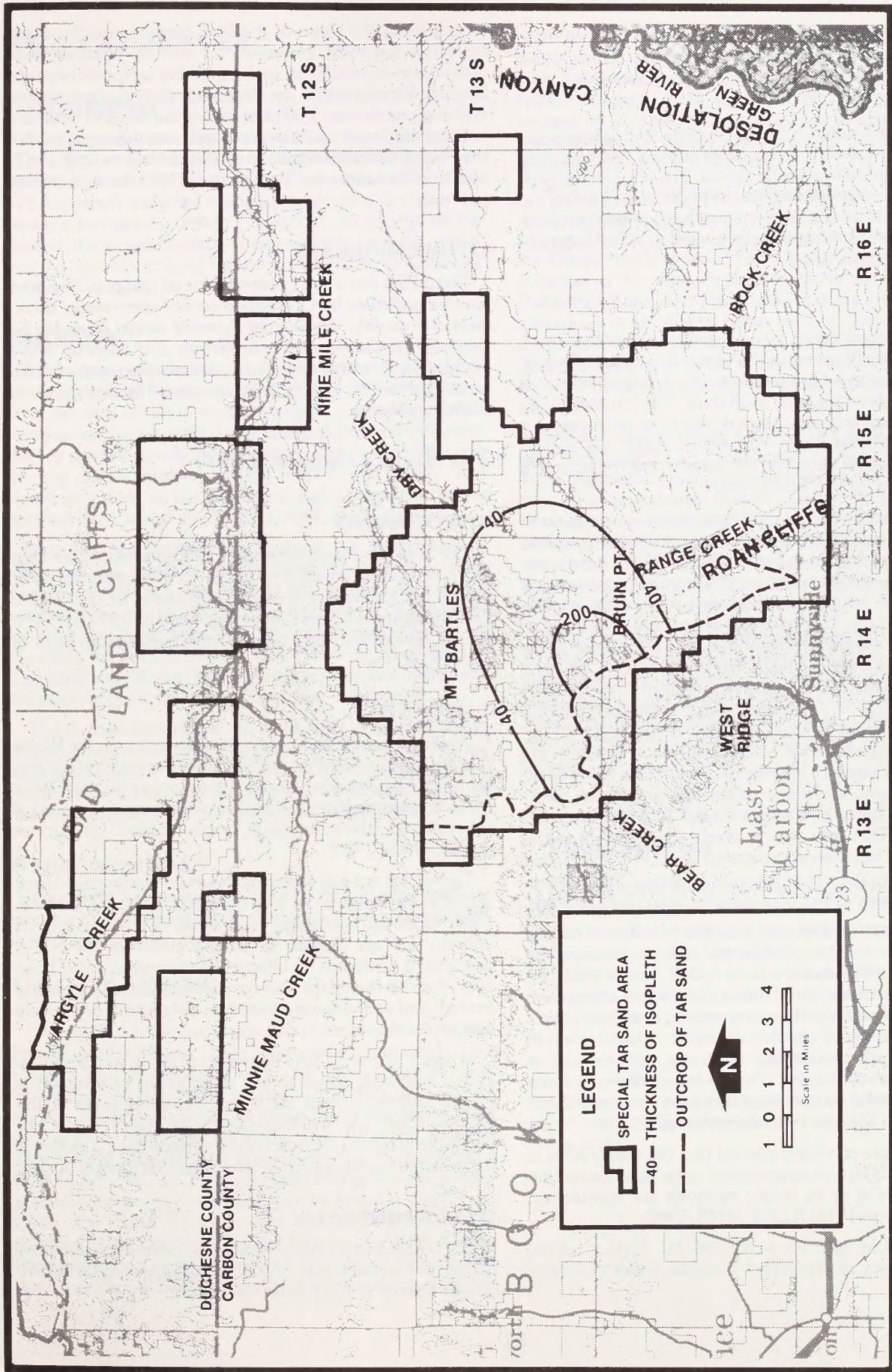


FIGURE 3-3
GENERALIZED DISTRIBUTION OF TAR SAND THICKNESS

CHAP 3--AFFECTED ENVIRONMENT

Sunnyside STSA

TOPOGRAPHY

The STSA is located in the deeply dissected western part of the West Tavaputs Plateau. Most of the STSA has steep slopes, with only a few gentle slopes. The bituminous beds lie at elevations between 9,000 and 10,000 feet near the top of the Roan Cliffs, a southwest-facing escarpment carved in gentle north- to northwest-dipping rocks on the southern margin of the Uinta Basin.

TAR SAND

Bitumen impregnations occur in sandstones of the Green River Formation (Ryder et al. 1976) (see Figure 3-2). Overlying these rocks are the predominantly fine-grained rocks that contain a few thin beds of oil shale. The bitumen in the tar sand deposit probably was derived from oil in younger beds of the Green River Formation; these oils moved through permeable beds and fractures to the rocks from a lower elevation (USDI, MMS, 1980).

The tar sand deposit is not homogeneous, but is composed of many overlapping lenses of bitumen-impregnated sandstone. The deposit in the Sunnyside STSA is the composite of many small lenticular deposits; the gross and net thicknesses of bitumen-impregnated rock differ greatly from place to place. The individual lenses vary from a foot to tens of feet in maximum thickness. The composite thickness of bitumen-impregnated rock at any one place is generally less than 200 feet and ranges from 15 to 550 feet. Near Bruin Point, the gross thickness of bitumen-impregnated rock is about 860 feet and the net thickness of the bitumen-impregnated rock is about 640 feet (Holmes et al., 1948). The thickness of impregnated rock decreases away from Bruin Point, and the smallest net and gross thicknesses occur near the margins of the STSA. Figure 3-3 divides the STSA into zones which generally show the thicknesses of bitumen-impregnated rock. Within any one zone, however, the net composite thickness of bitumen-impregnated rock differs considerably from place to place.

The thickness, quality, and quantity of bitumen on any particular area are speculative because test points are widely spaced and data are sparse (USDI, MMS, 1982). To estimate resource amounts, it was assumed that bitumen-impregnated sandstones have a specific gravity of 2.1 and a bitumen content of 9 percent or more. A cubic yard of bituminous sandstone weighs 1.77 tons and contains at least 38 gallons of bitumen. The thickness of overburden varies from 0 feet at outcrops to 500 feet or more at distances greater than 1/4 mile from the outcrop.

Test points are so widely spaced that the distribution of portions of the STSA most amenable to tar sand extraction by surface mining or by in-situ methods are speculative, except near Bruin Point (USDI, MMS, 1982).

Bitumen could not be extracted by surface-mining methods in parts of the STSA because rocks dip more

steeply than the slope of the land surface and the overburden is too thick. However, tar sand in locations near outcrops is amenable to surface-mining methods because bitumen impregnations are thick and relatively continuous. Although more than 1,000 feet of overburden and bitumen-impregnated rock could be removed from the upper part of the Roan Cliffs, the stripping ratio would be less than 1 to 1, which is favorable for development with surface-mining methods.

OTHER MINERALS

The STSA has a poor potential for oil and gas. The area may be underlain by Cretaceous coal of commercial thickness and quality. *These coal deposits would probably be confined to the Mesa Verde Group and Mancos Shale Formation. Any coal which may underlie the tract is buried so deeply that it could only be recovered by underground mining methods.*

Tar Sand Triangle STSA

TOPOGRAPHY

The area is a dissected plateau. Margins have stair-step topography, and mesas and buttes occur beyond the cliffs. Figure 3-2 shows the geologic formations of the STSA. Elevations in the STSA range from 4,800 to 6,975 feet. The area is remote and very rugged, with a maximum relief of about 3,700 feet.

TAR SAND

The principal bitumen impregnations occur in the White Rim Sandstone Member of the Cutler Formation (see Figure 3-2). Very minor impregnations occur in the Cedar Mesa Sandstone Member. Both members are composed of light-colored, thick, massive, cross-bedded sandstones (USDI, MMS, 1980).

Tar sand is not homogenous: bitumen-impregnated rock varies in thickness from 5 to over 300 feet (USDI, MMS, 1980). Concentrations and thicknesses of bitumen are not uniform and are difficult to predict. Much of the STSA probably is underlain by bitumen-impregnated rock; however, data on the distribution of recoverable resources are limited, and estimates are based on data from a few widely spaced test holes.

In most of the STSA, bitumen could be extracted by in-situ methods, although the distribution of bitumen is poorly known. Except for a few thousand acres in the Orange Cliffs and the Elaterite Basin, the STSA is not favorable to bitumen extraction by surface-mining methods because bitumen-impregnated rocks are too deeply buried.

OTHER MINERALS

The STSA has a poor potential for oil and gas. Isolated deposits of uranium may occur in the Shinarump Conglomerate Member of the Chinle Formation.

White Canyon STSA

TOPOGRAPHY

A large mesa extends southwest across most of the STSA. The mesa extends above a gently sloping surface which is incised by White Canyon. The southern part of the STSA is bench and slope topography. (Figure 3-2 shows the geologic formations within STSAs.) In the vicinity of the deposit, the ground surface slopes westerly, with elevations ranging from about 6,085 feet on the northeast to 4,800 feet on the southwest.

TAR SAND

Bitumen impregnations occur in the Hoskininni Member of the Moenkopi Formation (see Figure 3-2). The Hoskininni consists chiefly of reddish-brown, poorly sorted, calcareous sandstone which forms steep slopes and cliffs near the top sandstone which forms steep slopes and cliffs near the top of the mesa occupying most of the STSA. The Hoskininni thins to the northwest and wedges out in the northwestern part of the STSA (USDI, MMS, 1980).

Data are not sufficient to describe the physical parameters of the deposit. The relatively weak impregnated zone ranges from a few tens of feet in thickness in the southeastern portion to 0 in the northwest. Overburden ranges in thickness from 0 feet at the outcrop to 480 feet on the mesa top (USDI, MMS, 1980). However, according to Campbell and Ritzma (1979), the gross thickness of tar sand deposits ranges from 0 to 480 feet (see Table 3-10).

The deposit probably is too small and concentrations of bitumen too limited to be of commercial interest within the foreseeable future. Because of the thick overburden, in-situ methods would be necessary to extract bitumen from all but the margins of the deposit (USDI, MMS, 1980).

OTHER MINERALS

The STSA has a small potential for oil and gas. Uranium may occur in the Shinarump Conglomerate, which occurs in the southwestern part of the STSA.

VEGETATION

The 11 STSAs occur within two floristic sections of the Intermountain Region: Uinta Basin and Canyonlands. The Circle Cliffs, San Rafael Swell, Tar Sand Triangle, and White Canyon STSAs are located within the Canyonlands section. The Canyonlands section is by far the richest area for endemic plant species in the Intermountain Region. There are at least 69 plant species endemic to this section (Cronquist et al., 1972). Blackbrush and galleta-three awn shrubsteppe are two vegetation types found in the Circle Cliffs, Tar Sand Triangle, and White Canyon STSAs (Kuchler, 1964, as cited by Cronquist et al., 1972). These two types are not widely distributed throughout the remainder of the Canyonlands section nor are these types devel-

oped to such a large extent anywhere else. Most of the Canyonlands section is a characteristic desert vegetated with low-growing shadscale, mat saltbush, galleta, and Indian ricegrass, with scattered pinyon-juniper. This is caused by mountainous peripheries which cast a rain-shadow (see Glossary), allowing only between 5 and 8 inches of precipitation per year.

The Uinta Basin floristic section includes both east and west portions of the Tavaputs Plateau and the Uinta Basin proper. The Uinta Basin section is not as floristically rich as the Canyonlands section. There are about 25 plant species endemic to this area. Asphalt Ridge/White Rocks, Raven Ridge/Rim Rock, and Pariette STSAs are located at lower elevations in the Uinta Basin proper. The vegetation in lower-elevation, lower-precipitation areas within the Uinta Basin is typical of Utah's deserts and, except for the absence of blackbrush, is very similar to the Canyonlands section.

Argyle Canyon/Willow Creek, Hill Creek, P. R. Spring, and Sunnyside STSAs are located at mid to higher elevations and higher precipitation zones on the Tavaputs Plateau. The vegetation of these STSAs is much different than the vegetation of the other, more desert-like STSAs. Large sections of the Tavaputs Plateau STSAs are vegetated by spruce-fir, aspen, mountain brush, and sagebrush. These vegetation types are of high value and importance for big game habitat and for livestock forage.

Riparian vegetation occurs to some extent on each of the STSAs. This vegetation type is important for wildlife habitat and watershed. The more arid the area on which riparian vegetation occurs, the more relative importance this vegetation has, especially for wildlife. This vegetation type is estimated to contain about 925 acres or 76.3 miles of stream.

Threatened, Endangered, and Sensitive Plant Species

Two Federally listed plant species are known to occur within the boundaries of two designated STSAs. These are Wright's fishhook cactus (*Sclerocactus wrightiae*), listed as endangered, and the Uinta Basin hookless cactus (*Sclerocactus glaucus*), listed as threatened. Wright's fishhook cactus occurs within the San Rafael Swell STSA; the Uinta Basin hookless cactus occurs within the Pariette STSA. Suitable habitat for the Uinta Basin hookless cactus exists on the northern part of the Sunnyside STSA; however, its occurrence there has not yet been documented. All available information on the occurrence of threatened, endangered, and sensitive plant species in each STSA is shown in Table 3-11.

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-11

Threatened, Endangered, and Sensitive Plant Species
Within STSAs

STSA	Threatened, Endangered, and Sensitive Species ^a	Designation
Argyle Canyon/Willow Creek	<u>Lepidium barnebyanum</u>	Sensitive
Asphalt Ridge/White Rocks	None	
Circle Cliffs	None	
Hill Creek	<u>Aquilegia barnebyi</u> <u>Astragalus hamiltonii</u> <u>Astragalus lutosus</u> <u>Astragalus saurinus</u> <u>Cryptantha barnebyi</u> <u>Fesuca dasyclada</u> <u>Hedysarum boreale</u> var. <u>gremiale</u>	Sensitive Sensitive Sensitive Sensitive Sensitive Sensitive Sensitive
Pariette	<u>Sclerocactus glaucus</u>	Threatened
P. R. Spring	Same as Hill Creek STSA.	
Raven Ridge/Rim Rock	Same as Hill Creek STSA.	
San Rafael Swell	<u>Astragalus rafaensis</u> <u>Cryptantha jonesiana</u> <u>Cryptantha jonstonii</u> <u>Gaillardia flava</u> <u>Psorothamnus polyadenius</u> var. <u>Jonesii</u> <u>Sclerocactus wrightiae</u>	Sensitive Sensitive Sensitive Sensitive Sensitive Sensitive Endangered
Sunnyside North	<u>Sclerocactus glaucus</u>	Threatened
Sunnyside South ^b	<u>Lepidium barnebyanum</u>	Sensitive
Tar Sand Triangle ^c	None	
White Canyon	None.	

Source: USDI, Fish and Wildlife Service, 1983.

^aClearances will be required for threatened, endangered, and sensitive plant species.

^bThe Uinta Basin hookless cactus (Sclerocactus glaucus) has been located immediately to the north of this STSA. This cactus is found on gravelly hills in the shrub zone and may be present within the STSA.

^cThe plant species Astragalus nidularis occurs in the Flint Flat area and may be sensitive but is currently not a candidate species for listing as threatened and endangered.

ANIMAL LIFE

Terrestrial Animals

BIG GAME

Mule Deer

Crucial deer range on the Argyle Canyon/Willow Creek, Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, and Sunnyside STSAs lies within the Utah Division of Wildlife Resources' (UDWR) deer herd units 22, 26, 27B, and 28A. There are 136,057 and 152,230 acres of crucial deer summer and winter ranges, respectively, on these five STSAs. Distribution of these acres is shown in Table 3-12. Mule deer populations for herd units 27B and 28A are presently below prior stable levels of the 1960s; however, the population appears to be increasing. Current deer populations for herd units 22, 26, 27B, and 28A are estimated to be 5,790, 8,160, 11,400, and 7,440 animals, respectively (UDWR, 1982).

Elk

Crucial elk range on the Argyle Canyon/Willow Creek, Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, and Sunnyside STSAs lie within the Range Creek, Book Cliffs, and Ashley White Rock elk herd units. There are 136,057 and 117,330 acres of crucial elk summer and winter ranges, respectively, on these five STSAs. Distribution of these acres is shown in Table 3-12. Elk in the Range Creek herd unit are becoming reestablished after being absent since the early 1900s. The Range Creek elk herd population is estimated at 88 animals. The current population for the Book Cliffs, Ashley White Rock and Ashley Vernal elk herd units are estimated to be 1,035 and 867 animals, respectively (UDWR, 1982).

Bighorn Sheep

There are 203,677 acres of substantial value desert bighorn sheep habitat located within the Circle Cliffs, San Rafael Swell, Tar Sand Triangle, and White Canyon STSAs. Distribution of these acres is shown in Table 3-12. Lambing and rutting grounds, as well as water sources within this range, are considered crucial to existing populations (less than 200 animals) of desert bighorn sheep. *Rocky Mountain bighorn sheep inhabit part of the Sunnyside STSA. These animals come from a release of sheep on the east side of the Green River. The number of animals or the extent of their habitat is not known.*

Antelope

The Pariette and Tar Sand Triangle STSAs lie within the Myton Bench and San Rafael antelope herd units, respectively. The current number of antelope on the Myton Bench herd unit is estimated to be 250 animals, while fewer than 100 animals are on the San Rafael herd unit. There are 25,921 acres, (representing about 4 percent of the total area on the Myton Bench and San Rafael herd units) of substantial value pronghorn antelope range within the Pariette and Tar Sand Triangle STSAs. Distribution of these acres is shown in Table 3-12.

SMALL GAME

Black bear and mountain lion, defined as important small game mammals by UDWR, occur on five STSAs (Argyle Canyon/Willow Creek, Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, and Sunnyside STSAs). Both of these species are considered common residents and are seen periodically. There are approximately 183,007 acres of substantial value yearlong habitat for these species on the four STSAs. Distribution of these acres is shown in Table 3-12. Some limited value mountain lion habitat can be found in most of the STSAs.

UPLAND GAME

There are approximately 6,800 and 26,597 acres of sage grouse yearlong and nesting habitat, respectively, located within four of the STSAs (Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, and Sunnyside STSAs) (see Table 3-12). In addition, nine known active strutting grounds occur in the Asphalt Ridge/White Rocks, P. R. Spring, and Sunnyside STSAs. These are the only known strutting grounds; however, a comprehensive inventory has not been made, and other strutting grounds could exist. Census data for sage grouse within these STSAs are insufficient to determine population sizes or trends.

UNIQUE AND LIMITED HIGH-VALUE WILDLIFE HABITAT

Aspen Communities

Aspen has been identified as supporting an exceptionally large diversity of wildlife species, particularly nongame birds. In addition, aspen communities are invaluable for providing forage and cover in the summer and fall seasons for big game species (Julander et al., 1961). About 30,000 acres of limited high-value aspen habitat occur in the Sunnyside STSA.

Riparian Habitat

A combination of available water, lush vegetation, diversified cover types, micro-climate, increased edge effect, and generally accessible terrain make riparian communities extremely valuable wildlife habitat (Hubbard, 1977; Thomas et al., 1979). These communities, containing about 925 acres, are the most productive forage type for big game species (Thomas et al., 1979).

Wetland Habitat

Pariette Waterfowl Management Area provides waterfowl and raptor nesting habitat. This area contains about 3,000 acres, of which 80 are located within the Pariette STSA. This area serves as an important raptor foraging area. The wetland provides nesting habitat for 300 to 500 pairs of ducks annually, as well as four to eight pairs of Canada geese.

Raptor Habitat

There are 653,354 acres of yearlong raptor foraging habitat located within the 11 STSAs. Distribution of these acres

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-12

Summary of Significant Wildlife Resources Within STSAs

STSA	Acres of Crucial Range ^a		Acres of Substantial Value Habitat			Riparian Habitat (Miles) ^c	Golden Eagle Nest Sites ^d	Threatened and Endangered Species ^e	Acres of Sage Grouse Habitat ^f	Acres of Yearlong Raptor Habitat
	Deer	Elk	Antelope	Bighorn Sheep	Small Game ^b					
Argyle Canyon/Willow Creek	12,193 (S)	12,193 (S)			12,193	20.1		Black-footed ferret		12,877
Asphalt Ridge/White Rocks	14,700 (W)	14,700 (W)			14,700	1.8		Bald eagle Black-footed Ferret	1 (SG) 8,056 (N)	13,169
Circle Cliffs				1,080	8					50,318
Hill Creek	12,800 (W)	4,415 (W)				21.2		Black-footed ferret	205 (N)	57,932
P.R. Spring	92,480 (S) 110,225 (W)	92,480 (S) 83,710 (W)			110,225			Bald Eagle Black-footed ferret	2 (SG) 16,100 (N)	183,346
Pariette			22,071			1.0	1 (N) 795	Bald eagle Black-footed ferret		12,213
Raven Ridge/Rim Rock							4 (N) 3,180	Black-footed ferret		12,950
San Rafael Swell				111,266				Black-footed ferret		111,266
Sunnyside	31,384 (S) 14,505 (W)	31,384 (S) 14,505 (W)			45,889	30.2	1 (N) 795	Peregrine falcon Bald Eagle Black-footed ferret	6 (SG) 6,800 (YL) 2,236 (N)	107,952
Tar Sand Triangle			3,250	83,400		2.0	2 (N) 1,590	Black-footed ferret Peregrine falcon		83,400
White Canyon				7,931				Black-footed ferret Peregrine falcon		7,931
TOTALS	136,057 (S) 152,230 (W)	136,057 (S) 117,330 (W)	25,921	203,677	183,007	76.3	8 (N) 6,360		9 (SG) 6,800 (YL) 26,597 (N)	653,354

Source: USDI, BLM, 1983e.

^aS = summer range
W = winter range.

^bBear and mountain lion.

^cRiparian habitat occurs in each of the STSAs; however, because of a lack of data, figures are quantified only in those areas identified above.

^dN = known nest sites.

^eThese species may occur within STSAs.

^fSG = known strutting grounds
YL = yearlong habitat
N = nesting habitat.

^gBlack bear and mountain lion are known to occur in this STSA. However, exact areas of suitable habitat are not known.

CHAP 3--AFFECTED ENVIRONMENT

is shown in Table 3-12. Common raptors within STSAs include *prairie falcons*, red-tailed hawks, sharp-shinned hawks, goshawks, and rough-legged hawks.

THREATENED, ENDANGERED, AND SENSITIVE ANIMAL SPECIES

The only Federally listed endangered species that may occur within STSAs are the northern bald eagle, peregrine falcon, and black-footed ferret. There are no officially designated critical habitats (as defined by the Endangered Species Act), concentration use areas, or nest sites in any of the STSAs.

There are five known golden eagle (a sensitive species) nest sites located within the STSAs (see Table 3-12 for locations). These nest sites and a 3,280-foot-radius (1 kilometer) buffer zone, totaling approximately 795 acres per nest site, are considered crucial to golden eagles nesting in these areas. While these are the only nest sites known to occur, other nest sites could exist. Under the Eagle Protection Act of 1969, golden eagles are afforded the same protection as the bald eagle.

Aquatic Species

Fisheries would include perennial streams and sections of rivers located both inside and outside STSA boundaries. Table 3-13 lists the fisheries within the STSAs which would be affected by or used for tar sand extraction; Table 3-14 lists fisheries outside the STSAs that could be used as primary water sources for tar sand development. There are no sport fisheries within Circle Cliffs, P. R. Spring, Pariette, Raven Ridge/Rim Rock, San Rafael Swell, or White Canyon STSAs.

Fisheries habitat is inventoried and classified on a statewide basis by UDWR using four criteria: physical inventory, aesthetics, availability, and productivity. Based on the numerical ratings given for each criterion, a class value of I to VI is given, with Class I being the top-quality fishing waters of the state. Class III streams comprise approximately half of the total stream fish habitat in Utah and support the bulk of stream-fishing pressure.

The only game fish present in significant numbers within or near STSAs are listed in Tables 3-13 and 3-14, respectively. Mileage includes only that section of a perennial stream or river within the boundaries of the STSA identified as fish habitat.

THREATENED, ENDANGERED, AND SENSITIVE AQUATIC SPECIES

There are no threatened, endangered, or sensitive aquatic species within STSAs. However, the endangered Colorado squawfish and humpback chub and the sensitive razorback sucker occur in the Green and Colorado river systems, which are potential water sources for tar sand development (see Table 3-14).

Wild Horses and Burros

Approximately 25 to 30 wild horses occupy the eastern portion of the Sunnyside STSA. Wild burros occur in the San Rafael Swell STSA (about 25 to 50 animals). A herd of about 50 wild horses inhabit the Muddy Creek area (about 3,000 acres). This is only a small part of the herd's range. About three quarters of the wild horse range in the BLM Vernal District are within the Hill Creek STSA. The wild horse herd on this STSA is estimated to number between 175 and 200 animals (Gardner, 1983). The northeastern boundary of the Tar Sand Triangle STSA adjoins burro herd unit 5 (about 30 animals). These historic wild horse and burro ranges extend outside STSAs.

RECREATION

STSAs are mostly located in remote, undeveloped areas. The only STSA with developed recreational facilities are the San Rafael Swell and *Argyle Canyon/Willow Creek*, although the Circle Cliffs STSA includes the site of a proposed 20-unit campground. Primitive dispersed recreation constitutes the principal use of some STSAs, especially Circle Cliffs and Tar Sand Triangle, which include portions of Glen Canyon National Recreation Area (NRA) and Capitol Reef and Canyonlands national parks, respectively. Recreation (predominantly hunting and sightseeing [touring by 2- and 4-wheel drive vehicles]) is a principal use in most of the other STSAs.

River segments identified in the Nationwide Rivers Inventory qualify for study (i.e., are free-flowing and contain one or more outstandingly remarkable scenic, recreational, geological, historical, cultural, fish and wildlife, or other similar value[s]) for inclusion in the National Wild and Scenic Rivers System if Congress or the State Governor requests or directs. Outstandingly remarkable values can generally be defined as values of national or regional significance. Rivers with segments listed in the inventory which could be affected by construction of facilities and/or water withdrawals are listed in Table 3-15.

Five of the rivers listed in Table 3-15 are used for floatboating (canoeing, rafting, kayaking, and tubing), a sport that has grown significantly in participation in recent years. Floating use of the White, Price, and San Rafael rivers is estimated at 400-500 visitor days each per year. The Dirty Devil River receives more limited use (probably less than 50 visitor days/year). Floatboating use of these four rivers is largely limited to the periods of high flow in late spring/early summer.

The fifth river, the Green, is heavily utilized for floatboating and during most years its season of use extends from April to October. Desolation and Gray canyons usually receive about 65,000 visitor days/year. About 95 percent of that use is by floatboaters.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-13

Fisheries Within STSAs

STSAs	Sport Fishery	Class	Game Species Present in Significant Numbers	Mileage of Fishery Habitat Within STSA ^a	Comments
Argyle Canyon/Willow Creek	Argyle Creek	4	Trout ^b	2.2 B 0.9 S 12.8 P	Limited potential fishery, but mostly located on private land. UDWR may reinventory next year.
	Willow Creek	5	Trout ^b	0.6 S 3.6 P	Potential fishery, but mostly located on private land. UDWR may reinventory next year.
Asphalt Ridge/White Rocks	White Rocks River	3	Rainbow Trout Brook Trout Cutthroat Trout	0.6 F 1.2 P	
Hill Creek	Hill Creek	No Classification	Cutthroat Trout	21.2 I	
	Towave Reservoir	No Classification	Cutthroat Trout	40 surface acres	5,000 cutthroat trout stocked per year.
Sunnyside	Range Creek	3	Brown Trout Cutthroat Trout	2.0 B 4.0 P	Reproductive and nursery habitats.
	Rock Cr.	3	Rainbow Trout Cutthroat Trout	1.5 B 2.5 P	Reproductive and nursery habitats.
	Bear Canyon Creek	No Classification	Trout ^b	Not Inventoried	Trout sited about 0.5 mile above confluence with Rock Creek. Limited reproduction because of poor spawning habitat.
	Grassy Trail Creek	3	Rainbow Trout Brown Trout	3.0 P	Also known as Whitmore Creek, this stream is outside STSA boundaries, but crosses access roads into STSA.
	Flat Canyon Creek	No Classification	Trout ^b	Not Inventoried	Trout sited in lower sections below Cedar Corral and about 14 miles above confluence with Green River. Assumed to support a self-sustaining cold-water fishery.
Tar Sand Triangle	Nine Mile Creek	4	None	6.6 B 1.1 S 9.5 P	Limited potential fishery.
	Dirty Devil River	5	None	2.0 B	

Source: USDI, BLM, 1983c.

^aB = BLM land
S = State land
F = National Forest land
P = Private land
I = Indian land

^bUnidentified trout species.

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-14
Potential Water Sources of Fisheries Outside STSA Boundaries

STSA	Sport Fishery	Class	Game Species Present in Significant Numbers	Threatened and Endangered Species ^a	Comments
Argyle Canyon/Willow Creek	Price River	5	Channel Catfish		Not considered a sport fishery because of limited access and the present small population of catfish.
Asphalt Ridge/White Rocks	Green River	4	Channel Catfish Black Bullhead	Colorado Squawfish Humpback Chub	Channel catfish is the only game fish present in large numbers, having a naturally reproducing population.
Circle Cliffs	Escalante River	5	None	Colorado Squawfish	No sport fishery of any value.
Hill Creek	White River	4	Channel Catfish Black Bullhead	Colorado Squawfish	No sport fishery of any value.
P. R. Spring	Willow Creek White River	4	None Channel Catfish Black Bullhead	Colorado Squawfish	No sport fishery of any value.
Raven Ridge/Rim Rock	Willow Creek Green River	4	No Game Species Channel Catfish Black Bullhead	Colorado Squawfish Humpback Chub	Channel catfish is the only game fish present in large numbers, having a naturally reproducing population.
Sunnyside	White River Price River	4 5	Channel Catfish Black Bullhead Channel Catfish	Colorado Squawfish	Not considered a sport fishery because of limited access and the present small population of catfish.
Tar Sand Triangle	Green River Colorado River	4 3	Channel Catfish Black Bullhead Channel Catfish Black Bullhead	Colorado Squawfish Humpback Chub Colorado Squawfish	This section of the Colorado River (Lake Powell to confluence of the Green River) is considered excellent for natural reproduction.
	Dirty Devil River	5	None	Colorado Squawfish	No sport fishery of any value.

Source: USDI, BLM, 1983d.

^aThe razorback sucker, a sensitive species, occurs in the Colorado River system.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-15

River Segments on the Nationwide Rivers Inventory

River	Segment	Length (miles)	Outstandingly Remarkable Values ^a
Green River	Yampa River to Range Creek.	193	S, R, G, F, & W
	Range Creek to Colorado River.	156	S, R, G, F, W, & C
White River	Green River to Colorado/Utah State Line.	68	R, F, W
Range Creek	Green River to source.	34	S, R, & W
Price River	Green River to bridge west of Mounds.	70	S, R, and W
San Rafael River	Green River to Cottonwood/Fer- ron Creek confluence.	110	S, R, W, & C
Dirty Devil River	Lake Powell to Highway U-24.	68	S, G, W, & C
Escalante River	Lake Powell to Escalante.	82	S, R, G, F, W, H, & C

Source: USDI, NPS, 1982.

^aAbbreviations: Scenic (S), Recreational (R), Geological (G), Fish (F), Wildlife (W), Historical (H), and Cultural (C).

TABLE 3-16

County Land Use Plans Encompassing STSAs

County	Date	Plan
Carbon	1976	Overall Economic Development Program
Duchesne	1979	Uintah Basin Development Plan
Emery	1976	Overall Economic Development Program
Garfield	1979	Garfield County, Utah: A Master Plan for Development
Grand	1979	Grand County, Utah: A Master Plan for Development
Uintah	1979	Uintah Basin Development Plan
Wayne	1979	Six County Development Plan

Source: USDI, BLM, 1983e.

CHAP 3--AFFECTED ENVIRONMENT

Argyle Canyon/Willow Creek STSA

One National Forest developed recreation site (*Avintiquin Canyon Campground*) exists within this STSA. The area possesses a variety of undeveloped, dispersed recreational values and uses. Hunting elk (70 bull permits were issued in the area encompassing the STSA in 1982), mule deer, grouse, and rabbit constitute a major recreational use. Other opportunities and uses include geologic sightseeing and viewing of prehistoric rock art. Off-road vehicle (ORV) use is limited by the rough terrain.

The portions of the Ashley National Forest also provide hunting (deer and elk) and winter sports (cross-country skiing and snowmobiling) opportunities. Use of the Avintiquin Canyon Campground was estimated at 89,000 visitor days in 1982.

Asphalt Ridge/White Rocks STSA

There are no developed recreation sites in the STSA. The primary recreational use of the area is hunting. The area south of U.S. Highway 40 is part of an antelope hunting area (44 permits issued in 1983). The area also provides mule deer, sage grouse, and rabbit hunting opportunities. There is a scenic overlook along U.S. 40 that affords views of Ashley Valley. Some ORV use occurs in the area, especially during hunting seasons.

The portion of the White Rocks area on the Uintah and Ouray Indian Reservation provides hunting opportunities for tribe members. The roads to Paradise Park Reservoir and Campground and the White Rocks Campground pass through the STSA. The White Rock River, which flows through the STSA, provides fishing opportunities.

Circle Cliffs STSA

Recreation is the predominant land use in the majority of the STSA, which includes 30,720 acres of Capitol Reef National Park and 1,840 acres of the Glen Canyon NRA. There are no developed recreation facilities within the STSA, although the exceptional scenery of the Circle Cliffs and Waterpocket Fold draw thousands of visitors each year. Approximately 20,280 acres of the STSA are inside the Canyons of Escalante Cooperative Management Area (CMA), which is managed cooperatively by BLM and Glen Canyon NRA to preserve recreation values.

Recreational uses in the STSA include rockhounding, sightseeing, hiking, backpacking, ORV touring, and photography. Several clubs and commercial survival groups use the STSA for backcountry survival trips (use estimated at 2,500 visitor days per year). A proposed 20-unit campground along the Burr Trail would be located close to potential in-situ tar sand development sites.

Hill Creek STSA

Recreational use in the STSA is limited because of its remoteness and limited accessibility. There are no devel-

oped recreational facilities in the area. Principal dispersed/undeveloped recreational uses include hunting mule deer, fishing, ORV use in the spring, rock collecting, and some sightseeing (the wild horse herd is an attraction). There is a limited amount of camping and picnicking, mostly in conjunction with the above-mentioned activities.

P. R. Spring STSA

There are no developed recreational activities in the STSA. Hunting is the most popular recreational use of the area: mule deer, elk (40 permits issued in the area encompassing the STSA in 1983), sage grouse, mountain lion, and bear. In the southeast corner of the STSA, there is a ready water supply, and this area is a popular focal point for recreation, particularly camping (especially by hunters). An abandoned CCC camp occurs in that area, and some two- and four-wheel drive touring also occurs. Other uses include firewood collection and Christmas tree cutting. However, because of the area's remoteness and poor accessibility, recreational use is limited.

Pariette STSA

There are no developed recreational facilities in the STSA. The principal recreational use is hunting. Five to 15 buck antelope permits are issued for the Myton Bench herd unit, which encompasses the STSA. Driving for pleasure is the second most popular activity. Waterfowl, antelope, and gilsonite mines draw some visitors. The principal route to the Pariette Draw Waterfowl Management Area passes through a portion of the STSA, which includes about 80 acres of the management area. There are also limited opportunities for hunting rabbits and waterfowl and ORV use in the STSA.

Raven Ridge/Rim Rock STSA

There are no developed recreational facilities or intensive recreational uses. The STSA is within the Bonanza antelope hunting unit (44 permits issued in 1983) and also offers limited hunting opportunities (i.e., rabbits).

San Rafael Swell STSA

The STSA contains significant recreational values and uses. The portion of the San Rafael River in the STSA is a Nationwide Rivers Inventory segment, with study potential for inclusion in the National Wild and Scenic Rivers System. The inventory found that the segment possessed outstanding scenic (sandstone formations, deep canyons [1,000- to 2,000-feet deep]), recreational (excellent hiking, some boating opportunities, and sightseeing), wildlife (i.e., bald and golden eagles), and cultural values. The San Rafael River offers canoeing and rafting opportunities during spring flows, and tubing thereafter. It was estimated that well over 350 people hiked or floated the river in 1982.

CHAP 3--AFFECTED ENVIRONMENT

The majority of recreational use is by vehicle. The area is also popular for hiking and backpacking, especially on Easter weekend, when total visitation has exceeded 600 persons.

The STSA contains portions of four BLM potential Recreation Management Areas (RMAs) (recommended in 1982): Mexican Mountain, Buckhorn Draw, Sid's Mountain, and Goblin Valley/Temple Mountain.

The Buckhorn Draw proposed RMA contains 43,000 acres of public lands containing scenic vistas and vertical-walled redrock canyons which attract thousands of visitors each year. It includes the San Rafael Campground, which is adjacent to the San Rafael River and is one of two campgrounds in the desert of the San Rafael Swell.

The Goblin Valley/Temple Mountain proposed RMA is adjacent to Goblin Valley State Park, which received 20,314 visitors in 1981 (USDI, BLM, 1983b). Forty percent of these visitors used the Park as a base for ORV/exploration activities in the surrounding areas.

Mexican Mountain and Sid's Mountain proposed RMAs are also in Wilderness Study Areas (WSAs).

Sunnyside STSA

There are no developed recreation sites on public lands in the STSA. The area does offer a variety of excellent undeveloped, dispersed recreational opportunities. The Book Cliffs-Bruin Point and Nine Mile Canyon areas receive extensive use by recreationists. Bruin Point, *most of which is in private ownership*, offers exceptional vistas of canyons and mountains of the Roan Cliffs and San Rafael Swell. Other uses include picnicking, camping, and hunting. Use of the area is estimated at over 1,000 visits per year. Nine Mile Canyon is used principally for picnicking and historic and archaeological sightseeing. Use is estimated at 1,200 to 1,800 recreational visits per year. Argyle Canyon provides similar sightseeing/recreational attractions.

Other areas throughout the STSA are used for sightseeing (geological, botanical, zoological, cultural, etc.). Book Cliffs, Jack Creek, Rock Creek, and Flat canyons are highly scenic attractions. Picnicking, camping, hiking, winter sports, and hunting are also popular activities. Hunting in the STSA is principally for mule deer, although access is limited because of private lands in the STSA. There are two commercial hunting/horseback outfitters in the area near the head of Rock Creek.

Tar Sand Triangle STSA

The high-quality recreational and scenic resources in and around the STSA are nationally significant. The STSA includes a significant portion of the Glen Canyon NRA (including a 12-mile portion of the Orange Cliffs) and two small portions in Canyonlands National Park (i.e., Elaterite Basin and Teapot Canyon). The unique landforms, which eroded through sandstone formations by the Dirty Devil, Green and Colorado rivers and their tributaries, provide

unique scenic attractions throughout the STSA. The area draws several thousand sightseers, hikers, and backpackers each year. The Hans Flat Ranger Station, just north of the STSA's boundary, recorded between 2,320 and 3,532 visits annually for the past 5 years. Approximately 97 percent of the visitors are from outside the local region.

Although recreational opportunities and potential are outstanding, remoteness and isolation from major population centers, lack of publicity, and the presence of numerous nearby excellent recreational resources result in only moderate recreational use. Recreational opportunities present include 2- and 4-wheel drive touring, undeveloped camping and picnicking, photography, hiking, backpacking, horseback riding, and sightseeing (canyons, mesas, and rock formations varying from slickrock to tallus-faced cliffs). The Orange Cliffs provide a major vantage point for spectacular vistas of Canyonlands National Park (including the Maze).

White Canyon STSA

The STSA is located in a region of exceptional recreational values and uses about 5 miles southeast of Glen Canyon NRA. Recreational opportunities include hiking, sightseeing, and photography. The STSA is bisected by Highway U-95, Utah's Bicentennial Highway, dedicated for the unique scenic and recreational resources along its route. Much of the travel along the highway is recreation-related (associated with Lake Powell to the west and Natural Bridges National Monument to the east of the STSA).

White Canyon STSA is within the San Juan mule deer hunting unit, although that unit has been closed to hunting since 1980. It is also within the South San Juan desert bighorn sheep hunting unit where there have been five permits issued annually. Most bighorn hunting activity takes place south of the STSA in the Red Canyon area.

WILDERNESS

Under provisions of Section 603(c) of the Federal Land Policy and Management Act of 1976 (FLPMA), all public lands were inventoried to determine which lands possessed wilderness characteristics, as specified in the Wilderness Act of 1964. Those lands meeting the criteria have been identified as WSAs. The criteria are that the area: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical values.

Areas identified as WSAs are managed under BLM's Interim Management Policy (IMP) so as to not impair their suitability for wilderness preservation. Any CHLs within a WSA must contain appropriate nonimpairment stipula-

CHAP 3--AFFECTED ENVIRONMENT

tions. The nonimpairment provisions of the IMP specify activities which are prohibited in WSAs; these include surface-disturbing activities, unless impacts would be temporary and reclamation would be possible within specified time limits to a condition substantially unnoticeable in the WSA.

The wilderness study phase, now in progress, will determine the suitability of each area for addition to the National Wilderness Preservation System (NWPS). In Utah, study findings for all WSAs on public lands will be published in one EIS, scheduled for completion during 1985. Based on findings and public comments, the BLM State Director will make recommendations on each WSA. Congress will decide which WSAs will be designated for addition to the NWPS.

In accordance with the Wilderness Act of 1964, NPS lands in Glen Canyon NRA and Capitol Reef National Park were surveyed, and qualifying areas have also been proposed for addition to the NWPS.

The Glen Canyon NRA and Capitol Reef National Park proposed wilderness areas include lands which are scenically outstanding, relatively undisturbed, isolated, and remote from the activities of man, or bordering areas with complimentary land-use practices. Potential wilderness additions are areas with presently nonconforming conditions or uses. Once these conditions or uses are terminated, the additions will be proposed for wilderness designation. *Proposed wilderness lands in Glen Canyon NRA are now closed to oil and gas leasing, and existing leases on these lands are ineligible for CHL conversion.* Management of these areas generally conforms to the BLM's IMP to protect the wilderness values present. Use of motorized vehicles is prohibited unless use constitutes a 'minimum management tool.'

The proposed and potential wilderness additions include the Orange Cliffs and areas east thereof in Glen Canyon NRA within the Tar Sand Triangle STSA. Similarly, areas of proposed wilderness in Capitol Reef National Park and Glen Canyon NRA are located in the Circle Cliffs STSA.

Argyle Canyon/Willow Creek STSA: No present or potential wilderness areas are in or near this STSA.

Asphalt Ridge/White Rocks STSA: No present or potential wilderness areas are in or near this STSA.

Circle Cliffs STSA: This STSA includes the following proposed and potential wilderness areas: (1) *North Escalante Canyons/The Gulch Instant Study Area (ISA):* Approximately 10,260 acres of the western portion of the STSA is in this area under wilderness study by the BLM; (2) *Capitol Reef National Park:* The majority of the STSA inside the Park has been administratively endorsed for wilderness designation; (3) *Glen Canyon NRA:* The majority of the STSA inside the NRA has been proposed for wilderness designation.

Hill Creek STSA: There is no present or potential wilderness inside the STSA; however, the Winter Ridge WSA (UT-080-73) is located immediately (0.25 mile) to the east.

The Ute Tribal Business committee passed a resolution to establish the Hill Creek Extension of the Uintah and Ouray Reservation as a "Wildlife and Cultural Resource Protection Area". The resolution contains provisions calling for restricted access and limited development, much as in a wilderness area. A large portion of this Refuge is in the STSA.

P. R. Spring STSA: All but about 15 percent (6,600 acres) of the 43,963-acre Winter Ridge WSA (UT-080-730) is inside the west-central portion of this STSA. The STSA also covers about 2 percent (1,000 acres) of the northwestern corner of the 48,250-acre Flume Canyon WSA (UT-060-100B).

Pariette STSA: There are no present or potential wilderness areas in or near this STSA.

Raven Ridge/Rim Rock STSA: There are no present or potential wilderness areas in or near this STSA.

San Rafael Swell STSA: Approximately 24 percent (28,232 acres) of the STSA possesses potential for wilderness designation. Included in the STSA are portions of the following WSAs.

Wilderness Study Area ^a	Total WSA Acreage	Approximate WSA Acreage in STSA	Percent of WSA in STSA	Percent of STSA
Sid's Mountain (UT-060-023)	80,530	1,280	1.6	1.1
Devils Canyon (UT-060-025)	9,610	640	7	0.6
Crack Canyon (UT-060-028A)	25,315	480	2	0.4
San Rafael Reef (UT-060-029A)	55,540	1,280	2	1.1
Mexican Mountain (UT-060-054)	60,360	23,900	40	20.7
Total	231,355	27,580	12	24.0

^aAll figures are based on Federal acreage, exclusive of any State or private inholdings.

Sunnyside STSA: A total of 4,040 acres of Desolation Canyon WSA (UT-060-068A) are located within the STSA, including areas remanded (2,620 acres) by the Interior Board of Land Appeals (IBLA). This constitutes about 2.5 percent of the STSA. *Approximately 2,000 acres of the Jack Canyon WSA (UT-060-068C) are also located within the STSA. The Turtle Canyon WSA (UT-060-067), located approximately 5 miles south of the STSA, is bordered by Range Creek, which flows out of the STSA.*

Tar Sand Triangle STSA:

A significant portion of the STSA contains potential wilderness areas, as listed below:

Wilderness Study Area ^a	Total WSA Acreage	Approximate WSA Acreage in STSA	Percent of WSA in STSA	Percent of STSA
French Spring/Happy Canyon (T-050-036B)	25,000	23,750	95	15
Fiddler Butte (UT-050-241)	65,000	33,200	51	21
Horseshoe Canyon (UT-050-237)	38,000	30	0	0

^aAll figures are based on Federal acreage, exclusive of any State or private inholdings.

Two small areas of Canyonlands National Park are inside the eastern boundary of STSA, including approximately 750 acres in the Elaterite Basin and one section (640 acres) in Teapot Canyon.

CHAP 3--AFFECTED ENVIRONMENT

Two portions of the Glen Canyon NRA have been recommended for wilderness designation inside the STSA: small areas (<400 acres) along the Dirty Devil River in the southwestern corner of the STSA and approximately 22,000 acres along the eastern boundary of the STSA.

White Canyon STSA: The White Canyon STSA contains a small portion (40 acres) of the Dark Canyon ISA. The wilderness portion is located in the northeastern corner of the STSA about 6 miles northeast of U-95. The ISA has been studied, found suitable, and recommended for addition to the NWPS. Contiguous with the Dark Canyon ISA is an area in the Glen Canyon NRA that has been proposed and administratively endorsed for designation as wilderness.

VISUAL RESOURCES

The STSAs are generally located in areas with high scenic values which, in many cases, constitute the primary recreational appeal. Visual resources on the public and private lands have been inventoried in accordance with BLM Manual 8400. Based on scenic quality, visual sensitivity, and visual distance zone (see Glossary), visual resource management (VRM) classes were assigned. The classes specify the objectives for managing the visual resources (i.e., objectives for limiting the amount of contrast created by proposed development/management activities) and provide a basis for land use planning decisions.

VRM Classes

Class I areas are areas with special designations where resource values have been identified for special management by legislation (e.g., wilderness, wild and scenic rivers, and natural areas). Except for minimal impact recreation or management facilities, this class allows only natural ecological changes.

Class II are generally those exceptional areas rated highest in scenic quality (e.g., the Circle Cliffs, Roan Cliffs, San Rafael Reef and Swell, etc.). Management activities/modifications of the environment should not be evident in the characteristic landscape. Changes could be visible but should not attract attention.

Class III are generally those superior areas rated next highest in scenic quality (e.g., Sinbad country between the San Rafael Reef and Swell) or areas bordering principal travel routes where visual sensitivity is high (e.g., the flats along Interstate 70 between the San Rafael Reef and Swell). Changes caused by management activities may be evident but should remain subordinate to the existing landscape.

Class IV are generally common areas of less scenic quality and/or seldom seen areas (e.g., the Myton Desert benchlands in the area of the Pariette STSA). Changes may attract attention and be dominant landscape features but should reflect the basic visual elements (form, line, color, and texture) of the existing landscape.

Class V are areas where the natural character of the landscape has been so disturbed and scenic quality so lowered that rehabilitation is necessary to raise the classification to one of the other classes. Modification/management action is necessary to bring the landscape back into character with surrounding areas.

Scenic Quality

Scenic quality evaluation in accordance with BLM Manual 8411 rates the aesthetics of various visual components of an area. Landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications of the area are considered in the rating. Class A generally includes striking areas of high relief (cliffs, rock outcrops) which present interesting varieties of vegetation and color, are rare, and have few cultural discordant sights. Class B areas have interesting landforms with variety in size, shape, color, and vegetation that present distinctive landscapes. Class C areas have little variety or contrast in landform, vegetation, and color; are common; and have low visual appeal.

Argyle Canyon/Willow Creek STSA

This STSA is in an area of high scenic quality. It contains a variety of landforms (ridges, steep canyons, and benchlands) and vegetation (from Douglas fir and aspen at higher elevations to big sagebrush-grass communities and riparian areas along Argyle Creek). Scenic quality in the only area evaluated (along Highway 191) is Class A (exceptional). VRM classifications of the STSA have not been completed.

The portions of the STSA on the Ashley National Forest have high scenic values. About 25 percent is Retention Class (comparable to VRM Class II) and 75 percent is Partial Retention Class (comparable to VRM Class III.) Areas along Indian Canyon Highway and Reservation Ridge are located in the foreground/midleground.

Asphalt Ridge/White Rocks STSA

The Asphalt Ridge portion of this STSA is in an area of generally low scenic quality. Topography is generally gently sloping, and vegetation is limited to pinyon-juniper and mixed shrub. There are numerous visual intrusions. Therefore, scenic quality is rated as C and VRM Class as IV.

The portion of the STSA on the Uintah and Ouray Reservation is generally higher elevation and has slightly higher scenic quality (low Class B). VRM class rating for most of the area would be Classes II and IV. The area is in the foothill front to the Uinta Mountains. Portions of the STSA are components of the vistas from Dinosaur National Monument.

Most of the portion of the STSA on the Ashley National Forest offers high scenic values (approximately 60 percent variety Class A and 40 percent Class B). The white sandstone outcrops and riparian areas along the river offer vivid contrasts with the grey-greens of the predominantly pinyon-

CHAP 3--AFFECTED ENVIRONMENT

juniper and mountain brush vegetated area. This portion is on the travel route to White Rocks Campground, and the sensitivity level is 1 (highest public sensitivity to/concern for the visual environment). The distance zone is middleground (up to 5 miles from observation routes or points) except for the foreground zone (generally with .25 mile of observation points) along the road to White Rocks Campground. The visual quality objectives of the area are approximately 90-percent Retention (equivalent to BLM's VRM Class II), and 10-percent Partial Retention (equivalent to VRM Class III).

Circle Cliffs STSA

This STSA is in an area of outstanding scenery, which is one of the primary recreational values. A major portion (30,720 acres) of Capitol Reef National Park lies within the area. Scenic quality is the primary value in and along the 22-mile-long boundary of the Park. The scenery in the STSA is dominated by massive Navajo Sandstone and Wingate formations of the Circle Cliffs (VRM Class II area). The majority of the area between the Circle Cliffs and the Waterpocket Fold is VRM Class IV, where pinyon-juniper covered mesas offer B scenic qualities. The Waterpocket Fold on the east flank of the STSA constitutes a major visual feature of Capitol Reef National Park. The VRM classes of BLM land within the STSA are: Class I, 1,480 acres (Escalante Canyons Outstanding Natural Area and Wolverine Petrified Wood Recreation and Scientific Preservation Area); Class II, 9,497 acres; Class III, 9,873 acres; and Class IV, 37,030 acres (see Figure 2-21, Volume II).

Hill Creek STSA

Scenic values are generally moderate. Rolling desert topography with some deeply incised canyons and rocky buttes typify the area. Vegetation is generally sparse in lower elevations and more plentiful in upper elevations. The Big Pack Mountains in the north offer panoramas of the canyons and the STSA to the south. Approximately 35 percent of the STSA is in VRM Class III, and 65 percent is in Class IV.

P. R. Spring STSA

Visual resources are generally of low quality. About 99 percent of the area is VRM Class IV, about 1 percent in Class III, and about two sections (1,200 acres [less than 1 percent]) are in Class II. The terrain generally consists of several long ridges separated by canyons 800- to 1,500-foot deep. Vegetation is mostly mountain shrub and pinyon-juniper, with some stands of Douglas fir and mixed conifers on east and north slopes. From the top of the Roan Cliffs along the southeastern boundary of the STSA there are exceptional panoramas of the Book Cliffs and distant basins and mountains.

Pariette STSA

Visual resources in the STSA are generally low in quality. The entire STSA is in a VRM Class IV area. The terrain generally consists of visually homogenous flat to rolling land with occasional low, rugged ridges and hills vegetated by cold-desert shrubs and grasses. The area is visually uninteresting and common in the region.

Raven Ridge/Rim Rock STSA

Visual resource values are limited. Vegetation is limited to cold-desert shrub types, and landforms are relatively common (rolling hills and sparse vegetation, except for the Raven Ridge). Scenic quality is Class C and VRM Class is IV. Portions of the STSA are components of vistas from Dinosaur National Monument.

San Rafael Swell STSA

Visual resources are generally outstanding and constitute the prime recreational value of the STSA. The rugged topography and varied colors of dramatic rock formations in the Swell and along the San Rafael Reef provide exceptional scenery. Major portions of the STSA are in the I-70 viewing area, which passes through its center. Average annual daily traffic (ADT) on this corridor was 1,620 vehicles in 1981. There are scenic overlooks in the vicinity of Mexican Mountain, Sid's Mountain, and Devil's Canyon. The canyons of the San Rafael River (VRM Class II) in the northeast and tributaries of Muddy Creek in the southern portion of the STSA provide dramatic, colorful cliff and canyon scenery. The San Rafael Reef and San Rafael Swell also offer outstanding scenery, and are rated as VRM Class II. The flats of the Swell are Class C scenic quality along I-70 and Class B in Sinbad country to the south. The Swell is VRM Classes III and IV.

Sunnyside STSA

The STSA characteristically offers outstanding visual values. The Roan Cliffs and West Tavaputs Plateau areas north and east of Sunnyside STSA offer outstanding sight-seeing values. There are numerous rugged, mountainous, forested areas and canyons, perennial streams, and mountaintop vistas (e.g., Bruin Point, Mt. Bartles, and roads along the top of the cliffs). The canyons of Jack Creek, Flat Canyon, and Rock Creek offer the highest sightseeing values in the area, based on uniqueness and the variety of color, vegetation, landforms, and water in areas where slopes generally exceed 100 percent.

Similarly, the portions between the STSA in the Argyle and Nine Mile Creek areas offer exceptional scenery. These areas contain a variety of landforms and dramatic erosional patterns in steep, rugged canyons with differing colors in rocks and vegetation. The VRM classes assigned in the STSA reflect the high scenic values and public sensitivity to modification of the existing landscape. Approximately 53

CHAP. 3: AFFECTED ENVIRONMENT

percent is VRM Class II, 17 percent is Class III, and 30 percent is Class IV. The Roan Cliffs portion of the STSA is visible to travelers on U.S. 6 (average ADT of 2,350 to 8,700, depending on the segment) and residents of Wellington, Price, and other communities.

Tar Sand Triangle STSA

The STSA offers an exceptional variety of scenic resources. Landforms range from flat-topped mesas, buttes, rugged cliffs, and canyons to slickrock formations. The scenic quality is a prime resource value on BLM and NPS lands in the STSA. The scenic resources in the STSA and surrounding areas constitute the major attraction for recreationists. The majority of the area offers interesting scenery (e.g., North and South Hatch and Big Water Canyon). Areas of Class A scenery include the Block, Black Ledge, Orange Cliffs and Happy and French Spring canyons. The mesas north, south, and east of Happy Canyon and west of the Orange Cliffs are typical sagebrush-pinyon juniper flats.

Mesas *throughout the STSA* offer sightseeing opportunities of the surrounding canyons. The vistas from The Block, Big Ridge, and the plateau above Orange Cliffs include the steep, dramatic, eroded colorful landforms of the Maze; cliffs, pinnacles, buttes, and deeply incised canyons of the Colorado and Dirty Devil rivers; Lake Powell; and surrounding mountain ranges.

The Orange Cliffs provide spectacular panoramas of canyons of the Colorado inside Glen Canyon NRA and Canyonlands National Park. The Happy Canyon drainage is a spectacular staircase of terraces and vertical cliffs from the mesa tops to the canyon bottom. Interesting detached and sculptured buttes, monuments, and minarets (e.g., Gunsight Buttes, Teapot Rock, Fiddler Butte, and the Hat) are found within the STSA.

White Canyon STSA

The STSA is characterized by highly scenic canyon landforms. White Canyon is about 6 miles wide, where it bisects the STSA. The majority of the STSA is in Short Canyon, a side canyon of White Canyon. The canyons are eroded through colorful sandstones varying from the lower, light-colored Cedar Mesa sandstone to reddish rocks of Triassic and Jurassic ages. Contrasting with the reddish rock colors are the grey-green colors of scattered low shrubs, the dominant vegetation, and some pinyon-juniper at higher elevations.

LAND USES

Existing land uses in STSAs include recreation, mineral activities, and livestock grazing. These activities are described in separate sections in this chapter.

FEDERAL, STATE, AND LOCAL LAND USE PLANS, PROGRAMS AND CONTROLS

National Forest system lands in the Asphalt Ridge/White Rocks STSA are administered by Ashley National Forest using the South Slope Land Use Plan (USDA, Forest Service, 1979 b). National Forest system lands in Argyle Canyon/Willow Creek STSA are not currently covered by land use plans. U.S. Forest Service plans and management strategies emphasize multiple use, including mineral resource development.

The State Land Board manages State section inholdings within Federal lands. The State of Utah administers these sections without formal land use plans. Extraction of tar sand from State sections can be made under oil and gas leases issued from the Utah Department of Natural Resources and Energy.

County land use plans emphasize planning for private lands and local communities. However, multiple use of Federally owned lands is recognized as important to the local economy. Not all county land use plans specifically address tar sand, but some plans acknowledge that Federal leasing policies play a significant role in the location, timing, and extent of energy development. Additionally, these plans also recognize the value of scenic and recreational values found on Federally owned lands. Table 3-16 shows county land use plans encompassing STSAs.

CULTURAL RESOURCES

All of the 11 STSAs have had some form of cultural resource inventory. These inventories were all conducted in advance of various projects in affected areas and do not cover STSAs in their entirety. Using the results of these inventories, however, one can reasonably expect to find the following types of cultural resources within these STSAs.

Argyle Canyon/Willow Creek STSA

Because of the lack of data, it is impossible to determine the significance of cultural resource values in the STSA at the present time. A major Class II BLM sampling effort conducted in 1977 covered areas immediately south and east of the STSA. Early surveys have occurred in nearby Nine Mile Canyon. Site-specific cultural studies have been completed along and near the left fork in Indian Canyon. This canyon crosses one corner of the STSA.

Nearby studies indicate that Fremont and Anasazi rock art are most frequently found. Rock art and small seasonally occupied camps are found along the interface between canyons bottoms and canyon walls. Early surveys found villages and fortifications on ridgetops along Nine Mile Canyon. U.S. Forest Service inventories in Indian Canyon revealed several early twentieth century cabins along streams and near springs. Statistical studies indicate sites are located in the pinyon-juniper sand dune areas, except where sand dunes and rock outcrops exist near permanent water sources.

CHAP 3--AFFECTED ENVIRONMENT

Asphalt Ridge/White Rocks STSA

Approximately 2,520 acres of Asphalt Ridge were inventoried by personnel from Nickens & Associates during June 1981. Nineteen prehistoric sites and 22 isolated finds were recorded. On 16 of the sites the cultural affiliation was unknown, two sites were Fremont, and one was a multiple-cultural occupation by prehistoric/historic peoples. Of the 19 sites, three were considered eligible for inclusion to the National Register of Historic Places, two needed further testing to determine eligibility, and 14 were considered ineligible. These sites are all on lands administered by BLM. Site density is computed at 4.82 sites per square mile.

The unsurveyed areas could be expected to produce similar types of sites and site densities. Surveys by BLM personnel on the southern end of Asphalt Ridge indicate that similar site types are commonly found, including rock art and possible structural sites of Fremont/Anasazi cultural affiliation.

Circle Cliffs STSA

Existing data relevant to the archaeological resources of the STSA and most of the immediately surrounding area are limited. The area is so remote and limited in access that there have not been many archaeological studies completed or sites recorded. Lack of data for this analysis, then, reflects a lack of on-the-ground inventory and not necessarily a lack of resource. The area could be quite rich archaeologically.

A sample inventory of the STSA has recently been completed that indicates a site density of approximately nine sites per square mile, with a relatively low proportion of these sites potentially eligible to the National Register. *The majority of the sites in the sampled area are Archaic lithic scatters that were identified by the diagnostic artifacts they contain. The remaining sites consist of more recent Ute-Shoshoni and Euroamerican historic sites.* Known and recorded site concentrations near the STSA showed a highly varied pattern of site densities and may or may not be relevant to the area under consideration.

Hill Creek STSA

Little is known about the Hill Creek STSA; a sample cultural resource inventory was conducted for oil shale development in the area. This inventory indicated that the sites in the area consist mostly of Fremont and Ute rock art. There are a few Fremont structures on ledges throughout the area.

Pariette STSA

The Pariette STSA contains few sites. Overall site density is estimated at 0.2/square mile. Sites in the area are normally located on sand dunes, cobble fields, and elevated rock monoliths. The following types of sites are present: (1)

lithic scatters; (2) quarries; (3) camps; (4) rock art; (5) burials; (6) special activity sites; and (7) randomly located hearths.

P. R. Spring STSA

Indications of Archaic, Fremont, and Ute occupations of this area are abundant. The area has a relatively high site density (25 sites/square mile). Most sites are located on the interface between canyon walls and canyon rims and consist of (in order of abundance) rock art, large rockshelters, and overhang sites.

Ridgetops are the next area likely for site occurrences; these areas usually contain prehistoric camps, fire hearths, bifacial tools, cores, and utilized and non-utilized flakes. Inhabited rock shelters are sometimes found in canyon walls and often have associated lithic scatters located above on canyon rims. The canyon bottoms in the STSA are seemingly devoid of sites, except for historic cabins, line shacks, etc.

Raven Ridge/Rim Rock STSA

This area is rich in prehistoric remains, dating from several thousand years to historic times. Site density here is high. Evidence of a Paleo-Indian occupation of the Uinta Basin is present in this STSA, indicating man's presence as early as 10,000 years ago. Such sites are usually indicated by only surface remains. Hunting and gathering Archaic groups were in the area from approximately 6,000 B.C. to the inception of Fremont agriculture around 600 A.D. The Archaic sites in the area are represented by lithic scatters containing diagnostic artifacts and ground stone.

The Fremont occupied the area for a relatively short time (300-500 years), but did leave behind some large, stratified campsites that could yield much information on their lifestyles. The Fremont were followed by Ute/Shoshonean peoples in the thirteenth century, who left little evidence of their occupation.

Historic activity in the area is related mostly to gilsonite mining and the sheep industry; however, historic sites resulting from these activities are common.

San Rafael Swell STSA

A sample inventory of the STSA *has recently been completed*; this inventory indicates a prehistoric site density of approximately four sites per square mile, with a relatively large proportion of these exhibiting characteristics that would make them potentially eligible for the National Register. *Like the Circle Cliffs, most of the sites in this STSA are Archaic lithic scatters. Fremont ceramics are present on several sites, and there are a few Euroamerican historic sites in the STSA. Very few Numic sites are found in the area.*

Adjacent to the STSA in Black Dragon Canyon is a National Register pictograph panel. Two more National

CHAP 3--AFFECTED ENVIRONMENT

Register sites are located in the vicinity. The Buckhorn Wash Rock Art Sites are within 2 miles of the STSA in Buckhorn Wash, and the Temple Mountain pictograph panel is located on State land within the STSA.

Three other sites in the vicinity of the STSA are eligible for the National Register: the Lone Warrior pictograph, located 1 mile south of the Ghost Rock overlook on I-70; the Head of Sinbad pictograph panel, located 2 miles north of I-70; and the Swasey's Cabin historic site, also located near Ghost Rock.

Sunnyside STSA

Cultural resources are not well documented. Based on limited data, this STSA probably contains concentrations of San Rafael Fremont sites including rock art (both petroglyph and pictograph), dry masonry fortresses, pit houses, several styles of granaries, and caves or overhangs used for shelters. Formative-period cultures such as the Fremont and Anasazi have been identified. Graves, ceremonial, agricultural, and residential sites are reputed to be located in the canyons.

Sites have only been documented in the northern and eastern parts of the STSA. Documented sites include the proposed Nine Mile Canyon Archaeological District, northeast of Price, and the Flat Canyon Archaeological District, in and along Desolation and Gray canyons on the Green River. Because of these nearby districts, one can reasonably expect to find similar kinds of sites in the STSA.

The Nine Mile Canyon bottom contains several ranch headquarters and has historically been used for livestock grazing and agriculture.

Tar Sand Triangle STSA

Several inventories have been conducted in and around the general area. Many sites have been recorded, and indications are that there are many more. Recorded sites include quarries, rock art, temporary campsites, and rock shelters. The majority of these are from the Archaic tradition, a highly mobile, prehistoric lifestyle based on hunting and gathering which dates from approximately 10,000 years ago to the historic period. There is also evidence of Anasazi agriculturalists' use of the uplands and of Numic (prehistoric Ute) occupation of the area.

Sixteen sites in the area have been recommended to the National Register on an individual basis, and a formal determination of eligibility is being sought for an Orange Cliffs Archaeological District, significant because of numerous, pristine sites there that create a picture of prehistoric occupation and use of the region during the Archaic period.

Little is known about the historic resources present in the STSA. An old cabin in the Flint Flat area is referred to locally as the Wolverton Cabin, but little is known about its history. It is of local significance and interest to visitors to the area as an example of life in an earlier time. The eligibility

of the cabin and its surroundings for inclusion on the National Register has not been determined.

White Canyon STSA

A sample inventory of the STSA has recently been completed that indicates high site densities and a large proportion of sites potentially eligible to the National Register. Archaic through historic peoples occupied this area, with Pueblo cultural manifestations predominating. A large amount of material is available for scientific study.

Several inventories have also been conducted in the general vicinity of the White Canyon STSA, primarily related to uranium exploration and development. In 1978, a survey of 500 acres was conducted near the Happy Jack Mine at the southwestern corner of the STSA. Six prehistoric sites were located--five artifact (lithic) scatters and one campsite--all of which are of a Pueblo II cultural affiliation. In 1979, another large survey of 530 acres was conducted in the Jacob Chair locale. Twelve prehistoric sites were located: ten artifact (lithic) scatters, one quarry, and one camp. Only the quarry could be assigned a cultural affiliation. A gypsum point found at this site led to a late Archaic designation. In addition to the uranium-related inventories, another survey was conducted in the Horse Flat locale in 1969 for a chaining project. Thirteen prehistoric sites were located, most of which are Pueblo II and III habitation sites.

There are no existing National Register sites or nominations in the White Canyon STSA. However, potential National Register quality sites are located here. Also, because of the relative difficulty of access to this country, the White Canyon STSA potentially contains numerous pristine cultural resources.

LIVESTOCK GRAZING

Available livestock grazing data for each STSA is shown in Table 3-17. As indicated on this table, development on these STSAs could potentially affect current livestock management on more than 50 BLM and five FS grazing allotments. Grazing management could also be affected on privately owned surface within STSA boundaries.

About 87 percent of the livestock forage within STSAs is used by cattle, about 12 percent is used by sheep, and less than 1 percent is used by domestic horses. The amount of forage estimated to be used by cattle on the STSAs is 43,500 Animal Unit Months (AUMs). This would feed 3,625 cattle for 1 year or 8,700 cattle for 5 months, the average period of use on the affected allotments. There are an estimated 647,000 beef cattle in Utah (USDI, BLM, 1980). Based on these figures, about 1 percent of Utah's beef cattle are, to some extent, dependent on grazing provided within STSA boundaries. The amount of forage estimated to be used by sheep is 6,000 AUMs. This would feed 2,500 sheep (five sheep/AUM) for 1 year or 6,000 sheep for 5 months, the average period of use on the affected allotments. There are an estimated 462,000 sheep and/or goats in Utah (USDI, BLM, 1980). Based on these figures, about 1 percent of

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-17

Livestock Grazing Within STSAs

STSA	Allotment	Estimated Livestock Forage Within STSA (AUMS)	Percent of Allot- ment Area in STSA	Percent of Allotment's Total Live- stock Forage in STSA	Class of Livestock
Argyle Canyon/ Willow Creek	Isolated BLM Tracts State and private pastures and range- lands.	1,750	--	--	Cattle/Sheep
	Horse Ridge (FS)	54	12	12	Cattle
	Tub Ridge (FS)	29	18	18	Cattle
		<u>1,833</u>			
Asphalt Ridge/ White Rocks	Asphalt Ridge (BLM)	54 ^a	--	100	Sheep
	Twelve Mile (BLM)	22 ^a	--	5	Sheep
	Cook (BLM)	187 ^a	--	22	Sheep
	Powell (Twelve Mile) (BLM)	89 ^a	--	68	Sheep
	Holmes-Palmer (BLM)	129 ^a	--	100	Sheep
	Private pasture and Indian Lands.	2,438	--	--	Cattle/Sheep
	Mosby Mountains (FS)	217	7	18	Cattle
	Jay Schulthes (FS)	15	33	33	Cattle
	Farm Creek (FS)	117	--	10	Cattle
	<u>3,268</u>				
Circle Cliffs ^b	Big Bowns	225	15	--	Cattle
	Circle Cliffs	Not suitable	--	--	Cattle
	Death Hollow	874	87	--	Cattle
	Moody	240	15	--	Cattle
	Steep Creek	22	5	--	Cattle
	Wagon Box	551	91	--	Cattle
		<u>1,912</u>			
Hill Creek	Horse Point	916	33	33	Cattle
	Oil Shale	801	25	25	Sheep
	Tabyago	406	14	14	Sheep
	West Tabyago	33	13	13	Sheep
	Upper Showalter	404	100	100	Cattle
	Ute	1,353 ^c	100	100	Cattle
		<u>3,913^c</u> <u>6,360^d</u>			
	<u>10,273</u>				
Pariette	Antelope Powers	16	1	--	Sheep
	Wells Draw	197	9	--	Sheep
	Snyder Spring-Step Ant	247	6	--	Cattle
	Hungry Hollow	93	5	--	Cattle
	Eight Mile Flat	74	7	--	Cattle
	Wetlands	28	3	--	Cattle
		<u>655</u>			
P. R. Spring	Asphalt Draw	523	10	10	Sheep
	Olsen	1,654	13	13	Sheep
	Atchee Ridge	2,954	25	25	Cattle
	Watson	128	3	3	Sheep
	Sweetwater	4,819	63	63	Cattle

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-17 (continued)

STSA	Allotment	Estimated Livestock Forage Within STSA (AUMS)	Percent of Allotment Area in STSA	Percent of Allotment's Total Livestock Forage in STSA	Class of Livestock
P. R. Spring (Cont.)	Book Cliff Pastures	1,345	94	94	Cattle
	McLelland	1,950	36	36	Cattle
	Sand Wash	6	F1	F1	Sheep
	Sunday School Canyon	3,855	82	82	Cattle
	Horse Point	800	29	29	Cattle
	Winter Ridge	2,058	83	83	Cattle
		<u>20,092</u>			
Raven Ridge/ Rim Rock	Cocklebur	158	8	8	Sheep
	Antelope Draw	38	1	1	Sheep
	Snake John	34	3	3	Sheep
	Spring Hollow	179	35	35	Cattle
	Powder Wash	1,082	44	44	Sheep
	Walker Hollow	49	6	6	Cattle
	Bonanza	75	3	3	Sheep
	Total	<u>1,615</u>			
San Rafael Swell	Big Pond	315 ^e	14	14	Sheep/Cattle
	Black Dragon	1,031 ^e	32	32	Cattle
	George's Draw	79 ^e	8	8	Sheep
	Globe Link	228 ^e	38	38	Cattle
	Head of Sinbad	70 ^e	9	9	Cattle
	Iron Wash	25 ^e	F1	F1	Cattle
	Lone Tree	53 ^e	1	1	Cattle
	McKay Flat	45 ^e	2	2	Cattle
	North Sinbad	1,632 ^e	51	51	Cattle
	Oil Well Flat	601 ^e	23	23	Cattle
	Red Canyon	629 ^e	28	28	Cattle
	Saddle Horse Canyon	2 ^e	1	1	Cattle
	South Sid and Charlie	38 ^e	4	4	Cattle
	Taylor Flat	487 ^e	24	24	Sheep
Temple Mountain	470 ^e	76	76	Cattle	
	Total	<u>5,705</u>			
Sunnyside (North)	Parley's Canyon	88	19	--	Cattle
	Currant Canyon	68	28	--	Cattle
	Five Mile	60	8	--	Cattle
	Water Canyon 2	42	30	--	Cattle
	Devil's Canyon	159	12	--	Cattle
	Bull Canyon	68	7	--	Cattle
	Leers Canyon	215	36	--	Cattle
	Argyle Ridge	105	19	--	Cattle
	Total	<u>805</u>			
Sunnyside (South)	Cow Canyon	38 ^e	40	40	Cattle
	Sheep Canyon	557 ^e	80	80	Cattle
	Green River	3,433 ^e	40	40	Cattle
	Rock Creek	956 ^e	60	60	Cattle
	Dry Canyon	445 ^e	55	55	Cattle
	Stone Cabin	244 ^e	50	50	Cattle
	Sulphur Canyon	--	--	--	Cattle
	Max Canyon	13 ^e	65	65	Cattle
	Total	<u>5,686</u>			

CHAP. 3: AFFECTED ENVIRONMENT

TABLE 3-17 (concluded)

STSA	Allotment	Estimated Livestock Forage Within STSA (AUMS)	Percent of Allotment Area in STSA	Percent of Allotment's Total Livestock Forage in STSA	Class of Livestock
Tar Sand Triangle	Robbers Roost	609	11	9	Cattle
	Sewing Machine	921	51	35	Cattle
	Flint Trail ^f	1,337	59	100	N/A
	Little Rockies ^g	N/A	2	N/A	N/A
	Total	2,867			
White Canyon	White Canyon	28 ^h			Cattle

Source: USDI, BLM, 1983e; and Laing, 1983.

^aFederal AUMs.

^bAssuming 30 acres/AUM and 75-percent suitability.

^cRepresents 40,854 acres known production on BLM lands.

^dRepresents 66,395 acres, estimated production on Indian Reservation and private lands.

^eCalculated from multiplying active preference by percent of allotment in STSA.

^fUnallotted area, may be used on a temporary, non-renewable basis.

^gUnallotted area, no livestock grazing.

^hForage estimated to be 1/2 of 1 percent of 5,544-AUM preference.

CHAP 3--AFFECTED ENVIRONMENT

Utah's sheep are, to some extent, dependent on grazing provided within STSA boundaries.

SOCIOECONOMICS

The material used in this section of the EIS was taken from the "Draft Socioeconomic Technical Report: Regional Analysis of Tar Sand Development in Utah," unless otherwise stated. This report was prepared by Argonne National Laboratories (1983) under contract to BLM.

Regional Overview

Socioeconomic impacts are expected to occur in seven counties in east-central Utah: Carbon, Duchesne, Emery, Garfield, Grand, Uintah, and Wayne. In this EIS, where discussions below county levels are necessary, County Census Divisions (CCD) (see Glossary) are used.

Much of the region is sparsely populated. The seven affected counties had a total population of 80,526 people in 1980. There were only 3.2 people per square mile in the region in 1980, ranging from 0.7 per square mile in Garfield County to 15.0 per square mile in Carbon County. In the state as a whole, there were 17.8 people per square mile in 1980, while the figure for the U.S. was 64.0. Price and Vernal were the only two communities in the region with populations greater than 4,000 in 1980. No town had a population of more than 10,000 people (U.S. Department of Commerce [USDC], Bureau of Census, 1982).

Traditionally, most of the region has been dependent on agriculture or energy development, and residents are well acquainted with the cyclical nature of energy-related growth. The coal industry in Carbon and Emery counties, the uranium industry in Grand County, and, most recently, the oil industry in Uintah and Duchesne counties, have caused frequent "boom-and-bust" periods.

DEMOGRAPHIC CONDITIONS AND TRENDS

The State of Utah grew from a population of 1,059,273 in 1970 to a population of 1,461,037 in 1980. The growth rate in Utah was 37.9 percent (3.27 percent annually) in the 1970s, making it the fifth fastest-growing state in the United States. This population increase fluctuated considerably from county to county within the State. Of the counties of interest here, the four most populous counties (Carbon, Duchesne, Emery, and Uintah) grew more rapidly than the state as a whole. Conversely, the three least populous counties (Garfield, Grand, and Wayne) grew less rapidly than the state as a whole.

Table 3-18 presents 1970 and 1980 populations for the potentially impacted communities and counties in Utah. The average annual compound percent change in population is illustrated to show the growth rate during this 10-year period. Table 3-19 summarizes demographic characteristics of each potentially impacted county for 1980.

Carbon County

Carbon County grew 42 percent between 1970 and 1980. Price, the largest city in the county and the region, has been a coal center since the 1890s. The neighboring towns of Helper, East Carbon, and Sunnyside were developed to provide commercial and residential services for the coal mines in the area.

Of the 22,179 residents of the county in 1980, 20.1 percent were of school age, 57.6 percent were of work age, and 9.7 percent were of retirement age. The median age in the county in 1980 was 26.1. American Indians and blacks combined to comprise 1 percent of the population in the county, with American Indians outnumbering blacks two to one. There were 7,242 households with an average of 3.06 people per household in the county in 1980.

Duchesne County

Duchesne County grew 72 percent in the 1970s, reaching a population of 12,565 in 1980, mostly because of increased activity in the petroleum industry. Roosevelt grew 91 percent between 1970 and 1980, and the Town of Duchesne, while isolated from most of the oil-related growth, increased 53 percent in the same time period.

Table 3-19 shows that the 12,565 residents of Duchesne County in 1980 included 25.9 percent of the total who were of school age, 52.5 percent who were of work age, and 6.8 percent who were of retirement age. Median age in the county was 22.0 in 1980, the second lowest in the state. Over 2 percent of the population was American Indian. The 3.59 average household size was among the highest in the state.

Emery County

The population of Emery County increased by 125 percent between 1970 and 1980. Much of this growth can be traced to the construction of the Hunter and Huntington Canyon powerplants. Castle Dale is now the largest city in the county, mostly because of that energy-related development. Green River was the largest city in the county in 1970; however, its location on the eastern border of the county isolated it from development activities. Consequently, it was the only city in the region to lose population between 1970 and 1980.

Garfield County

Garfield County grew by only 16 percent in the 1970s, the least of any county in the region. The eastern part of the county--the area which would be potentially affected--is isolated. Rugged terrain and lack of water have inhibited growth in the county.

Grand County

The population of Grand County increased by 23 percent between 1970 and 1980. There was less growth in the Thompson CCD (see Glossary), the potentially impacted area. Most of the people in the county live in the valley around Moab.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-18

Historical Population Levels of Potentially
Affected Counties and Communities
(1970 and 1980)

County/Community	Years		Average Annual Compound Percent Change
	1970	1980	
State of Utah	1,059,273	1,461,037	3.27
<u>Carbon County</u>	15,647	22,179	3.55
East Carbon	1,808 ^a	1,942	0.72
Helper	1,964	2,724	3.33
Hiawatha	166	249	4.14
Price	6,218	9,086	3.87
Scotfield	71	105	3.99
Sunnyside	485	611	2.34
Wellington	922	1,406	4.31
<u>Duchesne County</u>	7,299	12,565	5.58
Duchesne City	1,094	1,677	4.36
Roosevelt	2,005	3,842	6.72
<u>Emery County</u>	5,137	11,451	8.35
Castle Dale	541	1,910	13.44
Clawson	-- ^a	88	--
Cleveland	244	522	7.90
Elmo	141	300	7.84
Emery	216	372	5.59
Ferron	663	1,718	10.00
Green River	969	956	-0.13
Huntington	857	2,316	10.45
Orangeville	511	1,309	9.86
<u>Garfield County</u>	3,157	3,673	1.53
Boulder	93	113	1.97
Escalante	638	652	0.22
Hite CCD	4 ^a	202	48.02
<u>Grand County</u>	6,688	8,241	2.11
Thompson CCD	4,793	5,333	1.07
<u>Uintah County</u>	12,684 ^a	20,506	4.92
Ballard ^b	230 ^a	558	9.27
Naples ^b	--	2,400	--
Vernal	3,908	6,600	5.38
<u>Wayne County</u>	1,483	1,911	2.57
Hanksville CCD	181	351	6.85

Source: Argonne National Laboratories, 1983.

^aNot incorporated in 1970.

^bNew incorporated in 1983, 1980 populations estimated.

^cCensus data for Ticaboo are unavailable.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-19

Summary of Demographic Characteristics
of Potentially Affected Counties (1980)

Affected Counties	Total Population	School Age ^a (Percent)	Retirement Age ^b (Percent)	Work Age ^c (Percent)	Number of Households
Carbon County	22,179	20.1	9.7	57.6	7,242
Duchesne County	12,565	25.9	6.8	52.5	3,499
Emery County	11,451	23.4	6.7	53.3	3,279
Garfield County	3,673	21.1	11.9	55.9	1,196
Grand County	8,241	21.4	6.6	60.1	2,759
Uintah County	20,506	24.1	6.0	55.1	5,949
Wayne County	<u>1,911</u>	22.0	13.6	51.4	<u>615</u>
Totals	80,526				24,539

Source: Argonne National Laboratories, 1983.

^a5-17 years of age.

^b65 plus years of age.

^c16-64 years of age.

CHAP. 3--AFFECTED ENVIRONMENT

Uintah County

The population of Uintah County grew by almost 66 percent during the 1970s. Vernal, the largest city in the county, also grew about 66 percent between 1970 and 1980. Oil development has been responsible for most of the growth during that time.

Wayne County

Wayne County had a population increase of 29 percent between 1970 and 1980, but it still *has* the smallest population of any county in the region. Growth was much more rapid in the Hanksville CCD, the potentially affected area. A total of only 351 people lived in the Hanksville CCD in 1980.

The Uintah and Ouray Reservation

The population of the Ute Tribe, according to the Bureau of Indian Affairs, has increased significantly through the last decade: 1,292 (1972), 1,670 (1976), 1,728 (1980), 1,890 (1981). In 1980, 85 percent of the tribal members lived on or near the Reservation. Another 420 Indians, who were either not enrolled in any tribe or who were members of other tribes, were also in residence on the Reservation (State of Utah, 1982).

EMPLOYMENT AND INCOME

Employment

Table 3-20 shows historical county employment levels for 1970, 1975, and 1980.

Growth in the number of employed workers in Carbon County was more than twice as rapid between 1975 and 1980 than between 1970 and 1975. Employment in the finance, insurance, and real estate sector increased most rapidly between 1970 and 1975, while employment in the services sector increased most rapidly between 1975 and 1980. The number of workers in the mining, construction, and manufacturing sectors grew 126 percent between 1970 and 1980.

Duchesne County had a total employment of 5,632 in 1980, a 112-percent increase since 1970. Nonfarm proprietors were the fastest growing sector between 1970 and 1975, while manufacturing was the fastest growing sector between 1975 and 1980. Government, mining, and wholesale and retail trade were the largest sectors in 1980.

The total employment of 5,452 in Emery County in 1980 was a 199-percent increase since 1970. The number of workers grew over 10 percent annually throughout the period. The most rapid growth was in the transportation, communication, and utilities sector, which increased 34.92 percent annually between 1970 and 1975, and 27.54 percent annually between 1975 and 1980. Employment in the mining sector jumped from 366 in 1970 to 2,105 in 1980.

Garfield County had a total employment increase from 1,431 in 1970 to 2,179 in 1980. This increase occurred between 1975 and 1980. Employment in the county fluctuated between 1974 and 1980. *In 1982, the county expe-*

rienced a 20 percent unemployment rate. The largest increase in the county between 1970 and 1975 was in the services sector, while the largest increase between 1975 and 1980 was in the construction sector. Government and construction were the largest sectors in 1980.

Grand County had a 49-percent increase in total employment at rates of 2.06 percent annually between 1970 and 1975 and 6.18 percent annually between 1975 and 1980. The wholesale and retail trade sector increased most rapidly between 1970 and 1975, while the mining sector increased most rapidly between 1975 and 1980. The combined mining, construction, and manufacturing sectors represented a 55-percent increase since 1970. Wholesale and retail trade, mining, and government were the largest sectors in 1980.

Uintah County had a total employment of 8,153 in 1980, a 77-percent increase since 1970. Growth in employment was twice as rapid between 1970 and 1975 than between 1975 and 1980. The transportation, communication, and utilities sector increased most rapidly between 1970 and 1975, while the mining sector increased most rapidly between 1975 and 1980. Employment in the mining, construction, and manufacturing sectors increased a total of 2,058, or an 81-percent increase since 1970. Mining, services, and wholesale and retail trade were the largest sectors in 1980.

The growth in employment in Wayne County was relatively constant--about 3 percent annually--through 1970 to 1980. The nonfarm proprietors sector increased most rapidly. Government, agriculture, and nonfarm proprietors were the largest sector in 1980.

Trends in Monthly Wages and Personal Income

Average monthly wages for each major nonagricultural employment sector are shown by county in Table 3-21. Mining, construction, transportation, communications, and utilities sectors showed the highest average wage levels during 1975-1980. Under the baseline projections and alternatives, increased employment would be primarily concentrated in the mining and construction sectors.

County per capita personal income (PCPI) and the ratio of county PCPI to Utah are shown in Table 3-22. Per capita income has increased in all seven counties from 1970 to 1980. However, not every county increased at a steady or continuous rate. Figure 3-4 illustrates the pattern of personal income growth for the affected counties. Utah per capita income increased by 12 percent over the 10-year period. Total personal income for Utah increased by 55 percent between 1970 and 1980.

Infrastructure

HOUSING

Table 3-23 contains existing data on housing within affected counties and communities by status and tenure, types of dwelling units, and average cost per unit.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-20

Historical County Employment Levels
for Potentially Affected Counties
(1970-1980)^{a, b}

Industrial Sector	Sectoral Employment (Number of Workers)			Average Annual Compound Percent Change		Sectoral Employment (Number of Workers)			Average Annual Compound Percent Change	
	1970	1975	1980	1970-1975	1975-1980	1970	1975	1980	1970-1975	1975-1980
	<u>Carbon County</u>					<u>Duchesne County</u>				
Agriculture	249	214	226	-2.98	1.10	797	741	733	-1.45	-0.22
Mining	987	1,350	2,325	6.46	11.49	269	1,060	1,071	31.56	0.21
Construction	128	220	338	5.57	8.97	NA	158	210	-- ^c	5.86
Manufacturing	187	276	281	8.10	0.36	52	93	174	12.33	13.35
Transportation, Communication, and Utilities	460	455	650	-0.22	7.39	85	169	238	14.73	7.09
Wholesale and Retail Trade	922	1,190	1,762	5.24	8.17	299	815	893	22.21	1.84
Finance, Insur- ance, and Real Estate	135	277	242	15.46	-2.67	NA	80	81	-- ^c	0.25
Services	464	567	1,083	4.09	13.82	211	228	298	1.56	5.50
Government	1,388	1,408	1,828	0.29	5.36	571	792	1,097	6.76	6.73
Nonfarm Pro- prietors	470	508	650	1.57	5.05	249	564	837	17.76	8.22
Total	5,390	6,465	9,385	3.70	7.74	2,656	4,700	5,632	12.09	3.68
	<u>Emery County</u>					<u>Garfield County</u>				
Agriculture	452	468	464	0.70	-0.17	281	237	236	-3.35	-0.08
Mining	366	1,061	2,105	23.72	14.69	NA	39	210	-- ^c	40.03
Construction	NA	587	522	-- ^c	-2.32	34	24	379	-6.73	73.65
Manufacturing	NA	NA	22	-- ^c	-- ^c	204	217	248	1.24	2.71
Transportation, Communication, and Utilities	34	152	513	34.92	27.54	46	49	85	1.27	11.65
Wholesale and Retail Trade	161	245	335	8.76	6.46	127	154	125	3.93	-4.09
Finance, Insur- ance, and Real Estate	NA	NA	65	-- ^c	-- ^c	NA	15	16	-- ^c	1.30
Services	63	205	225	26.61	1.88	220	278	266	4.79	-0.88
Government	370	350	716	-1.11	15.39	330	346	457	0.95	5.72
Nonfarm Pro- prietors	204	233	485	2.69	15.79	166	130	157	-4.77	3.85
Total	1,825	2,326	5,452	12.75	10.39	1,431	1,489	2,179	0.80	7.91

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-20 (concluded)

Industrial Sector	Sectoral Employment (Number of Workers)			Average Annual Compound Percent Change		Sectoral Employment (Number of Workers)			Average Annual Compound Percent Change	
	1970	1975	1980	1970-1975	1975-1980	1970	1975	1980	1970-1975	1975-1980
	<u>Grand County</u>					<u>Uintah County</u>				
Agriculture	70	79	75	2.45	-1.03	751	622	635	-3.70	0.41
Mining	499	423	735	-3.25	11.71	711	1,064	1,607	8.40	8.60
Construction	163	206	345	4.79	10.86	180	287	270	9.78	-1.21
Manufacturing	81	83	69	0.49	-3.63	249	287	181	2.88	-8.81
Transportation, Communication, and Utilities	186	224	245	3.79	1.81	177	503	611	23.23	3.97
Wholesale and Retail Trade	401	607	809	8.64	5.91	711	1,176	1,408	10.59	3.67
Finance, Insur- ance, and Real Estate	53	59	88	2.17	8.32	74	107	156	7.65	6.83
Services	343	368	401	1.42	1.73	548	1,066	1,459	14.23	6.48
Government	439	420	579	-0.88	6.63	860	993	1,152	2.92	3.02
Nonfarm Pro- prietors	238	270	349	2.56	5.27	342	617	674	12.53	1.78
Total	2,473	2,739	3,696	2.06	6.18	4,603	6,722	8,153	7.87	3.94
	<u>Wayne County</u>									
Agriculture	205	195	191	-1.00	-0.41					
Mining	NA	NA	9	NA	NA					
Construction	NA	NA	84	NA	NA					
Manufacturing	NA	NA	37	NA	NA					
Transportation, Communication, and Utilities	NA	NA	3	NA	NA					
Wholesale and Retail Trade	37	39	42	1.06	1.49					
Finance, Insur- ance, and Real Estate	NA	NA	12	NA	NA					
Services	31	NA	31	NA	NA					
Government	174	211	207	3.93	-0.38					
Nonfarm Pro- prietors	89	114	152	5.08	5.92					
Total	579	672	768	3.02	2.71					

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bNA = not available.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-21
Average Nonagricultural Wages and Yearly Rate of Change
for Potentially Affected Counties^a
(1975-1980)

	Carbon County		Duchesne County		Emery County		Garfield County		Grand County		Uintah County		Wayne County	
	Average 1980	% Change 1975-1980	Average 1980	% Change 1975-1980	Average 1980	% Change 1975-1980	Average 1980	% Change 1975-1980	Average 1980	% Change 1975-1980	Average 1980	% Change 1975-1980	Average 1980	% Change 1975-1980
Industrial Sector														
Mining	\$1,980	8.23	\$1,834	0.49	\$1,966	9.49	\$1,346	5.63	\$1,601	2.52	\$1,754	14.81	\$1,461	18.52
Construction	1,401	5.80	1,570	4.62	2,410	8.65	1,071	8.79	1,702	2.17	1,244	4.41	1,769	-- ^c
Manufacturing	820	4.83	1,365	7.23	882	-- ^c	972	8.99	714	-6.48	988	7.45	381	-- ^c
Transportation, Communication, and Utilities	1,725	8.49	1,615	3.12	1,777	11.62	1,214	5.98	1,279	-2.58	1,521	8.18	906	-- ^c
Wholesale and Retail Trade	775	8.50	708	0.21	490	5.82	420	7.78	796	-1.84	883	5.46	337	6.42
Finance, Insurance, and Real Estate	849	2.32	875	0.68	806	-- ^c	833	12.77	973	2.46	917	-- ^c	1,844	-- ^c
Services	704	10.11	787	0	716	13.44	640	14.70	662	1.18	983	8.70	431	-- ^c
Government	855	4.97	809	-2.64	842	6.11	828	4.55	1,054	0.24	1,041	7.30	794	6.44

Source: Argonne National Laboratories, 1983.

^aBased on 1980 dollars.

^bComputed as the compound average annual percent change.

^cNot available.

CHAP 3--AFFECTED ENVIRONMENT

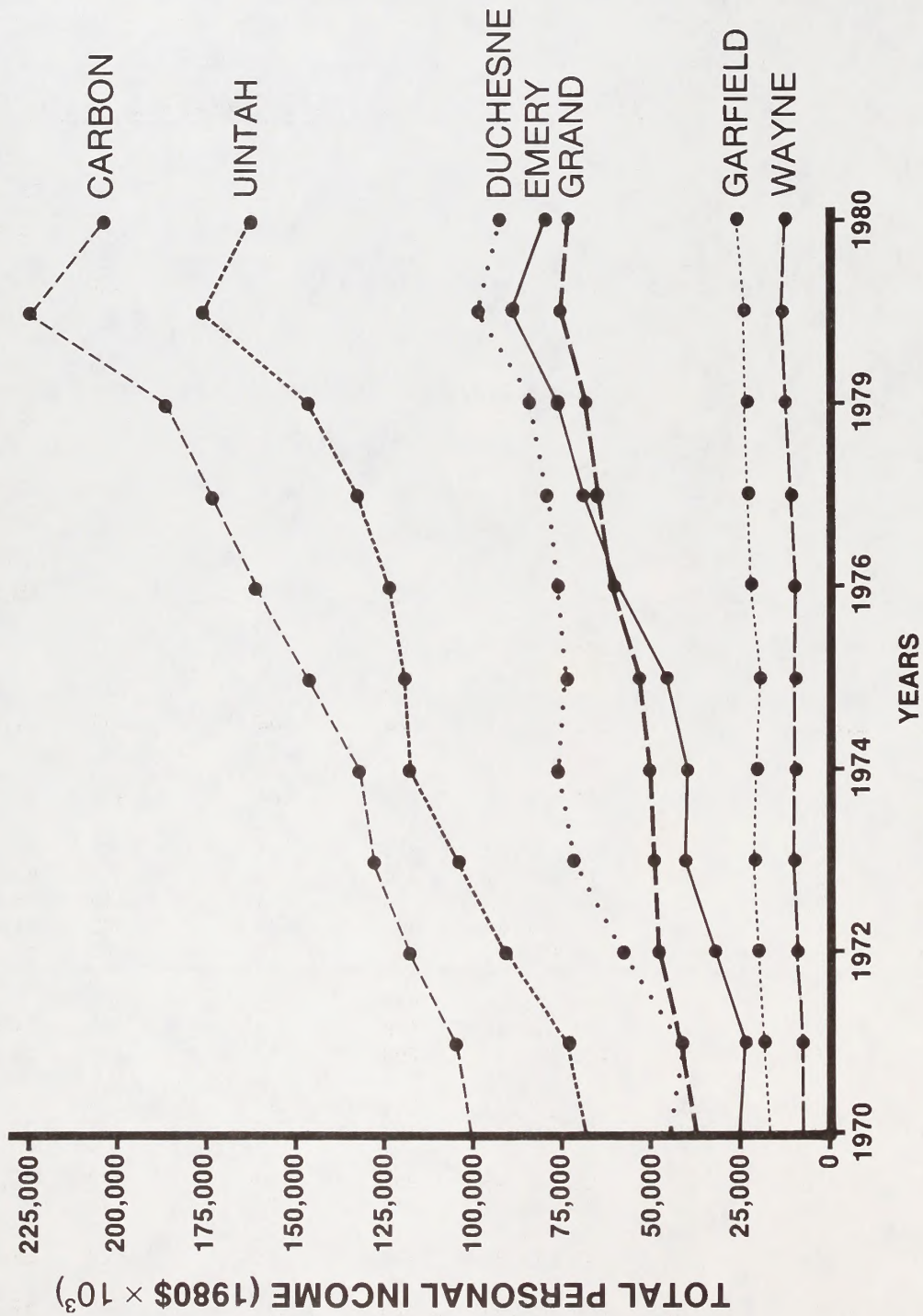
TABLE 3-22

County PCPI^a and Ratio of County PCPI to Utah
(1970-1980)

Area	1970		1975		1980	
	PCPI	Ratio	PCPI	Ratio	PCPI	Ratio
State of Utah	\$6,825		\$7,382		\$7,631	
Carbon County	6,409	0.9390	7,759	1.0511	9,105	1.1932
Duchesne County	5,057	0.7410	6,387	0.8652	7,302	0.9569
Emery County	4,852	0.7109	5,948	0.8057	6,810	0.8924
Garfield County	5,252	0.7695	5,974	0.8093	6,963	0.9125
Grand County	6,673	0.9777	7,658	1.0374	8,865	1.1617
Uintah County	5,364	0.7859	6,852	0.9282	7,837	1.0270
Wayne County	4,796	0.7027	5,684	0.7700	6,239	0.8176

Source: Argonne National Laboratories, 1983.

^aPer capita personal income (PCPI) based on 1980 dollars.



SOURCE: ARGONNE NATIONAL LABORATORIES, 1983

FIGURE 3-4
TOTAL PERSONAL INCOME BY POTENTIALLY AFFECTED COUNTIES

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-23

Existing Housing Units in Potentially Affected
Communities and Counties (1980)

County/Community	Housing By Status and Tenure (Number of Year-Round Units)			Total Occupied Housing			Average Cost Per Unit ^a
	Total	Occupied	Renter	Conventional	Multi- Family	Home/ Trailer	
			Occupied (% of Total Occupied)				
<u>Carbon County</u>	8,192	7,242	1,711 (23.6)	5,289	990	963	49,042 _{-b}
East Carbon CCD	932	874	129 (14.8)	767	9	98	- _b
East Carbon	722	675	102 (15.1)	620	9	46	29,138
Sunnyside	206	199	27 (13.6)	147	0	52	24,720
<u>Helper CCD</u>	2,171	1,643	364 (22.2)	1,180	172	291	- _b
Helper	1,076	993	250 (25.2)	837	126	30	44,437
Scofield	85	34	5 (14.7)	21	0	13	31,953
<u>Price CCD</u>	5,089	4,725	1,218 (25.8)	3,342	809	574	- _b
Price	3,202	2,967	872 (29.4)	2,114	693	160	57,107
Wellington	433	396	78 (19.7)	280	29	87	46,643 _{-b}
Hiawatha	89	82	82(100.0)	75	7	0	- _b
<u>Duchesne County</u>	4,478	3,499	667 (19.1)	2,338	248	913	48,979 _{-b}
Duchesne CCD	1,343	805	221 (27.5)	508	47	250	- _b
Duchesne City	574	492	168 (34.1)	267	36	189	44,625
<u>Roosevelt CCD</u>	2,954	2,694	446 (16.6)	1,830	201	663	- _b
Roosevelt	1,222	1,133	255 (22.5)	778	162	193	51,010
<u>Emery County</u>							
<u>Castle Dale- Huntington CCD</u>	3,660	3,276	672 (20.5)	2,118	164	994	50,238
Castle Dale	626	542	124 (22.9)	333	24	185	- _b
Cleveland	156	147	15 (10.2)	110	0	37	41,775
Elmo	90	82	7 (8.5)	63	4	15	48,577
Huntington	773	698	158 (22.6)	353	43	302	51,420
Orangeville	399	367	63 (17.2)	297	9	61	53,917
<u>Emery-Ferron CCD</u>	800	712	150 (21.1)	488	55	169	- _b
Emery	144	114	18 (15.8)	108	0	6	34,634
Ferron	538	489	115 (23.5)	293	52	144	58,242
<u>Green River CCD</u>	429	364	101 (27.7)	207	18	139	- _b
Green River	390	335	96 (28.7)	191	18	126	39,350
<u>Garfield County</u>	1,770	1,196	208 (17.4)	956	63	177	39,487 _{-b}
<u>Escalante CCD</u>	430	295	61 (20.7)	230	25	40	- _b
Boulder	71	38	13 (34.2)	19	12	7	40,625
Escalante	300	236	42 (17.8)	197	11	28	38,672
<u>Grand County</u>	3,046	2,759	620 (22.5)	1,529	289	944	54,201 _{-b}
Thompson CCD	136	117	53 (45.3)	50	15	52	- _b

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-23 (concluded)

County/Community	Housing By Status and Tenure (Number of Year-Round Units)			Total Occupied Housing			Average Cost Per Unit ^a
	Total	Occupied	Renter	Conventional	Multi- Family	Home/ Trailer	
			Occupied (% of Total Occupied)				
<u>Uintah County</u>	6,621	5,949	1,254 (21.1)	4,355	504	1,090	53,086 _{-b}
<u>Uintah-Ourray CCD</u>	1,251	1,065	226 (21.2)	823	40	202	
Ballard	172	157	18 (11.5)	127	0	30	47,339
Vernal CCD	5,370	4,884	1,028 (21.0)	3,532	464	888	_{-b}
Vernal	2,399	2,187	686 (31.4)	1,496	370	321	52,541
<u>Wayne County</u>	848	615	104 (16.9)	521	16	78	41,839 _{-b}
Hanksville CCD	151	93	21 (22.6)	53	4	36	

Source: Argonne National Laboratories, 1983.

^aMean value of owner-occupied, non-condominum housing units.

^bNot available.

TABLE 3-24

Student Enrollment, School Capacity, and Staffing Statistics
of potentially affected counties (1982)

School District	Student Enrollment	Present Capacity	Percent of Capacity Used	Teachers	Student/ Teacher Ratio
Carbon County	5,245	5,549	94.5	217	24:1
Duchesne County	4,247	4,886	86.9	184.5	23:1
Emery County	3,281	4,347	75.5	147	22:1
Garfield County	982	1,287	76.3	63	16:1
Uintah County	6,478	6,143	105.5	222.5	29:1
Wayne County	555	592	93.8	32.5	17:1

Source: Argonne National Laboratories, 1983.

CHAP 3--AFFECTED ENVIRONMENT

EDUCATION

Table 3-24 presents data pertaining to school enrollment, student capacity, and staffing statistics for schools in each potentially affected county.

Carbon County School District

In 1982, 5,245 students were enrolled in the 11 schools in Carbon County. The six schools in Price accounted for over 65 percent of the total enrollment in the school district. The total 1982 capacity of the schools in the county was 5,549, and schools had an average operating capacity of almost 95 percent in 1982. Five schools had enrollments greater than their stated capacity. To accommodate this increase, the district makes extensive use of portable classrooms.

Carbon County employed 217 teachers in 1982; this translates into a 24:1 student/teacher ratio, which is slightly greater than the state average of 23:1. A \$16-million bond was approved for school construction and improvements in 1982. The state estimates that the county will need to invest over \$10 million in schools in 1987, but does not indicate how much additional money will be needed through 1995. The 1982 bond issue exhausted the legal debt capacity in the school district.

Duchesne County School District

A total of 4,247 students were enrolled in Duchesne County schools in 1982. The total capacity of the schools in the county was 4,886 in 1982. Schools varied greatly in their operating capacity; however, as a whole, they were operating at 87 percent of capacity. The district employed 184.5 teachers in 1982 and the student/teacher ratio was 23:1, the same ratio as the state. Duchesne County has been devoting \$2 million annually to capital facilities. The state has estimated that the county will need to spend slightly more than \$20 million for school construction between 1982 and 1987.

Emery County School District

Enrollment in Emery County schools totaled 3,281 in 1982 and had a combined capacity of 4,347 students. Only one school in the district (Ferron Elementary School) had an enrollment that exceeded its capacity in 1982. The schools throughout the district were operating at slightly over 75 percent of capacity. Some portable classrooms are used, but most of the schools could accommodate another 100 students. The district employed 147 teachers in 1982. Student/teacher ratio for the district was 22:1, just below the state ratio (23:1). The county recently completed a building program that doubled the schools' capacities. Over \$30 million in bonding capacity remains; the state estimates the district will need to spend over \$18 million by 1987 to accommodate expected growth. Based on the 1980 age distribution, the school-age population will increase rapidly in coming years.

Garfield County School District

The seven schools had a total of 982 students in 1982, and the capacity of the schools was 1,287 students. Most of the

schools in the district were operating at well under their capacities. The most striking exception was the Ticaboo School, which was operating at 219 percent of capacity. The seven district schools together had an average operating capacity of 75 percent.

Garfield County employed 63 teachers in 1982. The highest student/teacher ratio in the county was 23:1, the same as the state average. The student/teacher ratio in the school district was substantially lower (16:1). The Garfield School District has a large building program; plans are to construct all new buildings in 10 years, at a cost of \$6 million. *However, this building program has been deferred indefinitely because the school bond initiative was recently defeated.* The distribution of school-age population indicates that the number of junior high and high school students will increase substantially in the near future. Several temporary measures have been proposed to reduce the overcrowding in the Ticaboo School and to increase the capacity of the high schools in the district.

Uintah County School District

A total of 6,478 students attended Uintah County schools in 1982. The average operating capacity in the school district was 106 percent in 1982. Only two schools were operating at less than 100 percent of capacity, while Todd Elementary School in western Uintah County was operating at 256 percent of capacity. Three other schools were operating at over 150 percent of capacity.

In 1982, the district employed 222.5 teachers and had a student/teacher ratio of 29:1. The Uintah Learning Center had a student/teacher ratio of 12:1, while Vernal Junior High School had a student/teacher ratio of 38:1.

In addition to the two elementary schools scheduled to open in 1983, Uintah County has plans to open another elementary school, a junior high school, and a high school in the 1984-85 school year. Funding for this construction exceeds county resources, so industry contributions are being sought.

Wayne County School District

The four schools in Wayne County had a combined enrollment of 555 in 1982. The combined capacity of the schools was 592 in 1982. It should be noted that three of the four schools in Wayne County are in the western end of the county, located outside the impact area. Hanksville Elementary School has 52 students enrolled. This is 62 percent of its capacity.

Wayne County employed 32.5 teachers in 1982, and the student/teacher ratio for the district was 17:1, well under the state ratio of 23:1. The district has \$3.3 million available for school improvements over the next 3 years. The state has estimated the needs of the district through 1987 at \$730,000. The school-age population projection reveals that school enrollment should increase slightly in the next several years.

Grand County School District

In 1982, 1,784 students were enrolled in the five schools in Grand County. Only one school, Southeast Elementary,

CHAP. 3: AFFECTED ENVIRONMENT

was operating under its capacity in 1982. The Sundwall Center was operating at 145 percent of capacity, and Grand County Middle School was operating at 122 percent of capacity. The five schools together had an average operating capacity of 107 percent.

Grand County employed 80 teachers in 1982. The student/teacher ratio in the county was 22:1, just below the state ratio of 23:1. The student/teacher ratios ranged from 16:1 at the Sundwall Center to 28:1 at Grand County Middle School.

The Uintah and Ouray Reservation

Currently, the 692 school age members of the tribe attend 8 elementary schools, 1 junior high, and 4 high schools while 50 students attend Bureau boarding schools. Almost 80 percent of the students are enrolled in the three schools, Todd Elementary and West Junior High in Fort Duchesne, and Union High School (currently overcrowded) in Roosevelt (State of Utah, 1982).

HEALTH CARE SERVICES

Carbon County

In general, health care services are at or above recommended service levels. Castleview Hospital in Price currently has 70 beds; an expansion to 88 beds will be completed in December 1983. It also serves Emery County, where there is no hospital. There are 21 physicians, with a wide range of medical specialists in the county. The existing mental health center in Carbon County is understaffed and has faced rising admissions and a declining staff since 1978.

Duchesne County

Duchesne County Hospital in Roosevelt currently has 32 beds and an occupancy rate of about 60 percent. An ongoing expansion project will raise the capacity to 42 beds and add new facilities throughout the hospital. Local doctors in Roosevelt are supplemented by doctors flown in to staff the hospital on nights and holidays. These facilities and personnel serve the residents of Ballard and rural Uintah County as well as residents of other parts of Duchesne County. A clinic in the Town of Duchesne is staffed by nurse-practitioners operating during regular business hours Monday through Friday and on Saturday morning. Two doctors make regular visits to the clinic.

Duchesne County is served by the Utah State Mental Health Services with offices in Roosevelt and Vernal in Uintah County. Duchesne County has a staff of two alcohol and drug abuse counselors, two mental health specialists, one psychology resident, and one psychiatric nurse.

Emery County

Because there is no hospital in Emery County, hospital services are provided by Castleview Hospital in Price (Carbon County) and by the hospital in Moab (Grand County). Green River has a clinic staffed by a nurse-practitioner, and Castle Dale has a clinic and two physicians. Mental health services in Emery County are provided by the Utah State Mental Health Services office in Price (Carbon County).

The state also maintains a permanent office in Castle Dale. An increased case load has been handled by a staff that has declined by 30 percent since 1978 because of insufficient funding.

Garfield County

Health care in Garfield County is very limited. A clinic in Escalante is visited by a doctor 3 days a week. Other physicians, dentists, and a small hospital are located in Panguitch, 65 miles from Escalante and 92 miles from Boulder. Limited mental health services for Garfield County are available in Panguitch as a satellite operation of the State Mental Health Services in St. George. One full-time psychologist is located in Panguitch, and a psychiatrist visits the Panguitch office twice monthly.

Uintah County

The Ashley Valley Medical Center, completed in 1980, is a 36-bed hospital located in Vernal. The full-time equivalent of about 11 physicians work in Vernal, along with ten dentists. Residents of the western part of Uintah County use the Duchesne County Hospital and other health care facilities in Roosevelt. The State Department of Social Services provides all mental health care in Uintah County. There are insufficient personnel to handle a large increase in the number of patients.

Wayne County

Wayne County residents generally use the Sevier Valley Hospital in Richfield. The Wayne County Clinic in Bicknell is staffed by a nurse-practitioner and visited by a doctor 3 days a week. Residents in the Hanksville area use clinic facilities in Green River or Bicknell. There is a part-time dentist in Bicknell. There is also one mental health worker in Bicknell, who is part of the staff of the Utah District IV Mental Health Services.

The Uintah and Ouray Reservation

The Indian Health Service of the U.S. Department of Public Health and Human Services provides health care to the Ute Indians. A medical clinic at the Duchesne County Hospital in Roosevelt currently serves the Tribe, but a new clinic at Fort Duchesne is under construction and will replace the hospital clinic. The clinic, however, serves only those Utes enrolled, under the Termination Act of 1954. The Indian Health Clinic provides outpatient care, family planning, immunization, pharmacology, and mental health services. Dental services for the Utes are provided at Fort Duchesne by the U.S. Department of Public Health, and the new clinic should provide adequate health care coverage under baseline growth assumption (State of Utah, 1982).

PUBLIC SAFETY

Law Enforcement

Carbon County

The Carbon County Sheriff's Department serves the unincorporated areas of the county. The 12 officers of the Department also provide backup and dispatching for the

CHAP. 3: AFFECTED ENVIRONMENT

police forces of the cities in the county, with the exception of East Carbon, which has its own dispatch service. The county jail in Price has been described as "essentially overcrowded" and does not meet most State and Federal standards. In addition to county resources several of the cities in the county employ law enforcement personnel. Wellington has one full-time police officer, Price has 17, Helper has five, and East Carbon and Sunnyside share one officer.

Duchesne County

The Duchesne County Sheriff's Department serves the unincorporated areas of the county and the City of Duchesne. The Department has 10 full-time officers, plus supporting dispatchers and jailers. It is also in the process of reorganizing a jeep posse to assist in search and rescue missions. The Duchesne County jail in Duchesne can accommodate up to 36 prisoners and averages about 14 prisoners. The facility is not licensed to hold juveniles (they must be transported to Vernal for detention). Additional law enforcement personnel are located in Roosevelt, which employs 12 full-time officers.

Emery County

The Emery County Sheriff's Department serves all areas of the county except for the City of Green River. The Department has 34 full-time officers, dispatchers, and jailers. The Emery County jail in Castle Dale currently accommodates an average of ten prisoners. Green River maintains its own two-officer police force. Five Utah Highway Patrol officers and two deputy sheriffs are also stationed in Green River.

Garfield County

Current law enforcement needs of Garfield County are handled by a *sheriff and three deputies. One deputy is assigned to the eastern portion of the county, and one deputy is assigned to Escalante.*

Uintah County

The Uintah County Sheriff's Department serves the unincorporated areas of the county. The Department employs about 15 officers and six support personnel. Central dispatching is handled through the City of Vernal. The county jail in Vernal is used by all law enforcement agencies operating in the county and accommodates 27 prisoners. The county jail does not comply with Federal and State standards. Various city resources supplement the county law enforcement effort. Vernal employs 21 full-time police officers and six support personnel. Naples has three full-time officers.

Wayne County

The Wayne County Sheriff's Department has a part-time deputy in Hanksville. There is also a Utah Highway patrol officer stationed in Hanksville. The response time to Hanksville for officers from Loa (the county seat) is approximately 1 hour, but inadequate radio communication over the mountains near Capitol Reef National Park affects service to the Hanksville area.

The Uintah and Ouray Reservation

The Ute Tribe has 14 police officers and 13 supplemental enforcement staff on the Reservation (State of Utah, 1982).

Fire Protection

Carbon County

Carbon County helps fund the fire departments in the cities, and all fire calls are dispatched through the county sheriff's department. Otherwise, fire protection is provided by local communities. East Carbon has a 12-member volunteer fire protection force, two pumpers, and one tanker with a combined 1,500-gallon capacity. Helper has a 16-member volunteer force, two pumpers, a tanker, and a pumper/rescue truck with a combined capacity of 2,500 gallons. The Price Fire Department has a full-time chief, 25 volunteers, three pumpers, a pumper/ladder truck, and a tanker with a combined capacity of 4,500 gallons. Sunnyside has a 16-member volunteer force and two pumpers with a combined capacity of 4,000 gallons. Wellington has a 20-member volunteer force, two pumpers and a tanker with a combined capacity of 2,150 gallons.

Duchesne County

The county is the principal funding agency for the volunteer fire departments located in Roosevelt and Duchesne. The county sheriff dispatches all fire calls in the county. The Roosevelt Fire Department is adequate for existing needs. The Department is equipped with two pumpers and a tanker with a combined capacity of more than 2,000 gallons.

Emery County

Emery County is the principal funding agency for the volunteer fire departments located throughout the county. The county recently constructed a new fire station in each Castle Valley community and provided new mini-pumper trucks for each department. The county also covered 75 percent of the cost of tankers for each department.

Garfield County

Garfield County is the principal funding agency for the volunteer fire departments in Escalante and Boulder. Escalante has two pumpers, and Boulder has one truck currently without a pumper.

Uintah County

Uintah County and the City of Vernal cooperate in the maintenance of the Ashley Valley Fire Department. The Department is staffed by 25 volunteers, has four pumpers, and a foam- and dry-powder truck. Naples has its own volunteer fire department with 20 volunteers and one 1,000-gallon pumper. Ballard is served by the Duchesne County Fire Department in Roosevelt.

Wayne County

Wayne County maintains a truck for the Hanksville Volunteer Fire Department, and the local department could be supported by a pumper and personnel from the local

CHAP. 3: AFFECTED ENVIRONMENT

BLM Henry Mountain Resource Area headquarters. There is also a need for an alarm and alert system for the fire department.

The Uintah and Ouray Reservation

The Ute Tribe contracts with Roosevelt for fire protection services, although the Bureau of Indian Affairs, Forestry Division, provides some volunteer assistance (State of Utah, 1982).

Emergency Medical Services

Carbon County

Carbon County provides ambulance service for all parts of the county. All ambulance calls are dispatched through the sheriff's department. The county has 19 active emergency medical technicians and five ambulances located in Price, and eight emergency medical technicians and two ambulances located in Sunnyside.

Duchesne County

Duchesne County provides ambulances staffed by volunteer emergency medical technicians in Altamont, Duchesne, Roosevelt, and Tabiona. The county sheriff dispatches all emergency calls in the county. Duchesne and Roosevelt each have one ambulance. The volunteer emergency medical technicians in Roosevelt have been partially responsible for the cost of their own training.

Emery County

Volunteer emergency medical technicians staff four ambulances provided by Emery County in Emery, Ferron, Castle Dale, and Huntington. There are three ambulances in Green River, also staffed by volunteer emergency medical technicians.

Garfield County

Garfield County provides one ambulance in Boulder and one ambulance in Escalante. Four volunteer emergency medical technicians staff the ambulance in Boulder, and five or six volunteer emergency medical technicians staff the ambulance in Escalante.

Uintah County

The Ashley Valley Medical Center in Vernal is served by two ambulances staffed by 18 emergency medical technicians. All parts of the county are served by the center, with the exception of Ballard, which is served by Duchesne County from Roosevelt.

Wayne County

Wayne County maintains an ambulance in Hanksville and funds the training of the volunteer emergency medical technicians.

The Uintah and Ouray Reservation

Emergency medical services to the Ute Tribe are provided by services in Duchesne and Uintah counties.

UTILITIES

Sewage System

Table 3-25 summarizes sewage systems operational in the region. Almost all of the communities are served by a central sewage system. Frequently, a special district is responsible for sewage collection and treatment in a county. The most common type of collection is gravity flow. Type and capacity of treatment facilities vary from county to county.

Solid Waste Disposal System

As seen in Table 3-26, solid waste disposal systems in the region are highly decentralized. Solid waste collection is done by private contractor or on an individual basis throughout the region, with the exception of Vernal, which operates a city collection system. In most cases, landfills are operated by the county, although several cities have their own landfill.

There is room for substantial expansion at the landfill in East Carbon. The Duchesne County landfill, located northwest of Myton, has a capacity to handle 10 years of supply at the present rate. The city landfill in the Town of Duchesne meets all current standards and has sufficient room for an undefined amount of expansion. Both the Emery County landfill near Castle Dale and the city-operated landfill in Green River have an undetermined capacity. Several dumps (i.e., unsanitary landfills) are located in Garfield County. Because these dumps are not engineered, they have an undetermined capacity. The landfill site in Vernal is adequate for substantial growth, and the landfill east of Moab presently has sufficient capacity.

State health standards requiring daily covering of waste material involve both labor and equipment costs. Counties and municipalities throughout the state, particularly in rural areas, have been unable or unwilling to comply with State standards regarding solid waste disposal.

Water Systems

Data on regional water systems are presented in Table 3-27. The numerous water districts and communities draw upon rivers, springs, reservoirs, and wells as sources for their culinary water. Several areas are approaching or exceeding their available water supply. Problems with existing facilities are also present. Efforts to expand and improve water systems are underway throughout the region.

Fiscal and Management Conditions

Table 3-28 provides a regional summary of fiscal data for affected counties and communities.

SCHOOL DISTRICT FINANCES

Carbon County School District spent \$10 million in 1982. Forty percent of this was raised from property taxes. The budget in the school district rose dramatically along with its

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-25

Sewage Disposal Systems of Potentially Affected Communities and Counties

County/Community	Central System	Collection Type	Number of Existing Connections	Sewage Treatment Plants				
				Design Flow Capacity (mgd)	Average Daily Flow (mgd)	System Type	Population Capacity	Expansion Plans
<u>Carbon County</u>								
East Carbon	yes ^a	gravity flow	963	0.5	0.5	lagoon trickling filter	4,000	yes
Helper	yes ^b	gravity flow	6,200	1.9	2.6		21,500	yes
Price	yes ^b	gravity flow	--	--	--	--	--	--
Sunnyside	yes ^a	gravity flow	--	--	--	--	--	--
Wellington	yes ^b	gravity flow	--	--	--	--	--	--
<u>Ouchesne County</u>								
Ouchesne	yes	gravity flow	425	0.60	0.25	lagoon	2,500	no
Roosevelt	yes	gravity flow	1,100	1.50	0.50	lagoon	12,000	yes
<u>Emery County</u>								
Castle Dale	yes ^{c,d}	gravity flow	NA ^e	NA	NA	lagoon	7,000	no
Cleveland	yes	gravity flow	NA	NA	NA	lagoon	1,400	
Elmo	yes ^c	gravity flow	NA	NA	NA	lagoon	700	
Emery	yes ^c	gravity flow	NA	NA	NA	lagoon	1,300	
Ferron	yes ^c	gravity flow	NA	NA	NA	lagoon	800	yes
Green River	yes	gravity flow	NA	NA	0.15	mechanical trickling filter		yes
Huntington	yes ^c	gravity flow	NA	NA	NA	lagoon	3,000	yes
Orangeville	yes ^{c,d}	gravity flow	--	--	--	--	--	no
<u>Garfield County</u>								
Boulder	no	none	--	--	--	septic tank	--	--
Escalante	no	none	--	--	--	septic tank	--	--
<u>Grand County</u>								
	NA	NA	NA	NA	NA	NA	NA	NA
<u>Uintah County</u>								
Ballard	no ^f	none	0	--	--	septic tank	--	--
Naples	yes ^f	--	--	--	--	--	--	--
Vernal	yes ^f	gravity flow	2,000	2.7	1.8	trickling filter	40,000	no
<u>Wayne County</u>								
	NA	NA	NA	NA	NA	NA	NA	NA

Source: Argonne National Laboratories, 1983.

^aHelper, Price, and Wellington are served by the Price Water Improvement District. A description of the capacity of the district is included under Helper.

^bSunnyside and East Carbon share facilities. A description appears under East Carbon.

^cServed by the Castle Valley Special Service District.

^dCastle Dale and Orangeville share the same sewage disposal system. A description appears under Castle Dale.

^eNA = Not available.

^fServed by the Ashley Valley Water and Sewer Improvement District facility completed in 1982. A description of the capacity of the facility is included under Vernal.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-26

Solid Waste Disposal Systems
for Potentially Affected Communities and Counties

County/Community	Collection	Landfill
<u>Carbon County</u>		
East Carbon	Private contractor	Shared with Sunnyside
Helper	Private contractor	Operated by county
Price	Private contractor	Operated by county
Sunnyside	Private contractor	Shared with East Carbon
Wellington	Private contractor	Operated by county
<u>Duchesne County</u>		
Duchesne	Private contractor	Operated by city
Roosevelt	Private contractor	Operated by county
<u>Emery County</u>		
Castle Dale	Private contractor	Operated by county
Cleveland	Private contractor	Operated by county
Elmo	Private contractor	Operated by county
Emery	Private contractor	Operated by county
Ferron	Private contractor	Operated by county
Green River	Private contractor	Operated by county
Huntington	Private contractor	Operated by county
Orangeville	Private contractor	Operated by county
<u>Garfield County</u>		
Boulder	Individual	Operated by city ^a
Escalante	Individual	Operated by county ^a
<u>Grand County</u>	Individual	Operated by county
<u>Uintah County</u>		
Ballard	Private contractor	Operated by county
Naples	Private contractor	Operated by county and Vernal
Vernal	City	Operated by county and city
<u>Wayne County</u>	b	--

Source: Argonne National Laboratories, 1983.

^aShould be considered a dump and not a sanitary landfill.

^bThere is no solid waste collection in the unincorporated areas of Wayne County.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-27

Summary of Water System Characteristics
for Potentially Affected Communities and Counties (1982)^a

County/Community	Water Sources(s)	Quantity Supplied	Storage Capacity (10 ⁶ gal/d)	Filtration Plant		Connections	Distribution Capacity (number of Connections)
				Design Capacity	Flow Capacity		
<u>Carbon County</u>							
East Carbon	surface water/springs	2.0 mgd	1.5	1.7 mgd	NA	963	NA
Helper ^c	springs/Scofield Res.	0.8 mgd	4.3	NA	NA	1,100	NA
Price	surface water/springs	3.6 mgd ^d	10.5	2.16 mgd	3.6 mgd	3,500	NA
Sunnyside ^b	surface water/springs	- ^b	- ^b	- ^b	NA	NA ^c	NA
Wellington	Scofield Reservoir	- ^c	- ^c	- ^c	- ^c	- ^c	NA
<u>Duchesne County^e</u>							
Duchesne	surface water	1.35 mgd ^g	2.0	2,000 _{-h} gpm	NA _{-h}	654	900
Roosevelt	springs ^g /deep wells	4.0 cfs ^g	2.5	- _{-h}	- _{-h}	1,100	3,125
<u>Emery County</u>							
Castle Dale ^j	surface water	1,000 gpm	0.75	1,000 gpm	NA	654	900
Cleveland ^j	surface water	275 gpm	NA	NA	NA	275	NA
Elmo ⁱ	surface water						
Emery ⁱ	wells	90-100 gpm	0.5	NA	NA	135	180
Ferron ⁱ	surface water	1,250 gpm	0.75	1,250 gpm	NA	615	500
Green River ⁱ	Green River	1.5 mgd	0.5	1.5 mgd	NA	475	NA
Huntington ⁱ	surface water	1,160 mgd	1.0	1,160 gpm	NA	950	1,050
Orangeville ⁱ	surface water	750 gpm	0.5	750 gpm	NA	380	680
<u>Garfield County</u>							
Boulder	springs	NA	0.1 (est.)	- _{-h}	- _{-h}	55	NA
Escalante	springs	NA	1.0	- _{-h}	- _{-h}	315	750
<u>Grand County^k</u>							
<u>Uintah County</u>							
Ballard ^l	spring ^g /cisterns	0.25 cf s ^g	0.2	- _{-h}	- _{-h}	185	NA
Naples ^m	Ashley Spring	- _{-m}	- _{-m}	- _{-m}	- _{-m}	824	NA
Vernal ^m	Ashley Spring	9.0 mgd	2.5	- _{-h}	- _{-h}	2,223	NA
<u>Wayne County</u>							
Hanksville ⁿ	NA	NA	NA	NA	NA	48	65

Source: Argonne National Laboratories, 1983.

^aKey to abbreviation:

mgd = million gallons per day
gpm = gallons per minute
afd = acre feet per day
cfs = cubic feet per second
NA = not available.

^bEast Carbon and Sunnyside share the same water system. The characteristics of the system are described under East Carbon.

^cServed by the Price Water Improvement District. The district draws water from the Scofield Reservoir and has 1,600 connections. The filtration plant has a design capacity of 4.0 mgd and a flow capacity of 1.9 mgd.

^dQuantity supplied during period of peak use.

^eAn area adjacent to Roosevelt is served by the Johnson Water Improvement District, and an area east of Duchesne is served by the East Duchesne Water Improvement District.

^fServed by the Central Utah Water Conservancy District.

^gServed by the Ute Tribe, which owns two springs that supply water to neighboring communities.

^hNo filtration plant is needed.

ⁱThe Castle Valley Special Service District provides funding support for communities in Emery County.

^jServed by the North Emery Water Users Association, a private system that cannot accommodate new connections.

^kThere is no central water system in Grand County.

^lServed by the Ballard Water Improvement District, which buys treated water from the Ute Tribe.

^mThe Ashley Valley Water and Sewer Improvement District (2,070 connections), the Maeser District (650 connections), the Jensen District (260 connections), and the City of Vernal (2,223 connections) use the same water system. The characteristics of the system are described here under Vernal.

ⁿA private water company operates in the unincorporated community of Hanksville.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-28
Summary of Fiscal Conditions for Potentially Affected
Communities and Counties (1982)

County/Community	Revenues (\$ x 10 ⁶)			1982 Mill Levy	Assessed Valuation (s x 10 ⁶)	Expenditures (\$ x 10 ⁶)		
	Average Annual	Current ^b Annual	Percent Difference			Average Annual	Current ^b Annual	Percent Difference
<u>Carbon County</u>	4.278	5.192	21.37	16.00	115.190	4.320	5.180	19.91
East Carbon	0.278	0.396	42.45	18.18	3.540	0.414	0.515	24.40
Helper	1.831	1.905	4.04	8.00	6.860	1.511	1.695	12.18
Price	6.573	7.948	20.92	14.35	28.668	6.376	8.019	25.77
Sunnyside	0.200	0.238	19.00	6.00	0.979	0.193	0.268	38.86
Wellington	0.328	0.465	41.77	11.16	3.137	0.345	0.462	33.91
<u>Duchesne County</u>	4.874	6.551	34.41	8.54	105.159	4.209	6.541	55.41
Duchesne	0.423	0.631	49.17	17.00	3.599	0.343	0.634	84.84
Roosevelt	2.355	2.605	10.62	17.87	14.529	2.175	2.671	22.80
<u>Emery County</u>	5.998	6.453	7.59	16.22	233.820	5.799	6.452	11.26
Castle Dale	0.454	0.358	-21.15	14.00	3.893	0.418	0.434	3.83
Cleveland	--	0.174	--	11.00	0.844	--	0.075	--
Elmo	--	0.050	--	11.00	0.591	--	0.029	--
Emery	--	0.081	--	17.65	0.601	--	0.060	--
Ferron	0.347	0.352	1.44	18.65	3.377	0.314	0.353	12.42
Green River	0.256	0.275	7.42	21.00	2.287	0.126	0.322	155.56
Huntington	--	0.577	--	14.25	5.091	--	0.588	--
Orangeville	0.243	0.236	-2.88	21.63	2.704	0.168	0.158	-5.95
<u>Garfield County</u>	2.145	2.266	5.65	6.80	39.831	2.145	1.730	-19.35
Boulder	--	0.018	--	5.00	0.446	--	0.010	--
Escalante	--	0.096	--	10.50	1.600	--	0.072	--
<u>Grand County</u>	2.776	2.637	-5.01	8.11	60.558	2.776	2.637	-5.01
<u>Uintah County</u>	17.787	10.420	-41.42	9.51	252.757	14.905	10.788	-27.62
Ballard	--	0.068	--	0.51	4.381	--	0.068	--
Naples	--	0.653	--	--	--	--	0.652	--
Vernal	4.604	4.949	7.49	1.80	35.738	4.660	5.083	9.08
<u>Wayne County</u>	0.918	0.805	-12.31	12.16	6.682	0.922	0.761	-17.46

Source: Argonne National Laboratories, 1983.

^aRevenue and expenditure budgets for the counties reflect 1980-82 averages; the communities represent 1980-81 and 1981-82 averages.

^bCurrent annual budgets are based on 1983 fiscal year data for the counties and 1982 fiscal year data for the communities.

^cNo mill levy; also, there is a political commitment not to use property taxes as a source of revenue.

CHAP. 3: AFFECTED ENVIRONMENT

mill levy in 1980 and has been quite stable (at between \$10 and \$11 million) since then. The jump in the budget and mill levy reflect a substantial increase in capital outlays. Carbon County spent \$2,130 per student in 1981-82, slightly below the state average of \$2,254.

The Duchesne County School District spent nearly \$8 million in 1981-82. About 72 percent of this money was raised from property taxes. Duchesne County spent \$2,135 per student in 1981-82, slightly below the state average of \$2,254.

About 75 percent of the \$12 million in Emery County School District expenditures in 1982 was raised from property taxes. Emery County spent \$4,168 per student in 1981-82, almost double the state average of \$2,254.

The Garfield County School District spent \$2.75 million in 1982. About 36 percent of this total was raised from property taxes. Garfield County spent \$3,136 per student in 1981-82, well above the state average of \$2,254.

The Grand County School District spent \$3.52 million in 1982. The district had an assessed valuation of \$29,659 per student in 1981-82. The county spent \$2,096 per student in 1981-82, also under the state average of \$2,254.

The Uintah County School District spent \$13.3 million in 1982. About 39 percent of this was raised from property taxes. The assessed valuation per student in the district was \$25,712 in 1981-82. Uintah County spent \$2,513 per student in 1981-82, above the state average of \$2,254.

The local portion of the Wayne County School District expenditure of \$1.5 million in 1981 and 1982 was raised primarily through a 30.49 mill levy on \$6,681,702 assessed valuation. The district ranks as one of Utah's poorest in terms of assessed valuation per student--\$14,264 in 1982-82. The district spent \$3,084 per student in 1981-82, well above the state average of \$2,254.

ATTITUDES AND LIFESTYLES

Originally, the communities within the tar sand project area were established as Mormon farming settlements. However, Price soon became an important support community for coal mining. Historically, these communities have been culturally homogenous and have valued their small-town way of life, community solidarity, and aesthetic and recreational opportunities as important lifestyle advantages. Energy development since World War II has gradually weakened this cultural homogeneity, particularly in the

Castle Valley and Uinta Basin portions of the affected area. Most communities in Emery, Carbon, Duchesne, and Uintah counties have experienced growth from oil and gas or coal. Of all of the communities in the affected area, Hanksville, in Wayne County, has been the least affected by energy-related growth influences.

In those communities where energy-related growth has been controlled, residents would generally support additional moderate growth, providing that the population increase be carefully accommodated by adequate planning and mitigation.

Green River, Price, and Sunnyside generally agree that additional growth would be good and that the quality of the surrounding environment is now either good or fair (Southeastern Utah Association of Governments and Economic Development District, 1980). Uinta Basin communities, such as Roosevelt and Vernal, also would support additional resource development and growth; however, residents generally perceived the need for enhancement of the existing urban infrastructure coupled with local government planning to mitigate additional growth (Skinner, 1980). The Ute Tribe, on the Uintah and Ouray Indian Reservation, is more cautious in its support of tar sand development. The tribe recognizes the importance of increased employment opportunities but expresses concerns about the cultural and environmental impacts and possible alternatives of mitigation (Duncan, 1983). Wayne County, including Hanksville, similarly acknowledges potential conflicts between existing cultural values and energy-induced population growth. The populace is generally more supportive of tar sand development (Fawcett, 1979).

TRANSPORTATION

Vehicular traffic within the regional tar sand area would occur on most State and Federal highways in the eastern half of Utah. Annual average daily traffic (ADT) values depicted in Table 3-29 have been compiled from Utah Department of Transportation (UDOT, 1982) data averaged from segments affected by STSAs. The Denver & Rio Grande Western Railroad mainline passes through the Salt Lake Valley southward through Spanish Fork Canyon to Price, Green River, then eastward to Grand Junction, Colorado. Access roads into STSAs are county-graded surface or dirt roads having minimal maintenance.

CHAP 3--AFFECTED ENVIRONMENT

TABLE 3-29

Annual ADT Levels

STSA	Highway	Segment Description	Average ADT (1981)	Affected Communities
Argyle Canyon/ Willow Creek		(Railroad)		
Asphalt Ridge/ White Rocks	U.S. Hwy 40	Vernal to west of Roosevelt.	4,951	Roosevelt ^a
Circle Cliffs	Utah Hwy 24	Notom Road to U.S. Hwy 70.	475	Hanksville Green River ^a
	U.S. Hwy 70	Utah Hwy 24 to Green River.	2,938	
Hill Creek	Utah Hwy 88	Ouray to U.S. Hwy 40.	355	Ouray ^a Roosevelt ^a
	U.S. Hwy 40	Utah Hwy 88 to west of Roosevelt.	5,418	
P. R. Spring	Utah Hwy 45	Bonanza to U.S. Hwy 40.	293	Bonanza ^a Jensen ^a Vernal ^a Naples ^a
	U.S. Hwy 40	Utah Hwy 45 to west of Roosevelt.	4,188	
Pariette	U.S. Hwy 40	Myton to Roosevelt.	5,240	Myton ^a Roosevelt ^a
Raven Ridge/ Rim Rock	Utah Hwy 45	South of U.S. Hwy 40 to U.S. Hwy 40.	285	Jensen ^a Vernal ^a Naples ^a
	U.S. Hwy 40	Utah Hwy 45 to west of Roosevelt.	4,188	
San Rafael Swell	U.S. Hwy 70	Head of Sinbad to Green River.	2,498	Green River ^a
Sunnyside	U.S. Hwy 6	Price to Utah Hwy 123	6,458	Price ^a Wellington ^a Sunnyside ^a East Carbon City ^a
	U.S. Hwy 123	Utah Hwy 6 to Sunnyside	2,833	
Tar Sand Triangle	Utah Hwy 24	Temple Junction to U.S. Hwy 70.	500	Green River ^a
	U.S. Hwy 70	Utah Hwy 24 to Green River.	2,938	
White Canyon	Utah Hwy 95	Fry Canyon to Hanksville.	330	Hanksville
	Utah Hwy 24	Hanksville to U.S. Hwy 70.	483	
	U.S. Hwy 70	Utah Hwy 24 to Green River.	2,938	Green River ^a

Source: Utah Department of Transportation, 1982.

^aCommunity is currently experiencing energy-related traffic.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This volume of the environmental impact statement (EIS) analyses anticipated impacts for tar sand development on 11 Special Tar Sand Areas (STSAs). Environmental impacts to resources are considered on a regional basis in this chapter of the EIS. Three alternatives are analyzed: (1) High Commercial Production; (2) Low Commercial Production; and (3) No Action (*baseline*). Only impacts to resources most significantly affected are considered.

The first section of this chapter describes assumptions and guidelines used in impact analysis. A second section gives a regional impact analysis for each resource by alternative. This is followed by an analysis of each STSA. Descriptions of the short-term use of man's environment, maintenance and enhancement of long-term productivity, and irretrievable and irreversible commitments of resource are also included in Table 2-4.

Because tar sand development is not presently proposed at either Pariette or White Canyon STSAs, they are not considered in this chapter. However, if development of these STSAs were proposed at a later date, an Environmental Assessment (EA) or an EIS would have to be conducted before development activities were allowed. These analyses could be tiered to the existing environment described in Chapter 3.

ANALYSES ASSUMPTIONS AND GUIDELINES

The following assumptions and/or guidelines were made to determine environmental impacts resulting from tar sand development:

1. Appropriate laws, *permitting processes*, regulations, and mitigating measures (i.e., stipulations) will be applied and enforced.
2. Impacts from conventional oil and gas development are not discussed in this EIS because these assessments were completed in Bureau of Land Management (BLM) District EAs. Because only oil and gas development is expected on Sunnyside tracts 10, 11, and 12 and Pariette tracts 1, 2, and 3, potential impacts to these tracts are not assessed in this volume of the EIS.
3. Surface disturbance in this volume refers only to the area on which tar sand related development could occur. However, it is expected that a portion of the disturbed area would be either: (1) disturbed by active mining; (2) would be in the reclamation phase; (3) would be reclaimed; and (4) would still be undisturbed until near the end of the tar sand develop-

ment period. Surface disturbance from surface mining would require area for the pit and additional acreage for sideslopes, roads, spent sand areas, and processing plants. Surface disturbance from in-situ development would require 40 percent of each lease tract for drill pads, pipelines, and roads. This includes only acreage where vegetation would be removed and soil was either leveled or moved. It does not include acreage where vegetation would be trampled.

4. Site-specific impacts from tar sand development on the Sunnyside and Tar Sand Triangle STSAs are analyzed in the *Sunnyside Combined Hydrocarbon Lease Conversion Draft EIS* (U.S. Department of Interior [USDI], BLM, 1983b) and the *Unit Plan of Operations of Tar Sand Triangle Combined Hydrocarbon Lease Conversion Draft EIS* (USDI, National Park Service [NPS], 1983). Also, *the Ashley National Forest is performing the site-specific environmental assessment work on a conversion application in the Asphalt Ridge/White Rocks STSA*.
5. A worst-case situation is assumed when two possible development options are possible. For example, the worst-case impact to soils would be to use surface-mining methods, which result in higher levels of surface disturbance. Use of surface-mining methods would be beneficial for the tar sand resource because more of the tar sand would be recovered. Conversely, in-situ development would result in the worst-case situation for tar sand because 70 percent of the bitumen would not be recovered.
6. The schedule for development of potential lease tracts is as follows:

1984 - Leases issued on potential tracts and conversion applications.

1985 - Plans of operations submitted by lessee for new leases.

1986 - Additional environmental review and reporting required.

1987 - Impacts begin, mainly from exploration. Construction begins on some tracts, while production begins on other tracts.

1988 - Exploration period ends and construction period continues.

1994 - All production on leases reviewed to prove diligence. Significant impacts still accumulating.

2005 - Maximum impacts would continue throughout the project's life. Site development could begin as

ALT. 1--HIGH COMMERCIAL PRODUCTION

early as 1984, and full production would be reached by 2005. Impacts are only analyzed to the year 2005, because it is assumed that operation activities on tracts would reach a steady level of production by that time.

7. Bitumen production figures are based on a 30-percent recovery rate from in-situ development and a 90-percent recovery rate from surface mining.
8. Lands used for community development and/or community or mine water would not be reclaimed or returned to original uses.
9. Work force data from companies were used when available. Where such information was lacking, the work force was estimated, considering construction periods from 2 to 3 years.
10. The intent of the air quality impact analysis is to satisfy the requirements of the National Environmental Policy Act (NEPA); it is not intended to satisfy the regulatory permitting procedures required under the Clean Air Act. These procedures will be evaluated on a case-by-case basis during the Prevention of Significant Deterioration (PSD) permitting process.
11. The Colorado River Simulation System computerized model was used to project effects on flow and salinity from tar sand development.
12. In the impact analysis on deer and elk summer crucial ranges, it is assumed that these animals are evenly distributed throughout the entire crucial range.
13. The transportation analysis assumes truck transportation to existing refineries in Salt Lake City and Roosevelt in Utah, and Grand Junction in Colorado, unless existing railroads were available.
14. For purposes of the transportation analysis, it is assumed that design modifications would be made to these existing refineries so that syncrude feedstock could be processed.
15. The regional overview considers only major transportation arteries (trucks, highways, railroads). Traffic localized to STSAs would be assessed as part of additional environmental analysis, as required, after submission by industry plans of operations.
16. *For analysis purposes it was assumed that for most projects the majority of surface-disturbing activities would occur within the boundaries of the STSAs. For some projects, impacts would also occur outside the STSA boundaries. These impacts will be analyzed later in site-specific EAs or EISs for specific plans of operations.*

THREATENED, ENDANGERED, AND SENSITIVE PLANT AND ANIMAL SPECIES

Because development of the proposed lease conversions and/or new leases could have an effect on threatened, endangered, or sensitive species, BLM has entered into consultation with the Fish and Wildlife Service (FWS) pursuant to the Endangered Species Act and is coordinating with FWS under the Fish and Wildlife Coordination Act. The FWS has provided BLM with a letter stating potentially threatened, endangered, or sensitive species affected within STSAs (see Appendix 4).

In addition to the officially listed threatened and endangered species discussed in this impact analysis, there are from 6 to 13 plant and animal species proposed for listing in the 11 STSAs. Impacts to these sensitive species were not specifically analyzed; however, these species will be considered on a project-by-project basis as each plan of operations is reviewed for approval.

However, the current project descriptions and/or tract analyses assumptions do not contain sufficient information to make a full determination whether or not the eventual development of any of the potential lease tracts or conversions would jeopardize the continued existence of any threatened or endangered species found in the region. This is particularly true for water use from the Colorado River system, in relation to endangered fish species. If water use occurred, it would be necessary for BLM to request Section 7 (Endangered Species Act) consultation with the FWS on a project-by-project basis as each plan of operations was reviewed for approval. Each potential or conversion lease tract would contain the following special provision to avoid a Section 7 jeopardy biological opinion:

"The lessee shall develop a plan of operations which will *fully* protect listed or proposed threatened or endangered species and shall submit the plan to BLM for formal consultation with FWS as required by Section 7 of the Endangered Species Act. The plan must cover species occurring on site as well as those off-site species which may be adversely impacted. Consultation must be completed prior to the irreversible or irretrievable commitment of resource or funds for on-the-ground development.

"This lease is issued and accepted with the express agreement that such consultation may require adjustments to the plan of operations, additions of special conservation measures, or limitations to the project in order to assure compliance with such provisions of the Endangered Species Act as may be applicable as determined by FWS at the time of development."

ALTERNATIVE 1: HIGH COMMERCIAL PRODUCTION

Regional Overview

Commercial production of tar sand would occur on only nine of the 11 STSAs under the alternative (see Table 2-1). There would be no tar sand production expected from Pariette and White Canyon STSAs, nor from the Capitol Reef National Park portion of the Circle Cliffs STSA. *The analysis for the air quality, water resources, and socio-economic sections is cumulative to the No Action baseline of Alternative 3.*

Air Quality

An air quality impact assessment was performed by Aerocomp, Inc. (1983a) under contract to the BLM. Results presented in this section are a synopsis of information contained in that report. The impact significance criteria and methodology for that report are shown in Appendix 5. The conclusions presented here are based on what BLM considers the best available input data and appropriate choices of atmospheric dispersion models. Various computer programs were used with inputs of existing meteorological data and potential project emissions to derive methodology and impacts.

The air quality analysis is designed to estimate the approximate types and magnitudes of impacts associated with alternative development levels of Federal tar sand resources in Utah. The intent of the analysis is to satisfy the requirements of NEPA; it is not intended to satisfy the regulatory permitting procedures required under the Clean Air Act. Table 4-1 summarizes air quality impacts within STSAs.

Air quality impacts resulting from tar sand facilities would be evaluated on a case-by-case basis during the PSD permitting process. The State of Utah, Bureau of Air Quality, which has been delegated PSD permitting authority by the Environmental Protection Agency (EPA), would perform the PSD review. The potential air quality impacts from development on industry-proposed projects on STSAs are being analyzed in greater detail in the *Sunnyside Combined Hydrocarbon Lease Conversion Draft EIS* (USDI, BLM, 1983b) and the *Unit Plan of Operations for Tar Sand Triangle Combined Hydrocarbon Lease Conversion Draft EIS* (USDI NPS, 1983)

Analysis Results

Regional impacts from development of nine STSAs at Alternative 1, High Commercial Production, are presented in this section. Tables 4-2 and 4-3 compare the estimated impacts with the PSD incremental limitations and the National Ambient Air Quality Standards (NAAQS), respectively for each STSA. Regional annual average isopleth maps for total suspended particulates (TSP), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂) were constructed from the individual analyses performed for each STSA. Regional

24-hour average isopleth maps for TSP and SO₂ were derived using the MESOPUFF model (see Appendix 5), based on results for one dispersion episode (Dec. 15-16, 1981). The Reactive Plume Model (RPM-2) (see Appendix 5) was used to estimate regional ozone concentrations. The MESOPUFF results were also used to estimate acid deposition.

Total Suspended Particulates

Particulate matter is any liquid or solid particles suspended in or falling through the atmosphere. Particulate matter below 2 to 3 microns in diameter has an especially long residence time in the atmosphere and penetrates deeply into the lungs. To the particulate matter introduced into the atmosphere as a result of natural events (e.g., pollen, volcanic eruptions), man additionally adds millions of tons annually.

Annual TSP isopleths show the NAAQS would be exceeded in an estimated six STSAs, particularly in areas with considerable traffic on unpaved roads, in cities and towns, and near areas of energy development (a 20 microgram/cubic meter [$\mu\text{g}/\text{m}^3$] background should be added to the values).

Twenty-four hour regional TSP concentrations resulting from point sources only (stack emissions) show small TSP concentrations would be expected. TSP concentrations from fugitive emissions would be expected to exceed 24-hour standards in and near many STSAs (as discussed under the site-specific analysis section for STSAs in this chapter) and in cities and towns.

Sulfur Dioxide

SO₂ pollutants generally originate from the combustion of sulfur containing fossil fuels and yield a pungent toxic gas. When SO₂ is inhaled in concentrations of only a few parts per million (ppm), respiratory passages become irritated, and this can contribute to asthma, emphysema, and bronchitis. When SO₂ combines with water in plant leaves, it destroys leaf cells. Alfalfa is particularly susceptible. Average annual concentrations as low as 80 $\mu\text{g}/\text{m}^3$ may have long-term effects upon some vegetation. Additionally, SO₂ combines with atmospheric water vapor to produce a mist of sulfuric acid droplets, both a corrosive and a visibility-restricting mixture.

Isopleths show the estimated annual average SO₂ concentrations which would result from tar sand development, interrelated sources, existing industrial facilities, and population centers.

No NAAQS violations of SO₂ would occur; however, as discussed in the site-specific section for STSAs, Class II PSD incremental limitations would be exceeded in or near several STSAs, and Class I increments would be exceeded at Capitol Reef and Canyonlands national parks. Local 24-hour maximum SO₂ values are expected to exceed 200 $\mu\text{g}/\text{m}^3$.

The 24-hour concentration levels are intended to show expected long-range transport concentration levels for one poor dispersion condition. These levels are not intended to show the maximum possible SO₂ levels near the STSAs.

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-1

Alternative 1
Air Quality Impacts Within STSAs

STSA	PSD Incremental Limitations Exceeded?						NAAQS Exceeded? TSP SO ₂ NOx	Significant Visibility Impacts?
	Class II		Class I					
	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂		
Argyle Canyon/ Willow Creek	yes	no	no	no	no	no	no	no
Asphalt Ridge/ Whie Rocks	yes	no	no	no	yes	no	no	no
Circle Cliffs	no	yes	no	yes ^a	no	no	no	no
Hill Creek	no	yes	no	no	yes	no	no	no
P. R. Spring	yes	yes	no	no	yes	no	no	yes ^b
Raven Ridge/ Rim Rock	no	no	no	no	yes	no	no	no
San Rafael Swell	no	no	no	no	no	no	no	no
Sunnyside	yes	yes	no	no	yes	no	yes	yes ^c
Tar Sand Triangle	yes	yes	no	yes ^d	yes	no	no	yes ^d

Source: Aerocomp, Inc., 1983a.

^aAt Capitol Reef National Park (Class I area).

^bAt Colorado National Monument (Colorado Category 1 area).

^cAt Uintah and Ouray Indian Reservation.

^dAt Canyonlands National Park (Class I area).

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-2

Alternative 1
Comparison of Maximum Increased Pollutant Concentrations
With PSD Incremental Limitations

STSA	PSD Increment/ Increment Consumption	SO ₂ Concentration (µg/m ³)			TSP Concentration (µg/m ³)	
		3-Hour Average	24-Hour Average	Annual Average	24-Hour Average	Annual Average
Argyle Canyon/ Willow Creek	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	14	4	1	39	9
	Cumulative Increment Consumption ^b	14	4	1	39	9
	Increment Consumption of Uintah and Ouray Indian Reservation	2	<1	<1	<1	<1
Asphalt Ridge/ White Rocks	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	131	37	18	100	20
	Cumulative Increment Consumption ^b	131	37	18	100	20
	Increment Consumption of Uintah and Ouray Indian Reservation	22	6	1	100	20
Circle Cliffs	Allowable Class I Increment	25	5	2	10	5
	Increment Consumption ^a	158	44	15	4	1
	Cumulative Increment Consumption ^b	158	44	15	4	1
	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	742	206	54	16	4
	Cumulative Increment Consumption ^b	742	206	54	16	4
Increment Consumption at Glen Canyon NRA	83	23	5	2	<1	
Hill Creek	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	634	176	7	30	8
	Cumulative Increment Consumption ^b	868	241	9	36	9
	Increment Consumption at Uintah and Ouray Indian Reservation	165	46	4	4	<1

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-2 (continued)

STSA	PSD Increment/ Increment Consumption	SO ₂ Concentration (µg/m ³)			TSP Concentration (µg/m ³)	
		3-Hour Average	24-Hour Average	Annual Average	24-Hour Average	Annual Average
P. R. Spring	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	443	123	6	229	57
	Cumulative Increment Consumption ^b	490	136	7	230	57
	Increment Consumption of Uintah and Ouray Indian Reservation	170	47	4	1	<1
	Increment Consumption of Colorado State Line	109	30	2	<1	<1
Raven Ridge/ Rim Rock	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	7	2	<1	13	3
	Cumulative Increment Consumption ^b	32	9	4	25	6
San Rafael Swell	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	162	45	2	25	6
	Cumulative Increment Consumption ^b	238	66	7	35	7
Sunnyside	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	648	180	24	809	202
	Cumulative Increment Consumption ^b	648	180	24	809	202
	Increment Consumption at Uintah and Ouray Indian Reservation	14	4	<1	1	<1
Tar Sand Triangle	Allowable Class I Increment	25	5	2	10	5
	Increment Consumption ^a at Canyonlands National Park	47	13	5	2	1
	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	684	190	14	120	30
	Cumulative Increment Consumption ^b	684	190	14	120	30

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-2 (concluded)

STSA	PSD Increment/ Increment Consumption	SO ₂ Concentration (µg/m ³)			TSP Concentration (µg/m ³)	
		3-Hour Average	24-Hour Average	Annual Average	24-Hour Average	Annual Average
Tar Sand Triangle (cont.)	Increment Consumption at Dark Canyon Primitive Area	124	34	8	6	2
	Increment Consumption at Glen Canyon NRA	192	53	12	114	28

Source: Aerocomp, Inc., 1983a.

^aIncludes direct and secondary sources.

^bAlso includes interrelated projects.

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-3

Alternative 1
Comparison of Maximum Increased Pollutant
Concentrations With NAAQS

STSA	Pollutant Average Time	Baseline Sources ($\mu\text{g}/\text{m}^3$)	Project Sources		Maximum Concentration ($\mu\text{g}/\text{m}^3$)	Cumulative		NAAQS ($\mu\text{g}/\text{m}^3$)
			Secondary ^a ($\mu\text{g}/\text{m}^3$)	Direct ^b ($\mu\text{g}/\text{m}^3$)		Maximum Concentration ($\mu\text{g}/\text{m}^3$)	Maximum Concentration ($\mu\text{g}/\text{m}^3$)	
Argyle Canyon/ Willow Creek								
	SO ₂							
	3-hour	18	0	14	32	32		1,300
	24-hour	7	0	4	11	11		365
	Annual	1	0					80
	TSP							
	24-hour	117	2	37	156	156		150
	Annual	33	<1	9	42	42		60
	NO ₂							
	Annual	2	0	10	13	13		100
Asphalt Ridge/ White Rocks								
	SO ₂							
	3-hour	18	0	133	151	151		1,300
	24-hour	7	0	37	44	44		365
	Annual	1	0	18	19	19		80
	TSP							
	24-hour	159	0	97	256	256		150
	Annual	42	0	19	61	61		60
	NO ₂							
	Annual	13	0	73	86	86		100
Circle Cliffs								
	SO ₂							
	3-hour	18	0	742	760	760		1,300
	24-hour	7	0	206	213	213		365
	Annual	1	0	54	55	55		80
	TSP							
	24-hour	62	0	16	80	80		150
	Annual	19	0	4	24	24		60
	NO ₂							
	Annual	13	0	22	35	35		100
Hill Creek								
	SO ₂							
	3-hour	18	0	634	652	883		1,300
	24-hour	7	0	176	183	248		365
	Annual	1	0	7	8	10		80
	TSP							
	24-hour	164	2	28	194	200		150
	Annual	44	1	7	52	53		60
	NO ₂							
	Annual	2	0	5	7	11		100

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-3 (continued)

STSA	Pollutant Average Time	Baseline Sources ($\mu\text{g}/\text{m}^3$)	Project Sources		Maximum Concentration ($\mu\text{g}/\text{m}^3$)	Cumulative		NAAQS ($\mu\text{g}/\text{m}^3$)
			Secondary ^a ($\mu\text{g}/\text{m}^3$)	Direct ^b ($\mu\text{g}/\text{m}^3$)		Maximum Concentration ($\mu\text{g}/\text{m}^3$)	Maximum Concentration ($\mu\text{g}/\text{m}^3$)	
P. R. Spring								
	SO ₂							
	3-hour	18	0	443	461	508		1,300
	24-hour	7	0	123	130	142		365
	Annual	1	0	6	7	8		80
	TSP							
	24-hour	69	7	222	299	300		150
	Annual	21	2	55	77	77		60
	NO ₂							
	Annual	2	0	18	20	21		100
Raven Ridge/ Rim Rock								
	SO ₂							
	3-hour	18	0	7	25	50		1,300
	24-hour	7	0	2	9	16		365
	Annual	1	0	<1	1	4		80
	TSP							
	24-hour	142	2	11	155	167		150
	Annual	39	1	2	42	45		60
	NO ₂							
	Annual	2	0	5	7	22		100
San Rafael Swell								
	SO ₂							
	3-hour	18	0	162	180	256		1,300
	24-hour	7	0	45	52	73		365
	Annual	1	0	2	3	8		80
	TSP							
	24-hour	62	0	25	87	97		150
	Annual	19	0	6	25	26		60
	NO ₂							
	Annual	13	0	2	15	30		100
Sunnyside								
	SO ₂							
	3-hour	18	0	648	666	666		1,300
	24-hour	7	0	180	187	187		365
	Annual	1	0	24	25	25		80
	TSP							
	24-hour	84	8	801	893	893		150
	Annual	24	2	200	226	226		60
	NO ₂							
	Annual	2	0	130	132	132		100

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-3 (concluded)

STSA	Pollutant Average Time	Baseline Sources ($\mu\text{g}/\text{m}^3$)	Project Sources		Maximum Concen- tration ($\mu\text{g}/\text{m}^3$)	Cumulative		
			Secondary ^a ($\mu\text{g}/\text{m}^3$)	Direct ^b ($\mu\text{g}/\text{m}^3$)		Maximum Concen- tration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	
Tar Sand Triangle								
	SO ₂							
	3-hour	18	0	684	702	702	1,300	
	24-hour	7	0	190	197	197	365	
	Annual	1	0	14	15	15	80	
	TSP							
	24-hour	62	0	120	172	172	150	
	Annual	19	0	30	49	49	60	
	NO ₂							
	Annual	13	0	51	64	64	100	

Source: Aerocomp, Inc., 1983a.

Note: Includes interrelated projects.

^aSecondary = Emissions resulting from population growth.

^bDirect = Emissions from the projected tar sand facility.

CHAP 4--ENVIRONMENTAL CONSEQUENCES

Nitrogen Dioxide

Nitric oxide (NO) is the product of the combination of atmospheric oxygen and nitrogen at high temperatures. Reaction of NO with oxygen yields the more toxic nitrogen dioxide (NO₂). Like carbon monoxide (CO), this pollutant reduces the blood's oxygen-carrying capacity. Because NO₂ is brown in color, it also causes impacts to visibility by discoloration. When combined with water vapor, it forms nitric acid, a highly corrosive substance. Violation of the NAAQS is predicted only for a small area near Sunnyside.

Annual average NO₂ concentration isopleths show broad areas of elevated levels are apparent, especially in the northern part of the region.

Ozone

Ozone is a colorless to bluish gas produced by the reaction of sunlight with hydrocarbons and oxides of nitrogen. This pollutant irritates the deeper regions of the lung, and exposure lowers resistance to pathogens and can lead to pulmonary edema. Volatile Organic Compounds (VOC) are the hydrocarbon emissions that react in the presence of sunlight to produce ozone.

The model RPM-2 was used to estimate ozone concentrations (see Appendix 5). The trajectory model would start at the Argyle Canyon/Willow Creek STSA, pick up emissions from the Sunnyside and San Rafael Swell STSAs, and complete its south-southwesterly heading at Capitol Reef National Park. The estimated maximum 1-hour ozone concentration is 182 µg/m³, compared to the NAAQS of 235 µg/m³. At Capitol Reef National Park, a 1-hour level of 153 µg/m³ is estimated.

Carbon Monoxide

CO is a colorless, odorless toxic gas that competes with oxygen for bonding sites on the hemoglobin molecule in the blood. In concentrations of 350,000 to 450,000 µg/m³ vision impairment, nausea, and abdominal pain may result; 1,000,000 µg/m³ is fatal.

CO concentrations are predicted to be well below the NAAQS for all areas in the affected region (Aerocomp, Inc., 1983). For this reason, concentrations resulting from development of each STSA are not presented in Tables 4-1 through 4-3.

Acid Rain

Large-scale combustion of fossil fuels (e.g., coal and oil) distributes sulfur and nitrogen oxides into the atmosphere. A series of complex chemical reactions with these pollutants can convert into acid precipitation. The process by which these acids are deposited through rain or snow is called wet deposition. However, another atmospheric process known as dry deposition may also occur. Dry deposition is the process by which particles such as fly ash or gasses such as sulfur and nitrogen oxides are deposited or absorbed on surfaces. While these particles or gasses are normally not in the acidic state prior to deposition, it is believed that they are converted into acids after contacting water in the form of rain, dew, fog, or mist following deposi-

tion. The processes in which dry deposition occur and its effect on soils, forests, crops, and buildings are not adequately understood.

Known effects include: (1) acidification of ground and surface waters resulting in damage to aquatic ecosystems; (2) acidification and release of metals from soils; (3) possible reductions in forest productivity; (4) possible damage to agricultural crops; (5) deterioration of manmade materials (e.g., buildings, metal structures, and paint); and (6) possible contamination of culinary water supplies (EPA, 1979).

Acid deposition estimates for the affected region are presented below:

Pollutant	Annual Deposition Flux (g/m ² /yr) ^a		
	Wet	Dry	Total
Sulfur oxide	0.8	0.6	1.4
Nitrogen oxide	2.0	1.5	3.5

Source: Aerocomp, Inc., 1983.

^aGrams per square meter per year.

These values may occur near development areas. Deposition rates at sensitive, high elevation lakes which were located farther from development would probably be less.

In submitted testimony before the Colorado Air Quality Control Commission, the Environmental Defense Fund suggested that sulfur deposition rates below 0.5 gram per square meter per year (g/m²/year) would not lead to acidification of sensitive lakes (Oppenheimer, 1982). Thus, the results show that significant acidic deposition impacts cannot be ruled out.

WATER RESOURCES

Water use and sedimentation and salinity of streams would increase. Water quality could be altered from mining wastes or accidental spills, and water right allocations would change. *This could include a change in water use from downstream irrigation to tar sand development. Most of the data for water quality and quantity are taken from a contract prepared for the BLM by the USDI, Geological Survey (GS) (1983).*

Water Quantity

The Colorado River Simulation System computerized model was used to project effects on flow and salinity from a tar sand industry. Flow depletion for Alternative 1 is shown in Table 4-4. Under average river conditions, these reductions would be modest (Konwinski, 1983).

Water Quality (Surface and Groundwater)

Soil disturbance and vegetation removal from tar sand construction and mining activities would increase erosion and sediment yield on up to 51,300 acres. The amount of increased sediment would depend on such variables as susceptibility of the disturbed area to erosion, high intensity rainfall or wind storms during vulnerable periods, and effectiveness of erosion control measures. Water quality

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-4

Alternative 1
Water Sources and Estimated Depletions

Water Source	Measuring Point	STSA	Depletion Schedule ^a				
			1985	1990	1995	2000	2005
White River	White River at the Green River	Hill Creek	0	0	0	2,300	2,300
		P. R. Spring ^b	0	1,240	10,720	21,300	21,300
		Total	0	1,000	11,000	24,000	24,000
Price River	Green River at Green River, Utah	Argyle Canyon/Willow Creek	0	0	1,250	1,250	1,250
		Sunnyside	0	4,112	6,878	8,842	8,842
		Total	0	4,000	8,000	10,000	10,000
Green River Escalante ^c	Green River at Green River, Utah	Sunnyside	0	6,483	14,303	17,223	27,303
		Raven Ridge/Rim Rock	0	0	1,250	1,250	1,250
		Circle Cliffs	0	0	4,600	4,600	4,600
		Total	0	6,000	20,000	23,000	33,000
White Rocks River ^d	Duchesne River at the Green River	Asphalt Ridge/White Rocks	0	1,250	1,250	1,250	1,250
		Total	0	1,000	1,000	1,000	1,000
Dirty Devil River ^e	Inflow to Lake Powell	Tar Sand Triangle	0	0	1,679	8,579	11,079
		Total	0	0	2,000	9,000	11,000
San Rafael	San Rafael River at Green River, Utah	San Rafael Swell	0	0	4,600	4,600	4,600
		Total	0	0	5,000	5,000	5,000
Total			0	12,000	47,000	72,000	84,000

Source: Konwinski, 1983.

Note: Stream footnotes c, d, and e are not actual tributaries, but appear as such in the Colorado River Simulation System Computer Model.

^aSome STSAs would show an increasing rate of water use until the maximum level was reached.

^bTotals for nodes (see Glossary) have been rounded to the nearest 1,000 acre-feet/year. Actual water requirements are shown above.

^cNo node exists for the Escalante River, which is a tributary to the Green River; therefore, water depletions are shown as coming from the Green River.

^dNo node exists for the White Rocks River, which is a tributary to the Duchesne River; therefore, water depletions are shown as coming from the Duchesne River.

^eA node exists for the Dirty Devil River; however, water depletions are shown as coming from its tributary stream, the Green River.

CHAP 4--ENVIRONMENTAL CONSEQUENCES

could be impacted by accidental release of process or leachate waters or failure of holding ponds to retain wastes. As mining progressed and reclamation practices were implemented, the rate of erosion could be slowed and sediment prevented from reaching nearby streams.

Tar sand mining would seldom impact a principal aquifer such as the Navajo Sandstone because of its location in relation to tar sand deposits (i.e., aquifers being deeper or above the tar sand or isolated by impervious layers). However, surface mining could impact local springs which supply water for livestock or domestic and irrigation use.

The residues from processing tar sand could contain leachable organic and inorganic substances that could degrade local water quality. Some of the leachable substances could be toxic to stream organisms if present in large concentrations, and some substances could be carcinogenic. *Increased salt loading to streams could occur from a reestablished groundwater system in mined areas if water from the disturbed strata were unconfined.*

The leachable substances in water that would seep through tar sand wastes could be reduced in concentration naturally by biological degradation, attachment to mineral surfaces, or dispersion. *State and Federal regulations (e.g. the Safe Drinking Water Act which authorizes the Public Water Supply and Underground Injection Control programs) control the types and amounts of substances which may be introduced into the environment. Surface and groundwater monitoring plans which would be required in any approved plan of operations would insure that these levels were not exceeded.* Groundwater movement is slow, however, and a long period of time could pass before contaminants were reduced to acceptable limits *should contaminants be detected from the monitoring plan.*

Stream sediment resulting from surface construction could be the most serious water quality problem resulting from tar sand development. For example, *sedimentation* erosion rates resulting from surface mining of coal have been estimated to be 10 times greater than that expected under natural conditions (USDI, 1979).

Sheet erosion rates are high for many areas in eastern Utah (Seiler and Tooley, 1982; and Mundorff, 1979); however, because of the small amount of flow in most tributaries, sediment yield to larger streams is less than what might be expected. If water used for mining, oil processing, or surface facility construction were discharged into a normally dry streambed, increased channel erosion and sediment transport would result. This problem could be minimized if construction were completed at times other than during the thunderstorm season.

Other sediment-related problems could arise from waste disposal in spoil piles. The maximum 2-year rain intensity in and near the 11 STSAs in eastern Utah averages about 0.5 inch per hour (Miller et al., 1973).

Holding ponds for waste disposal would need to retain at least 100 percent of the maximum flow expected once every

100 years. Periodic inspection and cleaning would be necessary because of the potential for rapid filling with sediment (USDI, GS, 1983).

Water Rights

Because most water in the tar sand areas is fully appropriated, water rights for tar sand development would have to be purchased or leased if not already owned by a tar sand proponent (USDI, GS, 1983).

Water Requirements and Effects on Colorado River System

The output of the Colorado River System Salinity model computes water flow and salinity levels before and after tar sand development. This impact analysis is centered on a yearly value calculated at the measuring points discussed in Chapter 3, Water Resources section. Three types of output are included: (1) maximum river flow; (2) average river flow; and (3) minimum river flow. It can be seen from Table 4-5 that depletions are predicted to steadily increase from current levels to the year 2005 when depletions would begin to stabilize. The current and projected baseline depletions in Table 4-5 are based on the projected water supply and depletions shown in Appendix 3. Therefore, these figures represent the most probable future baseline. The 'With Project Depletions' column in Table 4-5 represents the additional water required for a tar sand industry. The maximum amount of water depleted for STSAs (84,000 acre-feet per year) would increase salinity levels at Imperial Dam by less than 2 milligrams per liter (mg/l) (see Figure 4-1) (Konwinski, 1983). *However, should saline water from other streams (e.g., Price River) be used, salinity levels could be reduced in the Colorado River system.*

The Bureau of Reclamation estimates that annual cost of salinity increases would be \$540,000 per mg/l yearly at Imperial Dam (Stewart, 1983). The maximum amount of water depleted for the STSAs would increase salinity costs by about \$1,080,000 yearly. This compares to the 1982 yearly cost of about \$113,000, for salinity.

SOILS

Impacts on soils would result from surface disturbance by activities such as construction of access roads, storage sites, sediment ponds, mine facilities, drilling pads, and overburden removal within surface-mining areas.

Mixing of the soil profile would alter the soil and could affect productivity by changing slope, salinity, toxicity, texture (high clay or high sand content), infiltration and permeability rates, fertility, and other soil characteristics. This would limit successful rehabilitation for post-mining uses. Vegetation removal and soil disturbance would leave the soil vulnerable to increased erosion and sediment yield from water and wind action. Amounts of increased erosion and sediment yield would vary, according to such variables as climate, slope, parent material of the soil, effectiveness of erosion control measures, and time required for reclamation. Increased erosion and sediment yields would occur

ALT. 1--HIGH COMMERCIAL PRODUCTION

TABLE 4-5

Alternative 1
Current and Projected Water Depletions
Within or Near STSAs

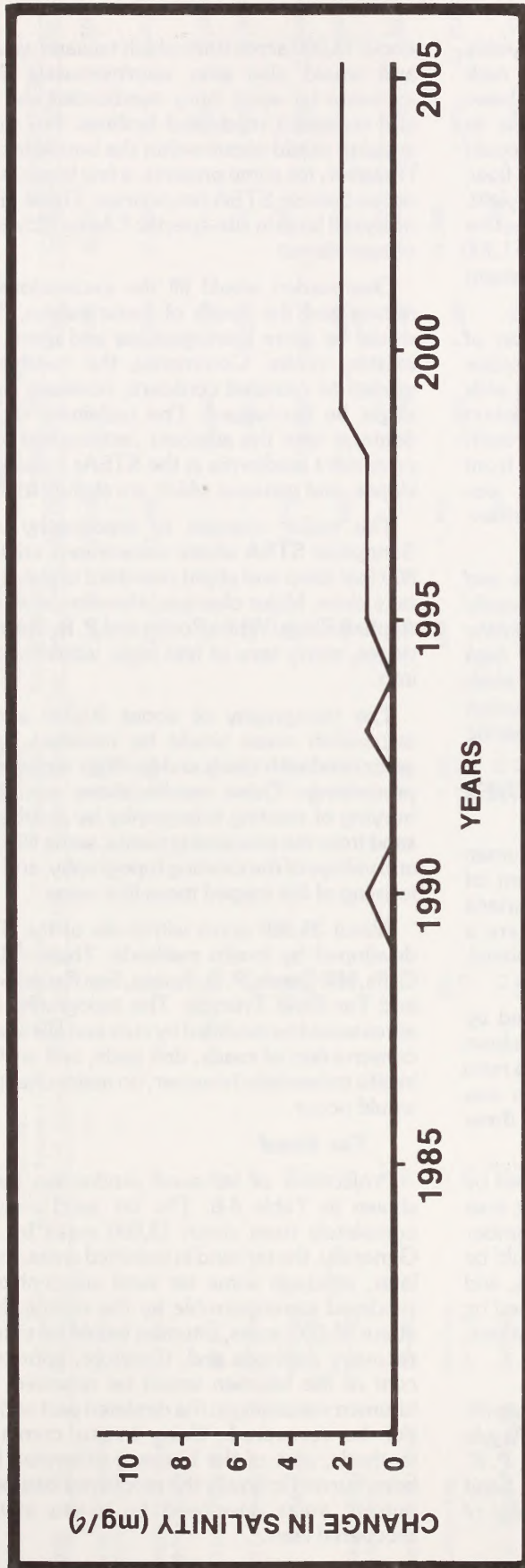
Water Source	Measuring Point	Depletion Schedule ^a						
		1983	1985	1990	1995	2000	2005	
White Rocks River	Duchesne River at Green River	448	467	538	591	668	668	Baseline ^b
		NA ^c	NA	539	592	669	669	With Project
White River	White River at the Green River	42	42	133	156	210	210	Baseline
		NA	NA	134	167	234	234	With Project
San Rafael River	San Rafael River at Green River, Utah	84	84	99	99	99	99	Baseline
		NA	NA	NA	104	104	104	With Project
Green, Price, and Escalante Rivers	Green River at Green River, Utah	155	155	168	168	205	205	Baseline
		NA	NA	178	196	238	248	With Project
Dirty Devil River	Inflow to Lake Powell	34	34	50	50	50	50	Baseline
		NA	NA	NA	52	59	61	With Project
Collective water required for tar sand industry from all sources		0	0	12	47	72	84	

Source: Konwinski, 1983.

^aExpressed in thousands of acre feet.

^bBaseline depletion projections for the years 1985 to 2005 are based on the schedule in Appendix 3.

^cNA: Not Applicable. No water depletions required for tar sand production in these years.



SOURCE: KONWINSKI, 1983

FIGURE 4-1
PREDICTED SALINITY CHANGES AT IMPERIAL DAM

ALT. 1: HIGH COMMERCIAL PRODUCTION

on highly erodible shales and clays; low sediment yields would occur on areas with sand hills, resistant rock outcrops, and good vegetation cover. Table 3-9 shows approximate acreages and percentages of STSAs in sediment yield and salinity classes. Increased erosion would result in loss of topsoil, increased overland water flow, formation of rills and gullies, and increased sediment yield. Because of the variables mentioned, soil loss could not be quantified, but would be expected to occur on up to 51,300 acres. Total soil acreage disturbed by tar sand development is shown in Table 4-6.

Soil losses would be *lessened* by implementation of erosion control measures, stockpiling of topsoil, landscape reconstruction, and revegetation. In areas of shallow soils and steep slopes, proper reconstruction and reclamation methods could enhance soil productivity and plant growth over the pre-development period. Soil losses from disturbed areas would occur until reclamation was completed and soil stabilized. Soil lost would be irretrievable.

Reclamation potential would be best in non-saline and slightly saline soils. Reclamation would be most successful in the low sediment yield classes and most difficult in the high and very high sediment yield classes. These high sediment yield areas are generally eroded badland shale areas with little vegetation in a natural state. Reclamation potential would have to be determined on a site-specific basis.

TOPOGRAPHY, TAR SAND, AND OTHER MINERALS

Table 4-6 shows assumed quantities of produced bitumen and the acreages required to extract that amount of bitumen. This table also predicts acres of projected surface disturbance. These calculated disturbed acreages are a general estimate and not a precise calculation (Hubbard, 1983).

Surface Mining: The estimated acreages disturbed by surface mining were calculated by multiplying the area from which bitumen would be mined by 3. The number 3 is a ratio of the area mined to the area disturbed. This ratio was determined by averaging acreages, as described in three plans of operations.

In-Situ Extraction: The estimated acreages disturbed by in-situ extraction were calculated by multiplying the area from which bitumen would be extracted by 0.4. The number 0.4 is a ratio of the area from which the bitumen would be extracted to the area disturbed by drill pads, roads, and other ancillary facilities. This ratio was also determined by averaging acreages as described in three plans of operations.

Topography

The topography of six STSAs would be modified significantly by surface mining. These STSAs include Argyle Canyon/Willow Creek, Asphalt Ridge/White Rocks, P. R. Spring, Raven Ridge/Rim Rock, Sunnyside, and Tar Sand Triangle. Surface mining would alter the topography of

about 13,000 acres from which tar sand would be extracted, and would also alter approximately 38,000 acres to excavate tar sand, bury overburden and waste disposal, and construct roads and facilities. For most projects, all impacts would occur within the boundaries of the STSAs. However, for some projects, a few impacts probably would occur outside STSA boundaries. These impacts would be analyzed later in site-specific EAs or EISs for specific plans of operations.

Overburden would fill the excavations resulting from mining and the heads of some valleys. The overburden would be more homogeneous and more permeable than existing rocks. Commonly, the overburden would be graded to rounded contours; however, in some places it might be flat-topped. The reclaimed topography would contrast with the adjacent undisturbed topography. The prominent landforms in the STSAs include cliffs, benches, slopes, and plateaus which are slightly to deeply dissected.

The major changes to topography would occur at Sunnyside STSA where excavations could be more than 800 feet deep and about one-third of the production would take place. Major changes in landforms would also occur at Asphalt Ridge/White Rocks and P. R. Spring STSAs where ridges, many tens of feet high, would be removed or cut into.

The topography of about 30,000 acres outside the excavation areas would be modified by cuts and fills associated with roads and facilities required for mining and processing. These modifications would include some burying of existing topography by overburden and waste sand from the processing plants; some filling of depressions and valleys of the existing topography; and, in some places, forming of flat-topped mesa-like areas.

About 35,000 acres within six of the STSAs would be developed by in-situ methods. These STSAs are Circle Cliffs, Hill Creek, P. R. Spring, San Rafael Swell, Sunnyside, and Tar Sand Triangle. The topography of about 14,000 acres would be modified by cuts and fills associated with the construction of roads, drill pads, and surface facilities for in-situ extraction; however, no major changes to landforms would occur.

Tar Sand

Projections of tar sand production through 2005 are shown in Table 4-6. The tar sand would be removed completely from about 13,000 acres by surface mining. Generally, the tar sand in unmined areas could be extracted later, although some tar sand adjacent to pits might be rendered unrecoverable by the mining. In areas totaling about 35,000 acres, bitumen would be extracted by in-situ recovery methods and, therefore, approximately 30 percent of the bitumen would be removed. In these areas, bitumen remaining in the depleted part of the deposit could not be recovered. Using in-situ combustion recovery methods, part of the bitumen otherwise lost would have been burned to liquify the recovered bitumen. The tar sand outside areas developed by in-situ methods could be recovered later.

TABLE 4-6
Alternative 1
Projected Bitumen Production and Acres Developed and Disturbed^a

STSA	Type of Production	Projected Daily Production (1,000 of bbls)	Cumulative Production (Millions of bbls)	Estimated Tar Sand Required (Acre-Feet)	Estimated Average Net Thickness of Tar Sand (feet)	Approximate Acres Developed Through 2005 ^c		Acres Disturbed ^d		
						Surface	In-situ	Surface	In-situ	Total
Argyle Canyon/ Willow Creek	Surface	5	26	7.14	20	1,200	--	3,600	--	3,600
Asphalt Ridge/ White Rocks	Surface	10	62	6.83	60	1,000	--	3,000	--	3,000
Circle Cliffs	In-situ	20	95	7.2	40	--	7,300	--	2,900	2,900
Hill Creek	In-situ	10	40	7.1	20	--	6,000	--	2,400	2,400
P. R. Spring	Surface In-situ	50 50	215 164	7.38 7.10	45	5,000	11,000	15,000	4,000	19,000
Raven Ridge/ Rim Rock	Surface	5	26	6.78	50	500	--	1,500	--	1,500
San Rafael Swell	In-situ	20	99	5.2	20	--	1,100	--	500	500
Sunnyside	Surface In-situ	110 15	465 75	7.28 7.21	100	4,800	2,300	14,000	1,000	15,000
Tar Sand Triangle	Surface In-situ	10 60	11 225	6.41 7.31	50 100	200	7,000	600	2,800	3,400
Total		365	1,500			12,700	34,700	37,700	13,600	51,300

Source: Hubbard, 1983; and USOI, BLM, 1983a.

Note: All numbers are rounded and, consequently, some columns may not total exactly.

^aUsing Argyle Canyon/Willow Creek as an example, the following shows how figures in this table were calculated.

5,000 bbls of bitumen/day X 260 days/year X 20 years = 26,000,000 bbls of bitumen
 26,000,000 of bitumen/20 years ÷ 7,758 bbls/1 acre-foot = 3,351 acre-feet of bitumen
 3,351 acre-feet of bitumen/20 years X 7.14 acre-feet of tar sand/1 acre-foot of bitumen = 23,926 acre-feet of tar sand/20 years
 23,926 acre-feet of tar sand/20 years ÷ 20 feet of tar sand (thickness) = 1,196 acres/20 years
 1,196 acres/20 year + 10 percent mining loss = 1,315 acres mined/20 years
 1,315 acres mined/20 years rounded to 1,200 acres mined/20 years
 1,200 acres mined/20 years X 3 surface disturbance (through all activities)/20 years = 3,600 acres disturbed/20 years.

^bEstimated acre-feet of tar sand required to produce 1 acre-foot of bitumen.

^cAcres required for mining.

^dAcres required for surface and in-situ processes and ancillary facilities.

ALT. 1: HIGH COMMERCIAL PRODUCTION

The chemical composition of the tar sand varies greatly statewide because of the different origins of the sand. Chemical composition of overburden is even more variable because a number of stratigraphic units (sandstones, shales, limestones, etc.) make up the overburden. At this time it is not possible to determine which, if any, salts or metals would be released from the tar, spent sand, or overburden.

All waste material, including overburden and spent sand (which could contain up to 5-percent bitumen and residual amounts of any processing chemicals) would be mixed together and dumped in waste rock disposal sites. Concentrations of toxins from overburden or the spent sand, while not exceeding toxicity levels at the present, could build up or combine with other naturally occurring substances in the rock and eventually exceed the allowable limits for the substances as set by State or Federal agencies.

Other Minerals

All of the STSAs are prospectively valuable for oil and gas. Hill Creek and P. R. Spring have very good potential for oil and gas. Uranium may occur in the Shinarump Conglomerate and Chinle Formation, which overlies the layers of rock containing bitumen in the San Rafael Swell and Tar Sand Triangle STSAs. Copper has also been taken from the Chinle Formation. Such uranium and copper deposits might be lost if the underlying rocks were surface mined for tar sand, although mining at such sites would be unlikely. Coal that may underlie Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, and Sunnyside STSAs would not be affected by the extraction of tar sand. Oil shales with commercial potential occur in the northernmost parts of Hill Creek and P. R. Spring STSAs. They would not be affected by in-situ extraction of bitumen except for possible thermal effects related to in-situ combustion: these effects would have to be evaluated on a site-specific basis. Any oil shale overlying the tar sand would be destroyed by surface mining, unless it were stockpiled. However, surface mining that would affect oil shale is unlikely because the overburden is generally much too thick. Oil shale that occurs in other STSAs in the Uinta Basin is of too low grade or too thin to be of commercial interest.

VEGETATION

Tar sand recovery would require the removal of vegetation from an estimated 51,300 acres. This figure was derived by adding the acreage disturbed, based on production estimates for this alternative for each STSA (see Table 4-6). On a statewide basis, impacts to vegetation diversity, productivity, etc., within the Canyonlands and Uinta Basin floristic sections would be unimportant. On a local basis, impacts to riparian, aspen, spruce-fir, and mountain brush communities on Argyle Canyon/Willow Creek, Hill Creek, P. R. Spring, Sunnyside, and the White Rocks portions of Asphalt Ridge/White Rocks STSAs would be the most important vegetation losses. This is because of these vegetation types' high value and importance for elk and deer summer and winter ranges. The major impacts to

vegetation would result from surface mining or in-situ processes. Impacts to vegetation would also result from surface clearance resulting from road construction, installation of facilities, pipelines, construction of check dams, and overburden stockpiling.

The surface-mining process would require stripping of vegetation and removal of topsoil and overburden from the area to be mined. The topsoils and overburden would then be stockpiled. Overburden would subsequently be used to refill or backfill the mined area, and the topsoils would be placed over the recontoured overburden. This process would cause the mixing of different soil horizons and rock strata and changes in density, aeration, and moisture-retention capacity of the natural plant growth medium.

The in-situ mining process would require stripping of vegetation and removal of topsoils, along with removal of some subsurface soils and rock strata from areas that would be leveled for drill pads and injection equipment, etc. The subsurface soils and rock material would subsequently be used to recontour the surface; topsoils would be placed over the recontoured surface. As with surface mining, this process would result in the mixing of different soil horizons and rock strata and changes in density, aeration, and moisture retention qualities of the natural plant growth medium.

After the topsoil was respread, the process of revegetating the mined areas would begin. Revegetation potentials or seeding suitability of the STSAs would vary according to the climate, pH, fertility, texture, depth, permeability, presence of toxic materials, and water-retention capacities of the mine spoils. The chemistry of the spoils (and respread topsoils) within and between STSAs would vary.

Alkaline spoils and spoils deficient in nitrogen and phosphorus are common to Western mining. Strongly alkaline mine spoils are difficult to successfully revegetate. The resulting post-mining soil chemistry would be critical to successful reclamation of mined areas. In the vast majority of cases, topsoil provides the most suitable growing medium for plants because it has the fertility and physical conditions needed for plant growth. In addition, more plant species are more adapted to topsoil than to subsurface material (U.S. Department of Agriculture [USDA], Forest Service [FS], 1979).

Native plants considered for revegetation of saline areas have to be species adapted to saline conditions. There is potential for a "reclaimed site" to be more saline than it was in its natural state. In such a situation, species adapted to more saline conditions would have to be used in reclamation. The result would be that the range site potential of the area would be changed and could no longer support the plant communities it did prior to mining.

Even if topsoil provides an excellent growing medium before mining, it may not be adequate as a growing medium for postmining use by native species because of changes in soil characteristics. Studies of revegetated mine spoils have shown that seeding mixtures consisting of all introduced species were more effective than native or combination

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

mixtures in providing rapid cover and plant growth. The introduced mixture also produced greater numbers of plants and higher amounts of biomass. Relative to adjacent native communities, revegetated sites were shown to reach higher levels of productivity within 2 years of seeding, under certain combinations of treatments (Koehler and Redente, 1980). Vegetation would become established on most reclaimed mine spoils, including arid and semi-arid areas, within 2-5 years (USDA, FS, 1979). However, original or premining levels of native plant diversity would not be reached until further successional processes altered the revegetated site (Koehler and Redente, 1980). Invasion of weeds into revegetated areas could also occur. Weeds could present a fire hazard, especially along roads, and are aesthetically displeasing, noxious, or provide too much competition for growth of desired plants (USDA, FS, 1979). This would delay the successful revegetation of mined areas.

In addition to changes in natural plant species, composition, and cover, and perhaps long-term modification in range site potential, the useability of the site for livestock and big game could be reduced or lost. For example, reclaimed areas could be more sensitive than adjacent native rangeland, and special standards could have to be implemented for successful rehabilitation. Reseeded areas sometimes attract animals such as livestock and big game in numbers sufficient to damage the stand. Therefore, reseeded areas might have to be fenced or seeded with less palatable plant species; also, water might have to be provided away from the seeded area or nearby water might have to be fenced out (USDA, FS, 1979).

Based on this analysis it can be assumed that, because of mixing of soil horizons and rock material, structural and chemical changes in the plant growth medium, and introduction of weeds, there is a risk of modifying range site potential. Although vegetation composed mostly of introduced species would become established within 2-5 years, the useability of reclaimed sites for big game and livestock might be reduced or lost.

The impact to vegetation, as a resource, would be the long-term replacement of native vegetation with vegetation not of the same diversity, seasonal variety, cover, or composition.

Threatened and Endangered Plant Species

The Federally listed endangered plant species *Sclerocactus wrightiae* (Wright's fishhook cactus) occurs on the San Rafael Swell STSA. Assuming a worst-case analysis, some individuals, populations, and/or habitat of this species could be lost. No Federally listed threatened plant species are known to occur on any of the STSAs analyzed in this alternative.

ANIMAL LIFE

Tar sand development could impact wildlife populations directly (i.e., loss of habitat) and indirectly (i.e., human activity such as increased hunting pressure, harassment,

wanton killing, poaching, and off-road vehicle [ORV] use). *It is important to note, however that, depending on the extent of development, indirect impacts to wildlife populations or habitats could equal or exceed direct impacts in some cases (Thomas, 1983). This potential impact has not been quantified.*

Terrestrial Animals

Big Game

Mule Deer. Approximately 20,600 and 22,400 acres of deer crucial summer and winter ranges, respectively, could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-7). Because summer range is considered a limiting factor, deer populations on herd units 27B and 28A could decline by 474 and 203 animals, respectively. This represents a reduction of approximately 3 and 4 percent, respectively, for these herd units (UDWR, 1983).

In addition, because winter range is considered a limiting factor, deer populations on herd units 22 and 26 could decline by 57 and 46 animals, respectively. This represents about a one-percent reduction in herd size for these units.

Elk. Approximately 20,600 and 22,400 acres of elk crucial summer and winter ranges, respectively, could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-7). Because elk use this summer range for calving, development could prevent or retard the reestablishment of elk on the Range Creek unit (Sunnyside STSA). It is expected that the loss of summer range could also cause a decline of approximately 104 animals on the Book Cliffs elk herd unit. This represents about a 10-percent reduction in herd size.

Because winter range is considered a limiting factor, elk populations on Ashley White Rocks herd unit could decline by 446 animals. This represents a reduction of about 51 percent for this herd unit.

Antelope. Because of the large amount of substantial value range and few numbers of animals, no impacts to pronghorn antelope are expected to occur from surface-disturbance activities associated with tar sand development under this alternative.

Desert Bighorn Sheep. Approximately 4,980 acres, representing about 2 percent of the desert bighorn substantial value range in the STSAs, could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-7). Because these species are extremely sensitive to human encroachment (Gallizioli, 1977), loss of this habitat, especially lambing and rutting grounds and water sources, could reduce or eliminate existing bighorn populations as well as prevent or retard the success of planned reintroduction programs.

Small Game

Approximately 37,600 acres of mountain lion and black bear habitat could be destroyed from surface-disturbing activities associated with tar sand development (see Table

ALT. 1--HIGH COMMERCIAL PRODUCTION

TABLE 4-7

Alternative 1
Summary of Impacts to Wildlife

STSA	Deer Range (Acres)	Elk Range (Acres)	Bighorn Sheep Range (Acres)	Sage Grouse Habitat (Acres)	Small Game Habitat (Acres)	Golden Eagle Nest Sites (No. and Acres)	Yearlong Raptor Habitat (Acres)
Argyle Canyon/ Willow Creek	3,600(S)	3,600(S)			3,600		3,600
Asphalt Ridge/ White Rocks	3,000(W)	3,000(W)		1(SG) 1,200(N)			1,200
Circle Cliffs			1,080				2,900
Hill Creek	2,400(W)	2,400(W)		205(N)			2,400
P. R. Spring	9,500(S) 9,500(W)	9,500(S) 9,500(W)		2(SG) 9,500(N)	19,000		19,000
Raven Ridge/ Rim Rock						2(N) 1,500	1,500
San Rafael Swell			500				500
Sunnyside	7,500(S) 7,500(W)	7,500(S) 7,500(W)		6(SG) 2,236(N) 5,264(YL)	15,000	1(N) 795	15,000
Tar Sand Triangle			3,400			2(N) 1,590	3,400
Totals	20,600(S) 22,400(W)	20,600(S) 22,400(W)	4,980	9(SG) 13,141(N) 5,264(YL)	37,600	5(N) 3,885	49,500

Source: USDI, BLM, 1983e.

Abbreviations: S = Summer Range; W = Winter Range; SG = Sage Grouse Strutting Ground; N = Nest Site or Habitat; YL = Yearlong Habitat.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

4-7). This represents approximately 21 percent of the existing habitat for these species on the STSAs. Because these species are extremely sensitive to human encroachment, existing populations could be either reduced or eliminated on the area of development (USDI, BLM and USDI, NPS, 1983). However, because of a lack of census data, these reductions cannot be quantified.

Upland Game

Nine sage grouse strutting grounds, 13,141 acres of nesting habitat, and 5,264 acres of yearlong habitat could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-7). This level of development could eliminate or greatly reduce sage grouse populations within the STSAs. However, because of a lack of census data, the number of sage grouse lost under this alternative cannot be quantified.

Unique and Limited High-Value Wildlife Habitats

Tar sand development could destroy unique and limited wildlife habitats such as aspen communities, riparian habitats, mule deer fawning and elk calving grounds, desert bighorn sheep lambing and rutting grounds, and mule deer/elk migration corridors. Destruction of these habitats could either eliminate or reduce the wildlife populations dependent on these areas (Thomas et al., 1979; Pederson and Harper, 1978; Julander et al., 1961; Hunter and Yeager, 1969; Murie, 1966).

Raptor Habitat: Approximately 49,500 acres of yearlong raptor foraging habitat could be destroyed from surface-disturbing activities associated with tar sand development. Distribution of these acres is shown in Table 4-7. This represents about 8 percent of the total yearlong raptor habitat within the 11 STSAs. Raptors dependent on this habitat could be eliminated or reduced (USDI, BLM and USDI, NPS, 1983). However, because of a lack of census data, the number of raptors lost under this alternative cannot be quantified.

Threatened and Endangered Species

Because there are no officially designated critical habitats or known concentration use areas or nest sites within any of the STSAs, *except for wanton killing*, no significant impacts to the northern bald eagle, peregrine falcon, or black-footed ferret would be expected to occur. Four known golden eagle nest sites and 3,180 acres of nesting habitat could be destroyed from surface-disturbing activities associated with tar sand development. A comprehensive raptor inventory of the area has not been completed; therefore, other unidentified golden eagle nest sites could be impacted.

Aquatic Species

A total of 88,295 acre-feet of water per year would be required, assuming the worst-case situation. Actual water requirements would vary, according to recovery methods and possible recycling of some water.

Fish habitat would be impacted by altering stream channels, increasing turbidity and sedimentation, reducing instream flows, and possibly degrading water quality by

leaching and contamination. Habitat components such as temperature, cover, and stabilized streambanks are provided primarily by the adjacent riparian vegetation. Reducing or destroying riparian vegetation would eliminate or reduce the quality of fisheries, depending on the extent and location of tar sand development; consequently, fish populations would be kept below their biotic potential. Depending on the magnitude to which these impacts occurred, the total elimination of fisheries could result. Even after reclamation, it might not be possible to restore the fisheries to their present condition.

Threatened and Endangered Species

Tar sand development would adversely affect fish habitat essential for two endangered species, Colorado squawfish and humpback chub. Any water depletions from tributaries to the White, Green, or Colorado rivers are of major concern to Federal and State agencies. Interest in these depletions would also pertain to rivers such as the Price (a potential water source for Sunnyside STSA) and the San Rafael River (located in the San Rafael Swell STSA), even though these rivers are not identified as fisheries.

Impacts to the Colorado squawfish and humpback chub could occur from degradation of water quality and reduction of instream flows in the White, Green, and Colorado rivers and their tributaries. Both the Green and Colorado rivers have experienced significant peak flow reductions because of existing reservoir operations and an overall water depletion for various purposes. Peak flow levels, magnitude, and duration primarily determine river morphology and habitat conditions. Peak flows have been drastically reduced in the Colorado River system, resulting in sediment build-up, water temperature changes, and other chemical changes in the system (USDI, FWS, 1982).

Tar sand development could change peak flow regimes of tributaries to the White, Green, and Colorado rivers during spring runoff, reducing the amount of water reaching these rivers during this period. This would further add to the chemical and physical changes occurring in the White, Green, and Colorado rivers. A decline in populations of Colorado squawfish correlates very closely with the construction of dams and reservoirs and the removal of water from the Colorado River system (USDI, FWS, 1982). Tar sand development could adversely alter habitat characteristics in the White, Green, and Colorado rivers, believed essential for the perpetuation of Colorado squawfish by reducing peak spring flows, increasing turbidity and silt load, and reducing annual flows.

Impacts to the Green River (i.e., degraded water quality and reduced flows) would adversely affect humpback chub habitat in Desolation and Gray canyons. Reductions in flows could significantly alter habitat needed for spawning and rearing, consequently reducing reproductive success (USDI, FWS, 1979).

Wild Horses and Burros

The amount of historic wild horse or burro range occurring outside the boundaries of the San Rafael Swell,

ALT. 1: HIGH COMMERCIAL PRODUCTION

Sunnyside, and Tar Sand Triangle STSAs is unknown. Therefore, no accurate estimate of impacts to herd size or productivity can be made. It is expected that tar sand development in the Hill Creek STSA would reduce the wild horse range and possible numbers (Gardner, 1983).

RECREATION

Significant adverse impacts on recreational uses and values would result from tar sand development. Surface-mined areas would lose recreational uses and values for up to several decades. Sightseeing values in such areas would be permanently impaired. During operations and through rehabilitation, camping/picnicking, hiking/backpacking, hunting opportunities would be lost over most of the affected area. However, some of the values (e.g., hunting and associated camping and picnicking) would recover after rehabilitation. During operation and rehabilitation, some winter sports, ORV use, and horseback-riding values could remain, but their quality would be degraded. On affected sites, recreational visits for all uses would be expected to decline.

In-situ development would generally cause loss of visual quality and any camping/picnicking, hiking/backpacking, hunting, winter sports, or horseback-riding opportunities from construction to rehabilitation. Improved access from construction of roads and pipelines could result in some increase in ORV use in the affected areas. Following rehabilitation, most recreational uses and values would return. There would be some permanent loss of scenic/sightseeing values in highly scenic areas. Impacts would be greatest from cuts and fills on areas of steep slopes.

In addition to on-site impacts, there would be significant off-site impacts from water developments and production facility construction. Additionally, construction of water supply system facilities and withdrawals would affect the flows of rivers listed on the Nationwide Rivers Inventory (see Table 3-15). Six rivers qualify for study for inclusion in the National Wild and Scenic River System: construction of facilities and/or water withdrawals could affect their suitability for addition to this system.

Five of these rivers are used for floatboating. The water withdrawals for tar sand development reflected in Table 4-4 would constitute reductions of average annual flow of the following amounts in 2005:

River	Flow Reductions (percent)
<i>White</i>	<i>5</i>
<i>Price</i>	<i>14</i>
<i>Green</i>	<i>2</i>
<i>San Rafael</i>	<i>5</i>
<i>Dirty Devil</i>	<i>16</i>

These reductions could shorten the useable season for floatboating. When these withdrawals are added to other

withdrawals projected for the rivers (see Table 4-5), the depletions could significantly degrade floatboating opportunities on the White, Green (through Desolation and Gray canyons), and Price rivers and eliminate it on the San Rafael and Dirty Devil rivers, where withdrawals would be 99 and 87 percent of average annual flow, respectively.

Population increases associated with construction and operation would increase use of recreational resources in the affected areas. *This could contribute to restoration of prior attendance levels in National Park Service (NPS) administered lands. In most cases, impacts would probably be negligible (Hornback, 1984). There could, however, be localized crowding/overutilization of some resources on BLM, FS, NPS, and State lands. This would degrade resources and the quality of recreational experiences of users.*

WILDERNESS

None of the STSAs contain designated wilderness areas. However, the Circle Cliffs, Hill Creek, P. R. Spring, San Rafael Swell, Sunnyside, and Tar Sand Triangle STSAs contain or are immediately adjacent to potential wilderness areas (BLM Wilderness Study Areas [WSAs] or NPS proposed wilderness areas).

Under present laws and regulations, any tar sand development lease or lease conversions inside WSAs would have to meet wilderness nonimpairment standards. A converted lease in a WSA issued before the Federal Land Policy and Management Act (FLPMA) (1976) would be a pre-FLPMA lease for conventional oil and gas only. It would be a post-FLPMA lease for tar sand development. Therefore, all converted leases in a WSA must contain stipulations which ensure nonimpairment of wilderness values resulting from tar sand operations (USDI, Office of the Solicitor, 1983).

Therefore, surface mining or commercial-scale in-situ development inside WSAs or remanded areas would not be possible because such development would impair wilderness values, at least in the near future. If the WSAs are not designated wilderness by Congress, development of these areas could then occur.

Tar sand development in areas contiguous with or adjacent to proposed wilderness or WSAs would degrade wilderness values because of impacts on solitude from visual intrusions and sounds of operations. The impacts on wilderness values would be greatest from surface mining because the sights (visual intrusions) and sounds would be greater than in-situ recovery. The sights and sounds of in-situ development would also be significant, especially during production. During this phase, dust from mining operations and vehicular traffic would affect wilderness values in adjacent areas.

Table 4-8 lists areas where tar sand development would affect wilderness values. Impacts would include visual and sound intrusions and dust/pollutants. If the areas mentioned in Table 4-8 were not designated wilderness by Congress, these areas could be subject to tar sand development. This would result in significant loss and impairment of wilderness values.

CHAP 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-8

Alternative 1
Potential Wilderness Areas Affected

STSA	Potential Wilderness Area
Circle Cliffs	North Escalante Canyons/The Gulch ISA Capitol Reef National Park (NPS) Glen Canyon NRA (NPS)
Hill Creek ^a	Winter Ridge WSA
P. R. Spring	Winter Ridge WSA Flume Canyon WSA
San Rafael Swell	Sid's Mountain WSA Devil's Canyon WSA Crack Canyon WSA San Rafael Reef WSA Mexican Mountain WSA Link Flats ISA
Sunnyside	Jack Canyon WSA Desolation Canyon WSA Turtle Cnyon WSA
Tar Sand Triangle	French Spring/Happy Canyon WSA Fiddler Butte WSA Glen Canyon NRA (NPS) Canyonlands National Park Horseshoe Canyon Detached Unit, Canyonlands National Park

Source: USDI, BLM, 1983e.

^aThe Ute Tribe has passed a resolution which contains provisions calling for restricted access and limited development, much as in wilderness areas, on the Hill Creek Extension portion of the Uintah and Ouray Reservation. This Extension has been established as a Wildlife and Cultural Resource Protection Area.

ALT. 1: HIGH COMMERCIAL PRODUCTION

VISUAL RESOURCES

Significant adverse visual impacts would result from tar sand development. On-site impacts would vary according to the type of development. Visual resource management (VRM) objectives would not be met in most cases. Strip mining and construction of roads, pipelines, drill pads, tanks, and other production facilities would affect the landform, vegetation, and structural components of the landscape. The degree of impact (contrast created) would depend on how development projects were designed, located, and constructed. The visual impacts would depend on the size and amount of contrast (in form, color, texture, and line) with the existing landscape. Therefore, design and construction minimizing change or contrast could substantially reduce the degree of visual impact.

In most cases, the contrast created would be high or strong and would probably exceed the standards set by BLM Manual 4831 (Visual Resource Contrast Rating) for VRM Classes. Visual impacts would, therefore, be considered significant. In accordance with BLM Manual 4831, proposed activities would have to be designed to reduce visual impacts as much as possible. Prompt recontouring and revegetation of disturbed areas could significantly reduce the duration of impacts; however, rehabilitation would require up to several decades.

Visual impacts of drill pads, pipelines, tanks, etc., would be noticeable until any structures were removed and reclamation efforts were successful. The time required would vary, according to soil, moisture, and existing vegetation conditions. Impacts would be long term, especially in affected desert and forest areas where vegetative recovery would require *many* years.

Surface mining would cause permanent scenic value degradation in all VRM Class II and III areas and *FS Retention and Partial Retention areas*. Rehabilitation of areas to a condition harmonious with the natural landscape would not be feasible. Angular landforms and diversity of color in existing landscapes would be permanently altered. With extensive rehabilitation efforts, recovery of scenic values to a VRM Class IV condition would be possible.

In-situ tar sand development would result in up to 40 percent of the area experiencing surface disturbance. This would significantly change scenic quality. Impacts would require rehabilitation, and until or unless rehabilitation was completed, these areas would be out of character with surrounding areas. In VRM Class IV and possibly some Class III areas, existing scenic values could be substantially recovered. In most VRM Class III and all Class II areas, a permanent degradation of scenic values would be expected from in-situ development.

Development of water requirements (construction of pipelines, reservoirs, etc.) would at least temporarily impair visual values in affected areas.

CULTURAL RESOURCES

Tar sand development could result in various types of activities which would damage or destroy cultural resources. These include: (1) surface mining; (2) construction of drill pads and support facilities; (3) road access, pipelines, powerlines, etc.; and (4) waste disposal. Secondary impacts could be expected through vandalism and increased human activity. However, inventories required for mitigation purposes would produce new data for scientific use.

Prior to entry upon the land or surface disturbance for mining, drilling, or other purposes, the lessee would be required to submit for approval an Application for Permit to Drill (APD), exploration plan, or plan of operations, containing the methods and actions proposed for cultural resource clearance and protection. This would be in accordance with 36 Code of Federal Regulations (CFR) 800 and BLM Manual 8100. A Memorandum of Understanding between the State Historic Preservation Officer and BLM outlining BLM's responsibility for mitigation appears as Appendix 6 in this EIS.

LIVESTOCK GRAZING

This alternative could modify livestock patterns of use, reduce grazing capacity, and diminish suitability for grazing use on 74 BLM allotments, *five* Forest Service (FS) allotments, and large tracts of privately owned surface (including the Uintah and Ouray Indian Reservation). Total forage production on these areas is estimated to exceed 50,000 Animal Unit Months (AUMs).

It is estimated that 3,192 AUMs would be lost directly to surface or in-situ mining of tar sand. This number of AUMs is roughly equivalent to 1,277 tons of hay. Assuming that 87 percent of this is used by cattle and 12 percent is used by sheep, forage for about 555 cattle and 383 sheep would be lost. (Eighty-seven percent cattle and 12 percent sheep is the composition of the classes of livestock on allotments involved under Alternative 1.)

The acreage used for tar sand development could be a relatively small portion of each STSA. However, both in-situ processes and surface mining would require increased vehicle access, changes in fencing, and alteration of waterways, springs, etc. Each allotment would be affected differently. Under a worst-case analysis, livestock grazing would have to be discontinued for more than 20 years on parts of many of the affected allotments (see Table 3-17).

Tar sand development under this alternative would probably have no important impact on Utah's beef cattle or sheep industries. However, elimination or severe reduction in grazing suitability on large tracts of contiguous rangeland could negatively affect local livestock economies and individuals.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

SOCIOECONOMICS

A socioeconomic impact assessment was performed by Argonne National Laboratories (1983) under contract to the BLM. This section is a synopsis of information contained in that report. The following analysis is based on the difference between Alternative 3 (No Action) projections and the projections for Alternative 1 (High Commercial Production). A general summary of the socioeconomic impacts for the region (i.e., Carbon, Duchesne, Emery, Garfield, Grand, Uintah, and Wayne counties) is presented in Table 4-9. *Socioeconomic impacts to the Ute Tribe are included in the analysis for Duchesne and Uintah counties.* Appendix 7 presents a description of socioeconomic data. Projected impacts are expressed in terms of the difference between baseline projections (growth without Federal tar sand development) and Alternative 1.

Fiscal Conditions

Although all counties and communities in Utah presently appear fiscally sound, it is expected that severe fiscal pressures would result from Alternative 1 unless mitigated by Federal, State, and/or private funds. The rapid growth in population would cause immediate service demand increases, which would have to be met. Revenues would lag initially, and coordinated mitigation planning, as required under *Utah Code Annotated Section 63-51-10, Supplement 1981*, would be necessary to avoid severe short-term deficit situations.

Demands on most State public service agencies (i.e., Highway Patrol, Division of Health, Division of Wildlife Resources) would increase. For example, as stated by the State of Utah, Office of the Governor, 1984, Letter 14.22, "Approximately nine Conservation Officer Districts could experience a marked increase in fish and game violations and a corresponding need for additional law enforcement effort."

Population

It is projected that the region's population for tar sand development (directly and indirectly) would increase by an additional 213 people in 1985 to 45,681 in 2005 over the baseline population projected in Alternative 3. That population would reach a peak of 53,091 in 1995. Table 4-9 shows that, unlike total population, school-age population would increase between 1995 and 2005. School-age population would grow from 41 in 1985 to 13,255 in 2005.

The number of households would grow 71.79 percent annually from 1985 to 1995, but would then decline 2.63 percent annually from 1995 to 2005.

School-age population growth related to tar sand development would create a demand for three more teachers and classrooms in 1985, rising to 534 more teachers and classrooms in 2005 (see Table 4-9). Housing demands would increase slightly more rapidly for single-family homes than multi-family homes or mobile homes between 1985 and 1995; the demand for all three types of housing would decrease at an annual rate of 2.6 percent from 1995 to 2005.

Figure 4-2 illustrates projected increases in county tar sand related populations for Alternative 1. A summary of the population and household impacts for each county is presented in Table 4-10. *Carbon County would experience the largest tar sand related population growth, increasing to 25,649 by 2005. This increase would be followed by Grand County, which would increase to 15,383 by 1993.*

Employment

Total regional employment is also projected to grow rapidly during 1985-2005. In particular, employment resulting from Federal tar sand development would expand from 111 additional workers in 1985 to 19,236 in 2005; this level is 173 times that projected in 1985. The increase would be most dramatic from 1985 to 1995: total employment would rise 73 percent annually, while in the next 10 years there would actually be a negative change (-3 percent annually).

Figure 4-3 graphically illustrates county employment trends. This figure illustrates that Carbon County is expected to absorb the greatest amount of employment growth, because the largest tar sand development included in Alternative 1 (Sunnyside STSA) is located within Carbon County. Employment in the region would rise from 111 in 1985 to 19,237 in 2005. This would represent a 73-percent annual growth rate in the 1985-1995 period followed by a 3-percent decrease in the 1995-2005. Carbon County would absorb around 60 percent of the regional employment growth in 2005. Table 4-11 shows the projected employment figures.

Total Wage and Personal Income

Total regional wage and personal income increases for Alternative 1 are presented in Table 4-12. The wage and income data are presented by industrial sector and income category. Average monthly wages are assumed to have an approximate annual increase of 1.72 percent, independent of the tar sand development. The number of employees and total wage payments would increase as a result of the tar sand development considered and are expressed as a change from the baseline projection.

Total monthly personal income in the region would grow from \$0.3 million in 1985 to \$75.8 million in 1995. Between 1995 and 2005, personal income would decrease to \$59.0 million. Wages would account for about 80 percent of the change in total monthly personal income; property income and other labor income would account for the other 20 percent.

Employees in the construction sector would experience the highest increases in wages during 1985, 1990, and 1995. The construction sector would also have the largest increase in average monthly wages throughout the 20-year analysis period. Employees in the mining sector would have the highest increase in wages in 2000 and 2005. Average monthly wages in the service sector would increase from \$767 in 1985 to \$1,079 in 2005. The increase in average monthly wages in the service sector would be the lowest of any sector.

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-9

Alternative 1
Summary of Regional Socioeconomic Impacts

Socioeconomic Development Category	Change From projected Baseline					Cumulative Growth Factor ^a	Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005		1985-2005	1995-2005
Population Growth								
Total	213	18,267	53,091	37,369	45,681	214.46	73.65	-3.49
School Age	41	3,743	12,463	9,959	12,255	323.29	77.13	0.62
Employment Growth								
	111	9,323	26,086	16,182	19,236	173.30	72.63	-3.00
Household Growth								
	77	6,553	17,241	11,038	13,205	171.49	71.79	-2.63
Infrastructure Requirements								
Housing								
Single family	47	3,935	10,347	6,625	7,926	168.64	71.50	-2.63
Multi-family	13	987	2,590	1,659	1,983	152.54	69.80	-2.64
Mobile homes	20	1,642	4,312	2,764	3,305	165.25	71.15	-2.62
Education								
Students	41	3,743	12,463	9,959	13,255	323.29	77.13	0.62
Classrooms	3	154	503	402	534	178.00	66.89	0.60
Teachers	3	154	503	402	534	178.00	66.89	0.60
Health Care								
Hospital beds								
General care	3	40	111	79	95	31.67	43.49	-1.54
Long-term care	0	17	41	52	62	-- ^b	-- ^b	4.22
Medical personnel								
Doctors	3	15	35	26	30	10.00	27.84	-1.53
Dentists	3	13	29	22	26	8.67	25.46	-1.09
Nurses	3	35	95	66	81	27.00	41.27	-1.58
Public health nurses	3	9	16	11	13	4.33	18.22	-2.06
Mental health care								
Clinical psychologists	3	7	7	7	8	2.67	8.84	1.34
Mental health workers	3	8	10	8	9	3.00	12.79	-1.05
Public Safety								
Law enforcement								
Police officers	3	40	111	79	95	31.67	43.49	-1.54
Patrol cars	3	40	111	79	95	31.67	43.49	-1.54
Jail space (sq. ft.)	107	9,136	26,547	18,686	22,843	213.48	73.56	-1.49
Juvenile holding cells	3	8	11	9	11	3.67	13.87	0
Fire Protection								
Fire flow (gpm)/duration (hr) ^c								
Emergency Medical Service								
Ambulances	3	9	16	11	13	4.33	18.22	-2.06
Emergency medical technicians	21	63	112	77	91	4.33	18.22	-2.06
Utility Service Demands								
Water system								
Connections	70	5,897	17,130	12,059	14,739	210.56	73.33	-1.49
Supply (10 ⁶ gal)	41	3,444	10,004	7,042	8,608	209.95	73.33	-1.49
Storage (10 ⁶ ga.)	20	1,722	5,002	3,521	4,304	215.20	73.33	-1.49
Treatment (10 ⁶ gal)	41	3,444	10,004	7,042	8,608	209.95	73.33	-1.49
Sewage System (10 ⁶ gal) ^d	8	667	1,938	1,364	1,667	208.38	73.15	-1.50
Solid waste ^d								

Source: Argonne National Laboratories, 1983.

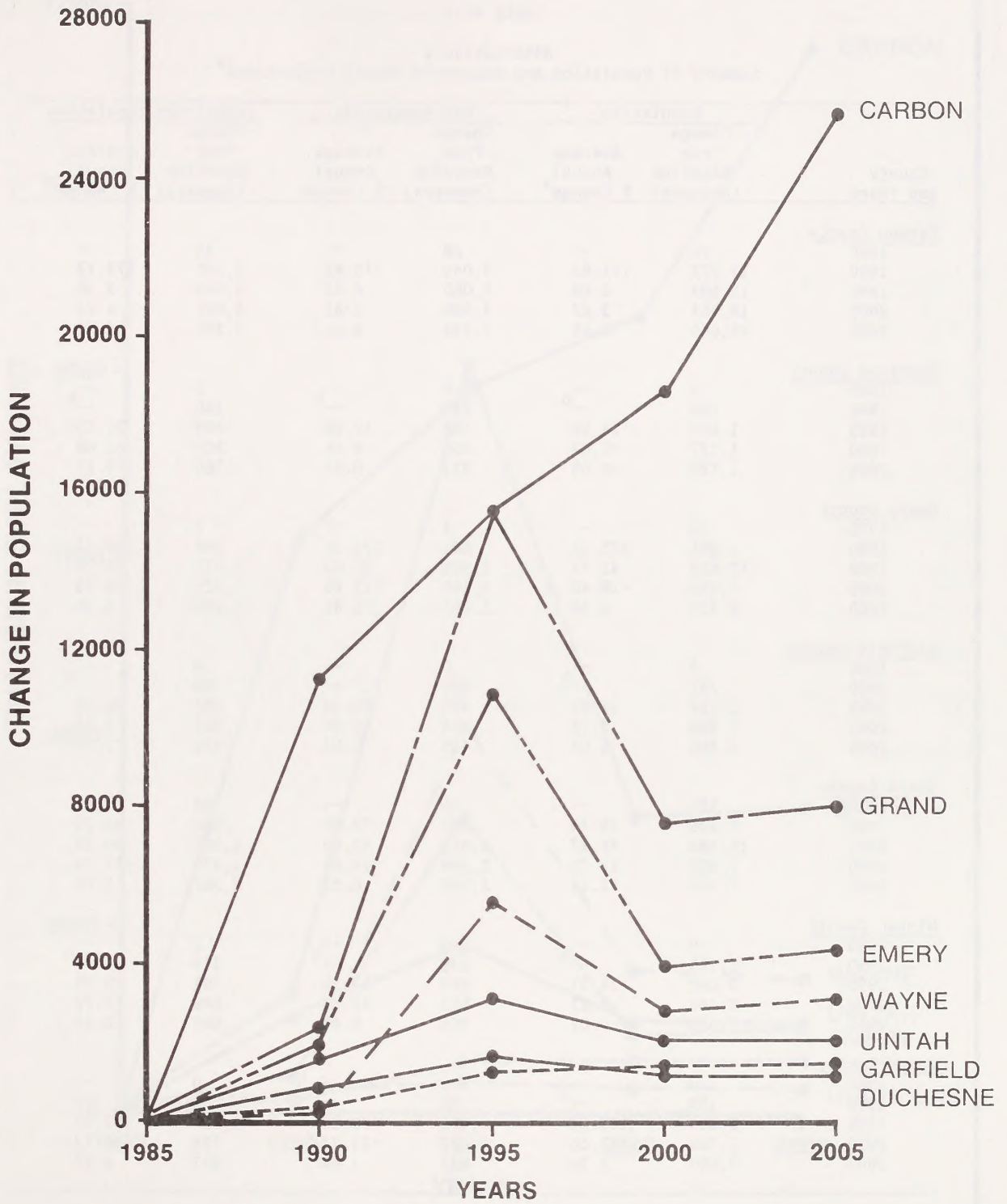
^aComputed as the ratio between 1985 and 2005.

^bUnavailable.

^cFire protection measured in fire flow (gpm)/duration (hr) cannot be aggregated across the affected counties.

^dThe State of Utah community facility guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES



SOURCE: UTAH STATE PLANNING COORDINATOR OFFICE

FIGURE 4-2
ALTERNATIVE 1
PROJECTION OF COUNTY POPULATION INCREASES

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-10

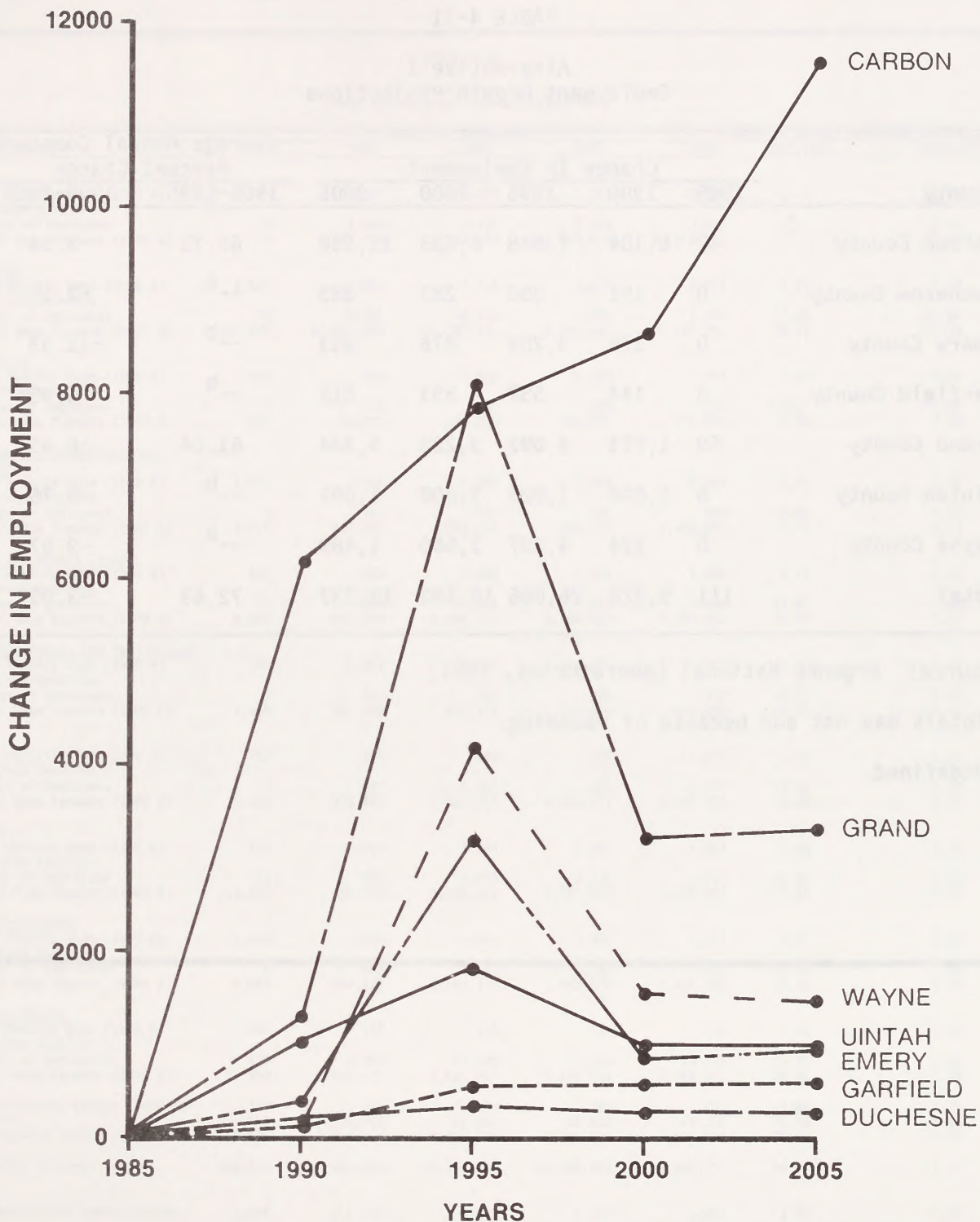
Alternative 1
Summary of Population and Household Impact Projections^a

County and Years	Population		New Households		School-Age Population	
	Change From Baseline (Numbers)	Average Annual % Change ^a	Change From Baseline (Numbers)	Average Annual % Change	Change From Baseline (Numbers)	Average Annual % Change ^a
<u>Carbon County</u>						
1985	76	--	28	--	15	--
1990	11,217	171.53	4,049	170.42	2,305	173.73
1995	15,503	6.69	5,050	4.52	3,609	9.38
2000	18,563	3.67	5,525	1.81	4,861	6.14
2005	25,649	6.68	7,434	6.12	7,385	8.72
<u>Duchesne County</u>						
1985	0	-- ^b	0	-- ^b	0	-- ^b
1990	798	-- ^b	274	-- ^b	160	-- ^b
1995	1,604	14.98	504	12.96	409	20.65
2000	1,127	-6.82	305	-9.56	357	-2.68
2005	1,124	-0.05	313	0.52	360	0.17
<u>Emery County</u>						
1985	12	--	4	--	2	--
1990	1,891	175.11	683	179.56	389	186.94
1995	10,813	41.73	3,522	38.83	2,517	45.27
2000	3,913	-18.40	1,165	-19.85	1,025	-16.45
2005	4,319	1.99	1,252	1.45	1,244	3.95
<u>Garfield County</u>						
1985	0	-- ^b	0	-- ^b	0	-- ^b
1990	292	-- ^b	105	-- ^b	60	-- ^b
1995	1,212	32.93	395	30.34	282	36.28
2000	1,390	2.78	414	0.94	364	5.24
2005	1,466	1.07	425	0.53	422	3.00
<u>Grand County</u>						
1985	125	--	45	--	24	--
1990	2,345	79.74	847	79.86	482	82.21
1995	15,383	45.67	5,011	42.69	3,581	49.35
2000	7,556	-13.25	2,249	-14.81	1,978	-11.19
2005	7,997	1.14	2,318	0.61	2,302	3.08
<u>Uintah County</u>						
1985	0	-- ^b	0	-- ^b	0	-- ^b
1990	1,565	-- ^b	538	-- ^b	314	-- ^b
1995	3,062	14.37	963	12.35	781	19.99
2000	2,040	-7.81	553	-10.50	646	-3.72
2005	2,033	-0.07	566	0.47	651	0.15
<u>Wayne County</u>						
1985	0	-- ^b	0	-- ^b	0	-- ^b
1990	159	-- ^b	57	-- ^b	33	-- ^b
1995	5,514	103.24	1,796	99.38	1,284	107.97
2000	2,780	-12.80	827	-14.37	728	-10.73
2005	3,093	2.16	897	1.64	891	4.12

Source: Argonne National Laboratories, 1983.

^aComputed as average annual compound percent change from previous 5-year period.

^bUndefined.



SOURCE: UTAH STATE PLANNING COORDINATOR OFFICE

FIGURE 4-3
ALTERNATIVE 1
PROJECTION OF COUNTY EMPLOYMENT LEVELS

ALT. 1: HIGH COMMERCIAL PRODUCTION

TABLE 4-11

Alternative 1
Employment Growth Projections

County	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Carbon County	42	6,184	7,848	8,633	11,550	68.71	3.94
Duchesne County	0	191	350	283	283	-- ^b	-2.10
Emery County	0	376	3,209	876	963	-- ^b	-11.33
Garfield County	0	144	557	593	611	-- ^b	0.93
Grand County	69	1,273	8,092	3,228	3,334	61.04	-8.49
Uintah County	0	1,034	1,823	1,008	1,007	-- ^b	-5.76
Wayne County	0	124	4,207	1,560	1,489	-- ^b	-9.87
Total	111	9,326	26,086	16,181	19,237	72.63	-3.00

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-12
Alternative 1
Wage and Personal Income Projections

Industrial Sector	Wages and Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Mining							
Average Monthly Wage (1980 \$)	2,157	2,349	2,559	2,787	3,036	1.72	1.72
Change from Baseline							
Number of Employees	0	1,994	5,136	7,653	9,347	-- ^a	6.17
Total Wage Payment (1980 \$)	0	4,683,906	13,143,024	24,328,911	28,377,492	-- ^a	12.41
Construction							
Average Monthly Wage (1980 \$)	2,625	2,859	3,114	3,367	3,695	1.72	1.73
Change from Baseline							
Number of Employees	79	4,255	12,138	1,859	1,550	74.88	-18.60
Total Wage Payment (1980 \$)	207,375	12,165,045	37,797,732	6,259,253	5,727,250	68.29	-17.20
Manufacturing							
Average Monthly Wage (1980 \$)	893	973	1,060	1,154	1,257	1.73	1.72
Change from Baseline							
Number of Employees	1	61	182	126	155	68.27	-1.59
Total Wage Payment (1980 \$)	893	59,353	192,920	145,404	194,835	71.18	0.10
Transportation, Communications, and Utilities							
Average Monthly Wage (1980 \$)	1,879	2,047	2,296	2,501	2,724	2.02	1.72
Change from Baseline							
Number of Employees	2	151	459	326	400	72.22	-1.37
Total Wage Payment (1980 \$)	3,758	309,097	1,053,864	815,326	1,089,600	75.70	0.33
Wholesale and Retail Trade							
Average Monthly Wage (1980 \$)	844	919	1,002	1,091	1,188	1.73	1.72
Change from Baseline							
Number of Employees	11	860	2,591	1,819	2,230	72.67	-1.49
Total Wage Payment (1980 \$)	9,284	790,340	2,596,182	1,984,529	2,649,240	75.65	0.20
Finance, Insurance, and Real Estate							
Average Monthly Wage (1980 \$)	925	1,007	1,097	1,195	1,302	1.72	1.73
Change from Baseline							
Number of Employees	2	127	395	284	349	69.65	-1.23
Total Wage Payment (1980 \$)	1,850	127,889	433,315	339,380	454,398	72.57	0.48
Services							
Average Monthly Wage (1980 \$)	767	835	910	991	1,079	1.72	1.72
Change from Baseline							
Number of Employees	7	567	1,761	1,281	1,578	73.81	-1.09
Total Wage Payment (1980 \$)	5,369	473,445	1,602,510	1,269,471	1,702,662	76.80	0.61
Government							
Average Monthly Wage (1980 \$)	931	1,014	1,144	1,246	1,357	2.08	1.72
Change from Baseline							
Number of Employees	12	927	2,893	2,138	2,711	73.07	-0.65
Total Wage Payment (1980 \$)	11,172	939,978	3,309,592	2,663,948	3,678,827	76.67	1.06
Nonfarm Proprietors							
Average Monthly Wage (1980 \$)	1,230	1,340	1,459	1,590	1,731	1.72	1.72
Change from Baseline							
Number of Employees	8	563	1,741	1,228	1,516	71.31	-1.37
Total Wage Payment (1980 \$)	9,840	754,420	2,540,119	1,952,520	2,624,196	74.26	0.33
Other Labor Income							
Average Monthly Wage (1980 \$)	106	115	126	137	149	1.74	1.69
Change from Baseline							
Number of Recipients	118	9,305	27,079	16,722	19,899	72.22	-3.03
Total Wage Payment (1980 \$)	12,508	1,070,075	3,411,954	2,290,914	2,964,951	75.22	-1.39
Average Property Income (1980 \$)	141	156	170	185	202	1.89	1.74
Population	247	18,889	56,900	38,652	47,150	72.28	-1.86
Total Property Income (1980 \$)	34,827	2,946,684	9,673,000	7,150,620	9,524,300	75.54	-0.15
Total Monthly Personal Income (1980 \$)	296,876	24,320,232	75,754,212	46,200,276	58,987,751	74.05	-2.47
Average Monthly Per Capita Income	1,202	1,288	1,331	1,195	1,251	-1.02	-0.62

Source: Argonne National Laboratories, 1983.

^aUndefined.

ALT. 1: HIGH COMMERCIAL PRODUCTION

Infrastructure

Three more general care hospital beds would be needed in 1985; this figure would rise to 111 beds in 1995 and would then fall to 95 beds in 2005. The change in long-term care hospital beds would grow from none in 1985 to a high of 62 in 2005. In 1985, three more doctors, dentists, nurses, public health nurses, clinical psychologists, and mental health workers would be needed. By 2005, the demand for medical personnel would increase to 30 doctors, 26 dentists, 81 nurses, 13 public health nurses, eight clinical psychologists, and nine mental health workers. *Carbon and Uintah counties would generally experience the largest medical service demands.*

The demand for public safety services would increase at varying rates. The greatest increase would occur in jail space, which would grow from 107 square feet in 1985 to 22,843 square feet in 2005. During the same period, the following growth is projected: police officers and patrol cars would increase from 3 to 95; emergency medical technicians would increase from 21 to 91; and the number of juvenile-holding cells would increase from 3 to 11. In each case, the demand for these services would peak in 1995 and would then decline between 1995 and 2005. *Carbon, Duchesne, and Uintah counties would generally experience the largest demands for public safety services.*

Utility service demands are projected to increase 73.3 percent annually from 1985 to 1995 and then decrease 1.5 percent annually from 1995 to 2005. In 2005, water system demands would increase by 14,739 connections to the water system, 8,608 million gallons of water supply and treatment, and 4,304 million gallons of water storage. Sewage system demands would increase by 1,667 million gallons. *Carbon, Duchesne, and Uintah counties would generally experience the greatest utility service demands.*

Communities' park services would need to be increased by 3 acres in 1985, by 323 acres in 1995, and by 276 acres in 2005. Demand for library books and space would increase at an annual rate of 74 percent between 1985 and 1995. A total of 92,632 books and 22,843 square-feet of space would be needed in 2005. *Carbon, Duchesne, and Uintah counties would generally experience the largest demands for park and library services.*

ATTITUDES AND LIFESTYLES

As in the Socioeconomics section, most of the information contained in this section is taken from a report prepared by Argonne National Laboratories (1983). All communities within the development area would experience, to varying degrees, a diminution of traditional small-town "way-of-life" values because of population growth and a consequential decrease in cultural homogeneity.

Social changes would be felt least in the larger communities that have already experienced energy-related growth, such as Price and Vernal. In Hanksville, the likelihood of major social changes would be the greatest,

where newcomers would outnumber native residents by the year 1992.

Ute tribal members not participating in the economic benefits of tar sand development would feel a heightened sense of cultural and economic alienation. Environmental problems (i.e., degradation of air and water) and social concerns (i.e., trespassing on Reservation lands and overcrowding of services) would cause stress among tribal members (Duncan, 1983).

The extent of quality-of-life impacts cannot be quantified; however, many of these impacts could be at least partially mitigated through careful planning. The social consequences arising from Western energy-related "boom towns" have been well documented (Cortese and Jones, 1977). These investigations have shown that the social impacts of "boom-town" growth involve changes far beyond increases in population, strains on municipal services, and mental health problems. Long-range community impacts would occur to the social and cultural structures (e.g., increasing impersonalization, bureaucratization, and specialization). Many impacted long-time residents in communities would perceive these changes as a way of life rapidly slipping away.

TRANSPORTATION

This analysis assumes truck transportation of bitumen products to existing refineries in Salt Lake City and Roosevelt in Utah and Grand Junction in Colorado. These refineries are designed to process specific types of hydrocarbon crudes and *some may not presently be able to process bitumen.* However, for purposes of this analysis, it is assumed that necessary design modifications would be made to handle syncrude feedstock.

It is possible, based on high production and cost effectiveness, that pipelines could be used to transport syncrude feedstock. Depending on location, the use of pipelines could result in greater impacts than existing transportation facilities because of surface disturbance. Surface disturbance could be as much as 6.07 acres per mile (USDI, BLM, 1981b).

Table 4-13 shows communities potentially affected by energy-related, heavy-truck traffic. Of these communities, only Hanksville is not experiencing this type of traffic.

Noise levels in all affected communities would increase. Peak noise level from haul trucks at 35 miles per hour (mph) or greater would be 86 dBA (A-weighted sound level--see Glossary), measured at 50 feet (EPA, 1971). Typical outdoor residual noise levels for rural areas are 16-35 dBA, urban residential area levels are 46-55 dBA, and very noisy urban residential and downtown city levels are 56-75 dBA. Those communities currently experiencing energy-related, heavy truck traffic would realize increases in noise frequency and magnitude. Resultant impacts on population would include interference or temporary inability in hearing and speaking and disruptions in sleep patterns or concentration. Noise impacts would range from minor annoyance to disruption of activities (U.S. Department of Transportation, 1978) but would not cause serious health problems.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-13

Alternative 1
Annual ADT Projections

STSA	Peak Production Year	Highway	Segment Description	Heavy Trucks	Commuter Round Trips
Argyle Canyon/ Willow Creek	1993		County road access.	(railroad)	230
Asphalt Ridge/ White Rocks	1990	U.S. Hwy 40	Vernal to west of Roosevelt.	50	550
Circle Cliffs	1993	Utah Hwy 24	Notom Road to U.S. Hwy 70.	100	760
		U.S. Hwy 70	Utah Hwy 24 to Green River.		
Hill Creek	1995	Utah Hwy 88	Ouray to U.S. Hwy 40.	50	800
		U.S. Hwy 40	Utah Hwy 88 to west of Roosevelt.		
P. R. Spring	1998	Utah Hwy 45	Bonanza to U.S. Hwy 40.	500	2,300
		U.S. Hwy 40	Utah Hwy 45 to west of Roosevelt.		
Raven Ridge/ Rim Rock	1992	Utah Hwy 45	South of U.S. Hwy 40 to U.S. Hwy 40.	25	230
		U.S. Hwy 40	Utah Hwy 45 to west of Roosevelt.		
San Rafael Swell	1993	U.S. Hwy 70	Head of Sinbad to Green River.	100	740
Sunnyside	2005	Utah Hwy 6	Price to Utah Hwy 123.	(railroad)	6,125
		Utah Hwy 123	Utah Hwy 6 to Sunnyside.		
Tar Sand Triangle	2003	Utah Hwy 24	Temple Junction to U.S. Hwy 70.	350	1,360
		U.S. Hwy 70	Utah Hwy 24 to Green River.		

Source: Utah Department of Transportation, 1982.

ALT. 1: HIGH COMMERCIAL PRODUCTION

Traffic from the Circle Cliffs, Sunnyside, and Tar Sand Triangle STSAs would exceed the level of service on Utah Highways 6, 24, 40, and 123. The composite traffic from Asphalt Ridge/White Rocks, Hill Creek, P. R. Spring, and Raven Ridge/Rim Rock would exceed the level of service on U.S. Highway 40 near Vernal. Utah Highway 6, from Price to Wellington, and U.S. Highway 40, near Vernal, have already exceeded the design traffic volume capability from existing energy-related traffic; additional traffic from tar sand development would add to the system overload. Traffic from other STSAs would not overload any of the other regional highways.

On all affected regional highways, significant increases in high-tonnage truck traffic would result in an unquantifiable damage to road surfaces. Unquantifiable accident rates would increase on all roadways, particularly at grade intersections because of increased congestion.

Development of the Circle Cliffs STSA via the Burr Trail and Notom Road would route haul trucks through Capitol Reef National Park, thereby detracting from the natural setting and increasing the hazards to park visitors.

Analysis of STSAs

This section contains an analysis for each STSA considering Alternative 1, High Commercial Production.

ARGYLE CANYON/WILLOW CREEK STSA

It is assumed that this STSA would contribute 5,000 barrels/day of bitumen from surface mines.

Air Quality

The analysis assumptions included a surface mine, a hot-water extraction plant, and an upgrading facility producing 5,000 barrels/day of bitumen.

Estimated annual pollutant emissions would be:

Total Suspended Particulates (TSP):	1,194 tons
Sulfur Oxides (SO _x):	193 tons
Nitrogen Oxides (NO _x):	2,182 tons
Carbon Monoxide (CO):	343 tons
Volatile Organic Compounds (VOC):	384 tons

Tables 4-2 and 4-3 compare the estimated emissions resulting from Alternative 1 with PSD incremental limitations and NAAQS, respectively. Twenty-four hour average TSP concentrations could exceed the primary and secondary NAAQS and the PSD Class II limitation. All other pollutant concentrations would be expected to be within the NAAQS and PSD incremental limitations. There are no PSD Class I areas near the Argyle Canyon/Willow Creek STSA. A visibility analysis indicated that no perceptible visibility impairment would occur at Dinosaur National Monument or the Uintah and Ouray Indian Reservation (Aerocomp, Inc., 1983a).

Water Resources

Water requirements (approximately 1,250 acre-feet per year) could be met by water stored in major streams in the area. A shift in water right allocations would be necessary to meet water needs. Surface disturbance from construction and mining activities on approximately 3,600 acres would increase sediment yield. Water quality could also be lowered by the accidental release of process or leachate water into nearby streams or the overflow of waste-holding ponds (USDI, GS, 1983).

Soils

Surface disturbance from construction of roads and tar sand facilities and overburden removal on an estimated 3,600 acres, would increase erosion and alter the soil profile by changing its physical and chemical composition. Approximately 86 percent of the STSA is in the low sediment yield class, and 14 percent is in the moderate class.

Topography, Tar Sand, and Other Minerals

Topography

Surface mining would be feasible only in limited areas within this STSA because most slopes are very steep, and overburden is thick. Surface mining would cause extensive cuts: benches and sidewalls would remain after mining. In addition, large cuts and fills would result from the construction of roads and surface facilities. About 3,600 acres would be disturbed by the projected operation.

Tar Sand

Tar sand would be removed completely from mined areas: this would total about 1,200 acres. Tar sand under thicker overburden would remain undisturbed.

Other Minerals

Surface mining of tar sand could impair oil and gas development during mining activities; however, oil and gas resources underlying tar sand deposits would not be affected by tar sand development.

Vegetation

Vegetation would be removed on about 3,600 acres in the Tavaputs Plateau portion of the Uinta Basin floristic section. Major vegetation types in the Argyle Canyon/Willow Creek STSA are Douglas fir, aspen, and big sagebrush-grass. The most important vegetation types are those producing the most livestock forage and providing the highest quality elk and deer summer ranges. The aspen type provides the highest quality elk and deer summer ranges. The location(s) of the proposed 3,600 acres of development within the STSA is unknown; therefore, a worst-case analysis would assume that 3,000 acres of the aspen vegetation type would be lost. The period of loss (the time from initial vegetation clearing to rehabilitation) is estimated to be the project's life plus 20 years. Because of (1) mixing of soil horizons and rock strata; (2) potential introduction of weeds; and (3) structural and chemical changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of mined areas.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

Threatened and Endangered Plant Species

There are no threatened and endangered plant species known to occur in this STSA. Based on this existing inventory information, there would be no on-site impacts to plant species currently protected by law.

Animal Life

Terrestrial Wildlife

Over the development period, approximately 3,600 acres of deer/elk crucial summer range and yearlong small game and raptor habitats could be subject to surface disturbance from tar sand development (Table 4-7). This represents about 30 percent of each of these habitats in the STSA. Because summer range is considered the limiting factor for deer in this herd unit, populations could decline. Based on the assumption (made only for analysis purposes), that deer are evenly distributed over crucial summer range, it is estimated that destruction of 3,600 acres of this range would reduce deer numbers on herd unit 27B by 148 animals. This represents approximately 1 percent of the deer on this herd unit. Because elk use summer range for calving, tar sand development could prevent and/or retard the reestablishment of elk in the Range Creek elk herd unit. Small game and raptor populations dependent on this habitat could also be reduced. However, because of inadequate census data these reductions cannot be quantified. In addition, tar sand development that destroyed unique and/or limited wildlife habitat (i.e., aspen communities, riparian habitats, deer/elk fawning/calving grounds or migration corridors) could reduce or eliminate wildlife populations dependent on these areas.

Aquatic Species

An estimated annual 1,250 acre-feet of water would be required for tar sand development in this STSA. The potential trout fisheries of Argyle and Willow creeks could be lost. A reduction in channel catfish population in the Price River could result from degradation or loss of fish habitat resulting from reduced flows, possible leaching, and/or contamination of drainages. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (Western Division of American Fisheries Society [WDAFS], 1982). This would degrade the quality of fish habitat by reducing food *supplies*. The extent would depend on the location and magnitude of tar sand development.

Wild Horses and Burros

There are no wild horses or wild burros occupying this STSA.

Recreation and Wilderness

Hunting, *winter sports*, and sightseeing (*including vistas from the Indian Canyon Highway and along Reservation Ridge*) values in developed areas would be lost or degraded from construction through rehabilitation. Sightseeing values would be permanently degraded. *Camping values*

could be degraded by development of tar sand in the vicinity of Avintaquin Campground on the Ashley National Forest. No present or potential wilderness would be affected by tar sand development in this STSA.

Visual Resources

Surface mining would result in permanent degradation of scenic values. Rehabilitation to a VRM Class 4 (scenic quality Class C) condition would be possible, but would require several years after completion of rehabilitation actions. Even then, reclaimed areas (rounded landforms) would be out of character with the existing scenic environment (i.e., ridges, steep canyons, and benchlands).

Livestock Grazing

This STSA is 95 percent State land and private surface, and *includes portions of two FS cattle allotments*. It is estimated that the STSA is 75-percent suitable for livestock grazing and that forage production is about 8 acres/AUM. Based on this estimation, there would be about 338 AUMs lost annually by the proposed 3,600 acres of tar sand development. This number of AUMs is equivalent to 135 tons of hay. In addition to the loss of forage and range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing, including loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic and vandalism, disruptions in patterns of use, and a general reduction in the area's suitability for livestock grazing. Complete rehabilitation of livestock forage and grazing suitability would likely require the project's life plus 5 years.

ASPHALT RIDGE/WHITE ROCKS STSA

This STSA is projected to produce 5,000 barrels/day of bitumen.

Air Quality

The analysis assumed a 10,000 barrels/day hot-water extraction plant, an upgrading facility, and a surface mine. The estimated annual pollutant emissions would be:

TSP:	2,072 tons
SO _x :	383 tons
NO _x :	3,226 tons
CO:	727 tons
VOC:	613 tons

Increased pollutant concentrations are compared to PSD incremental limitations in Table 4-2. This table indicates that particulate concentrations would equal or exceed the 24-hour and annual Class II increments, while SO₂ concentrations would approach the Class II annual average increment. TSP concentration estimates exceed the Class II increment on the Uintah and Ouray Indian Reservation. Table 4-3 indicates that particulate concentrations could exceed the secondary NAAQS for both 24-hour and annual averaging periods. NO₂ concentrations could approach the primary NAAQS, while concentrations of SO₂ and CO would be well within the NAAQS.

ALT. 1: HIGH COMMERCIAL PRODUCTION

A level-1 visibility analysis indicated a potential for visibility impairment at Dinosaur National Monument and the Uintah and Ouray Indian Reservation; therefore, a level-2 analysis was performed. The level-2 analysis indicated that significant impairment would not occur at Dinosaur National Monument or the Indian Reservation (Aerocomp, Inc., 1983a).

Water Resources

An estimated annual 5,771 acre-feet of water would be supplied from the area, which would require conveyances of water rights. Consumptive water use could deplete local spring flow and decrease yields of existing wells. Water quality could be impacted on an estimated 3,000 acres by increased sediment yield from construction and mining activities, accidental release of process waters into nearby water sources, or the failure of holding ponds to retain wastes.

Soils

Surface disturbance from construction of roads, tar sand facilities, and overburden removal on an estimated 3,000 acres would increase erosion and alter the soil by changing slope, toxicity, infiltration and permeability rates; fertility; and other soil characteristics. Approximately 64 percent of the STSA is in the high sediment yield class, with 22 percent in moderate and 14 percent in low.

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 1,000 acres at White Rocks and 2,000 acres at Asphalt Ridge would be altered in surface-mined areas. The cuesta that forms Asphalt Ridge would be partly or completely destroyed and replaced with a rounded ridge. All of the rock in the excavation would be broken up and moved, and the backfill would consist of a more homogeneous material than the existing rocks.

Tar Sand

About 6,000 acre-feet of tar sand would be removed from a pit in steeply dipping layers by surface mining. Any tar sand remaining in the excavations would be unrecoverable in the future.

Other Minerals

Coal, oil, and gas resources underlying tar sand would not be affected by tar sand development; however, oil and gas exploration and development activities could be hindered in surface-mined areas.

Vegetation

About 3,000 acres in the Uinta Basin floristic section would be stripped of vegetation. The major vegetation types on this STSA are mountain brush, juniper, sagebrush, and mixed-desert shrub. The most important vegetation types are those producing the most livestock forage and providing the highest-quality elk and deer winter ranges and sage grouse habitat. Sheep are the only class of livestock, and sage grouse is the major wildlife species on the Asphalt

Ridge portion of this STSA; therefore, the most important vegetation type on the Asphalt Ridge portion is probably mixed desert shrub.

Cattle is the major class of livestock, and critical elk and deer winter range is the major wildlife value of the White Rocks portion of this STSA. Therefore, the most important vegetation type on the White Rocks portion is probably the mountain brush and sagebrush vegetation types.

The location(s) of the proposed 3,000 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 3,000 acres of vegetation of the highest value to livestock, wintering elk and deer, and sage grouse would be lost. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and structural and chemical changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying range site potentials on mined areas.

Threatened and Endangered Plant Species

There are no threatened or endangered plant species known to occur in this STSA. Based on existing inventory information, there would be no on-site impacts to plant species currently protected by law.

Animal Life

Terrestrial Wildlife

There are approximately 3,000 acres of deer/elk winter range in this STSA (Laing, 1983). Because winter range is a limiting factor on deer populations, herd units 22 and 26 could decline by 52 and 46 animals, respectively. This represents less than a 1-percent reduction in herd size for these units. Because winter range is also a limiting factor for elk, populations of these animals on herd unit 9A (Ashley-White Rocks) could decline by 446 animals. This represents a reduction of approximately 51 percent for this herd unit.

One sage grouse strutting ground and 1,200 acres of sage grouse nesting and yearlong raptor habitat could be subject to surface disturbance from tar sand development (Table 4-7). Because of its importance to the nesting and reproductive success of sage grouse, the loss of strutting ground and 1,200 acres of nesting habitat could eliminate the sage grouse population on the STSA. Other unidentified sage grouse strutting grounds could also be impacted because a comprehensive inventory of the STSA has not been conducted.

Raptor species (e.g., red-tailed hawks) dependent on this habitat could be reduced; however, the reduction in numbers cannot be quantified. In addition, tar sand development that destroyed riparian areas could reduce or eliminate various wildlife species dependent on this habitat.

Aquatic Wildlife

Degradation or loss of fish and associated riparian habitat provided by the White Rocks River could occur, which would reduce the populations of rainbow, brook, and cutthroat trout. These species could be kept below their biotic potential.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

The Green River could also be impacted, which is a potential water source located outside the STSA. Reduced flows, possible leaching, and contamination of drainages could result from tar sand development. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of channel catfish habitat by reducing food *supplies*.

Wild Horses and Burros

There is no wild horse or wild burro range on this STSA.

Recreation and Wilderness

Surface mining and in-situ development in the Asphalt Ridge/White Rocks STSA would affect recreational uses and values, as described in the Recreation section in the Regional Overview analysis contained in this chapter. Hunting values would be degraded or lost until the affected areas were rehabilitated. Sightseeing values in the portion on the Ashley National Forest would be permanently degraded. Improved access could increase ORV use of the areas. No present or potential wilderness would be *directly* affected by tar sand development in this STSA.

Visual Resources

Surface mining would cause some degradation of scenic values in the Asphalt Ridge portion of the STSA. However, the present scenic quality there is low; therefore, rehabilitation would probably successfully restore most present scenic values. Recovery would, however, probably require several decades. Development of the Ashley National Forest portion of the STSA would permanently degrade exceptional scenic values and violate FS Visual Quality Objectives for the area, since activities and rehabilitation would be out of character with the existing landscape. *There could be impairment of vistas from Dinosaur National Monument if tar sand development occurred within the STSA.*

Livestock Grazing

Portions of five FS cattle allotments, two BLM sheep grazing allotments, and portions of three other BLM sheep grazing allotments fall within the boundaries of this STSA. The 14,700-acre White Rocks portion of this STSA is predominantly Uintah and Ouray Indian Reservation lands; the rest is FS and private lands. The primary use is livestock grazing, and cattle is the major class of livestock. Forage production is estimated to be about 6 acres/AUM; therefore, this portion of the STSA produces about 2,450 AUMs.

The 26,695-acre Asphalt Ridge portion of this STSA is predominantly BLM and State lands. The primary class of livestock is sheep, and average forage production of the five BLM allotments is about 55 acres/AUM (26,695 acres divided by 481 AUMs equals 55 acres/AUM [see Table 3-17]).

Based on estimated forage production and the assumption that 1,500 acres on Asphalt Ridge and 1,500 acres on White Rocks would be surface mined, a total of about 277 AUMs would be lost by tar sand development (27 AUMs on

Asphalt Ridge and 250 AUMs on White Rocks). Forage is a renewable resource; therefore, the equivalent of 111 tons of hay would be lost every year for the project's life.

In addition to the loss of forage, range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. These impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be the project's life plus 5 years.

CIRCLE CLIFFS STSA

A 20,000 barrels/day in-situ operation with upgrading bitumen facilities was projected for Alternative 1.

Air Quality

Estimated annual emissions would be:

TSP:	847 tons
SO _x :	4,964 tons
NO _x :	2,059 tons
CO:	108 tons
VOC:	112 tons

Table 4-2 compares the estimated increased pollutant concentrations with the PSD incremental limitations. The results indicate violations of the Class I SO₂ increments at Capitol Reef National Park and violations of the Class II increments. The predicted violations would occur for all averaging periods. The high SO₂ concentration estimates would be caused by a combination of the following factors: (1) a high sulfur content in the bitumen; (2) close proximity to elevated terrain features; and (3) close proximity of the STSA to Capitol Reef National Park. Increased TSP concentrations would be within the Class I and Class II incremental limitations. Table 4-3 indicates that no NAAQS violations would be expected.

A level-1 visibility analysis indicated a potential for significant visibility impairment at Capitol Reef National Park. A more detailed level-2 analysis did not indicate significant visibility impairment at Capitol Reef, although the blue-red ratio (see Glossary) was close to the threshold for which significant discoloration could occur (Acrocomp, Inc., 1983a).

Water Resources

Approximately 4,600 acre-feet of water per year would be water required from wells, which could decrease stream-flow in nearby streams. Water quality could be impacted by accidental release of process or leachate waters into nearby water sources or the failure of holding ponds to retain wastes. Indirect effects would result from construction, in-situ mining, processing, or disposal activities. Increased sediment yield could result from surface disturbance on 2,900 acres.

ALT. 1: HIGH COMMERCIAL PRODUCTION

Soils

Surface disturbance from construction of roads, tar sand facilities, and drilling pads on an estimated 2,900 acres would increase erosion. Approximately 62 percent of the STSA is in the moderate sediment yield class, 35 percent in high, and 3 percent in very high.

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 2,900 acres on mesa tops, ridges, and valley sides would be modified with cuts and fills for roads, drill pads, and facilities related to in-situ extraction on about 7,300 acres. No major changes would affect landforms. The largest potential changes would be the cuts and fills associated with roads built along the sides of mesas or buttes.

Tar Sand

About 30 percent (or less) of the bitumen would be removed by in-situ methods on about 7,300 acres. The bitumen remaining in the developed deposit would not be recoverable in the future. If in-situ combustion methods were used, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas beneath the STSA could be recovered after operations and reclamation for tar sand had been completed. Any uranium deposits overlying tar sand would not be affected significantly by in-situ operations.

Vegetation

About 2,900 acres in the Canyonlands floristic section would be stripped of vegetation. The major vegetation type on this STSA is pinyon-juniper woodland. The most important vegetation associations in this STSA are those contributing the most livestock forage and furnishing the best bighorn sheep habitat. Vegetation types most valuable to livestock are those with a high composition of galleta grass, Indian ricegrass, four-wing saltbush, Mormon tea, and shadscale. The location(s) of the 2,900 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 2,900 acres of vegetation of the highest value to livestock and bighorn sheep would be lost. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and structural and chemical changes in the plant growth medium, there is a risk of permanently modifying range site potentials of mined areas.

Threatened and Endangered Plant Species

There are no threatened or endangered plant species known to occur in this STSA. Based on this existing inventory information, there would be no on-site impacts to plant species currently protected by law or by policy.

Animal Life

Terrestrial Wildlife

Approximately 1,080 acres, representing 100 percent of the crucial desert bighorn sheep range on the STSA, could be destroyed from tar sand development. Because these animals are extremely sensitive to human encroachment (Gallizioli, 1977), this level of development could eliminate the sheep from the STSA.

In addition, 2,900 acres of yearlong raptor habitat could be subject to surface disturbance from tar sand development. Raptor populations dependent upon this habitat could be eliminated or reduced; however, because of inadequate census data, population reductions cannot be quantified.

Any tar sand development that destroyed riparian areas could eliminate or reduce wildlife populations dependent on this habitat.

Aquatic Species

The Escalante River could be adversely impacted from reduction in flows, possible leaching, and contamination of drainages. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse or wild burro range identified on this STSA.

Recreation and Wilderness

In-situ development of tar sand in the Circle Cliffs STSA would affect recreational values and uses as described in the Recreation portion of the Regional Overview section. Construction of roads, drill pads, pipelines, and production facilities would cause loss or degradation of high quality primitive recreational values and uses on BLM, Capitol Reef National Park, and Glen Canyon NRA lands. While there would not be development inside the Park or portions of Glen Canyon NRA, primitive recreation values and sight-seeing values in those areas could be degraded. Population increases would increase use and demand for recreational opportunities. Increased traffic would alter the character of present uses and cause changes in visitation patterns at recreation resources in the area. Water requirements/-developments could impact the Escalante River, a Nationwide River Inventory listed segment.

Development of tar sand resources in this STSA could affect wilderness values in three potential wilderness areas: *North Escalante Canyons/The Gulch Instant Study Area* (ISA) (BLM), *Capitol Reef* (NPS), and *Glen Canyon NRA* (NPS). Construction and operation of facilities and systems would create visual intrusions and sounds that would degrade opportunities for solitude in these areas.

Visual Resources

In-situ development of the tar sand in this STSA would cause temporary and possibly permanent degradation of

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

scenic values. Exceptional scenic values present constitute the prime recreational value of the area, which includes a segment of the Waterpocket Fold in Capitol Reef National Park. *It should be noted that development in this STSA could have an intrusive effect on views from overlooks in Capitol Reef National Park.* Overall, impacts would be as described in the Visual Resources portion of the Regional Overview section. Rehabilitation could recover most visual values, unless areas with steep slopes experienced surface disturbance. Up to several decades could be required for restoration of affected areas.

Livestock Grazing

Portions of five cattle allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total is shown in Table 3-17. The location(s) of the 2,900 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production for the entire STSA has been averaged as follows: 91,080 acres divided by 1,912 AUMs equals 47.6 acres/AUM. Based on this estimation, about 61 AUMs would be lost annually to tar sand development. This is equivalent to 24 tons of hay.

In addition to the loss of forage and range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. Off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

HILL CREEK STSA

Alternative 1 assumes that 10,000 barrels of bitumen would be produced per day by in-situ development on this STSA.

Air Quality

It was assumed that in-situ steam injection processes and associated upgrading facilities would be used for this STSA. Estimated annual emissions would be:

TSP:	940 tons
SO _x :	3,380 tons
NO _x :	2,667 tons
CO:	365 tons
VOC:	179 tons

Table 4-2 compares estimated increased pollutant concentrations with PSD incremental limitations; this table indicates that the 3-hour and 24-hour Class II SO₂ increment could be exceeded. The SO₂ increment consumption on the Uintah and Ouray Indian Reservation would be about one-half of the Class II increment. Total concentration estimates are compared to the NAAQS in Table 4-3, which indicates that the 24-hour secondary NAAQS could be violated for TSP. All other pollutants would meet the

NAAQS. A level-1 visibility analysis for Arches National Park, Dinosaur National Monument, and Uintah and Ouray Indian Reservation indicated a potential for visibility impairment at the reservation. However, a more detailed level-2 analysis indicated that visibility impairment would probably not be perceptible on the reservation.

Water Resources

The required 2,300 acre-feet/year could be supplied from area sources, if water rights were reallocated. Water quality would be impacted by increased sediment yield from 2,400 acres of surface disturbance from construction, in-situ mining, processing, or disposal activities. Other water quality impacts could be caused by accidental release of process or leachate waters into nearby water sources or the failure of holding ponds to retain wastes.

Soils

Surface disturbance on approximately 2,400 acres from construction of roads, tar sand facilities, and drilling pads would increase erosion. Approximately 47 percent of the STSA is in the high sediment yield class, 53 percent in moderate, and less than 1 percent in low (see Table 3-9).

Topography, Tar Sand and Other Minerals

Topography

Major topographic features would not be altered by in-situ processes. About 6,000 acres would be disturbed. Large cuts and fills would be associated with any road built along the side of a major valley. The land surface above the tar sand would be altered by roads, drill pads, and other facilities. These disturbed areas would total about 2,400 acres.

Tar Sand

About 30 percent of the bitumen would be extracted from tar sand underlying about 6,000 acres. The bitumen remaining in the developed part of the deposit would be unrecoverable unless in-situ combustion processes were used to liquify the recovered bitumen; in that case, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas deposits underlying tar sand could be produced after tar sand operations were completed. Oil shale, which overlies the tar sand in the northern part of the area, might be affected by heat from in-situ combustion. The effect of heat on oil shale would have to be evaluated on a site-specific analysis. Coal beneath the tar sand deposit would be unaffected by tar sand operations.

Vegetation

About 2,400 acres in the Tavaputs Plateau portion of the Uinta Basin floristic section would be stripped of vegetation. The major vegetation types in this STSA are: aspen, coniferous forest, sagebrush-grass, salt shrub, pinyon-juniper, riparian, and wet meadow. The most important vegetation types are those that contribute or produce the most livestock forage and provide the highest quality elk

ALT. 1: HIGH COMMERCIAL PRODUCTION

and deer winter ranges. Also of high importance is the riparian vegetation, which helps stabilize watersheds, affects quality and quantity of stream water, and provides important wildlife habitat. Fair to good quality and quantity livestock forage is provided in this STSA. The highest quality elk and deer winter range is probably provided by the mountain brush and sagebrush-grass at lower elevations. The sagebrush-grass and pinyon-juniper communities probably provide most of the winter range. The rehabilitation potential of these areas is less than areas receiving greater amounts of rainfall higher on the Plateau.

The location(s) of the 2,400 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 2,400 acres of mountain brush and sagebrush-grass vegetation types would be lost to tar sand development. It is expected that each vegetation type would be interspersed with about equal acreages of riparian and wet-meadow vegetation and that each vegetation type would be important to livestock and would also be of high importance to big game. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and structural and chemical changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying range site potentials on the mined areas.

Threatened and Endangered Plant Species

No Federally listed threatened or endangered plant species are known to occur within this STSA.

Animal Life

Terrestrial Wildlife

About 2,400 acres of deer and elk winter ranges, respectively, could be subject to surface disturbance from tar sand development (Table 4-7). This represents 19 and 54 percent of the winter ranges for deer and elk, respectively, on the STSA. However, because winter range is not considered a limiting factor on deer herd unit 28A or the Range Creek elk herd unit, no reductions in deer or elk numbers on these herd units are expected.

About 205 acres, representing 100 percent of the sage grouse nesting habitat on the STSA, could be destroyed from tar sand development. Because of its importance to the reproductive success of sage grouse, loss of this habitat could reduce sage grouse numbers on the STSA.

Approximately 2,400 acres, representing about 4 percent of the total yearlong raptor habitat on the STSA, would be subject to surface-disturbing activities associated with tar sand development. Raptor populations dependent upon this habitat could be eliminated or reduced; however, because of a lack of adequate census data, reductions cannot be quantified.

In addition, tar sand development that destroyed unique and/or limited wildlife habitat (i.e., deer/elk migration corridors) could reduce or eliminate wildlife populations dependent on this habitat.

Aquatic Species

Degradation or loss of fish and associated riparian habitat would occur on Hill Creek and Towave Reservoir, thus reducing the cutthroat populations of these two fisheries.

Degradation or loss of fish habitat would occur to White River and Willow Creek, potential water sources located outside the STSA. Reduced flows, possible leaching, and contamination of drainages could reduce the quality of catfish habitat in the White River. Because no game fish are present, Willow Creek would mainly be affected by reduced flows and possible loss or degradation to riparian habitat. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

About 2,400 acres of wild horse range would be disturbed by tar sand development. It is estimated that 75 percent of the range for a herd of between 175 and 200 animals is contained within this STSA. Loss of range would result from surface clearing and resultant loss of forage, increased access, ORV use, and increased harassment. It is estimated that tar sand development on this STSA would have a significant impact on this herd (Gardner, 1983).

Recreation and Wilderness

Impacts to recreational values and uses would be limited. Some hunting activity would be displaced during the period of operation. Present values and uses would be restored following rehabilitation. Improved access could increase touring by motor vehicles in the area.

Development of tar sand resources in the Hill Creek STSA could degrade wilderness/natural values in the *Ute Indian "Wildlife and Cultural Resource Protection Area"* (Hill Creek Extension of the Reservation) and Winter Ridge WSA, which is located 0.25 mile to the east. The visual intrusions and sounds created would degrade opportunities for solitude in the WSA.

Visual Resources

In-situ development of tar sand would cause long-term degradation of scenic values, especially in areas where steep slopes experienced surface disturbance. Most other areas could be successfully rehabilitated; however, it is possible that decades could be required for vegetative recovery.

Livestock Grazing

Two BLM grazing allotments and portions of four others fall within the boundaries of this STSA. Also included are large tracts of grazing lands on the Uintah and Ouray Indian Reservation. Estimated forage production by allotment and in total for this STSA is shown in Table 3-17. The location(s) of the 2,400 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: Forage production on BLM, State, and private lands on this STSA is estimated to

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

average 10.44 acres/AUM. Using the same forage production figure, it can be estimated that 230 AUMs would be lost directly to the 2,400 acres of in-situ tar sand development. This number of AUMs is equivalent to 92 tons of hay. Forage is a renewable resource, so this would be an annual loss until vegetation of equal production was re-established.

In addition to the loss of forage and range improvements, etc., on the developed area proper, there would be off-site impacts to livestock grazing. Off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

P. R. SPRING STSA

It is estimated that 50,000 barrels/day of bitumen would be produced by surface mining and 50,000 barrels/day of bitumen would be extracted by in-situ methods in this STSA.

Air Quality

The analysis scenario for P. R. Spring includes (1) a 30,000 barrels/day hot-water extraction plant, a bitumen upgrading facility, and an associated surface mine; (2) a 20,000 barrel/day hot-water extraction plant, upgrading facility, and surface mine; and (3) a 50,000 barrel/day in-situ steam injection facility and upgrading plant. Estimated annual emissions would be:

TSP:	13,637 tons
SO _x :	18,824 tons
NO _x :	29,477 tons
CO:	5,872 tons
VOC:	2,393 tons

Table 4-2 compares increased concentrations with PSD incremental limitations. The concentration estimates for 24-hour Class II SO₂ levels and annual and 24-hour Class II TSP levels would exceed the incremental limitations. Table 4-3 compares increased concentrations with NAAQS. Annual and 24-hour TSP concentrations could exceed the primary NAAQS, while levels of all other pollutants would be well within the NAAQS.

A level-2 visibility analysis was performed to estimate visibility impacts at Arches National Park (a Federal Class I area), Colorado National Monument, and the Uintah and Ouray Indian Reservation (Aerocomp, Inc., 1983a). Atmospheric discoloration could be significant if the blue-red ratio (see Glossary) was less than 0.90. The analysis predicted blue-red ratios of 0.86 at Colorado National Monument, 0.92 at Arches National Park, and 0.63 at the Uintah and Ouray Indian Reservation. The ratios for the reservation and Colorado National Monument would be less than the significance level, and would be close to the significance level at Arches National Park. A highly visible yellow-brown discoloration would occur at the reservation. A faintly visible discoloration would be expected at

Colorado National Monument. Discoloration at Arches National Park would be either imperceptible or faintly visible (Aerocomp, Inc., 1983a). Visual range reductions of 2.4 percent at Colorado Rim and 3.7 percent at Arches National Park were estimated. These reductions are not considered significant. It should be noted that, as a Federal Class I area, the Clean Air Act requires visibility protection for Arches National Park; however, Colorado National Monument, a Federal Class II area, is not given protection by the Act.

Water Resources

The estimated water requirement of 21,300 acre-feet/year could be supplied from the area, although transfer of water rights would be required. Water quality would be impacted by increased erosion and sediment yield from surface disturbance on approximately 19,000 acres (see Tables 4-5 and 4-6). Other water quality impacts could result from accidental release of process or leachate into nearby water sources or the failure of holding ponds to retain wastes.

Soils

Surface disturbance from construction of roads, tar sand facilities, and overburden removal would occur on an estimated 19,000 acres (see Table 4-6). This would increase erosion and sediment yield and alter the soil profile by changing the physical and chemical composition. Approximately 22 percent of the STSA is in the high sediment yield class and 78 percent is in the moderate class.

Topography, Tar Sand, and Other Minerals

Topography

Topography on about 19,000 acres would be altered by tar sand development. The areas most feasible for surface mining occur in the southern part of the STSA. About 5,000 acres of ridgetops would be destroyed and about 10,000 acres would be modified by waste sand disposal, overburden (which would fill valleys), roads, and facilities. Generally, the tar sand is too deeply buried for surface mining in the remainder of the STSA.

About 4,000 acres would be required for in-situ development. Roads, pipelines, drill pads, and operation facilities would require surface disturbance. Topography would not be altered significantly by in-situ methods. The major landscape features would remain unchanged, but slopes would be changed by cut and fill associated with the construction of roads, drill pads, and facilities. Large cuts and fills could occur on areas with steep slopes. Subsidence could occur with in-situ extraction.

After reclamation, the topography of surface-mined areas would be rounded and would contrast with the existing cliffs and slopes. Also, the backfill in excavated areas would be more porous than the existing layered rocks.

Tar Sand

All of the bitumen would be removed from about 5,000 acres by surface mining requiring surface disturbance of 15,000 acres. About 30 percent of the bitumen would be

ALT. 1: HIGH COMMERCIAL PRODUCTION

removed by in-situ methods on about 11,000 acres and the remainder of the depleted deposit would not be recoverable. If in-situ combustion methods were used, part of the bitumen would be burned. In-situ recovery would disturb about 4,000 acres.

Other Minerals

Coal and oil and gas resources underlying the tar sand would not be affected by extraction; however, oil and gas development activities could be hindered in areas that were surface mined. Coal, which may underlie the STSA, would not be affected. Oil shale that overlies the tar sand might be affected by heat from an in-situ combustion process or could be destroyed by surface mining.

Vegetation

About 19,000 acres in the Tavaputs Plateau portion of the Uinta Basin floristic section would be stripped of vegetation. Available vegetation data on this STSA are inadequate; however, the major vegetation types are as follows: aspen, coniferous forest, sagebrush-grass, salt shrub, pinyon-juniper, riparian, and wet meadow. Important vegetation types in this STSA are those that contribute or produce the most livestock forage and provide the highest quality elk and deer winter ranges. Also of high importance is the riparian vegetation, which helps stabilize watershed, affects quality and quantity of stream water, and provides important wildlife habitat. The highest quality elk and deer winter ranges are provided by mountain brush and sagebrush-grass at lower elevations.

The location(s) of the 19,000 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume 19,000 acres of the most important vegetation types would be disturbed by tar sand development. Therefore, it is assumed that about half the development would occur on aspen/conifer areas and about half would occur on mountain brush and sagebrush-grass vegetated areas. It is expected that each vegetation type would be interspersed with about equal amounts of riparian and wet-meadow vegetation and each would be equally important to livestock and big game. The period of loss is estimated to be in the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds and structural and chemical changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of the mined areas.

Threatened and Endangered Plant Species

No Federally listed threatened or endangered plant species are known to occur within this STSA.

Animal Life

Terrestrial Wildlife

Approximately 9,500 acres of deer and elk summer and winter ranges could be subject to disturbance from tar sand development. This represents approximately 10 percent of the deer and elk summer ranges and about 8 and 11 percent

of the deer and elk winter ranges, respectively, on the STSA. Because summer range is considered the limiting factor for deer in this herd unit, populations could decline. Based on the assumption (for analysis purposes only) that deer are evenly distributed over crucial summer range, it is estimated that destruction of 9,500 acres of this range would reduce deer numbers on herd unit 28A by 203 animals. This represents approximately 7 percent of the deer on this herd unit. Also, based on the assumption that elk are evenly distributed over crucial summer range, it is estimated that destruction of 9,500 acres of this range would reduce elk numbers on the Book Cliffs elk herd unit by 106 animals or approximately 10 percent of the elk on this herd unit.

In addition, about 19,000 acres of small game and yearlong raptor habitat could be subject to surface disturbance (see Table 4-7). This represents approximately 17 and 10 percent of the total acreage for these habitats on the STSA. Small game and raptor populations dependent on this habitat could be eliminated or reduced; however, because of a lack of census data, population reductions cannot be quantified.

Any tar sand development that destroyed unique or limited wildlife habitat (i.e., riparian habitats, aspen communities, deer and elk fawning/calving ground or migration corridors) could *displace*, reduce, or eliminate the various wildlife populations dependent upon these areas.

Aquatic Species

Estimated water requirements are 21,300 acre-feet per year. Degradation or loss of fish habitat would occur to White River and Willow Creek, potential water sources located outside the STSA. Reduced flows, possible leaching, and contamination of drainages could reduce the quality of catfish habitat in the White River. Since no game fish are present, Willow Creek would mainly be affected by reduced flows and possible loss or degradation to riparian habitat. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse or wild burro range identified within this STSA.

Recreation and Wilderness

Hunting would be displaced from affected areas. Scenic values would be temporarily and/or permanently degraded, depending on the activity and the area. Improved access and increased population in the area would increase recreational use, especially 2- and 4-wheel drive touring.

Surface and in-situ development of tar sand resources in the P. R. Spring STSA would create visual intrusions, sounds, and dust that would degrade opportunities for solitude in the Winter Ridge and Flume Canyon WSAs. A small portion of both WSAs are inside the STSA. *The Ute "Wildlife and Cultural Resource Protection Area" (Hill Creek Extension) could also be impaired by tar sand development.*

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

Visual Resources

Although 99 percent of the STSA is VRM Class IV, scenic quality is good to moderate in much of the area. The steep nature of the terrain would be difficult or impossible to successfully rehabilitate from the effects of surface mining and in-situ development. In disturbed areas, vegetative recovery to a condition compatible with existing conditions would require several years.

Livestock Grazing

Portions of 11 BLM grazing allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total for this STSA is shown in Table 3-17. The location(s) of the 19,000 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production for the entire STSA has been averaged as follows: Forage production on BLM, State, and private lands is estimated to average 13.16 acres/AUM (USDI, BLM, 1983). Using this forage production figure, it can be estimated that 1,444 AUMs would be lost directly to tar sand surface mining. This number of AUMs is equivalent to 578 tons of hay. Because forage is a renewable resource, an annual loss would occur until forage was re-established.

In addition to the loss of forage, range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. Off-site impacts could include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

RAVEN RIDGE/RIM ROCK STSA

This STSA is east of Vernal, Utah, near the Colorado state line. It is one of the smaller STSAs and would be developed by surface mining. It is estimated that 5,000 barrels/day of bitumen would be produced in this STSA.

Air Quality

This analysis assumed a surface mine, a 5,000 barrels/day hot-water extraction plant, and an upgrading facility. Estimated annual emissions would be:

TSP:	1,172 tons
SO _x :	193 tons
NO _x :	2,182 tons
CO:	342 tons
VOC:	384 tons

Table 4-2, which compares increased pollutant concentrations of SO₂ and TSP to the PSD incremental limitations, indicates that no PSD increments would be exceeded. As shown in Table 4-3, all NAAQS would be met, with the possible exception of the 24-hour TSP secondary standard which could be exceeded, primarily from 2005 baseline sources. Because development on the Raven Ridge/Rim Rock STSA is small, this would probably not result in NAAQS TSP standards being exceeded.

The level-1 visibility analysis indicates a potential for visibility impairment at Dinosaur National Monument. The more detailed level-2 analysis ruled out a significant impairment of Dinosaur National Monument. A level-1 analysis for the Flat Tops Wilderness Area in Colorado indicated no visibility impairment at this Class I area.

Water Resources

An estimated water requirement of 1,250 acre-feet/year (see Tables 4-4 and 4-5) would have little impact, except water rights would have to be reallocated. Increased sediment yield would result from surface disturbance by construction, mining, and related tar sand activities on 1,500 acres (see Table 4-6). Other water quality impacts could occur from accidental release of process or leachate waters into nearby water sources or the failure of holding ponds to retain wastes (USDI, GS, 1983).

Soils

Surface disturbance from construction of roads, tar sand facilities, and overburden removal on an estimated 1,500 acres (see Table 4-6) would increase erosion and sediment yield and alter the soil profile by changing physical and chemical compositions. Approximately 6 percent of the STSA is in a high sediment yield class and 94 percent is in a moderate class (see Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

Topography would be altered by surface mining. About 500 acres of ridges would be excavated and about 1,000 more acres would be modified by roads, facilities, and disposal of overburden and waste sand. Areas favorable to surface mining occur on the ridges in the eastern and northern part of the STSA. The reclaimed landforms would be rounded ridges instead of the existing cuestas and angular ridges. Elevation of the mined area would be tens of feet lower than existing elevations unless waste sands were returned to the pit.

Tar Sand

Tar sand would be removed completely from about 500 acres. The remaining bitumen-impregnated rock could be recovered later.

Other Minerals

Oil and gas resources underlying tar sand would not be affected by tar sand extraction; however, oil and gas development activities could be hindered in surface-mined areas. The Mahogany oil shale zone that overlies the tar sand deposit could be lost if surface mining for tar sand occurred.

Vegetation

Vegetation would be removed on about 1,500 acres in the Uinta Basin floristic section. Available vegetation data on this STSA are inadequate. However, the major vegetation types are assumed to be similar to those on the Asphalt Ridge/White Rocks STSA, which includes pinyon-juniper

ALT. 1: HIGH COMMERCIAL PRODUCTION

and mixed desert shrub. The most important vegetation in this STSA is mixed desert shrub, which produces the most livestock forage. The location(s) of the 1,500 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 1,500 acres of mixed-desert shrub would be lost to tar sand development. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and structural and chemical changes in plant growth medium from the tar sand recovery processes, there is a risk of permanently modifying range site potentials of mined areas.

Threatened and Endangered Plant Species

No Federally listed threatened or endangered plant species are known to occur within this STSA.

Animal Life

Terrestrial Wildlife

Four golden eagle nests, 1,500 acres of golden eagle nesting habitat, and 1,500 acres of yearlong raptor habitat could be subject to surface disturbance from tar sand development (Table 4-7). Such development could cause the golden eagle to abandon its nest site and eliminate or reduce raptor population dependent on this habitat. However, because comprehensive raptor inventories have not been conducted, reduction in raptor populations cannot be quantified. Any tar sand development that destroyed unique or limited wildlife habitat such as riparian areas could either eliminate or displace the various wildlife populations dependent on these habitats.

Aquatic Species

Estimated water requirements are 1,250 acre-feet per year. Impacts would occur to the Green and White rivers located outside the STSA. Fish habitat for channel catfish and black bullhead could be impacted by reduced flows, possible leaching, and contamination of drainages. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse or wild burro range identified within this STSA.

Recreation and Wilderness

Surface mining would displace the present limited recreational use of the area (slight hunting and ORV use) until the area was rehabilitated. Improved access could then attract increased ORV use. No present or potential wilderness would be affected by tar sand development in this STSA.

Visual Resources

Surface mining would cause long-term impairment of visual values; however, after rehabilitation (requiring several years), most visual values would be restored to the present VRM classes; however, landforms would contrast with the surrounding environment. *During the period from*

preliminary development through rehabilitation there could be intrusions visible from Dinosaur National Monument and Colorado National Monument.

Livestock Grazing

Portions of seven BLM grazing allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total for this STSA is shown in Table 3-17. The location(s) of the 1,500 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: forage production on BLM, State, and private lands is estimated to average 11 acres/AUM. Using this forage production figure, it can be estimated that 136 AUMs would be lost directly to tar sand surface mining. This number of AUMs is equivalent to 54 tons of hay. Forage is a renewable resource; therefore, an annual loss of equal forage production would occur until this resource was established.

In addition to the loss of forage and range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. Off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

SAN RAFAEL SWELL STSA

This large STSA is located in Emery County. There are 20,000 barrels/day of bitumen estimated for this STSA, which would be mined by in-situ methods.

Air Quality

Annual pollutant emissions would be an estimated:

TSP:	1,077 tons
SO ₂ :	6,759 tons
NO _x :	5,333 tons
CO:	717 tons
VOC:	426 tons

Tables 4-2 and 4-3 compare the estimated increased pollutant concentrations to the PSD incremental limitations and the NAAQS, respectively. All concentrations are expected to be within the PSD limitations and the NAAQS.

Level-1 visibility analyses were performed for Arches, Canyonlands, and Capitol Reef national parks. The level-1 contrast reduction limit of 0.10 was marginally exceeded at all three parks, so a level-2 analysis was performed. The level-2 test was easily passed, thus indicating no significant visibility impairment at these three Class I areas (Aero-comp, Inc. 1983a).

Water Resources

An estimated water requirement of 4,600 acre-feet/year (see Tables 4-4 and 4-5) could be supplied from surface and supplemental groundwater sources in the area. Transfer of

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

water rights would be necessary and sediment yield would increase, which would impact streams by surface disturbance from construction, mining, and related tar sand activities on approximately 500 acres (see Table 4-6). Other water quality effects would be caused by accidental release of process or leachate waters into nearby water sources or the failure of ponds to retain wastes (USDI, GS, 1983).

Soils

Surface disturbance from construction of roads, tar sand facilities, and drilling pads on an estimated 500 acres (see Table 4-6) would increase erosion and sediment yield. Approximately 18 percent of the STSA is in a very high sediment yield class, 18 percent in high, and 64 percent in moderate (see Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

Topography would not be significantly altered by in-situ extraction. Major landscape features would remain unchanged, although the slopes of mesas and buttes would be changed on about 500 acres by cuts and fills associated with construction of roads, drill pads, and facilities. Large cuts and fills could occur on steep slopes.

Tar Sand

About 30 percent of the tar sand would be recovered by in-situ methods on about 1,100 acres. The remainder of the bitumen in the developed deposit would be unrecoverable. If in-situ combustion methods were used, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas resources underlying the tar sand would not be affected by tar sand extraction. The Chinle Formation contains some uranium and copper deposits in the vicinity of Temple Mountain. Other places would not be damaged by in-situ development.

Vegetation

About 500 acres in the Canyonlands floristic section would be stripped of vegetation. The major vegetation types on this STSA are pinyon-juniper, grassland, desert shrub, and riparian in the floodplain of the San Rafael River.

The most important vegetation types are those that contribute the most livestock forage and provide the highest quality desert bighorn sheep habitat. The best livestock forage in this STSA is probably provided by the grassland vegetation type, and the highest quality bighorn sheep habitat is probably provided by the desert-shrub type. The riparian vegetation type is equally important to livestock and wildlife.

The location(s) of the 500 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 500 acres of vegetation of the highest value to livestock and bighorn sheep would be lost. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata,

potential introduction of weeds, and chemical and structural changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying range site potentials on the mined areas.

Threatened and Endangered Plant Species

Wright's fishhook cactus (*Sclerocactus wrightiae*), an endangered species occurs within the STSA. The distribution of this plant species is not well known. The location(s) of the 500 acres of tar sand development within the STSA and the exact method of mining are also unknown. Therefore, a site-specific analysis cannot be made. Under a worst-case analysis, it can be assumed that loss of some individuals, populations, and habitat would occur. These losses would result from surface clearing, mixing of soil horizons and rock strata, introduction of weeds and chemical residues from tar sand recovery processes, and establishing of new access which would increase ORV activity.

Animal Life

Terrestrial Wildlife

Approximately 500 acres of desert bighorn sheep habitat and yearlong raptor habitat could be subject to surface disturbance from tar sand development. This represents about less than 1 percent of the total acreage for both of these habitats on the STSA. Any tar sand development that destroyed unique or limited wildlife habitat such as riparian areas could eliminate or reduce the various wildlife populations dependent on these habitats.

Aquatic Species

The San Rafael River is not considered a sport fishery of any value; however, water depletions could reduce flows in the Colorado River system, as discussed in the Regional Analysis section of this chapter.

Wild Horses and Burros

About 500 acres of burro range would be lost to tar sand development. It is estimated that between 25 and 50 animals depend on range within the STSA. About 50 wild horses also use about 3,000 acres of range in the STSA. The loss of range would result from surface clearing and resulting loss of forage, increased access and ORV use, and resulting increased harassment.

Recreation and Wilderness

With in-situ development in the San Rafael Swell STSA, scenic quality along I-70 and primitive recreational values would be lost or degraded. Also, increases in vehicular-related recreation activities would be expected from improved access. Scenic and primitive recreational values could be permanently impaired in some areas. Development of water requirements could affect the San Rafael River, a Nationwide Rivers Inventory listed segment.

Tar sand development in the San Rafael Swell STSA could degrade wilderness values in the five wilderness areas identified in Chapter 3, which overlap or are adjacent to the STSA. While tar sand development would not be allowed

ALT. 1: HIGH COMMERCIAL PRODUCTION

inside the WSAs, visual intrusions, odors, and sounds created in adjacent areas by tar sand operation could degrade opportunities for solitude in these areas.

Visual Resources

In-situ development of tar sand would degrade outstanding visual values in the San Rafael Swell STSA. The magnitude of impact would depend on the area developed since visual values vary greatly within the STSA. Most Class III and all Class II areas would experience some permanent degradation of scenic values. Class IV areas could be successfully rehabilitated, except in areas with steep slopes where permanent contrast would be created.

Livestock Grazing

Portions of fifteen livestock allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total within the STSA is shown in Table 3-17. The location(s) of the 500 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: 130,292 acres divided by 5,705 AUMs equals 23 acres/AUM. Based on this estimation, about 22 AUMs would be lost to tar sand development annually. This is equivalent to 9 tons of hay.

In addition to the loss of forage and range improvements, etc., on the mined areas proper, there would be off-site impacts to livestock grazing. Off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

SUNNYSIDE STSA

Estimated impacts associated with a production total of 125,000 barrels/day from several facilities are presented here. This regional STSA analysis assumes surface-mining projects to extract 115,000 barrels/day while 10,000 barrels would be developed by in-situ methods. For a detailed analysis of the singular and collective impacts from individual lease conversion applicants, refer to the *Sunnyside Combined Hydrocarbon Lease Conversion Draft EIS* (USDI, BLM, 1983).

Air Quality

The analysis assumed: (1) a 52,500 barrels/day hot-water extraction plant (with no upgrading) and an associated surface mine; (2) a 12,500 barrels/day hot-water extraction plant, upgrading facility, and associated surface mine; (3) a 22,500 barrels/day hot-water extraction plant, an upgrading facility, and a surface mine; (4) a 32,500 barrels/day solvent extraction plant, upgrading facility and an associated surface mine; and (5) a 15,000 barrels/day in-situ steam-injection operation.

The following estimated emissions would occur annually:

TSP:	42,940 tons
SO ₂ :	10,414 tons
NO _x :	70,523 tons
CO:	9,361 tons
VOC:	4,205 tons

Estimated increased ground level concentrations are compared to the PSD incremental limitations in Table 4-2. SO₂ impacts are predicted to exceed the 3-hour, 24-hour, and annual average PSD Class II incremental limitations. TSP impacts are predicted to greatly exceed the PSD Class II increments. Total estimated concentrations are compared to the NAAQS in Table 4-3. Violations of the annual NO₂ standard could occur, primarily from heavy equipment exhaust emissions in mine areas.

TSP levels would greatly exceed the NAAQS. The high TSP levels would occur because of the huge size of surface mines planned for the area. Surface mines cause large quantities of particulate emissions. Some of the surface mines being considered in the Sunnyside STSA would mine about 100 million tons of tar sand each year. In comparison, the largest surface coal mines in the United States mine approximately 10 to 12 million tons of coal each year.

As shown in Table 4-2, SO₂ and TSP impacts at the Uintah and Ouray Indian Reservation would be well within the Class II incremental limitations. The level-1 visibility analyses for Arches, Canyonlands, and Capitol Reef national parks, Dinosaur National Monument, and the Uintah and Ouray Indian Reservation indicated potential for visibility impairment at these areas. However, a more detailed level-2 analyses indicated that no significant impairment would occur at these national parks or Dinosaur National Monument because of the relatively large distance of these areas from the Sunnyside STSA. The level-2 analysis did indicate, however, that a highly visible yellow-brown atmospheric discoloration from NO_x emissions could occur at the Uintah and Ouray Indian Reservation (Aerocomp, Inc., 1983a). Particulate plumes could also be visible on the reservation. Visual range would be reduced by an estimated 13 percent. However, because the Reservation is not a Federal Class I area, visibility protection is not required by the Clean Air Act.

Water Resources

Approximately 554,750 acre-feet of water per year flows in seven streams located in the general area of the STSA. To meet the 36,145 acre-feet of water required annually, water storage would be needed from major streams that head or flow through the area. Also, additional pumping from the Price River, which is a considerable distance from the STSA and at a lower altitude, could be required. During dry years, the flow in the Price River would be insufficient to meet water needs and would require water from Green River. This river is farther from the deposits than is the Price River. Supplemental water could be provided by using groundwater. If water were pumped from wells, however, it might be diverted from existing springs or streamflows.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

A reallocation of water rights would be necessary to meet tar sand needs. Approximately 36,145 acre-feet/year could be met by water storage from major streams in the area. Surface disturbance from construction and mining on approximately 15,000 acres would increase sediment yield and impact water quality. Water quality could also be affected by accidental release of process or leachate waters into nearby water sources or the failure of holding ponds to retain wastes (USDI, GS, 1983).

Soils

Surface disturbance from construction of roads, tar sand facilities, and overburden removal on an estimated 15,000 acres would increase erosion and alter the soil profile by changing the physical and chemical composition. Approximately 10 percent of the STSA is in the high sediment yield class, 28 percent in moderate, and 62 percent in low (Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

Topography on about 15,000 acres would be altered by tar sand extraction during the 20-year evaluation period using surface-mining methods. All rock would be broken up in the excavations (about 5,000 acres) and part of it would be replaced in the excavations as backfill. Some overburden would fill the heads of some valleys. Final topographic forms would be more rounded than existing landscape. Waste sand deposits, roads, foundations, and surface facilities could affect another 10,000 acres. Elevations of the reclaimed landscape could be as much as several hundred feet lower than the existing topography if the waste sand from tar sand processing were not returned to the pit. If waste sand were returned to the pit, the elevations could be higher than the existing topography. Waste sand areas may be nearly flat-topped and would fill canyons or form mesa-like areas.

Major topographic features would not be significantly altered by in-situ methods. Major landscape features would remain unchanged, but slopes on about 1,000 acres would be changed by cuts and fills associated with construction of roads, drill pads, and facilities. Large cuts and fills could occur on areas with steep slopes. A few feet of subsidence could occur with in-situ development, but subsidence is not expected.

Tar Sand

Bitumen-impregnated rock underlying about 5,000 acres would be completely removed by surface mining. About 30 percent of the bitumen would be removed from about 2,300 acres by in-situ methods. The remaining bitumen in that area would be unrecoverable or, if in-situ combustion recovery methods were used, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas and coal resources underlying the tar sand would not be affected by tar sand extraction; however, later

operations for oil and gas exploration and development could be hindered in surface-mined areas.

Vegetation

About 15,000 acres in the Tavaputs Plateau portion of the Uinta Basin floristic section would be stripped of vegetation. The major vegetation types on this STSA are aspen, coniferous forest, mountain brush, sagebrush-grass, salt-shrub, pinyon-juniper, riparian, and wet meadow.

The most important vegetation types are those that produce the most livestock forage and provide the highest quality elk and deer winter and summer ranges. Also of high importance is the riparian vegetation, which helps stabilize watersheds, affects the quantity and quality of stream water, and provides important wildlife habitat. Fair to good quality and quantity livestock forage is probably provided by each of this STSA's vegetation types. The highest quality elk and deer summer ranges are provided by the aspen/conifer and riparian vegetation types. The highest quality elk and deer winter ranges are provided by the mountain brush and sagebrush-grass at lower elevations.

The exact location(s) of the 15,000 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 15,000 acres of the most important vegetation types would be lost to tar sand development. About half the development would occur on aspen/conifer areas and about half would occur on mountain brush and sagebrush-grass vegetated areas. Each would have about equal amounts of riparian and wet-meadow vegetation interspersed and each are equally important to livestock and big game. The period of loss or time from initial clearing to re-establishment is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and chemical and structural changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying range site potentials of the mined areas.

Threatened and Endangered Plant Species

Potential habitat for the Federally listed threatened plant species Uinta Basin hookless cactus (*Sclerocactus glaucus*) has been identified within this STSA. In addition, available data do not indicate with certainty the occurrence of any individuals or populations of *Sclerocactus glaucus* within the STSA. The location(s) of the 15,000 acres of tar sand development within the STSA and the exact method of mining are unknown. Under a worst-case analysis, it can be assumed that loss of some individuals, populations, and habitat would occur. Existing conversion proposals and new leased areas would not affect threatened and endangered species. However, some impact could be expected if development were to occur on the north portion of the STSA.

Available data indicate occurrences of Uinta Basin hookless cactus in eastern Utah and western Colorado: much of the known habitat of this species is subject to impacts from energy development.

ALT. 1: HIGH COMMERCIAL PRODUCTION

Animal Life

Terrestrial Wildlife

Approximately 7,500 acres of deer/elk summer and winter ranges could be subject to surface disturbance from tar sand development (see Table 4-7). This represents about 24 and 52 percent of the total summer and winter ranges, respectively, for these species within the STSA. Because summer range is considered a limiting factor and because of the extent of development on winter range, it is expected that deer and elk populations could significantly decline on the STSA from this level of development. Based on the assumption (made for analysis purposes only) that deer are evenly distributed over crucial summer range, it is estimated that destruction of 7,500 acres of this range would reduce deer numbers on herd unit 27B by 474 animals. This represents approximately 4 percent of the deer on this herd. Because elk use summer range for calving, tar sand development could prevent or retard the reestablishment of elk in the Range Creek elk herd unit.

Six sage grouse strutting grounds, 2,236 acres of nesting habitat, and 5,264 acres of yearlong habitat could be destroyed from tar sand development (see Table 4-7). Because of its importance in the nesting and reproductive success of sage grouse, the loss of the strutting ground and nesting habitat could eliminate the sage grouse population on the STSA.

One golden eagle nest site and 795 acres of nesting and foraging habitat could be subject to surface disturbance from tar sand development. Such development could cause the eagle to abandon its nest.

In addition, about 15,000 acres of small game and yearlong raptor habitat could be subject to surface disturbance from tar sand development. This represents approximately 33 and 14 percent of the total acreage for these habitats, respectively, on the STSA. Small game animals and raptors dependent on these habitats could be eliminated or reduced; however, because of inadequate census data, these reductions cannot be quantified.

Any tar sand development that destroyed unique or limited wildlife habitats such as aspen communities, riparian habitats, deer and elk fawning/calving grounds, or deer and elk migration corridors could either eliminate or reduce the various wildlife populations dependent on these areas.

Aquatic Species

Estimated water requirements for Alternative 1 are 36,145 acre-feet per year. Fish habitat of Range, Rock, Nine Mile, and Grassy Trail creeks could be impacted. Over 30.2 miles of fish and associated riparian habitat on Federal, State, and private lands could be reduced in quality or destroyed. Reproductive and nursery habitats of Range, Rock, and *Grassy Trail* creeks could be adversely impacted, thus reducing the populations of brown, rainbow, and cutthroat trout in these streams. Fish habitat in the Price and Green rivers, potential water sources outside the STSA, could also be affected. Populations of channel

catfish and black bullhead could be reduced by reduced flows, possible leaching, and contamination of drainages. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

About 15,000 acres of critical range for about 25 to 30 wild horses would be lost to tar sand development. This loss would result from surface clearing and resulting forage loss, increased access, and ORV use and resultant increased harassment.

Recreation and Wilderness

Significant, permanent degradation of exceptional scenic resources in the Roan Cliffs/West Tavaputs Plateau would result from tar sand development. Hunting would be displaced and/or degraded until affected areas were rehabilitated. Development of water requirements could adversely affect the Price River and Range Creek; both are Nationwide River Inventory listed segments. Tar sand development in the Sunnyside STSA could degrade opportunities for solitude and primitive recreation values in the Desolation Canyon, *Jack Canyon*, and *Turtle Canyon* WSAs.

Visual Resources

The outstanding scenic values in this STSA, including a major portion of the Roan Cliffs, would be permanently degraded by surface mining and in-situ development. Surface mining would lower peaks by up to hundreds of feet, and rounded landforms would replace and contrast with the present angular/steep visual environment of peaks, canyons, and ridges.

Impacts would be visible to residents in Price, Wellington, and other local communities. Successful rehabilitation of visual values would not be possible in most cases.

Livestock Grazing

Portions of 16 cattle allotments fall within the STSA. Estimated forage production by allotment and in total for the STSA is shown in Table 3-17. The location(s) of the 15,000 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: 157,445 acres divided by 6,491 AUMs equals 24 acres/AUM. Based on this estimation, about 625 AUMs would be lost to tar sand development annually. This is equivalent to 250 tons of hay.

In addition to the loss of forage and range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. These impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TAR SAND TRIANGLE STSA

This STSA is located in the Canyonland area of eastern Wayne and Garfield counties. Only the general magnitude (regional assessment) of potential impacts were analyzed in this EIS. It is estimated that 60,000 barrels/day of bitumen would be extracted by in-situ development and 10,000 barrels/day of bitumen would be produced by surface mining. For a more detailed analysis of impacts from the proposed Santa Fe-Altex Project refer to the *Unit Plan of Operations for the Tar Sand Triangle Combined Hydrocarbon Lease Conversion Draft EIS* (USDI, NPS, 1983).

Air Quality

The assumed scenario for development for this STSA includes: (1) a 30,000 barrels/day in-situ steam injection plant with an upgrading facility; (2) another 30,000 barrels/day in-situ steam injection plant with an upgrading facility; and (3) a 10,000 barrels/day solvent extraction plant and associated surface mine.

Annual pollutant emissions would be estimated:

TSP:	12,881 tons
SO _x :	17,771 tons
NO _x :	24,389 tons
CO:	2,555 tons
VOC:	694 tons

Table 4-2 compares the estimated increased concentrations to PSD incremental limitations. Concentration estimates would exceed the 3-hour, 24-hour, and annual average Class II SO₂ incremental limitations. The 3-hour, 24-hour, and annual average concentration estimates would also exceed the Class I SO₂ increments at Canyonlands National Park. The 24-hour and annual average TSP estimates are in excess of the Class II incremental limitations. Class I TSP impacts are not predicted to exceed the incremental limitations. Estimated TSP impacts to Glen Canyon NRA would exceed the Class II 24-hour and annual increments.

Because the level-1 visibility analysis showed a potential of visibility impairment at Canyonlands National Park, a level-2 analysis was performed. The level-2 results suggest that a yellow-brown atmospheric discoloration caused by NO_x would be visible at Canyonlands National Park. Discoloration could be expected if the blue-red ratio (see Glossary) is below 0.90. The blue-red ratio at Canyonlands National Park would be an estimated 0.87. However, the level-2 analysis did not predict a significant reduction in visual range at Canyonlands National Park (AeroComp, Inc., 1983a). The Clean Air Act requires protection of Class I areas from adverse impacts to air quality related values (including visibility).

Water Resources

An estimated water requirement of 11,079 acre-feet/year (Tables 4-4 and 4-5) could be supplied *directly* from the Green, Colorado, or Dirty Devil rivers. Some water could be obtained from bedrock aquifers in the lower Dirty Devil River basin in and near the STSA. Withdrawal of large

amounts of water from wells, however, could result in the lessening of streamflow in the lower Dirty Devil River and also in reduction of some spring flow. Surface disturbance on approximately 3,400 acres by construction, mining, and other tar-sand related activities would impact streams by increasing erosion and sediment load. Other water quality effects would be caused by accidental release of process or leachate waters into nearby water sources or the failure of holding ponds to retain wastes (USDI, GS, 1983).

Soils

Surface disturbance from construction of roads, tar sand facilities, and the removal of overburden on an estimated 3,400 acres (see Table 4-6) would increase erosion and sediment yield. The soil profile would be altered and the physical and chemical composition of the soil changed. Approximately 1 percent of the STSA is in a very high sediment yield class, 80 percent in high, 18 percent in moderate, and 1 percent in low (see Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

The areas most feasible for surface mining occur in the Glen Canyon NRA (located in the eastern part of the STSA along the Orange Cliffs and in the Elaterite Basin). Surface mining is not, however, projected in this area because of stipulations limiting surface disturbance in the NRA. Topography would be altered on about 600 acres by surface mining possible in the Hatch Canyon or Cove Canyon areas. The excavations would require about 200 acres; roads, facilities, and waste disposal areas would require about 400 acres. Generally, tar sand is too deep or topography is too rugged for surface mining elsewhere in the STSA. After reclamation of surface-mined areas, the topography would be rounded and would contrast with the adjacent existing ledge-and-slope topography. The backfill in the excavated areas would be more homogeneous and porous than the existing rocks. The waste sand disposal would fill canyons or form flat-topped mesas on level areas.

Topography would not be significantly altered by recovery of tar sand by in-situ methods. Major landscape features would remain unchanged, although on about 2,800 acres, slopes would be changed by cuts and fills associated with the construction of roads, drill pads, and facilities. Large cuts and fills could occur on areas with steep slopes. Subsidence is very unlikely, but a few feet could occur where bitumen was extracted with in-situ methods.

Tar Sand

Bitumen-impregnated rock underlying about 600 acres would be removed completely by surface mining. About 30 percent of the bitumen would be removed from about 7,000 acres by in-situ methods. The remaining bitumen in the developed deposit would never be recovered. If in-situ combustion methods were used, part of the otherwise unrecoverable bitumen would be burned during recovery.

ALT. 1: HIGH COMMERCIAL PRODUCTION

Other Minerals

Oil and gas resources underlying the tar sand would not be impaired by tar sand extraction. In nearby areas, uranium deposits occur in the Chinle Formation. In some places within the STSA, the Chinle overlies the White Rim Sandstone (which is the host rock for the bitumen impregnations), and any uranium deposits in the Chinle would be destroyed if the Chinle were removed during surface mining.

Vegetation

About 3,400 acres in the Canyonlands floristic section would be stripped of vegetation. The major vegetation types on this STSA are blackbrush, galleta-three awn shrub-steppe, grassland, pinyon-juniper, and salt shrub. The most important vegetation types are those that produce the most livestock forage and provide the highest quality desert bighorn sheep habitat. The best livestock forage in this STSA is provided by grassland, and the highest quality desert bighorn sheep habitat is probably provided by the blackbrush vegetation type. The location(s) of the 3,400 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 3,400 acres of vegetation of the highest value to livestock and bighorn sheep would be lost to tar sand development. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and chemical residues from tar sand recovery processes, there is a risk of permanently modifying range site potentials of the mined area.

Threatened and Endangered Plant Species

There are no threatened or endangered plant species known to occur within this STSA.

Animal Life

Terrestrial Wildlife

It is estimated that 3,400 acres, representing about 4 percent of the total desert bighorn sheep range in the STSA, could be subject to surface disturbance from tar sand development. Because these animals are extremely sensitive to human encroachment (Gallizioli, 1977), this level of development could reduce or eliminate existing populations and retard the success of the bighorn sheep reproduction programs.

In addition, this STSA contains two golden eagle nests, and 1,590 and 3,400 acres of nesting and foraging habitat, respectively. This represents 4 percent of the total yearlong raptor habitat in the STSA, which could be subject to surface disturbance from tar sand development. Such a development level could cause the eagles to abandon their nest sites and reduce existing raptor populations. Any tar sand development that destroyed unique or limited wildlife habitats such as riparian habitats could eliminate or reduce the various wildlife populations dependent on these areas.

Aquatic Species

Estimated water requirements are 11,079 acre-feet per year. Degradation of catfish habitat could occur from

reduced flows, possible leaching, and contamination of drainages in the Colorado River and at the mouth of the Dirty Devil River. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse range identified on this STSA. A small portion of the burro range located in the north end of the STSA is not crucial to the burro herd.

Recreation and Wilderness

There would be significant degradation of high quality recreational and scenic resources on both BLM and Glen Canyon NRA lands. Development of water requirements could impact the Dirty Devil and/or Green rivers, both of which are Nationwide Rivers Inventory listed segments. Population increases and improved access would increase motorized recreational uses, especially during the construction phase, and would impact primitive recreational values and uses. Attractions such as the Orange Cliffs and Canyons of the Dirty Devil River could also be significantly degraded.

Development of tar sand resources in the Tar Sand Triangle STSA could degrade wilderness values in five areas: Horseshoe Canyon, Fiddler Butte and French Spring/Happy Canyon BLM WSAs, and NPS-proposed wilderness in Glen Canyon NRA and Canyonlands National Park. Visual intrusions, odors, and sounds created by development could degrade solitude in these areas.

Visual Resources

In-situ and surface-mining development of tar sand resources in this STSA would permanently degrade exceptional scenic values. The steep, rugged nature of the majority of the terrain would prohibit successful rehabilitation of visual values. Permanent contrasts would be created and would degrade the prime recreational attraction of the area. Some impacts from in-situ developments could be successfully rehabilitated; however, it would not be feasible to reclaim areas of cuts and fills on steep slopes or surface-mined areas.

Livestock Grazing

Portions of two cattle allotments and two unallotted areas fall within the boundaries of this STSA. Estimated forage production by allotment and in total for the STSA is shown in Table 3-17. The location(s) of the 3,400 acres of tar sand development within the STSA is unknown. Under a worst-case analysis, it is assumed that all tar sand recovery would take place on the cattle allotments. To estimate the amount of forage lost, forage production within the STSA on Robbers Roost and Sewing Machine Allotments has been averaged as follows: Robbers Roost, 22,000 acres; and Sewing Machine, 66,000 acres. This would total 88,000 acres within the STSA, divided by total estimated forage production within the STSA: 88,000 acres divided 1,530 AUMs equals 58 acres/AUM. Based on this estimation, about 59

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

AUMs would be lost to tar sand development annually. This is equivalent to 24 tons of hay.

In addition to the loss of forage, range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. These impacts would include

loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

ALT. 2: LOW COMMERCIAL PRODUCTION

ALTERNATIVE 2: LOW COMMERCIAL PRODUCTION

Regional Overview

Regional impacts from tar sand development of six STSAs at a low commercial production are presented in this section. STSAs not considered for production in this alternative are not discussed. Tar sand development would occur on the Asphalt Ridge/White Rocks, Circle Cliffs, P. R. Spring, San Rafael Swell, Sunnyside, and Tar Sand Triangle STSAs (see Table 2-3).

AIR QUALITY

This section presents the results of the air quality analyses for each STSA for Alternative 2. Table 4-14 summarizes impacts expected from this alternative. Tables 4-15 and 4-16 compare the estimated impacts with the PDS incremental limitations and the NAAQS.

Total Suspended Particulates

Particulate matter is any liquid or solid particles suspended in or falling through the atmosphere. Particulate matter below 2 to 3 microns in diameter has an especially long residence time in the atmosphere and penetrates deeply into the lungs. To the particulate matter introduced into the atmosphere as a result of natural events (e.g., pollen, volcanic eruptions), man annually adds millions of tons.

Estimated annual TSP concentrations are shown in Figure 4-1. A background concentration of 20 $\mu\text{g}/\text{m}^3$ should be added to the values. It is estimated that the annual NAAQS would be exceeded in three areas. Annual Class II TSP increments would not be exceeded.

Small TSP concentrations are expected from point sources. TSP concentrations from fugitive sources are expected to exceed the 24-hour NAAQS and PSD Class II incremental limitations in several areas, as discussed in the Specific Analysis section for each STSA.

Sulfur Dioxide

SO_2 pollutants originate from the combustion of sulfur containing fossil fuels and yield a pungent toxic gas at concentrations above the 3-hour secondary NAAQS. When inhaled, SO_2 in concentrations of only a few ppm irritate respiratory passages and can contribute to asthma, emphysema, and bronchitis. When SO_2 combines with water in plant leaves, it destroys leaf cells. Alfalfa is particularly susceptible. Average annual concentrations as low as 0.03 ppm may have long-term effects upon some vegetation. Additionally, SO_2 combines with atmospheric water vapor to produce a mist of sulfuric acid droplets, both a corrosive and a visibility-restricting mixture.

No NAAQS violations of SO_2 are expected to occur, nor are annual PSD limitations expected to be exceeded,

except the Class I limitation at Canyonlands National Park. A 24-hour concentration for one period of poor dispersion exceeded the PSD Standard. This period of poor dispersion resulted from emissions in the Tar Sand Triangle STSA. A 24-hour concentration for one poor dispersion period was modeled and is intended to show long-range transport levels associated with a typical poor dispersion condition. This example was not intended to show near source maximum concentrations. No short-term NAAQS or PSD Class II violations are expected to occur. However, the 24-hour PSD Class I standard could be exceeded at Canyonlands National Park because of emissions from the Tar Sand Triangle STSA.

Nitrogen Dioxide

NO is the product of the combination of atmospheric oxygen and nitrogen at high temperatures. Reaction of NO with oxygen yields the more toxic NO_2 . Like carbon monoxide, this pollutant reduces the blood's oxygen-carrying capacity. Because NO_2 is brown in color, it affects visibility. When combined with water vapor, it forms nitric acid, a highly corrosive substance. Some areas of elevated NO_2 concentrations are expected in the STSA, but no NAAQS violations would occur.

Ozone

Ozone is a colorless to bluish gas produced by the reaction of sunlight with hydrocarbons and oxides of nitrogen. This pollutant irritates the deeper regions of the lung, and exposures lower resistance to pathogens and can lead to pulmonary edema. VOC are the hydrocarbon emissions that react in the presence of sunlight to produce ozone.

Because estimated ozone concentrations were estimated to be below the NAAQS for Alternative 1 (High Commercial Production), no photochemical oxidant impacts are expected from Alternative 2.

Carbon Monoxide

CO is a colorless, odorless toxic gas that competes with oxygen for bonding sites on the hemoglobin molecule in the blood. Automobile exhaust is a major source of CO . In concentrations of 300 to 400 ppm, vision impairment, nausea, and abdominal pain may result; 1,000 ppm is fatal. CO concentrations were predicted to be well below NAAQS for all areas in the affected region (Aerocomp, Inc., 1983)

Acid Rain

As a result of large-scale combustion of fossil fuels (e.g., coal and oil) sulfur and nitrogen oxides are discharged into the atmosphere. A series of complex chemical reactions with these pollutants can convert into acid precipitation. The process by which these acids are deposited through rain or snow is called wet deposition. However, another atmospheric process known as dry deposition may also occur. Dry deposition is the process by which particles such as fly ash or gasses (e.g., sulfur and nitrogen oxides) are deposited or absorbed on surfaces. While these particles or gasses are normally not in the acidic state prior to deposi-

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-14

Alternative 2
Summary of Air Quality Impacts Within STSAs

STSA	PSD Incremental Limitations Exceeded?						NAAQS Exceeded?		Significant Visibility Impacts?
	Class II		Class I		TSP	SO ₂	NO _x		
	TSP	SO ₂	TSP	SO ₂					
Asphalt Ridge/ Willow Creek	yes	no	no	no	yes	no	no	no	
Circle Cliffs	no	no	no	no	no	no	no	no	
P. R. Spring	yes	no	no	no	yes	no	no	no	
San Rafael Swell	no	no	no	no	no	no	no	no	
Sunnyside	yes	no	no	no	yes	no	no	no	
Tar Sand Triangle	yes	no	no	yes ^a	no	no	no	no	

Source: Aerocomp, Inc., 1983a.

^aAt Canyonlands National Park.

ALT. 2--LOW COMMERCIAL PRODUCTION

TABLE 4-15

Alternative 2
Comparison of Maximum Increased Pollutant Concentrations
With PSD Incremental Limitations

STSA	PSD Increment/ Increment Consumption	SO ₂ Concentration (µg/m ³)			TSP Concentration (µg/m ³)	
		3-Hour Average	24-Hour Average	Annual Average	24-Hour Average	Annual Average
Asphalt Ridge/ White Rocks	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	72	20	10	51	11
	Cumulative Increment Consumption ^b	72	20	10	51	11
	Increment Consumption at Uintah and Ouray Indian Reservation	15	4	<1	51	11
Circle Cliffs	Allowable Class I Increment	25	5	2	10	5
	Increment Consumption ^a	14	4	1	<1	<1
	Cumulative Increment Consumption ^b	14	4	1	<1	<1
	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	115	32	5	12	3
	Cumulative Increment Consumption ^b	115	32	5	12	3
P. R. Spring	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	140	39	2	104	27
	Cumulative Increment Consumption ^b	241	67	3	105	27
	Increment Consumption at Colorado State Line	14	4	1	<1	<1
	Increment Consumption at Uintah and Ouray Indian Reservation	30	8	1	<1	<1
	San Rafael Swell	Allowable Class II Increment	512	91	20	37
Increment Consumption ^a	14	4	4	2	<1	
Cumulative Increment Consumption ^b	90	25	5	12	1	

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-15 (concluded)

STSA	PSD Increment/ Increment Consumption	SO ₂ Concentration (µg/m ³)			TSP Concentration (µg/m ³)	
		3-Hour Average	24-Hour Average	Annual Average	24-Hour Average	Annual Average
Sunnyside	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	79	22	4	145	36
	Cumulative Increment Consumption ^b	79	22	4	145	36
	Increment Consumption at Uintah and Ouray Indian Reservation	4	1	<1	1	<1
Tar Sand Triangle	Allowable Class I Increment	25	5	2	10	5
	Increment Consumption ^a at Canyonlands National Park	22	6	3	1	4
	Allowable Class II Increment	512	91	20	37	19
	Increment Consumption ^a	209	58	12	38	9
	Cumulative Increment Consumption ^b	209	58	12	38	9
	Increment Consumption at Glen Canyon NRA	115	32	9	38	9
Increment Consumption at Dark Canyon Primitive Area	126	35	6	6	1	

Source: Aerocomp, Inc., 1983a.

^aIncludes direct and secondary sources.

^bAlso includes interrelated projects.

ALT. 2: LOW COMMERCIAL PRODUCTION

TABLE 4-16

Alternative 2
Comparison of Maximum Increased Pollutant Concentrations
With NAAQS

STSA	Pollutant Average Time	Baseline Sources	Project Sources		Maximum Concen- tration	Cumulative		NAAQS
			Secondary ^a	Direct ^b		Maximum Concen- tration	Maximum Concen- tration	
Asphalt Ridge/ White Rocks								
	SO ₂							
	3-hour	18	0	72	90	90		1,300
	24-hour	7	0	20	27	27		365
	Annual	1	0	10	11	11		80
	TSP							
	24-hour	154	1	50	205	205		150
	Annual	42	0	11	53	53		60
	NO ₂							
	Annual	13	0	36	49	50		100
Circle Cliffs								
	SO ₂							
	3-hour	18	0	115	133	133		1,300
	24-hour	7	0	32	39	39		365
	Annual	1	0	5	6	6		80
	TSP							
	24-hour	62	0	12	74	74		150
	Annual	19	0	3	22	22		60
	NO ₂							
	Annual	13	0	2	15	15		100
P. R. Spring								
	SO ₂							
	3-hour	18	0	140	148	259		1,300
	24-hour	7	0	39	46	74		365
	Annual	1	0	2	3	4		80
	TSP							
	24-hour	69	2	102	173	174		150
	Annual	21	1	26	48	48		60
	NO ₂							
	Annual	2	0	9	11	12		100
San Rafael Swell								
	SO ₂							
	3-hour	18	0	14	32	108		1,300
	24-hour	7	0	4	11	32		365
	Annual	1	0	<1	1	6		80
	TSP							
	24-hour	62	0	2	64	74		150
	Annual	19	0	<1	19	20		60
	NO ₂							
	Annual	13	0	<1	13	28		100

CHAP 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-16 (concluded)

STSA	Pollutant Average Time	Baseline Sources	Project Sources		Maximum Concen- tration	Cumulative		
			Secondary ^a	Direct ^b		Maximum Concen- tration	NAAQS	
Sunnyside								
	SO ₂							
	3-hour	18	0	79	97	97	1,300	
	24-hour	7	0	22	29	29	365	
	Annual	1	0	4	5	5	80	
	TSP							
	24-hour	84	3	142	229	229	150	
	Annual	24	1	35	60	60	60	
	NO ₂							
	Annual	2	0	23	25	25	100	
Tar Sand Triangle								
	SO ₂							
	3-hour	18	0	209	227	227	1,300	
	24-hour	7	0	58	65	65	365	
	Annual	1	0	12	13	13	80	
	TSP							
	24-hour	62	0	38	100	100	150	
	Annual	19	0	9	28	28	60	
	NO ₂							
	Annual	13	0	11	24	24	100	

Source: Aerocomp, Inc., 1983a.

Note: Includes interrelated projects.

^aSecondary = Emissions resulting from population growth.

^bDirect = Emissions from the named tar sand facility.

ALT. 2: LOW COMMERCIAL PRODUCTION

tion, it is believed that they are converted into acids after contacting water in the form of rain, dew, fog, or mist following deposition. The processes by which dry deposition occurs and its effects on soils, forests, crops, and buildings are not adequately understood.

Known effects of wet and dry deposition include: (1) acidification of ground and surface waters, resulting in damage to aquatic ecosystems; (2) acidification, and release of metals from soils; (3) possible reductions in forest productivity; (4) possible damage to agricultural crops; (5) deterioration of manmade materials such as buildings, metal structures, and paint; and (6) possible contamination of culinary water supplies (EPA, 1979).

Acid deposition estimates for the affected region are presented below:

Pollutant	Annual Deposition Flux (g/m ² /yr)		
	Wet	Dry	Total
Sulfur oxide	0.2	0.1	0.3
Nitrogen oxide	1.5	0.3	1.8

Source: Aerocomp, Inc., 1983a.

The acidic sulfur deposition is within the "safe" threshold value of 0.5 g/m²/yr suggested by the Environmental Defense Fund (Oppenheimer, 1982). A similar "safe" threshold value for nitrogen deposition has not been established.

WATER RESOURCES

Tar sand development would occur on six STSAs (see Table 4-17), and surface disturbance from construction and mining would increase erosion and sediment yield on up to 13,950 acres.

Based on Table 4-17, depletions would begin in 1990 and reach a maximum of 17,000 acre-feet per year by the year 2000. The annual increase of 17,000 acre-feet of water for this alternative would not cause a measureable change in salinity at Imperial Dam, nor would this amount of water significantly impact the Colorado River system (Konwinski, 1983). *Wells used in the Asphalt Ridge/White Rocks STSA would produce 4,521 acre-feet of water.*

Implementation of this alternative would increase consumptive water use, increased sedimentation and salinity of streams, lower water quality from mining wastes and accidental spills, and would require a reallocation of water rights. *These reallocations could include changes in water use.*

SOILS

Surface disturbance and vegetation removal on up to 13,950 acres would leave the soil susceptible to increased erosion and sediment yield. Estimated acreages of surface disturbance are shown in Table 4-18.

TOPOGRAPHY, TAR SAND, AND OTHER MINERALS

Topography

The topography of three of the STSAs would be modified significantly by surface mining. These STSAs are Argyle Ridge/White Rocks, P. R. Spring, and Sunnyside. The calculation for estimated acres disturbed by tar sand development in STSAs are presented below.

Surface Mining

The estimated acreages disturbed by surface mining were calculated by multiplying the area from which bitumen would be mined by three. The number three is a ratio of the area mined to the area disturbed. This ratio was determined by averaging acreages, as described in three plans of operations (Hubbard, 1983). These calculated disturbed acreages are a general estimate and not a precise calculation (Hubbard, 1983).

In-Situ Extraction

The estimated acreages disturbed by in-situ extraction were calculated by multiplying the area from which bitumen would be extracted by 0.4. The number 0.4 is a ratio of the area from which the bitumen would be extracted to the area disturbed by drill pads, roads, and other ancillary facilities. This ratio was also determined by averaging acreages as described in three plans of operations. These calculated disturbed acreages are a general estimate and not a precise calculation (Hubbard, 1983). Surface mining would destroy the topography of about 4,200 acres, and the topography of an additional 8,400 acres would be impacted by the disposal of overburden and waste sand from processing plants and the construction of roads and other facilities (see Table 4-18).

The greatest impacts would occur at Sunnyside STSA, where nearly half of the production would occur because rich bitumen impregnations are thicker than at other STSAs. Ridgetops would be removed and some valley heads would be filled and covered by overburden from surface mining and waste sand from processing plants. Generally, the reclaimed topography would be more rounded than that prior to development. Some reclaimed areas might be nearly flat-topped.

About 5,000 acres within five STSAs would be developed by in-situ methods (see Table 4-18). No major changes to landforms would occur; however, the topography of about 2,000 acres would be modified by roads, drill pads, and facilities. Related subsidence would be unlikely and, even if it did occur, displacements of the land surface would be no more than a few feet.

Tar Sand

The tar sand projected to be produced through 2005 is shown in Table 4-18. About 90 percent of the tar sand would be removed from 4,200 acres that would be surface mined to recover 28,000 barrels/day of bitumen.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-17

Alternative 2
Water Sources and Estimated Depletions

Water Source	Measuring Point	STSA	Depletion Schedule				
			1985	1990	1995	2000	2005
White River	White River at the Green River	P R Spring	0	2,750	5,250	5,250	5,250
		Total ^a	0	3,000	5,000	5,000	5,000
Price River	Green River at Green River, Utah	Sunnyside	0	4,112	6,878	8,842	8,842
		Total	0	4,000	7,000	9,000	9,000
Green River	Green River at Green River, Utah	Sunnyside	0	0	0	0	0
		Total	0	0	0	0	0
Escalante		Circle Cliffs	0	0	460	460	460
		Total ^b	0	0	F1,000	F1,000	F1,000
White Rocks River	Duchesne River at the Green River	Asphalt Ridge ^c	0	0	0	0	0
		Total	0	0	0	0	0
Dirty Devil River ^d	Inflow to Lake Powell	Tar Sand Triangle	0	0	600	2,900	2,900
		Total	0	0	1,000	3,000	3,000
San Rafael	San Rafael River at Green River, Utah	San Rafael Swell	0	0	230	230	230
		Total ^b	0	0	F1,000	F1,000	F1,000
Grand Total			0	7,000	13,000	17,000	17,000

Source: Konwinski, 1983.

^aTotals for nodes have been rounded to the nearest 1,000 acre-feet/year. Actual water requirements are shown above.

^bWhere depletions are less than 1,000 acre-feet/yr, they are considered insignificant.

^cWater would come from wells.

^dA node exists for the Dirty Devil River; however, water depletions are shown as coming from its tributary stream, the Green River.

ALT. 2: LOW COMMERCIAL PRODUCTION

TABLE 4-18
Alternative 2
Estimated Bitumen Production and Acres Developed and Disturbed

STSA	Type of Production	Projected Production (Barrels/day)	Cumulative Production for 20-Year Period (Millions of barrels)	Estimated Average Net Thickness of Produced Tar Sand (feet)	Acres Developed Through 2005		Acres Disturbed			
					Surface	In-situ	Surface	In-situ	Total	
Asphalt Ridge/White Rocks	Surface	5,000	34	60	600	--	600	1,800	--	1,800
Circle Cliffs	In-situ	2,000	9	40	--	700	700	--	300	300
P. R. Spring	Surface In-situ	20,000 5,000	98 27	45	2,200	1,900	4,100	6,300	700	7,000
San Rafael Swell	In-situ	1,000	5	20	--	100	100	--	50	50
Sunnyside	Surface In-situ	28,000 2,000	134 10	100	1,400 --	300	1,700	3,900	100	4,000
Tar Sand Triangle	In-situ	20,000	67	100	--	2,000	2,000	--	800	800
Total		83,000	384		4,200	5,000	9,200	12,600	1,950	13,950

Source: Hubbard, 1983; and USDI, BLM, 1982a.

Note: All numbers are rounded and, consequently, some columns may not total.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

On about 5,000 acres, bitumen would be removed by in-situ methods, and 30 percent (2,000 barrels/day) of the in-place bitumen would be recovered. In these areas, bitumen remaining in the developed deposit could not be recovered with existing technology. If in-situ combustion recovery methods were used, part of the bitumen that otherwise would be left would be burned to liquify the recovered bitumen. Tar sand outside of the developed areas could be recovered later.

Other Minerals

All of the STSAs are prospectively valuable for oil and gas. P. R. Spring has good potential for oil and gas. Locally, in the San Rafael Swell and Tar Sand Triangle STSAs, uranium occurs in the Chinle Formation and Shinarump Conglomerate, which overlie the rock containing bitumen. A uranium deposit which overlies surface-mined tar sand could be lost; however, but the overburden is so thick in most of these STSAs that surface mining is unlikely.

Coal that may underlie Asphalt Ridge/White Rocks, Sunnyside, and P. R. Spring STSAs would not be affected by the extraction of tar sand. The oil shales of commercial potential at P. R. Spring STSA would not be affected by in-situ mining, except for possible thermal effects related to in-situ combustion. These effects would have to be evaluated on a site-specific basis to determine impacts. Oil shale overlying tar sand would be destroyed by surface mining unless the oil shale were stockpiled; however, surface mining is unlikely in such places because the overburden is thick.

VEGETATION

Tar sand recovery would require the removal of vegetation from an estimated 13,950 acres. This figure was derived by adding the acreage disturbed, based on production estimates for each STSA (see Table 4-18). On a statewide basis, impacts to vegetation diversity, productivity, etc., within the Canyonlands and Uinta Basin floristic sections would be unimportant. On a local basis, impacts to riparian, aspen, spruce-fir, and mountain-brush communities on Sunnyside, P. R. Spring, and on the White Rocks portion of Asphalt Ridge/White Rocks STSAs would be the most important vegetation losses. This is because these vegetation types are of high value and are important elk and deer summer and winter ranges. The major impacts to vegetation would result from surface mining or in-situ processes.

Impacts to vegetation would also result from surface clearance resulting from road construction; installation of facilities, pipelines, construction of check dams; and overburden stockpiling.

The surface-mining process would require stripping of vegetation and removal of topsoil and overburden from the area to be mined. The topsoil and overburden would then be stockpiled. The overburden would subsequently be used to refill or backfill the mined area, and the topsoil would be placed over the recontoured overburden. This process would mix different soil horizons and rock strata and

change density, aeration, and moisture-retention capacities of the topsoil's natural plant growth medium.

The in-situ mining process would require stripping of vegetation and removal of topsoils, along with some subsurface soils and rock strata from areas that would be leveled for drill pads and injection equipment, etc. The subsurface soils and rock material would subsequently be used to recontour the surface, and the topsoils would be placed over the recontoured surface. As with surface mining, this process would cause the mixing of different soil horizons and rock strata and would result in changes in density, aeration, and moisture retention qualities of the topsoil's natural plant growth medium.

After the topsoil was respread, the process of revegetating the mined areas would begin. Revegetation potentials or seeding suitability of the STSAs would vary according to climate, pH, fertility, texture, depth, permeability, presence of toxic materials, and water retention capacities of the mine spoils. The chemistry of the spoils (and re-spread topsoil) within and between STSAs would vary. However, alkaline spoils and spoils deficient in nitrogen and phosphorus are common to Western mining areas (USDA, FS, 1979). Strongly alkaline mine spoils are difficult to successfully revegetate. The resulting post-mining soil chemistry would be critical to successful reclamation of mined areas (USDA, FS, 1979).

In the vast majority of cases, topsoil provides the most suitable growing medium for plants because it has the fertility and physical conditions needed for plant growth. In addition, more plant species are adapted to topsoils than to subsurface material (USDA, FS, 1979). Even if topsoil provided an excellent growing medium before mining, it might not be adequate as a growing medium for postmining use by native species because of changes in soil characteristics.

Studies of revegetated mine spoils have shown that seeding mixtures consisting of all introduced species were more effective than native or combination mixtures in providing rapid cover and plant growth. The introduced mixture also produced greater numbers of plants and higher amounts of biomass. Relative to adjacent native communities, revegetated sites were shown to reach higher levels of productivity within 2 years of seeding under certain combinations of treatments (Koeler and Redente, 1980). Vegetation would become established on most reclaimed mine spoils, even in arid and semi-arid areas, within 2-5 years (USDA, FS, 1979). However, original or premining levels of native plant diversity would not be reached until further successional processes altered the revegetated site (Koeler and Redente, 1980). Invasion of weeds into revegetated areas could also occur. Weeds would present a fire hazard, especially along roads, would be aesthetically displeasing and noxious, or would provide too much competition with desired plants (USDA, FS, 1979); this could delay the successful revegetation of mined areas.

In addition to changes in natural plant species, composition, cover, and perhaps long-term modification in range site potential, the useability of the site for livestock and big

ALT. 2: LOW COMMERCIAL PRODUCTION

game might be reduced or lost. For example, reclaimed areas could be more sensitive than adjacent native rangeland, and special standards might have to govern their rehabilitation. Reseeded areas sometimes attract animals such as livestock and big game in numbers sufficient to damage the stand. Therefore, reseeded areas might have to be fenced or seeded with less palatable plant species. Also, water might have to be provided away from the seeded area or nearby water fenced (USDA, FS, 1979).

Based on this analysis, it can be assumed that, because of (1) mixing of soil horizons and rock material; (2) structural and chemical changes in the plant growth medium; and (3) introduction of weeds, there is a risk of modifying range site potential. Although vegetation composed mostly of introduced species would become established within 2-5 years, the useability of reclaimed sites for big game and livestock might be reduced or lost.

A major impact to vegetation, as a resource, would be the long-term replacement of native vegetation with vegetation not of the same diversity, seasonal variety, cover, or composition as the native stand.

On a local basis, impacts to riparian, aspen, spruce-fir, and mountain brush communities on Sunnyside and P.R. Spring STSAs would be the most important vegetation losses. These vegetation types are of high value and importance to big game on the Tavaputs Plateau/Book Cliffs area.

Threatened and Endangered Plant Species

The Federally listed endangered plant species Wright's fishhook cactus (*Sclerocactus wrightiae*) occurs on the San Rafael Swell STSA. Under a worst-case analysis, it is assumed that some individuals, populations, and/or habitat of this species could be lost to tar sand development. No Federally listed threatened plant species are known to occur on any of the STSAs in this alternative.

ANIMAL LIFE

Tar sand development could impact wildlife populations directly (i.e., loss of habitat) and indirectly (i.e., human activity such as increased hunting pressure, harassment, poaching, *wanton killing*, and ORV use). *It is important to note, however, that depending on the extent of development indirect impacts to wildlife populations or habitats could equal or exceed direct impacts in some cases (Thomas, 1983).*

Terrestrial Animals

Big Game

Mule Deer. Approximately 7,300 and 5,500 acres of crucial deer *winter and summer* ranges could be destroyed by surface-disturbing activities associated with tar sand development (see Table 4-19). Because summer range is considered a limiting factor, deer populations on herd units 27B and 28A could decline by 85 and 75 animals, respectively. This represents a reduction of approximately 1 percent for

these herd units. *In addition, because winter range is considered a limiting factor, deer populations on herd units 22 and 26 could decline by 31 and 27 animals, respectively. This represents less than a 1-percent reduction in herd size for these units.*

Elk. Approximately 7,300 and 5,500 acres of crucial elk *winter and summer* ranges could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-19). Because elk use summer range for calving, tar sand development on this range could prevent or retard the reestablishment of elk on the Range Creek herd unit (Sunnyside STSA). It is expected that the loss of summer range could also cause a decline of approximately 39 animals in the elk population on the Book Cliffs herd unit. This represents about a 4-percent reduction in herd size. However, impacts to these populations would be less than Alternative 1. Because *winter range is a limiting factor on the Asphalt Ridge/White Rocks STSA, elk populations on herd unit 9A could decline by 267 animals. This represents a reduction of approximately 31 percent for this herd unit.*

Antelope. Because of the large amount of substantial value range and the few number of animals, no impacts to pronghorn antelope are expected to occur from surface-disturbance activities.

Desert Bighorn Sheep. Approximately 1,150 acres, representing about 1 percent of the substantial value desert bighorn sheep range within the Circle Cliffs, San Rafael Swell, and Tar Sand Triangle STSAs, could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-19). Because this species is extremely sensitive to human encroachment (Gallizioli, 1977), loss of this habitat (especially lambing and rutting grounds and water sources) could reduce existing bighorn sheep populations as well as prevent or retard the success of planned reintroduction programs on these developed areas. However, impacts would be considerably less than Alternative 1.

Small Game

Approximately 11,000 acres, representing approximately 6 percent of the existing black bear and mountain lion habitat within the STSAs, could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-19). Because these species are extremely sensitive to human encroachment, existing populations could be either eliminated or reduced on the areas developed. Because of a lack of census data, these reductions cannot be quantified. However, impacts would be less than Alternative 1.

Upland Game

Three known sage grouse strutting grounds and 3,800 acres of nesting habitat could be destroyed from surface-disturbing activities associated with tar sand development (see Table 4-19). This level of development could reduce sage grouse populations within STSAs. However, because of a lack of census data, the number of sage grouse lost cannot be quantified. (A comprehensive inventory of the

CHAP 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-19

Alternative 2
Summary of Impacts to Wildlife

STSA	Deer Range (Acres)	Elk Range (Acres)	Bighorn Sheep Range (Acres)	Sage Grouse Habitat (Acres)	Small Game Habitat (Acres)	Golden Eagle Nest Sites (No. and Acres)	Yearlong Raptor Habitat (Acres)
Asphalt Ridge/ White Rocks	1,800(W)	1,800(W)		1(SG) 1,800(N)			1,800
Circle Cliffs			300				300
P. R. Spring	3,500(S) 3,500(W)	3,500(S) 3,500(W)			7,000		7,000
San Rafael Swell			50				50
Sunnyside	2,000(S) 2,000(W)	2,000(S) 2,000(W)		2(SG) 2,000(N)	4,000	1(N) 795	4,000
Tar Sand Triangle			800			1(N) 800	800
Totals	5,500(S) 7,300(W)	5,500(S) 7,300(W)	1,150	3(SG) 3,800(N)	11,000	2(N) 1,595	13,450

Source: USDI, BLM, 1983e.

Abbreviations: S = Summer Range; W = Winter Range; SG = Sage Grouse
Strutting Ground; N = Nest Site or Habitat; YL = Yearlong
Habitat.

ALT. 2: LOW COMMERCIAL PRODUCTION

area has not been conducted, and it is possible that other unidentified sage grouse strutting grounds could be impacted.)

Unique and Limited High-Value Wildlife Habitats

Tar sand development could destroy unique and limited wildlife habitats such as aspen communities, riparian habitats, mule deer fawning and elk calving grounds, desert bighorn sheep lambing and rutting grounds, and mule deer/elk migration corridors. Destruction of these habitats could either eliminate or reduce the various wildlife populations dependent on these habitats.

Approximately 13,450 acres, representing approximately 2 percent of the yearlong raptor habitat within the STSAs, could be destroyed from surface-disturbing activities associated with tar sand development. Distribution of these acres is shown in Table 4-19. Raptors dependent on this habitat could either be reduced or eliminated. Because of a lack of census data, the number of raptors lost cannot be quantified; however, impacts to raptors would be considerably less than under Alternative 1.

Threatened and Endangered Animal Species

Because there are no officially designated critical habitats or known concentration use areas or nest sites on any of the STSAs, no significant impacts to the northern bald eagle or peregrine falcon are expected.

Two golden eagle nest sites and 1,595 acres of nesting habitat could be destroyed from surface-disturbing activities associated with tar sand development. (Comprehensive raptor inventories of the area have not been completed, and it is possible that other unidentified golden eagle nests could be impacted.) Impacts to the golden eagle and its nesting habitat would be less than under Alternative 1.

Aquatic Species

A total of 22,203 acre-feet of water per year would be required. The nature of impacts would be similar to Alternative 1; however, the magnitude would be less because of a 75-percent or 66,092 acre-feet reduction per year in water requirements.

Fish habitat would be impacted by altering stream channels, increasing sedimentation, reducing instream flows, and degrading water quality, possibly by leaching and contamination. Habitat components (i.e., temperature, cover, and stabilized streambanks) are provided primarily by the adjacent riparian vegetation. Reducing or destroying riparian vegetation would eliminate or reduce the quality of fisheries, depending on the extent and location of tar sand development; consequently, fish populations would be kept below their biotic potential. These impacts, depending on their magnitude, could result in total elimination of fisheries. Even after reclamation, fisheries might not be restored to their present condition.

Degradation of fish habitat would also result from increased human disturbance (cutting firewood, polluting

streams, and destroying vegetation). These secondary impacts could result in a greater loss of fish than increased fishing pressure.

Threatened and Endangered Species

Because of the reduced water requirement under this alternative, impacts to the White, Green, and Colorado rivers would be less severe than Alternative 1. However, these three rivers provide essential habitat for the Colorado squawfish and humpback chub, and reduced instream flows could adversely affect the populations of these two species. Consequently, any water depletions from these rivers or tributaries to these rivers are of major concern to Federal and State agencies. The nature of impacts would be the same as Alternative 1: in addition to reduction of instream flows, degradation of water quality by possible leaching and contamination could also occur. According to FWS (1982), reductions in peak flows in the Colorado River system have resulted in sediment buildup and water temperature and other chemical changes in the river system.

Impacts to the Green River (i.e., degraded water quality and reduced flows) would adversely affect *Colorado squawfish* and humpback chub habitat in Desolation and Gray canyons. Reductions in flows could significantly alter habitat needed for spawning and rearing, consequently reducing reproductive success (USDI, FWS, 1979).

Wild Horses and Burros

The amount of historic wild horse or burro range occurring outside the boundaries of the Sunnyside, Tar Sand Triangle, and San Rafael Swell STSAs in relationship to the range occurring inside is unknown. Therefore, no accurate estimate of tar sand development impacts to total herd size and productivity can be made.

RECREATION

Recreational values and uses would deteriorate from surface mining and in-situ development of tar sand resources. Sightseeing values would be permanently impaired by changes to the landscape. From the initiation of the project through rehabilitation, camping/picnicking, hiking/backpacking, and hunting opportunities would be lost over most of the affected areas. Some values would recover following rehabilitation. Impacts would be as in Alternative 1, but less area and fewer STSAs would be affected.

WILDERNESS

Potential wilderness areas are identified in Table 4-20. Impacts, however, would be significantly less because of the smaller scale of proposed operation. In-situ and surface mining would cause visual intrusions, odor, sounds, and dust which would impair solitude and primitive recreation values in potential wilderness areas in/near the Circle Cliffs, P. R. Spring, San Rafael Swell, Sunnyside, and Tar Sand Triangle STSAs.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-20

Alternative 2
Potential Wilderness Areas Affected

STSA	Potential Wilderness Area
Circle Cliffs	North Escalante Canyons/The Gulch ISA Capitol Reef National Park (NPS) Glen Canyon (NPS)
P. R. Spring	Winter Ridge WSA Flume Canyon WSA
San Rafael Swell	Sid's Mountain WSA Devil's Canyon WSA Crack Canyon WSA San Rafael Reef WSA Mexican Mountain WSA Link Flats ISA
Sunnyside	Desolation Canyon WSA
Tar Sand Triangle	French Spring/Happy Canyon WSA Fiddler Butte WSA Glen Canyon NRA (NPS) Canyonlands National Park Horseshoe Canyon Detached Unit, Canyonlands National Park

Source: USDI, BLM, 1983e.

^aThe Ute Tribe has passed a resolution which contains provisions calling for restricted access and limited development, much as in wilderness areas, on the Hill Creek Extension portion of the Uintah and Ouray Reservation. This Extension has been established as a Wildlife and Cultural Resource Protection Area.

ALT. 2: LOW COMMERCIAL PRODUCTION

VISUAL RESOURCES

The impacts of in-situ and surface-mining development of tar sands would be as described in Alternative 1. In affected areas, impacts would be analogous; however, under this alternative, only six STSAs would experience production activities, and disturbed areas would be significantly smaller in magnitude. The STSAs involved include those possessing greater visual resource values (e.g., Circle Cliffs, San Rafael Swell, Sunnyside, and Tar Sand Triangle). Some long-term to permanent impairment of scenic quality would result in all affected areas, especially those surface mined. In-situ development in the Circle Cliffs STSA could be successfully mitigated. Surface mining in the Asphalt Ridge/White Rocks STSA would permanently alter the visual environment; however, rehabilitation (requiring several years after the end of production activities) could be successful in most areas (Class IV values would be restored).

CULTURAL RESOURCES

Tar sand development could result in various types of activities which would damage or destroy cultural resources. These include: (1) surface mining; (2) construction of drill pads and support facilities; (3) road access, pipelines, powerlines, etc.; and (4) waste disposal. Secondary impacts could be expected through vandalism and increased human activity. However, inventories required for mitigation purposes would produce new data for scientific use.

Prior to entry upon the land or surface disturbance for mining, drilling, or other purposes, the lessee would be required to submit for approval an APD, exploration plan, or plan of operations containing the methods and actions proposed for cultural resource clearance and protection. This would be in accordance with 36 Code of Federal Regulations (CFR) 800 and BLM Manual 8100. A Memorandum of Understanding between the State Historic Preservation Officer and BLM outlining BLM's responsibility for mitigation appears as Appendix 6 in this EIS.

LIVESTOCK GRAZING

This alternative could modify livestock grazing patterns of use, reduce grazing capacity, and diminish suitability for grazing use on 55 BLM allotments, three FS allotments, and large tracts of Uintah and Ouray Indian Reservation and private lands. Forage production on these allotments is estimated to exceed 38,000 AUMs.

It is estimated that 887 AUMs would be lost directly to surface or in-situ mining of tar sand. This number of AUMs is roughly equivalent to 355 tons of hay. Assuming that 91 percent of this was used by cattle and 9 percent was used by sheep, about 161 cattle and 80 sheep would have to be taken from the affected allotments under this alternative. (Ninety-one percent cattle and 9 percent sheep is the composition of livestock classes on involved allotments under this alternative.)

Acreage required for tar sand development would be a relatively small portion of each STSA. However, both in-situ and surface mining would require increased vehicle access, changes in fencing, alteration of waterways, springs, etc. Each allotment would be affected differently. Under a worst-case analysis, livestock grazing would be discontinued for more than 20 years on many of the affected allotments (see Table 3-17).

Tar sand development under this alternative would probably have no important impact on Utah's beef cattle or sheep industries. However, the elimination or severe reduction in grazing suitability and use of large tracts of contiguous rangeland could negatively affect local livestock economies and individuals.

SOCIOECONOMICS

A socioeconomic impact assessment was performed by Argonne National Laboratories (1983) under contract to the BLM. This section is a synopsis of information contained in that report. The following analysis is based on the difference between the baseline projections and the projections of Alternative 2.

A general summary of regional socioeconomic impacts is presented in Table 4-21. Throughout this section and in tables, projected impacts are expressed in terms of the difference between the baseline projections and this alternative.

Population

It is projected that the population from tar sand development would grow continually throughout the period, from 474 in 1985 to 15,034 in 2005. Most of this growth would take place between 1985 and 1995, when the population would increase at an annual rate of 39.82 percent.

Figure 4-4 illustrates the increase in population for each county from tar sand development. A summary of the population and household impacts in each county is presented in Table 4-22. All projections are presented as a change from the baseline forecast and, therefore, only reflect the population and household growth attributable to tar sand development under this alternative. *Carbon County would experience the greatest tar sand related growth, increasing to 9,137 by 2005. This increase is followed by Grand County, having a growth of 2,878 by 1995.*

Employment and Income

Total regional employment is also projected to grow rapidly over the baseline during the 1985-2005 period. In particular, employment would expand from 250 additional workers in 1985 to 6,111 in 2005. This 2005 employment level is 24 times that projected in 1985. Again, this increase would be most dramatic from 1985 to 1995. In this period, total employment would rise 38.04 percent annually; in the next 10 years there would actually be a negative change, -0.27 annually. Figure 4-5 illustrates the increase in employment for each county resulting from this alternative. Table

CHAP 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-21

Alternative 2
Summary of Regional Socioeconomic Impacts

Socioeconomic Development Category	Change From Baseline					Cumulative Growth Factor ^a 1985-2005	Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005		1985-1995	1995-2005
Population Growth								
Total	474	7,288	13,537	14,515	15,034	31.72	39.82	1.05
School-Age	90	1,522	3,347	4,215	4,615	51.28	43.56	3.26
Employment Growth	250	3,747	6,279	5,993	6,111	24.44	38.04	-0.27
Household Growth	174	2,565	4,355	4,035	4,177	24.06	37.99	-0.42
Infrastructure Requirements								
Housing								
Single family	106	1,542	2,605	2,423	2,509	23.67	37.74	-0.37
Multi-family	28	389	654	610	630	22.50	36.53	-0.37
Mobile homes	44	645	1,088	1,012	1,047	23.80	37.82	-0.38
Education								
Students	90	1,522	3,347	4,215	4,615	51.28	43.56	3.26
Classrooms	6	65	137	172	188	31.33	36.73	3.22
Teachers	6	65	137	172	188	31.33	36.73	3.22
Health Care								
Hospital beds								
General Care	5	19	31	32	34	6.80	20.02	0.93
Long-term care	5	9	15	22	22	4.40	11.61	3.90
Medical personnel								
Doctors	5	9	13	13	13	2.60	10.03	0
Dentists	5	9	11	12	12	2.40	8.20	0.87
Nurses	5	16	26	28	30	6.00	17.92	1.44
Public health nurses	5	7	8	8	8	1.60	4.81	0
Mental health care								
Clinical psychologists	5	7	7	7	7	1.40	3.42	0
Mental health workers	5	7	7	7	7	1.40	3.42	0
Public Safety								
Law enforcement								
Police officers	5	9	31	32	34	6.80	20.02	0.93
Patrol cars	5	9	31	32	34	6.80	20.02	0.93
Jail space (sq. ft.)	238	3,647	6,770	7,260	7,520	31.60	39.77	1.06
Juvenile holding cells	5	7	7	8	8	1.60	3.42	1.34
Fire Protection								
Fire flow (gpm)/duration (hr) ^c								
Emergency Medical Service								
Ambulances	5	7	8	8	8	1.60	4.81	0
Emergency medical technicians	35	49	56	56	56	1.60	4.81	0
Utility Service Demands								
Water system								
Connections	155	2,354	4,372	4,687	4,852	31.30	39.65	1.05
Supply (10 ⁶ gal)	91	1,375	2,553	2,737	2,834	31.14	39.57	1.05
Storage (10 ⁶ ga.)	45	687	1,277	1,369	1,417	31.49	39.73	1.05
Treatment (10 ⁶ gal)	91	1,375	2,553	2,737	2,834	31.14	39.57	1.05
Sewage System (10 ⁶ gal)	19	265	494	530	561	29.53	38.52	1.28
Solid waste ^d								

Source: Argonne National Laboratories, 1983.

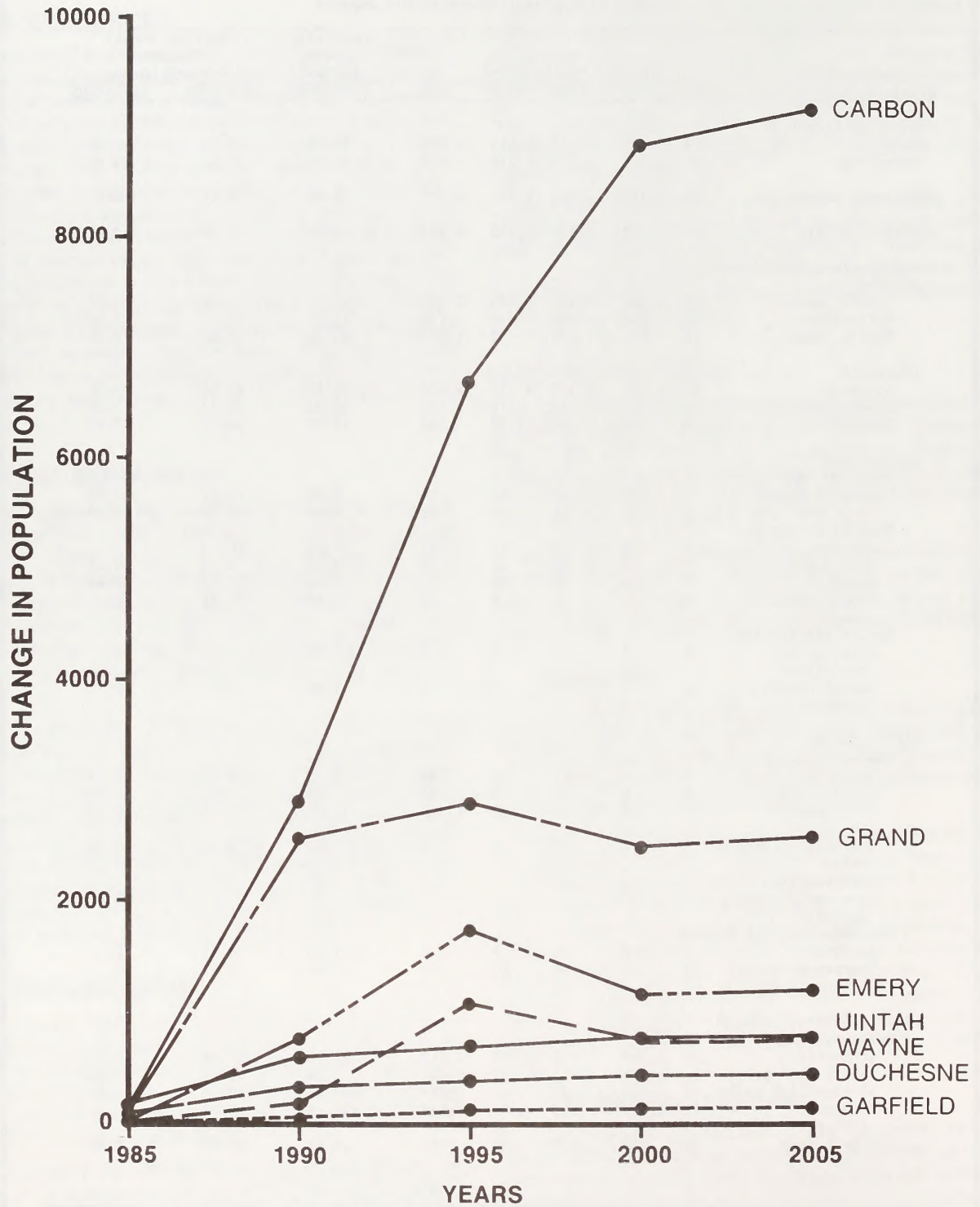
^aComputed as the ratio between 1985 and 2005.

^bUndefined.

^cFire protection measured in fire flow (gpm)/duration (hr) cannot be aggregated across the affected counties.

^dThe State of Utah community facility guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

ALT. 2--LOW COMMERCIAL PRODUCTION



SOURCE: ARGONNE NATIONAL LABORATORIES, 1983

FIGURE 4-4
ALTERNATIVE 2
PROJECTION OF COUNTY POPULATION INCREASES

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-22

Alternative 2
Summary of Population and Household Impact Projections^a

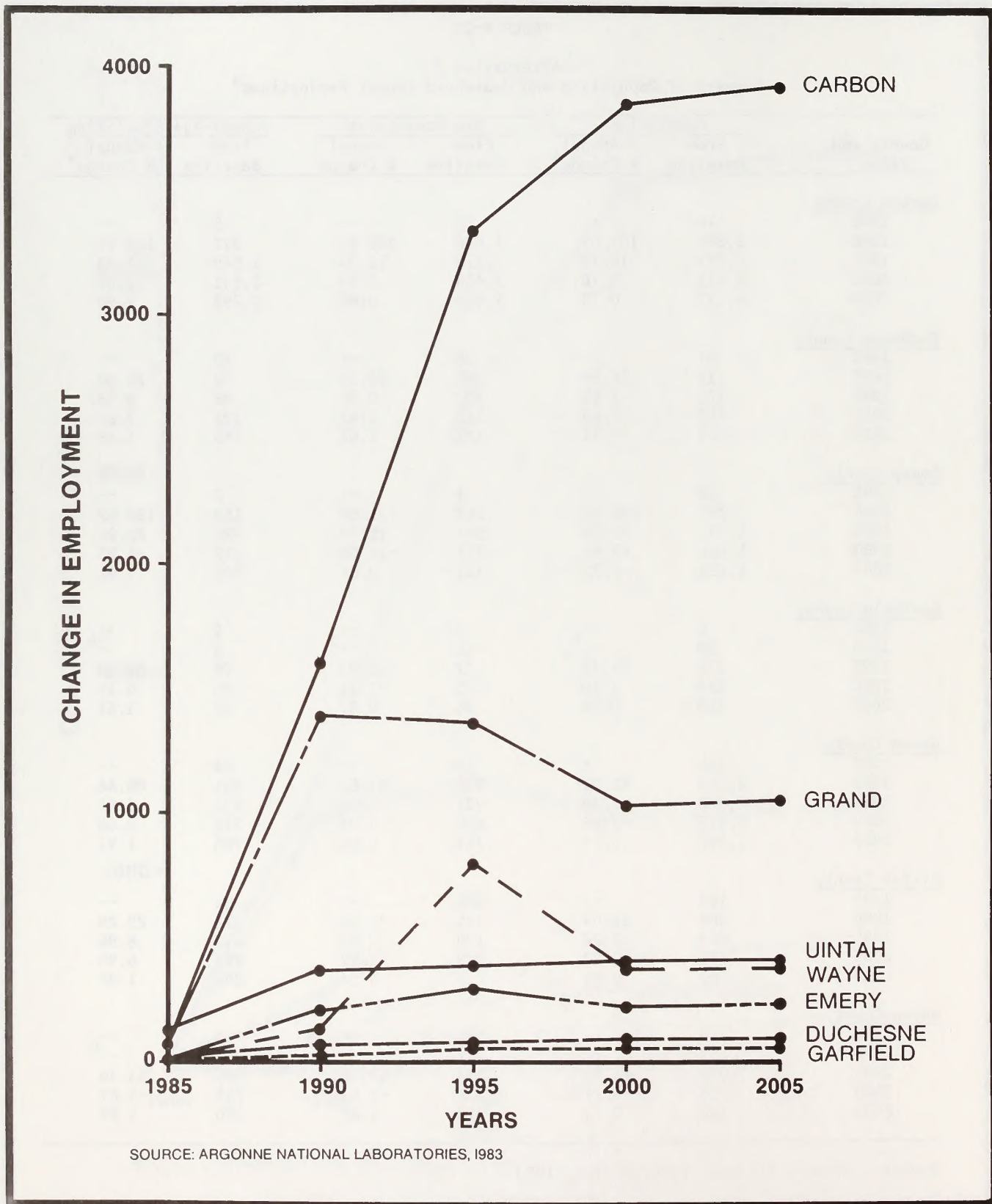
County and Years	Population		New Households		School-Age Population	
	From Baseline	Annual % Change ^a	From Baseline	Annual % Change	From Baseline	Annual % Change ^a
<u>Carbon County</u>						
1985	76	--	28	--	15	--
1990	2,895	107.09	1,034	105.81	612	109.96
1995	6,677	18.19	2,175	16.03	1,649	21.93
2000	8,811	5.70	2,454	2.44	2,541	9.03
2005	9,137	0.73	2,538	0.68	2,792	1.90
<u>Duchesne County</u>						
1985	97	--	36	--	18	--
1990	311	26.24	98	22.18	59	26.80
1995	372	3.65	102	0.80	93	9.53
2000	423	2.60	115	2.43	132	7.26
2005	433	0.47	121	1.02	140	1.18
<u>Emery County</u>						
1985	12	--	4	--	2	--
1990	747	128.45	267	131.68	158	139.62
1995	1,731	18.30	564	15.38	428	22.06
2000	1,151	-7.84	321	-10.08	332	-4.95
2005	1,193	0.72	331	0.62	365	1.91
<u>Garfield County</u>						
1985	0	-- ^b	0	-- ^b	0	-- ^b
1990	29	-- ^b	10	-- ^b	6	-- ^b
1995	114	31.49	37	29.91	28	36.08
2000	124	1.70	35	-1.11	36	5.15
2005	129	0.79	36	0.57	39	1.61
<u>Grand County</u>						
1985	125	--	46	--	24	--
1990	2,559	82.91	914	81.82	541	86.46
1995	2,878	2.38	937	0.50	711	5.62
2000	2,477	-2.96	690	-5.94	714	0.08
2005	2,569	0.73	714	0.69	785	1.91
<u>Uintah County</u>						
1985	164	--	60	--	31	--
1990	588	29.09	185	25.26	112	29.29
1995	689	3.22	190	0.53	172	8.96
2000	771	2.27	209	1.92	241	6.98
2005	787	0.41	219	0.94	254	1.06
<u>Wayne County</u>						
1985	0	-- ^b	0	-- ^b	0	-- ^b
1990	159	-- ^b	57	-- ^b	34	-- ^b
1995	1,076	46.58	350	43.76	266	53.10
2000	758	-6.77	211	-9.63	219	-3.81
2005	786	0.73	218	0.65	240	1.85

Source: Argonne National Laboratories, 1983.

^aComputed as average annual compound percent change from the previous 5-year period.

^bUndefined.

ALT. 2: LOW COMMERCIAL PRODUCTION



**FIGURE 4-5
ALTERNATIVE 2
PROJECTION OF COUNTY EMPLOYMENT LEVELS**

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

4-23 summarizes total employment impacts by county. Total personal income and per capita income projections are shown in Table 4-24. As stated previously, all impacts presented here are a change from the baseline conditions.

Infrastructure

The number of households would grow from 174 more than baseline in 1985 to 4,355 more than baseline in 1995, but it would then drop to 4,177 more than baseline in 2005. Housing demands would increase slightly more rapidly for mobile homes than single family homes or multi-family homes between 1985 and 1995, but housing demand would decline 0.40 percent annually between 1995 and 2005.

Six more classrooms and teachers in 1985, and 188 more classrooms and teachers in 2005, would be needed to accommodate the number of students above the baseline projections between 1985 and 2005. The number of students would be 51 times greater in 2005 than in 1985, with most of this growth taking place from 1985 to 1995. *Carbon, Duchesne, and Uintah counties would experience the greatest demand in educational services.*

The demand for each type of health care service would be between two and six times greater than the baseline projections in 1985. By 2005, this demand would increase to 34 general care hospital beds, 30 nurses, 22 long-term care hospital beds, 13 doctors, 12 dentists, 8 public health nurses, and seven clinical psychologists and mental health workers. However, only the number of nurses would increase between 2000 and 2005. *Carbon and Uintah counties would generally experience the greatest increase in medical service demands.*

The additional demand for jail space attributable to this alternative would increase much more rapidly than the demand for any other public safety service. The 3,647 square feet needed for jail space in 1990 would be 15 times greater than the amount of jail space in 1985. Five more police officers and patrol cars would be needed in 1985, increasing to 34 in 2005. The five ambulances and juvenile holding cells required by this alternative would grow to eight in 2005. *Carbon, Duchesne, and Uintah counties would generally experience the greatest increase in demands for public safety services.*

Water system service demands would grow by a factor of 31 between 1985 and 2005. Similarly, sewage system requirements would increase from 19 million gallons in 1985 to 561 million gallons in 2005. All utility service demands would increase about 39 percent annually from 1985 to 1995, and about 1 percent annually from 1995 to 2005. *Carbon, Duchesne, and Uintah counties would generally experience the greatest increase in utility service demands.*

Wage and Personal Income

The total regional wage and personal income are presented in Table 4-25. The wage and income data is presented by industrial sector and income category. Average baseline monthly wages are expected to have an approximate annual increase of 1.72 percent. The number of employees

and total wage payments would increase as a result of this alternative and are expressed as a change from the baseline projections.

The average monthly wage in the mining sector would increase from \$2,157 in 1985 and to \$3,036 in 2005. The resulting total wage payment in the sector would increase from \$2.3 million in 1990 to \$9.6 million in 2005, the largest of any sector. Growth in total wage payments between 1995 and 2005 would be the most rapid of any sector, increasing at an annual rate of 7.52 percent.

Construction would have the highest monthly wage of any sector, rising from \$2,625 in 1985 to \$3,695 in 2005. The total wage payment in the sector would increase 29.85 percent annually from 1985 to 1995 and decrease 21.46 percent annually from 1995 to 2005.

Average property income would increase from \$141 in 1985 to \$202 in 2005. Total property income would increase by a factor of 39 during the same period.

The total monthly personal income in the region would grow from \$662,002 in 1985 to \$17,989,763 in 2005. Most of this increase would occur from 1985 to 1995, with only an 0.53 percent annual increase thereafter. The average monthly per capita income would fluctuate throughout the 20-year period, eventually declining \$7.00 between 1985 and 2005.

ATTITUDES AND LIFESTYLES

As in the Socioeconomics section, information in this section is derived from a report prepared by Argonne National Laboratories (1983).

All communities within the tar sand development area would experience, in varying degrees, a lessening of traditional small-town way of life values because of population growth and consequential decrease in cultural homogeneity. The same community impacts would occur as discussed in Alternative 1, but would be of a lesser magnitude and frequency.

Social changes would be felt least in the larger communities that have already experienced energy-related growth, such as Price and Vernal. In Hanksville, the likelihood of major social changes would be the greatest, where newcomers would outnumber native residents by the year 1993.

Ute tribal members not participating in the economic benefits of tar sand development would feel a heightened sense of cultural and economic alienation. Environmental problems (i.e., degradation of air and water) and social concerns (i.e., trespassing on reservation lands and crowding of services) would cause stress among tribal members (Duncan, 1983).

The extent of quality-of-life impacts cannot be quantified, but many of these could at least be partially mitigated through careful planning. The social consequences arising from Western energy-related "boom towns" have been well documented (Cortese and Jones, 1977).

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-23

Alternative 2
Employment Growth Projections^a

County	Change In Employment, By Year					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Carbon County	42	1,597	3,330	3,838	3,913	54.85	1.63
Duchesne County	16	62	76	89	92	16.86	1.93
Emery County	0	202	290	219	229	-- ^b	-2.33
Garfield County	0	14	49	51	52	-- ^b	0.60
Grand County	69	1,385	1,361	1,023	1,044	34.74	-2.62
Uintah County	123	363	383	403	405	12.03	0.59
Wayne County	0	124	790	370	376	-- ^b	-7.16
Total	250	3,747	6,279	5,993	6,111	38.04	-0.27

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-24

Alternative 2
Total Personal Income and Per Capita Income Projections

County Population and Income Category	Income and Population					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Per Capita Income (1980 \$)	14,448	15,816	15,132	13,416	14,364	-0.46	-0.52
Change From Baseline							
Carbon County							
Population	76	2,895	6,677	8,811	9,137	56.45	3.19
Total Personal Income (1980 \$ X 10 ⁶)	1.10	45.79	101.04	118.21	131.24	57.15	2.65
Change From Baseline							
Duchesne County							
Population	97	311	372	423	433	14.39	1.53
Total Personal Income (1980 \$ X 10 ⁶)	1.40	4.92	5.63	5.67	6.22	14.93	1.00
Change From Baseline							
Emery County							
Population	12	747	1,731	1,151	1,193	64.40	-3.65
Total Personal Income (1980 \$ X 10 ⁶)	0.17	11.81	26.19	15.44	17.14	65.49	-4.15
Change From Baseline							
Garfield County							
Population	0	29	114	124	129	-- ^a	1.24
Total Personal Income (1980 \$ X 10 ⁶)	0	0.46	1.73	1.67	1.85	-- ^a	-0.67
Change From Baseline							
Grand County							
Population	125	2,559	2,878	2,477	2,569	36.84	-1.13
Total Personal Income (1980 \$ X 10 ⁶)	1.81	40.47	43.55	33.23	36.90	37.45	-1.64
Change From Baseline							
Uintah County							
Population	164	588	689	771	787	15.44	1.34
Total Personal Income (1980 \$ X 10 ⁶)	2.37	9.30	10.34	10.34	11.30	15.97	-0.80
Change From Baseline							
Uintah County							
Population	0	159	1,076	758	786	-- ^a	-3.09
Total Personal Income (1980 \$ X 10 ⁶)	0	2.51	16.28	10.17	11.29	-- ^a	-3.59

Source: Argonne National Laboratories, 1983.

^aUndefined.

ALT. 2: LOW COMMERCIAL PRODUCTION

TABLE 4-25
Alternative 2
Wage and Personal Income Impact Projections

Industrial Sector	Wages and Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Mining							
Average Monthly Wage (1980 \$)	2,157	2,349	2,559	2,787	3,036	1.72	1.72
Change from Baseline							
Number of Employees	0	983	1,810	3,151	3,151	--b	5.70
Total Wage Payment (1980 \$)	0	2,309,067	4,631,790	8,781,837	9,566,436	--b	7.52
Construction							
Average Monthly Wage (1980 \$)	2,625	2,859	3,114	3,367	3,695	1.72	1.73
Change from Baseline							
Number of Employees	185	1,562	2,126	154	160	22.26	-22.79
Total Wage Payment (1980 \$)	485,625	4,465,758	6,620,364	518,518	591,200	29.85	-21.46
Manufacturing							
Average Monthly Wage (1980 \$)	893	973	1,060	1,154	1,257	1.73	1.72
Change from Baseline							
Number of Employees	0	20	41	45	46	--b	1.16
Total Wage Payment (1980 \$)	0	19,460	43,460	51,930	57,822	--b	2.90
Transportation, Communications, and Utilities							
Average Monthly Wage (1980 \$)	1,879	2,047	2,296	2,501	2,724	2.02	1.72
Change from Baseline							
Number of Employees	4	54	104	119	122	38.52	1.61
Total Wage Payment (1980 \$)	7,516	110,538	238,784	297,619	332,328	41.32	3.36
Wholesale and Retail Trade							
Average Monthly Wage (1980 \$)	844	919	1,002	1,091	1,188	1.73	1.72
Change from Baseline							
Number of Employees	20	319	606	671	694	40.65	1.37
Total Wage Payment (1980 \$)	16,880	293,161	607,212	732,061	824,472	43.09	3.11
Finance, Insurance, and Real Estate							
Average Monthly Wage (1980 \$)	925	1,007	1,097	1,195	1,302	1.72	1.73
Change from Baseline							
Number of Employees	4	45	90	102	107	36.53	1.75
Total Wage Payment (1980 \$)	3,700	45,315	98,730	121,890	139,314	38.88	3.50
Services							
Average Monthly Wage (1980 \$)	767	835	910	991	1,079	1.72	1.72
Change from Baseline							
Number of Employees	12	197	393	457	475	41.75	1.91
Total Wage Payment (1980 \$)	9,204	164,495	357,630	452,887	512,525	44.19	3.66
Government							
Average Monthly Wage (1980 \$)	931	1,014	1,144	1,246	1,357	2.08	1.72
Change from Baseline							
Number of Employees	23	359	700	836	884	40.71	2.36
Total Wage Payment (1980 \$)	21,413	364,026	800,800	1,041,656	1,199,588	43.64	4.12
Nonfarm Proprietors (NFP)							
Average Monthly Wage (1980 \$)	1,230	1,340	1,459	1,590	1,731	1.72	1.72
Change from Baseline							
Number of Employees	9	211	409	455	472	46.47	1.44
Total Wage Payment (1980 \$)	11,070	282,740	596,731	723,450	817,032	48.99	3.19
Other Labor Income							
Average Monthly Wage (1980 \$)	106	115	126	137	149	1.74	1.69
Change from Baseline							
Number of Recipients	274	3,588	6,086	5,982	6,122	36.35	0.06
Total Wage Payment (1980 \$)	29,044	412,620	766,836	816,534	912,177	38.73	1.75
Average Property Income (1980 \$)	141	156	170	185	202	1.89	1.74
Population	550	7,288	13,537	14,515	15,034	37.76	1.05
Total Property Income (1980 \$)	77,550	1,136,928	2,301,290	2,685,275	3,036,868	40.36	2.81
Total Monthly Personal Income (1980 \$)	666,002	9,604,108	17,063,637	16,226,657	17,989,763	38.40	0.53
Average Monthly Per Capita Income	1,204	1,318	1,261	1,118	1,197	-0.46	-0.52

Source: Argonne National Laboratories, 1983.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TRANSPORTATION

Traffic from tar sand development would not, by itself, exceed the level of service on any regional highways. However, significant increases in high-tonnage truck traffic would result in an unquantifiable amount of damage to road surfaces. Because of increased congestion, unquantifiable accident rates would also increase on all affected roadways, particularly intersections. Table 4-26 shows affected highways and estimates the number of trucks and annual trips required for tar sand development in each STSA.

Specific Analysis of STSAs

This section analyzes each STSA for which production would be expected should this alternative be implemented.

ASPHALT RIDGE/WHITE ROCKS STSA

This alternative assumes that 5,000 barrels/day would be produced in the White Rocks portion of this STSA by surface mining.

Air Quality

For analysis purposes, a 5,000 barrels/day hot-water extraction plant, an upgrading facility, and a surface mine were assumed. The estimated annual pollutant emissions would be:

TSP:	1,082 tons
SO ₂ :	193 tons
NO _x :	1,613 tons
CO:	364 tons
VOC:	307 tons

Table 4-15 compares estimated TSP and SO₂ concentrations to PSD incremental limitations. The 24-hour Class II TSP increments could be exceeded on the Uintah and Ouray Indian Reservation. Table 4-16 compares estimated total concentrations to the NAAQS, which shows that the secondary 24-hour TSP NAAQS could be exceeded. All other pollutant concentrations would be well within the NAAQS. Because the level-1 visibility analysis showed potential for atmospheric discoloration at Dinosaur National Monument, a more detailed level-2 analysis was performed. The level-2 analysis indicated that no visibility impairment would occur at Dinosaur National Monument (Aerocomp, Inc., 1983a).

Water Resources

An estimated water requirement of 4,521 acre-feet per year would be supplied from underground water sources. There are several water-bearing formations in the area (see Table 3-6). Consumptive water use could deplete local spring flow and decrease yields of existing wells. Water quality could be impacted by accidental release of process waters into nearby water sources or the failure of holding ponds to retain wastes (USDI, GS, 1983). Increased sediment yield would occur from surface disturbance by tar sand-related construction and mining activities on an estimated 1,800 acres (Table 4-18).

Soils

Construction of roads and tar sand facilities and removal of overburden would cause surface disturbance on an estimated 1,800 acres. This would increase erosion and sediment yield and, through mixing of the soil profile, change the physical and chemical composition of the soil. Approximately 64 percent of the STSA is in the high sediment yield class, with 22 percent in moderate, and 14 percent in low (Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 600 acres or less of the ridge at White Rocks would be destroyed by the removal of tar sand by surface mining. The excavation would cut a steep-sided valley as wide as 1,000 feet at the top and tens of feet deep into the ridge. An additional 1,200 acres would be modified by excavations: (1) to form the slopes at the sides of the excavation; (2) construct roads and facilities related to the production of tar sand; and (3) to bury overburden and waste sand from the processing plant.

Tar Sand

About 3,600 acre-feet of tar sand at White Rocks would be removed from an irregular pit by surface mining. The remaining tar sand could be recovered later.

Other Minerals

The STSA is prospectively valuable for oil and gas, which could be removed after the completion of tar sand production and reclamation.

Vegetation

About 1,800 acres in the Uinta Basin floristic section would be stripped of vegetation. The major vegetation types on this STSA are mountain brush, sagebrush, juniper and mixed desert-shrub. The most important vegetation associations are those which produce the most livestock forage and provide the highest quality elk and deer winter ranges and sage grouse habitat. Sheep are the only class of livestock, and sage grouse is the major wildlife species on the Asphalt portion of this STSA; therefore, the most important vegetation type on the Asphalt Ridge portion is probably mixed-desert shrub.

Cattle is the major class of livestock, and critical elk and deer winter ranges are the major wildlife values of the White Rocks portion of this STSA. Therefore, the most important vegetation type on this portion is probably the mountain brush and sagebrush vegetation types.

The location(s) of the 1,800 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 1,800 acres of vegetation of the highest value to livestock, elk, deer, and sage grouse would be lost. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and chemical and structural changes in the plant growth medium from tar

ALT. 2: LOW COMMERCIAL PRODUCTION

TABLE 4-26

Alternative 2
Annual ADT Projections

STSA	Peak Production Year	Highway	Segment Description	Heavy Trucks (Number)	Commuter Round Trips
Asphalt Ridge/ White Rocks	1988	U.S. Hwy 40	Vernal to west of Roosevelt.	25	430
Circle Cliffs	1993	Utah Hwy 24	Notom Road to U.S. Hwy 70.	10	50
		U.S. Hwy 70	Utah Hwy 24 to Green River.		
P. R. Spring	1996	Utah Hwy 45	Bonanza to U.S. Hwy 40. Utah Hwy 45 to west of Roosevelt.	125	780
		U.S. Hwy 40			
San Rafael Swell	1990	U.S. Hwy 70	Head of Sinbad to Green River.	5	90
Sunnyside	1998	Utah Hwy 6	Price to Utah Hwy 123. (railroad)		3,025
		Utah Hwy 123	Utah Hwy 6 to Sunnyside.		
Tar Sand Triangle	1998	Utah Hwy 24	Temple Junction to U.S. Hwy 70.	100	590
		U.S. Hwy 70	Utah Hwy 24 to Green River.		

Source: Utah Department of Transportation, 1982.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

sand recovery processes, there is a risk of permanently modifying the range site potential of the mined areas.

Threatened and Endangered Plant Species

There are no threatened or endangered plant species known to occur in this STSA. Based on this existing inventory information, there would be no on-site impacts to plant species currently protected by law.

Animal Life

Terrestrial Wildlife

Approximately 1,800 acres of crucial deer winter range could be destroyed by surface disturbing activities associated with tar sand development (see Table 4-19). Because winter range is a limiting factor, deer populations on herd units 22 and 26 could decline by 31 and 27 animals, respectively. This represents less than a 1-percent reduction in herd size for these units.

One sage grouse strutting ground and 1,800 acres of sage grouse nesting and yearlong raptor habitats could be subject to surface disturbance from tar sand development. Because of its importance to the nesting and reproductive success of sage grouse, the loss of the strutting ground and 1,800 acres of nesting and brood-rearing habitat could eliminate the sage grouse population on the STSA. Raptor species dependent upon this habitat could either be eliminated or displaced into adjacent areas. Any tar sand development that destroyed riparian areas could either eliminate or displace the various wildlife species dependent on this habitat.

Aquatic Species

Estimated water requirements are 4,521 acre-feet per year, a reduction of 1,250 acre-feet per year (22 percent of Alternative 1). Degradation of fish and associated riparian habitat provided by the White Rocks River could occur, which would reduce populations of rainbow, brook, and cutthroat trout. These populations would, therefore, be kept below their biotic potential. The Green River, a potential water source located outside the STSA, could also be impacted from reduced flows, possible leaching, and contamination of drainages. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse or wild burro range within this STSA.

Recreation and Wilderness

The impacts of surface mining would be loss of hunting values and displacement of hunting activity from affected areas until rehabilitation was completed. Improved access would probably increase ORV activity in the area. The magnitude of impacts would be less than Alternative 1

because of the smaller scale of operation proposed. There are no present or potential wilderness areas that would be affected by tar sand development of the Asphalt Ridge/White Rocks STSA.

Visual Resources

Surface mining of tar sand resources would cause long-term degradation of scenic values. Scenic quality is low and rehabilitation, requiring several years after the project ends, would be possible in most areas. The area and magnitude of impact would be significantly less than under Alternative 1.

Livestock Grazing

The 14,700-acre White Rocks portion of this STSA is predominantly Uintah and Ouray Indian Reservation lands, the rest is FS and private lands. The primary use is livestock grazing; cattle is the major livestock class. Forage production is estimated at about 6 acres/AUM; therefore, this portion of the STSA produces about 2,450 AUMs. Portions of the FS's Mosby Mountain, *White Rocks*, and *J. Schulthes* cattle allotments fall within the STSA (see Table 3-17).

The 26,695-acre Asphalt Ridge portion of this STSA is predominantly BLM and State lands. The primary class of livestock is sheep, and average forage production of the five BLM allotments is about 55 acres/AUM (26,695 acres divided by 481 AUMs equals 55 acre/AUM) (see Table 3-17).

Based on estimated forage production and the assumption that 1,800 acres on the White Rocks would be surface mined, a total of about 300 AUMs would be lost directly to tar sand development. This forage would be the equivalent of 180 tons of hay and would be lost every year for the project's life plus 5 years.

In addition to the loss of forage and range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. Off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic and vandalism, disruptions in patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be the project's life plus 5 years.

CIRCLE CLIFFS STSA

This alternative assumes that 2,000 barrels/day of bitumen would be produced from BLM land in the west end of the STSA by in-situ processes.

Air Quality

A 2,000 barrels/day in-situ combustion operation is proposed including associated upgrading facilities. The estimated annual pollutant emissions would be:

TSP:	338 tons
SO _x :	497 tons
NO _x :	206 tons
CO:	10 tons
VOC:	12 tons

ALT. 2: LOW COMMERCIAL PRODUCTION

Table 4-15 compares the estimated increased pollutant concentration with PSD incremental limitations. No increments are predicted to be exceeded, although the estimated impact to Capitol Reef National Park is very close to the 24-hour SO₂ Class I increment. Table 4-16 compares total concentrations to the NAAQS; this table indicates that concentrations would be well within the NAAQS.

A level-1 visibility analysis indicated a potential for significant visibility impairment at Capitol Reef National Park. A more detailed level-2 analysis did not indicate a significant visibility impact at Capitol Reef National Park (Aerocomp, Inc., 1983a).

Water Resources

An estimated water requirement of 460 acre-feet per year (Table 4-17) could be supplied from the area. There is no unappropriated water; therefore, water rights would have to be purchased. Water quality could be impacted from accidental release of process or leachate waters into nearby water sources or the failure of ponds to retain wastes (USDI, 1983). Surface disturbance from tar-sand related construction and in-situ mining on approximately 300 acres would increase sediment yield and impact area streams.

Soils

Construction of roads, tar sand facilities, and removal of overburden would cause surface disturbance on approximately 300 acres. This would increase erosion and sediment yield. Approximately 62 percent of the STSA is in the moderate sediment yield class, with 35 percent in high and 3 percent in very high (see Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 300 acres on mesa tops, ridges, and valley sides would be modified by cuts and fills for roads, drill pads, and facilities related to in-situ extraction. The largest potential changes would be cuts and fills associated with roads built on the sides of mesas or buttes.

Tar Sand

Bitumen would be removed from about 700 acres by in-situ methods. About 30 percent of the in-place bitumen would be removed. The remainder of the bitumen in the developed deposit would not be recoverable. If in-situ combustion were used, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas beneath the STSA could be recovered after operations and reclamation for tar sand were completed. Uranium overlying tar sand would not be affected significantly by in-situ operations.

Vegetation

About 300 acres of the Canyonlands floristic section would be stripped of vegetation. The major vegetation type on this STSA is pinyon-juniper woodland. The most

important vegetation associations are those contributing the most livestock forage and furnishing the best desert bighorn sheep habitat. The vegetation associations most valuable to livestock on this STSA are assumed to be those with a high percentage or composition of galleta grass, Indian ricegrass, four-wing salt bush, Mormon tea, and shadscale. The location(s) of the 300 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 300 acres of vegetation of the highest value to livestock and bighorn sheep would be lost. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and chemical and structural changes in the plant growth medium from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of the mined areas.

Threatened and Endangered Plant Species

There are no threatened or endangered plant species known to occur in this STSA. Based on this existing inventory information, there would be no on-site impacts to plant species currently protected by law or by policy.

Animal Life

Terrestrial Wildlife

Approximately 300 acres, representing about 27 percent of the crucial desert bighorn sheep range on the STSA, could be destroyed from tar sand development. Because of the extent of this development and because these animals are extremely sensitive to human encroachment, this level of development could eliminate bighorn sheep from the STSA.

In addition, 300 acres, representing about 2 percent of total yearlong raptor habitat on the STSA, would be subject to surface-disturbing activities. Raptor species dependent on this habitat could be eliminated or displaced into adjacent habitats.

Any tar sand development that destroyed unique or limited wildlife habitat such as riparian areas could either reduce or displace the various wildlife species dependent on this habitat.

Aquatic Species

Estimated water requirements are 460 acre-feet per year, a reduction of 4,140 acre-feet per year or 90 percent of Alternative 1. The Escalante River could be adversely impacted by reduction in flows, possible leaching, and contamination of drainages. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse or wild burro range identified within this STSA.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

Recreation and Wilderness

Construction and production activities in the Circle Cliffs STSA would degrade primitive recreation values both on affected sites and in adjacent areas of Capitol Reef National Park and Glen Canyon NRA because of visual intrusions and sounds. Sightseeing values would be degraded, possibly permanently if cuts and fills were permitted on steep slopes. Increased motorized recreation would be expected. Most recreation values could be successfully rehabilitated upon cessation of operations.

Development of tar sand resources in the Circle Cliffs STSA could degrade opportunities for solitude in three areas of potential wilderness as under Alternative 1; however, the impacts would be less because of the small scale of operations. Visual intrusions, odors, and sounds created would be of a smaller magnitude.

Visual Resources

In-situ development of tar sand would cause long-term impairment of scenic values. Rehabilitation of affected areas would probably be possible in most areas but could require up to several decades for vegetative recovery. The area affected would be significantly smaller than under Alternative 1.

Livestock Grazing

Portions of five cattle allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total is shown in Table 3-17. The location(s) of the 300 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: 91,080 acres divided by 1,912 AUMs equals 47.6 acres/AUM. Based on this estimation, about 6 AUMs would be lost to tar sand development annually. This is equivalent to 2 tons of hay. Loss of this amount of forage would probably not affect livestock operations on the STSA.

In addition to the loss of forage, range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. These impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

P. R. SPRING STSA

Both in-situ processes (5,000 barrels/day) and surface mining (20,000 barrels/day) would occur in the P. R. Spring STSA.

Air Quality

Alternative 2 for P. R. Spring considered: (1) a 10,000 barrels/day hot-water extraction plant, an upgrading facility, and associated surface mine; (2) another 10,000

barrels/day hot-water extraction plant, an upgrading facility, and associated surface mine; and (3) a 5,000 barrels/day in-situ steam injection plant and upgrading facility. Estimated annual pollutant emissions would be:

TSP:	6,646 tons
SO ₂ :	2,461 tons
NO _x :	7,792 tons
CO:	1,817 tons
VOC:	692 tons

Table 4-15 compares the estimated increased SO₂ and TSP concentration to PSD incremental limitations; this table indicates that the TSP 24-hour Class II standards would be exceeded. Table 4-16 compares the total estimated pollutant concentrations to the NAAQS: 24-hour TSP concentrations could exceed the secondary NAAQS. All other pollutant concentrations would be well within the NAAQS.

A level-1 visibility analysis indicated a potential for atmospheric discoloration at Arches National Park and Colorado National Monument; therefore, a level-2 analysis was performed. The level-2 analysis indicated that discoloration or other visibility impairment would not occur at these areas (Aerocomp, Inc., 1983a).

Water Resources

An estimated water requirement of 5,250 acre-feet per year (Table 4-17) could be supplied from the area without any impacts except reallocation of water rights. Water quality could be impacted from accidental release of process or leachate waters into nearby water sources or the failure of holding ponds to retain wastes (USDI, GS, 1983). Surface disturbance from tar sand related construction and mining on approximately 7,000 acres (see Table 4-18) would increase sediment yield and impact area streams.

Soils

Construction of roads, tar sand facilities, and overburden removal would cause surface disturbance on approximately 7,000 acres. This would increase erosion and sediment yield and, through mixing of the soil profile, would alter the physical and chemical composition of the soil. Approximately 22 percent of the STSA is in the high sediment yield class, with 78 percent in moderate (Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 6,300 acres would be altered by surface mining. About 2,200 acres of the tops of ridges would be destroyed and about 4,100 acres would be modified by waste sand disposal by overburden filling valleys and by roads and facilities related to the extraction of bitumen. The areas most feasible for surface mining occur in the southern part of the STSA. Generally, the tar sand is too deeply buried in the rest of the STSA for surface mining to be practical. After reclamation, the topography of the surface-mined area might be more even and rounded, would probably be lower in elevation than the original topography, and would contrast with the topography of the

ALT. 2: LOW COMMERCIAL PRODUCTION

adjacent dissected plateau. All rocks in the excavations would be broken and moved, and the backfill in the excavated areas would be more porous than the undisturbed rocks.

Landforms would not have large alterations by in-situ production methods. The major topographic features would remain, but the surface of about 800 acres would be changed by cuts and fills associated with the construction of roads, drill pads, and facilities. Large cuts and fills would occur on the sides of valleys. No significant subsidence would be likely with in-situ extraction.

Tar Sand

All of the bitumen would be removed from about 2,200 acres of surface mining. About 30 percent of the bitumen would be removed from about 1,900 acres by in-situ methods, and the remainder of the depleted deposit would not be recoverable. If in-situ combustion were used, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas could be recovered after completion of the in-situ extraction of bitumen. Any coal underlying the deposit would not be affected by the extraction of bitumen. Thermal effects from in-situ extraction could affect overlying oil shale in the northern part of the STSA.

Vegetation

About 7,000 acres in the Tavaputs Plateau portion of the Uinta Basin floristic section would be stripped of vegetation. Available vegetation data on this STSA are inadequate; however, the major vegetation types are assumed to be similar to those on the Sunnyside STSA, as follows: aspen, coniferous forest, sagebrush-grass, salt-shrub, pinyon-juniper, riparian, and wet meadow. The most important vegetation types are assumed to be those producing the most livestock forage and providing the highest quality elk and deer winter ranges. Also of high importance is the riparian vegetation, which helps stabilize watersheds, affects quality and quantity of stream water, and provides important wildlife habitat. Fair to good quality and quantity livestock forage is probably provided by each of the STSA's vegetation types. The highest quality elk and deer summer ranges are provided by the aspen/conifer and riparian vegetation types. The highest quality elk and deer winter range is provided by the mountain brush and sagebrush-grass type at lower elevations.

The location(s) of the 7,000 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 7,000 acres of the most important vegetation types would be lost to tar sand development. About half the development would then be expected to occur on aspen-conifer areas and about half would take place on mountain brush and sagebrush-grass vegetated areas. It is expected that each vegetation type would be interspersed with about equal amounts of riparian and wet-meadow vegetation and each would be equally important to livestock and big game. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil

horizons and rock strata, potential introduction of weeds, and chemical and structural changes in the topsoil residues from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of the mined areas.

Threatened and Endangered Plant Species

No Federally listed threatened or endangered plant species are known to occur within this STSA.

Animal Life

Terrestrial Wildlife

Big Game: Approximately 3,500 acres of deer and elk summer and winter ranges could be subject to surface disturbance from tar sand development. This represents approximately 2 percent of the deer and elk summer range and about 2 and 3 percent of the deer and elk winter ranges, respectively, on the STSA. Because summer range is considered a limiting factor, loss of this range could slightly reduce the numbers of deer and elk on the STSA.

Small Game and Raptor Habitat: In addition, 7,000 acres of small game and yearlong raptor habitat could also be subject to surface disturbance from tar sand development. This represents approximately 4 and 2 percent of the total acreage, respectively, for these habitats on the STSA. Small game and raptors dependent on this habitat could be eliminated or displaced into adjacent areas.

Unique and Limited High-Value Wildlife Habitat: Any tar sand development that destroyed unique or limited wildlife habitat such as riparian habitats, aspen communities, deer and elk fawning/calving grounds or deer/elk migration corridors could either eliminate or displace the various wildlife populations dependent on these areas.

Aquatic Species

Estimated water requirements are 5,250 acre-feet per year, or 75 percent of Alternative 1. Degradation or loss of fish habitat would occur to White River and Willow Creek, potential water sources located outside the STSA. Reduced flows, possible leaching, and contamination of drainages could reduce the quality of catfish habitat in the White River. Because no game fish are present, Willow Creek would mainly be affected by reduced flows and possible loss or degradation to riparian habitat. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

There is no wild horse or wild burro range identified within this STSA.

Recreation and Wilderness

Impacts on recreational values and uses from surface mining and in-situ development would be as described in Alternative 1, but of significantly smaller magnitude. Hunting values would be lost, activity would be displaced, and improved access would increase motorized recreation in the area. Primitive recreation and scenic values in two

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

potential wilderness areas could be degraded by the visual intrusions and sounds from operations.

Development of tar sand resources in the P. R. Spring STSA could degrade wilderness values (opportunities for solitude) in the Winter Ridge and Flume Canyon WSAs and the Ute Tribe Cultural and Wilderness Resource Protection Area as under Alternative 1. However, the magnitude of impact would be substantially less because of the smaller scale of operations and area of surface disturbance.

Visual Resources

Surface mining and in-situ development of tar sand would cause permanent impairment of scenic quality. Steep terrain would hinder rehabilitation of affected areas. Recovery to class C scenic quality (VRM Class IV) would require several years. The area impacted would be large but substantially smaller than under Alternative 1.

Livestock Grazing

Portions of 11 BLM grazing allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total for this STSA is shown in Table 3-17. The location(s) of the 7,000 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: Forage production on BLM, State, and private lands is estimated to average 13.16 acres/AUM. Using this forage production figure, it can be estimated that 532 AUMs would be lost directly to tar sand surface mining. This number of AUMs is equivalent to 213 tons of hay. Because forage is a renewable resource, this would result in an annual loss until vegetation of equal production was re-established.

In addition to the loss of forage, range improvements, etc. on the mined area proper, there would be off-site impacts to livestock grazing. Off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

SAN RAFAEL SWELL

This STSA would be developed using in-situ methods to produce 1,000 barrels/day of bitumen.

Air Quality

A 1,000 barrels/day in-situ steam-injection plant and an upgrading facility were assumed for analysis purposes. Estimated annual pollutant emissions would be:

TSP:	64 tons
SO ₂ :	339 tons
NO _x :	268 tons
CO:	37 tons
VOC:	22 tons

Tables 4-15 and 4-16 compare increased concentrations and total concentrations to PSD incremental limitations and NAAQS, respectively. Concentrations would be well within all PSD limitations and NAAQS. A level-1 visibility analysis for Arches, Canyonlands, and Capitol Reef national parks indicated insignificant impacts at these Class I areas (Aerocomp, Inc., 1983a).

Water Resources

An estimated water requirement of 230 acre-feet per year could be supplied in the area without any impacts except reallocation of water rights. Increased sediment yield from surface disturbance by construction, in-situ mining, and related tar sand activities on approximately 50 acres would occur. Other water quality effects would be caused by accidental release of process or leachate waters into nearby water sources, or the failure of ponds to retain wastes (USDI, GS, 1983).

Soils

Construction of roads, tar sand facilities, and drilling pads would cause surface disturbance on approximately 50 acres. This would increase erosion. Approximately 18 percent of the STSA is in a very high sediment yield class, 18 percent in high, and 64 percent in moderate (Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 50 acres in the STSA would be affected by roads, drill pads, and facilities related to extraction of bitumen. The major impact would be cuts related to construction of roads up the sides of mesas.

Tar Sand

About 30 percent of the bitumen would be recovered from about 100 acres by in-situ methods. The remaining bitumen in the developed part of the deposit would not be recoverable.

Other Minerals

Oil and gas could be recovered after the in-situ operations and reclamation had been completed. Any uranium deposits would not be adversely affected by in-situ production of bitumen.

Vegetation

About 50 acres in the Canyonlands floristic section would be stripped of vegetation. The major vegetation types on this STSA are pinyon-juniper, grassland, desert shrub, and riparian in the floodplain of the San Rafael River.

The most important vegetation types in this STSA are those that contribute or produce the most livestock forage and provide the highest quality desert bighorn sheep habitat. The best livestock forage is probably provided by the grassland vegetation type, and the highest quality desert bighorn sheep habitat is probably provided by the desert-shrub type. The riparian vegetation type is equally important to livestock and wildlife.

ALT. 2: LOW COMMERCIAL PRODUCTION

The location(s) of the 50 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 50 acres of vegetation of the highest value to livestock and bighorn sheep would be lost to tar sand development. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and chemical residue from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of the mined areas.

Threatened and Endangered Plant Species

The endangered species, Wright's fishhook cactus (*Sclerocactus wrightiae*) occurs within the boundaries of this STSA. The location(s) of the 50 acres of tar sand development within the STSA and the exact method of mining are unknown. Therefore, a site-specific analysis cannot be made. Under a worst-case analysis, it can be assumed that loss of some individuals, populations, and habitat would occur. These losses would result from surface clearing, mixing of soil horizons and rock strata, introduction of weeds and chemical residues from tar sand recovery process, and establishment of new access and resulting increases in ORV activity.

Animal Life

Terrestrial Wildlife

Big Game and Raptor Habitat: Approximately 50 acres of desert bighorn sheep habitat and yearlong raptor habitat could be subject to surface disturbance from tar sand development. This represents less than 1 percent of the total acreage for both of these habitats on the STSA. Although it would cause displacement, this level of development should not seriously impact either desert bighorn sheep numbers or raptors. Secondary impacts would cause more displacement than the project.

Unique and Limited High-Value Wildlife Habitat: Any tar sand development that destroyed unique or limited wildlife habitat such as riparian areas could either eliminate or displace the various wildlife populations dependent on these habitats.

Aquatic Species

Estimated water requirements are 230 acre-feet per year, a reduction of 4,370 acre-feet per year (95 percent of Alternative 1).

San Rafael River is not considered a fishery but is a tributary to the Green River; therefore, impacts from tar sand development would mainly be reduced flows and possible leaching and contamination, which could adversely affect the Green River, the habitat of two endangered aquatic species (Colorado squawfish and humpback chub). There are no known threatened aquatic species which would be affected by tar sand development.

Wild Horses and Burros

About 50 acres of burro range would be lost to tar sand development. It is estimated that between 25 and 50 animals

depend on range within the STSA. The loss of range would result from surface clearing and resultant loss of forage and increased access, ORV use, and harassment.

Recreation and Wilderness

Impacts to recreation values and uses from in-situ development would be as described under Alternative 1 but significantly smaller in magnitude. Because of the small scale of proposed development, most impacts could probably be successfully mitigated. There would be at least temporary impacts on primitive recreation and scenic values until rehabilitation was completed.

Tar sand development in the San Rafael Swell STSA could degrade wilderness values in five potential wilderness areas, as under Alternative 1. However, because of the smaller scale of operations, the magnitude of visual intrusions and sounds created by development activities would probably be less in each area of potential wilderness: Sid's Mountain, Devil's Canyon, Crack Canyon, San Rafael Reef, and Mexican Mountain WSAs.

Visual Resources

In-situ development of tar sand would degrade visual values in localized areas of the STSA. The magnitude of impact and success of rehabilitation efforts would depend on the topography and scenic quality of areas developed. Impacts would be substantially less than under Alternative 1 because of the small scale of the operation proposed under this alternative.

Livestock Grazing

Portions of 15 livestock allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total (within the STSA) is shown in Table 3-17. The location(s) of the 50 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production throughout the STSA has been averaged as follows: 130,292 acres divided by 5,705 AUMs equals 23 acres/AUM. Based on this estimation, about 2 AUMs would be lost to tar sand development annually. This is equivalent to 1 ton of hay. The loss of this amount of forage would cause no adverse impact to livestock operations unless off-site impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruption in established patterns of use, and a general reduction in the area's suitability for livestock grazing.

SUNNYSIDE STSA

Alternative 2 considers 28,000 barrels/day of bitumen would be developed by surface mining while 2,000 barrels would be developed with in-situ methods. Site-specific analysis for conversion application in this STSA are being considered in the *Sunnyside Combined Hydrocarbon Lease Conversion Draft EIS (USDI, BLM, 1983b)*.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

Air Quality

For analysis purposes, this scenario included: (1) a 9,250 barrels/day hot-water extraction plant (no upgrading) and an associated surface mine; (2) a 1,250 barrels/day hot-water extraction plant, upgrading facility, and surface mine; (3) a 6,250 barrels/day hot-water extraction plant, upgrading facility, and surface mine; (4) an 11,250 barrels/day solvent-extraction plant, upgrading facility, and surface mine; and (5) a 2,000 barrels/day in-situ steam injection plant. Estimated annual emission would be:

TSP:	11,349 tons
SO ₂ :	1,994 tons
NO _x :	16,882 tons
CO:	2,203 tons
VOC:	865 tons

Increased concentrations are compared to the PSD incremental limitations in Table 4-15. The Class II 24-hour TSP increment is predicted to be exceeded. All other PSD standards would be met.

Table 4-16 compares total concentrations with the NAAQS. The secondary 24-hour and annual TSP NAAQS could be violated. Concentrations of other pollutants would be well within the NAAQS. Visibility impacts would not be significant at Arches, Canyonlands, and Capitol Reef national parks and Dinosaur National Monument, as shown by the level-2 visibility analysis (Aerocomp, Inc., 1983). However, a yellow-brown atmospheric discoloration resulting from NO_x emissions would be visible on the Uintah and Ouray Indian Reservation.

Water Resources

An estimated water requirement of 8,842 acre-feet per year could be met with water from streams in the area. Transfer of water rights would be necessary to meet needs of a tar sand industry. Surface disturbance from tar sand construction and mining on approximately 4,000 acres would increase sediment yield and impact water quality. Quality could also be affected by accidental release of process or leachate waters or the failure of waste ponds (USDI, GS, 1983).

Soils

Surface disturbance from construction of roads, tar sand facilities, and overburden removal on an estimated 4,000 acres would increase erosion and alter the soil profile by changing the physical and chemical composition of the soil. Approximately 10 percent of the STSA is in the high sediment yield class, 28 percent in moderate, and 62 percent in low (Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

About 1,400 acres of the ridgetops of the dissected Tavaputs Plateau would be destroyed by surface mining. An additional 2,500 acres would be modified by roads and facilities related to tar sand extraction or would be buried by overburden or waste sand from processing plants. The

ridgetops at Sunnyside would also be removed. Overburden and, possibly, waste sand from the processing plants would be placed in the heads of valleys and in excavations. The topography after reclamation would be more rounded, subdued, and probably lower than the existing topography.

Level areas could be created in some valley heads and below the former tops of some ridge crests. The reclaimed topography would contrast with the adjacent topography.

Tar Sand

The tar sand would be excavated from about 1,400 acres by surface mining. About 30 percent (or less) of the tar sand in about 300 acres would be removed by in-situ methods. The depleted parts of the deposit would not be recoverable later.

Other Minerals

The STSA is prospectively valuable for oil and gas. Oil and gas could be recovered after tar sand operations and reclamation were completed. Any coal under the STSA would be unaffected by tar sand operations.

VEGETATION

About 4,000 acres in the Tavaputs Plateau portion of the Uinta Basin floristic section would be stripped of vegetation. The major vegetation types on this STSA are aspen, coniferous forest, mountain brush, sagebrush-grass, salt-shrub, pinyon-juniper, riparian, and wet meadow.

The most important vegetation types are those that produce the most livestock forage and provide the highest quality elk and deer winter and summer ranges. Also of high importance is riparian vegetation, which helps stabilize watersheds, affects the quantity and quality of stream water, and provides important wildlife habitat. Fair to good quality and quantity livestock forage is probably provided by each of the STSA's vegetation types. The highest quality elk and deer summer ranges are provided by the aspen/conifer and riparian vegetation types. The highest quality elk and deer winter ranges are provided by the mountain brush and sagebrush-grass at lower elevations.

The location(s) of the 4,000 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 4,000 acres of the most important vegetation types would be lost to tar sand development. About half the development would occur on aspen/conifer areas and about half would take place on mountain brush and sagebrush-grass vegetated areas. Each would have about equal amounts of riparian and wet-meadow vegetation interspersed, and each are equally important to livestock and big game. The period of loss or time from initial clearing to re-establishment is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds, and chemical and structural changes in the soil surface from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of the mined areas.

ALT. 2: LOW COMMERCIAL PRODUCTION

Threatened and Endangered Plant Species

Potential habitat for the Federally listed threatened plant species Uinta Basin hookless cactus (*Sclerocactus glaucus*) has been identified within this STSA. This cactus is protected under the Endangered Species Act. In addition, available data does not indicate the certain occurrence of any individuals or populations of *Sclerocactus glaucus* within the STSA. The exact location(s) of the 2,000 acres of tar sand development within the STSA and the exact method of mining are unknown. Under a worst-case analysis, though, it can be assumed that loss of some individuals, populations, and habitat would occur. The losses would result from surface clearing, removal of topsoil, and mixing of soil horizons and rock strata, introduction of weeds and chemical residues from tar sand recovery processes, and establishment of new access with resulting increases in ORV activity.

Available data indicates occurrence of this plant species in eastern Utah and western Colorado. Much of the known habitat of this species is subject to impacts from energy development.

Animal Life

Terrestrial Wildlife

Big Game: Approximately 2,000 acres of deer/elk summer and 2,000 acres of winter ranges could be subject to surface disturbance from tar sand development. This represents about 3 and 7 percent of the total summer and winter ranges, respectively, for these species on the STSA. Because summer range is considered the limiting factor, deer and elk numbers could decline on the STSA. However, this decline should not be significant.

Upland Game: Two sage grouse strutting grounds and 2,000 acres of nesting habitat could be destroyed from tar sand development. Because of its importance in the nesting and reproductive success of sage grouse, loss of strutting ground and nesting habitats could eliminate the sage grouse population on the STSA.

Unique and Limited High-Value Wildlife Habitat: One golden eagle nest site and 795 acres of nesting and foraging habitat could be subject to surface disturbance from tar sand development. Such development could cause the eagle to abandon its nest.

About 4,000 acres of small game and yearlong raptor habitat could be subject to surface disturbance from tar sand development. This represents approximately 4 and 2 percent of the total acreage for these habitats, respectively, on the STSA. Small game animals and raptors dependent on these habitats could be eliminated or displaced into adjacent areas.

Any tar sand development that destroyed unique or limited wildlife habitats such as aspen communities, riparian habitats, deer and elk fawning/calving grounds or migration corridors could either eliminate or displace the various wildlife populations dependent on these areas.

Aquatic Species

Estimated water requirements are 8,842 acre-feet per year, 76 percent of Alternative 1. Even with a reduced 76-percent water requirement, impacts would be similar to Alternative 1. Fish and associated riparian habitats of Range, Rock, Nine Mile, and Grassy Trail creeks could be impacted. A total of 30.2 miles of fish and associated riparian habitat on Federal, State, and private lands could be reduced in quality or destroyed, depending on the location and extent of tar sand development. Reproductive and nursery habitats of Range and Rock creeks could be adversely impacted, thus reducing the populations of brown, rainbow, and cutthroat trout in these streams. Fish habitat in the Price and Green rivers and potential water sources outside the STSA could also be affected. Populations of channel catfish and black bullhead could be reduced by reduced flows, possible leaching, and contamination. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

About 2,000 acres of range for about 25 to 30 wild horses would be lost to tar sand development. The loss would result from surface clearing and resultant loss of forage, increased access and ORV use, which would result in increased harassment.

Recreation and Wilderness

The impacts to recreational values and uses from in-situ and surface-mining development would be as described under Alternative 1, but of much smaller magnitude. There would be significant impact on scenic values, recreational opportunities would be lost, and activities would be displaced in affected areas. Water development could affect Range Creek and/or the Price River, both of which are Nationwide Rivers Inventory listed segments.

Development of tar sand resources in the Sunnyside STSA could degrade wilderness values in portions of the Desolation Canyon, *Jack Canyon and Turtle Canyon WSAs*, as under Alternative 1. However, the magnitude of visual intrusions and sounds created would probably be less because of the smaller scale of operations proposed under this alternative.

Visual Resources

Surface mining and in-situ development of tar sand would permanently degrade exceptional scenic values in the STSA. Mined areas could be lowered by hundreds of feet, and rounded landforms would replace the canyons, peaks, and ridges of the present environment. Substantial portions of the STSA would be affected; however, the impacts would be less than under Alternative 1 because of the smaller scale of operations proposed under this alternative.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

Livestock Grazing

Portions of 16 cattle allotments fall within the boundaries of this STSA. Estimated forage production by allotment and in total for the STSA is shown in Table 3-17. The location(s) of the 4,000 acres of tar sand development within the STSA is unknown. Therefore, to estimate the amount of forage that would be lost, forage production for the entire STSA has been averaged as follows: 157,445 acres divided by 6,491 AUMs equals 24 acres/AUM. Based on this estimation, about 167 AUMs would be lost to tar sand development annually. This is equivalent to 67 tons of hay.

In addition to the loss of forage, range improvements, etc. on the mined area proper, there would be off-site impacts to livestock grazing. These impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

TAR SAND TRIANGLE STSA

This alternative assumes 20,000 barrels/day from in-situ development. A site-specific analysis of lease conversions is also being evaluated in the *Unit Plan of Operations for Tar Sand Triangle Combined Hydrocarbon Lease Conversion Draft EIS* (USDI, NPS, 1983).

Air Quality

The analysis assumed two separate 10,000 barrels/day in-situ steam injection plants with upgrading facilities. Annual pollutant emission would be an estimated:

TSP:	4,074 tons
SO ₂ :	5,626 tons
NO _x :	5,540 tons
CO:	580 tons
VOC:	130 tons

Table 4-15 compares estimated increased concentrations to the PSD incremental limitation. The Class II 24-hour TSP standard and the annual and 24-hour Class I SO₂ limitations at Canyonlands National Park would be violated. It is also predicted that the 24-hour TSP increment would also be exceeded in the Glen Canyon NRA. Table 4-16 compares total concentrations to the NAAQS; this table indicates that pollutant levels would be well within the NAAQS.

Although a level-1 visibility analysis identified a potential for visibility impairment at Canyonlands National Park, a level-2 analysis indicated that significant impairment would not occur at this Class I area (Aerocomp, Inc., 1983a).

Water Resources

An estimated water requirement of 2,900 acre-feet per year could be supplied by area sources. Withdrawal from wells could reduce some spring flow or lessen flow in the lower Dirty Devil River. Surface disturbance on approximately 800 acres would increase erosion and sediment

yield, thereby impacting streams in the area. Other water quality impacts could be caused by accidental release of process or leachate waters into nearby water sources or the failure of ponds to retain waste (USDI, GS, 1983).

Soils

Surface disturbance from tar-sand related construction and in-situ mining on an estimated 800 acres (Table 4-18) would increase erosion and sediment yield. Approximately 1 percent of the STSA is in the very high sediment yield class, 80 percent is in high, 18 percent in moderate, and 1 percent in low (Table 3-9).

Topography, Tar Sand, and Other Minerals

Topography

The topography of about 800 acres would be modified by cuts and fills for roads, drill pads, and facilities related to the in-situ extraction of bitumen.

Tar Sand

About 30 percent of the bitumen would be removed by in-situ methods on about 2,000 acres. The bitumen remaining in the depleted deposit would not be recoverable. If in-situ combustion were used to recover bitumen, part of the otherwise unrecoverable bitumen would be burned.

Other Minerals

Oil and gas could be recovered after tar sand operations and reclamation were completed. Uranium deposits would not be adversely affected by the development of tar sand.

Vegetation

About 800 acres in the Canyonlands floristic section would be stripped of vegetation. The major vegetation types on this STSA are blackbrush and galleta-three awn shrub-steppe, grassland, pinyon-juniper, and salt-shrub. The most important vegetation types are those that produce the most livestock forage and provide the highest quality desert bighorn sheep habitat. The best livestock forage in this STSA is provided by the grassland vegetation type, and the highest quality desert bighorn sheep habitat is probably provided by the blackbrush vegetation type. The location(s) of the 800 acres of tar sand development within the STSA is unknown. Therefore, a worst-case analysis would assume that 800 acres of vegetation of the highest value to livestock and desert bighorn sheep would be lost to tar sand development. The period of loss is estimated to be the project's life plus 5 years. Because of mixing of soil horizons and rock strata, potential introduction of weeds and chemical and structural changes in the plant growth medium resulting from tar sand recovery processes, there is a risk of permanently modifying the range site potentials of the mined area.

Threatened and Endangered Plant Species

There are no threatened or endangered species known to occur on this STSA. Based on this existing inventory information, there would be no on-site impacts to plant species currently protected by law or policy.

ALT. 2: LOW COMMERCIAL PRODUCTION

ANIMAL LIFE

Terrestrial Wildlife

Big Game: Approximately 800 acres, representing about 3 percent of the total desert bighorn sheep range in the STSA, could be subject to surface disturbance from tar sand development. Even though desert bighorn sheep would be displaced from this area, because of the small acreage involved, it is doubtful that their numbers would be reduced or reintroduction programs would be jeopardized from this level of development.

Unique and Limited High-Value Wildlife Habitat: Two golden eagle nests and 800 acres of nesting, as well as 800 acres of foraging habitat (representing about 3 percent of the total yearlong raptor habitat on the STSA) could be subject to surface disturbance from tar sand development. Such levels of development could cause the eagles to abandon their nest sites and eliminate or displace various raptor species dependent on this habitat. Any tar sand development that destroyed unique or limited wildlife habitats such as riparian habitats could either eliminate or displace various wildlife populations dependent on these areas.

Aquatic Species

Estimated water requirements are 2,900 acre-feet per year, 74 percent of Alternative 1. Catfish habitat of the Colorado River and mouth of the Dirty Devil River could be degraded by reduced flows and possible contamination. Water diversion facilities could cause entrainment and/or impingement of aquatic organisms (WDAFS, 1982). This would degrade the quality of fish habitat by reducing food supplies.

Wild Horses and Burros

No impacts are expected to impact the wild burros on the north end of this STSA because large areas of range exist outside the STSA.

RECREATION AND WILDERNESS

The impacts on recreational values and uses from in-situ development of tar sand would be as described under Alternative 1 but much smaller in magnitude. Exceptional scenic and primitive recreation values on both BLM and Glen Canyon NRA lands could be lost or degraded until affected areas were rehabilitated. Primitive recreation values in a portion of Canyonlands National Park could be affected by visual intrusions, odors, and sounds. Improved access could change recreational visitation, use patterns, and increase vehicle-related activities.

Development of tar sand resources in The Tar Sand Triangle STSA could degrade wilderness values in BLM WSAs and NPS potential wilderness areas as under Alternative 1. The magnitude of impacts (visual intrusions and sounds) on solitude would probably be less because of the smaller scale of operations proposed. Areas potentially affected would be BLM French Spring/Happy Canyon, Horseshoe Canyon, and Fiddler Butte WSAs and NPS Glen Canyon NRA and Canyonlands National Park.

VISUAL RESOURCES

In-situ development of tar sand could permanently degrade high scenic values in portions of the STSA. The success of rehabilitation efforts would depend on the location (topography and scenic quality) of the areas of operation. At a minimum, there would be long-term impairment of visual resources in the affected areas.

LIVESTOCK GRAZING

Portions of two cattle allotments and two unallotted areas fall within the boundaries of this STSA. Estimated forage production by allotment and in total for the STSA is shown in Table 3-17. The location(s) of the 800 acres of tar sand development within the STSA is unknown. Under a worst-case analysis, it is assumed that all tar sand recovery would take place on the cattle allotments. To estimate the amount of forage lost, estimated forage production within the STSA on Robbers Roost and Sewing Machine allotments has been averaged as follows: Robbers Roost, 22,000 acres; Sewing Machine, 66,000 acres; this totals 88,000 acres within the STSA, divided by total estimated forage production within the STSA: 88,000 acres divided by 1,530 AUMs equals 58 acres/AUM. Based on this estimation, about 14 AUMs would be lost to tar sand development annually. This is equivalent to 6 tons of hay. The loss of this amount of forage would have no adverse effect on livestock operations on these areas.

However, in addition to the loss of forage, range improvements, etc., on the mined area proper, there would be off-site impacts to livestock grazing. These impacts would include loss of stock water or access to water, loss of trails, changes in fencing, increased vehicle traffic, vandalism, disruptions in established patterns of use, and a general reduction in the area's suitability for livestock grazing. The period of loss of livestock forage and grazing suitability would likely be for the project's life plus 5 years.

ALTERNATIVE 3: NO ACTION

Leasing for tar sand would not be approved on conversions or potential tracts, although conventional oil and gas exploration and development could continue on existing leases. There could be some tar sand development on State and private lands in the STSAs. Based on historic development activities in the area, occasional oil and gas exploration would occur sporadically at relatively low levels. The location and intensity of exploration and development activities cannot be accurately predicted; however, environmental controls governing these activities would minimize impacts and protect natural resources at present levels. Environmental impacts of specific proposals would be assessed on a case-by-case basis or be covered by the Districtwide Oil and Gas EAs.

Impacts to soils, vegetation, animal life, recreation, and topography would be expected from private and State tar sand development. Some disturbed areas could, in most cases, be successfully rehabilitated. However, the extent of disturbance cannot be predicted, and these lands are outside BLM's jurisdiction. These projects would, however, result in increases in population, off-hour time, and income, which would increase recreational use in all areas by approximately 4 to 5 percent per year through 1990 (Utah Department of Natural Resources, Outdoor Recreation Agency, 1980).

The sections below describe projections for air quality, water, and socioeconomics with tar sand development on private and State lands but not on Federal lands in STSAs. These analyses also include changes expected within the region for a 20-year period from interrelated projects such as coal and other energy-related development.

Regional Overview

AIR QUALITY

This alternative considers other forms of development but does not consider tar sand development within STSAs. Annual average concentrations of TSP, SO₂ and NO₂ for 2005 were modeled using the point sources listed below as interrelated projects. These cumulative totals are used in Alternatives 1 and 2 to determine levels without Federal tar sand development. The following lists the planned and existing major point sources used by Aerocamp, Inc. (1983a), in developing the air quality pollution baseline for comparison to the expected tar sand development activities.

The following lists companies proposing development which would result in major point sources of air pollution.

C & A Tar Sands
Chevron-GNC
Geokinetics
Hunter Power Plant Units 3 and 4
Magic Circle
Moon Lake Power Plant Units 1 and 2

Paraho
Plateau Refinery Expansion
SOHIO
Syntana-Utah
TOSCO
Western Tar Sands
White River Oil Shale

Source: Aerocamp, Inc., 1983.

The following lists existing major point sources of air pollution:

Carbon Power Plant Units 1 and 2
Hunter Power Plant Units 1 and 2
Huntington Canyon Power Plant Units 1 and 2
Plateau Refinery

Source: Aerocamp, Inc., 1983.

The concentrations include contributions from cities and towns, including increased population growth, vehicular-related pollution; existing industrial sources, and inter-related projects (planned industrial facilities). A background of 20 µg/m³, should be added to the TSP levels. Nine areas are expected to exceed the secondary annual average TSP NAAQS, primarily from fugitive particulate emissions. Annual SO₂ concentrations would be low, generally less than 5 µg/m³, and well below the standards. Although NO₂ concentrations would also be well below the NAAQS, somewhat elevated levels of NO₂ would occur over much of the Uinta Basin area, mostly because of proposed synfuel and other development in that area. Table 4-27 compares concentration levels for the year 2005 with NAAQS for each STSA. The secondary 24-hour NAAQS could be exceeded within the Asphalt Ridge/White Rocks, Hill Creek STSAs, and Raven Ridge/Rim Rock, mostly because of 2005 baseline sources. SO₂ and NO₂ concentrations would be well within the NAAQS at all STSAs. Some PSD incremental limitations would be exceeded at STSAs by inter-related projects, especially in the Uinta Basin area.

WATER RESOURCES

Water depletions from projects and uses other than Federal tar sand would probably utilize all but 48,000 acre-feet of Utah's allocation from the Upper Colorado River Basin by the year 2000 (see Appendix 3 for a list of projects). By the year 2010, all but 39,000 acre-feet would be utilized. Depending on water quality improvement measures adopted, water salinity at Imperial Dam (1980 level of 781 mg/ℓ) would increase from 870 to 1,024 mg/ℓ by the year 2000, and from 894 to 1,089 mg/ℓ by 2010 (USDI, 1983).

SOCIOECONOMICS

Appendix 9 contains pertinent data from the technical socioeconomics report prepared by Argonne National Laboratories (1983). Additional detail is provided in that appendix, which shows baseline projections for the cities and unincorporated areas within each CCD and county.

ALT. 3: NO ACTION

TABLE 4-27

Alternative 3
Comparison of Concentration Levels to NAAQS (2005)

STSA	Pollutant Averaging Time ($\mu\text{g}/\text{m}^3$)	2005 Baseline ($\mu\text{g}/\text{m}^3$)	Interrelated Projects ($\mu\text{g}/\text{m}^3$)	Cumulative Total ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)		
Argyle Canyon/ Willow Creek	SO ₂	3-hour	18	0	18	1,300	
		24-hour	7	0	7	365	
		Annual	1	0	1	80	
	TSP	24-hour	117	0	117	150	
		Annual	33	0	33	60	
	NO ₂	Annual	2	0	2	100	
	Asphalt Ridge/ White Rocks	SO ₂	3-hour	18	0	18	1,300
			24-hour	7	0	7	365
Annual			1	0	1	80	
TSP		24-hour	159	0	159	150	
		Annual	42	0	42	60	
NO ₂		Annual	13	0	13	100	
Circle Cliffs		SO ₂	3-hour	18	0	18	1,300
			24-hour	7	0	7	365
	Annual		1	0	1	80	
	TSP	24-hour	62	0	62	150	
		Annual	19	0	19	60	
	NO ₂	Annual	13	0	13	100	
	Hill Creek	SO ₂	3-hour	18	234	252	1,300
			24-hour	7	65	72	365
Annual			1	2	3	80	
TSP		24-hour	164	6	170	150	
		Annual	44	1	45	60	
NO ₂		Annual	2	4	6	100	

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-27 (continued)

STSA	Pollutant Averaging Time ($\mu\text{g}/\text{m}^3$)	2005 Baseline ($\mu\text{g}/\text{m}^3$)	Interrelated Projects ($\mu\text{g}/\text{m}^3$)	Cumulative Total ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)		
P. R. Spring	SO ₂	3-hour	18	47	65	1,300	
		24-hour	7	13 ^a	20	365	
		Annual	1	1	2	80	
	TSP	24-hour	69	1	70	150	
		Annual	21	1	21	60	
	NO ₂	Annual	2	1	3	100	
	Raven Ridge/ Rim Rock	SO ₂	3-hour	18	25	43	1,300
			24-hour	7	7	14	365
			Annual	1	3	4	80
TSP		24-hour	142	12	152	150	
		Annual	39	3	42	60	
NO ₂		Annual	2	15	17	100	
San Rafael Swell		SO ₂	3-hour	18	76	94	1,300
			24-hour	7	21	28	365
			Annual	1	5	6	80
	TSP	24-hour	62	10	72	150	
		Annual	19	1	20	60	
	NO ₂	Annual	13	15	28	100	
	Sunnyside	SO ₂	3-hour	18	0	18	1,300
			24-hour	7	0	7	365
			Annual	1	0	1	80
TSP		24-hour	84	0	84	150	
		Annual	24	0	24	60	
NO ₂		Annual	2	0	2	100	

ALT. 3: NO ACTION

TABLE 4-27 (concluded)

STSA	Pollutant Averaging Time ($\mu\text{g}/\text{m}^3$)	2005 Baseline ($\mu\text{g}/\text{m}^3$)	Interrelated Projects ($\mu\text{g}/\text{m}^3$)	Cumulative Total ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	
Tar Sand Triangle	SO ₂	3-hour	18	0	18	1,300
		24-hour	7	0	7	365
		Annual	1	0	1	80
	TSP	24-hour	62	0	62	150
		Annual	19	0	19	60
		NO ₂				
		Annual	13	0	13	100

Source: Aerocomp, Inc., 1983a.

Population Projections

The baseline population projections were determined by the Utah State Planning Coordinator's Office (1983). Table 4-28 presents the population projections for each county from 1985 to 2005. Total population is also illustrated in Figure 4-6. Projections for households are presented in Table 4-29 by county and community. *Appendix 10 contains a summary of interrelated projects. This summary can be used to differentiate the affects of baseline projects (i.e., those projects which can reasonably be expected to occur) with interrelated projects (i.e., those projects which are currently speculative).*

The following is a summary of the expected population changes for each affected county.

Carbon County

The population of Carbon County is projected to increase from 29,590 in 1985 to 37,280 in 2005 (Table 4-28). This would be a 68-percent increase from 1980 and would make this the largest for any county in the region. School-age population would increase more rapidly than total population between 1985 and 1995, but it would actually decrease between 1995 and 2000.

Most of the population increase is expected to occur in the Price CCD, and especially in Price, Wellington, and unincorporated areas. In these areas, population is projected to grow from 2 to 3 percent annually between 1985 and 1995 and only marginally in the following 10 years.

The number of households in Carbon County is expected to increase from 9,460 in 1985 to 11,700 in 2005. Most of this growth (1.79 percent annually) would take place during the first 10 years, with less growth (0.35 percent annually) in the next 10 years. This growth patterns is illustrated in Table 4-30.

Duchesne County

The population of Duchesne county is projected to increase 43 percent between 1980 and 2005. All of this growth is projected to occur by 1995, and the population of the county is expected to decline 0.39 percent annually after 1995. The school-age population would increase more rapidly than total population between 1985 and 1995, and would decrease more rapidly than the total population from 1995 to 2005.

Household growth would be less than population growth in Duchesne County between 1985 and 1995. The Roosevelt CCD is projected to increase 0.58 percent annually, while the Duchesne CCD would decrease 1.41 percent annually through 1995. However, unlike the decrease in county population projected after 1995, the number of households would increase in both the Roosevelt CCD (0.21 percent annually) and Duchesne CCD (0.47 percent annually).

Emery County

Emery County population is expected to increase from 14,060 in 1985 to 14,550 in 2005. Most of the 27-percent increase between 1985 and 2005 is projected to take place by 1990. The population of the county is expected to reach a

peak of 15,080 in 1995 and would decline by 0.36 percent annually after 1995. School-age population would grow more rapidly than the total population through 1995, at which time it would drop 0.87 percent annually in the next 5 years and would remain constant through 2005.

The most rapid growth in population is projected to occur in the Green River CCD, with the City of Green River projected to grow 1.40 percent annually between 1985 and 1995, and the unincorporated areas increasing 1.96 percent annually during the same period. The population of the Green River CCD is projected to remain constant from 1995 until 2005.

The number of households in Emery County is projected to change only slightly, from 3,920 in 1985 to 3,970 in 2005. A peak of 4,070 households would be reached in 1995. This would be followed by a 0.25-percent annual decrease.

Garfield County

The population of Garfield County is forecast to increase 42 percent between 1980 and 2005, reaching a total of 5,210 in 2005. The greatest increase would occur between 1985 and 1995--1.10 percent annually--but the county would continue to grow 0.82 percent annually from 1995 to 2005. The school-age population is projected to increase throughout the period, growing from 1,000 in 1985 to 1,500 in 2005.

The population of the Escalante CCD would increase by 30 between 1985 and 1995 and by 20 between 1995 and 2005. With the exception of an additional 10 people in Boulder in 2005, all of this growth would take place in Escalante. There is no change in population forecasted in the Hite CCD between 1985 and 2005. Most of the growth would occur in other parts of the county, where the population would increase 1.43 percent annually from 1985 to 1995 and 1.04 percent annually from 1995 to 2005.

The number of households in Garfield County is projected to increase from 1,440 in 1985 to 1,740 in 2005. There would be little difference between the rate of increase in population and the rate of increase in households, even on the community level.

Grand County

The population of Grand County is forecast to increase by only 3.14 percent between 1980 and 2005. After a drop between 1980 and 1985, the population would grow 0.82 percent annually from 1985 to 1995 and 0.05 percent annually from 1995 to 2005. The population of school age is expected to increase 3.46 percent annually between 1985 and 1990 and then would fluctuate for the remaining years until 2005.

The number of households in Grand County are projected to increase from 2,600 in 1985 to 2,870 in 2005. The change in the number of households would closely reflect the projected change in the population.

Uintah County

The population of Uintah County is forecast to increase from 25,720 in 1985 to 28,200 in 2005. The county would grow 1.50 percent annually from 1985 to 1995, but would then decrease 0.57 percent annually from 1995 to 2005.

ALT. 3--NO ACTION

TABLE 4-28

Alternative 3
Summary of Population Projections
(1985-2005)

County and Years	Total Population		School-Age Population	
	Baseline Projection	Average Annual % Change ^a	Baseline Projection	Average Annual % Change
<u>Carbon County</u>				
1985	29,590	--	6,800	--
1990	34,500	3.12	8,700	5.05
1995	36,500	1.13	9,700	2.20
2000	36,790	0.16	9,500	-0.42
2005	37,280	0.26	9,600	0.21
<u>Duchesne County</u>				
1985	17,780	--	4,760	--
1990	18,640	0.95	5,430	2.67
1995	18,680	0.04	5,750	1.15
2000	18,300	-0.41	5,330	-1.51
2005	17,970	-0.36	5,230	-0.38
<u>Emery County</u>				
1985	14,060	--	3,800	--
1990	14,840	1.09	4,400	2.98
1995	15,080	0.32	4,700	1.33
2000	14,730	-0.47	4,500	-0.87
2005	14,550	-0.25	4,500	0
<u>Garfield County</u>				
1985	4,300	--	1,000	--
1990	4,600	1.36	1,200	3.71
1995	4,800	0.85	1,300	1.61
2000	4,990	0.77	1,400	1.49
2005	5,210	0.87	1,500	1.39
<u>Grand County</u>				
1985	7,800	--	2,050	--
1990	8,250	1.13	2,430	3.46
1995	8,460	0.50	2,550	0.97
2000	8,330	-0.31	2,430	-0.96
2005	8,500	0.40	2,480	0.41
<u>Uintah County</u>				
1985	25,720	--	6,820	--
1990	29,310	2.58	8,430	4.33
1995	29,850	0.37	9,190	1.74
2000	28,970	-0.60	8,440	-1.69
2005	28,200	-0.54	8,210	-0.55

CHAP. 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-28 (concluded)

County and Years	Total Population		School-Age Population	
	Baseline Projection	Average Annual % Change ^a	Baseline Projection	Average Annual % Change
<u>Wayne County</u>				
1985	2,130	--	510	--
1990	2,340	1.90	560	1.89
1995	2,570	1.89	620	2.06
2000	2,740	1.29	660	1.26
2005	2,930	1.35	700	1.18

Source: Argonne National Laboratories, 1983.

^aComputed as average annual compound percent change from previous 5-year period.

ALT. 3: NO ACTION

TABLE 4-29

Alternative 3
Summary of Household Projections^{a,b}
(1985-2005)

County	Household Projections					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Carbon County</u>	9,460	10,850	11,300	11,520	11,700	1.79	0.35
East Carbon CCD	670	500	460	430	410	-3.69	-1.14
East Carbon	500	380	350	330	310	-3.50	-1.21
Sunnyside	160	120	110	100	100	-3.68	-0.95
Unincorp. Areas	5	4	3	3	3	-4.98	0
Helper CCD	1,880	2,060	2,110	2,130	2,170	1.16	0.28
Helper	1,110	1,220	1,250	1,260	1,280	1.19	0.23
Scofield	40	40	50	50	50	2.26	0
Unincorp. Areas	730	800	810	820	840	1.05	0.36
Price CCD	6,910	8,290	8,730	8,960	9,120	2.37	0.43
Hiawatha	70	80	80	80	80	1.34	0
Price	4,250	5,130	5,470	5,690	5,790	2.56	0.57
Wellington	680	820	860	880	900	2.38	0.46
Unincorp. Areas	1,910	2,260	2,320	2,310	2,350	1.96	0.13
<u>Duchesne County</u>	5,260	5,370	5,340	5,400	5,480	0.15	0.26
Duchesne CCD	1,210	1,030	1,050	1,080	1,100	-1.41	0.47
Duchesne City	720	610	620	640	650	-1.48	0.47
Rest of CCD	490	420	430	440	450	-1.30	0.46
Roosevelt CCD	4,050	4,350	4,290	4,320	4,380	0.58	0.21
Altamont	60	80	80	80	80	2.92	0
Myton	200	210	210	210	210	0.49	0
Roosevelt	1,600	1,720	1,700	1,710	1,730	0.61	0.18
Rest of CCD	2,190	2,330	2,300	2,320	2,360	0.49	0.26
<u>Emery County</u>	3,920	4,030	4,070	4,030	3,970	0.38	-0.25
Castle Dale- Huntington CCD	2,720	2,850	2,860	2,830	2,780	0.50	-0.28
Castle Dale	730	790	800	790	780	0.92	-0.25
Cleveland	160	170	170	170	160	0.61	-0.60
Elmo	100	100	100	100	100	0	0
Huntington	790	810	800	790	780	0.13	-0.25
Orangeville	520	540	550	540	530	0.56	-0.37
Unincorp. Areas	420	440	440	440	430	0.47	-0.23
Emery-Ferron CCD	930	870	880	870	870	-0.55	-0.11
Clawson	80	70	70	70	70	-1.33	0
Emery	140	130	130	130	130	-0.74	0
Ferron	630	600	610	600	600	-0.32	-0.17
Unincorp. Areas	80	70	70	70	70	-1.33	0

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

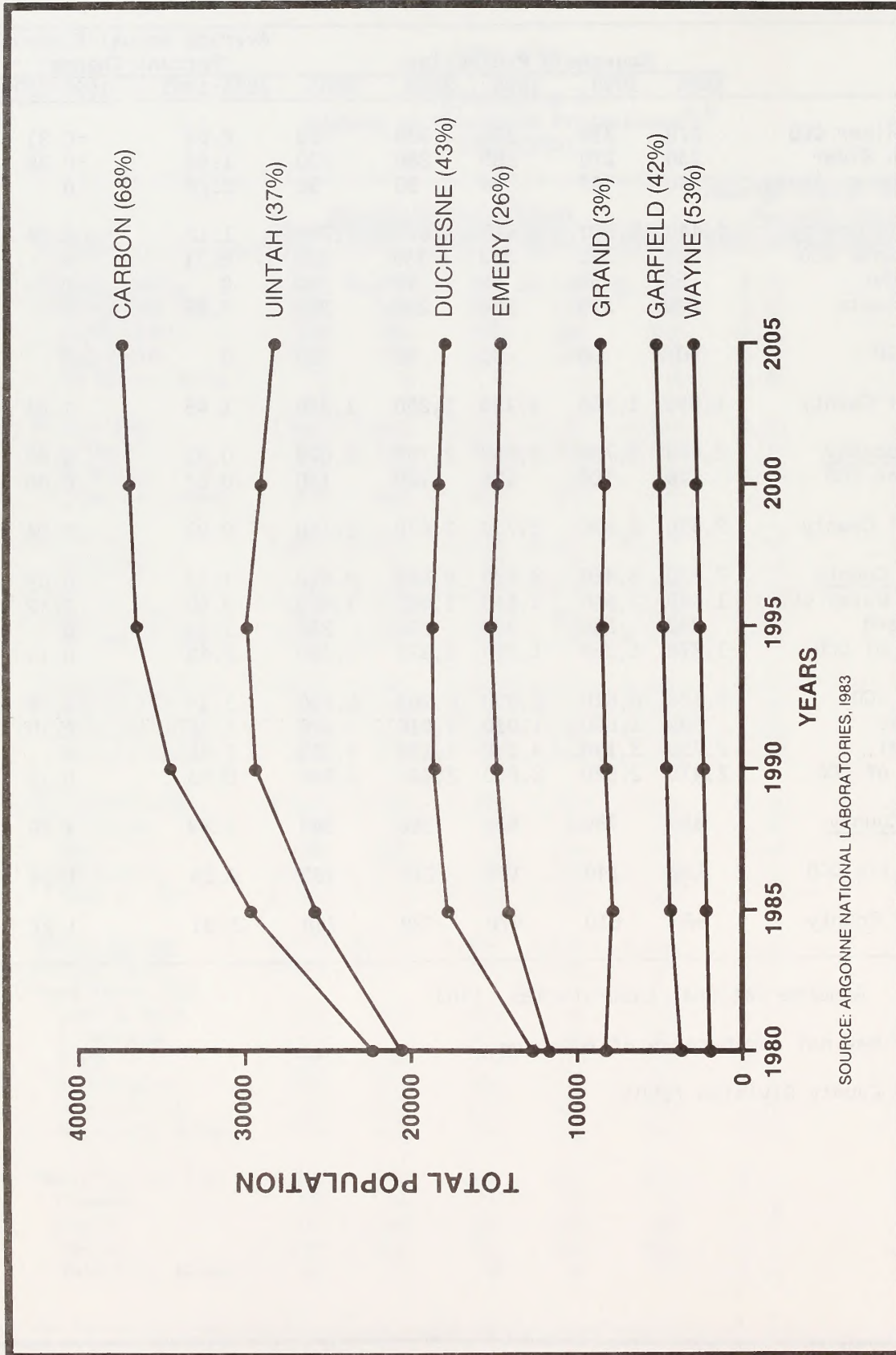
TABLE 4-29 (concluded)

County	Household Projection					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Green River CCD	270	310	330	330	320	2.03	-0.31
Green River	230	270	280	280	270	1.99	-0.36
Unincorp. Areas	40	40	50	50	50	2.26	0
<u>Garfield County</u>	1,440	1,540	1,610	1,670	1,740	1.12	0.78
Escalante CCD	320	320	330	330	330	0.31	0
Boulder	50	50	50	50	50	0	0
Escalante	270	270	280	280	280	0.36	0
Hite CCD	90	90	90	90	90	0	0
Rest of County	1,030	1,130	1,190	1,250	1,320	1.45	1.04
<u>Grand County</u>	2,600	2,790	2,850	2,790	2,870	0.92	0.07
Thompson CCD	110	120	120	120	130	0.87	0.80
Rest of County	2,490	2,670	2,730	2,670	2,740	0.92	0.04
<u>Uintah County</u>	7,620	8,450	8,530	8,540	8,610	1.13	0.09
Uintah Ouray CCD	1,500	1,640	1,640	1,640	1,660	0.90	0.12
Ballard	230	280	280	270	280	1.99	0
Rest of CCD	1,270	1,360	1,360	1,370	1,380	0.69	0.14
Vernal CCD	6,120	6,810	6,890	6,900	6,950	1.19	0.09
Naples	900	1,000	1,010	1,010	1,020	1.16	0.10
Vernal	2,750	3,190	3,250	3,230	3,250	1.68	0
Rest of CCD	2,470	2,620	2,630	2,660	2,680	0.63	0.19
<u>Wayne County</u>	680	750	820	890	940	1.89	1.38
Hanksville CCD	120	140	150	170	180	2.26	1.84
Rest of County	560	610	670	720	760	1.81	1.27

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bCensus County Division (CCD).



SOURCE: ARGONNE NATIONAL LABORATORIES, 1983

FIGURE 4-6
ALTERNATIVE 3
PROJECTION OF COUNTY POPULATION INCREASES

CHAP. 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-30

Alternative 3
Personal Income Projections^a
(1985-2005)

Geographic Area and Income Category	Income Projections				
	1985	1990	1995	2000	2005
<u>State of Utah</u>					
PCPI ^b	8,932	9,736	10,631	11,568	12,585
<u>Carbon County</u>					
PCPI ^b	10,182	10,612	10,525	11,568	12,585
Total Personal Income (\$10 ³)	301,389	366,114	384,163	426,859	469,421
<u>Duchesne County</u>					
PCPI ^b	8,485	9,249	10,099	10,990	11,956
Total Personal Income (\$10 ³)	150,870	172,313	188,658	201,000	214,845
<u>Emery County</u>					
PCPI ^b	8,932	9,736	10,631	11,568	12,585
Total Personal Income (\$10 ³)	125,941	144,093	160,528	170,050	183,741
<u>Garfield County</u>					
PCPI ^b	7,592	8,276	9,036	9,833	10,697
Total Personal Income (\$10 ³)	32,646	38,070	43,373	49,165	55,624
<u>Grand County</u>					
PCPI ^b	8,932	9,736	10,613	11,568	12,585
Total Personal Income (\$10 ³)	69,670	80,332	89,786	96,361	106,973
<u>Uintah County</u>					
PCPI ^b	8,932	9,736	10,631	11,568	12,585
Total Personal Income (\$10 ³)	229,642	285,362	317,335	335,125	354,771
<u>Wayne County</u>					
PCPI ^b	7,146	7,789	8,505	9,254	10,068
Total Personal Income (\$10 ³)	15,007	17,915	22,113	24,986	29,197

Source: Argonne National Laboratories, 1983.

^a1980 dollars

^bPCPI = per capita personal income.

ALT. 3: NO ACTION

Similarly, school-age population would jump from 6,820 in 1985 to 9,190 in 1995, and then would decline 10.7 percent in the following 10 years.

The number of households in Uintah County is projected to increase from 7,620 in 1985 to 8,610. Most of this growth would occur during the 1985 to 1995 period. The Vernal and Uintah Ouray CCDs are expected to increase at rates of 1.19 percent annually and 0.90 percent annually, respectively. The number of households would increase most rapidly in Ballard.

Wayne County

Between 1980 and 2005, the population of Wayne County is forecasted to increase by slightly over 50 percent. This growth would be roughly continuous throughout the period, reaching 2,930 in 2005. The number of school-age children would grow at rates that ranged from 1.12 percent annually to 2.06 percent annually between 1985 and 2005.

The most rapid growth in the county would occur in the Hanksville CCD, which would grow 3.51 percent annually from 1985 to 1995 and 1.73 percent annually from 1995 to 2005.

The number of households in Wayne County is forecasted to increase from 680 in 1985 to 940 in 2005. In the county as a whole, the rate of growth in households would be similar to the rate of population growth.

Employment Projections

Employment projections are based on the existing and expected future economic structure and the changing demographic characteristics of the population. These projections were made subject to the same assumptions and qualifications described for the population projection section.

Figure 4-7 illustrates the change in baseline employment projected between 1980 and 2005. It is evident from this figure that all counties are projected to experience some employment growth between 1980 and 2005. The fastest rate of increase appears to be 1980 and 1985 for most counties. However, Carbon and Uintah counties are expected to remain on an almost continuous growth trend throughout the period, while the other counties are forecasted to have relatively little change between 1985 and 2005—less than 1 percent annually in most cases. A detailed description of the baseline employment projections by industrial sector for each county is presented in Appendix 9.

Carbon County is projected to have the second largest growth in employment in the region. The total employment of 16,020 in 2005 would be a 71-percent increase over 1980 and 31 percent greater than the projected 1985 level. The annual growth rate would be 2.09 percent from 1985 to 1995 and 0.66 percent from 1995 to 2005. The most rapid increase is expected to occur in the finance, insurance, and real estate sector, which would increase 3.13 percent annually between 1985 and 1995 and 1.87 percent annually between 1995 and 2005. Wholesale and retail trade would

be the largest sector in the county in 2005, followed by government and mining.

In Duchesne County, basic employment in the oil and gas industry is projected to increase during the 1980s, although at slower growth rates than were evidenced during the 1970s. In the baseline projections, the oil and gas industry is projected to reach maturity in 1990 and remain constant thereafter. Very little change is anticipated in other basic sectors in the baseline projections.

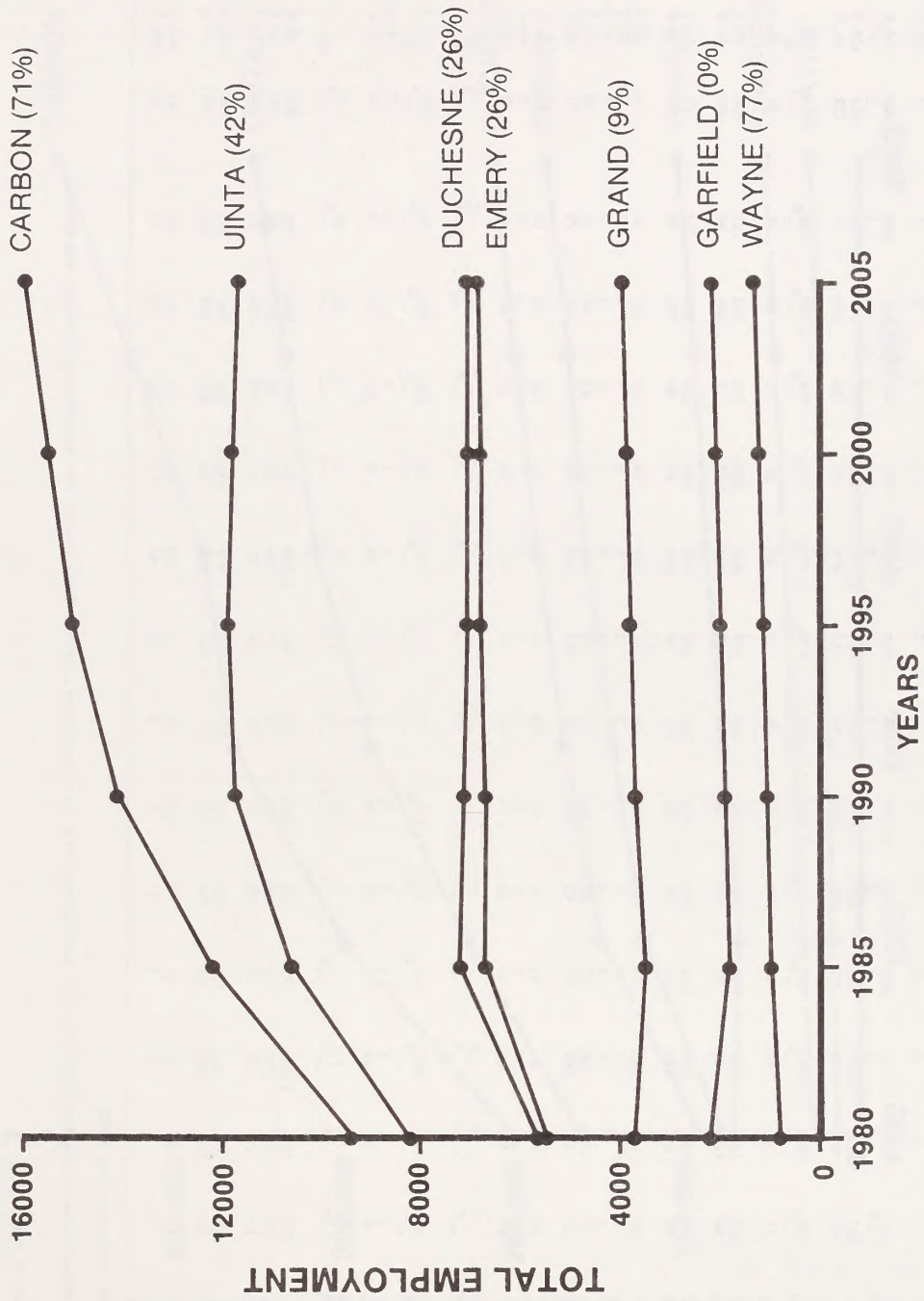
Total employment in Emery County is projected to increase 26 percent between 1980 and 2005. This growth would occur at a 0.06-percent rate between 1985 and 1990, and 0.16 percent annually thereafter. The most rapid growth from 1985 to 1995 is expected to be in the manufacturing sector, while the most rapid growth from 1995 to 2005 would be in the services sector. Of the 6,880 employees projected to be in the county in 2005, 2,500 would be working in the mining sector. Transportation, communication, and utilities would be the next largest sector, with 880 employees in 2005.

Total employment in Garfield County is forecasted to decrease slightly (-0.41 percent) between 1980 and 2005. A drop in employment is projected to occur between 1980 and 1985, followed by a roughly 1-percent annual increase from 1985 to 2005. The most rapid increase would occur in the wholesale and retail trade sector and the finance, insurance, and real estate sectors. Employment in each of these sectors is projected to increase 50 percent between 1985 and 2005. Government, nonfarm proprietors, and wholesale and retail trade would be the largest sectors in the county in 2005, according to these projections.

Total employment in Grand County is forecasted to increase 9 percent between 1980 and 2005. After a slight drop between 1980 and 1985, employment is projected to increase by less than 1 percent annually from 1985 through 2005. The transportation, communication, and utilities sectors would increase more rapidly than other sectors between 1985 and 2005: these sectors are expected to decrease 4.18 percent annually between 1995 and 2005. The services sector would grow most rapidly between 1995 and 2005. Wholesale and retail trade, government, and mining would be the largest sectors in the county in 2005.

Employment in Uintah County is projected to total 11,710 in 2005, a 42-percent increase since 1980. All of this growth is forecasted to occur by 1995, and the county would experience a slight decline in growth from 1995 to 2005 (-0.16 percent). Nonfarm proprietors would be the fastest growing sector, increasing at 2 percent annually from 1985 to 1995 and 1.9 percent annually from 1995 to 2005. Mining is expected to account for 2,890 of the employees projected to be in the county in 2005. Government, services, and wholesale and retail trade would employ over 1,800 workers each.

Wayne County is forecasted to have the most rapidly growing number of employees, in percentage terms, of any county in the region. Total employment is projected to be



SOURCE: ARGONNE NATIONAL LABORATORIES, 1983

FIGURE 4-7
ALTERNATIVE 3
PROJECTION OF COUNTY EMPLOYMENT LEVELS

ALT. 3--NO ACTION

TABLE 4-31
Alternative 3, b, c (1985-2005)
Housing Demand Projections By Year and Type

County/Community	Change in Housing Demand By Year and Type												Percent Change 1985-2005					
	1985			1990			1995			2000			2005			Single Family	Multi-Family	Mobile Homes
	Single Family	Multi-Family	Mobile Homes	Single Family	Multi-Family	Mobile Homes	Single Family	Multi-Family	Mobile Homes	Single Family	Multi-Family	Mobile Homes	Single Family	Multi-Family	Mobile Homes	Single Family	Multi-Family	Mobile Homes
Carbon County	1,290	323	538	2,126	532	996	2,529	633	1,054	2,636	659	1,098	104.3	104.0	104.1			
East Carbon CCD	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
East Carbon	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Sunnyside	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Helper CCD	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Helper	86	22	36	153	38	64	175	44	73	189	48	79	119.2	118.2	119.4			
Scotfield	3	1	2	6	2	3	8	2	3	8	2	4	166.7	100.0	100.0			
Price CCD	1,095	274	457	1,915	479	1,048	2,321	581	967	2,418	605	1,008	120.6	120.8	120.6			
Hivawha	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Price	745	187	311	1,272	318	530	1,477	403	671	1,671	418	697	124.3	123.5	124.1			
Wellington	162	41	68	243	61	102	270	71	118	293	74	122	80.9	80.5	79.4			
Duchesne County	1,007	252	420	1,072	268	447	1,088	273	454	1,139	285	475	13.1	13.1	13.1			
Duchesne CCD	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Duchesne City	133	34	56	70	18	29	77	22	36	93	24	39	-30.1	-29.4	-30.4			
Roosevelt CCD	659	165	275	831	208	347	800	200	334	818	215	358	30.2	30.3	30.2			
Roosevelt	264	66	110	333	84	139	320	82	137	344	86	143	30.3	30.3	30.2			
Emery County	376	94	157	455	114	190	468	117	195	434	104	173	10.1	10.6	10.2			
Castile-Dale	144	36	60	227	57	95	237	60	99	206	48	80	32.6	33.3	33.3			
Castile-Dale	114	29	48	149	37	62	160	40	67	151	37	61	28.9	27.6	27.1			
Cleveland	6	2	3	11	3	5	9	3	5	9	3	4	50.0	50.0	50.0			
Elmo	6	2	3	9	3	4	9	2	4	8	2	3	33.3	0	0			
Huntington	48	12	20	60	15	25	55	14	23	46	11	18	-12.5	-8.3	-10.0			
Orangeville	88	22	37	104	26	43	106	27	44	100	25	41	10.2	13.6	10.8			
Emery-Ferron CCD	76	19	32	45	12	19	50	13	21	42	10	16	-50.0	-47.4	-50.0			
Emery	9	3	4	5	2	2	6	2	3	6	2	2	-44.4	-33.3	-50.0			
Ferron	87	22	37	68	17	29	73	19	31	70	17	28	-23.0	-22.7	-24.3			
Green River CCD	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Green River	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Garfield County	135	34	56	195	49	81	235	59	98	275	69	131	133.3	132.4	133.9			
Escalante CCD	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Boulder	2	1	1	3	1	1	3	1	2	3	1	2	50.0	0	100.0			
Escalante	24	6	10	26	7	11	30	8	13	30	8	13	29.2	33.3	30.0			
Grand County	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Thompson CCD	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	--d	NA	NA	NA			
Utah County	1,007	252	420	1,510	378	629	1,569	390	650	1,599	400	667	58.8	58.7	58.8			
Utah-Orray CCD	148	37	62	235	59	98	232	58	97	240	234	100	62.2	62.2	61.3			
Ballard	57	14	24	86	22	36	83	21	35	84	21	35	47.4	50.0	45.8			
Vernal CCD	444	111	185	861	216	359	913	229	381	921	231	394	112.8	113.5	113.0			
Vernal	326	82	136	590	148	246	626	157	261	613	154	260	91.4	90.2	91.2			
Wayne County	39	10	16	31	21	34	126	32	53	159	40	81	400.0	390.0	406.3			
Hanksville CCD	15	4	7	26	7	11	35	9	15	44	11	22	246.7	225.0	214.3			

Source: Argonne National Laboratories, 1983.

^aIt is assumed that each household would require a housing unit, thereby resulting in a one-to-one correspondence between the household projections and housing demand.

^bTotals may not add because of rounding.

^cCensus County Division (CCD).

^dPopulation projections indicate a decline in future population levels. Consequently, existing housing units should become available in future time periods. The following 1980 to 2005 housing availability is expected: East Carbon CCD - 268 to 520; East Carbon - 127 to 377; Sunnyside - 27 to 87; Helper CCD - 291 to 2; Hivawha - 2 in 1985; Duchesne CCD - 135 to 248; Green River CCD - 158 to 110; Green River - 158 to 117; Escalante CCD - 116 to 103; Grand County - 172 in 1985; and Thompson CCD - 27 to 11.

^eUndefined.

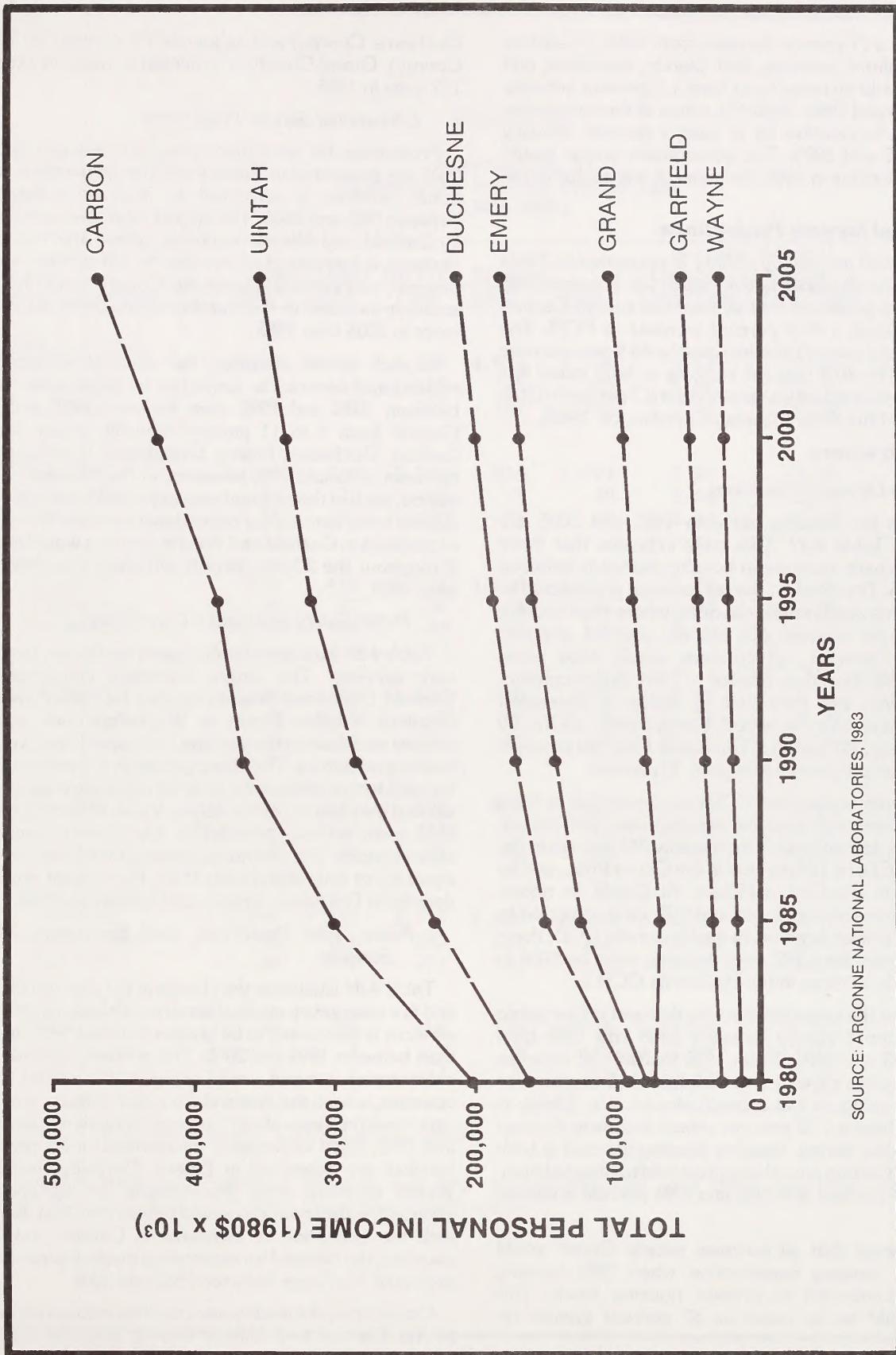


FIGURE 4-8
 ALTERNATIVE 3
 PROJECTION OF TOTAL PERSONAL INCOME

ALT. 3: NO ACTION

1,360 in 2005, a 77-percent increase from 1980. All sectors except agriculture, services, and finance, insurance, and real estate would increase by at least 1.5 percent annually between 1985 and 1995. Similarly, seven of the ten sectors are expected to increase by at least 1 percent annually between 1995 and 2005. The government sector would employ 430 workers in 2005, the most of any sector in the county.

Personal Income Projections

Total personal income by county is presented in Table 4-30 and graphically illustrated in Figure 4-8. Between 1985 and 2005, it is projected that all counties except Carbon would experience a 40.9 percent increase in PCPI. The PCPI for the state would also increase by 40.9 percent over this period. The 40.9 percent increase in both cases is a result of the assumed annual growth rate (1.7 percent) (Utah State Office of the State Planning Coordinator, 1983).

Infrastructure

Housing Demand Projections

Projections for housing between 1985 and 2005 are presented in Table 4-31. This table indicates that there would be dramatic increase in housing demands between 1985 and 2005. The greatest overall increase is projected to occur in Wayne and Garfield counties, where total housing demands would increase 406 percent and 134 percent, respectively; however, all counties would need more housing in 2005 than they needed in 1985. Some communities, however, are projected to realize a decreased housing demand over the period: Emery-Ferron CCD, -50 percent; Emery, -47 percent; Duchesne City, -30 percent; Ferron, -23 percent; and Huntington, -13 percent.

Several communities and CCDs are projected to have dramatic increases in housing demand over this period. Most notably, demand would increase by 244 percent in the Hanksville CCD, by 124 percent in the City of Price, and by 120 percent in the City of Helper. (It should be noted, however, that even though demand in Price is projected to increase at a slower rate than in the Hanksville CCD, there would be a need for 2,785 more housing units by 2005 in Price, but only 86 more in the Hanksville CCD.)

Throughout the counties, housing demand is forecasted to increase more rapidly between 1985 and 1995 than between 1995 and 2005. From 1995 to 2005, all counties except Emery are expected to maintain their demand for additional housing, but at a much slower rate. Emery is projected to have a 1.22-percent annual decline in demand over this 10-year period. Baseline housing demand in both Garfield and Carbon counties is projected to drop substantially, to 2.97 percent annually and 0.98 percent annually, respectively.

It is projected that all counties except Grand would require new housing construction when 1985 housing demand is compared to present housing stock. This demand would be as much as 37 percent greater (in

Duchesne County) and as low as 7.5 percent (in Wayne County). Grand County is expected to have an excess of 172 units in 1985.

Educational Service Projections

Projections for educational services between 1985 and 2005 are presented in Table 4-32. The demand for educational services is projected to increase substantially between 1985 and 2005. The largest increases would occur in Garfield and Wayne counties, where the number of students is forecasted to increase by 391 percent and 396 percent, respectively. Duchesne County would have the smallest increase in the number of students: 31 percent more in 2005 than 1985.

In each of the counties, the demand for additional educational services is projected to grow more rapidly between 1985 and 1995 than between 1995 and 2005. Growth from 5 to 11 percent annually would occur in Carbon, Duchesne, Emery, Grand, and Uintah counties between 1985 and 1995; however, in the following 10-year period, each of those counties is expected to realize a slight decline in the demand for educational services. The number of students in Garfield and Wayne counties would increase throughout the 20-year period, although at a slower rate after 1995.

Public Safety and Health Care Services

Table 4-33 illustrates the change in the demand for health care services. The largest increases would occur in Garfield, Grand and Wayne counties. Because there are no hospitals in either Emery or Wayne counties, even the modest increases in the demand for hospital beds would tax existing resources. The sharp growth in the projected need for long-term care hospital facilities in Uintah County would exceed the capacity of the Ashley Valley Medical Center by 2005—even without considering the current demand for such services. The additional demand for doctors would be equal to, or only slightly less than, the present number of doctors in Duchesne, Emery, and Uintah counties.

Police, Fire Protection, and Emergency Medical Services

Table 4-34 illustrates the change in the demand for police and fire emergency medical services. The demand for most services is forecasted to be greater between 1985 and 1995 than between 1995 and 2005. The greatest increase in law enforcement services would occur in Wayne and Carbon counties, where the demand for police officers and patrol cars would increase about 7 percent annually between 1985 and 1995. Slight increases in the demand for fire protection services are projected in Emery, Garfield, Grand, and Wayne counties, while the demand for fire protection services in other counties would remain constant. Similarly, with the exception of increases in Carbon and Grand counties, the demand for emergency medical services is not projected to change between 1985 and 2005.

Considering the inadequate conditions currently existing in the Carbon and Uintah county jails, the additional

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-32

Alternative 3
Educational Service Projections
(1985-2005)

Service Demand	Additional Service Demands ^a					Average Annual Compound % Change		% Change 1985-2005
	1985	1990	1995	2000	2005	1985-1995	1995-2005	
<u>Carbon County</u>								
Students	1,924	3,824	4,824	4,624	4,724	9.63	-0.21	145.5
Classrooms	77	153	193	185	189	9.62	-0.21	145.5
Teachers	77	153	193	185	189	9.62	-0.21	145.5
<u>Duchese County</u>								
Students	1,254	1,924	2,244	1,824	1,724	5.99	-2.60	37.5
Classrooms	51	77	90	73	69	5.84	-2.62	35.3
Teachers	51	77	90	73	69	5.84	-2.62	35.3
<u>Emery County</u>								
Students	816	1,416	1,716	1,516	1,516	7.72	-1.23	85.8
Classrooms	33	57	69	61	61	7.56	-1.22	84.8
Teachers	33	57	69	61	61	7.56	-1.22	84.8
<u>Garfield County</u>								
Students	128	328	428	528	628	12.83	3.91	390.6
Classrooms	6	14	18	22	26	11.61	3.75	333.3
Teachers	6	14	18	22	26	11.61	3.75	333.3
<u>Grand County</u>								
Students	99	479	599	479	529	19.72	-1.24	434.3
Classrooms	4	20	24	20	22	19.62	-0.87	450.0
Teachers	4	20	24	20	22	19.62	-0.87	450.0
<u>Uintah County</u>								
Students	1,400	3,010	3,770	3,020	2,790	10.41	-2.97	99.3
Classrooms	56	121	151	121	112	10.43	-2.94	100.0
Teachers	56	121	151	121	112	10.43	-2.94	100.0
<u>Wayne County</u>								
Students	48	98	158	198	238	12.65	4.18	395.8
Classrooms	2	4	7	8	10	13.35	3.63	400.0
Teachers	2	4	7	8	10	13.35	3.63	400.0

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth regardless of 1980 operating conditions.

ALT. 3--NO ACTION

TABLE 4-33

Alternative 3
Health Care Service Projections (1985-2000)^a
Resulting From Baseline Population Growth

County/ Service Demand	Change in Health Care Demand					Average Annual Compound % Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Carbon County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	15	25	29	30	31	6.81	0.67
Long-term care	23	39	39	39	43	5.42	0.98
<u>Medical personnel</u>							
Doctors	5	8	9	9	9	6.05	1.06
Dentists	4	7	8	8	8	7.18	0
Nurses	13	21	25	25	26	6.76	0.39
Public health nurses	2	3	3	3	4	4.14	2.92
<u>Mental Health Care</u>							
Clinical psychologist	1	1	1	1	1	0	0
Mental health workers	1	2	2	2	2	7.18	0
<u>Duchesne County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	11	13	13	12	11	1.68	-1.66
Long-term care	6	9	14	18	24	8.84	5.54
<u>Medical personnel</u>							
Doctors	3	4	4	4	4	2.92	0
Dentists	3	4	4	3	3	2.92	-2.84
Nurses	9	11	11	10	10	2.03	-0.95
Public health nurses	2	2	2	2	2	0	0
<u>Mental Health Care</u>							
Clinical psychologist	1	1	1	1	1	0	0
Mental health workers	1	1	1	1	1	0	0
<u>Emery County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	6	7	8	7	7	2.92	-1.33
Long-term care	6	6	6	4	4	0	3.97
<u>Medical personnel</u>							
Doctors	2	3	3	2	2	4.14	-3.97
Dentists	2	2	2	2	2	0	0
Nurses	5	6	7	6	6	3.40	0
Public health nurses	1	1	1	1	1	0	0
<u>Mental Health Care</u>							
Clinical psychologist	1	1	1	1	1	0	0
Mental health workers	1	1	1	1	1	0	0

CHAP. 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-33 (continued)

County/ Service Demand	Increase in Health Care Demand					Average Annual Compound % Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Garfield County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	2	2	3	3	4	0	0
Long-term care	3	3	3	1	2	0	0
<u>Medical personnel</u>							
Doctors	1	1	1	1	1	0	0
Dentists	1	1	1	1	1	0	0
Nurses	2	2	2	3	3	0	4.14
Public health nurses	1	1	1	1	1	0	0
<u>Mental Health Care</u>							
Clinical psychologist	1	1	1	1	1	0	0
Mental health workers	1	1	1	1	1	0	0
<u>Grand County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	0	1	1	1	1	- ^b	0
Long-term care	2	2	2	2	2	0	0
<u>Medical personnel</u>							
Doctors	0	1	1	1	1	- ^b	0
Dentists	0	1	1	1	1	- ^b	0
Nurses	0	1	1	1	1	- ^b	0
Public health nurses	0	1	1	1	1	- ^b	0
<u>Mental Health Care</u>							
Clinical psychologist	0	1	1	1	1	- ^b	0
Mental health workers	0	1	1	1	1	- ^b	0
<u>Uintah County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	11	18	19	17	16	5.62	-1.70
Long-term care	10	21	29	35	42	11.23	3.77
<u>Medical personnel</u>							
Doctors	4	6	6	6	5	7.18	-1.81
Dentists	3	5	5	5	4	5.24	-2.21
Nurses	9	15	16	15	14	5.92	-1.33
Public health nurses	2	2	2	2	2	0	0
<u>Mental Health Care</u>							
Clinical psychologist	1	1	1	1	1	0	0
Mental health workers	1	1	1	1	1	0	0

ALT. 3--NO ACTION

TABLE 4-33 (concluded)

County/ Service Demand	Increase in Health Care Demand					Average Annual Compound % Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Wayne County</u>							
<u>General Health Care</u>							
<u>Hospital beds</u>							
General care	1	1	2	2	3	7.18	4.14
Long-term care	2	3	4	5	6	7.18	4.14
<u>Medical personnel</u>							
Doctors	1	1	1	1	1	0	0
Dentists	1	1	1	1	1	0	0
Nurses	1	1	2	2	2	7.18	0
Public health nurses	1	1	1	1	1	0	0
<u>Mental Health Care</u>							
Clinical psychologist	1	1	1	1	1	0	0
Mental health workers	1	1	1	1	1	0	0

Source: Argonne National Laboratories, 1983.

^aThese figures do not include projections for tar sand development.

^bUndefined.

CHAP. 4: ENVIRONMENTAL CONSEQUENCES

TABLE 4-34

Alternative 3
Public Safety Requirements by County and Year

County/ Service Demand	Change in Service Demands					Average Annual	
	1985	1990	1995	2000	2005	Compound Percent Change 1985-1995	1995-2005
<u>Carbon County</u>							
<u>Law Enforcement</u>							
Police officers	15	25	29	30	31	6.81	0.67
Patrol cars	15	25	29	30	31	6.81	0.67
Jail Space (sq. ft.)	3,703	6,161	7,161	7,306	7,551	6.82	0.53
Juvenile holding cells ^a	1	2	2	2	3	7.18	4.14
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	3,000/ 10	3,000/ 10	3,000/ 10	3,000/ 10	3,000/ 10	0	0
<u>Emergency Medical Service</u>							
Ambulances	2	3	3	3	4	4.14	2.92
Emergency medical technicians	14	21	21	21	28	4.14	2.92
<u>Duchesne County</u>							
<u>Law Enforcement</u>							
Police officers	11	13	13	12	11	1.68	-1.66
Patrol cars	11	13	13	12	11	1.68	-1.66
Jail Space (sq. ft.)	2,608	3,033	3,058	2,863	2,703	1.60	-1.23
Juvenile holding cells ^a	1	1	1	1	1	0	0
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	2,500/ 10	3,000/ 10	3,000/ 10	2,500/ 10	2,500/ 10	1.84	-1.81
<u>Emergency Medical Service</u>							
Ambulances	2	2	2	2	2	0	0
Emergency medical technicians	14	14	14	14	14	0	0
<u>Emery County</u>							
<u>Law Enforcement</u>							
Police officers	6	7	8	7	7	2.92	-1.33
Patrol cars	6	7	8	7	7	2.92	-1.33
Jail Space (sq. ft.)	1,305	1,695	1,815	1,640	1,550	3.35	-1.57
Juvenile holding cells ^a	1	1	1	1	1	0	0
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	1,750/ 7	2,000/ 8	2,000/ 8	2,000/ 8	2,000/ 8	1.34	0
<u>Emergency Medical Service</u>							
Ambulances	1	1	1	1	1	0	0
Emergency medical Technicians	7	7	7	7	7	0	0

ALT. 3: NO ACTION

TABLE 4-34 (continued)

County/ Service Demand	Change in Service Demands					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Garfield County</u>							
<u>Law Enforcement</u>							
Police officers	2	2	3	3	4	4.14	2.92
Patrol cars	2	2	3	3	4	4.14	2.92
Jail Space (sq. ft.)	314	464	564	664	764	6.03	3.08
Juvenile holding cells ^a	1	1	1	1	1	0	0
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	1,000/ 4	1,000/ 4	1,000/ 5	1,000/ 5	1,000/ 6	2.26	1.84
<u>Emergency Medical Service</u>							
Ambulances	1	1	1	1	1	0	0
Emergency medical Technicians	7	7	7	7	7	0	0
<u>Grand County</u>							
<u>Law Enforcement</u>							
Police officers	0	1	1	1	1	c	0
Patrol cars	0	1	1	1	1	c	0
Jail Space (sq. ft.)	-220	5	110	45	130	c	1.68
Juvenile holding cells ^a	0	1	1	1	1	c	0
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	0/ 0	1,000/ 4	1,000/ 4	1,000/ 4	1,000/ 4	c	0
<u>Emergency Medical Service</u>							
Ambulances	0	1	1	1	1	c	0
Emergency medical Technicians	0	7	7	7	7	c	0
<u>Uintah County</u>							
<u>Law Enforcement</u>							
Police officers	11	18	19	17	16	5.62	-1.70
Patrol cars	11	18	19	17	16	5.62	-1.70
Jail Space (sq. ft.)	2,602	4,402	4,672	4,222	3,842	6.03	-1.94
Juvenile holding cells ^a	1	2	2	2	2	7.18	0
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	2,500/ 10	3,000/ 10	3,000/ 10	3,000/ 10	3,000/ 10	1.84	0
<u>Emergency Medical Service</u>							
Ambulances	2	2	2	2	2	0	0
Emergency medical Technicians	14	14	14	14	14	0	0

CHAP. 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-34 (concluded)

County/ Service Demand	Change in Service Demands					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Wayne County							
<u>Law Enforcement</u>							
Police officers	1	1	2	2	2	7.18	4.14
Patrol cars	1	1	2	2	2	7.18	4.14
Jail Space (sq. ft.)	105	215	330	420	510	12.18	4.45
Juvenile holding cells ^a	1	1	1	1	1	0	0
<u>Fire Protection</u>							
Fire flow (gpm)/ duration (hrs) ^b	1,000 4	1,000/ 4	1,000/ 4	1,000/ 4	1,000/ 5	0	0
<u>Emergency Medical Service</u>							
Ambulances	1	1	1	1	1	0	0
Emergency medical Technicians	7	7	7	7	7	0	0

Source: Argonne National Laboratories, 1983.

^aNumber of 16-hour juvenile holding cells.

^bFire flow is measured in gallons per minute (gpm) for a length of time (duration) measured in hours.

^cUndefined.

ALT. 3--NO ACTION

TABLE 4-35

Alternative 3
Utility Service Demands

County Service Demands	Additional Service Demands					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Carbon County</u>							
Water System							
Connections	2,390	3,975	4,620	4,714	4,872	6.81	0.53
Supply (10 ⁶ gal/d)	3.8	6.4	7.4	7.5	7.8	6.89	0.53
Storage (10 ⁶ gal/d)	1.9	3.2	3.7	3.8	3.9	6.89	0.53
Treatment (10 ⁶ gal/d)	3.8	6.4	7.4	7.5	7.8	6.89	0.53
Sewage System (10 ⁶ gal/d)	0.7	1.2	1.4	1.5	1.5	7.18	0.69
Solid Waste ^a							
<u>Duchesne County</u>							
Water System							
Connections	1,683	1,957	1,973	1,847	1,744	1.60	-1.23
Supply (10 ⁶ gal/d)	2.7	3.1	3.2	3.0	2.8	1.71	-1.33
Storage (10 ⁶ gal/d)	1.3	1.6	1.6	1.5	1.4	2.10	-1.33
Treatment (10 ⁶ gal/d)	2.7	3.1	3.2	3.0	2.8	1.71	-1.33
Sewage System (10 ⁶ gal/d)	0.5	0.6	0.6	0.6	0.5	1.84	-1.81
Solid Waste ^a							
<u>Emery County</u>							
Water System							
Connections	842	1,094	1,171	1,058	1,000	3.35	-1.57
Supply (10 ⁶ gal/d)	1.3	1.8	1.9	1.7	1.6	3.87	-1.70
Storage (10 ⁶ gal/d)	0.7	0.9	0.9	0.8	0.8	2.54	-1.17
Treatment (10 ⁶ gal/d)	1.3	1.8	1.9	1.7	1.6	3.87	-1.70
Sewage System (10 ⁶ gal/d)	0.3	0.3	0.4	0.3	0.3	2.92	-2.84
Solid Waste ^a							
<u>Garfield County</u>							
Water System							
Connections	203	300	364	429	493	6.01	3.08
Supply (10 ⁶ gal/d)	0.3	0.5	0.6	0.7	0.8	7.18	2.92
Storage (10 ⁶ gal/d)	0.2	0.2	0.3	0.3	0.4	4.14	2.92
Treatment (10 ⁶ gal/d)	0.3	0.5	0.6	0.7	0.8	7.18	2.92
Sewage System (10 ⁶ gal/d)	0.1	0.1	0.1	0.1	0.2	0	7.18
Solid Waste ^a							

CHAP. 4--ENVIRONMENTAL CONSEQUENCES

TABLE 4-35 (concluded)

County Service Demands	Additional Service Demands					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Grand County</u>							
<u>Water System</u>							
Connections	-142	3	71	29	84	-- ^b	1.70
Supply (10 ⁶ gal/d)	-0.2	0.1	0.1	0.1	0.1	-- ^b	0
Storage (10 ⁶ gal/d)	-0.1	0.1	0.1	0.1	0.1	-- ^b	0
Treatment (10 ⁶ gal/d)	-0.2	0.1	0.1	0.1	0.1	-- ^b	0
Sewage System (10 ⁶ gal/d)	-0.1	0.1	0.1	0.1	0.1	-- ^b	0
Solid Waste ^a							
<u>Uinta County</u>							
<u>Water System</u>							
Connections	1,679	2,841	3,015	2,731	2,479	6.03	-1.94
Supply (10 ⁶ gal/d)	2.7	4.5	4.8	4.4	4.0	5.92	-1.81
Storage (10 ⁶ gal/d)	1.7	2.3	2.4	2.2	2.0	3.51	-1.81
Treatment (10 ⁶ gal/d)	2.7	4.5	4.8	4.4	4.0	5.92	-1.81
Sewage System (10 ⁶ gal/d)	0.5	0.9	0.9	0.8	0.8	6.05	-1.17
Solid Waste ^a							
<u>Wayne County</u>							
<u>Water System</u>							
Connections	68	139	213	271	329	12.10	4.44
Supply (10 ⁶ gal/d)	0.1	0.2	0.3	0.4	0.5	11.61	5.24
Storage (10 ⁶ gal/d)	0.1	0.1	0.2	0.2	0.3	7.18	4.14
Treatment (10 ⁶ gal/d)	0.1	0.2	0.3	0.4	0.5	11.61	5.24
Sewage System (10 ⁶ gal/d)	0.1	0.1	0.1	0.1	0.1	0	0
Solid Waste ^a							

Source: Argonne National Laboratories, 1983.

^aThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

^bUndefined.

ALT. 3: NO ACTION

demand for jail space would be especially severe in those counties. The demand for police officers by 2005 would be well over twice as large as the existing police force in Carbon and Garfield counties and would be roughly equal to the existing force in Duchesne, Uintah, and Wayne counties. It is difficult to compare the existing fire protection services with the future demand because the existing services are described in terms of fire flow and duration. The emergency medical services in each county are expected to be adequate for the projected population increases.

Utility Service Projection

Table 4-35 identifies the changes in utility service demands. Additional service demands are calculated for

each county between 1985 and 2005. Water system needs are presented in terms of the number of connections and the supply, storage, and treatment requirements in mpg. Sewage system demands are also presented in mpg. Because Utah does not have a solid waste standard, an estimate of solid waste disposal impacts could not be determined.

The demand for utility services between 1985 and 2005 is projected to increase most rapidly in Grand and Wayne counties and least rapidly in Duchesne County. Service demands are expected to increase in each county between 1985 and 1995 by 1.7 percent to 12.1 percent annually.



APPENDIX 1

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
RICHFIELD DISTRICT OFFICE
150 EAST 900 NORTH
RICHFIELD, UTAH 84701

IN REPLY
REFER TO:

STAFF REPORT

SUBJECT: Rationale and Data Sources For Determining Alternative Production Levels For Special Tar Sand Areas In Utah

DATE: March 1983.

AUTHORS: Brad Palmer, Vernal District; Ferris Clegg, Richfield District; Earl Hindley, Utah State Office.

INTRODUCTION

On March 23 and 24, 1983 a meeting was held in the Utah State Office for the purpose of setting final estimated production levels from the various Special Tar Sand Areas (STSAs) in Utah. These production levels will be utilized in the Utah Combined Hydrocarbon Regional EIS.

In addition to setting the production levels, the attendees also established work force estimates and water requirements needed for construction and operation at the various production levels.

Meeting Attendees:

Earl Hindley, Utah State Office
Thom Slater, Utah State Office
Alan Partridge, Richfield District Office
Ferris Clegg, Richfield District Office
Brad Palmer, Vernal District Office
Sid Vogelpohl, Price River Resource Area Office
Hal Hubbard, Minerals Management Service (now BLM)
Brad Barber, Utah State Planning Coordinators Office
Richard Winter, Argonne National Laboratory

A. ESTIMATED TOTAL IN-PLACE RESERVES

Total reserve data were obtained from the Minerals Management Service (MMS). Data are combined in Utah Tar Sand Leasing Minutes, Nos. 1-11, November 5, 1980 and January 12, 1981.

B. MINING METHOD

Two mining methods were considered from information contained in the Utah Tar Sand Leasing Minutes by MMS, a personal communication with Grethen Kuhn of Sohio Shale Oil Company, and a report prepared for the U.S. Department of Energy entitled "The Economic Potential of Domestic Tar Sands" by Vello A. Kuuskraa et al., University of Southern California, January 1978. Basically these data indicated that, where the ratio of overburden to net pay does not exceed 10:1, surface mining is possible.

APPENDIX 1

C. ESTIMATED CONTACTS

Production levels were estimated for each STSA from one or more of the following sources:

1. Industry Contacts

- a. Telephone conversations with representatives from companies which submitted "Expressions of Interest to Lease" in response to the formal call issued in the Federal Register on July 16, 1982.
- b. Telephone conversations with company representatives and letters from companies which have submitted "Notices of Intent" to convert their existing oil and gas lease to Combined Hydrocarbon Leases (CHLs).
- c. Telephone conversations with representatives of selected companies holding existing oil and gas leases within STSAs who did not express an interest in leasing and have not submitted a "Notice of Intent" to convert.

2. Resource Data

Total estimated tar sand reserves as provided in the Utah Tar Sand Leasing Minutes from MMS were used as a resource base.

D. ESTIMATED PRODUCTION SCENARIOS BY STSAs

1. Sunnyside and Vicinity STSA

- a. The high commercial scenario was estimated from data submitted by four companies interested in developing tar sand in the Sunnyside area. A fifth company has proposed to develop Sunnyside tar sand. However, their estimated production was not included in the scenarios because the vast majority of the mining and processing plants would be on private lands. They have applied for a small (160-acre) conversion but this tract is not key to development and would only augment the project. Thus, they will be included as an interrelated project in the EIS.

The four company proposals total 105,000 barrels per day (BLD) (100,000 from surface mining and 5,000 from in-situ). Because there are unleased tracts within the Sunnyside STSA and other companies may still apply for conversions until November 16, 1983, an additional 10,000 BLD in-situ operation were projected for analysis purposes. Thus, the total high commercial production scenario is 125,000 BLD (110,000 BLD surface and 15,000 BLD in situ).

There is some concern that the Sunnyside STSA would not support such a high surface mining production level. This concern was voiced by several company representatives and the following calculation based on existing resource estimates.

APPENDIX 1

Surface Minable Tar Sand Resources

Total resource - low estimate (thousands of barrels)	3,500,000
Times percent amenable to surface mining (30%)	1,050,000
Times percent of mined ore of high enough quality to be processed (65%) (total recoverable tar sand)	682,500
Times efficiency of retort (85%) (total barrels of recoverable product)	580,125
Divided by years of required reserves (20) (annual production)	29,006
Divided by days of operation annually (330) (daily production)	88

However, because a new tar sand resource estimate is being prepared by Lewin Associates with funding from the Department of Energy and Geological Survey which indicates a larger tar sand resource base, the production level will remain at 110,000 BLD. However, the tar sand conversion EIS will analyze a "unitized" production level of something less than the 88,000 BLD.

There would be no problem (from an availability standpoint) in sustaining a 15,000-BLD production from in-situ developable reserves. In fact, on the basis of available information, 11,000 BLD could be produced:

In-Situ

Total resource - low estimate (thousands of barrels)	3,500,000
Times percent amenable to in-situ (70%)	2,450,000
Times efficiency rate of in-situ (30%) (total barrels of recoverable product)	735,000
Divided by years of required reserves (20) (annual production)	36,750
Divided by days of operation annually (330) (daily production)	111

The comparatively low 15,000-BLD scenario was established because only one company has shown interest in developing their lease.

- b. The low commercial production level was developed from information submitted by the four companies or estimating a reduced level where no lower figure was given. The scenario calls for 28,000 BLD from surface operations and 2,000 BLD from in-situ development.

2. Asphalt Ridge/White Rocks

- a. The high production level was derived by doubling the figures given by the one company that has submitted a conversion application in the STSA. That company proposes a 5,000-BLD surface-mining operation in the White Rocks portion of the STSA. It was estimated that the available tar sand resource could sustain a 10,000-BLD operation.

Production in the Asphalt Ridge portion of the STSA was not included because such production is not dependent on decisions emanating from the

APPENDIX 1

Combined Hydrocarbon Leasing Act. The company interested in developing Asphalt Ridge (Sohio) has three options, none of which are the result of the CHL Act:

- (1) All the potential Federal tar sand area in the Asphalt Ridge is under mining claim patent appreciation which is not dependent on the CHL Act.
- (2) If the claims do not meet patent requirements, the company could acquire the lands under mill site application.
- (3) Also, if the patent requirements are not met, the subject lands are subject to a State selection application. The State would lease the tracts to Sohio for development in conjunction with existing State leases now held by Sohio.

Impacts resulting from potential development on Asphalt Ridge would be identified as the CHL EIS in the Project section.

3. P. R. Spring

- a. The high production scenario results from preliminary information submitted by one company that is developing an application to convert their existing oil and gas leases. The company is developing a plan for a 30,000-BLD surface-mining operation. However, because of the size of P. R. Spring tar sand resource and the number of companies who expressed interest in future development, additional production was projected. The projections included up to 20,000 BLD from surface operations and 50,000 BLD from in-situ operations. These figures were then added to obtain the high figure of 100,000 BLD.

Two other companies have expressed a desire to develop tar sand in P. R. Spring, but have not been included in the production level because the operations would be on private land.

- b. The low figure is strictly an estimate which was derived by reducing the company's production to 10,000 BLD and reducing the projected development to 10,000 BLD surface and 5,000 BLD in situ.

4. Tar Sand Triangle

- a. The high commercial production scenario was based on data received from several companies who have submitted a unitized conversion proposal of a 30,000-BLD in-situ operation. Because of the size of the tar sand resource in the Tar Sand Triangle and the fact that two additional companies have submitted plans of operation for in-situ projects (without commercial production estimates), an additional 30,000 BLD in-situ operation was included.

The western portion of the Triangle also contains some potentially strip-pable tar sand reserves. Thus, a 10,000-BLD surface operation was included to arrive at the total 70,000 BLD figure.

APPENDIX 1

- b. The low commercial figure is strictly an estimate of two 10,000-BLD in-situ operations. No surface mining was included in the low figure.

5. Argyle Canyon/Willow Creek

- 1. The high commercial estimate here is strictly a projection. No "Notices of Intent" to convert have been filed and no Expression of Leasing Interest were received. However, 43 oil placer claims exist on the STSA. Some production from surface operations is possible. However, tar sand resource estimates indicate a relatively small production potential. MMS estimates from 60 to 90 million barrels of in place reserves. The Department of Energy (DOE) estimates from 15 to 23 million barrels of recoverable bitumen exist. A 5,000-BLD operation with a 20-year life would produce 33 million barrels. This is more than the DOE estimate, but approximately one half of the low MMS estimate.
- b. No low commercial production estimates were made because development efforts will most likely be targeted to more promising tar sand areas.

6. Raven Ridge/Rim Rock

- a. The high commercial production figure is strictly an estimate. No conversion applications have been submitted to date.

None of our telephone contacts revealed any particular interest in development. However, one company (Western Tar Sand) has proposed development on a State lease, which could be supported by adjacent Federal lands. Thus, a 5,000-BLD in-situ operation was projected. A 20-year operation would produce 33 million barrels, which is approximately 30 percent of the MMS in-place estimate of 101 to 131 million barrels.

- b. No low commercial production estimates were made because development efforts will most likely be targeted to the more promising tar sand areas.

7. San Rafael Swell

- a. The high commercial production figure was based on two companies who expressed an interest in leasing in this STSA. One company indicated a 10,000 BLD production level. The second did not suggest a production level. Both would produce using in-situ methods. Therefore, it was estimated that two 10,000-BLD operations could result for a high production figure of 20,000 BLD.
- b. A low commercial production figure of 1,000 BLD was set because of the interest of the two companies. However, the figure is very low because any major development here would be largely beyond the 20-year time frame of the EIS.

8. Circle Cliffs

- a. The high commercial estimate was based on information supplied by one company which has submitted a unitized plan of operations for the entire area of the STSA which is located outside the Capitol Reef National Park.

APPENDIX 1

Currently, the plan does not suggest a commercial production figure. However, a telephone contact indicated that a 20,000-BLD in-situ project would be the maximum possible production; thus, this figure was selected as the high.

- b. The low commercial figure (2,000 BLD) is the production level suggested by the company as their probable target.

9. Hill Creek

- a. The high commercial figure is strictly an estimate. To date, no conversion applications have been submitted. The companies contacted by telephone did not indicate future plans. However, because of the size of the resource, a 10,000-BLD in-situ operation could be possible.
- b. No low commercial estimate was made because of apparent lack of interest.

10. White Canyon

There is no projected tar sand development in this STSA because of the lack of interest in the tar sand resource. Also, the limited physical data available indicated that the quality of the resource is probably not of commercial grade.

11. Pariette

There is no projected tar sand development because of the lean quality of the resource and the existing oil and gas activity. One Expression of Leasing Interest was received on this STSA, but the company was only interested in oil and gas.

E. WATER REQUIREMENTS

Actual data were used when submitted by companies, otherwise the water requirements were calculated as follows, assuming the worst-case situation of geothermal-type recovery (steam) and 100-percent consumption. Actual water requirements would vary according to recovery method and possible recycling of same water:

1. Surface Mining

Twenty-five percent of the daily production (BLD) would equal the water requirement in acre-feet per year. As an example, a 5,000 BPD operation would have an annual water requirement of 1,250 acre-feet. Solvent recovery methods would, of course, require less water.

2. In-Situ Development

Assuming an approximate average of 5 barrels of water used per 1 barrel of bitumen produced, the annual water requirement would equal 23 percent of the daily production (barrels per day) in acre-feet. These figures were derived from data compiled by Thomas N. Keefer and Raul S. McQuivey, a Department of Energy report titled "Water Availability for Development of Major Tar Sand Areas in Utah," May 1979.

APPENDIX 1

APPENDIX 1 GENERAL POLICY GUIDELINES

F. WORK FORCE

When actual data were submitted by the companies, it was used; otherwise the work force was calculated for both surface and in-situ mining and for both constructional and operational levels for each mining method. Calculations were based on ratios between production and work force requirements actually submitted by some companies. The ratios were established by dividing the daily production level and peak construction and operational workforce to obtain the ratio. For example, the Uinta Basin Synfuels EIS contains a proposal for a 50,000 BLD surface mine with a peak construction force of 2,215 and an operation force of 1,500. The workforce ratios would be:

$$\frac{\text{Construction Work Force } 2,215}{\text{Production in BLD } 50,000} = .044$$

$$\frac{\text{Operational Work Force } 1,500}{\text{Production in BLD } 50,000} = .030$$

When analyzing the data submitted, it was found that these ratios were extremely variable. After considerable discussion, the meeting attendees selected the following ratios:

Surface Mine	Construction	=	.040
	Operation	=	.026
In-situ	Construction	=	.070
	Operation	=	.012

These ratios were used to calculate work force in the absence of company data or where production levels were estimated.

The work force spread by year appears in Appendix B. Again, where companies submitted such data, they were used. Where such information was lacking, the spreads were estimated. Construction periods were from 2 to 3 years.

APPENDIX 2

GENERAL POLICY GUIDELINES

OIL AND GAS LEASING

The following general policy guidelines have been developed for review of the oil and gas categories. The guidelines form the foundation for a consistent statewide approach to meeting the Bureau's objective of making public lands available for oil and gas leasing while at the same time adequately protecting resource values. Adherence to these guidelines is desirable, but management must fit the specific situation. It is recognized that there are exceptions to any guideline, since it is impossible to include all situations and because there is a wide range in the significance of resource values. These guidelines are not intended to limit the alternatives that can be considered during planning.

OIL AND GAS CATEGORY GUIDELINES

1. Unless special or significant other natural resource values are involved, public lands will be in category 1. Standard surface disturbance stipulations which are a part of an oil and gas lease will generally provide adequate protection for the resource values. BLM has the responsibility and the authority to implement additional surface management necessary to protect common resource values when specific proposals for oil and gas development are considered under the operating plan. As an example, study exclusions can normally be protected in this manner.
2. Areas should not be in categories 2, 3 and 4 to protect known or suspected occurrences of other mineral values. Laws and regulations governing multiple mineral development are adequate to allow placing these areas in category 1. If there is considerable disparity of values between mineral resources, conflicts will be handled in the State Office.
3. Generally, areas under wilderness review should be in category 1 with utilization of the wilderness stipulation and Interim Management Policy (IMP) management of wilderness values. However, in cases where an area has values incidental or in addition to wilderness values such as high scenic qualities, wildlife habitat, scientific, educational, historical, ecological or geological values that may be unavoidable and irreparably impacted, an area may logically be placed in categories 2, 3 and 4. However, if the area of concern is being protected primarily for wilderness values, it cannot logically be justified as a category 3 or 4 designation in lieu of the policy to allow leasing and exploration in areas under wilderness review.
4. Known geologic structures are to be in categories 1 or 2. Exceptions, such as small recreation sites which fall within a KGS, could be in category 3. Unitized areas are not given any special consideration as to category designation.
5. Cultural values (archaeological and historic) are normally placed in category 1, but known significant values, such as National or State Register sites or sites eligible for inclusion on a register may be in category 2 or 3 if they would be adversely affected by oil and gas related activities. Such values identified after lease issuance can be protected as appropriate through the plans of operations.
6. Paleontological or geological sites of scientific or educational value are normally included in category 2. However, due to the size of the area or other special circumstances, *these sites* may be placed either in categories 1 or 3.
7. Travel influence zones should be in categories 1 or 2 unless they are designated scenic travel areas or have unusual values that could be permanently damaged by access roads or drill pads. In this case they may be in category 3 or 4 to protect the visual corridor.
8. All springs, perennial streams, and reservoirs are important for water quality and riparian habitat purposes and are to be protected. Generally, categories 1 and 2 will provide sufficient protection, but depending on size, location, and significance, they may need to be in categories 3 or 4.
9. Critical big game winter ranges and fawning areas or other critical habitat areas are to be in category 2 with a seasonal restriction on exploration and drilling activities. However, this does not mean that, just because an area is identified as winter range, it automatically is a category 2 area. Category 2 seasonal limitations are to be applied only where: 1) populations and/or habitats are so sensitive or fragile in nature that oil and gas activities may prevent maintenance of existing population levels over an extended period of time; 2) the habitat provides high economic or social value; and 3) where big game and/or habitat requires special management. Certain species such as the desert bighorn sheep may require yearlong habitat protection under categories 3 and 4.
10. Habitat for threatened and endangered species and raptor nesting should be placed in category 2 with an

APPENDIX 2

appropriate seasonal limitation on surface occupancy when the seasonal occupancy situation is present. If the habitat and/or species is considered to be jeopardized (unavoidably impacted) at the time of surface occupancy of the lease, authority is provided by the "Surface Disturbance Stipulations" to adjust the location of well sites, roads, and other facilities. Yearlong habitat areas for *threatened and endangered* species should be in categories 3 and 4. Undefined habitat areas and known habitat for candidate species are to be in category 1 and managed for protection under the open end stipulations. There is no official State list of *threatened and endangered* species.

11. Bald and golden eagle seasonal roost and concentration areas are to be in category 2 with appropriate seasonal restrictions on exploration and drilling activities (or under special circumstances may be placed in category 3 or 4).
12. Known critical and traditional sage grouse strutting and brooding areas and possibly other similar critical wildlife and aquatic habitat are to be in category 3. Other general sage grouse or other wildlife areas can be protected by category 2.
13. Municipal watersheds and important lakes and reservoirs should be in category 2, 3, or 4, depending on the size and significance. However, some of these areas were withdrawn by special legislation which may preclude leasing. These should not be included in the category system.
14. Identified floodplains (100-year storm recurrence interval) are to be in either categories 1 or 2 depending on size and significance of floodplain area.
15. All areas of concern that need additional protection and which are less than 1 mile wide are to be in category 3, assuming that directional drilling can occur from opposite sides of the area. If directional drilling can occur from only one side, the width limitation is one half mile.
16. It is optional as to what category small tracts, airport leases, R&PP leases, etc., can be placed. Depending on the individual circumstances (as determined on a case-by-case basis) such areas may be placed in any of the first four categories. If placed in category 2, the following stipulations may be used in lieu of other stipulations on the special stipulation list (enclosure 2).

"The following described lands are contained with a (R&PP lease, airport lease etc.). No occupancy or other activities will be allowed within (legal subdivision) unless it can be demonstrated that the proposed activities do not interfere with the current surface uses. Occupancy of the surface will be subject to specific written permission of the authorized officer of the surface management agency."

17. Designated wild and scenic study rivers should be categories 3 and 4, depending on the individual circumstances.
18. Designated and proposed research natural areas, recreation sites, and potential ACECs may be in categories 2, 3, or 4, depending on the individual circumstances.
19. In any cases where lands in category 4 are adjacent to lands in categories 1 or 2, the outermost half mile of the category 4 area is to be placed in category 3. This will decrease the acreage in the no lease category without decreasing protection of surface values.

SPECIAL TAR SAND GUIDELINES

General

Only one category designation is to be assigned to an area regardless of differences between conventional oil and gas and tar sand development and the respective resource potentials. *A separate category designation for tar sand is not to be made.*

The following stipulation is currently attached automatically to all oil and gas leases issued outside STSAs in categories 1 and 2 and will continue to be used in these areas where planning has not been updated to include tar sand.

Oil and Gas Lease Stipulations for Non-Conventional Oil Recovery

"Under the provisions of Public Law 97-78, this lease includes all deposits of nongaseous hydrocarbon substances other than coal, oil shale, or gilsonite (including all vein-type solid hydrocarbons). Development methods not conventionally used for oil and gas extraction such as fire flooding, underground, and surface mining will require the lessee to submit a plan of operations and will be subject to regulations governing such development by these methods when those rules are issued by the Bureau of Land Management (BLM) and the rules or procedures of the surface managing agency, if other than BLM. Development may proceed only if the plan of operations is approved.

Category 1

The stipulations applied are the same as those used for all oil and gas leases *and the surface disturbance stipulation for CHLs listed below.*

Category 2

Special stipulations numbers 2 and 4 through 10 as contained on enclosures 3-1 and 3-2 can be applied to tar sand in the same manner as applied to conventional oil and gas. In addition, the following stipulations specific to tar sand

APPENDIX 2

development may be used either separately or in conjunction with special stipulations contained in enclosure 3. Under these circumstances two sets of stipulations may be attached to the same oil and gas lease. If two sets of stipulations are used, they will be identified on the lease form as follows:

1. The following stipulation(s) applies to all oil and gas operations including the exploration for and extraction of tar sand.
2. The following stipulation(s) applies to the development and extraction of any tar sand on this lease.

Category 2 Tar Sand Stipulations

1. No surface mining of tar sand deposits are allowed on this lease. The tar sand may be extracted by in-situ or underground-mining methods only.
2. Oil and gas resources may be extracted by conventional methods only; no in-situ or mining methods will be employed to extract tar sand deposits. Secondary recovery of liquid hydrocarbons and underground mining methods may be employed only upon approval by the authorized officer.

Additional stipulations specific to tar sand development may be proposed based on the environmental assessment. These stipulations are to address site-specific conditions that cannot be adequately covered by existing oil and gas stipulations in enclosure 3 or the special tar sand stipulations.

Category 3

The potential for off-site exploitation of tar sand deposits is virtually nonexistent compared to conventional oil and gas exploration and development. Although underground mining and off-site in-situ extraction may be considered as alternative methods employable to tar sand development, the use of these methods is expected to be highly improbable because of technical and economic limitations. In most cases a no surface occupancy stipulation will render a lease unusable for tar sand development. In order to retain an area in category 3 within a potential tar sand area, it must be documented that the resource potential and less stringent alternatives were given consideration in the decision. When tar sand potential of high value exists, a category 3 designation may be difficult to sustain where there is no possibility of utilizing the resource.

SURFACE DISTURBANCE STIPULATIONS FOR COMBINED HYDROCARBON LEASES

1. Notwithstanding any provisions of this lease to the contrary, any drilling, construction, or other operation on the leased lands that will disturb the surface thereof or otherwise affect the environment, hereinafter called "surface-disturbing operation," conducted by lessee shall be subject, as set forth in this stipulation, to prior approval of such operation by

the BLM in consultation with any other appropriate surface management agency and to such reasonable conditions, not inconsistent with the purposes for which this lease is issued, as the BLM may require to protect the surface of the leased lands and the environment.

2. *Prior to entry upon the land or the disturbance thereof for mining, drilling, or other purposes, the lessee shall submit for approval a plan of operations to the authorized officer of BLM and the appropriate surface management agency. The plan shall meet the requirements of 43 CFR 3160 for drilling and in-situ operations and 43 CFR 3570 for mining operations. The submitted plan of operations must be in compliance with applicable operation orders and notices to lessees and must contain, in addition to all requirements stated above, the methods and actions proposed for the following:*
 - *Stripping and saving of topsoil.*
 - *Reclamation of the disturbed areas, including, but not limited to recontouring and revegetation with native species or ecological equivalents.*
 - *Erosion control measures on all disturbed areas, roads and waterway crossings.*
 - *Road design, construction, and maintenance standards would be subject to BLM 9113 Roads Manual.*
 - *Cultural resource protection and clearance and/or protection plan would be required prior to all surface-disturbing activities. All costs of inventory and data recovery would be borne by the lessee.*
 - *Livestock protection such as fencing or otherwise excluding livestock from active mining areas.*
 - *Fugitive dust and emissions control with fugitive dust abatement being required on all major haulage roads.*
 - *Wildlife protection and mitigation would include threatened or endangered species. Clearance would have to be given by the appropriate agency prior to any surface disturbance, and all transmission lines would be raptor-proof.*
 - *Protection of streams, springs, water wells, and other water sources would include, but would not be limited to, stream and drainage crossings being protected by appropriate stipulations, including a U.S. Army Corps of Engineers 404 Permit.*
 - *Methods of retaining all mine drainage and runoff on-site.*
 - *Environmental analysis will be made by the authorized officer in consultation with the appropriate surface management agency for the purpose of assuring proper protection of the surface, the natural resources, the environment, existing improvements, and for assuring timely reclamation of disturbed lands.*

APPENDIX 2

3. Upon completion of said environmental analysis, the BLM, as appropriate, shall notify lessee of the conditions, if any, to which the proposed surface disturbing operations will be subject.

Said conditions may relate to any of the following:

- A. Location of drilling or other exploratory or developmental operations or the manner in which they are to be conducted, and
- B. Manner or location in which improvements such as roads, buildings, pipelines, or other improvements are to be constructed.

SPECIAL STIPULATIONS

The following special stipulations are in addition to the lease terms and standard stipulations, and are necessary to protect specific resource values on the lease area. If found to be in the public interest, these stipulations may be made less restrictive when specifically approved in writing by the authorized officer of the Federal surface management agency.

1. All of the land in this lease is included in (recreation or special area, etc.). Therefore, no occupancy or disturbance of the surface of the land described in this lease is authorized. The lessee, however, may exploit the oil and gas resources in this lease by directional drilling from sites outside this lease. If a proposed drilling site lies on land administered by the Bureau of Land Management, or by the Forest Service, a permit for use of the site must be obtained from the BLM District Manager, or the Forest Service District Ranger, before drilling or other development begins.
2. No access or work trail or road, earth cut or fill, structure or other improvement, other than an active drilling rig, will be permitted if it can be viewed from the (road, lake, river, etc.).
3. No occupancy or other activity on the surface of (legal subdivision) is allowed under this lease.
4. No occupancy or other surface disturbance will be allowed within _____ feet of the _____ (road, trail, river, creek, canal, etc.). This distance may be modified when specifically approved in writing by the authorized officer of the Federal surface management agency.
5. No drilling or storage facilities will be allowed within _____ feet of (live water, the reservoir, the archaeological site, the historical site, the paleontological site, etc.) located in (legal subdivision). This distance may be modified when specifically approved in writing by the concurrence of the authorized officer of the Federal surface management agency.
6. No occupancy or other surface disturbance will be allowed on slopes in excess of _____ percent, without written permission from the authorized officer of the Federal surface management agency.

7. In order to (minimize watershed damage, protect important seasonal wildlife habitat, etc.) exploration, drilling, and other development activity will be allowed only (during the period from _____ to _____ during dry soil period, over a snow cover, frozen ground). This limitation does not apply to maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically approved by the authorized officer of the Federal surface management agency.
8. In order to minimize watershed damage during muddy and/or wet periods the authorized officer of the Federal surface management agency may prohibit exploration, drilling, or other development. This limitation does not apply to maintenance and operation of producing wells.
9. The _____ (trail/road) will not be used as an access road for activities on this lease, except as follows: (No exceptions, weekdays during recreation season, etc.).
10. To maintain esthetic values, all semi-permanent and permanent facilities may require painting or camouflage to blend with the natural surroundings. The paint selection or method of camouflage will be subject to approval by the authorized officer of the Federal surface management agency.
11. No occupancy or other activity on the surface of the following described lands is allowed under this lease:
Reasons for this restriction are:
Examples of appropriate reasons for this restriction are:
 1. Steep slope
 2. Specific ecosystem, ecological land unit, land-type, or geologic formation which present hazards such as mass failure
 3. Roadless or essentially roadless area (includes Chevron and Rainbow stipulations)
 4. Special management units such as: Recreation Type I, water supply, administrative site, etc.() Approximately _____ % if lease
Note: This stipulation could be used in place of Nos. 1, 3, and 6.
12. No _____ will be allowed within _____ feet of the _____. This area contains _____ acres and is described as follows:
Reasons:
First blank to be filled in with one or more of the following: drilling, storage facilities, surface disturbance or occupancy. Second and third blanks to be filled in with one or more of the following:
 1. _____ feet wildlife habitat essential to specific species

APPENDIX 2

2. _____ feet peripheral or unique vegetative type
3. 200 feet either side of centerline of roads or highways
4. 500 feet of normal high water line on all streams, reservoirs, lakes
5. 600 feet of all springs
6. 400 feet of any improvements

Note: Stipulation No. 12 could be used in place of Stipulation Nos. 4 and 5.

13. In order to (minimize) (protect) _____

_____ will be allowed only during _____
This does not apply to maintenance and operation of producing wells and facilities. Lands within leased area to which this stipulation applies are described as follows:

Reasons:

First blank to be filled in with one or more of the following:

1. Watershed damage
2. Soil erosion
3. Seasonal wildlife habitat (winter range, calving/lambing area, etc.)
4. Conflict with recreation

Second blank to be filled in with one or more of the following:

1. Surface-disturbing activities
2. Exploration
3. Drilling
4. Development

Third blank to be filled in with one or more of the following:

1. Period from _____ to _____
2. Dry soil periods
3. Over the snow
4. Frozen ground.

Note: Stipulation No. 13 could be used in place of Stipulation No. 4, giving greater definition as to restriction.

14. The lessee is given notice that all or portions of the lease area contain special values, are needed for special purposes or require special attention to prevent damage to surface resources. Any surface use or occupancy within such areas will be strictly controlled. Use or occupancy will be authorized only when the lessee/operator demonstrates that the area is essential for operations and when the lessee/operator submits a surface use and operations

plan, which is satisfactory to the Federal surface management agency, for the protection of these special values and existing or planned uses. Appropriate modifications to the imposed restrictions will be made for the maintenance and operations of producing oil and gas wells.

After the Federal surface management agency has been advised of the proposed surface use or occupancy on these lands, and on request of the lessee/operator, the Federal surface management agency will furnish further data on such areas, which now include but are not limited to:

(Legal land description to lot and/or quarter, quarter section.)

Reasons for Restriction:

Duration of Restriction: (year-round, month[s])

Prior to acceptance of this stipulation the prospective lessee is encouraged to contact the Federal surface management agency for further information regarding the restrictive nature of this stipulation.

Note: Stipulation No. 14 is not exclusionary but it notifies the lessee/operator that the described lands contain special values and that these values must be considered in the proposed operating plan. This stipulation is an alternative to many of the above stipulations.

ENDANGERED SPECIES, CULTURAL, AND PALEONTOLOGICAL WILDERNESS RESOURCES AND PUBLIC WATER RESERVE 107 AND LEGAL WATER SOURCE STIPULATIONS

Protection of Endangered or Threatened Species

The Federal surface management agency is responsible for assuring that the area to be disturbed is examined, prior to undertaking any surface-disturbing activities on lands covered by this lease, to determine effects upon any plant or animal species listed or proposed for listing as endangered or threatened, or their habitats. If the findings of this examination determine that the operation may detrimentally affect an endangered or threatened species, some restrictions to the operator's plans or even disallowances of use may result.

The lessee/operator may, at his discretion and cost, conduct the examination on the lands to be disturbed. This examination must be done by or under the supervision of a qualified resource specialist approved by the surface management agency. An acceptable report must be provided to the surface management agency identifying the anticipated effects of the proposed action on endangered or threatened species or their habitat.

APPENDIX 2

Protection of Cultural and Paleontological Resources

The Federal surface management agency is responsible for determining the presence of cultural resources and specifying mitigation measures required to protect them. Prior to undertaking any surface-disturbing activity on the lands covered by this lease, the lessee/operator, unless notified to the contrary by the authorized officer of the surface management agency, shall:

1. Engage the services of a qualified cultural resource specialist acceptable to the surface management agency to conduct an intensive inventory for evidence of cultural resource values;
2. Submit a report acceptable to the authorized officer of the surface management agency; and
3. Implement such mitigation measures as required by the authorized officer of the surface management agency to preserve or avoid destruction of inventoried cultural resource values. Mitigation may include relocation of proposed facilities, testing, and salvage or other protective measures deemed necessary. All costs of the inventory and mitigation shall be borne by the lessee/operator and all data and materials salvaged shall remain under the jurisdiction of the U.S. Government.

The lessee/operator shall immediately bring to the attention of the authorized officer of the surface management agency any cultural resources, paleontological, and other objects of scientific interest discovered as a result of surface operations under this lease and shall leave such discoveries intact until directed to proceed by the BLM.

Wilderness Protection Stipulations

By accepting this lease, the lessee acknowledges that the following described lands are being inventoried or evaluated for their wilderness potential by the Bureau of Land Management (BLM) under Section 603 of the Federal Land Policy and Management Act of 1976, 90 Stat. 2743 (43 USC Sec. 1782), and that exploration or production activities which are not in conformity with Section 603 may never be permitted. Expenditures in leases on which exploration drilling or production are not allowed will create no additional rights in the lease, and such leases will expire in accordance with law.

Activities will be permitted under the lease so long as BLM determines they will not impair wilderness suitability. This will be the case either until the BLM wilderness inventory process has resulted in a final wilderness inventory decision that an area lacks wilderness characteristics, or in the case of a wilderness study area until Congress has decided not to designate the lands included within this lease as wilderness. Activities will be considered nonimpairing if the BLM determines that they meet each of the following three criteria:

1. It is temporary. This means that the use or activity may continue until the time when it must be terminated in order to meet the reclamation requirement of paragraphs 2 or 3 below. A temporary use that creates no new surface disturbance may continue unless Congress designates the area as wilderness, so long as it can easily and immediately be terminated at that time if necessary to management of the area as wilderness.
2. Any temporary impacts caused by the activity must, at a minimum, be capable of being reclaimed to a condition of being substantially unnoticeable in the wilderness study area (or inventory unit) as a whole by the time the Secretary of the Interior is scheduled to send his recommendations on that area to the President, and the operator will be required to reclaim the impacts to that standard by that date. If the wilderness study is postponed, the reclamation deadline will be extended accordingly. If the wilderness study is accelerated, the reclamation deadline will not be changed. A full schedule of wilderness studies will be developed by the Department upon completion of the intensive wilderness inventory. In the meantime, in areas not yet scheduled for wilderness study, the reclamation will be scheduled for completion within 4 years after approval of the activity. (Obviously, if and when the Interim Management Policy ceases to apply to an inventory unit dropped from wilderness review following a final wilderness inventory decision of the BLM State Director, the reclamation deadline previously specified will cease to apply.) The Secretary's schedule for transmitting his recommendations to the President will not be changed as a result of any unexpected inability to complete the reclamation by the specified date, and such inability will not constrain the Secretary's recommendation with respect to the area's suitability or nonsuitability for preservation as wilderness.

"The reclamation will, to the extent practicable, be done while the activity is in progress. Reclamation will include the complete recontouring of all cuts and fills to blend with the natural topography, the replacement of topsoil, and the restoration of plant cover at least to the point where natural succession is occurring. Plant cover will be restored by means of reseeding or replanting, using species previously occurring in the area. If necessary, irrigation will be required. The reclamation schedule will be based on conservative assumptions with regard to growing conditions, so as to ensure that the reclamation will be complete, and the impacts will be substantially unnoticeable in the area as a whole, by the time the Secretary is scheduled to send his recommendations to the President." ("Substantially unnoticeable" is defined in Appendix F of the *Interim Management Policy and Guidelines for Lands Under Wilderness Review*.)

APPENDIX 2

3. When the activity is terminated, and after any needed reclamation is complete, the area's wilderness values must not have been degraded so far, compared with the area's values for other purposes, as to significantly constrain the Secretary's recommendation with respect to the area's suitability or nonsuitability for preservation as wilderness. The wilderness values to be considered are those mentioned in Section 2(c) of the Wilderness Act, including naturalness, outstanding opportunities for solitude, or for primitive and unconfined recreation, and ecological, geological, or other features of scientific, educational, scenic, or historical value. If all or any part of the area included within the leasehold estate is formally designated by Congress as wilderness, exploration and development operations taking place or to take place on that part of the lease will remain subject to the requirements of this stipulation, except as modified by the Act of Congress

designating the land as wilderness. If Congress does not specify in such act how existing leases like this one will be managed, then the provisions of the Wilderness Act of 1964 will apply, as implemented by rules and regulations promulgated by the Department of the Interior.

Public Water Reserve 107 and Legal Water Source Stipulations

To protect important aquifers, all surface and in-situ mining must be preceded by complete hydrological testing and evaluation as specified by the authorized officer of BLM. Any loss of springs or reduction in perennial streamflow will be fully mitigated with an equal quantity and quality of *water lost*. *Such mitigation must be approved* by the authorized officer of BLM.

APPENDIX 3

BUREAU OF RECLAMATION
 UPPER COLORADO REGION
 SALT LAKE CITY, UTAH
 PROJECTED WATER SUPPLY AND DEPLETIONS
 UPPER COLORADO RIVER BASIN

August 1982

Table and
 Explanatory Notes

APPENDIX 3

Bureau of Reclamation
 Upper Colorado Region
 Projected water supply and depletions
 Upper Colorado River Basin
 (Unit--1,000 acre-feet)

	Present and projected depletions						
	1980	1990	2000	2010	2020	2030	2040
	<u>Arizona</u>						
Present	13	13	13	13	13	13	13
Navajo Powerplant	21	34	34	34	34	34	34
Gallup-Navajo Indian Municipal Water Supply Project		(5)	(7)	(7)	(7)	(7)	(0)
Other municipal		3	3	3	3	3	3
Total depletion	34	50	50	50	50	50	50
Compact apportionment	50	50	50	50	50	50	50
	<u>Colorado</u>						
Present	1,794	1,794	1,794	1,794	1,794	1,794	1,794
Fryingpan-Arkansas	56	69	69	69	69	69	69
Ruedi Reservoir--municipal and industrial		16	32	48	48	48	48
Blue Mesa Reservoir--municipal and industrial		10	10	10	10	10	0
Animas-La Plata		3	119	120	120	120	120
Dallas Creek		12	17	17	17	17	17
Dolores		78	80	81	81	81	81
Fruitland Mesa ^{1/}							21
Savery Pot Hook ^{1/}							12
San Miguel ^{1/}							25
West Divide ^{1/}							38
Denver expansion	60	110	160	216	216	216	216
Colorado Springs expansion			5	5	5	5	5
Homestake expansion		15	31	31	31	31	31
Pueblo (Eagle River)	3	3	3	3	3	3	3
Englewood	10	10	10	10	10	10	10
Independence Pass expansion	7	7	7	7	7	7	7
Rangely		5	12	18	18	18	18
Hayden-Craig steam plants	10	20	20	20	20	20	20
Windy Gap		39	54	54	54	54	54
Oil shale development		30	75	100	100	100	76
Hydroelectric development			30	30	30	30	30
Colorado Ute--Southwest Project		12	12	12	12	12	12
Total depletion	1,940	2,224	2,540	2,645	2,645	2,645	2,707
Evaporation, storage units	269	269	269	269	269	269	269
Total	2,209	2,493	2,809	2,914	2,914	2,914	2,976
State share of 5.8 million acre-foot level	2,976	2,976	2,976	2,976	2,976	2,976	2,976
Remaining water available	767	483	167	62	62	62	0

APPENDIX 3

Aug. 1982

	Present and projected depletions						
	1980	1990	2000	2010	2020	2030	2040
		<u>Utah</u>					
Present	664	664	664	664	664	664	664
Bonneville Unit	42	136	166	166	166	166	166
Upalco Unit	0	12	12	12	12	12	12
Jensen Unit	11	15	15	15	15	15	15
Uintah Unit	0	3	28	28	28	28	28
Deferred Indian	0	9	84	84	84	84	84
DWR Projects	7	12	12	12	12	12	12
White River Irrigation	4	4	4	4	4	4	4
Conversion of Irrigation to Power	-4	-12	-12	-12	-12	-12	-12
Emery County Project	11	8	8	8	8	8	8
Emery County Powerplants	13	39	39	39	39	39	39
Wellington Powerplant	0	0	35	35	35	35	35
Deseret Generation and Trans- mission Co-op	0	12	12	12	12	12	12
White River Dam Evap.	0	6	6	6	6	6	6
Oil Shale	0	50	75	75	75	75	75
Gallup-Navajo Municipal	0	1	1	1	1	1	0
Other municipal	2	3	5	6	7	9	10
Unidentified				8	16	24	44
Total depletion	750	962	1,154	1,163	1,172	1,182	1,202
Evaporation, storage units	120	120	120	120	120	120	120
Total	870	1,082	1,274	1,283	1,292	1,302	1,322
State share of 5.8 million acre- foot level	1,322	1,322	1,322	1,322	1,322	1,322	1,322
Remaining water available	452	240	48	39	30	20	0
		<u>Upper Colorado River Basin Totals</u>					
Depletions	3,478	4,272	4,932	5,121	5,186	5,246	5,280
Evaporation, storage units	520	520	520	520	520	520	520
Total depletion	3,998	4,792	5,452	5,641	5,706	5,766	5,800
5.8 million acre-foot level	5,800	5,800	5,800	5,800	5,800	5,800	5,800
Remaining water available	1,802	1,008	348	159	94	34	0

1/ This project is authorized but currently inactive. An administrative decision was made to defer the depletion until the year 2040. Reimbursable costs will also be deferred to correspond to the depletions. In the event the project is reactivated, the depletion schedule will be revised to show the best estimate of when it will come on line. In the event the project is deauthorized, it will be deleted from the schedule.

2/ Assumes Congressional approval can be obtained for extending Navajo M&I contracts from 2005 to 2030.

3/ Assumes 11,000 acre-feet shortages would be distributed to New Mexico in some manner to be determined.

APPENDIX 3

Aug. 1982

	Present and projected depletions						
	1980	1990	2000	2010	2020	2030	2040
	<u>New Mexico</u>						
Present	106	106	106	106	106	106	106
Animas-La Plata			27	34	34	34	34
San Juan-Chama	110	110	110	110	110	110	110
Navajo Reservoir evaporation	26	26	26	26	26	26	26
Hogback expansion		10	10	10	10	10	10
Utah International, Inc.	22	39	39	39	39	39	39
Farmington municipal and industrial		5	5	5	5	5	5
Navajo Indian Irrigation	100	208	267	267	267	267	267
Jicarilla Apache		3	3	3	3	3	3
Navajo municipal and industrial contracts ^{2/}	10	71	75	63	69	69	0
San Juan (New Mexico Public Service Company)	(10)	(16)	(16)	(0)	(0)	(0)	0
Utah International Inc.		(35)	(35)	(35)	(35)	(35)	0
Gallup-Navajo Indian Municipal Water Supply Project		(10)	(14)	(18)	(24)	(24)	0
Other		(10)	(10)	(10)	(10)	(10)	0
Total depletion	374	578	668	663	669	669	600
Evaporation, storage units	58	58	58	58	58	58	58
Total	432	636	726	721	727	727	658
State share of 5.8 million acre-foot level	647	647	647	647	647	647	647
Remaining water available	215	11	-79	-74	-80	-80	3/0
	<u>Wyoming</u>						
Present	333	333	333	333	333	333	333
Lyman Project	8	10	10	10	10	10	10
Savery-Pot Hook ^{1/}							11
Little Snake river Out-of-Basin Diversions	8	15	20	50	50	50	50
LaBarge ^{1/}							4
Fontenelle Reservoir	31	50	100	150	200	250	267
Private industrial rights		50	57	57	57	57	57
Total depletion	380	458	520	600	650	700	732
Evaporation, storage units	73	73	73	73	73	73	73
Total	453	531	593	673	723	773	805
State share of 5.8 million acre-foot level	805	805	805	805	805	805	805
Remaining water available	352	274	212	132	82	32	0

APPENDIX 3

Disclaimer

The Colorado River Simulation System that was used in preparing the water section of this EIS is not to be construed as reflecting the present or future position of the states of the upper or lower Colorado River Basin or of the federal government with regard to interpretation and application of the treaties, compacts, and laws which do or may affect the allocation of water among the states and among private claimants within each state. In particular, nothing in this EIS is intended to interpret the provisions of the Colorado River Compact (45 Stat. 1957), the Upper Colorado River Basin Compact (53 Stat. 31), the Water Treaty of 1944 with the United Mexican States (Treaty Series 994, 59 Stat. 1219), the decree entered by the Supreme Court of the United States in *Arizona v. California* (376 U.S. 340), the Boulder Canyon Project Adjustment Act (54 Stat. 774; 43 U.S.C. 618a), the Colorado River Storage Project Act (70 Stat. 105; 43 U.S.C. 620), or the Colorado River Basin Project Act (82 Stat. 885; 43 U.S.C. 1501), or to interpret or reach any conclusions regarding future application of the federal reserved rights doctrine. For a complete summary of the CRSS series, refer to the USDI, Bureau of Reclamation, Colorado River Simulation System-Executive Summary, October 1982.

APPENDIX 4



United States Department of the Interior FISH AND WILDLIFE SERVICE

ENDANGERED SPECIES OFFICE
1406 Federal Building
125 South State Street
Salt Lake City, Utah 84138

IN REPLY REFER TO:

13 June 1983

MEMORANDUM

TO: District Manager, U. S. Bureau of Land Management, Richfield
District Office, Richfield, Utah

FROM: Field Supervisor, U. S. Fish and Wildlife Service, Endangered
Species Office, Salt Lake City, Utah

SUBJECT: Species list for the Combined Hydrocarbon (Tar Sand) leasing.

We have reviewed your memo of 18 May 1983 and attached information concerning the combined hydrocarbon leasing in eastern and southern Utah. It appears that listed endangered and threatened species, or species proposed for listing, may occur in the area of influence of this action.

To comply with Section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies or their designees are required to obtain from the Fish and Wildlife Service (FWS) information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed construction project. Therefore, we are furnishing you the following list of species which may be present in the concerned area:

1. Asphalt Ridge - White rocks

Listed Species

Colorado squawfish
black-footed ferret
bald eagle
Uinta Basin hookless cactus

Ptychocheilus lucius
Mustela nigripes
Haliaeetus leucocephalus
Sclerocactus glaucus

Candidate Species

razorback sucker
western yellow-billed cuckoo
mountain plover
white-faced ibis
Swainson's hawk
ferruginous hawk
long-billed curlew
Hamilton milk-vetch
Dinosaur milk-vetch
Horseshoe Bend milk-vetch

Xyrauchen texanus
Coccyzus americanus occidentalis
Charadrius montanus
Plegadis chihi
Buteo swainsoni
Buteo regalis
Numenius americanus
Astragalus hamiltonii
Astragalus saurinus
Astragalus equisolensis

APPENDIX 4

Vernal beardtongue

Penstemon angustifolius var.
vernalensis

No Common Name (N.C.N.)
N.C.N.

Hedysarum boreale var. gremiale

Gutierrezia sarothrae var. pomariense

2. Raven Ridge-Rimrock

Listed Species

Colorado squawfish
black-footed ferret

Candidate Species

razorback sucker
western yellow-billed cuckoo
mountain plover
white-faced ibis
Swainson's hawk
ferruginous hawk
long-billed curlew
Hamilton milk-vetch
Dinosaur milk-vetch Vernal beard tongue
Vernal beardtongue

3. Pariette

Listed Species

Colorado squawfish
bald eagle
black-footed ferret
Uinta Basin hookless cactus

Candidate Species

razorback sucker
western yellow-billed cuckoo
mountain plover
white-faced ibis
Swainson's hawk
ferruginous hawk
long-billed curlew

4. Argyle Canyon-Willow Creek

Listed Species

Colorado squawfish
black-footed ferret
Uintah Basin hookless cactus

Candidate Species

razorback sucker
long-billed curlew
ferruginous hawk

APPENDIX 4

- spotted bat Euderma maculatum
Garrett's beard tongue Penstemon garrettii
Sedge fescue Festuca dasyclada
5. Sunnyside
Listed Species
Colorado squawfish
black-footed ferret
bald eagle
Uintah Basin hookless cactus
- Candidate Species
razorback sucker
long-billed curlew
ferruginous hawk
spotted bat
Canyon sweetvetch Hedysarum occidentale var. canone
Sedge fescue
6. Hill Creek
Listed Species
Colorado squawfish
black-footed ferret
- Candidate Species
razorback sucker
southern spotted owl Strix occidentalis lucida
ferruginous hawk
long-billed curlew
Sedge festuca
Barneby catseye Cryptantha barnebyi
toad flox cress Glaucocarpum suffrutescens
Barneby Columbine Aquilegia barneby
Graham beardtongue Penstemon grahamii
7. PR Springs
Listed Species
Colorado squawfish
black-footed ferret
- Candidate Species
razorback sucker
Southern spotted owl
ferruginous hawk
long-billed curlew
Dragon milkvetch Astragalus lutosus
Barneby catseye
Aquilegia barnebyi
White River beardtongue Penstemon albifluvis
Graham beard tongue
Sedge fescue
8. San Rafael Swell
Listed Species
Colorado squawfish
black-footed ferret

APPENDIX 4

Candidate Species

razorback sucker
ferruginous hawk
long-billed curlew
spotted bat
N.C.N.
N.C.N.
Ruth milkweed
San Rafael milk-vetch
Johnston catseye
Jones catseye
Jones cycladenia
Maguire daisy
Drab phacelia

Pediocactus despainii
Hymenozys depressa
Asclepias ruthiae
Astragalus rafaelensis
Cryptantha johnstonii
Cryptantha jonesiana
Cycladenia humilis var. jonesii
Erigeron maguirei
Phacelia indecora

9. Tar Sand Triangle

Listed Species

Colorado squawfish
black-footed ferret
peregrine falcon
Wright fishhook cactus

Falco peregrinus

Candidate Species

razorback sucker
ferruginous hawk
spotted bat
Smith wild buckwheat
monument milkvetch
Jones cycladenia
San Rafael milk-vetch
Drab phacelia

Eriogonum smithii
Astragalus monumentalis

Phacelia indecora

10. White Canyon

Listed Species

Colorado squawfish
black-footed ferret
peregrine falcon

Candidate Species

razorback sucker
Southern spotted owl
white-faced ibis
yellow-billed cuckoo
spotted bat
San Rafael milk-vetch
monument milkvetch
Cottam milk-vetch
Kachina daisy
Sheathed deathcamus

Astragalus cottamii
Erigeron kachinensis
Zigadensu vaginatus

APPENDIX 4

11. Circle Cliffs

Candidate Species

southern spotted owl

white-faced ibis

Swainson's hawk

ferruginous hawk

long-billed curlew

spotted bat

Kaiparowits milk-vetch

Astragalus malacoides

Barneby milk-vetch

Section 7(c) also requires the Federal agency proposing a major Federal action significantly affecting the quality of the human environment to conduct and submit to the FWS a biological assessment to determine the effects of the proposal on listed and proposed species. The biological assessment shall be completed within 180 days after the date on which initiated or a time mutually agreed upon between the agency and the FWS. Before physical modification/alteration of a major Federal action is begun the assessment must be completed. If the biological assessment is not begun within 90 days, you should verify this list with us prior to initiation of your assessment. We do not feel that we can adequately assess the effects of the proposed action on listed and proposed species or critical habitat and proposed critical habitat without a complete assessment. When conducting a biological assessment, you shall, at a minimum:

1. conduct a scientifically sound on-site inspection of the area affected by the action, which must, unless otherwise directed by the FWS, include a detailed survey of the area to determine if listed or proposed species are present or occur seasonally and whether suitable habitat exists within the area for either expanding the existing population or potential reintroduction of populations;
2. interview recognized experts on the species at issue, including those within the Fish and Wildlife Service, state conservation agencies, universities, and others who may have data not yet found in scientific literature;
3. review literature and other scientific data to determine the species' distribution, habitat needs, and other biological requirements;
4. review and analyze the effects of the action on the species, in terms of individuals and populations, including consideration of the cumulative effects of the action on the species and habitat;
5. Listed fishes may be impacted as a result of water withdrawals from the Green and Colorado River systems. To evaluate possible impacts to listed fishes the following information is needed: net depletion figures (acre-feet), intake volumes and reservoir storage, evaporative losses from reservoirs and reservoir volumes, location, timing, and water quality characteristics of any return flows. Also, certain

APPENDIX 4

instantaneous flows during various times of the year for sections of the Green and Colorado Rivers need to be met to insure survival of the listed fishes. Potential impacts to these flows need to be analyzed.

6. analyze alternative actions that may provide conservation measures;
7. conduct any studies necessary to fulfill the requirements of (1) through (5) above;
8. review any other relevant information.

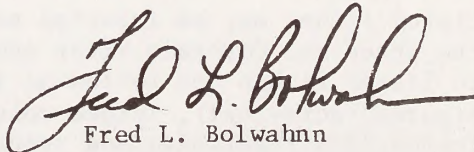
The FWS can enter into formal Section 7 consultation only with another Federal agency or its designee. State, county, or any other governmental or private organizations can participate in the consultation process, help prepare information such as the biological assessment, participate in meetings, etc.

After your agency has completed and reviewed the assessment, it is your responsibility to determine if the proposed action "may affect" any of the listed species or critical habitats. You should also determine if the action is likely to jeopardize the continued existence of proposed species or result in the destruction or an adverse modification of any critical habitat proposed for such species. If the determination is "may affect" for listed species you must request in writing formal consultation from the Field Supervisor, Endangered Species Office, U.S. Fish and Wildlife Service at the address given above. In addition, if you determine that the proposed action is likely to jeopardize the continued existence of proposed species or result in the destruction or adverse modification of proposed critical habitat, you must confer with the FWS. At this time you should provide this office a copy of the biological assessment and any other relevant information that assisted you in reaching your conclusion.

Your attention is also directed to Section 7(d) of the Endangered Species Act, as amended, which underscores the requirement that the Federal agency or the applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which, in effect, would deny the formulation or implementation of reasonable and prudent alternatives regarding their actions on any endangered or threatened species.

We are prepared to assist you whenever you have questions which we may be able to answer. If we can be of further assistance, please advise us.

The FWS representative who will provide you with technical assistance is Terry J. Hickman of our Salt Lake City Office ([801] 524-4430; FTS 588-4430).


Fred L. Bolwahn

Note: The candidate plant species Lepidium barnebyanum may occur within the boundaries of the Argyle Canyon/Willow Creek and Sunnyside and Vicinity (Northern Portion) STSAs. This information was included in response to a comment subsequent to publishing of the Draft EIS and has been added to this appendix with concurrence from the FWS (England, 1984).

APPENDIX 5

AIR QUALITY IMPACT SIGNIFICANCE CRITERIA AND ANALYSIS METHODOLOGY

SIGNIFICANCE CRITERIA

General

The Clean Air Act requires a national air quality program aimed at not only improving air quality in places where the air is relatively dirty, but also preventing serious degradation of air quality where the air is relatively clean. To help accomplish these goals, the Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) provisions. Whereas the NAAQS are uniform minimum national standards for air quality, the PSD provisions give air quality and related values additional protection in areas where existing air quality is better than the minimum required. States may also establish air quality goals and objectives insofar as they do not allow pollutant levels above the national minimum limits.

The State and Federal air quality program requirements are quantitative criteria for assessing the significance of air quality impacts of tar sand development. However, this analysis is conducted to satisfy the broader requirements of the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations. Therefore, other impact criteria (normally less quantitative) are also considered in this EIS analysis. Likewise, this analysis is not designed to satisfy the specific air quality permit processes of the State and Federal agencies.

Subsequent sections elaborate on the following criteria:

- State and National Ambient Air Quality Standards
- Prevention of Significant Deterioration Incremental Limitations
- Air Quality Related Values (including visibility)
- National Emission Standards for Hazardous Air Pollutants
- Other Considerations.

State and National Ambient Air Quality Standards

Appendix Table 5-1 lists the applicable Utah, Colorado, and Federal air quality standards. As noted in the table, both Utah and Colorado have ambient air quality standards equal to the NAAQS. The primary standards are intended

to protect public health allowing for an adequate margin of safety. The secondary standards are intended to protect the public welfare from known or anticipated adverse impacts. Public welfare includes effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, climate, damage to and deterioration of property, and hazards to transportation as well as effects on economic values and on personal comfort and well-being. Thus, comparing the impact to the secondary NAAQS is one way of assessing many air quality issues.

Appendix Table 5-1 shows that standards are written as specific pollutant concentrations for various averaging times (e.g., 1-hour exposure, etc.). Other than the standard for ozone or those based on annual averages, the standards are not to be exceeded more than once per year. The air quality impact evaluation must address the maximum concentration of a particular pollutant (averaged over a specific time interval) that will not be exceeded more than once per year.

Prevention of Significant Deterioration of Air Quality

Utah and Colorado areas covered by the PSD provisions of the Clean Air Act are basically divided into two classes. Class I areas are those areas in which practically any air quality deterioration would be considered significant. Class II areas are those areas in which deterioration that would normally accompany moderate, well-controlled growth would not be considered significant. Different degrees of degradation of air quality are deemed acceptable in the two classes of land. Appendix Figure 5-1 shows the study area and the current classifications. Appendix Table 5-2 lists the Federal Class I, Colorado Category I, and areas of special concern shown in Appendix Figure 5-1. Class I and Class II degradation limits and the secondary NAAQS become the most relevant quantitative criteria to compare the pollutant concentrations resulting from tar sand development.

The Act defines specific maximum allowable increases over baseline concentrations for only two pollutants: SO₂ and TSP. Appendix Table 5-3 lists those allowable increments. The Act also requires the Environmental Protection Agency (EPA) to devise means for preventing significant deterioration of air quality from other pollutants regulated under the Act. This has not yet been accomplished except for a broad interpretation of air quality related values as discussed in Appendix 5-3.

APPENDIX 5

APPENDIX TABLE 5-1

NAAQS for National Levels and Colorado and Utah

Pollutant	Averaging Time	Primary ($\mu\text{g}/\text{m}^3$) ^a	Secondary ($\mu\text{g}/\text{m}^3$) ^b
Ozone	1 hour ^c	235	d
Carbon monoxide	8 hour	10,000 ^e	d
	1 hour	40,000 ^e	d
Nitrogen dioxide	Annual Arithmetic Mean	100	d
Sulfur dioxide	Annual Arithmetic Mean	80	NA ^f
	24 hour	365	NA ^f
	3 hour	NA ^f	1,300
Total suspended particulates	Annual Geometric Mean	75	60
	24 hour	260	150
Lead	Calendar Quarter	1.5	d

Source: Aerocomp, Inc., 1983a.

Note: National standards, other than for ozone or those based on annual average: these standards are not to be exceeded more than once per year.

^aAir quality levels which affect human health.

^bAir quality levels which affect human welfare (e.g., crops, cropland, other vegetation, and animal life).

^cThe number of days during a calendar year in which one or more hourly values could equal or exceed the ozone standard must be less than or equal to 1.

^dSame as primary standard.

^eMilligram/meter³.

^fStandard not established.



APPENDIX FIGURE 5-1
**FEDERAL CLASS 1, COLORADO CATEGORY 1
 AND AREAS OF SPECIAL CONCERN**

APPENDIX 5

APPENDIX TABLE 5-2

Federal Class I, Colorado Category I,
and Areas of Special Concern

Index	Areas
<u>Federal Class I Areas</u>	
1.	Arches National Park
2.	Canyonlands National Park
3.	Capitol Reef National Park
4.	Horseshoe Extension of Canyonlands National Park
5.	Mesa Verde National Park
<u>Colorado Category I</u>	
6.	Colorado National Monument
7.	Dinosaur National Monument
<u>Areas of Special Concern</u>	
8.	Dark Canyon Primitive Area
9.	Glen Canyon National Recreation Area
10.	Grand Gulch Primitive Area
11.	Navajo Indian Reservation
12.	Uintah and Ouray Indian Reservation

Source: Aerocomp, Inc., 1983a.

APPENDIX TABLE 5-3

PSD Incremental Limitations

Pollutant	Averaging Time	Maximum Allowable Concentrations ($\mu\text{g}/\text{m}^3$)		
		Class I	Class II	Class III
SO ₂	Annual	2	20	40
	24-hour	5	91	182
	3-hour	25	512	700
TSP	Annual	5	19	37
	24-hour	10	37	75

Source: Aerocomp, Inc., 1983a.

As part of a PSD review, ambient air quality modeling is required for each pollutant whose emission rate is above certain limits. The pollutants of concern and their corresponding significant, or de minimis, emission levels are presented in Appendix Table 5-4. These emission rates or the corresponding monitoring exemptions can be used as criteria in NEPA analysis.

Colorado has adopted regulations for SO₂ similar in nature to the national PSD provisions. All Federal Class I areas are included in the Colorado Category I classification, although not all Colorado Category I areas are considered in the Federal Class I provisions. Appendix Figure 5-1 shows the Colorado Category I and Federal Class I lands that are in the study area.

The PSD increments are not applicable to Class II areas until a major source or modification submits a completed PSD permit application. Also, the total area encompassed by the Class I or II area is not subject to the PSD increments, but only that portion considered in the "baseline area." As of this writing, neither a baseline date, baseline concentration, or baseline area has been established within the study region except for small areas in Emery and Uintah counties. Consequently, the PSD Class II increments are not applicable to most of the study area at this time. However, this may not be the situation when the combined hydrocarbon developments go through the permit process. The Class I increment is applicable to all sources which may affect a Class I area.

If the PSD increments have been "triggered" at the time of the permit application, the State of Utah will have to ensure that the combined hydrocarbon developments would not cause or contribute to a violation of PSD increments. This could be accomplished by requiring more stringent fugitive emission controls, additional control technology, alternative siting, more stringent controls on non-project sources, or denying the project a PSD permit.

The tar sand facilities in this study will be subject to the general air pollution control provisions of the State of Utah. Facilities developed in Utah must file a notice of intent and must receive an order from the Executive Secretary of the Air Conservation Committee permitting the proposed development.

Air Quality Related Values

While the PSD increments for SO₂ and TSP are uniformly applicable in each of the classes of land, the Act also contains provisions for determining on a case-by-case basis the extent to which a proposed deterioration in a mandatory Class I area is significant. A proposed degradation (such as impacts from tar sand development) is to be judged by taking into account the air quality related values (AQRV), including visibility, which are important to the specific Class I area, whether or not the SO₂ or TSP increments are exceeded. AQRVs include odors, acid deposition, effects on ecological systems, and visibility.

Currently, there are limited objective criteria for judging

the impact on AQRVs. In this study, only visibility impairment is discussed in detail. Acid deposition and other issues are briefly addressed.

The EPA recommended guidelines for determining a potential for significant visibility impairment are 0.10 for Sky/Plume Contrast and Plume/Terrain Contrast and a change in Sky/Terrain Contrast of 0.10. Atmospheric discoloration may also be significant if the blue-red ratio is less than 0.90.

National Emission Standards for Hazardous Air Pollutants

Also part of the Clean Air Act is the National Emission Standards for Hazardous Air Pollutants (NESHAP). Under the Act, the EPA designates and sets emission standards for hazardous air pollutants (HAPs). To date only seven chemicals have been designated as NESHAP pollutants (asbestos, beryllium, mercury, vinyl chloride, benzene, radionuclides, and inorganic arsenic). The emission standards have been set for asbestos, beryllium, mercury, and vinyl chloride (40 CFR, Part 61). None of the emission standards presently quantified are specifically applicable to tar sand facilities. However, these standards can be viewed as criteria to be considered in an EIS.

Other Considerations

EPA is currently considering the adoption of an air quality standard for inhalable particulates (IP) which are a subset of the current particles included in the TSP standard. The IP particles have smaller diameters than those now considered under TSP. This EPA-proposed action could have considerable implications for all fugitive emission sources including surface mining of tar sand, since mining emissions typically consist of larger size particulates.

If the current TSP standards are revised to exclude the larger particles, the one significant criteria for judging the impact of mining operations would certainly change. It is not possible at this time to determine how the proposed IP standard would affect mining activities. This cannot be ascertained until the magnitude of the standard is set and also the size fraction of the IPs is determined. Similarly, the emission factors used to establish emissions from specific operations would have to be revised to estimate IP-size particles, not TSP-size particles.

ANALYSIS METHODOLOGY

To conduct an air quality analysis for tar sand development, the following information is necessary: (1) a determination of whether surface mining or in-situ techniques would be used; (2) the method proposed for extracting bitumen from the sand; (3) whether or not upgrading of the bitumen would be necessary; (4) sizes and locations of mines and facilities; (5) demographic data to assess secondary impacts; (6) meteorological data for input into atmos-

APPENDIX 5

APPENDIX TABLE 5-4

De Minimis Levels

Pollutant	Emission Rate (tons/year)	Monitoring Exemptions	
		($\mu\text{g}/\text{m}^3$)	Averaging Period
Carbon monoxide	100	575	8-hour
Nitrogen oxide	40	14	Annual
Sulfur dioxide	40	13	24-hour
Particulate matter	25	10	24-hour
Ozone (volatile organic compounds)	40	N/A	
Lead	0.6	0.1	24-hour
Asbestos	0.007	N/A	
Beryllium	0.0004	0.0005	24-hour
Mercury	0.1	0.25	24-hour
Vinyl chloride	1.0	15	24-hour
Fluorides	3	0.25	24-hour
Sulfuric acid mist	7	N/A	
Hydrogen sulfide	10	0.04	1-hour
Total reduced sulfur (including H_2S)	10	10	1-hour
Reduced sulfur compounds (including H_2S)	10	10	1-hour

Source: Aerocomp, Inc., 1983a.

APPENDIX 5

pheric dispersion models; and (7) a determination of appropriate atmospheric dispersion models.

This information was gathered and used to develop an emissions inventory which described types of air pollutants emitted, emission rate, and locations of pollutant sources. Emission and meteorological data were used as input to atmospheric dispersion models, which then calculated air pollutant concentrations and visibility impairment.

BLM minerals specialists or lease conversion applicants determined whether surface or in-situ methods would be used, and was based primarily on overburden thickness. For in-situ operations, hot water extraction was assumed unless another method was specifically proposed. Upgrading of bitumen was also assumed necessary unless otherwise proposed. Locations of proposed mines were based on applicant-supplied information and available tar sand resource data. Locations for facilities associated with leases on conversion tracts were also obtained from applicants, if available. In cases where no location was specified, facilities were located reasonably close to deposits with good access and, if possible, away from terrain resulting in unacceptably adverse impacts. Demographic data used to assess air quality impacts from induced population growth was supplied by the Utah State Office of Planning Coordinator (1983).

With the exception of the Sunnyside STSA, on-site meteorological data for model input within STSAs were not available. For annual average concentration estimates, the most representative meteorological data available were used. For STSA analyses, data from the following sites were used: White River Shale Project, Sunnyside, Cedar Mountain, and Salt Wash.

To estimate maximum short-term pollutant concentrations for all STSAs, hypothetical meteorological conditions were used. These conditions were specified by EPA for input into the screening mode of the VALLEY Model. Conditions include a stable atmospheric stability (F), light wind speeds (2.5 meters per second), and persistent flow toward receptors for 6 hours in a 24-hour period.

Because of uncertainty in the emissions inventory and

the sparseness of meteorological data, it was not appropriate to apply sophisticated atmospheric dispersion models. In general, screening-type models were used. For maximum short-term (3-hour and 24-hour average) and long-term (annual average) concentration estimates of total suspended particulates (TSP), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂), VALLEY-BID (VALLEY with buoyancy-induced dispersion) was used for each STSA. For maximum short-term concentration estimates, VALLEY-BID was used in the screening mode, which assumes hypothetical meteorological conditions. For annual average calculations, VALLEY-BID was used with monitored meteorological data judged to be the most representative of each STSA.

Concentrations from area sources were calculated using BU422, a regression model (Aerocomp, Inc., 1983). The model empirically determines the relationship between local air pollution emissions and ambient concentrations by regression of gridded emission density and observed air quality. Ground-level concentrations resulting from the area source emissions were then estimated from the empirical relationships.

Visibility impacts were estimated with the models BU425 and BU426 (Aerocomp, Inc., 1983). BU425, a screening model, uses the level-1 visibility analysis algorithm recommended by the EPA workbook for Estimating Visibility Impairment. If BU425 indicated a potential for significant visibility impairment, BU426 was used to perform a level-2 analysis. BU426 is a modified version of PLUVUE and calculates atmospheric discoloration and reductions in visual range and contrast.

For the short-term regional scale analysis, MESOPUFF was used. The wind field input for MESOPUFF was generated using BU501 (Aerocomp, Inc., 1983). Wind data from December 15-16, 1981 was used for input into the wind field model. During this period, a high pressure system, with associated light wind conditions was centered over eastern Utah.

Ozone concentrations were estimated on a regional scale by RPM-2 (Reactive Plume Model).

APPENDIX 6

CULTURAL RESOURCES
MEMORANDUM OF UNDERSTANDING
UTAH COMBINED HYDROCARBON REGIONAL EIS
BETWEEN
THE BUREAU OF LAND MANAGEMENT
AND
THE UTAH STATE
HISTORIC PRESERVATION OFFICER

I. PURPOSE

The Bureau of Land Management, hereinafter referred to as the Bureau, is preparing the Utah Combined Hydrocarbon Regional Environmental Impact Statement (CHL Regional EIS) under the provisions of the National Environmental Policy Act of 1969. The Bureau has determined that cultural values could be damaged or lost as a result of actions proposed in the CHL Regional EIS. The following kinds of actions are proposed on public lands administered by the Bureau:

- a. Mineral exploration
- b. Mining activities
- c. Construction of drill pads and support facilities
- d. Rights-of-way for access, pipelines, powerlines, etc.
- e. Waste disposal

The Bureau has the responsibility to protect the cultural values on land administered by the Bureau. The Utah State Historic Preservation Officer, hereinafter referred to as the State, is designated as the state representative by the National Historic Preservation Act of 1966, as amended, within the State of Utah. The Bureau has entered into this Memorandum of Understanding with the State in order to outline the responsibilities and procedures that will be used to protect cultural resources affected by the above-mentioned actions. In this agreement, "cultural resources" means data and sites which have archaeological, historical, architectural, or cultural importance and interest.

Investigators will be qualified to evaluate these "cultural resources." Qualifications of investigators will be submitted to the State Historic Preservation Officer.

II. AUTHORITY

This agreement is authorized under the Federal Land Policy and Management Act of 1976 and the National Historic Preservation Act of 1966. It is in accord with Bureau policies and programs. It does not abrogate nor amend any other agreement between the Bureau and the State.

III. RESPONSIBILITIES AND PROCEDURES

The Bureau will comply with 36 CFR 800 in identifying sites which are listed in or eligible for inclusion in the National Register of Historic Places.

APPENDIX 6

A. As part of the planning and environmental analysis required prior to any decision to authorize rights-of-way for the proposed project, the Bureau will search for archaeological and historical literature concerning the affected areas.

B. After completing the planning and environmental analysis process, should the proposed management be implemented, the Bureau will inform project participants of, monitor compliance with, and enforce the following stipulations:

1. Prior to initiation of ground-disturbing activities, literature searches and intensive surveys will be undertaken on all areas which would be disturbed.
2. Wherever possible and feasible, cultural resources will be avoided by construction and related activities. This will be accomplished mainly by rerouting linear facilities such as pipelines and access roads, and adjusting the location of other facilities.
3. A professional archaeologist may be required to be present when ground-disturbing operations are underway.
4. Subsurface cultural resources that are encountered during any construction will be salvaged if there is no other recourse in such a situation.

C. Wherever it is not possible and feasible to avoid sites that contain cultural values, the Bureau will consult with the State Historic Preservation Officer to determine the most satisfactory means of mitigating damage, as required by 36 CFR 800.

D. The Bureau will provide cultural resource reports, technical reports, and other pertinent material to the State.

IV. IMPLEMENTATION

A. This agreement will become effective on the date of the last signature on this agreement.

B. Either party may request revision or cancellation of this agreement by written notice, not less than 30 days prior to the time when such action is proposed.

C. Any problems resulting from this agreement which cannot be resolved by the Bureau and the State will be referred to the Secretary of the Interior and the Advisory Council on Historic Preservation.

8-16-83
Date

Earl C. Hinckley
ACTING Utah State Director
Bureau of Land Management
Department of the Interior

8-22-83
Date

Melvin I. Smith
Utah State Historic Preservation Officer

APPENDIX 7

ALTERNATIVE 1

COUNTY SOCIOECONOMIC ANALYSIS

COUNTY-LEVEL SOCIOECONOMIC IMPACT ANALYSIS OF THE NINE STSA DEVELOPMENTS

The projected impacts of tar sand development for each county are described in this appendix. Population, household, economic base, employment, housing, public and private infrastructure, and the Uintah and Ouray Indian Reservation impacts are discussed. In each instance, the projected impacts are expressed in terms of the difference between the baseline projections and this alternative.

Population and Housing Impacts

A summary of the population and household impacts in each county is presented in Chapter 4. Further detail of the potential population and household impacts by community and CCD can be found in Appendix Tables 7-1 through 7-11. Only those CCDs where significant changes would occur are included separately, but all CCDs are included in the county totals presented in Chapter 4. All projections are presented as a change from the baseline forecast and thereby, only reflect the population and household growth attributable resulting from this alternative.

Economic Base and Employment Impacts

This section describes the potential changes to the economic base of the seven counties likely to be affected. Employment growth by sector and county is assessed together with the projections of total personal income and per capita income.

TOTAL EMPLOYMENT IMPACTS

All seven counties are forecast to realize an increase in total employment between at least one window year; particular counties are forecast to realize a continuous increase in employment throughout the study period while five counties are projected to grow through 1995 before declining. Carbon and Grand counties would experience particularly rapid employment growth in the 1985-1995 time frame; their annual growth rate would be 68.71 percent and 61.04 percent, respectively. Besides a large percentage growth, the actual level of employment in these two coun-

ties from this alternative, is also large. This is evidenced by the fact that, in the year 1995, the employment in Carbon County is projected to be 7,848 above the baseline, while in Grand County the employment would be 8,092 above the baseline. Only Carbon County is expected to realize employment growth through the year 2005, with 11,550 more workers than that projected under baseline conditions. Garfield County is the only other county expected to realize employment growth throughout the period; 611 workers above the baseline are projected in 2005.

Five counties are forecast to have no additional employment from this alternative in 1985, but would expand substantially between 1985 and 1995. Duchesne County is expected to have 350 additional workers in 1995; Emery County, 3,209; Garfield County, 557; Uintah County, 1,823; and Wayne County, 4,207. Each of these counties but Garfield County, however, are projected to realize a decrease in employment requirements between 1995 and 2005.

Appendix Table 7-8 illustrates these county employment trends. Carbon County is expected to absorb the greatest amount of employment growth. The largest tar sand development included in this high alternative--Sunnyside STSA--is located within Carbon County, thereby precipitating this employment growth. Employment in the region as a whole would rise from 111 above the baseline in 1985 to a level of 19,237 greater in 2005. This would represent a 72.63-percent annual growth rate in the 1985-1995 period, followed by a negative 3-percent rate of change in the 1995-2005 time frame. Carbon County would compose around 60 percent of the regional employment growth in 2005.

EMPLOYMENT IMPACTS BY INDUSTRIAL SECTOR

A description of the employment impacts by industrial sector is presented in Appendix Tables 7-9 through 7-16.

PERSONAL INCOME IMPACT PROJECTIONS

The total personal income projections by county are presented in Appendix Table 7-17. These projections are based on a forecast of per capita income and population growth. Per capita income for the years 1985-2005 was derived by aggregating the average monthly wage levels by industrial sector and assuming (1) that the personal income component would remain at the same proportion as the national level and (2) the average annual rate of growth would remain constant.

APPENDIX 7

The per capita income levels for the region are shown in the first line of Appendix Table 7-17. Per capita income is projected to increase from \$14,424 in 1985 to \$15,972 in 1995, but then decrease to \$15,012 in 2005. The annual rate of increase in the first 10 years would be 1.02 percent with an -0.62 percent decline in the final 10 years.

Public and Private Infrastructure Effects

Housing, education, health care, public safety, and utility service are included in this analysis. Summaries of the changes in infrastructure service demands resulting from this alternative are presented by county in Appendix Table 7-18.

APPENDIX 7

APPENDIX 7-1

Alternative 1 Population and Household Impact Projections for Carbon County^a

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>East Carbon Census County Division (CCD)</u>					
East Carbon CCD Total					
Population	19	3,138	4,036	5,283	7,391
Households	7	1,133	1,315	1,572	2,142
East Carbon					
Population	14	2,322	2,987	3,909	5,469
Households	5	838	973	1,163	1,585
Sunnyside					
Population	5	816	1,049	1,374	1,922
Households	2	295	342	409	557
Unincorporated Areas					
Population	0	0	0	0	0
<u>Helper CCD</u>					
Helper CCD Total					
Population	7	937	1,072	1,171	1,548
Households	3	338	349	349	449
Helper					
Population	4	562	643	703	929
Households	2	203	209	209	269
Scotfield					
Population	0	0	0	0	0
Unincorporated Areas					
Population	3	375	429	468	619
Households	1	135	140	140	180
<u>Price CCD</u>					
Price CCD Total					
Population	49	7,142	10,396	12,108	16,711
Households	18	2,578	3,386	3,604	4,844
Price					
Population	32	4,642	6,757	7,870	10,862
Households	12	1,676	2,201	2,343	3,149

APPENDIX 7

APPENDIX TABLE 7-1 (concluded)

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Price CCD (continued)</u>					
Wellington					
Population	9	1,286	1,871	2,179	3,008
Households	3	464	609	649	872
Hiawatha					
Population	0	0	0	0	0
Unincorporated Areas					
Population	8	1,214	1,767	2,058	2,841
Households	3	438	576	613	823

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 7

APPENDIX TABLE 7-2

Alternative 1
Population and Household Impact Projections^a
for Duchesne County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Duchesne Census</u>					
<u>County Division (CCD)</u>					
Duchesne CCD Total					
Population	0	129	228	249	248
Households	0	44	72	67	69
Duchesne					
Population	0	129	228	249	248
Households	0	44	72	67	69
Unincorporated Areas					
Population	0	0	0	0	0
<u>Roosevelt CCD</u>					
Roosevelt CCD Total					
Population	0	669	1,376	878	876
Households	0	230	433	238	244
Roosevelt					
Population	0	401	826	527	526
Households	0	138	260	143	146
Myton					
Population	0	20	41	26	26
Households	0	7	13	7	7
Unincorporated Areas					
Population	0	248	509	325	324
Households	0	85	160	88	90

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 7

APPENDIX TABLE 7-3

Alternative 1
Population and Household Impact Projections
for Emery County^a

Geographic Area and Impact Category	Change From Baseline Population And Households ^b				
	1985	1990	1995	2000	2005
<u>Castle Dale-Huntington Census</u>					
<u>County Division (CCD)</u>					
Castle Dale-Huntington					
CCD Total					
Population	8	1,178	3,658	1,752	2,287
Households	3	425	1,192	521	663
Castle Dale					
Population	3	412	1,280	613	800
Households	1	149	417	182	232
Cleveland					
Population	0	71	219	105	137
Households	0	26	72	31	40
Elmo					
Population	0	47	146	70	91
Housholds	0	17	48	21	27
Huntington					
Population	2	295	915	438	572
Households	1	106	298	130	166
Orangeville					
Population	2	295	915	438	572
Households	1	106	298	130	166
Unincorporated Areas					
Population	0	59	183	88	114
Households	0	21	60	26	33
<u>Emery-Ferron CCD</u>					
Emery-Ferron CCD Total					
Population	0	77	1,220	244	260
Households	0	28	397	73	75
Clawson					
Population	0	0	0	0	0
Emery					
Population	0	19	305	61	65
Households	0	7	99	18	19

APPENDIX 7

APPENDIX TABLE 7-3 (concluded)

Geographic Area and Impact Category	Change From baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Emery-Ferron CCD (continued)</u>					
Ferron					
Population	0	58	915	183	195
Households	0	21	298	55	56
Unincorporated Areas					
Population	0	0	0	0	0
<u>Green River CCD</u>					
Green River CCD Total					
Population	4	635	5,935	1,917	1,771
Households	1	229	1,933	571	513
Green River					
Population	3	546	5,104	1,649	1,523
Households	1	197	1,662	491	441
Unincorporated Areas					
Population	1	89	831	268	248
Households	0	32	271	80	72

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 7

APPENDIX TABLE 7-4

Alternative 1
Population and Household Impact Projections^a
for Garfield County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Escalante Census</u>					
<u>County Division (CCD)</u>					
Escalante CCD Total					
Population	0	292	1,212	1,390	1,466
Households	0	105	395	414	425
Boulder					
Population	0	29	121	139	147
Households	0	11	40	41	43
Escalante					
Population	0	263	1,091	1,251	1,319
Households	0	95	356	373	383
Unincorporated Areas					
Population	0	0	0	0	0

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 7

APPENDIX TABLE 7-5

Alternative 1
Population and Household Impact Projections^a
for Grand County^b

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Thompson Census</u>					
<u>County Division (CCD)</u>					
<u>Thompson CCD Total</u>					
Population	123	2,259	14,874	7,258	7,643
Households	45	816	4,845	2,160	2,215

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 7

APPENDIX TABLE 7-6

Alternative 1
Population and Household Impact Projections
for Uintah County^a

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Uintah-Ouray Census</u>					
<u>County Division (CCD)</u>					
<u>Uintah-Ouray CCD Total</u>					
Population	0	497	841	661	660
Households	0	171	264	179	184
Ballard					
Population	0	199	336	264	264
Households	0	68	106	72	74
Unincorporated Areas					
Population	0	298	505	397	396
Households	0	103	158	107	110
<u>Vernal CCD</u>					
<u>Vernal CCD Total</u>					
Population	0	1,068	2,221	1,379	1,373
Households	0	367	698	374	382
Vernal					
Population	0	534	1,111	690	687
Households	0	184	349	187	191
Unincorporated Areas					
Population	0	534	1,111	690	687
Households	0	184	349	187	191

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 7

APPENDIX TABLE 7-7

Alternative 1
Population and Household Impact Projections
For Wayne County^a

Geographic Area and Impact Category	Change From baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Hanksville Census</u>					
<u>County Division (CCD)</u>					
<u>Hanksville CCD Total</u>					
Population	0	159	5,514	2,780	3,093
Households	0	57	1,796	827	897

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX TABLE 7-8

Alternative 1
Total Employment Growth by County^a

County	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Carbon County	42	6,184	7,848	8,633	11,550	68.71	3.94
Duchesne County	0	191	350	283	283	-- ^b	-2.10
Emery County	0	376	3,209	876	963	-- ^b	-11.33
Garfield County	0	144	557	593	611	-- ^b	0.93
Grand County	69	1,273	8,092	3,228	3,334	61.04	-8.49
Uintah County	0	1,034	1,823	1,008	1,007	-- ^b	-5.76
Wayne County	0	124	4,207	1,560	1,489	-- ^b	-9.87
Total	111	9,326	26,086	16,181	19,237	72.63	-3.00

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-9

Alternative 1
Carbon County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	1,470	2,593	3,719	5,153	-- ^b	7.11
Construction	28	2,671	1,927	1,246	1,321	52.68	-3.71
Manufacturing	0	39	63	66	90	-- ^b	3.63
Transportation, Communication, and Utilities	1	89	141	158	216	64.03	4.36
Wholesale and Retail Trade	4	531	817	911	1,254	70.22	4.36
Finance, Insurance, and Real Estate	1	82	137	149	204	63.56	4.06
Services	2	359	617	671	921	77.39	4.09
Government	5	583	1,018	1,095	1,537	70.17	4.21
Nonfarm Proprietors	2	358	535	619	854	74.88	4.79
Total	42	6,184	7,848	8,633	11,550	68.71	3.94

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-10

Alternative 1
Duchesne County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	0	65	65	65	-- ^b	0.00
Construction	0	58	16	12	12	-- ^b	-2.84
Manufacturing	0	4	7	5	5	-- ^b	-3.31
Transportation, Communication, and Utilities	0	6	12	9	9	-- ^b	-2.84
Wholesale and Retail Trade	0	43	83	62	61	-- ^b	-3.03
Finance, Insurance, and Real Estate	0	6	11	8	8	-- ^b	-3.13
Services	0	20	40	30	30	-- ^b	-2.84
Government	0	41	90	74	74	-- ^b	-1.94
Nonfarm Proprietors	0	13	25	19	19	-- ^b	-2.71
Total	0	191	350	283	283	-- ^b	-2.10

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-11

Alternative 1
Emery County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	21	248	244	244	-- ^b	-0.16
Construction	0	88	1,507	41	46	-- ^b	-29.46
Manufacturing	0	4	21	8	9	-- ^b	-8.12
Transportation, Communication, and Utilities	0	17	74	34	40	-- ^b	-5.97
Wholesale and Retail Trade	0	70	388	151	167	-- ^b	-8.08
Finance, Insurance, and Real Estate	0	8	45	18	19	-- ^b	-8.26
Services	0	34	200	79	87	-- ^b	-7.99
Government	0	73	417	174	207	-- ^b	-6.76
Nonfarm Proprietors	0	61	309	127	144	-- ^b	-7.35
Total	0	376	3,209	876	963	-- ^b	-11.34

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-12

Alternative 1
Garfield County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	--b	--b
Mining	0	0	360	360	361	--b	0.03
Construction	0	103	13	15	16	--b	2.10
Manufacturing	0	1	4	4	4	--b	0.00
Transportation, Communication, and Utilities	0	2	9	11	11	--b	0.20
Wholesale and Retail Trade	0	12	51	59	62	--b	1.97
Finance, Insurance, and Real Estate	0	2	8	9	10	--b	2.26
Services	0	6	29	34	36	--b	2.19
Government	0	10	47	59	66	--b	3.45
Nonfarm Proprietors	0	8	37	42	44	--b	1.75
Total	0	144	557	593	611	--b	0.93

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-13

Alternative 1
Grand County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	101	876	1,903	1,903	-- ^b	8.07
Construction	51	831	4,852	80	85	57.70	-33.27
Manufacturing	0	6	40	20	21	-- ^b	-6.24
Transportation, Communication, and Utilities	1	15	99	51	55	58.33	-5.71
Wholesale and Retail Trade	5	100	643	330	351	62.53	-5.87
Finance, Insurance, and Real Estate	1	13	88	46	49	56.48	-5.69
Services	3	55	363	190	202	61.54	-5.69
Government	5	100	674	372	419	63.29	-4.64
Nonfarm Proprietors	4	70	457	236	250	60.61	-5.85
Total	69	1,291	8,092	3,228	3,334	61.04	-8.49

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-14

Alternative 1
 Uintah County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	--b	--b
Mining	0	400	641	660	660	--b	0.30
Construction	0	416	731	22	22	--b	-29.55
Manufacturing	0	3	6	4	4	--b	-3.97
Transportation, Communication, and Utilities	0	11	21	15	15	--b	-3.31
Wholesale and Retail Trade	0	55	110	74	74	--b	-3.89
Finance, Insurance, and Real Estate	0	7	15	10	10	--b	-3.97
Services	0	46	94	67	67	--b	-3.33
Government	0	76	165	128	128	--b	-2.51
Nonfarm Proprietors	0	20	40	27	27	--b	-3.85
Total	0	1,034	1,823	1,008	1,007	--b	-5.76

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

APPENDIX TABLE 7-15

Alternative 1
Wayne County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	0	351	701	960	-- ^b	10.59
Construction	0	101	3,055	429	33	-- ^b	-36.42
Manufacturing	0	0	16	8	9	-- ^b	-5.59
Transportation, Communication, and Utilities	0	1	40	21	24	-- ^b	-4.98
Wholesale and Retail Trade	0	6	222	116	131	-- ^b	-5.14
Finance, Insurance, and Real Estate	0	1	35	19	21	-- ^b	-4.98
Services	0	3	124	67	76	-- ^b	-4.78
Government	0	6	206	116	140	-- ^b	-3.79
Nonfarm Proprietors	0	5	158	83	94	-- ^b	-5.06
Total	0	124	4,207	1,560	1,489	-- ^b	-9.87

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 7

TABLE 7-16
Alternative 1
Total Personal Income and Per Capita Income Projections

County Population and Income Category	Income and Population					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Per Capita Income	14,424	15,456	15,972	14,340	15,012	1.02	-0.62
Change From Baseline, Carbon County							
Population	76	11,217	15,503	18,563	25,649	70.20	5.16
Total Personal Income (1980 \$ x 10 ⁶)	1.10	173.37	247.61	266.19	385.04	71.88	4.51
Change From Baseline, Duchesne County							
Population	0	798	1,604	1,127	1,124	-- ^a	-3.49
Total Personal Income (1980 \$ x 10 ⁶)	0	12.33	25.62	16.16	16.87	-- ^a	-4.09
Change From Baseline, Emery County							
Population	12	1,891	10,813	3,913	4,319	97.46	-8.77
Total Personal Income (1980 \$ x 10 ⁶)	0.17	29.23	172.71	56.11	64.84	99.84	-9.33
Change From Baseline, Garfield County							
Population	0	292	1,212	1,390	1,466	-- ^a	1.92
Total Personal Income (1980 \$ x 10 ⁶)	0	4.51	19.36	19.93	22.01	-- ^a	1.29
Change From Baseline, Grand County							
Population	125	2,345	15,383	7,556	7,997	61.81	-6.33
Total Personal Income (1980 \$ x 10 ⁶)	1.80	36.24	245.70	108.35	120.05	63.50	-6.91
Change From Baseline, Uintah County							
Population	0	1,565	3,062	2,040	2,033	-- ^a	-4.01
Total Personal Income (1980 \$ x 10 ⁶)	0	24.19	48.91	29.25	30.52	-- ^a	-4.61
Change From Baseline, Wayne County							
Population	0	159	5,514	2,780	3,093	-- ^a	-5.62
Total Personal Income (1980 \$ x 10 ⁶)	0	2.46	88.07	39.87	46.43	-- ^a	-6.20

Source: Argonne National Laboratories, 1983.

^aUndefined.

APPENDIX 7

APPENDIX TABLE 7-17

Alternative 1
Projections of Carbon County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand % of Total	
Housing	1,331	17	2,165	2,430	3,030	2,429	3,315	2,567	3,315	2,675	3,315	2,675	3,315		
Single family	333	5	542	608	758	606	829	642	829	669	829	669	829		
Multi-family	555	7	902	1,013	1,263	1,012	1,382	1,070	1,382	1,115	1,382	1,115	1,382		
Mobile homes															
Education	1,924	15	3,824	2,305	3,609	4,824	4,861	4,624	4,861	4,724	4,861	4,724	4,861		
Students	77	1	153	93	145	193	195	185	195	189	195	189	195		
Classrooms	77	1	153	93	145	193	195	185	195	189	195	189	195		
Teachers															
Health Care	15	1	25	23	32	29	38	30	38	31	38	31	38		
Hospital beds	23	0	39	9	12	39	27	39	27	43	27	43	27		
General care															
Long-term care															
Medical personnel	5	1	8	7	10	9	12	9	12	10	12	10	12		
Doctors	4	1	7	6	8	7	10	8	10	8	10	8	10		
Dentists	13	1	21	20	27	25	32	25	32	26	32	26	32		
Nurses	2	1	3	3	4	3	4	3	4	4	4	4	4		
Public health nurses															
Mental health care	1	1	1	1	1	1	1	1	1	1	1	1	1		
Clinical psychologists	1	1	2	2	2	2	2	2	2	2	2	2	2		
Mental health workers															
Public Safety	15	1	25	23	32	29	38	30	38	31	38	31	38		
Law enforcement	15	1	25	23	32	29	38	30	38	31	38	31	38		
Police officers	15	1	25	23	32	29	38	30	38	31	38	31	38		
Patrol cars	3,703	38	6,161	5,609	7,752	7,161	9,282	7,306	9,282	7,551	9,282	7,551	9,282		
Jail space (sq. ft.)	1	1	2	2	3	2	3	2	3	2	3	2	3		
Juvenile holding cells															
Fire protection	3,000/	4	3,000/	3,000/	4,000/	3,000/	4,000/	3,000/	4,000/	3,000/	4,000/	3,000/	4,000/		
Fire flow (gpm)/	10	1	10	10	10	10	10	10	10	10	10	10	10		
duration (hr)															
Emergency Medical Service	2	1	3	3	4	3	4	3	4	4	4	4	4		
Ambulances	14	7	21	21	28	21	28	21	28	21	28	21	28		
Emergency medical technicians															
Utility Service Demands	2,390	25	3,975	3,619	5,002	4,620	5,989	4,714	5,989	4,872	5,989	4,872	5,989		
Water system	1,396	15	2,321	2,113	2,921	2,698	3,498	2,753	3,498	2,825	3,498	2,825	3,498		
Connections	648	7	1,161	1,057	1,461	1,349	1,749	1,376	1,749	1,433	1,749	1,433	1,749		
Supply (10 ⁶ gal)	1,396	15	2,321	2,113	2,921	2,698	3,498	2,753	3,498	2,825	3,498	2,825	3,498		
Storage (10 ⁶ gal)	1,396	15	2,321	2,113	2,921	2,698	3,498	2,753	3,498	2,825	3,498	2,825	3,498		
Treatment (10 ⁶ gal)	270	3	450	409	566	523	678	533	678	551	678	551	678		
Sewage system (10 ⁶ gal)															
Solid waste															
Other services	45	1	74	68	94	86	112	88	112	91	112	91	112		
Parks (acres)	14,812	152	24,642	22,434	31,006	28,642	37,126	29,222	37,126	30,202	37,126	30,202	37,126		
Libraries	3,703	38	6,161	5,609	7,752	7,161	9,282	7,306	9,282	7,551	9,282	7,551	9,282		
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 7

APPENDIX TABLE 7-1B

Alternative 1
Projections of Duchesne County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand ^a Increment	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand	% of Total
Housing	1,057	0	0	1,123	165	12.8	1,105	303	21.5	1,141	183	13.8	1,189	188	13.7
Single family	265	0	0	281	42	13.0	277	76	21.5	286	46	13.9	298	47	13.6
Multiple family	441	0	0	468	69	12.8	461	126	21.5	476	77	13.9	496	79	13.7
Education	1,254	0	0	1,924	160	7.7	2,244	409	15.4	1,824	357	16.4	1,724	360	17.3
Students	51	0	0	77	7	8.3	90	17	15.9	73	15	17.0	69	15	17.9
Classrooms	51	0	0	77	7	8.3	90	17	15.9	73	15	17.0	69	15	17.9
Teachers															
Health Care															
Hospital beds	11	0	0	13	2	13.3	13	4	23.5	12	3	20.0	11	3	21.4
General care	6	0	0	9	1	10.0	14	1	6.7	18	1	5.3	24	1	4.0
Long-term care															
Medical personnel	4	0	0	4	1	20.0	4	1	20.0	4	1	20.0	4	1	20.0
Doctors	3	0	0	4	1	20.0	4	1	20.0	3	1	20.0	3	1	20.0
Dentists	9	0	0	11	2	15.4	11	3	21.4	10	2	16.7	10	2	16.7
Nurses	2	0	0	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Public health nurses															
Mental health care	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers															
Public Safety															
Law enforcement	11	0	0	13	2	13.3	13	4	23.5	12	3	20.0	11	3	21.4
Police officers	11	0	0	13	2	13.3	13	4	23.5	12	3	20.0	11	3	21.4
Patrol	2,608	0	0	3,033	399	11.6	3,058	802	20.8	2,863	564	16.5	2,703	562	17.2
Jail space (sq. ft.)	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Juvenile holding cells															
Fire protection	2,500/ *10	0/0	0	3,000/ 10	1,000/ 4	25.0	3,000/ 10	1,250/ 5	29.4	2,500/ 10	1,000/ 4	28.6	2,500/ 10	1,000/ 4	28.6
Fire flow (gpm)/ duration (hr)															
Emergency Medical Service	14	0	0	14	2	33.3	14	7	33.3	14	7	33.3	14	7	33.3
Ambulances															
Emergency medical technicians															
Utility Service Demands															
Water system	1,683	0	0	1,957	258	11.6	1,978	518	20.8	1,847	364	16.5	1,744	363	17.2
Connections	983	0	0	1,143	151	11.7	1,152	303	20.8	1,079	213	16.5	1,018	302	17.2
Supply (10 ⁶ gal)	491	0	0	571	75	11.6	576	151	20.8	539	106	16.4	508	102	17.2
Storage (10 ⁶ gal)	983	0	0	1,143	151	11.7	1,152	303	20.8	1,079	213	16.5	1,018	302	17.2
Treatment (10 ⁶ gal)	190	0	0	221	29	11.6	223	59	20.9	209	41	16.4	197	41	17.2
Sewage system (10 ⁶ gal)															
Solid waste															
Other services	32	0	0	37	5	11.9	37	10	21.3	35	7	16.7	33	7	17.5
Parks (acres)															
Libraries	10,430	0	0	12,130	1,596	11.6	12,230	3,208	20.8	11,450	2,254	16.4	10,810	2,248	17.2
Books	2,608	0	0	3,103	399	11.6	3,058	802	20.8	2,863	564	16.5	2,703	562	17.2
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth regardless of 1980 operating conditions.
^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 7

APPENDIX TABLE 7-19

Alternative 1
Projections of Emery County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total
Housing	379	3	0.8	457	410	47.3	469	2,114	81.8	439	699	61.4	415	752	64.4
Single family	95	1	1.0	115	103	47.2	118	529	81.8	110	175	61.4	104	188	64.4
Mobile homes	158	1	0.6	191	171	47.2	196	881	81.8	183	292	61.5	173	313	64.4
Education	216	2	0.2	1,416	389	21.6	1,716	2,517	59.5	1,516	1,025	40.3	1,516	1,244	45.1
Students	33	1	2.9	57	16	21.9	69	101	59.4	61	41	40.2	61	50	45.0
Classrooms	33	1	2.9	57	16	21.9	69	101	59.4	61	41	40.2	61	50	45.0
Teachers															
Health Care															
Hospital beds	6	1	14.3	7	4	36.4	8	22	73.3	7	8	53.3	7	9	56.3
General care	6	1	14.3	6	2	25.0	6	9	60.0	4	6	60.0	4	6	60.0
Long-term care															
Medical personnel	2	1	33.3	3	2	40.0	3	7	70.0	2	3	60.0	2	3	60.0
Doctors	2	1	33.3	2	1	33.3	2	6	75.0	2	2	50.0	2	3	60.0
Dentists	5	1	16.7	6	4	40.0	7	19	73.1	6	7	53.8	6	8	57.1
Nurses	1	1	50.0	1	1	50.0	1	3	75.0	1	1	50.0	2	1	50.0
Public health nurses															
Mental health care	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	1	1	50.0	1	1	50.0	1	2	66.7	1	1	50.0	1	1	50.0
Mental health workers															
Public Safety															
Law enforcement	6	1	14.3	7	4	36.4	8	22	73.3	7	8	53.3	7	9	56.3
Police officers	6	1	14.3	7	4	36.4	8	22	73.3	7	8	53.3	7	9	56.3
Patrol cars	1,305	6	0.5	1,695	946	35.8	1,815	5,407	74.9	1,640	1,957	54.4	1,550	1,160	58.2
Jail space (sq. ft.)	1	1	50.0	1	1	50.0	1	2	66.7	1	1	50.0	1	1	50.0
Juvenile holding cells															
Fire protection	1,750/	4	36.4	2,000/	6	42.9	2,000/	3,000/	60.0	2,000/	2,000/	50.0	2,000/	2,000/	50.0
Fire flow (gpm)/ duration (hr)															
Emergency Medical Service	1	1	50.0	1	1	50.0	1	3	75.0	1	1	50.0	1	1	50.0
Ambulances	7	7	50.0	7	7	50.0	7	21	75.0	7	7	50.0	7	7	50.0
Emergency medical technicians															
Utility Service Demands															
Water system															
Connections	842	4	0.5	1,094	611	35.8	1,171	3,489	74.9	1,058	1,263	54.4	1,000	1,394	58.2
Supply (10 ⁶ gal)	492	2	0.4	639	357	35.8	684	2,038	74.9	609	708	54.4	590	804	58.2
Storage (10 ⁶ gal)	495	1	0.4	319	359	35.8	382	2,038	74.9	309	369	54.4	292	404	58.2
Treatment (10 ⁶ gal)	492	2	0.4	319	359	35.8	382	2,038	74.9	618	738	54.4	584	814	58.2
Swimming pool	95	1	1.0	124	69	35.7	132	395	75.0	120	143	54.4	113	158	58.3
Solid waste															
Other services															
Parks (acres)	16	1	5.9	21	12	36.4	22	65	74.7	20	24	54.5	19	26	57.8
Libraries	5,218	24	0.5	6,778	3,782	35.8	7,258	21,626	74.9	6,558	7,826	54.4	6,198	8,638	58.2
Books	1,305	6	0.5	1,695	946	35.8	1,815	5,407	74.9	1,640	1,957	54.4	1,550	2,160	58.2
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.
^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 7

APPENDIX TABLE 7-20

Alternative 1
Projections of Garfield County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2005			
	Projected Baseline Demand ^a Increment	Alternative 1 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 1 Demand % of Total	
Housing	141	0	201	63	23.9	243	237	49.4	285	249	46.6	255	44.3
Single family	36	0	51	16	23.9	61	60	49.6	72	63	46.7	81	44.1
Multi-family	59	0	84	27	24.3	101	99	49.5	119	104	46.6	134	44.4
Mobile homes													
Education	128	0	328	60	15.5	428	282	39.7	588	364	40.8	422	40.2
Students	6	0	14	3	17.6	18	12	40.0	22	15	40.5	26	17
Classrooms	6	0	14	3	17.6	18	12	40.0	22	15	40.5	26	17
Teachers													
Health Care													
Hospital beds	2	0	2	1	33.0	3	3	50.0	3	3	50.0	4	42.9
General care	3	0	3	1	25.0	3	1	25.0	1	2	66.7	2	50.0
Long-term care													
Medical personnel	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Doctors	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Dentists	1	0	2	1	33.3	2	3	60.0	3	3	50.0	3	50.0
Nurses	2	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Public health nurses													
Mental health care	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Clinical psychologists	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Mental health workers													
Public Safety													
Law enforcement	2	0	2	1	33.3	3	3	50.0	3	3	50.0	4	42.9
Police officers	2	0	2	1	33.3	3	3	50.0	3	3	50.0	4	42.9
Patrol cars	314	0	464	146	23.9	564	606	51.8	664	695	51.1	764	49.0
Jail space (sq. ft.)	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Juvenile holding cells													
Fire protection	1,000/	0	1,000/	1,000/	50.0	1,250/	1,000/	44.4	1,250/	1,250/	50.0	1,500/	45.5
Fire flow (gpm)/	4	0	4	4	50.0	5	4	50.0	5	5	50.0	6	50.0
duration (hr)													
Emergency Medical Service	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	50.0
Ambulances	7	0	7	7	50.0	7	7	50.0	7	7	50.0	7	50.0
Emergency medical technicians													
Utility Service Demands													
Water system	203	0	300	95	24.1	364	391	51.8	429	449	51.1	493	49.0
Connections	119	0	175	55	23.9	213	228	51.7	251	262	51.2	288	48.9
Supply (10 ⁶ gal)	59	0	88	28	24.1	106	114	51.5	135	144	51.2	154	48.9
Storage (10 ⁶ gal)	119	0	175	55	23.9	213	228	51.7	251	262	51.1	288	48.9
Treatment (10 ⁶ gal)	23	0	34	11	24.4	41	44	51.6	48	51	51.5	56	49.1
Sewage system													
Solid waste													
Other services	4	0	6	2	25.0	7	8	53.3	8	9	52.9	10	47.4
Public services													
Libraries	1,254	0	1,854	584	24.0	2,254	2,424	51.8	2,654	2,780	51.2	3,054	49.0
Books	314	0	464	146	23.9	564	606	51.8	664	695	51.1	764	49.0
Space (sq ft.)													

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 7

APPENDIX TABLE 7-21

Alternative 1
Projections of Grand County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total
Housing	-95	27	--b	19	509	96.4	55	3,007	98.2	1,350	98.2	61	1,391	95.8	
Single family	-23	7	--b	5	128	96.2	14	732	98.2	238	98.0	16	348	95.6	
Multi-family	-39	12	--b	8	212	96.4	23	1,253	98.2	563	98.1	26	580	95.7	
Education	99	24	19.5	479	482	50.2	599	3,581	85.7	1,978	80.5	529	2,302	81.3	
Students	4	1	20.0	20	20	50.0	24	144	85.7	80	80.0	22	93	80.9	
Classrooms	4	1	20.0	20	20	50.0	24	144	85.7	80	80.0	22	93	80.9	
Teachers															
Health Care															
Hospital beds	0	1	100.0	1	5	83.3	1	31	96.9	16	94.1	1	16	94.1	
General care	2	1	33.3	2	2	50.0	1	12	85.7	11	84.6	2	11	84.6	
Long-term care															
Medical personnel	0	1	100.0	1	2	66.7	1	10	90.9	5	83.3	1	5	83.3	
Doctors	0	1	100.0	1	2	66.7	1	8	88.9	4	80.0	1	4	80.0	
Dentists	0	1	100.0	1	4	80.0	1	27	96.4	13	92.9	1	14	93.3	
Nurses	0	1	100.0	1	1	50.0	1	4	80.0	2	66.7	1	2	66.7	
Public health nurses	0	1	100.0	1	1	50.0	1	1	50.0	1	50.0	1	1	50.0	
Mental health care	0	1	100.0	1	1	50.0	1	2	66.7	1	50.0	1	1	50.0	
Clinical psychologists	0	1	100.0	1	1	50.0	1	1	50.0	1	50.0	1	1	50.0	
Mental health workers															
Public Safety															
Law enforcement	0	1	100.0	1	5	83.3	1	31	96.9	16	94.1	1	16	94.1	
Police officers	0	1	100.0	1	5	83.3	1	31	96.9	16	94.1	1	16	94.1	
Patrol cars	-220	63	--b	5	1,173	99.6	110	7,692	98.6	3,778	98.8	130	3,999	96.9	
Jail space (sq. ft.)	0	1	100.0	1	1	50.0	1	2	66.7	1	50.0	1	2	66.7	
Juvenile holding cells															
Fire protection	0/	1,000/	100.0	1,000/	1,500/	60.0	4	4,000/	80.0	2,500/	71.4	4	2,500/	71.4	
Fire flow (gpm)/	0	4		4	6		4	10		10		4	10		
duration (hr)															
Emergency Medical Service	0	1	100.0	1	1	50.0	1	4	80.0	2	66.7	1	2	66.7	
Ambulances	0	7	100.0	7	7	50.0	7	28	80.0	7	66.7	7	14	66.7	
Emergency medical technicians															
Utility Service Demands															
Water system															
Connections	-142	41	--b	3	757	99.6	71	4,963	98.6	2,438	98.8	84	2,580	96.8	
Supply (10 ⁶ gal)	-83	24	--b	2	442	99.5	41	2,898	98.6	1,778	98.6	49	1,507	96.9	
Storage (10 ⁶ gal)	-41	12	--b	1	221	99.5	21	1,449	98.6	712	98.8	25	753	96.8	
Treatment (10 ⁶ gal)	-83	24	--b	2	442	99.5	41	2,898	98.6	1,778	98.6	49	1,507	96.9	
Sewage system (10 ⁶ gal)	-16	5	--b	1	86	98.9	8	561	98.6	276	98.9	9	292	97.0	
Solid waste															
Other services	-2	1	--b	1	15	93.8	2	93	97.9	46	97.9	2	48	96.0	
Parks (acres)	-882	250	--b	18	4,690	99.6	438	30,766	98.6	15,112	98.8	518	15,934	96.9	
Libraries	-220	63	--b	5	1,173	99.6	110	7,692	98.6	3,778	98.8	130	3,999	96.9	
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bUndefined.

^cThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 7

APPENDIX TABLE 7-22

Alternative 1
Projections of Uintah County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total
Housing	997	0	0	1,501	323	17.7	1,549	578	27.2	1,561	332	17.5	1,591	340	17.6
Single family	250	0	0	376	81	17.7	388	145	27.2	391	83	17.5	398	85	17.6
Multi-family	416	0	0	626	135	17.7	646	241	27.2	651	139	17.6	663	142	17.6
Mobile homes															
Education	1,400	0	0	3,010	314	9.4	3,370	781	17.2	3,020	646	17.6	2,790	651	18.9
Students	56	0	0	121	13	9.7	151	32	17.5	121	26	17.7	112	27	19.4
Classrooms	96	0	0	121	13	9.7	151	32	17.5	121	26	17.7	112	27	19.4
Teachers															
Health Care															
Hospital beds	11	0	0	18	4	18.2	19	7	26.9	17	5	22.7	16	5	23.8
General care	10	0	0	21	1	4.5	29	1	3.3	35	1	2.8	42	2	4.5
Long-term care															
Medical personnel	4	0	0	6	1	14.3	6	2	25.0	6	2	25.0	5	2	28.6
Doctors	3	0	0	5	1	16.7	5	2	28.6	5	2	28.6	4	2	33.3
Dentists	9	0	0	15	3	16.7	16	6	27.3	15	4	21.1	14	4	22.2
Nurses	2	0	0	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Public health nurses															
Mental health care	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers															
Public Safety															
Law enforcement	11	0	0	18	4	18.2	19	7	26.9	17	5	22.7	16	5	23.8
Police officers	11	0	0	18	4	18.2	19	7	26.9	17	5	22.7	16	5	23.8
Patrol cars	2,602	0	0	4,402	783	15.1	4,672	1,531	24.7	4,232	1,020	33.4	3,842	1,017	20.9
Jail space (sq. ft.)	1	0	0	2	1	33.3	2	1	33.3	2	1	33.3	1	1	50.0
Juvenile holding cells															
Fire protection	2,500/	0	0	3,000/	1,250/	29.4	3,000/	1,750/	36.8	3,000/	1,500/	33.3	3,000/	1,500/	33.3
Fire flow (gpm)/	10			10	5		10	7		10	6		10	6	
duration (hr)															
Agency/Medical Service	2	0	0	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Amplifiers	14	0	0	14	7	33.3	14	7	33.3	14	7	33.3	14	7	33.3
Emergency medical technicians															
Utility Service Demands															
Water system	1,679	0	0	2,841	505	15.1	3,015	988	24.7	2,731	659	19.4	2,479	656	20.9
Connections	981	0	0	1,659	295	15.1	1,761	577	24.7	1,595	385	19.4	1,448	383	20.9
Supply (10 ⁶ gal)	490	0	0	830	147	15.0	880	288	24.7	797	192	19.4	724	192	21.0
Storage (10 ⁶ gal)	981	0	0	1,659	295	15.1	1,761	577	24.7	1,595	385	19.4	1,448	383	20.9
Treatment (10 ⁶ gal)	190	0	0	321	57	15.1	341	112	24.7	309	74	19.3	280	74	20.9
Seepage system (10 ⁶ gal)															
Solid waste															
Other services	32	0	0	53	10	15.9	57	19	25.0	51	13	20.3	47	13	21.7
Parks (acres)	10,408	0	0	17,608	3,130	15.1	18,688	6,124	24.7	16,928	4,080	19.4	15,368	4,066	20.9
Libraries	2,608	0	0	4,402	783	15.1	4,672	1,531	24.7	4,232	1,020	19.4	3,842	1,017	20.9
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 7

APPENDIX TABLE 7-23

Alternative 1
Projections of Wayne County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 1 Demand	% of Total
Housing	39	0	0	81	35	30.2	129	1,078	89.3	159	497	75.8	195	539	73.4
Single family	10	0	0	21	9	30.0	33	270	89.1	40	125	75.8	49	135	73.4
Multi-family	17	0	0	34	15	30.6	54	449	89.3	67	207	75.5	82	225	73.3
Mobile homes															
Education	48	0	0	98	33	25.2	158	1,284	89.0	198	728	78.6	238	891	78.9
Students	2	0	0	4	2	33.3	7	52	88.1	8	30	78.9	10	36	78.3
Classrooms	2	0	0	4	2	33.3	7	52	88.1	8	30	78.9	10	36	78.3
Teachers															
Health Care	1	0	0	1	1	50.0	2	12	85.7	2	6	75.0	3	7	70.0
Hospitals	2	0	0	3	1	25.0	4	5	5.6	5	4	44.4	6	5	45.5
Long-term care															
Medical personnel	1	0	0	1	1	50.0	1	4	80.0	1	2	66.7	1	2	66.7
Doctors	1	0	0	1	1	50.0	1	3	75.0	1	2	66.7	1	2	66.7
Dentists	1	0	0	1	1	50.0	1	10	83.3	2	5	71.4	2	6	75.0
Nurses	1	0	0	1	1	50.0	1	2	66.7	1	1	50.0	1	1	50.0
Public health nurses															
Mental health care	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers															
Public Safety	1	0	0	1	1	50.0	2	12	85.7	2	6	75.0	3	7	70.0
Law enforcement	1	0	0	1	1	50.0	2	12	85.7	2	6	75.0	3	7	70.0
Police officers	1	0	0	1	1	50.0	2	12	85.7	2	6	75.0	3	7	70.0
Patrol cars	105	0	0	215	80	27.1	330	2,757	89.3	420	1,390	76.8	3	7	73.2
Jail space (sq. ft.)															
Juvenile holding cells															
Fire protection	1,000/	0	0	1,000/	1,000/	50.0	1,000/	1,000/	71.4	1,000/	1,750/	63.6	1,250/	1,750/	58.3
Fire flow (gpm)/	4	0	0	4	4	100.0	4	10	100.0	4	7	100.0	5	7	100.0
duration (min)															
Emergency medical service	1	0	0	1	1	50.0	1	2	66.7	1	1	50.0	1	1	50.0
ambulances	7	0	0	7	7	100.0	7	14	100.0	7	7	100.0	7	7	100.0
Emergency medical technicians															
Utility Service Demands	68	0	0	139	52	27.2	213	1,779	89.3	271	897	76.8	329	998	75.2
Water system	40	0	0	81	30	27.0	124	1,039	89.3	158	524	76.8	192	583	75.2
Connections	20	0	0	41	15	26.8	62	519	89.3	79	262	76.8	96	291	75.2
Supply (10 ⁶ gal)	40	0	0	81	30	27.0	124	1,039	89.3	158	524	76.8	192	583	75.2
Storage (10 ⁶ gal)	8	0	0	16	6	27.3	24	201	89.3	31	101	76.5	37	113	75.3
Treatment (10 ⁶ gal)															
Sewage system (10 ⁶ gal)															
Solid waste															
Other services	2	0	0	3	1	25.0	4	34	89.5	6	17	73.9	7	19	73.0
Parks (acres)	418	0	0	858	318	47.5	1,318	11,028	89.3	1,678	5,560	76.8	2,038	6,186	75.2
Libraries	105	0	0	215	80	27.1	330	2,757	89.3	420	1,390	76.8	510	1,547	75.2
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

ALTERNATIVE 2

COUNTY SOCIOECONOMIC ANALYSIS

COUNTY-LEVEL SOCIOECONOMIC IMPACT ANALYSIS

The projected impacts of this alternative on each county are described in this section. Population, household, economic base, employment, housing, public and private infrastructure, fiscal, social, and cultural impacts are discussed. In each instance, the projected impacts are expressed in terms of the difference between the baseline projections and this alternative.

Population and Housing Impacts

A summary of the population and household impacts in each county is presented in Chapter 4. Further detail of the population and household impacts by community and CCD can be found in Appendix Tables 8-1 through 8-8. Only those CCDs where significant changes would occur are included separately, but all CCDs are included in the county totals presented in Chapter 4. All projections are presented as a change from the baseline forecast and, therefore, only reflect the population and household growth attributable to this alternative.

Economic Base and Employment Impacts

The projected changes to the economic base and employment of the counties in the region are described in this section. A description of the employment impacts by industrial sector and county is presented in Appendix Tables 8-9 through 8-16. Total personal income and per capita income projections are shown in Table 8-17.

TOTAL EMPLOYMENT IMPACTS BY COUNTY

Carbon and Grand counties would experience particularly rapid employment growth in the 1985-1995 timeframe; their annual growth rate would be 54.85 percent and 34.74 percent, respectively. Besides a large percentage growth, the actual level of employment in these two counties from the development of Alternative 2, is also large. This is evidenced by fact that, in the year 1995, employment in Carbon County is projected to be 3,330 above the baseline, while in Grand County the employment would be 1,361 above the baseline. Only Carbon County is expected to realize large employment growth through the year 2005, with 3,913 more workers than that projected under the baseline conditions. Duchesne, Garfield, and Uintah counties are the other counties expected to realize employment growth throughout the period; 92 workers above the baseline are projected in 2005 for Duchesne, 52 in Garfield, and 405 in Uintah.

Three counties are forecasted to have no additional employment from Alternative 2 in 1985 but expand substantially between 1985 and 1995. Emery County is expected to have 290 additional workers in 1995; Garfield County, 49; and Wayne County, 790. Each of these counties but Garfield County, however, are projected to realize a decrease in employment requirements between 1995 and 2005.

Carbon County is expected to absorb the greatest amount of employment growth. The largest tar sand development included in Alternative 2--Sunnyside STSA--is located within Carbon County, thereby precipitating this employment growth. Employment in the region as a whole would rise from 250 above the baseline in 1985 to a level of 6,111 greater in 2005. This would represent a 38.04-percent annual growth rate in the 1985-1995 period followed by a negative 0.27-percent rate of change in the 1995-2005 time frame. Carbon County would compose around 65 percent of the regional employment growth in 2005.

EMPLOYMENT IMPACTS BY INDUSTRIAL SECTOR

A description of the employment impacts by industrial sector is presented in Appendix Tables 8-10 through 8-16.

PERSONAL INCOME IMPACT PROJECTION

The total personal income projections by county are presented in Appendix Table 8-17. These projections are based upon a forecast of per capita income and population growth. Per capita income for the years 1985-2005 was derived by aggregating the average monthly wage levels by industrial sector and assuming (1) that the personal income component would remain at the same proportion as the national level; and (2) the average annual rate of growth would remain constant.

The per capita income levels for the region are shown in the first line of Appendix Table 8-17. Per capita income is projected to increase from \$14,448 in 1985 to \$15,132 in 1995, but then decrease to \$14,364 in 2005. The annual rate of increase in the first 10 years would be 0.46 percent, with a -0.52 percent decline in the final 10 years. A description of county trends follows.

Public and Private Infrastructure Effects

Housing, education, health care, public safety, and utility services are included in this analysis. Summaries of the changes in the infrastructure service demands resulting from this alternative are presented in Appendix Tables 8-18 through 8-25.

APPENDIX 8

APPENDIX TABLE 8-1

Alternative 2
Population and Household Impact Projections
for Carbon County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>East Carbon Census</u>					
<u>County Division (CCD)</u>					
<u>East Carbon CCD Total</u>					
Population	19	821	1,867	2,624	2,715
Households	7	293	608	731	754
<u>East Carbon</u>					
Population	14	608	1,382	1,942	2,009
Households	5	217	450	541	558
<u>Sunnyside</u>					
Population	5	213	485	682	706
Households	2	76	158	190	196
<u>Unincorporated Areas</u>					
Population	0	0	0	0	0
<u>Helper CCD</u>					
<u>Helper CCD Total</u>					
Population	7	219	480	468	482
Households	3	78	156	130	134
<u>Helper</u>					
Population	4	131	288	281	289
Households	2	47	94	78	80
<u>Scotfield</u>					
Population	0	0	0	0	0
<u>Unincorporated Areas</u>					
Population	3	88	192	187	193
Households	1	31	62	52	54
<u>Price CCD</u>					
<u>Price CCD Total</u>					
Population	49	1,855	4,331	5,719	5,940
Households	18	663	1,411	1,593	1,650
<u>Price</u>					
Population	32	1,206	2,815	3,717	3,861
Households	12	431	917	1,035	1,073

APPENDIX 8

APPENDIX TABLE 8-1 (concluded)

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
Price CCD (continued)					
Wellington					
Population	9	334	780	1,029	1,069
Households	3	119	254	287	297
Hiawatha					
Population	0	0	0	0	0
Unincorporated Areas					
Population	8	315	736	972	1,010
Households	3	113	240	271	281

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 8

APPENDIX TABLE 8-2

Alternative 2
Population and Household Impact Projections
for Duchesne County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Duchesne Census</u>					
<u>County Division (CCD)</u>					
Duchesne CCD Total					
Population	1	5	6	7	8
Households	0	2	2	2	2
Duchesne					
Population	1	5	6	7	8
Households	0	2	2	2	2
Unincorporated Areas					
Population	0	0	0	0	0
<u>Roosevelt CCD</u>					
Roosevelt CCD Total					
Population	96	306	366	416	425
Households	35	97	101	113	118
Roosevelt					
Population	58	184	220	250	255
Households	21	58	61	68	71
Myton					
Population	3	9	11	12	13
Households	1	3	3	3	4
Altamont					
Population	0	0	0	0	0
Unincorporated Areas					
Population	36	113	135	154	157
Households	13	36	37	42	44

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 8

APPENDIX TABLE 8-3

Alternative 2
Population and Household Impact Projections
for Emery County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Castle Dale-Huntington Census County Division (CCD)</u>					
Castle Dale-Huntington CCD Total					
Population	8	385	622	681	705
Households	3	138	203	190	196
Castle Dale					
Population	3	135	218	238	247
Households	1	48	71	67	69
Cleveland					
Population	0	23	37	41	42
Households	0	8	12	11	12
Elmo					
Population	0	15	25	27	28
Households	0	6	8	8	8
Huntington					
Population	2	96	156	170	176
Households	1	35	51	48	49
Orangeville					
Population	2	96	156	170	176
Households	1	35	51	48	49
Unincorporated Areas					
Population	0	19	31	34	35
Households	0	7	10	10	10
<u>Emery-Ferron CCD</u>					
Emery-Ferron CCD Total					
Population	0	67	33	32	33
Households	0	24	11	9	9
Clawson					
Population	0	0	0	0	0
Emery					
Population	0	17	8	8	8
Households	0	6	3	2	2

APPENDIX 8

APPENDIX TABLE 8-3 (concluded)

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Emery-Ferron CCD (continued)</u>					
Ferron					
Population	0	50	25	24	25
Households	0	18	8	7	7
Unincorporated Areas					
Population	0	0	0	0	0
<u>Green River CCD</u>					
Green River CCD Total					
Population	4	295	1,076	438	454
Households	1	105	350	122	126
Green River					
Population	3	254	925	377	390
Households	1	90	301	105	108
Unincorporated Areas					
Population	1	41	151	61	64
Households	0	15	49	17	18

APPENDIX 8

APPENDIX TABLE 8-4

Alternative 2
Population and Household Impact Projections
for Garfield County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Escalante Census</u>					
<u>County Division (CCD)</u>					
<u>Escalante CCD Total</u>					
Population	0	29	114	124	129
Households	0	10	37	35	36
<u>Boulder</u>					
Population	0	3	11	12	13
Households	0	1	4	4	4
<u>Escalante</u>					
Population	0	26	103	112	116
Households	0	9	33	32	32
<u>Unincorporated Areas</u>					
Population	0	0	0	0	0

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 8

APPENDIX TABLE 8-5

Alternative 2
Population and Household Impact Projections
for Grand County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Thompson Census</u>					
<u>County Division (CCD)</u>					
<u>Thompson CCD Total</u>					
Population	123	2,510	2,770	2,369	2,453
Households	45	896	902	660	681

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 8

APPENDIX TABLE 8-6

Alternative 2
Population and Household Impact Projections
for Uintah County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Uintah-Ouray Census County Division (CCD)</u>					
<u>Uintah-Ouray CCD Total</u>					
Population	51	322	363	394	400
Households	19	102	100	107	111
Ballard					
Population	20	129	145	158	160
Households	8	41	40	43	44
Unincorporated Areas					
Population	31	193	218	236	240
Households	11	61	60	64	67
<u>Vernal CCD</u>					
<u>Vernal CCD Total</u>					
Population	113	267	326	377	387
Households	42	84	90	102	108
Vernal					
Population	57	134	163	189	194
Households	21	42	45	51	54
Unincorporated Areas					
Population	57	134	163	189	194
Households	21	42	45	51	54

Source: Argonne National Laboratories, 1983.

^aOnly those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^bTotals may not add because of rounding.

APPENDIX 8

APPENDIX TABLE 8-7

Alternative 2
Population and Household Impact Projections
for Wayne County

Geographic Area and Impact Category	Change From Baseline Population and Households ^b				
	1985	1990	1995	2000	2005
<u>Hanksville Census</u>					
<u>County Division (CCD)</u>					
<u>Hanksville CCD Total</u>					
Population	0	159	1,076	758	786
Households	0	57	350	211	218

Source: Argonne National Laboratories, 1983.

^a Only those CCDs and communities which satisfied the 5-percent/year growth criterion are of interest and are included in this table. All CCDs and communities are included in the county totals.

^b Totals may not add because of rounding.

APPENDIX 8

APPENDIX TABLE 8-8

Alternative 2
Total Employment Growth by County^a

County	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Carbon	42	1,597	3,330	3,838	3,913	54.85	1.63
Duchesne	16	62	76	89	92	16.86	1.93
Emery	0	202	290	219	229	-- ^b	-2.33
Garfield	0	14	49	51	52	-- ^b	0.60
Grand	69	1,385	1,361	1,023	1,044	34.74	-2.62
Uintah	123	363	383	403	405	12.03	0.59
Wayne	0	124	790	370	376	-- ^b	-7.16
Total	250	3,747	6,279	5,993	6,111	38.04	-0.27

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-9

Alternative 2
Carbon County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	501	888	1,999	1,999	-- ^b	8.45
Construction	28	539	1,157	94	97	45.08	-21.96
Manufacturing	0	10	23	31	32	-- ^b	3.36
Transportation, Communication, and Utilities	1	24	55	74	77	49.29	3.42
Wholesale and Retail Trade	4	141	321	429	445	55.04	3.32
Finance, Insurance, and Real Estate	1	22	51	69	72	48.17	3.51
Services	2	97	230	313	325	60.72	3.52
Government	5	169	388	535	562	54.52	3.77
Nonfarm Proprietors	2	94	217	293	304	59.79	3.43
Total	42	1,597	3,330	3,838	3,913	54.85	1.63

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-10

Alternative 2
Duchesne County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	0	0	0	0	0	-- ^b
Construction	1	3	4	5	5	14.87	2.26
Manufacturing	0	2	2	2	2	-- ^b	0
Transportation, Communication, and Utilities	1	3	3	4	4	11.61	2.92
Wholesale and Retail Trade	5	21	24	27	27	16.98	1.18
Finance, Insurance, and Real Estate	1	3	3	4	4	11.61	2.92
Services	2	9	11	13	13	18.59	1.68
Government	5	17	22	28	30	15.97	3.15
Nonfarm Proprietors	1	6	7	8	8	21.48	1.34
Total	16	62	76	89	92	16.86	1.93

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-11

Alternative 2
Emery County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	21	21	21	21	-- ^b	0
Construction	0	77	17	12	13	-- ^b	-2.65
Manufacturing	0	1	4	2	2	-- ^b	-6.70
Transportation, Communication, and Utilities	0	6	14	12	12	-- ^b	-1.53
Wholesale and Retail Trade	0	27	67	46	47	-- ^b	-3.48
Finance, Insurance, and Real Estate	0	3	8	5	6	-- ^b	-2.84
Services	0	13	34	24	25	-- ^b	-3.12
Government	0	30	71	57	61	-- ^b	-1.51
Nonfarm Proprietors	0	23	54	40	42	-- ^b	-2.48
Total	0	202	290	219	229	-- ^b	-2.33

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-12

Alternative 2
Garfield County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	0	30	30	30	-- ^b	0
Construction	0	10	1	1	1	-- ^b	0
Manufacturing	0	0	0	0	0	-- ^b	-- ^b
Transportation, Communication, and Utilities	0	0	1	1	1	-- ^b	0
Wholesale and Retail Trade	0	1	5	5	5	-- ^b	0
Finance, Insurance, and Real Estate	0	0	1	1	1	-- ^b	0
Services	0	1	3	3	3	-- ^b	0
Government	0	1	5	6	6	-- ^b	1.84
Nonfarm Proprietors	0	1	3	4	4	-- ^b	2.92
Total	0	14	49	51	52	-- ^b	0.60

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-13

Alternative 2
Grand County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	181	471	581	581	-- ^b	2.12
Construction	51	825	429	26	27	23.73	-24.16
Manufacturing	0	6	8	7	7	-- ^b	-1.33
Transportation, Communication, and Utilities	1	16	19	17	17	34.23	1.11
Wholesale and Retail Trade	5	105	124	108	112	37.86	-1.01
Finance, Insurance, and Real Estate	1	14	17	15	15	37.75	-1.24
Services	3	56	70	62	65	37.02	-0.74
Government	5	108	135	129	139	39.04	0.29
Nonfarm Proprietors	4	75	88	77	80	36.22	-0.95
Total	69	1,385	1,361	1,023	1,044	34.74	-2.62

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-14

Alternative 2
 Uintah County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	280	280	280	280	-- ^b	0
Construction	102	6	7	8	9	-23.50	2.54
Manufacturing	0	1	1	1	1	-- ^b	0
Transportation, Communication, and Utilities	1	4	4	5	5	14.87	2.26
Wholesale and Retail Trade	6	18	21	24	25	13.35	1.76
Finance, Insurance, and Real Estate	1	2	3	3	4	11.61	2.92
Services	5	17	20	23	24	14.87	1.84
Government	8	28	37	47	49	16.55	2.85
Nonfarm Proprietors	2	7	9	10	10	16.23	1.06
Total	123	363	383	403	405	12.03	0.56

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-15

Alternative 2
Wayne County Employment Projections^a

Industrial Sector	Change In Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	0	0	0	0	0	-- ^b	-- ^b
Mining	0	0	120	240	240	-- ^b	7.18
Construction	0	102	511	8	8	-- ^b	-34.01
Manufacturing	0	0	3	2	2	-- ^b	-3.97
Transportation, Communication, and Utilities	0	1	8	6	6	-- ^b	-2.84
Wholesale and Retail Trade	0	6	44	32	33	-- ^b	-2.84
Finance, Insurance, and Real Estate	0	1	7	5	5	-- ^b	-3.31
Services	0	4	25	19	20	-- ^b	-2.21
Government	0	6	42	34	37	-- ^b	-2.26
Nonfarm Proprietors	0	5	31	23	24	-- ^b	-2.53
Total	0	124	790	370	376	-- ^b	-7.16

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bUndefined.

APPENDIX 8

APPENDIX TABLE 8-16

Alternative 2
Total Personal Income and Per Capita Income Projections

County Population and Income Category	Income and Population					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Per Capita Income	14,447	15,816	15,132	13,416	14,364	-0.46	-0.52
Change From Baseline, Carbon County							
Population	76	2,895	6,677	8,811	9,137	56.24	3.19
Total Personal Income (1980 \$ x 10 ⁶)	1.10	45.79	101.04	118.21	131.24	57.15	2.65
Change From Baseline, Duchesne County							
Population	97	311	372	423	433	14.39	1.53
Total Personal Income (1980 \$ x 10 ⁶)	1.40	4.92	5.63	5.67	6.22	14.93	1.00
Change From Baseline, Emery County							
Population	12	747	1,731	1,151	1,193	64.40	-3.65
Total Personal Income (1980 \$ x 10 ⁶)	0.17	11.81	26.19	15.44	17.14	65.59	-4.15
Change From Baseline, Garfield County							
Population	0	29	114	124	129	-- ^a	1.24
Total Personal Income (1980 \$ x 10 ⁶)	0	0.46	1.73	1.67	1.85	-- ^a	-0.67
Change From Baseline, Grand County							
Population	125	2,559	2,878	2,477	2,569	36.84	-1.13
Total Personal Income (1980 \$ x 10 ⁶)	1.81	40.47	43.55	33.23	36.90	37.45	-1.64
Change From Baseline, Uintah County							
Population	164	588	689	771	787	15.44	1.34
Total Personal Income (1980 \$ x 10 ⁶)	2.37	9.30	10.43	10.34	11.30	15.97	-0.80
Change From Baseline, Wayne County							
Population	0	159	1,076	758	786	-- ^a	-3.09
Total Personal Income (1980 \$ x 10 ⁶)	0	2.51	16.28	10.17	11.29	-- ^a	-3.59

Source: Argonne National Laboratories, 1983.

^aUndefined.

APPENDIX 8

APPENDIX TABLE 6-17

Alternative 2
Projections of Carbon County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand % of Total	
															Demand
Housing	1,331	1.3	2,165	621	22.3	2,429	1,305	35.0	2,567	1,473	36.5	2,675	1,523	36.3	
Single family	333	1.5	542	156	22.3	608	327	35.0	669	369	36.5	669	381	36.3	
Multi-family	555	7	902	259	22.3	1,012	544	35.0	1,070	614	36.5	1,115	635	36.3	
Mobile homes															
Education	1,924	0.8	3,824	612	13.8	4,824	1,649	25.5	4,624	2,541	35.5	4,724	2,792	37.1	
Students	77	1.3	153	25	14.0	193	66	25.5	185	102	35.5	189	112	37.2	
Classrooms	77	1.3	153	25	14.0	193	66	25.5	185	102	35.5	189	112	37.2	
Teachers															
Health Care	15	6.3	25	6	19.4	29	14	32.6	30	18	37.5	31	19	38.0	
Hospital beds	23	4.2	39	3	7.1	39	6	13.3	39	12	23.5	43	12	21.8	
General care															
Long-term care															
Medical personnel	5	16.7	8	2	20.0	9	5	35.7	9	6	40.0	10	6	37.5	
Doctors	4	20.0	7	2	22.2	8	4	33.3	8	5	38.4	8	5	38.5	
Dentists	13	7.1	21	5	19.2	25	12	32.4	25	15	37.5	26	16	38.1	
Nurses	2	33.3	3	1	25.0	3	2	40.0	3	2	40.0	4	2	33.3	
Public health nurses															
Mental health care	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Clinical psychologists	1	50.0	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3	
Mental health workers															
Public Safety	15	6.3	25	6	19.4	29	14	32.6	30	18	37.5	31	19	38.0	
Law enforcement	15	6.3	25	6	19.4	29	14	32.6	30	18	37.5	31	19	38.0	
Police officers	16	1.0	26	6	19.4	29	14	32.6	30	18	37.5	31	19	38.0	
Police cars	3,703	1.0	6,161	1,448	19.0	7,161	3,339	31.8	7,306	4,406	37.6	7,551	4,569	37.7	
Jail (sq. ft.)	1	50.0	2	1	33.3	2	1	33.3	2	2	50.0	2	2	50.0	
Juvenile holding cells															
Fire protection	3,000/	25.0	3,000/	1,750/	36.8	3,000/	2,500/	45.5	3,000/	3,000/	50.0	3,000/	3,000/	50.0	
Fire flow (gpm)/	10		10	7		10	10		10	10		10	10		
duration (hr)															
Emergency Medical Service	2	33.3	3	1	25.0	3	2	40.0	3	2	40.0	4	2	33.3	
Ambulances	14	33.3	21	7	25.0	21	14	40.0	21	14	40.0	28	14	33.3	
Emergency medical technicians															
Utility Service Demands	2,390	1.0	3,975	934	19.0	4,620	2,155	31.8	4,714	2,843	37.6	4,672	2,948	37.7	
Water system	1,396	1.1	2,321	545	19.0	2,698	1,259	31.8	2,753	1,660	37.6	2,845	1,722	37.7	
Connections	648	1.0	1,161	273	19.0	1,349	629	31.8	1,376	830	37.6	1,423	861	37.7	
Supply (10 ⁶ gal)	1,396	1.1	2,321	545	19.0	2,698	1,259	31.8	2,753	1,660	37.6	2,845	1,722	37.7	
Storage (10 ⁶ gal)	1,396	1.1	2,321	545	19.0	2,698	1,259	31.8	2,753	1,660	37.6	2,845	1,722	37.7	
Treatment (10 ⁶ gal)	270	1.1	450	106	19.1	523	244	31.8	553	322	37.7	551	334	37.7	
Sewage system (10 ⁶ gal)															
Solid waste															
Other services	45	2.2	74	18	19.6	86	41	32.3	88	53	37.6	91	55	37.7	
Parks (acres)	14,812	1.0	24,642	5,790	19.0	28,642	13,354	31.8	29,222	17,622	37.6	30,202	18,274	37.7	
Libraries	3,703	1.0	6,161	1,448	19.0	7,161	3,339	31.8	7,306	4,406	37.6	7,551	4,569	37.7	
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

APPENDIX TABLE 8-18
Alternative 2
Projections of Ouachese County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total
Housing															
Single family	1,057	22	2.0	1,123	59	5.0	1,105	62	5.3	1,141	69	5.7	1,189	73	5.8
Multi-family	265	6	2.0	281	15	5.1	277	16	5.4	286	18	5.9	298	19	6.0
Mobile homes	441	9	2.0	468	25	5.1	461	26	5.3	476	29	5.7	496	31	5.9
Education															
Students	1,254	18	1.4	1,924	59	3.0	2,244	93	4.0	1,824	132	6.7	1,724	140	7.5
Classrooms	51	1	1.9	77	3	3.8	90	4	4.3	73	6	7.6	69	6	8.0
Teachers	51	1	1.9	77	3	3.8	90	4	4.3	73	6	7.6	69	6	8.0
Health Care															
Hospital beds	11	1	8.3	13	1	7.1	13	1	7.1	12	1	7.7	11	1	8.3
General care	6	1	14.3	9	1	10.0	14	1	6.7	18	1	5.3	24	1	4.0
Long-term care															
Medical personnel	4	1	20.0	4	1	20.0	4	1	20.0	4	1	20.0	4	1	20.0
Occupants	3	1	25.0	4	1	20.0	4	1	20.0	3	1	25.0	3	1	25.0
Dentists	9	1	10.0	11	1	8.3	11	1	8.3	10	1	9.1	10	1	9.1
Nurses	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Public health nurses															
Mental health care	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers															
Public Safety															
Law enforcement	11	1	8.3	13	1	7.1	13	1	7.1	12	1	7.7	11	1	8.3
Police officers	11	1	8.3	13	1	7.1	13	1	7.1	12	1	7.7	11	1	8.3
Patrol cars	2,608	49	1.8	3,033	156	4.9	3,058	186	5.7	2,863	212	6.9	2,703	217	7.4
Jail space (sq. ft.)	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Juvenile holding cells															
Fire protection	2,500/	1,000/	28.6	3,000/	1,000/	25.0	3,000/	1,000/	29.4	2,500/	1,000/	28.6	2,500/	1,000/	28.6
Fire flow (gpm)/	10	4		10	10		10	4		10	4		10	4	
duration (hr)															
Emergency Medical Service	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Ambulances	14	7	33.3	14	7	33.3	14	7	33.3	14	7	33.3	14	7	33.3
Emergency medical technicians															
Utility Service Demands															
Water systems	1,683	32	1.9	1,957	101	4.9	1,973	121	5.8	1,847	137	6.9	1,744	140	7.4
Sanitation	983	19	1.9	1,143	59	4.9	1,152	71	5.8	1,079	80	6.9	1,018	82	7.5
Supply (10 ⁶ gal)	491	9	1.8	571	29	4.8	576	35	5.7	539	40	6.9	509	41	7.5
Storage (10 ⁶ gal)	983	19	1.9	1,143	59	4.9	1,152	71	5.8	1,079	80	6.9	1,018	82	7.5
Treatment (10 ⁶ gal)	190	4	2.1	221	11	4.7	223	14	5.9	209	15	6.7	197	16	7.5
Sewage system															
Solid waste															
Other services															
Parks (acres)	32	1	3.0	37	2	5.0	37	3	7.5	35	3	7.9	33	3	8.3
Libraries	10,430	194	1.8	12,130	622	4.9	12,230	744	5.7	11,450	846	6.9	10,810	866	7.4
Books	2,608	49	1.8	3,033	156	4.9	3,058	186	5.7	2,863	212	6.9	2,703	217	7.4
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

APPENDIX TABLE 8-19
Alternative 2
Projections of Emery County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Alternative 2 Demand % of Total
Housing															
Single family	379	0.8	161	469	26.1	42.0	439	42.0	193	30.5	30.5	415	30.5	199	32.4
Multi-family	95	1.0	41	118	26.3	41.9	110	41.9	49	30.8	30.8	104	30.8	50	32.5
Mobile homes	158	0.6	67	196	26.0	41.8	183	41.8	81	30.7	30.7	173	30.7	83	32.4
Education															
Students	816	0.2	158	1,716	10.0	20.0	1,516	20.0	332	18.0	18.0	1,516	18.0	365	19.4
Classrooms	33	2.9	7	57	10.9	20.7	61	20.7	14	18.7	18.7	61	18.7	15	19.7
Teachers	33	2.9	7	57	10.9	20.7	61	20.7	14	18.7	18.7	61	18.7	15	19.7
Health Care															
Hospital beds	6	14.3	2	7	22.2	33.3	7	33.3	4	33.3	30.0	7	30.0	3	30.0
General care	6	14.3	2	6	14.3	25.0	4	25.0	2	33.3	33.3	4	33.3	2	33.3
Long-term care	6	14.3	2	6	14.3	25.0	4	25.0	2	33.3	33.3	4	33.3	2	33.3
Medical personnel	2	33.3	1	3	25.0	40.0	2	40.0	2	33.3	33.3	2	33.3	1	33.3
Doctors	2	33.3	1	3	25.0	40.0	2	40.0	2	33.3	33.3	2	33.3	1	33.3
Dentists	2	33.3	1	3	25.0	40.0	2	40.0	2	33.3	33.3	2	33.3	1	33.3
Nurses	5	16.7	2	6	25.0	30.0	6	30.0	3	25.0	25.0	6	25.0	3	33.3
Public health nurses	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Mental health care	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Clinical psychologists	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Mental health workers	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Public Safety															
Law enforcement	6	14.3	2	7	22.2	33.3	7	33.3	4	33.3	30.0	7	30.0	3	30.0
Police officers	6	14.3	2	7	22.2	33.3	7	33.3	4	33.3	30.0	7	30.0	3	30.0
Patrol cars (sq. ft.)	1,305	0.3	374	1,695	18.1	32.3	1,640	32.3	866	26.0	26.0	1,550	26.0	597	27.8
Juvenile holding cells	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Fire protection	1,750/7	36.4	1,000/4	2,000/8	33.3	38.5	2,000/8	38.5	1,250/5	33.3	33.3	2,000/8	33.3	1,000/4	33.3
Fire flow (gpm)/duration (hr)	1,750/7	36.4	1,000/4	2,000/8	33.3	38.5	2,000/8	38.5	1,250/5	33.3	33.3	2,000/8	33.3	1,000/4	33.3
Emergency medical service	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Ambulances	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Emergency medical technicians	1	50.0	1	1	50.0	50.0	1	50.0	1	50.0	50.0	1	50.0	1	50.0
Utility Service Demands															
Water system	842	0.5	241	1,171	18.1	32.3	1,058	32.3	372	26.0	26.0	1,000	26.0	385	27.8
Connections	492	0.4	141	684	18.1	32.3	618	32.3	217	26.0	26.0	584	26.0	225	27.8
Supply (10 ⁶ gal)	246	0.4	319	342	18.0	32.3	309	32.3	109	26.0	26.0	292	26.0	112	27.7
Storage (10 ⁶ gal)	492	0.4	141	684	18.1	32.3	618	32.3	217	26.0	26.0	584	26.0	225	27.8
Treatment (10 ⁶ gal)	95	1.0	27	132	17.9	32.3	120	32.3	42	25.9	25.9	113	25.9	44	28.0
Sewage system (10 ⁶ gal)	95	1.0	27	132	17.9	32.3	120	32.3	42	25.9	25.9	113	25.9	44	28.0
Solid waste	16	5.9	21	22	7.7	33.3	20	33.3	11	25.9	25.9	19	25.9	8	29.6
Other services	5,218	0.5	6,778	7,258	18.1	32.3	6,558	32.3	2,302	26.0	26.0	6,198	26.0	2,386	27.8
Parks (acres)	1,305	0.5	1,695	1,815	18.1	32.3	1,640	32.3	576	26.0	26.0	1,550	26.0	597	27.8
Libraries															
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.
^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

APPENDIX TABLE 8-20

Alternative 2
Projections of Garfield County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	Projected Baseline Demand ^a Increment	Alternative 2 Demand % of Total	
Housing	141	0	201	6	2.9	243	23	8.6	285	21	6.9	321	22	6.4	
Single family	36	0	51	2	3.8	61	6	9.0	72	6	7.7	81	6	6.9	
Multi-family	59	0	84	3	3.4	101	10	9.0	119	9	7.0	134	9	6.3	
Education	128	0	328	6	1.8	428	28	6.1	528	36	6.4	628	39	5.8	
Students	6	0	14	1	6.7	18	2	10.0	22	2	8.3	26	2	7.1	
Classrooms	6	0	14	1	6.7	18	2	10.0	22	2	8.3	26	2	7.1	
Teachers															
Health Care															
Hospital beds	2	0	2	1	33.3	3	1	25.0	3	1	25.0	4	1	20.0	
General care	3	0	3	1	25.0	3	1	25.0	3	1	25.0	2	1	33.3	
Long-term care															
Medical personnel	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Doctors	2	0	2	1	50.0	2	1	50.0	2	1	50.0	2	1	50.0	
Nurses	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Public health nurses	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Mental health care	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Clinical psychologists	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Mental health workers															
Public Safety															
Law enforcement	2	0	2	1	33.3	3	1	25.0	3	1	25.0	4	1	20.0	
Police officers	3	0	3	1	33.3	3	1	25.0	3	1	25.0	4	1	20.0	
Patrol cars	314	0	464	15	3.1	564	57	9.2	664	62	8.5	764	65	7.8	
Jail space (sq. ft.)	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Juvenile holding cells	1,000/	0	1,000/	1,000/	50.0	1,250/	1,000/	44.4	1,250/	1,000/	44.4	1,500/	1,000/	40.0	
Fire protection	4	0	4	4	50.0	5	4	50.0	5	4	50.0	6	4	50.0	
Fire flow (gpm)/duration (hr)	1	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	
Ambulances	7	0	7	7	50.0	7	7	50.0	7	7	50.0	7	7	50.0	
Emergency medical technicians															
Utility Service Demands															
Water systems	203	0	300	10	3.2	364	37	9.2	429	41	8.7	493	42	7.9	
Sanitary	119	0	175	6	3.3	213	22	9.4	251	24	8.7	288	25	8.0	
Supply (10 ⁶ gal)	59	0	88	3	3.3	106	11	9.4	125	12	8.8	144	12	7.7	
Storage (10 ⁶ gal)	119	0	175	6	3.3	213	22	9.4	251	24	8.7	288	25	8.0	
Treatment (10 ⁶ gal)	23	0	34	1	2.9	41	4	8.9	48	5	9.4	56	5	8.2	
Sewage system (10 ⁶ gal)															
Solid waste	4	0	6	1	14.3	7	1	12.5	8	1	11.1	10	1	9.1	
Other services	1,254	0	1,854	58	3.0	2,254	228	9.2	2,654	248	8.5	3,054	258	7.8	
Parks (acres)	314	0	464	15	3.1	564	57	9.2	664	62	8.5	764	65	7.8	
Libraries															
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bLess than one person or unit of service required as a result of the change in projected population.

^cThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

APPENDIX TABLE 8-21
Alternative 2
Projections of Grand County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total
Housing															
Single family	-95	28	--b	19	549	96.7	55	563	91.1	25	414	94.3	61	429	87.6
Multi-family	-23	7	--b	5	138	96.5	14	141	91.0	7	104	93.7	16	108	87.1
Mobile homes	-39	12	--b	8	229	96.6	23	235	91.1	11	173	94.0	26	179	87.3
Education															
Students	99	24	19.5	479	541	53.0	599	711	54.3	479	714	59.8	529	785	59.7
Classrooms	4	1	20.0	20	22	52.4	24	29	54.7	20	29	59.2	22	32	59.3
Teachers	4	1	20.0	20	22	52.4	24	29	54.7	20	29	59.2	22	32	59.3
Health Care															
Hospital beds	0	1	100.0	1	6	85.7	1	6	85.7	1	5	83.3	1	6	85.7
General care	0	1	33.3	2	2	50.0	2	2	66.7	2	4	66.7	2	4	66.7
Long-term care	0	1	100.0	1	2	66.7	1	2	66.7	1	2	66.7	1	2	66.7
Medical personnel ^c	0	1	100.0	1	2	66.7	1	2	66.7	1	2	66.7	1	2	66.7
Doctors	0	1	100.0	1	5	83.3	1	5	83.3	1	5	83.3	1	5	83.3
Nurses	0	1	100.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Public health nurses	0	1	100.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	0	1	100.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers	0	1	100.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Public Safety															
Law enforcement	0	1	100.0	1	6	85.7	1	6	85.7	1	5	83.3	1	6	85.7
Police officers	0	1	100.0	1	6	85.7	1	6	85.7	1	5	83.3	1	6	85.7
Patrol cars	0	1	100.0	1	6	85.7	1	6	85.7	1	5	83.3	1	6	85.7
Jail space (sq. ft.)	-220	63	--b	5	1,280	99.6	110	1,439	92.9	45	1,239	96.5	130	1,285	90.8
Juvenile holding cells	0	1	100.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Fire protection	0/	1,000/	100.0	1,000/	1,750/	63.6	1,000/	1,750/	63.6	1,000/	1,500/	60.0	1,000/	1,750/	63.6
Fire flow (gpm)/	0	4	--b	4	7	50.0	4	7	50.0	4	6	50.0	4	7	50.0
duration (hr)	0	4	--b	4	7	50.0	4	7	50.0	4	6	50.0	4	7	50.0
Emergency medical technicians	0	1	100.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Ambulances	0	7	100.0	7	7	50.0	7	7	50.0	7	7	50.0	7	7	50.0
Utility Service Demands															
Water system	-142	41	--b	3	826	99.6	71	929	92.9	29	800	96.5	84	829	90.9
Connections	-83	24	--b	2	482	99.6	41	543	93.0	17	467	96.5	49	484	90.8
Supply (10 ⁶ gal)	-41	12	--b	1	241	99.6	21	271	92.8	8	234	96.7	25	242	90.6
Storage (10 ⁶ gal)	-83	24	--b	2	482	99.6	41	543	93.0	17	467	96.5	49	484	90.8
Treatment (10 ⁶ gal)	-16	5	--b	1	93	98.9	8	105	92.9	3	90	96.8	9	94	91.3
Solid waste															
Other services	-2	1	--b	1	16	94.1	2	18	90.0	1	15	93.8	2	16	88.9
Parks (acres)	-882	250	--b	18	5,118	99.6	438	5,756	92.9	178	4,954	96.5	518	5,138	90.8
Libraries	-220	63	--b	5	1,280	99.6	110	1,439	92.9	45	1,239	96.5	130	1,285	90.8
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bUndefined.

^cThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

APPENDIX TABLE 8-22

Alternative 2
Projections of Uintah County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 2 Demand	Alternative 2 % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	Alternative 2 % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	Alternative 2 % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	Alternative 2 % of Total	Projected Baseline Demand Increment ^a	Alternative 2 Demand	Alternative 2 % of Total
Housing															
Single family	997	36	3.5	1,501	111	6.9	1,549	114	6.9	1,561	126	7.5	1,591	132	7.7
Multi-family	250	9	3.5	376	28	6.9	388	29	7.0	391	32	7.6	398	33	7.7
Mobile homes	416	15	3.5	626	47	7.0	646	48	6.9	651	53	7.5	663	55	7.7
Education															
Students	1,400	31	2.2	3,010	12	3.6	3,770	172	4.4	3,020	241	7.4	2,790	254	8.3
Classrooms	56	2	3.4	121	5	3.0	151	7	4.4	121	10	7.6	112	11	8.9
Teachers	56	2	3.4	121	5	3.0	151	7	4.4	121	10	7.6	112	11	8.9
Health Care															
Hospital beds															
General care	11	1	8.3	18	2	10.0	19	2	9.5	17	2	10.5	16	2	11.1
Long-term care	10	1	9.1	21	1	4.5	29	1	3.3	35	1	2.8	42	1	2.3
Medical Personnel															
Local personnel	4	1	20.0	6	1	14.3	6	1	14.3	6	1	14.3	5	1	16.7
Nurses	3	1	25.0	5	1	16.7	5	1	16.7	5	1	16.7	4	1	20.0
Nurses	9	1	10.0	15	1	6.3	16	2	11.1	15	2	11.8	14	2	12.5
Public health nurses	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Mental health care															
Clinical psychologists	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Public Safety															
Law enforcement															
Police officers	11	1	8.3	18	1	5.3	19	1	5.0	17	2	10.5	16	2	11.1
Patrol cars	11	1	8.3	18	1	5.3	19	1	5.0	17	2	10.5	16	2	11.1
Jail space (sq. ft.)	2,602	82	3.1	4,402	294	6.3	4,672	345	6.9	4,232	386	8.4	3,842	394	9.3
Juvenile holding cells	1	1	50.0	2	1	33.3	2	1	33.3	2	1	33.3	1	1	50.0
Fire protection	2,500/	1,000/	28.6	3,000/	1,000/	25.0	3,000/	1,000/	25.0	3,000/	1,000/	25.0	3,000/	1,000/	25.0
Fire flow (gpm)/	10	4		10	4		10	4		10	4		10	4	
Emergency Medical Service	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3	2	1	33.3
Ambulances	14	7	33.3	14	7	33.3	14	7	33.3	14	7	33.3	14	7	33.3
Utility Service Demands															
Water service															
Connections	1,679	53	3.1	2,841	190	6.3	3,015	223	6.9	2,731	249	8.4	2,479	254	9.3
Supply (10 ⁶ gal)	981	31	3.1	1,659	111	6.3	1,763	130	6.9	1,595	145	8.3	1,448	148	9.3
Storage (10 ⁶ gal)	490	15	3.0	880	55	6.2	880	65	6.9	797	73	8.4	724	74	9.3
Treatment (10 ⁶ gal)	981	31	3.1	1,659	111	6.3	1,761	130	6.9	1,595	145	8.3	1,448	148	9.3
Sewage system (10 ⁶ gal)	190	6	3.1	321	21	6.1	341	25	6.8	309	28	8.3	280	29	9.4
Other services															
Parks (acres)	32	1	3.0	53	4	7.0	57	5	8.1	51	5	8.9	47	5	9.6
Libraries	10,408	328	3.1	17,608	1,176	6.3	18,688	1,378	6.9	16,928	1,542	8.3	15,368	1,574	9.3
Books	2,602	82	3.1	4,402	294	6.3	4,672	345	6.9	4,232	386	8.4	3,842	394	9.3
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 8

APPENDIX TABLE 8-23

Alternative 2
Projections of Wayne County Infrastructure Service Demands

County/Service Category	1985			1990			1995			2000			2005		
	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total Demand	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total Demand	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total Demand	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total Demand	Projected Baseline Demand Increment ^a	Alternative 2 Demand	% of Total Demand
Housing	39	0	0	61	35	30.2	129	210	61.9	159	127	44.4	195	327	44.4
Single family	10	0	0	21	9	30.0	53	58	63.6	40	32	44.4	49	33	40.2
Multi-family	17	0	0	34	15	30.6	54	88	62.0	67	53	44.2	82	55	40.1
Mobile homes															
Education	48	0	0	98	34	25.8	158	266	62.7	198	219	52.5	238	240	50.2
Students	2	0	0	4	2	33.3	7	11	61.1	8	9	52.9	10	10	50.0
Classrooms	2	0	0	4	2	33.3	7	11	61.1	8	9	52.9	10	10	50.0
Teachers															
Health Care															
Hospital beds	1	0	0	1	1	50.0	2	3	60.0	2	2	50.0	3	2	40.0
General care	2	0	0	3	1	25.0	4	1	20.0	5	1	16.7	6	1	14.3
Long-term care															
Medical personnel	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Doctors	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Dentists	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Nurses	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Public health nurses	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health care	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Clinical psychologists	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Mental health workers															
Public Safety															
Law enforcement	1	0	0	1	1	50.0	2	3	60.0	2	2	50.0	3	2	40.0
Police officers	1	0	0	1	1	50.0	2	3	60.0	2	2	50.0	3	2	40.0
Patrol cars	105	0	0	215	80	27.1	330	538	62.0	420	379	47.4	510	393	43.5
Jail space (sq. ft.)															
Juvenile holding cells															
Fire protection	1,000/	0/	0	1,000/	1,000/	50.0	1,000/	1,000/	50.0	1,000/	1,000/	50.0	1,250/	1,000/	44.4
Fire flow (gpm)/	4	0	0	4	4	50.0	4	4	50.0	4	4	50.0	5	4	50.0
duration (hr)															
Emergency medical service	1	0	0	1	1	50.0	1	1	50.0	1	1	50.0	1	1	50.0
Ambulances	7	0	0	7	7	50.0	7	7	50.0	7	7	50.0	7	7	50.0
Emergency medical technicians															
Utility Service Demands															
Water system	68	0	0	139	52	27.2	213	348	62.0	271	245	47.5	239	254	43.5
Connections	40	0	0	81	30	27.0	124	203	62.1	158	143	47.5	192	148	43.5
Supply (10 ⁶ gal)	20	0	0	41	15	26.8	52	72	62.1	79	72	47.7	96	74	43.5
Storage (10 ⁶ gal)	40	0	0	81	30	27.0	124	203	62.1	158	143	47.5	192	148	43.5
Treatment (10 ⁶ gal)	8	0	0	16	6	27.3	24	39	61.9	31	28	47.5	37	29	43.9
Sewage system (10 ⁶ gal)															
Solid waste															
Other services	2	0	0	3	1	25.0	4	7	63.6	6	5	45.5	7	5	41.7
Parks (acres)	418	0	0	858	318	27.0	1,318	2,152	62.0	1,678	1,516	47.5	2,038	1,572	43.5
Libraries	105	0	0	215	80	27.1	330	538	62.0	420	379	47.4	510	343	43.5
Books															
Space (sq ft)															

Source: Argonne National Laboratories, 1983.

^aNumbers represent service demands required to satisfy the post-1980 baseline population growth, regardless of 1980 operating conditions.

^bThe State of Utah Community Facility Guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX TABLE 9-1

Baseline Population Projections By County and Community^{a, b}
(1985-2005)

County/Community	Population Projections					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Carbon County</u>	29,590	34,500	36,500	36,790	37,280	2.12	0.21
East Carbon CCD	2,060	1,600	1,500	1,390	1,320	-3.12	-1.27
East Carbon	1,550	1,210	1,130	1,050	995	-3.11	-1.26
Sunnyside	490	380	360	330	315	-3.04	-1.33
Unincorp. Areas	20	10	10	10	10	-6.70	0
Helper CCD	5,880	6,540	6,750	6,750	6,910	1.39	0.23
Helper	3,490	3,900	4,000	4,000	4,100	1.37	0.25
Scofield	130	140	150	150	150	1.44	0
Unincorp. Areas	2,260	2,500	2,600	2,600	2,660	1.41	0.23
Price CCD	21,650	21,360	28,250	28,650	29,050	2.70	0.28
Hiawatha	230	260	250	250	250	0.84	0
Price	13,300	16,300	17,700	18,200	18,500	2.90	0.44
Wellington	2,140	2,600	2,800	2,800	2,800	2.72	0
Unincorp. Areas	5,980	7,200	7,500	7,400	7,500	2.29	0
<u>Duchesne County</u>	17,780	18,640	18,680	18,300	17,970	0.50	-0.39
Duchesne CCD	4,080	3,580	3,680	3,660	3,590	-1.03	-0.25
Duchesne City	2,420	2,120	2,180	2,170	2,130	-1.04	-0.23
Rest of CCD	1,660	1,460	1,500	1,490	1,460	-1.01	-0.27
Roosevelt CCD	13,700	15,060	15,000	14,640	14,380	0.91	-0.42
Altamont	270	300	300	290	290	1.06	-0.34
Myton	710	780	770	750	740	0.81	-0.40
Roosevelt	5,420	5,960	5,930	5,790	5,690	0.90	-0.41
Rest of CCD	7,300	8,020	8,000	7,810	7,660	0.92	-0.43
<u>Emery County</u>	14,060	14,840	15,080	14,730	14,550	0.70	-0.36
Castle Dale-Huntington CCD	9,770	10,490	10,600	10,380	10,200	0.82	-0.38
Castle Dale	2,650	2,900	3,000	2,900	2,850	1.25	-0.51
Cleveland	580	610	620	610	600	0.67	-0.33
Elmo	350	380	380	370	360	0.83	-0.54
Huntington	2,850	3,000	3,000	2,900	2,850	0.51	-0.51
Orangeville	1,870	2,000	2,000	2,000	1,970	0.67	-0.15
Unincorp. Areas	1,470	1,600	1,600	1,600	1,570	0.85	-0.19
Emery-Ferron CCD	3,280	3,210	3,310	3,180	3,180	0.10	-0.40
Clawson	270	260	260	250	250	-0.38	-0.39
Emery	480	480	490	480	480	0.21	-0.21
Ferron	2,250	2,200	2,300	2,200	2,200	0.22	-0.44
Unincorp. Areas	280	270	260	250	250	-0.74	-0.39
Green River CCD	1,010	1,140	1,170	1,170	1,170	1.48	0
Green River	870	980	1,000	1,000	1,000	1.40	0
Unincorp. Areas	140	160	170	170	170	1.96	0

APPENDIX 9

APPENDIX TABLE 9-1 (concluded)

County/Community	Population Projections					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
<u>Garfield County</u>	4,300	4,600	4,800	4,990	5,210	1.10	0.82
Escalante CCD	940	950	970	970	990	0.31	0.20
Boulder	140	140	140	140	150	0	0.69
Escalante	800	810	830	830	840	0.37	0.12
Hite CCD	270	270	270	270	270	0	0
Rest of County	3,090	3,380	3,560	3,750	3,950	1.43	1.04
<u>Grand County</u>	7,800	8,250	8,460	8,330	8,500	0.82	0.05
Thompson CCD	330	350	360	360	370	0.87	0.27
Rest of County	7,470	7,900	8,100	7,970	8,130	0.81	0.04
<u>Uintah County</u>	25,720	29,310	29,850	28,970	28,200	1.50	-0.57
<u>Uintah Ouray CCD</u>	5,070	5,700	5,730	5,570	5,420	1.23	-0.55
Ballard	780	970	980	930	900	2.31	-0.85
Rest of CCD	4,290	4,730	4,750	4,640	4,520	1.02	-0.50
Vernal CCD	20,650	23,610	24,120	23,400	22,780	1.57	-0.57
Naples	3,030	3,460	3,540	3,430	3,340	1.57	-0.58
Vernal	9,290	11,070	11,370	10,940	10,650	2.04	-0.65
Rest of CCD	8,330	9,080	9,210	9,030	8,790	1.01	-0.47
<u>Wayne County</u>	2,130	2,340	2,570	2,740	2,930	1.90	1.32
Hanksville CCD	340	430	480	520	570	3.51	1.73
Rest of County	1,790	1,910	2,090	2,220	2,360	1.56	1.22

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

^bCensus County Division (CCD).

APPENDIX 9

APPENDIX TABLE 9-2

Baseline Employment Projections by Industrial Sector
Carbon County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	230	230	230	240	240	0	1.43
Mining	2,460	2,860	2,860	2,860	2,860	1.52	0
Construction	490	550	590	610	630	1.87	0.66
Manufacturing	320	360	390	420	450	2.00	1.44
Transportation, Communica- tions, and Utilities	920	970	1,100	1,200	1,250	1.80	1.29
Wholesale and Retail Trade	2,260	2,590	2,890	3,909	3,300	2.49	1.34
Finance, Insurance, and Real Estate	360	430	490	540	590	3.13	1.87
Services	1,580	1,890	2,090	2,190	2,300	2.84	0.96
Government	2,470	2,880	2,970	2,970	3,000	1.86	0.10
Nonfarm Proprietors	1,150	1,290	1,390	1,390	1,400	1.91	0.07
Total	12,249	14,050	15,000	15,510	16,020	2.05	0.66

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 9

APPENDIX TABLE 9-3

Baseline Employment Projections by Industrial Sector
Duchesne County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	510	460	420	380	350	-1.92	-1.69
Mining	1,420	1,720	1,720	1,720	1,720	1.94	0
Construction	1,050	420	280	280	270	-12.38	-0.36
Manufacturing	140	140	140	140	140	0	0
Transportation, Communi- cations, and Utilities	220	220	230	220	220	0.45	-0.22
Wholesale and Retail Trade	1,170	1,210	1,205	1,190	1,170	0.30	-0.29
Finance, Insurance, and Real Estate	130	140	150	150	140	1.44	-0.35
Services	470	500	520	520	510	1.02	-0.10
Government	1,330	1,480	1,480	1,430	1,370	1.07	-0.77
Nonfarm Proprietors	780	850	950	1,070	1,210	1.99	2.45
Total	7,220	7,140	7,100	7,100	7,100	-0.17	0

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 9

APPENDIX TABLE 9-4

Baseline Employment Projections by Industrial Sector
Emery County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	360	360	360	370	370	0	0.27
Mining	2,460	2,500	2,500	2,500	2,500	0.16	0
Construction	850	440	470	480	500	-5.75	0.62
Manufacturing	40	50	50	50	50	2.26	0
Transportation, Commu- nications, and Utilities	720	820	840	860	880	1.55	0.47
Wholesale and Retail Trade	630	670	700	700	730	1.06	0.42
Finance, Insurance, and Real Estate	60	60	70	70	70	1.55	0
Services	340	380	400	430	450	1.64	1.18
Government	770	840	840	810	800	0.87	-0.49
Nonfarm Proprietors	500	530	540	530	530	0.77	-0.19
Total	6,730	6,650	6,770	6,800	6,880	0.06	0.16

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 9

APPENDIX TABLE 9-5

Baseline Employment Projections by Industrial Sector
Garfield County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	180	170	160	150	160	-1.17	0
Mining	230	240	240	250	260	0.43	0.80
Construction	70	70	70	70	70	0	0
Manufacturing	180	190	210	230	240	1.55	1.34
Transportation, Communica- tions, and Utilities	90	90	90	100	100	0	1.06
Wholesale and Retail Trade	200	230	260	290	300	2.66	1.44
Finance, Insurance, and Real Estate	20	30	30	30	30	4.14	0
Services	240	250	260	270	290	0.80	1.10
Government	350	370	380	390	410	0.83	0.76
Nonfarm Proprietors	220	240	270	300	310	2.07	1.39
Total	1,780	1,880	1,970	2,080	2,170	1.02	0.97

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 9

APPENDIX TABLE 9-6

Baseline Employment Projections by Industrial Sector
Grand County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	180	190	190	190	190	0.54	0
Mining	430	430	430	430	650	0	4.22
Construction	210	220	230	240	250	0.91	0.84
Manufacturing	90	90	90	90	100	0	1.06
Transportation, Commu- nications, and Utilities	390	430	460	480	300	1.66	-4.18
Wholesale and Retail Trade	660	690	700	700	740	0.59	0.56
Finance, Insurance, and Real Estate	80	90	90	90	100	1.18	1.06
Services	430	480	500	530	570	1.52	1.32
Government	620	670	680	670	660	0.93	-0.30
Nonfarm Proprietors	440	450	460	460	470	0.45	0.22
Total	3,530	3,740	3,830	3,880	4,030	0.82	0.51

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 9

APPENDIX TABLE 9-7

Baseline Employment Projections by Industrial Sector
 Uintah County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	460	380	350	320	300	-2.04	-1.53
Mining	2,440	2,900	2,890	2,890	2,890	1.71	0
Construction	380	400	400	400	400	0.51	0
Manufacturing	400	400	400	400	400	0.24	-0.25
Transportation, Commu- nications, and Utilities	690	720	740	740	720	0.70	-0.27
Wholesale and Retail Trade	1,740	1,860	1,870	1,840	1,800	0.72	-0.38
Finance, Insurance, and Real Estate	180	200	200	200	200	1.06	0
Services	1,730	1,840	1,870	1,860	1,830	0.78	-0.22
Government	1,760	2,090	2,110	2,000	1,890	1.83	-1.10
Nonfarm Proprietors	870	970	1,060	1,180	1,280	2.00	1.90
Total	10,620	11,760	11,900	11,830	11,710	1.14	-0.16

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 9

APPENDIX TABLE 9-8

Baseline Employment Projections by Industrial Sector
Wayne County (1985-2005)^a

Industrial Sector	Sectoral Employment					Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Agriculture	170	170	170	170	190	0	1.12
Mining	30	30	40	50	50	2.92	2.26
Construction	130	140	160	190	210	2.10	2.51
Manufacturing	30	40	40	40	50	2.92	2.26
Transportation, Commu- nications, and Utilities	2	2	3	3	3	4.14	0
Wholesale and Retail Trade	50	60	60	70	80	1.84	2.92
Finance, Insurance, and Real Estate	20	20	20	20	20	0	0
Services	30	30	30	30	30	0	0
Government	290	330	360	390	430	2.19	1.79
Nonfarm Proprietors	210	230	250	280	300	1.76	1.84
Total	960	1,050	1,130	1,240	1,360	1.64	1.87

Source: Argonne National Laboratories, 1983.

^aTotals may not add because of rounding.

APPENDIX 10

PROJECTIONS OF ENERGY-RELATED PROJECTS

Appendix 10 contains projections of energy-related projects other than tar sand throughout the affected area.

These projections consist of projects that are reasonably expected to occur and/or projects that are speculative at the present time.

APPENDIX 10

APPENDIX 10

Projection of Interrelated Projects

TABLE 10-1

Annual Construction and Operation Manpower Requirements
for Other Energy-Related Projects in Eastern Utah

Project	Type of Development	Project Size ^a	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Geokinetics (Lofreco)	Oil Shale	50,000 bbl/d	0	0	0	20	40	60	80	100	120	140	160	180	200	200	200
	Operation		0	0	0	130	260	390	520	650	780	910	1,040	1,170	1,300	1,300	1,300
Geokinetics (Agency Draw)	Oil Shale	20,000 bbl/d	0	0	0	480	780	1,040	0	0	320	120	0	0	0	0	0
	Operation		0	0	0	320	320	320	640	640	640	720	720	720	720	720	720
Syntana-Utab	Oil Shale	57,000 bbl/d	0	0	240	950	1,525	190	125	700	1,350	150	125	700	1,350	65	0
	Operation		0	0	0	0	255	660	790	780	910	1,290	1,400	1,400	1,525	1,975	2,100
EnerCor Pilot Plant	Oil Shale	5,000 bbl/d	0	130	200	200	75	0	0	0	0	0	0	0	0	0	0
	Operation		0	0	60	120	275	275	275	275	275	275	275	275	275	275	275
Parabo	Oil Shale	42,000 bbl/d	0	110	925	1,430	2,075	1,355	550	0	0	0	0	0	0	0	0
	Operation		0	0	0	0	725	960	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
TOSCO	Oil Shale	45,000 bbl/d	0	0	190	770	2,625	3,590	1,920	240	115	0	0	0	0	0	0
	Operation		0	0	25	330	510	665	1,340	2,070	2,185	2,185	2,185	2,185	2,185	2,185	2,185
SOHIO	Oil Shale	20,000 bbl/d	0	0	0	0	0	0	450	1,525	375	0	0	0	0	0	0
	Operation		0	0	0	0	0	0	0	0	445	820	820	820	820	820	820
Magic Circle	Oil Shale	31,500 bbl/d	0	380	725	550	520	820	780	0	0	0	0	0	0	0	0
	Operation		0	60	175	450	835	1,430	1,755	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890
White River Shale	Oil Shale	100,000 bbl/d	0	175	1,830	1,030	345	1,030	2,390	4,035	3,795	2,940	2,880	1,620	280	0	0
	Operation		0	0	10	70	370	840	885	990	1,285	1,865	2,215	2,490	3,040	3,355	3,355
C and A Tar Sands	Tar Sand	20,000 bbl/d	0	45	0	125	200	225	0	0	0	0	0	0	0	0	0
	Operation		0	0	0	65	145	320	320	320	320	320	320	320	320	320	320
Western Tar Sand	Tar Sand	5,000 bbl/d	0	25	0	0	50	50	0	0	0	0	0	0	0	0	0
	Operation		0	4	4	4	0	0	7	7	7	7	7	7	7	7	7
Chevron/Great National	Tar Sand	NA	0	0	0	1,000	2,400	1,000	0	0	0	0	0	0	0	0	0
	Operation		0	0	0	0	200	200	200	200	200	200	200	200	200	200	200
Deserado Mine	Coal Mine	2.0 x 10 ⁶ t/y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sunedco	Coal Mine	5.0 x 10 ⁶ t/y	0	0	0	115	335	328	495	589	655	750	775	775	775	775	775
U.S. Fuels	Coal Mine ^b	2.2 x 10 ⁶ t/y	0	0	0	163	169	194	394	369	344	568	568	568	568	568	568
Western Reserve	Coal Mine	0.3 x 10 ⁶ t/y	0	0	0	0	0	0	40	40	40	40	40	40	40	40	40
Blazon	Coal Mine	1.0 x 10 ⁶ t/y	0	0	0	14	14	14	14	14	14	14	14	14	14	14	14
UCO	Coal Mine	0.7 x 10 ⁶ t/y	0	0	0	109	109	109	109	109	109	109	109	109	109	109	109
First Western	Coal Mine	0.3 x 10 ⁶ t/y	0	0	0	40	35	30	20	10	2	0	0	0	0	0	0
C and W	Coal Mine ^b	0.3 x 10 ⁶ t/y	0	0	0	35	35	0	0	0	0	0	0	0	0	0	0
Price River	Coal Mine ^b	1.9 x 10 ⁶ t/y	0	0	0	413	413	413	413	413	413	413	413	413	413	413	413
Coastal States	Coal Mine	4.0 x 10 ⁶ t/y	0	0	0	82	70	348	476	604	680	680	680	680	680	680	680

APPENDIX 10

APPENDIX TABLE 10-1 (concluded)

Project	Type of Development	Project Size ^a	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
			1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Valley Camp	Coal Mine ^b	2.6 x 10 ⁶ t/y	0	0	0	234	199	210	210	210	210	560	560	560	560	560	560
Beaver Creek-Hunt.	Coal Mine ^b	0.3 x 10 ⁶ t/y	0	0	0	25	25	22	20	17	14	0	0	0	0	0	0
Natomas	Coal Mine ^b	0.4 x 10 ⁶ t/y	0	0	0	165	146	130	114	97	82	78	78	78	78	78	78
Utah Power and Light	Coal Mine ^b	NA	0	0	0	78	0	0	0	0	0	50	50	50	50	50	50
North Horn Mtn.	Coal Mine	1.0 x 10 ⁶ t/y	0	0	0	0	0	0	62	89	123	135	162	195	234	281	337
Kaiser-South Lease	Coal Mine	1.0 x 10 ⁶ t/y	0	0	0	50	56	112	206	300	450	475	475	475	475	475	475
Emery Co. -North, Central, and South Lease	Coal Mine	1.0 x 10 ⁶ t/y	0	0	0	0	0	0	123	136	162	103	124	149	178	214	257
Bonanza Power Plant Unit 2	Other	400 MW	0	0	0	0	0	0	0	380	506	781	692	300	0	0	0
Water Development Project	Other	NA	0	0	0	0	0	0	0	0	20	20	66	80	0	0	0
White River Dam	Other	NA	0	94	94	36	36	0	0	0	0	0	0	0	0	0	0
Ramex	Other	NA	0	50	50	0	0	0	0	0	0	0	0	0	0	0	0
Total	Tar Sand Oil Shale Coal Mines	395,500 bbl/d 24.0 x 106 t/y	0	1,009	4,254	6,601	10,691	9,400	6,345	7,065	6,811	4,339	3,967	2,830	1,833	265	200
			0	64	274	2,742	5,556	8,025	10,583	11,983	13,504	15,850	16,581	17,088	17,931	18,779	19,003

Source: Argonne National Laboratories, 1983.

^abbl/d = barrels/day; x 106 t/y = million tons/year.

^bRepresents an expansion of existing coal mining activities.

^cNA = not available.

^dCoal mine employment requirements are included in the operation total because the data provided did not distinguish between construction and operation phases. Moreover, mines often have relatively short construction time periods and employ construction workers that eventually become operations workers.

APPENDIX 10

APPENDIX TABLE 10-2

Summary of Regional Socioeconomic Impacts
Resulting From Other Energy Project Development in East-Central Utah

Socioeconomic Development Category	Change from Baseline, by Year					Cumulative Growth Factor ^a 1985-2005	Average Annual Compound Percent Change	
	1985	1990	1995	2000	2005		1985-1995	1995-2005
Population Growth								
Total	36,244	56,456	73,477	85,873	96,291	2.66	7.32	2.74
School-Age	6,158	10,657	18,877	26,627	32,508	5.28	11.85	5.59
Retirement-Age	394	891	1,465	1,648	1,797	4.56	14.03	2.06
Employment Growth								
	21,089	29,415	33,180	36,842	39,860	1.89	4.63	1.85
Household Growth								
	11,019	17,450	21,612	24,323	27,132	2.46	6.97	2.30
Infrastructure Requirements								
Housing								
Single Family	6,611	10,469	12,967	14,594	16,109	2.44	6.97	2.19
Multi-family	1,652	2,617	3,242	3,649	4,026	2.44	6.97	2.19
Mobile Homes	2,755	4,364	5,404	6,082	6,712	2.44	6.97	2.19
Education								
Students	6,158	10,657	18,877	26,627	32,508	5.28	11.85	5.59
Classrooms	247	425	754	1,065	1,301	5.27	11.81	5.61
Teachers	247	425	754	1,065	1,301	5.27	11.81	5.61
Health Care								
Hospital Beds								
General Care	72	112	147	172	191	2.65	7.40	2.65
Long-term Care	16	35	59	66	71	4.44	13.94	1.87
Medical Personnel								
Doctors	21	34	44	52	57	2.71	7.68	2.62
Dentists	19	28	37	44	49	2.58	6.89	2.85
Nurses	61	96	125	145	162	2.66	7.44	2.63
Public Health Nurses	8	12	16	18	19	2.38	7.18	1.73
Mental Health Care								
Clinical Psychologists	4	5	5	6	6	1.50	2.26	1.84
Mental Health Workers	5	7	7	10	11	2.20	3.42	4.62
Public Safety								
Law Enforcement								
Police Officers	72	113	147	172	191	2.65	7.40	2.65
Patrol Cars	72	113	147	172	191	2.65	7.40	2.65
Jail Space (sq ft)	18,123	28,363	36,738	42,937	47,392	2.62	7.32	2.58
Juvenile Holding Cells	6	8	11	12	13	2.17	6.25	1.68
Fire Protection								
Fire flow (gpm)/ Duration (hr) ^b								
Emergency Medical Service								
Ambulances	8	12	16	18	19	2.38	7.18	1.73
Emergency Medical Technicians	50	78	112	126	133	2.66	8.40	1.73
Utility Service Demands								
Water System								
Connections	11,692	18,213	23,704	27,703	30,733	2.63	7.32	2.63
Supply (10 ⁶ gal)	6,828	10,637	13,843	16,178	17,948	2.63	7.32	2.63
Storage (10 ⁶ gal)	3,414	5,318	6,922	8,089	8,974	2.63	7.32	2.63
Treatment (10 ⁶ gal)	6,828	10,637	13,843	16,178	17,948	2.63	7.32	2.63
Sewage System (10 ⁶ gal)	1,322	2,060	2,682	3,134	3,478	2.63	7.32	2.63
Solid Waste^c								
Other Services								
Parks (acres)	217	339	441	515	572	2.64	7.35	2.64
Libraries								
Books	72,488	112,912	146,954	171,746	190,532	2.63	7.32	2.63
Space (sq ft)	18,122	28,228	36,739	42,937	47,633	2.63	7.32	2.63

Source: Argonne National Laboratories, 1983.

^aComputed as the ratio between 1985 and 2005.

^bFire protection measured in fire flow (gpm)/duration (hr) cannot be aggregated across the affected counties.

^cThe State of Utah community facility guidelines do not include a solid waste standard. Therefore, an estimate of solid waste disposal impacts could not be determined.

APPENDIX 10

APPENDIX TABLE 10-3

Summary of Population and Household Impact Projections
by County for Other Energy Projects in East-Central Utah

Years	Population			New Households			School-Age Population			Retirement-Age Population			
	Change From Baseline	Average Annual % Change ^a	Baseline	Change From Baseline	Average Annual % Change ^a	Baseline	Change From Baseline	Average Annual % Change ^a	Baseline	Change From Baseline	Average Annual % Change ^a	Baseline	Change From Baseline
Carbon County													
1985	10,627	--		3,864	--		2,017	--		236	--		
1990	10,502	-0.24		3,334	-2.91		2,052	0.34		480	15.26		
1995	14,018	5.95		4,235	4.90		3,679	12.39		567	3.39		
2000	15,342	1.82		4,371	0.63		4,790	5.42		600	1.14		
2005	16,754	1.78		4,654	1.26		5,037	1.01		629	0.95		
Duchesne County													
1985	4,965	--		1,683	--		989	--		24	--		
1990	9,542	13.96		3,042	12.57		1,858	13.44		71	24.23		
1995	12,333	5.27		3,614	3.51		3,160	11.21		169	18.94		
2000	14,910	3.87		4,234	3.22		4,632	7.95		204	3.84		
2005	17,167	2.86		4,875	2.86		5,941	5.10		235	2.87		
Emery County													
1985	1,712	--		623	--		303	--		42	--		
1990	1,722	0.12		547	-2.57		336	2.09		83	14.60		
1995	2,952	11.38		892	10.27		779	18.31		124	8.36		
2000	3,176	1.47		908	0.36		1,000	5.12		125	0.16		
2005	3,364	1.16		935	0.59		1,045	0.88		125	0		
Uintah County													
1985	18,940	--		4,849	--		2,849	--		92	--		
1990	34,690	12.87		10,527	16.77		6,411	17.61		257	22.81		
1995	44,174	4.95		12,871	4.10		11,259	11.92		605	18.68		
2000	52,445	3.49		14,810	2.85		16,205	7.55		719	3.51		
2005	59,006	2.3		16,668	2.39		20,485	4.80		808	2.36		

Source: Argonne National Laboratories, 1983.

^a Computed as average annual compound percent change from previous 5-year period.

APPENDIX TABLE 10-4

Total Regional Employment Impacts Resulting From
Other Energy Project Developments in East-Central Utah^a

Industrial Sector	Change From Baseline Employment, by Year					Average Annual	
	1985	1990	1995	2000	2005	Compound Percent Change 1985-1995	Percent Change 1995-2005
Agriculture	0	0	0	0	0	0	0
Mining	5,253	15,441	18,568	18,568	18,568	13.46	0
Contract Construction	10,686	4,690	1,160	1,540	1,810	-19.91	4.55
Manufacturing	99	185	265	324	381	10.35	3.70
Transportation, Communica- tions, and Utilities	259	613	677	801	932	10.09	3.25
Wholesale and Retail Trade	1,426	2,529	3,551	4,261	4,965	9.55	3.41
Finance, Insurance, and Real Estate	193	346	502	621	698	10.03	3.35
Services	922	1,686	2,436	2,984	3,477	10.20	3.62
Government	1,564	2,782	4,286	5,598	6,551	10.61	4.33
Nonfarm Proprietors	687	1,142	1,735	2,145	2,476	9.71	3.62
Total	21,091	29,414	33,181	36,841	39,860	4.64	1.85

Source: Argonne National Laboratories, 1983.

^aTotals may not add due to rounding.

APPENDIX TABLE 10-5
 Summary of Total Employment Impact by County--
 Other Energy Projects in East-Central Utah

County	Change From Baseline Employment Projections, by Year				Average Annual Compound Percent Change		
	1985	1990	1995	2000	2005	1985-1995	1995-2005
Carbon	5,803	5,394	6,234	6,608	6,803	0.72	0.88
Duchesne	789	1,738	2,528	3,321	4,055	12.35	4.84
Emery	487	1,104	1,646	1,700	1,735	12.95	0.53
Uintah	14,010	21,178	22,772	25,213	27,267	4.98	1.82
Total	21,091	29,414	33,181	36,841	39,860	4.64	1.85

Source: Argonne National Laboratories, 1983.

LIST OF ABBREVIATIONS

<u>Abbreviation</u>	<u>Term</u>
ACEC:	Area of Critical Environmental Concern
ADT:	Average Daily Traffic
APD:	Application for Permit to Drill
API:	American Petroleum Institute
AUM:	animal unit month
bbbl:	barrels
BIA:	Bureau of Indian Affairs
BLM:	Bureau of Land Management
Btu:	British thermal unit
CCD:	Census County Division
CFR:	Code of Federal Regulations
CHL:	Combined Hydrocarbon Lease
CMA:	Cooperative Management Area
CO:	carbon monoxide
dBA:	A-weighted sound level
DOE:	Department of Energy
EA:	environmental assessment
EIS:	environmental impact statement
EPA:	Environmental Protection Agency
ERT:	Environmental Research and Technology, Inc.
F:	Fahrenheit
FIRE:	Finance, Insurance, and Real Estate
FLPMA:	Federal Land Policy and Management Act
FR:	Federal Register
FS:	Forest Service
FWS:	Fish and Wildlife Service
g/cc:	grams per cubic centimeter
g/m ² /yr:	grams per square meter per year
gpm:	gallons per minute
H ₁ :	hydrogen
HMP:	Habitat Management Plan
HUD:	Department of Housing and Urban Development
IBLA:	Interior Board of Land Appeals
IMP:	Interim Management Policy
IPP:	Intermountain Power Project
ISA:	Instant Study Area
KGS:	known geologic structure
KRCRA:	known recoverable coal resource area
lbs.:	pounds
MFP:	Management Framework Plan
µg/m ³ :	micrograms per cubic meter
mg/l:	milligrams per liter
mg/m ³ :	milligrams per cubic meter
mm:	millimeter
mmhos:	millimhos per cubic meter
MMS:	Minerals Management Service
mpg:	miles per gallon
mph:	miles per hour
NO _x :	nitrogen oxide
NO ₂ :	nitrogen dioxide
NPS:	National Park Service
NRA:	National Recreation Area
NWPS:	National Wilderness Preservation System
OSPC:	Office of the State Planning Coordinator
ORV:	off-road vehicle
PCPI:	per capita personal income
ppm:	parts per million
PSD:	Prevention of Significant Deterioration
PRLA:	Preference Right Lease Application
R&PP:	Recreation and Public Purposes
RMA:	Recreation Management Area
RMP:	Resource Management Plan
ROS:	Recreation Opportunity Spectrum
RVD:	Recreation Visitor Day
S:	sulfur
Sec:	section
SERI:	Solar Energy Research Institute
SLM:	Salt Lake Meridian
SMSA:	standard metropolitan statistical area
SO _x :	Sulfur oxides
SO ₂ :	sulfur dioxide
SSA:	site-specific analysis
SSF:	soil surface factor
STSA:	Special Tar Sand Area
SVIM:	soil-vegetation inventory method
TDS:	total dissolved solids
TSP:	total suspended particulates
UDES:	Utah Department of Employment Security
UDOT:	Utah Department of Transportation
UDWR:	Utah Division of Wildlife Resources
UGMS:	Utah Geological and Mineralogical Survey
U ₃ O ₈ :	uranium oxide
USDA:	United States Department of Agriculture
USDC:	United States Department of Commerce
USDI:	United States Department of Interior
USGS:	United States Geological Survey
V ₂ O ₅ :	vanadium oxide
VOC:	volatile organic compounds
VRM:	visual resource management
WA:	Wilderness Area
WDAFS:	Western Division of American Fisheries Society
WSA:	Wilderness Study Area

GLOSSARY

- A-WEIGHTED SOUND LEVEL (dBA).** The measurement of sound approximating the auditory sensitivity of the human ear.
- ACCIPITERS.** A genus of small- or medium-sized hawks having short, rounded wings and long tails.
- AIR POLLUTION.** Accumulation of aerial wastes beyond the concentrations that the atmosphere can absorb and, in turn, which may damage the environment.
- ALLOTMENT (RANGE ALLOTMENT).** A management area designated for the use of a prescribed number and kind of livestock under one management plan. An area where one or more livestock permittees graze their livestock, consisting of public lands and any enclosed State and private lands.
- ALLUVIAL FANS.** Unconsolidated sedimentary material deposited by streams in fan- or cone-shaped deposits at the base of mountains.
- ALTERNATIVE.** One of at least two proposed means of accomplishing planning objectives.
- AMBIENT AIR QUALITY.** Prevailing condition of the atmosphere at a given time; the outside air. All lands are categorized in one of the Prevention of Significant Deterioration (PSD) classes. Class I is the most restrictive and generally applies to specific national parks and monuments. No decrease in air quality is allowed under this class. Class II areas allow some decrease in air quality. Class III areas allow for a substantial decrease in air quality such as is found in urban areas.
- ANALYSIS.** The examination of existing and/or recommended management needs and their relationships to discover and determine the outputs, benefits, effects, and consequences of initiating a proposed action.
- ANIMAL UNIT MONTH (AUM).** The amount of forage required to sustain the equivalent of 1 cow or 6.2 sheep for 1 month; 5.8 deer for 1 month; 9.6 antelope for 1 month; 5.5 bighorn sheep for 1 month; or 2.2 burros for one month (usually 800 lbs. of useable air-dried forage).
- ANTICLINE.** An upfold or arch of stratified rock in which the beds or layers bend downward in opposite directions from the crest or axis of the fold.
- AQUATIC.** Living or growing in or on the water.
- AQUIFER.** A geologic formation or structure that transmits water. Aquifers are usually saturated sands, gravel, fractured rock, or cavernous rock.
- ARCHAEOLOGY.** The scientific study of past cultures.
- AREA OF CRITICAL ENVIRONMENTAL CONCERN (ACEC).** An area of public lands where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values; fish and wildlife resources; or other natural systems or processes, or to protect life/provide safety from natural hazards.
- AVERAGE DAILY TRAFFIC (ADT).** The total number of vehicles traveling both directions on a section of road during a time period divided by the number of days in that time period.
- AVULSION.** A sudden change in the course of a river.
- BASIC VISUAL ELEMENTS.** See Visual Elements.
- BITUMEN.** A naturally occurring viscous mixture of hydrocarbons that may contain sulphur compounds and that, in its naturally occurring state, is not recoverable at a commercial rate through a well.
- BRITISH THERMAL UNIT (Btu).** The quantity of heat required to raise the temperature of one avoirdupois pound of water 1 degree Fahrenheit at or near 39.2°F.
- CARBON MONOXIDE.** A colorless, odorless, toxic gas that competes with oxygen for bonding sites on the hemoglobin molecule in the blood.
- CARRYING CAPACITY.** The maximum stocking rate of livestock and/or big game possible without damaging vegetation or related resources. It may vary from year to year on some areas because of fluctuating forage production.
- CATEGORIES (LEASING).** The four categories used to determine leasing activities for oil and gas and tar sand were based on potential for development, other resource uses, and protection of sensitive resource values. *Category 1* opens all public lands to leasing with standard stipulations. *Category 2* allows leasing with standard and special stipulations to protect sensitive resource values. *Category 3* allows leasing with no right of surface occupancy: recovery methods must not disturb the surface; and *Category 4* closes lands to leasing.
- CENSUS COUNTY DIVISION (CCD).** A division designated to represent community areas focused on trading centers or to represent major land use areas. (CCDs have visible, permanent, and easily described boundaries.)
- CENTIPOISE.** A unit of viscosity equal to 1/100 poise. (A poise is a cgs absolute unit of viscosity that is equal to one dyne-second per square centimeter.)
- CHANGE AGENT.** Any factor (person, physical force, living entity, chemical, etc.) which affects the primary characteristics of an ecological element, either positively or negatively.
- CLEAN AIR ACT (42 USC 1857 et seq.).** An act for air pollution prevention and control: (1) to protect and enhance public health and welfare and the productive capacity of its population; (2) to initiate and accelerate a national research and development program to achieve the prevention and control of air pollution; (3) to provide technical and financial assistance to state and local governments in connection with the development and execution of their air pollution prevention and control programs; (4) to encourage and assist the development and operation of regional air pollution control programs.
- COMBINED HYDROCARBON LEASE (CHL).** A lease issued in a Special Tar Sand Area (STSA) which entitles the lessee to remove any gas and nongaseous hydrocarbon substance other than coal, oil shale, or gilsonite.
- COMPLETE HYDROLOGICAL TESTING.** As used in this EIS, it is in reference to maintaining the water balance in the affected area. A hydrologic inventory to determine the water balance would be completed to detect any losses in either quantity or quality so that mitigation could occur. The hydrogeologic evaluation would be of an extent capable of predicting whether or not mining activities would interrupt the flow of springs or reduce the base flow of perennial streams.
- CONVERSION LEASE TRACT.** As used in this EIS, changing an oil and gas lease existing before November 16, 1981 to a Combined Hydrocarbon Lease (CHL). A CHL allows production of all hydrocarbons except coal, oil shale, and gilsonite.
- CRUCIAL WILDLIFE HABITAT.** That portion of wildlife habitat essential to the survival and perpetuation of a certain species in an area.
- CRUDE OIL.** Oil as it comes from a well.
- CULTURAL RESOURCES.** Those resources of historical or archaeological significance.
- DECANT SYSTEM.** A system for separating water from solid waste material.
- DEPOSIT.** An accumulation of a mineral.
- DIRECTIONAL DRILLING.** Slant drilling or drilling on an angle. Directional drilling is utilized when the operator is not allowed to occupy the surface of a given tract of land, but still wishes to drill a structure or target beneath that tract.
- EDGE EFFECT.** The effect that occurs when two or more habitat types come together and create more favorable wildlife habitat than either type could provide alone.

ERODIBILITY. Susceptibility of a soil to erosion by water or wind. Relative terms are none, slight, moderate, and high.

ENDANGERED SPECIES. Any animal or plant species in danger of extinction throughout all or a significant portion of its range.

ENVIRONMENTAL ANALYSIS. A systematic process for consideration of environmental factors in land management actions.

EXPLORATION PERMIT. A prospecting permit; a short-term agreement granting the holder the right to explore for minerals, oil and gas, or tar sand.

EXPRESSIONS OF INTEREST. As used in this EIS, industry nominations to lease tracts within Special Tar Sand Areas (STSA) which are not currently under lease.

EXTRACTION. As used in this EIS, the process by which bitumen is separated from sand, water, and other impurities.

FLOODPLAIN. Nearly level land bordering a stream; this land consists of stream sediments and is subject to flooding.

FORAGE. Vegetation of all forms available and of a type used for animal consumption.

FORB. A broad-leafed herb.

HABITAT. A specific set of physical conditions that surrounds a single species, a group of species, or a large community. In wildlife management, the major components of habitat are food, water, cover, and living space.

HERD UNIT. An area designated by the Utah Division of Wildlife Resources (UDWR) as a big game (i.e., deer, elk, moose, etc.) herd management area.

HOMOGENEOUS. In this EIS, of uniform structure or composition throughout.

HYDROCARBONS. Organic chemical compounds of hydrogen and carbon atoms which form the basis of all petroleum products.

HYDROPHILIC. Having an affinity for water.

INFRASTRUCTURE. The set of supporting systems and facilities (i.e., transportation, education, medical service, communication, fire, and police protection, etc.) that support a region's or community's social and economic structures.

IN PLACE. As used in this EIS, the gross volume of crude bitumen or oil calculated or interpreted to exist in a reservoir before any volume has been produced.

IN SITU. In place; in the original location.

IN-SITU EXTRACTION. As used in this EIS, extracting the oil from tar sand while it is still in place by injecting steam, solvents, and/or heat.

INTERIM MANAGEMENT POLICY (IMP). An interim measure governing uses on lands under wilderness review. This policy protects Wilderness Study Areas (WSAs) from impairment of their suitability for designation as wilderness.

INTERMITTENT STREAM. A stream which flows part of the time, usually after a rainstorm or during a spring thaw.

ISOPLETH. A line connecting points at which a given variable has a constant value.

KNOWN GEOLOGIC STRUCTURE (KGS). A geologic structure known to be present containing a producing or producible oil or gas well.

LAND USE PLAN. A planning decision document which establishes resource allocations and coordinated objectives and constraints for all forms of public land and resource uses within a specified area.

LEASE (MINERAL). A contract between a landowner and another granting the latter the right to search for and produce gas, hydrocarbons, or other mineral substances upon payment of an agreed-upon rental, bonus, and/or royalty.

LEASE CONVERSION. As used in this EIS, the process of converting an existing oil and gas lease in a Special Tar Sand Area (STSA) to a

Combined Hydrocarbon Lease (CHL). The conversion is completed through approval of a plan of operation outlining how the hydrocarbon resource will be developed.

LEASING CATEGORIES. Refer to categories (leasing).

LENTICULAR. Having the shape of a double-convex lens.

LEVEL OF SERVICE. A maximum number of vehicles that can pass over a given section of roadway during a specified time period. This is a qualitative measure of the effect of a number of factors, which include speed and travel time, traffic interruptions, freedom to maneuver, safety, driving comfort, and convenience, and operating costs.

LINEAR SOURCE. A line or trajectory at which material or other matter is added to a system either instantaneously or continuously. An example of a linear source in the context of air pollution would be highway traffic.

LIQUID HYDROCARBONS. Oil substances other than gas and solid substances (i.e., coal, oil shale, and gilsonite) which occur naturally in the earth.

LOGICAL PRODUCTION AREA. An area of land in which the recoverable mineral reserve can be developed in an efficient, economical, and orderly manner as a unit with due regard to conservation of other resources.

MANAGEMENT FRAMEWORK PLAN (MFP). A land use plan for public lands administered by BLM which provides a set of goals, objectives, and constraints for a specific planning unit or area; a guide to the development of detailed plans for the management of each resource.

MEAN VISUAL RANGE. The average distance of how far any object can be seen by the human eye.

MIGRATION ROUTES. Historical wildlife routes used to travel from one type of seasonal range to another.

MILLIDARCY. A unit of porous permeability equal to 1/1000 darcy. Having to do with flow of fluids under pressure. A darcy is a unit of measure where the rate of flow of a fluid having one centipoise viscosity under pressure gradient of one atmosphere per centimeter would be 1 cubic centimeter per second per square centimeter cross section.

MITIGATION MEASURES. Measures developed to lessen impacts to resources resulting from proposed projects.

MONOCLINE. A geologic structure in which the strata are all inclined in the same direction at a uniform angle of dip.

MULTIPLE USE. Management of public lands and their various resource values so that they are used in the combination best meeting the present and future needs of the American people. Relative resource values are considered, not necessarily the combination of uses that will give the greatest potential economic return or the greatest unit output.

NATIONAL AMBIENT AIR QUALITY STANDARD (NAAQS). National standards, established under the Clean Air Act by the Environmental Protection Agency, prescribing levels of pollution in the outdoor air which may not be exceeded. **PRIMARY NAAQS:** Standard set at a level to protect public health from damage from air pollution. **SECONDARY NAAQS:** Standard set at a level to protect public welfare from damage from air pollution.

NATIONAL WILDERNESS PRESERVATION SYSTEM (NWPS). A system composed of Federally owned areas designated by Congress as Wilderness Areas. These areas shall be administered for the use and enjoyment of the American people; management actions will preserve wilderness values for future use and enjoyment.

NITROGEN OXIDES (NO_x). Compounds produced by combustion, particularly when there is an excess of air or when combustion temperatures are very high. Nitrogen oxides are primary air pollutants.

NONIMPAIRMENT CRITERIA. A series of guidelines which govern surface-disturbing activities on lands being studied by BLM for inclusion in the National Wilderness Preservation System (NWPS). The guidelines require that lands be managed so as to not impair their

- suitability for designation as wilderness and so that any reclamation of disturbed areas be substantially unnoticeable by the time the Secretary of Interior makes his recommendation on Wilderness Areas to the President.
- NOTICE OF INTENT.** A notice submitted to BLM by an existing oil and gas lessee in a Special Tar Sand Area (STSA). This notice states that the lessee intends to submit a plan of operation to convert his existing lease to a Combined Hydrocarbon Lease (CHL).
- NO ACTION ALTERNATIVE.** An alternative which would continue the current management direction or level of management intensity.
- NODE.** As used in this EIS, the actual measuring point for the Colorado River simulation system which determines flow and salinity.
- OFF-ROAD VEHICLE (ORV).** Any motorized vehicle designed for or capable of cross-country travel over land, water, sand, snow, ice, marsh, swampland, or other terrain.
- OIL.** All nongaseous hydrocarbon substances other than those substances leasable as coal, oil shale, or gilsonite (including all vein-type solid hydrocarbons).
- OUTCROPS (TAR SAND).** Those parts of a tar sand deposit exposed at the surface.
- OVERBURDEN.** Material of any nature, consolidated or unconsolidated, that overlies a deposit of useful materials, ores, or coal, especially those deposits mined from the surface by open cuts.
- OZONE.** A colorless to bluish gas produced by photochemical reactions with hydrocarbons and oxides of nitrogen.
- PARTICULATE MATTER.** Any material, except water, in a chemically uncombined form that is or has been airborne and exists as a liquid or a solid at standard temperature and pressure conditions. Minute particles of coal dust, fly ash, and oxides temporarily suspended in the atmosphere.
- PATENTED MINING CLAIM.** A parcel of mineral land for which the Federal Government has conveyed title to an individual.
- PERCHED WATER TABLE.** An aquifer formed by beds of clay or silt, unfractured consolidated rock, or other material with a relatively lower permeability than the surrounding materials, present in some areas above the regional water table. It is of limited areal extent with an unsaturated zone between bottom of the perching bed and the regional water table.
- PERENNIAL STREAM.** A stream with a yearlong flow.
- PERMEABILITY (SOIL).** The ease with which gasses, liquids, or plant roots penetrate or pass through a layer of soil.
- PETROGLYPH.** Prehistoric rock art pecked or carved into rock.
- PICTOGRAPH.** Prehistoric rock art drawn or painted onto rock.
- PILOT PLANT.** A small plant for testing chemical processes under actual production conditions.
- PLAN OF OPERATIONS.** As used in this EIS, a plan submitted by a lessee which outlines in detail exploration and mining proposals.
- PLANNING AREA.** One or more planning units for which Management Framework Plans (MFPs) or Resource Management Plans (RMPs) are revised/prepared.
- PLANNING UNIT.** A geographic unit within a BLM district which includes related lands, resources, and use pressure problems; these items are all considered for resource inventory and planning.
- POINT SOURCE.** A point at which matter is added to a system either instantaneously or continuously. An example of a point source in the context of air pollution would be a smokestack.
- POTENTIAL LEASE TRACT.** Areas within Special Tar Sand Areas (STSAs) not already leased for oil and gas, and which may be considered for new competitive leasing.
- PRECURSOR:** In this EIS, a substance from which another substance is formed, especially by natural processes.
- PRIMITIVE RECREATION.** Nonmotorized and undeveloped types of outdoor recreational activities.
- PRIMITIVE RECREATION VALUES.** Environmental features that enhance the quality of unconfined, undeveloped, and unmotorized recreation (i.e. hiking, backpacking, horseback riding, cross-country skiing, etc.). A general description would be scenic, undeveloped lands essentially removed from the effects of civilization with opportunities for solitude.
- PRIOR STABLE LEVEL.** This number is derived from consideration of deer population dynamics data averaging 10 or more years when deer populations were stable. This level is at the range's carrying capacity for a given deer herd unit.
- PUBLIC LANDS.** Any lands or interest in lands outside of Alaska owned by the United States and administered by the Secretary of Interior through the BLM, except lands located on the Outer Continental Shelf and lands held for the benefit of Indians.
- PUBLIC PARTICIPATION.** The process of attaining citizen input into each stage of the planning process. It is required as a major input into BLM's planning system.
- QUAD.** One quadrillion British thermal units (Btus) of energy.
- RAIN SHADOW.** A region of reduced rainfall to the lee of high mountains.
- RAPTORS.** Birds of prey such as eagles, hawks, and owls.
- RECLAMATION.** The process of converting mined land to its former or other productive uses.
- RECREATION AND RESOURCE UTILIZATION (RRU) ZONE.** A land use planning zone within lands administered by the National Park Service (NPS) which allows mineral development and livestock grazing to the extent these uses are compatible with recreation.
- RESOURCE.** A product of the earth or biosphere capable of serving, supplying, or supporting some human purpose or need.
- RESOURCE AREA.** A manageable geographic subdivision of a BLM district consisting of one or more planning units or areas.
- RESOURCE MANAGEMENT PLAN (RMP).** A written land use plan that outlines BLM's decisions and strategy for management of the resources in a particular area. The RMP is replacing Management Framework Plans (MFPs) in BLM's planning system.
- RIPARIAN HABITAT.** A native environment which supports plants adapted to moist growing conditions. Such habitat is found along waterways, ponds, and other wet areas.
- RIVER MORPHOLOGY.** The structure and form of the river.
- RURAL LIFESTYLE VALUES.** Those lifestyle values of significant worth as perceived by residents or local communities in a rural social environment.
- SAGE GROUSE STRUTTING GROUNDS.** A communal courtship display ground where both sexes of sage grouse congregate during the breeding season to mate.
- SATURATION.** As used in this EIS, a measure of the extent to which pore space in the sand or rock is occupied by bitumen or oil. Also, the extent to which pore space in soil is occupied by water.
- SCENIC QUALITY.** The visual aesthetics of an area, based on the visual elements of landforms, vegetation, color, water, adjacent scenery, and amount of cultural modification. It indicates the visual quality of an area relative to other scenery in the region. BLM ratings are A (exceptional/extraordinary); B (high); and C (low/common).
- SCOPING PROCESS.** A process whereby public issues and concerns for a proposed project are identified.
- SEDIMENT YIELD.** The average amount of sediment (mineral or organic soil material) from a square mile transported by water from source areas into local water courses. Sediment yield represents an average over a long period, such as 25 years or more (USDI, Bureau of Reclamation, 1975).

- SEMI-PRIMITIVE MOTORIZED RECREATION.** A roaded area (primitive and secondary county maintained) of at least 2,500 acres, which is largely natural with surface disturbances limited. Only small, isolated structures and evidences of man are present, and encounters between users are moderate. Off-site administration of users is encouraged with small on-site controls evident.
- SENSITIVE SPECIES.** Species not yet officially listed but undergoing status review for listing on the official Fish and Wildlife Service (FWS) Threatened and Endangered list; species whose populations are small and widely dispersed or restricted to a few localities; and species whose numbers are declining so rapidly that official listing may be necessary.
- SERIAL COMMUNITIES.** Communities depicting various stages of plant development.
- SHRUB.** A plant that has a persistent woody stem, a relatively low growth habit, and generally produces several basal shoots instead of a single trunk.
- SPECIAL TAR SAND AREA (STSA).** An area designated by the Department of Interior's Orders of November 20, 1980 (45 Federal Register 76800) and January 21, 1981 (46 Federal Register 6077), and referred to in those orders as Designated Tar Sand Areas, as containing substantial deposits for tar and sand. Eleven STSAs are recognized in Utah by the Combined Hydrocarbon Leasing Act of 1981. The Act provided for the conversion of existing oil and gas leases in STSAs to Combined Hydrocarbon Leases (CHLs). This Act also requires competitive leasing for currently unleased lands within STSAs.
- SOIL-VEGETATION INVENTORY METHOD (SVIM).** A uniform, systematic method for inventory of soil and vegetation resources and data collection for use in planning and environmental assessments.
- STAGING GROUND.** A gathering and starting point for a recreational activity.
- STATE LANDS.** Lands owned by the State of Utah: school lands, sovereign lands, and lands acquired for special purposes.
- SULFUR OXIDES.** Combustion of fossil fuels that may yield a pungent toxic gas.
- TAR SAND.** Any consolidated or unconsolidated rock (other than coal, oil shale, or gilsonite) that either: (1) contains a hydrocarbonaceous material with a gas-free viscosity at original reservoir temperature greater than 10,000 centipoise; or (2) contains a hydrocarbonaceous material and is produced by mining or quarrying. Tar sand constitutes one of the largest known nonfluid petroleum resources in the United States. Approximately 90 percent of the United States' tar sand (27 billion barrels) is located in Utah.
- TAR SAND DEPOSIT.** A natural bitumen (oil-impregnated) containing or appearing to contain an accumulation of tar sand, separated or appearing to be separated from any other such accumulation.
- THREATENED SPECIES.** Any plant or animal species likely to become endangered within the foreseeable future throughout all or a part of its range.
- TIERING.** Tiering of Environmental Impact Statements (EISs) refers to the process of addressing a broad, general program, policy, or proposal in an EIS and analyzing a narrower site-specific proposal related to the initial program.
- UNIT RESOURCE ANALYSIS (URA).** A compilation of physical resource data and an analysis of the current use, production, condition, and trend of resources; the URA also contains a profile of ecological values and describes potentials and opportunities for development of resources within a planning unit or area.
- VISCOUS.** Having a thick consistency and lacking easy movement or fluidity.
- VISIBILITY.** The greatest distance in a given direction of which it is possible to see and identify with the unaided eye a prominent dark object against the sky at the horizon.
- VISUAL DISTANCE ZONE.** The expression of the normal distance of viewers from an area being viewed: foreground/middle ground-up to 5 miles; background-up to 15 miles; and seldom seen-greater than 15 miles or areas screened from normal view points.
- VISUAL ELEMENTS (BASIC).** The elements which determine how the character of a landscape is perceived. *Form:* the shape of objects such as landforms or patterns in the landscape. *Line:* Perceivable linear changes in contrast resulting from abrupt differences in form, color, and texture. *Color:* The reflected light of different wave lengths that enables the eye to differentiate otherwise identical objects. *Texture:* The visual result of variation in the surface of an object.
- VISUAL RESOURCE MANAGEMENT (VRM) SYSTEM.** Classification containing specific objectives for maintaining or enhancing visual resources, including the kinds of structures and modifications acceptable to meet established visual goals.
- VISUAL SENSITIVITY.** An expression of the average number of people that view an area and the relative degree (high, medium, or low) of concern they have regarding potential or proposed modification of the landscape in that area.
- VOLATILE ORGANIC COMPOUNDS (VOC).** Hydrocarbon emissions that react in the presence of sunlight to produce ozone.
- WATERFOWL.** Wildlife species such as ducks, geese, and swans.
- WATERSHED.** The total area above a given point on a stream that contributes water to the flow at that point.
- WETLANDS.** Lands including swamps, marshes, bogs, and similar areas such as wet meadows, river overflows, mud flats, and natural ponds.
- WILDERNESS.** An area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements.
- WILDERNESS AREA.** An area officially designated as wilderness by Congress. Wilderness Areas will be managed to preserve wilderness characteristics and shall be devoted to the public purposes of conservation and recreational, scenic, scientific, educational, and historical uses.
- WILDERNESS MANAGEMENT POLICY.** The BLM policy which governs administration of public lands designated as Wilderness Areas by Congress. It is based on the mandate of Congress as contained in the Wilderness Act of 1964 and the Federal Land Policy and Management Act (FLPMA) of 1976. FLPMA requires a Wilderness Area to be a roadless area or island that has been inventoried and found to have wilderness characteristics as described in Section 603 of FLPMA and Section 2(c) of the Wilderness Act.
- WILDERNESS STUDY AREA (WSA).** An area under study for possible inclusion as a Wilderness Area in the National Wilderness Preservation System (NWPS).
- ZERO DISCHARGE.** The lack of any effluent from a given point or source.

BIBLIOGRAPHY

- Aerocomp, Inc. 1983a. "Air Quality Analysis for the Combined Hydrocarbon EIS, Eastern and South-Central Utah" (unpublished document). Volumes I and II. Costa Mesa, California.
- Aerocomp, Inc. 1983b. "Sunnyside Combined Hydrocarbon Lease Conversion Air Quality Technical Report" (unpublished document). November 1983. Costa Mesa, California.
- Aerocomp, Inc. 1984. *Final Air Quality Analysis for the Combined Hydrocarbon EIS, Eastern and South-Central Utah. Parts I and II.* June 1984. Costa Mesa, California.
- Allen, Rich. 1983. "Data for 1984 Grazing Fee Determination" (personal communication). August 2, 1983. U.S. Department of Agriculture. Washington, D.C.
- American Institute of Architects Research Corporation. 1979. *Life-Cycle Cost Study of Commercial Buildings.* December 1979. Washington, D.C.
- Argonne National Laboratories. 1983. "Draft Socioeconomic Technical Report: Regional Analysis of Tar Sand Development in Utah" (unpublished document). July 1983. Argonne, Illinois.
- Blakey, R. C. et al. 1977. "Petroliferous Lithosomes in the Moenkopi Formation, Southern Utah." Volume IV, No. 2. Utah Geological and Mineralogical Survey. Salt Lake City, Utah. pp. 67-84.
- Burnett, Keith J. 1976. *Overall Economic Development Program—1976.* Southeast Utah Economic Development District, Price Utah. 36 pp.
- Burns and McDonald. 1979. "The Environmental Analysis Report for the Moon Lake Project" (unpublished document). Volume I. December 31, 1979. Kansas City, Missouri.
- Burt, E. W. 1977. *Valley Model User's Guide.* Environmental Protection Agency, Office of Air and Waste Management, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.
- Campbell, J. A. and Ritzma, H. A. 1979. *Geology and Petroleum Resources of the Major Oil-Impregnated Sandstones of Utah.* August 1979. Utah Geological and Mineral Survey, Salt Lake City, Utah. 19 pp.
- Carter, Paul. 1983. "Tar Sand Extraction Within Circle Cliffs" (personal communication). June 1983. U.S. Department of the Interior, Bureau of Land Management, Cedar City, Utah.
- Clark, W. and Page, J. 1981. *Energy, Vulnerability, and War.* W. W. Norton, New York, New York.
- Colorado State University. 1971. *Water Pollution Potential of Spent Oil Shale Residues.* Environmental Protection Agency, Water Quality Office, Water Pollution Control Research Series 14030 No. DB. 101 pp.
- Cook, Earl F. 1976. *Man, Energy, Society.* W. H. Freeman, San Francisco, California.
- Cortese, Charles F. and Jones, Bernie. 1977. "The Sociological Analysis of Boom Towns in Contributions to Environmental Sociology." *Western Sociological Review.* Volume 8, No. 1. Utah State University, Department of Sociology, Social Work, and Anthropology. Logan, Utah. pp. 76-90.
- Council on Environmental Quality. 1980. "Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory" (personal communication). August 10, 1980. Washington, D.C. 8 pp.
- Council on Environmental Quality. 1983. "Proposed Guidance Memorandum for Federal Agency NEPA Liasons." *Federal Register Notice.* August 11, 1983. U.S. Government Printing Office, Washington, D.C.
- Cronquist et al. 1972. *Intermountain Flora.* Volume 1. Hafner Publishing Company. New York, New York. 103 pp.
- Dalton, Larry. 1983. "Mule Deer Population on Herd Unit 27B" (personal communication). August 31, 1983. Utah Division of Wildlife Resources, Price, Utah.
- Davidson, E. S. 1967. *Geology of the Circle Cliffs Area, Garfield and Kane Counties, Utah.* Bulletin 1229. U.S. Department of the Interior, Geological Survey. Washington, D.C. 140 pp.
- Duncan, Dawn H. 1983. "Ute Attitudes Regarding Energy Development in the Uinta Basin" (unpublished document). April 1983. Ute Indian Uintah and Ouray Indian Reservation, Utah.
- Earth Environmental Consultants, Inc. 1980. "Soil-Vegetation Inventory Method (SVIM) in the Henry Mountain Planning Unit, Utah" (unpublished document). Volumes 1 and 2. May 1980. U.S. Department of the Interior, Bureau of Land Management, Richfield District, Richfield, Utah.
- Electric Power Research Institute. 1983. "Acid Rain Research, A Special Report" (unpublished document). Volume 8, No. 9. November 1983. EPRI Journal, Palo Alto, California.
- Enercor. 1982. "An Application and Development Plan for the Conversion of Federal Oil and Gas Leases to Combined Hydrocarbon Leases" (unpublished document). November 24, 1982. Salt Lake City, Utah. 199 pp.
- Environmental Protection Agency. 1971. "Transportation Noise and Noise From Equipment Powered by Internal Combustion Engines" (unpublished document). December 1971. Office of Noise Abatement Control. Washington, D.C. p. 95.
- Environmental Protection Agency. 1977. "Acid Rain, Research Summary" (unpublished document). October 1977. Office of Research and Development, Washington, D.C. pp. 2-7.
- Fawcett, G. Allen. 1979. "Six-County Development Plans" (unpublished document). September 1979. Four Corners Regional Commission, Richfield, Utah.
- Federal Energy Administration. 1980. "Industrial Cogeneration—What It Is, How It Works, Its Potential." Report EMD-80-7. April 29, 1980. U.S. General Accounting Office. Washington, D.C.
- Gallizioli, Steve. 1977. "Overgrazing on Desert Bighorn Ranges." *Transactions of the Desert Bighorn Council.* pp. 21-23.
- Gardner, Dan. 1983. "Wild Horses or Burros on P. R. Spring and Hill Creek STSAs" (personal communication). August 22, 1983. U.S. Department of the Interior, Bureau of Land Management, Vernal District. Vernal, Utah.
- Gray, Charles, and Von Hippel. 1981. "The Fuel Economy of Light Vehicles." *Scientific American.* Volume 244, No. 5. May 1981. pp. 48-59.
- Hand, Forrest E., Jr. 1979. "Grand Water Resources in the Northern Part of the Glen Canyon National Recreation Area and Adjacent Lands West of the Colorado And Green Rivers, Utah" (Maps and Illustrations). University of Wyoming, Water Resources Institute. p. 40.
- Hayes, Denis. 1976. *Energy: The Case for Conservation.* January 1976. Worldwatch Institute, Washington, D.C.
- Herbeck, E. F.; Heintze, R. C.; and Hastings, J. R. 1977. "Fundamentals of Tertiary Oil Recovery." *Petroleum Engineer.* February 1977. University of Utah, Salt Lake City, Utah.

BIBLIOGRAPHY

- Holmes, C. M.; Page, B. M.; and Averitt, Paul. 1948. *Geology of the Bituminous Sandstone Deposits Near Sunnyside, Carbon County, Utah, Preliminary Map 86*. U.S. Department of the Interior, Geological Survey, Oil and Gas Investigations Division. Washington, D.C.
- Hood, J. W. 1977. *Hydrologic Evaluation of Ashley Valley, Northern Uinta Basin Area, Utah*. Utah Department of Natural Resources Technical Publication 54. 25 pp.
- Hornback, Ken. 1984. "Impacts of Tar Sand Development Related Population Increases on Visitation in National Park Service Lands" (personal communication). April 12, 1984. U. S. Department of the Interior, National Park Service. Denver, Colorado.
- Hubbard, Harold. 1983. "Estimates of Recoverable and Unrecoverable Tar Sand Resources" (unpublished document). August 1983. U.S. Department of the Interior, Bureau of Land Management. Richfield, Utah.
- Hubbard, Harold. 1984. "Relationship of Locations of Tar Sand Deposits and Groundwater in the Pariette STSA" (personal communication). February 1984. U.S. Department of the Interior, Bureau of Land Management. Vernal, Utah.
- Hubbard, John P. 1977. "Importance of Riparian Ecosystems: Biotic Considerations" (unpublished document). U.S. Department of Agriculture, Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado. pp. 14-18.
- Hunter G. N. and Yeager, L. E. 1969. "Management of the Mule Deer." *The Deer of North America*. The Stackpole Company, Harrisburg, Pennsylvania. pp. 449-482.
- Julander, O.; Robinette, W. L.; and Jones, D. A. 1961. "Relation of Summer Range Condition to Mule Deer Herd Productivity." *Journal of Wildlife Management*. Vol. 25 (1). Allen Press Publications, Lawrence, Kansas. pp. 54-60.
- Koehler, David A. and Redente, Edward F. 1980. "Revegetation Techniques on Disturbed Lands Associated With Oil Shale Development." Thirty-Second Annual Meeting of the Society for Range Management. p. 44.
- Konwinski, Gary. 1983. "Utah Special Tar Sand Areas, Their Water Requirements and the Future Effect on the Colorado River System" (unpublished document). June 1983. U.S. Department of the Interior, Bureau of Land Management, Denver Service Center. Denver, Colorado.
- Kuchler as cited by Cronquist, et al. 1972. *Intermountain Flora*. Volume 1. Hafner Publishing Company. New York and London. p. 103.
- Laing, Gary. 1983. "Discussion on Number of Acres of Crucial Deer Summer Range on the Asphalt Ridge/White Rocks STSA" (personal communication). September 1983. U.S. Department of Agriculture, Forest Service, Vernal Ranger District, Vernal, Utah.
- Latil, M.; Barobu, C.; Burger, J.; and Sourieau, P. 1980. *Enhanced Oil Recovery*. Gulf Publishing Company, Houston, Texas. pp. 178-204.
- Lawrence Livermore National Laboratory. 1981. *Energy Requirements From Technology Assessment: Environmental Health and Safety Impacts Associated With Oil Recovery from U.S. Tar Sand Deposits*. October 13, 1981.
- Lovins, Amory B., and Lovins, L. H. 1982. *Brittle Power: Energy Strategy for National Security*. Brick House, Andover, Massachusetts.
- Marchant, L. C. 1984. "Tar Sand Recovery Methods" (personal communication). March 9, 1984. Laramie Energy Technology Center, Laramie, Wyoming.
- McKell, Cyrus M., et al. 1978. *Rehabilitation Potential for Henry Mountain Coal Field*. U.S. Department of the Interior, Bureau of Land Management. Utah State University, Logan, Utah. p. 12.
- Miller, J. F.; Frederick, R. H.; and Tracey, R. J. 1973. *Precipitation Frequency Atlas of the Western United States*. Volume VI-Utah. National Oceanic and Atmospheric Administration NOAA Atlas 2. Washington, D.C.
- Molenaas, Cornelius M. and Sandberg, Charles A. 1982. "Petroleum Potential of Wilderness Lands in Utah." *Petroleum Potential of Wilderness Lands in the Western United States*. U.S. Geological Survey. Government Printing Office, Washington, D.C. pp. k-1-k-11.
- Mono Power Company. 1983. "Mono Power Company Plan of Operations" (unpublished document). April 19, 1983. Rosemead, California.
- Moran, Joseph M.; Morgan, Michael D.; Wiersma, James H. 1973. *An Introduction to Environmental Sciences*. Little, Brown and Company, Boston, Massachusetts.
- Mundorff, J. R. 1979. *Reconnaissance of Chemical Quality of Surface Water and Fluvial Sediment in the Dirty Devil River Basin, Utah*. Utah Department of Natural Resources Technical Publication 65. Salt Lake City, Utah. 132 pp.
- Murie, O. J. 1966. *The Elk of North America*. The Stackpole Company, Harrisburg, Pennsylvania. 376 pp.
- Nellis, Lee and Nicholson, John. "County and Community Infrastructure" (unpublished document). June 1983. Utah State University Foundation, Logan, Utah.
- Nelson, Brian. 1984. "Effluent Limitations for a Tar Sand Upgrading Facility" (personal communication). April 16, 1984. State of Utah, Department of Health, Bureau of Water Pollution Control. Salt Lake City, Utah.
- Ninety-Seventh Congress. 1981. "Combined Hydrocarbon Leasing Act." *Federal Register Notice*. January 5, 1981. U.S. Congress, Washington, D.C. 3 pp.
- Office of Surface Mining. 1983. "Regulations for Surface Coal Mining (30 CFR 816)" *Federal Register Notice*. September 2, 1983. U.S. Government Printing Office. Washington, D.C. p. 40160.
- Oppenheimer, M. 1982. "The PSD Increments and NAAQS for SO₂. Do Not Protect Against Acidification of Sensitive Environments: Colorado Needs an Acid Deposition Standard" (unpublished document). Environmental Defense Fund. New York, New York.
- Pederson, J. C. and Harpe, K. T. 1978. "Factors Influencing Productivity of Two Mule Deer Herds in Utah." *Journal of Range Management*. Volume 31. Society for Range Management, Denver, Colorado. pp. 105-111.
- Ritzma, H. R. 1979. *Oil-Impregnated Rock Deposits of Utah (Map 45)*. Utah Geological and Mineral Survey. Salt Lake City, Utah. 2 pp.
- Ritzma, H. R. 1984. "The Origin of Tar Sand Deposits" (personal communication). March 29, 1984. Salt Lake City, Utah.
- Ryder, R. T.; Fouche, T. D.; and Eliason, J. H. 1976. *Early Tertiary Sedimentation in the Western Uinta Basin, Utah*. Volume 87. Geological Society of America. Boulder, Colorado. pp. 496-512.
- Seiler, R. A. and Tooley, J. E. 1982. *Erosion and Sediment Characteristics of the Southeastern Uinta Basin, Utah and Colorado*. U.S. Geological Survey—Water Resources Investigations 82-428. 44 pp.
- Skinner, Quentin. 1980. "Environmental Survey—Tar Sands In-situ Processing Research Program (Vernal, Uintah County, Utah)" (unpublished document). March 1980. U.S. Department of Energy, Technical Information Center. Laramie, Wyoming. pp. 86-89.
- Solar Energy Research Institute. 1981. *A New Prosperity: Building a Sustainable Energy Future*. Brick House, Andover, Massachusetts.

BIBLIOGRAPHY

- Southeastern Utah Association of Governments and Economic Development District. 1980. "The Documentation of the Community Attitude Survey January 1980" (unpublished document). Price, Utah.
- Spencer, George B.; Echard, W. E.; Johnson, F. Sam. 1970. *Domestic Tar Sand and Potential Recovery Methods—A Review*.
- State of Utah. 1982. *Uintah Basin Synfuels Development Draft Socio-economic Technical Report, Volume I*. August 1982. Prepared for the U.S. Department of the Interior, Bureau of Land Management by the Utah State Energy Office, Utah State Planning Coordinator's Office, and Utah State Department of Community and Economic Development. Salt Lake City, Utah.
- State of Utah, Department of Health. 1978. *Wastewater Disposal Regulations, Standards of Quality for Waters of the State*. Division of Health, Salt Lake City, Utah.
- State of Utah, Office of the Governor. 1984. "Comments on the Utah Combined Hydrocarbon Leasing Draft EIS" (personal communication). January 17, 1984. Salt Lake City, Utah.
- Steward, Paul. 1983. "Colorado River Salinity Costs" (personal communication). August 22, 1983. U.S. Department of the Interior, Bureau of Reclamation. Durango, Colorado.
- Swedish Ministry of Agriculture. 1982. "Report of the 1982 Stockholm Conference on Acidification of the Environment" (unpublished document). June 1982. Stockholm, Sweden.
- System Applications, Inc. 1982. "Draft Air Quality Technical Report for the Uintah Basin Synfuels Development EIS" (unpublished document). August 1982. Prepared for U.S. Department of the Interior, Bureau of Land Management, Salt Lake City, Utah.
- Thomas, J. W.; Maser, Chris; and Rodiek, Jon E. 1979. *Riparian Zones in Wildlife Habitats in Managed Rangelands—The Great Basin of Southeastern Oregon*. U.S. Department of Agriculture, Forest Service. Pacific Northwest Forest and Range Experiment Station. 18 pp.
- Thomas, Margaret G. 1983. *Human Demographic Impacts on Fish and Wildlife Resources From Energy Development in Rural Western Areas*. September 1983. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 357 pp.
- Tripp, Bryce. 1984. "Tar Sand Quality and Grade Figures for the Special Tar Sand Areas Within Utah" (personal communication). March 29, 1984. Utah Geological and Mineral Survey, Salt Lake City, Utah.
- Uintah Basin Association of Governments. 1979. *Uintah Basin Development Plan*. Roosevelt, Utah. 125 pp.
- Uintex Corporation. 1981. "A Henry Mountain Resource Area Report, Part 1 and Part 2" (unpublished document). December 1981. U.S. Department of the Interior, Bureau of Land Management, Richfield District, Richfield, Utah.
- University of Utah, Bureau of Community Development. 1979. *Garfield County, Utah, A Master Plan for Development*. Salt Lake City, Utah. 89 pp.
- University of Utah, Bureau of Community Development. 1979. *Grand County, Utah, A Master Plan for Development*. October 1979. Salt Lake City, Utah. 131 pp.
- U.S./Canada Working Group on Impact Assessment. 1981. "Report of the Working Group, U.S./Canada Memorandum of Intent on Transboundary Air Pollution" (unpublished document). February 1981.
- U.S. Congress House Committee on Interstate and Foreign Commerce. 1980. *Powerplant Fuel Conservation Act of 1980. Hearings Before the Subcommittee on Energy and Power*. 96th Congress. Washington, D.C.
- U.S. Congress, Office of Technology Assessment. 1980. *An Assessment of Oil Shale Technologies*. Washington, D.C.
- U.S. Congress, Office of Technology Assessment. 1982a. *Energy Efficiency of Buildings in Cities*. Washington, D.C.
- U.S. Congress, Office of Technology Assessment. 1982b. *Increased Automobile Fuel Efficiency and Synthetic Fuels: Alternatives for Reducing Oil Imports*. September 1982. Washington, D.C.
- U.S. Congress, Senate. 1980. *Senate Reports Vol. 7. Nos. 784-824. Miscellaneous Reports*. 96th Congress, 2nd Session. Washington, D.C.
- U.S. Congressional Budget Office. 1980. *Fuel Economy Standards for New Passenger Cars After 1985*. December 1980. Washington, D.C.
- U.S. Congressional Budget Office. 1982. *Urban Transportation and Energy: The Potential Savings of Different Modes*. December 1977/August 1982. Washington, D.C.
- U.S. Department of Agriculture, Forest Service. 1979a. *User Guide to Vegetation, Mining, and Reclamation in the West*. November 1979. Ogden, Utah. 85 pp.
- U.S. Department of Agriculture, Forest Service. 1979b. "South Slope Land Use Plan" (unpublished document). Ashley National Forest, Vernal, Utah.
- U.S. Department of Agriculture, Soil Conservation Service. 1975. *Soil Taxonomy*. Agriculture Handbook No. 436. December 1975. U.S. Government Printing Office, Washington, D.C. 754 pp.
- U.S. Department of Agriculture, Soil Conservation Service. 1979. *Soil Descriptions and Interpretations of Portions of Duchesne and Uintah Counties' Soil Survey Area, Utah*. June 1979. Salt Lake City, Utah.
- U.S. Department of Agriculture, Soil Conservation Service. 1980. *Soil Survey—Range Creek Portion of Carbon Area, Carbon County, Utah*. April 1980. Salt Lake City, Utah.
- U.S. Department of Agriculture, Soil Conservation Service and U.S. Department of the Interior, Bureau of Land Management. 1979. *Ashley Creek, Duchesne, Soil Inventory*. June 1979. Utah Agricultural Experiment Station. Logan, Utah.
- U.S. Department of Agriculture, Soil Conservation Service and U.S. Department of the Interior, Bureau of Land Management. 1982a. *Draft Soil Survey Manuscript Carbon and Emery County Area*. Salt Lake City, Utah.
- U.S. Department of Agriculture, Soil Conservation Service and U.S. Department of the Interior, Bureau of Land Management. 1982b. *Draft Soil Survey Manuscript Grand County Central Part*. Salt Lake City, Utah.
- U.S. Department of Agriculture, Soil Conservation Service and U.S. Department of the Interior, Bureau of Land Management. 1982c. *Book Cliffs Soil Inventory*. Utah Agricultural Experiment Station. Logan, Utah.
- U.S. Department of Agriculture, Soil Conservation Service and U.S. Department of the Interior, Bureau of Land Management. 1983. *Draft Soil Survey Manuscript San Juan Central Part*. Salt Lake City, Utah.
- U.S. Department of Commerce, Bureau of the Census. 1982. *1980 Census of Population: Number of Inhabitants, Utah*. Government Printing Office, Washington, D.C.
- U.S. Department of Commerce, Bureau of the Census. 1983. *Statistical Abstract of the United States 103rd Edition 1982-1983*. March 1983. U.S. Government Printing Office, Washington, D.C.
- U.S. Department of Commerce, Bureau of Economic Analysis. 1982. *Regional Economics Information System*. Government Printing Office, Washington, D.C.

BIBLIOGRAPHY

- U.S. Department of Energy, Buildings Division. 1981. *Building Energy Use Compilation and Analysis, Part C, Conservation Progress in Retrofitted Commercial Buildings*. Revised August 1981. Washington, D.C.
- U.S. Department of Energy, Energy Information Administration. 1982. *Short Term Energy Outlook, Vol. 1—Quarterly Projections*. November 1982. Washington, D.C.
- U.S. Department of Energy, Energy Information Administration. 1983. *Short Term Energy Outlook, Quarterly Projections*. February 1983. Washington, D.C.
- U.S. Department of the Interior. 1979a. *Synthetic Fuels Development—Earth Science Consideration*. Library of Congress. Washington, D.C. 45 pp.
- U.S. Department of the Interior. 1983. *Quality of Water—Colorado River Basin Progress Report No. 11*. January 19, 1983. Washington, D.C. pp. 47-48.
- U.S. Department of the Interior, Bureau of Land Management. 1980. *BLM Facts and Figures for Utah 1980*. Salt Lake City, Utah. 48 pp.
- U.S. Department of the Interior, Bureau of Land Management. 1981a. *Moon Lake Power Plant Project Units 1 and 2, Draft Environmental Impact Statement*. January 8, 1981. Richfield District Office, Richfield, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1981b. *Rocky Mountain Pipeline Project, Final Environmental Impact Statement*. December 1981. U.S. Government Printing Office, Denver, Colorado.
- U.S. Department of the Interior, Bureau of Land Management. 1982a. *Environmental Assessments of the Regulations on Combined Hydrocarbon Leasing: Conversion of Existing Oil and Gas Leases and Valid Mining Claims*. January 1982. Salt Lake City, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1982b. *Environmental Assessments of the Regulations on Combined Hydrocarbon Leasing: Competitive Leasing*. April 1982. Salt Lake City, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1982c. *Energy Analysis Handbook for Preparation of Oil Shale Development Environmental Impact Statements*. March 1982. Colorado State Office, Denver, Colorado.
- U.S. Department of the Interior, Bureau of Land Management. 1983a. "Rationale and Data Sources for Determining Alternative Production Levels for Special Tar Sand Areas in Utah" (unpublished document). March 1983. Richfield District Office, Richfield, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1983b. *Sunnyside Combined Hydrocarbon Lease Conversion Draft EIS*. October 1983. U.S. Government Printing Office, Denver, Colorado.
- U.S. Department of the Interior, Bureau of Land Management. 1983c. "Fisheries Within Special Tar Sand Areas" (unpublished document). August 30, 1983. Richfield, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1983d. "Fisheries Outside Special Tar Sand Area Boundaries (Potential Water Sources)" (unpublished document). August 30, 1983. Richfield, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1983e. "Hydrocarbon Leasing Category Amendments to Management Framework Plans" (unpublished document). Moab, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1983f. "Acreage, Location, and Leasing Data for Special Tar Sand Areas Within Utah" (unpublished document). Utah State Office, Salt Lake City, Utah.
- U.S. Department of the Interior, Bureau of Land Management. 1983g. *Uintah Basin Synfuels Development Final EIS*. Volume I. February 1983. U.S. Government Printing Office. Denver, Colorado.
- U.S. Department of the Interior, Bureau of Land Management. 1984. "Definitions of Surface Mining and Related Reclamation Measures." January 30, 1984. U.S. Department of the Interior, Bureau of Land Management, Moab District Office. Moab, Utah.
- U.S. Department of the Interior, Bureau of Land Management and U.S. Department of the Interior, National Park Service. 1983. "Site-Specific Analyses for Special Tar Sand Areas" (unpublished documents). Richfield District Office, Richfield, Utah.
- U.S. Department of the Interior, Bureau of Reclamation. 1975. *Salinity and Sediment Study, Upper Colorado River Basin, Utah, Colorado, Wyoming*. June 1975. Salt Lake City, Utah.
- U.S. Department of the Interior, Fish and Wildlife Service. 1979. *Humpback Chub Recovery Plan*. August 22, 1979. Colorado River Fisheries Recovery Team. 69 pp.
- U.S. Department of the Interior, Fish and Wildlife Service. 1982. "Biological Opinion—White River Dam Project, Utah" (unpublished document). February 24, 1982. 16 pp.
- U.S. Department of the Interior, Fish and Wildlife Service. 1983. "Threatened, Endangered, and Sensitive Species in Special Tar Sand Areas" (personal communication). June 13, 1983. Salt Lake City, Utah.
- U.S. Department of the Interior, Geological Survey. 1983. *Potential Hydrologic Impacts of a Tar Sand Industry in 11 Special Tar Sand Areas in Eastern Utah*. Reston, Virginia.
- U.S. Department of the Interior, Minerals Management Service. 1980. "Utah Tar Sand Leasing Minutes 1-13." *Federal Register* Notice. U.S. Government Printing Office, Washington, D.C.
- U.S. Department of the Interior, Minerals Management Service. 1982. "Summary of Tract Delineation for Combined Hydrocarbon Leasing as of October 25, 1982" (personal communication). October 26, 1982. Salt Lake City, Utah. 4 pp.
- U.S. Department of the Interior, National Park Service. 1977. *General Management Plan, Wilderness Proposal, Road Study Alternatives, and Draft Environmental Statement, Glen Canyon National Recreation Area*. U.S. Government Printing Office, Washington, D.C. 389 pp.
- U.S. Department of the Interior, National Park Service. 1982. *The Nationwide River Inventory*. January 1982. Washington, D.C.
- U.S. Department of the Interior, National Park Service. 1984. *Unit Plan of Operations for Tar Sand Triangle Combined Hydrocarbon Leasing Conversion Draft EIS* (unpublished document). Denver, Colorado.
- U.S. Department of the Interior, Office of the Solicitor. 1983. "Wilderness Study Areas and Rights Under the Combined Hydrocarbon Leasing Act of 1981" (personal communication). May 22, 1983. Washington, D.C. 6 pp.
- U.S. Department of Transportation. 1978. "Environmental Assessment Techniques" (unpublished document). Washington, D.C. pp. 41-43.
- Utah Bureau of Air Quality. 1982. "1981 Utah Emissions Inventory" (unpublished document). Salt Lake City, Utah.
- Utah Department of Employment Security. 1980. *Annual Reports*. Salt Lake City, Utah.
- Utah Department of Employment Security. 1983. *Selected Annual Reports (1970-1980)*. Salt Lake City, Utah.
- Utah Department of Natural Resources, Outdoor Recreation Agency. 1980. *Utah Outdoor Recreation Plan 1980 (SCORP)*. Salt Lake City, Utah. p. 157.

BIBLIOGRAPHY

- Utah Department of Transportation. 1982. "Traffic on Utah Highways—1981." Transportation Planning Division, Travel Analysis Unit. Salt Lake City, Utah. 117 pp.
- Utah Division of Wildlife Resources. 1982. *The 1982 Utah Big Game Investigations and Management Recommendations Book*. May 27, 1982. Volume 82-3.
- Utah Geological and Mineral Survey. 1983. *Energy Resources Map of Utah*. Map 68. May 1983. Salt Lake City, Utah.
- Utah Office of the Governor. 1983. "Nuclear Waste Repository Visitor Survey, Canyonlands National Park, Utah" (unpublished document). July 22, 1983. Salt Lake City, Utah.
- Utah Office of the State Planning Coordinator. 1983. "Socioeconomic Data for Carbon and Emery Counties" (unpublished document). July 1983. Salt Lake City, Utah.
- Utah State Energy Office. 1983. "Final Socioeconomic Technical Report, Uinta Basin Synfuels Development" (unpublished document). February 1983. Salt Lake City, Utah.
- Wall Street Journal. 1983. "Vanpools Gain Despite Drop in Gas Prices" (news item). April 29, 1983. New York, New York. p. 27.
- Weber, Dr. James. 1983. "Vegetation Disturbance on Surface Mining Versus In-situ Development" (personal communication). May 3, 1983. University of Wyoming Research Corporation. Laramie, Wyoming.
- Western Division of American Fisheries Society (WDAFS). 1982. "The Best Management Practices for the Management and Protection of Western Riparian Stream Ecosystems" (unpublished document). August 1982. Riparian Habitat Committee and its Best Management Practices Subcommittee. Tualatin, Oregon. 45 pp.
- Wilson, L.; Olsen, M. E.; Hutching, T. B.; Southard, A. R.; and Erickson, A. J. 1975. *Soils of Utah*. Bulletin 492. March 1975. Utah State University, Agricultural Experiment Station and U.S. Department of Agriculture, Soil Conservation Service. Logan, Utah. 94 pp.

- Air quality: 1, 2, 5, 8, 14, 35-39, 96-105, 128, 129, 131, 133, 135, 137, 138, 140, 143, 146-152, 169, 171, 175, 177, 179, 181-184, 235-241
- Alternative energy sources: 1, 27-31, 96, 97-105, 128, 129, 131, 133
- Alternatives
 - 1: 2, 5, 17, 24, 95, 97-145
 - 2: 2, 5, 8, 17, 24, 95, 146-180
 - 3: 2, 8, 17, 24, 95, 181-208
- Animal life: 14, 57-59, 113-116, 129-132, 134, 136, 138, 139, 142, 156-158, 171, 172, 174, 176, 178, 180, 215, 217
- Antelope: 57, 63, 113, 156
- Application for Permit to Drill: 118, 160
- Arches National Park: 2, 35, 133, 135, 140, 173, 175, 177, 238
- Backpacking: 63, 64, 116
- Black bear: 57, 113, 156
- Black Dragon Canyon: 113, 156
- Black-footed ferret: 58, 59, 229-234
- Bitumen: 15, 19, 21, 23, 49-50, 128, 129, 131, 133, 135, 137, 138, 140, 143, 155, 169, 171, 173, 175, 176, 179
 - Impregnations: 17-19, 110, 154
 - Quantity: 17, 19, 96, 111, 128, 133, 154, 207-213
- Burr Trail: 63, 128
- Camping: 63, 64, 116, 129
- Canyonlands National Park: 2, 19, 35, 64, 65, 68, 98, 138, 140, 143, 146, 175, 177, 179, 180, 238
- Capitol Reef National Park: 2, 35, 63, 65, 67, 87, 97, 121-124, 128, 131-133, 138, 140, 162, 172, 175, 177, 238
- Carbon County: 1, 5, 14, 74, 119, 121-124, 185-186, 188, 190-198, 201, 204, 245-313
- Coal development: 14, 30, 130, 133, 136, 138, 141, 155
- Colorado National Monument: 2, 35, 98, 135, 173, 238
- Colorado Plateau: 1, 35, 39
- Colorado River: 8, 35, 39, 64, 68, 96, 106, 107, 115, 139, 143, 144, 152, 158, 180, 223-227
- Colorado squawfish: 5, 8, 59, 115, 158, 176, 229-234
- Combined Hydrocarbon Leases: 1, 12, 17
- Competitive lease sale (potential lease tracts): 1, 11, 14, 24
- Conversion lease tracts: 1, 11, 12, 24, 65
- Cultural resources: 5, 68-70, 118, 160, 215, 217-220, 243-244
- Desert bighorn sheep: 5, 8, 57, 64, 114, 115, 132, 139, 144, 156, 172, 175, 176, 180, 215
- Desolation Canyon: 65, 70, 158
- Dinosaur National Monument: 35, 130, 131, 133, 137, 140, 169, 177, 238
- Dirty Devil River: 39, 59, 64, 66, 68, 106, 108, 116, 143, 144, 179, 180
- Duchesne County: 1, 14, 74, 119, 121-124, 162, 185, 186, 188, 190-198, 201, 204, 245-313
- Elk: 5, 8, 57, 63, 96, 113, 115, 129, 130, 134, 136, 142, 155, 156, 158, 169, 171, 174, 178, 215
- Emery County: 1, 74, 119, 121-124, 162, 185, 186, 188, 190-198, 201, 204, 239, 245-313
- Employment: 2, 77, 119, 120, 123-125, 160, 192-197, 213, 245-313
- Environmental Assessments: 95, 96, 181
- Erosion: 107, 110, 217
- Fishing: 63, 115, 129, 130, 132
- Garfield County: 1, 74, 119, 121-124, 162, 185, 186, 189-197, 199, 202, 204, 245-313
- Geology: 2, 107, 217
- Glen Canyon National Recreation Area: 12, 63, 65, 66, 132, 179, 238
- Golden eagle: 5, 59, 63, 114, 115, 138, 142, 144, 156, 178, 180, 216
- Grand County: 1, 74, 119, 121, 122, 162, 185, 186, 189-197, 199, 202, 205, 245-313
- Green River: 8, 39, 57, 59, 70, 106, 108, 115, 116, 131, 138, 140, 142-144, 156, 171, 176, 178
- Groundwater: 39, 43, 107, 131
- Hanksville: 77, 85, 87, 88, 126
- Hiking: 63, 64, 116
- Humpback chub: 5, 8, 59, 115, 158, 176
- Hunting: 63, 64, 113, 119, 129, 131
- In-situ recovery methods: 5, 8, 15, 21, 23, 24, 95, 110, 111, 155, 172, 173, 175, 176, 179, 208-213
- Land ownership: 13, 18
- Land use plans: 12, 14, 62, 68
- Leasing categories: 1, 11
- Livestock grazing: 5, 8, 70-74, 118, 129, 131-138, 140-141, 142, 144, 145, 160, 171, 173, 175, 176, 178, 180, 217
- Mexican Mountain: 64, 67
- Mitigating measures: 24, 95, 215-221
- Mineral resources: 46-55, 110-112, 128, 130, 132, 133, 136, 137, 139, 141, 144, 155, 169, 172, 174, 177, 179, 215
- Mountain lion: 57, 113, 156
- Mule deer: 5, 8, 57, 63, 64, 96, 113-115, 129, 130, 134, 136, 142, 155, 156, 158, 169, 171, 174, 178, 215
- National Environmental Policy Act: 1, 14
- National Park Service: 1, 12-14, 65, 95, 116, 117, 134
- Nine Mile Canyon Archaeological District: 68, 70
- Northern bald eagle: 59, 63, 115, 158
- Oil and gas: 2, 11, 14, 28, 46, 95, 130, 132, 133, 136, 141, 144, 155, 169, 172, 179, 215-221
- Oil shale development: 14, 15, 31, 112, 133, 136, 141, 155, 181, 224
- Off-road vehicle use: 63, 116

INDEX

- Orange Cliffs: 64, 65, 68, 70
- Planning process: 12
- Plans of operations: 14, 95, 96, 118
- Population: 5, 6, 8, 116, 119, 122, 185-190, 245-313
- Privately owned lands: 11, 13, 24, 25, 131, 142, 171, 185-190
- Public attitudes: 5, 8, 93, 126, 165
- Range Creek: 60, 61, 142, 178
- Raptors: 57, 114, 115, 129, 130, 132, 134, 136, 138, 142, 158, 171, 172, 174, 178, 215
- Reclamation measures: 5, 24, 95, 96, 110, 155, 215-221
- Recreation: 5, 8, 59-64, 116, 129, 131, 132, 134, 138, 139, 142, 144, 158, 171, 173, 174, 176, 178, 180, 216
- Riparian areas: 2, 8, 57, 113, 129, 132, 134, 136, 139, 141, 155, 158, 171, 174, 176, 180, 215
- Roan (Brown) Cliffs: 66, 67, 142
- Rock Creek: 60, 142, 178
- Sage grouse: 5, 8, 57, 63, 114, 115, 130, 134, 142, 156, 171, 178, 216
- San Juan County: 1, 119, 121-124, 162
- San Rafael River: 59, 63, 67, 106, 108, 116
- Scoping: 1, 14
- Sightseeing: 63, 64, 116, 129, 131
- Socioeconomics: 1, 10, 14, 74-96, 119-126, 160-168, 181, 185-208, 213, 245-313
- Soils: 5, 39, 46-48, 107-110, 112, 128, 130, 132, 133, 135, 137, 138, 139, 141, 143, 152, 155, 169, 172, 173, 175, 177, 179
- Special Tar Sand Areas:
- Argyle Canyon/Willow Creek: 12, 13, 17, 18, 25, 26, 46, 57, 63, 65, 66, 68, 128, 129, 182, 211, 230, 231, 234
 - Asphalt Ridge/White Rocks: 11-13, 17, 18, 25, 26, 46, 57, 63, 65, 66, 68, 129-131, 182, 211, 230, 231, 234
 - Circle Cliffs: 12, 13, 17-19, 25, 26, 35, 46, 47, 57, 59, 63, 65, 67, 69, 131-133, 146, 156, 171-173, 177, 211-212
 - Hill Creek: 12, 13, 17, 18, 25, 26, 51, 57, 59, 63, 65, 67, 69, 133-135, 177, 212
 - Pariette: 12, 13, 17, 18, 25, 26, 35, 51, 52, 59, 63, 65-67, 69, 95, 214, 230
 - P. R. Spring: 8, 12, 13, 17, 18, 25, 26, 51, 57, 59, 63, 65, 67, 69, 135-137, 146, 173, 175, 183, 210, 211, 231
 - Raven Ridge/Rim Rock: 12, 13, 17, 18, 25, 26, 52, 59, 63, 56, 67, 69, 137, 138, 183, 211, 231
 - San Rafael Swell: 5, 12, 13, 18, 19, 25, 26, 35, 52, 59, 63-67, 69, 138-140, 146, 155, 156, 158, 175, 176, 183, 211, 231, 232
 - Sunnyside: 11-13, 17, 18, 25, 26, 53, 54, 57, 59, 64, 65, 67, 70, 140-142, 146, 155, 156, 158, 176-179, 183, 208, 209, 231, 234
 - Tar Sand Triangle: 11-13, 17-19, 25, 26, 35, 54, 57, 64, 65, 68, 70, 143-146, 155, 156, 158, 179, 180, 184, 232
 - White Canyon: 12, 13, 18, 19, 25, 26, 35, 55, 59, 64, 66, 68, 70, 95, 214, 232
- State of Utah: 1, 14, 239, 243, 244
- State-owned lands: 2, 24, 116, 142, 171, 181
- Stipulations (general and special): 95, 215-221
- Surface mining: 5, 8, 15, 19, 95, 110, 111, 160, 169, 173, 176, 207-213
- Tavaputs Plateau: 136, 141
- Threatened, endangered, or sensitive animals: 59, 96, 115, 215, 216, 219, 229-234
- Threatened, endangered, or sensitive plants: 96, 113, 129, 130, 132, 138, 144, 171, 174, 179, 215, 216, 219, 229-234
- Tiering: 1, 35, 95
- Transportation: 1, 5, 14, 93, 94, 96, 126, 128, 169, 170
- Uinta Basin: 17, 39, 169
- Uinta Basin hookless cactus: 55, 178, 229-234
- Uintah and Ouray Indian Reservation: 5, 12, 13, 63, 65, 66, 77, 87, 88, 93, 98, 117-119, 129, 130, 133-135, 140, 160, 169, 171, 238, 245
- Uintah County: 1, 14, 77, 119, 121-124, 162, 185, 186, 189-196, 199, 202, 205, 239, 245-313
- U.S. Forest Service: 11, 63, 66, 68, 70, 95, 116, 118, 129, 131, 160, 171, 176, 218
- Ute Indian Tribe: 1, 14, 65, 93, 118, 119, 126, 134, 159, 165, 175
- Vegetation: 2, 5, 8, 55, 56, 67, 112, 113, 128, 130, 132-134, 136-138, 141, 14, 155, 169, 172, 174, 175, 177, 179
- Visual resources: 1, 5, 8, 14, 66-68, 118, 129, 132-134, 137, 138, 140, 142, 144, 160, 171, 174, 176, 178, 180, 215
- Water resources: 2, 5, 8, 14, 24, 25, 39, 41-45, 61, 105-107, 128, 130-133, 135, 137, 140, 143, 152, 153, 169, 172, 173, 175, 177, 179, 181, 212, 216, 217, 221, 223-227
- Wayne County: 1, 77, 119, 121-124, 187, 189-197, 200, 203, 205, 245-313
- Wild burros and horses: 59, 115, 116, 129, 131, 132, 134, 136, 138, 139, 142, 144, 158, 171, 172, 174, 176, 178, 180
- Wilderness: 5, 8, 10, 64, 116, 117, 129, 131, 132, 137-139, 142, 144, 158, 159, 171, 173, 174, 178, 180, 215, 220-221
- Wright's fishhook cactus: 5, 8, 139, 141, 156, 175

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225

ER'S CARD

1984 v.1

hydrocarbon
leasing regional final EIS

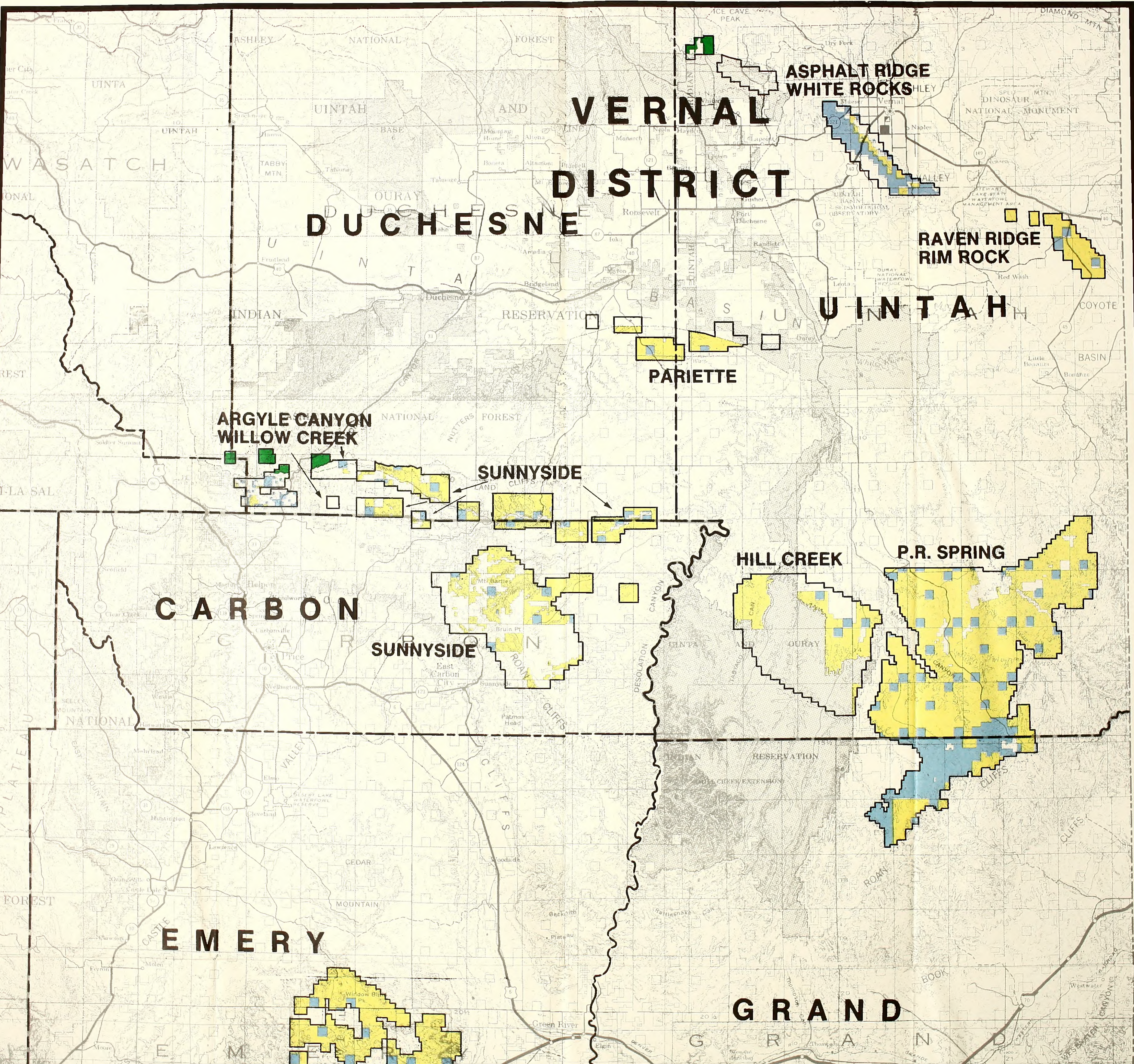
OFFICE	DATE RETURNED

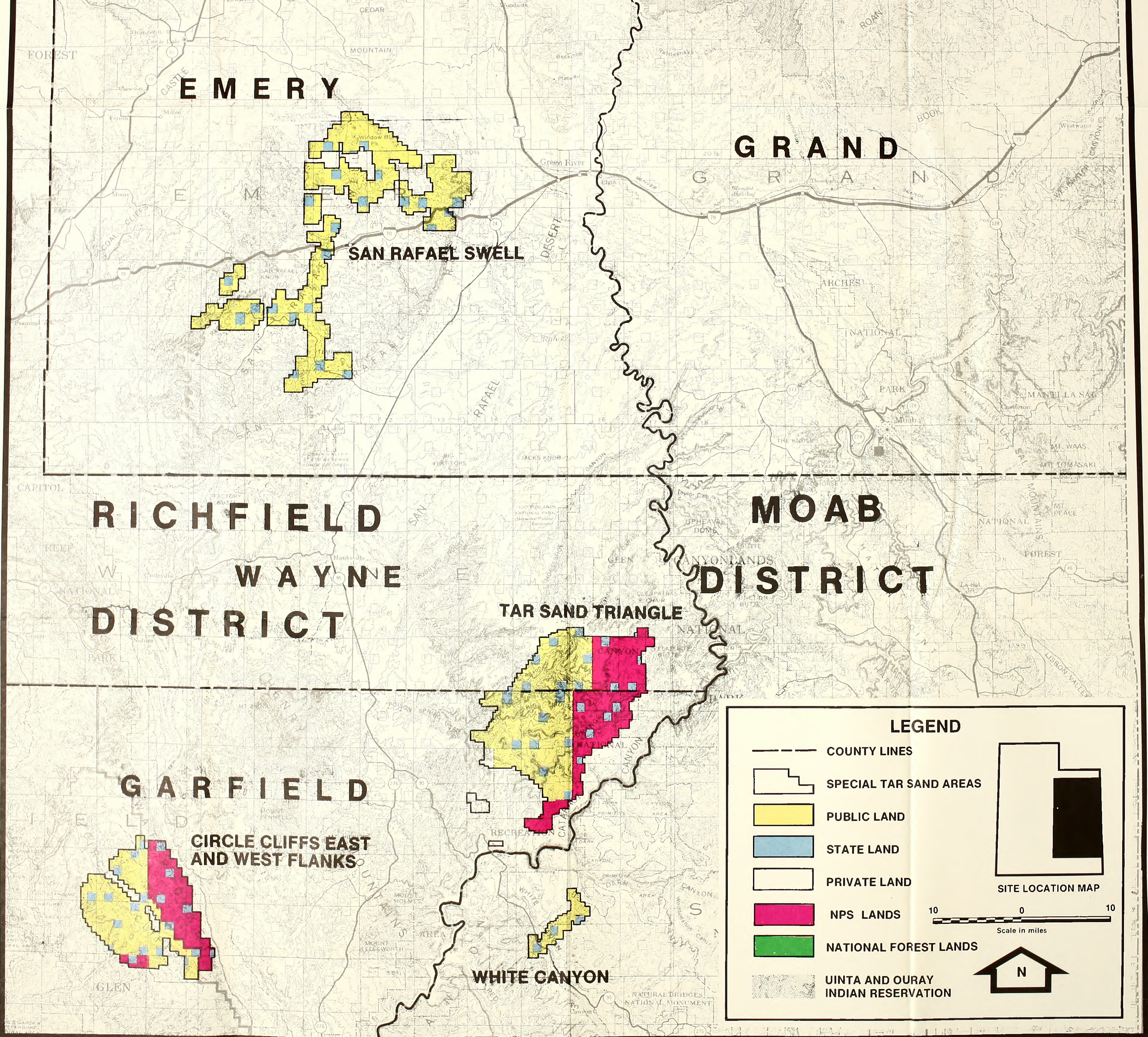
(Continued on reverse)

TD 195 .S95 U87 1984 v.1

Utah combined hydrocarbon
leasing regional final EIS

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225





EMERY

GRAND

SAN RAFAEL SWELL

RICHFIELD

MOAB

WAYNE

DISTRICT

DISTRICT

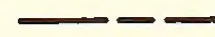



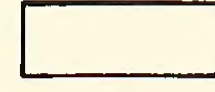



TAR SAND TRIANGLE

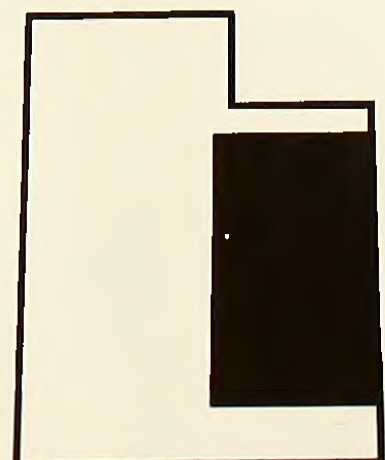
GARFIELD

CIRCLE CLIFFS EAST AND WEST FLANKS

WHITE CANYON

LEGEND

-  COUNTY LINES
-  SPECIAL TAR SAND AREAS
-  PUBLIC LAND
-  STATE LAND
-  PRIVATE LAND
-  NPS LANDS
-  NATIONAL FOREST LANDS
-  UINTEA AND OURAY INDIAN RESERVATION



SITE LOCATION MAP

