Oil Shale and

THE FUTURE OF A REGION

A Summary Report

OS-04

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Garfield, Mesa and Rio Blanco Counties, Colorado

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Colorado West Area Council Of Governments

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PREFACE

"The availability of adequate fuel supplies to meet the Nation's various energy requirements is today a major concern. We have already been confronted with some energy supply limitations, and others are apparent for the years ahead. Our ability to provide energy from conventional domestic fuel sources (crude oil, natural gas, coal) has failed to keep pace with consumption, and at the same time, events in other parts of the world continue to emphasize the risks engendered when a highly industrialized Nation becomes dependent on foreign energy supplies that could be readily interrupted by military, political, or economic actions. These circumstances require the Federal Government to develop an energy policy consistent with national needs and provide the administrative and economic climate under which industry can provide adequate and clean domestic fuel supplies at the lowest practical cost consonant with environmental protection."

"A major undeveloped energy resource available to the Nation is oil shale. The richest deposits, located in the Rocky Mountain area of the country, contain billions of barrels of oil. Development of this resource has not been undertaken in the past because accessible supplies of oil and gas have been available at a lower development cost. Our future energy needs are so large, however, that it is anticipated that the Nation's conventional domestic oil and gas supplies must be supplemented by liquid and gaseous fuels derived from oil shale, and tar sands within the next decade."

Program Statement for the Prototype Oil Shale Leasing Program, U. S. Department of the Interior, June, 1971.

I. INTRODUCTION

One of the largest and richest oil shale deposits in the world lies under 25,000 square miles of northwestern Colorado, northeastern Utah and southwestern Wyoming. The development of this natural resource depends on, among other things, a feasible technology for economically extracting the oil from the shale, and the policies of the federal government, since 80 percent of these resources lie under public lands administered by agencies of the U. S. Department of the Interior.

The Department of Interior has been engaged in oil shale research since 1944. The U. S. Bureau of Mines conducted a comprehensive research and development program at Anvil Points near Rifle from 1945 to 1955. Recently, the Department began a demonstration and research effort by offering six federally owned sites for lease to private industry, two each in Colorado, Utah and Wyoming. The Colorado lease offerings were highly successful with accepted bids of $210.3 million dollars for Colorado lease tract (a) in January, 1974 and of $117.7 million dollars for Colorado tract (b) in February, 1974. Both Colorado sites are located in the Piceance Creek Basin of northwestern Colorado.

There are also private land holdings in the Piceance Creek Basin on which commercial oil shale development might take place. The Colony Operation established a plant in 1964 on Parachute Creek near Rifle, Colorado to determine if production of oil from shale was technically, economically, and environmentally feasible. Other companies investigating the production of oil from shale on private holdings include Occidental Petroleum in Roan Creek, Union Oil Company in Parachute Creek and Superior Oil Company near the confluence of Piceance Creek and the White River. Oil shale plant development can therefore occur independent of the federal government's leasing program.

The Department of the Interior will continue to play a key role in the extent and timing of oil shale development on the vast federal land holdings in the Basin. The successful lease offerings in early 1974 signaled the beginning of an oil shale operation evaluation process. Commercial, prototype development on the lease sites will provide information on both on-site and off-site impacts of an oil shale industry.

The introduction of a new industry of oil shale's potential magnitude into predominantly rural western Colorado can have a decided effect on existing patterns of development. Construction of new plants will see an early influx of construction workers into the area to be followed by permanent employees of the industry once the plant is placed in operation. The successful operation of these prototype plants could result in a significant expansion of oil shale activity in the 1980's.

Rio Blanco, Garfield, and Mesa Counties will receive most of the impact of oil shale development in Colorado. In anticipation of these problems which extend beyond the jurisdiction of any single city or county, the three counties, in July, 1971, by joint resolution, created the Oil Shale Regional Planning Commission. The Commission was charged with:

1. Compiling a Comprehensive Regional Plan
2. Coordinating and assisting local governments
3. Providing a forum and clearing house for seeking solutions to regional problems
4. Serving as a liaison between local, State, and Federal governments, and industries concerned with oil shale development

Early in 1972, the Commission undertook an investigation to determine "the impact of the oil shale industry on the socio-economic and land use patterns in the tri-county area". Three other studies, confined more specifically to the Piceance Creek Basin, were to be conducted at the same time under the direction of the Colorado Department of Natural Resources. These studies, also aimed at determining the impact of the oil shale industry in this smaller geographic area were:

1. Water Resource Management
2. Revegetation and Rehabilitation
3. Environmental Inventory and Impact

All of these studies were funded jointly by the Federal Government, the State of Colorado, participating oil companies, and the involved counties. The studies were scheduled for completion so that the findings would be known prior to any substantial oil shale industry development.

In 1973, the functions of the Oil Shale Regional Planning Commission were incorporated into the newly formed Colorado West Area Council of Governments. The governing board of the Council is made up of a member of the Board of County Commissioners from each of the four counties (Garfield, Mesa, Rio Blanco, Moffat) in Planning and Management Region 11, and an elected representative from each county representing the municipalities. The Council continued the investigations begun by the Oil Shale Regional Planning Commission. The findings and recommendations of the Regional Development and Land Use Study are summarized in this report.

II. THE OIL SHALE REGION

Garfield, Mesa, and Rio Blanco Counties contain over 9,500 square miles of rugged, high plateaus cut by deep canyons. The three county area is sparsely populated with an estimated 82,000 people residing in the region in 1974. Unlike more heavily populated counties, there are more persons living on farms and ranches and in communities of under 2,500 population than in cities. Major towns in the region include; Grand Junction, Rifle, Glenwood Springs, Fruita Meeker, and Rangely. These major activity centers follow the generally flat land of the Colorado and White River Valleys.

The river valleys also shape the form of transportation in the region. They are the location of the major east-west highways and main rail lines. Land utilization patterns are also determined by the topography of the region. The river valleys are predominately used for irrigated and dryland farming and as the location for the towns in the region while the more rugged, upland terrain is used for grazing and timber operations.

The economy of the three county region is relatively diverse. Tourism and agriculture are the two leading components of the regional economy with construction, mining, and manufacturing following in ranking of importance. The individual counties have quite different patterns of support with Rio Blanco County being more oriented toward mining and agriculture, Garfield County towards construction and tourism, and Mesa County towards agriculture and tourism.

LAND USE AND PHYSIOGRAPHIC FEATURES

The accompanying map of existing land use reflects the predominantly rural character of the three county area. Grazing is the largest user of land, while urban development, in the form of towns and cities, uses less than one percent of the total area. A breakdown by type of land use shown in Table 1.

Landforms have a definite influence on the use of the land. The level land is more likely to be used for agriculture or urban settlements. The steeper areas, are more likely to be used for timber and grazing. Water is a complementary factor to this regional pattern in that the river and stream valleys foster irrigated agriculture.

The Colorado River Valley serves as the principal setting for urban development in the three county region. Communities are strung out along the valley at somewhat regular distances and provide convenience goods and services to the surrounding population. This urban settlement pattern illustrates the historical search for water and level land. Grand Junction, a city with over 50,000 people in its environs, serves as the regional center for the three county area.

National Forest Lands occupy a large portion of the three county region and provide recreational facilities, not only for local use but also for tourists from throughout the Rocky Mountain Area. In the region are portions of the White River, Routt, Grand Mesa, Uncompahgre' and Manti National Forests. The Colorado National Monument just west of Grand Junction annually attracts visitors from throughout the United States to view the unusual rock formations.

The three county area is part of the Colorado Plateau and is characterized as an uplifted area displaying either gently folded or nearly horizontal rocky layers sliced by streams, many of which are deeply entrenched in canyons. Examples of this geologic condition include

Table 1
EXISTING LAND USE
In Square Miles

	Mesa County	Garfield County	Rio Blanco County	Total
Total Area	3,303	2,997	3,263	9,563
Irrigated Crop Land	239.2	124.5	107.5	471.2
Percent Total	7.3 %	4.2 %	3.3 %	4.9 %
Dry Land Crop	2.8	11.2	29.1	43.1
Percent Total	.08%	.04%	.90%	.34%
Grazing	1,807.2	1,955.4	2,554.8	5,317.4
Percent Total	54.70%	65.43%	78.30%	66.10%
Timber/Grazing	1,220.3	645.0	375.6	2,240.9
Percent Total	36.9 %	21.5 %	11.5 %	23.3 %
Timber	24.3	103.5	153.1	280.9
Percent Total	.74%	3.55%	4.67%	2.9 %
Wilderness	--	153.45	41.67	195.1
Percent Total	--	5.15%	1.3 %	2.1 %
Urban	9.2	3.95	1.21	14.4
Percent Total	.28%	.13%	.03%	.14%

Roan and Book Cliffs which rise as much as 4,000 feet above their surrounding lowlands and the spectacular plateau of the Grand Mesa.

The three county region is part of four major drainage basins; the Colorado River, White River, Yampa River, and Delores River Basins. Major tributaries of these streams include, Yellow Creek, Rifle Creek, Piceance Creek, Parachute Creek, Roan Creek, the Gunnison River, and the Roaring Fork River. Other major bodies of water consist primarily of the man-made reservoirs in the region. Vega, Rifle Gap, and Harvey Gap Reservoirs, provide potable water reserves as well as recreational facilities for residents of the region.

The climate in the three county area can be described as moderate. The average growing season in the region numbers 139 days, although there is a significant difference among individual counties. Mesa County has an average growing season of 188 days while Rio Blanco County has less than half that at 90 days. The average mean temperature is relatively consistant at 48 degrees while the average annual snowfall is 63.1 inches. The snowfall, as well as the annual rainfall varies significantly among the counties. Rio Blanco County receives approximately 91 inches of snow per year compared to Mesa County's 27 inches. Rio Blanco County's average rainfall measures 20 inches compared to Mesa County's 9 inches.

Vegetation in the three county area is relatively sparse. Sage, pinon, and juniper are the predominant indigenous plant types at the lower elevations while lodgepole pine, blue spruce, and scattered groves of aspen grow in the higher elevations on the plateaus.

TRANSPORTATION

The major transportation corridor for the region follows the Colorado River and contains both highway (I-70) and rail facilities. Three of the region's five airports are located in close proximity to the corridor affording the opportunity to change mode from air carrier to a surface vehicle. The regional commercial airport at Grand Junction is one of these. The Denver and Rio Grande Western Railroad continues to provide passenger service in this main corridor from Denver to Salt Lake City and buses

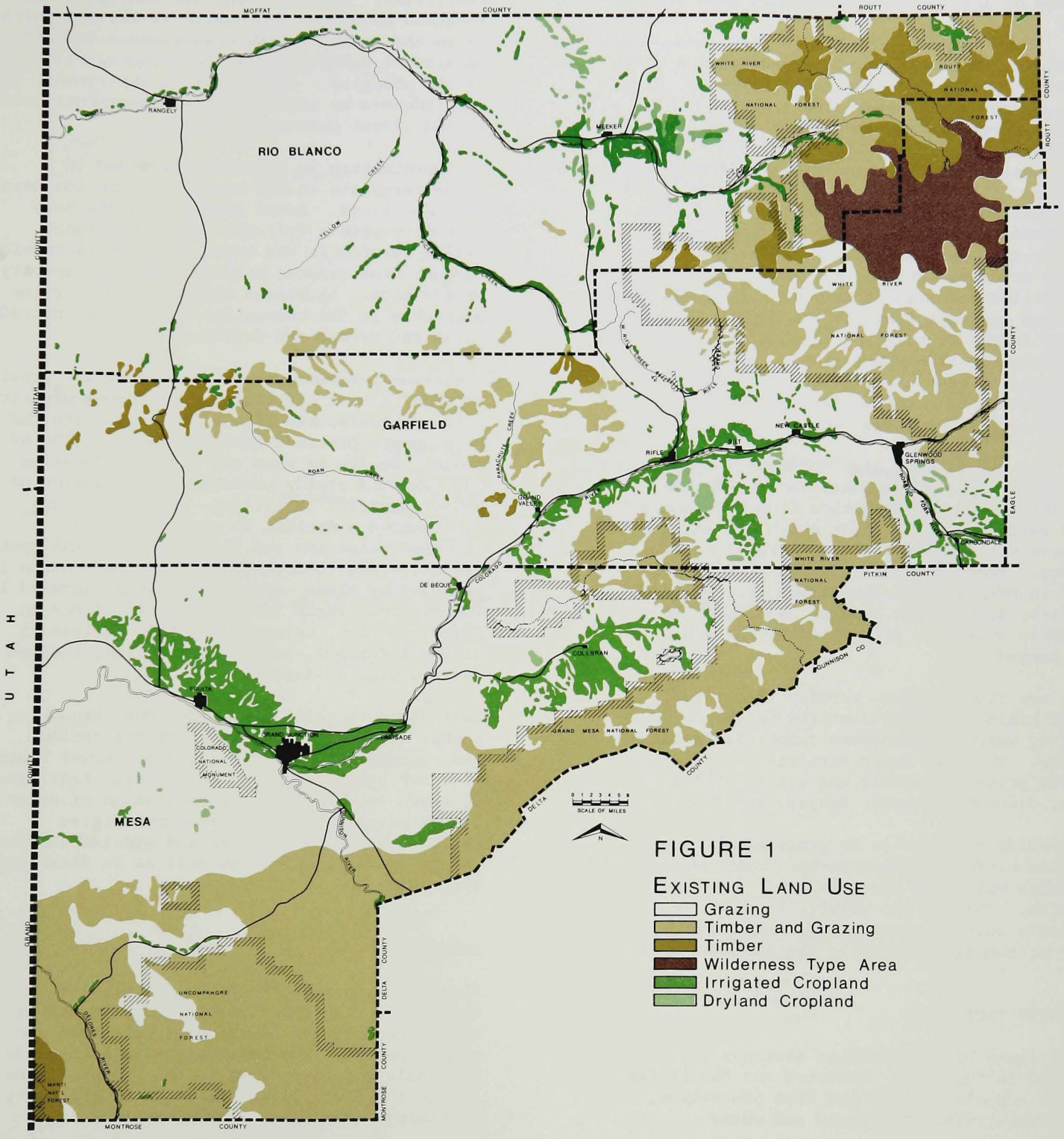


FIGURE 1

EXISTING LAND USE

- Grazing
- Timber and Grazing
- Timber
- Wilderness Type Area
- Irrigated Cropland
- Dryland Cropland

make use of the highways along this same general route.

Highways in the three county area continue to be improved. In the Colorado River corridor, U. S. Routes 6 and 24 are undergoing a phased improvement from a two lane facility to a four lane limited facility -- Interstate 70. Other significant connecting highways in the region include: State Highway 13 which connects Rifle and Meeker and continues north to Craig; State Highway 64 which is the northern most east-west route in the area and connects Meeker with Rangely and destinations in Utah; State Highway 141 facilitates movement from the region to the south and connects Grand Junction with Cortez/ Durango in the southern portions of the state. Grand Junction also connects to destinations to the southeast such as Delta and Montrose along U. S. Highway 50. These State Highway Primary Facilities are typically two-laned paved roads.

The three county area also contains a system of County Primary and Secondary roads. These facilities range in condition from two-laned paved roads to gravel roads which may require a four-wheel drive vehicle for travel in some seasons. These county designated facilities range in purpose from connecting to a state facility, such as the Douglas Pass road, to providing access to properties at the end of a long canyon.

There are five airports serving the region. Walker Field, in Grand Junction is the only facility which accommodates commercial airline traffic. The four other airports are oriented towards private aircraft and are located in Rifle, Glenwood Springs, Meeker, and Rangely.

Region-wide bus service is provided to many of the communities in the area by local bus companies which are headquartered in Grand Junction. Through bus service is also available which connnects the region with major metropolitan areas to the east and west.

COMMUNITY FACILITIES

A wide range of governmental services are provided in the area. Services and facilities include schools, police and fire protection, health facilities, and sewer and water facilities. The following map indicates the location of safety and health facilities which serve the region. Each county has a sheriffs' department which patrols the unincorporated areas of the counties. The sheriff's departments are supplemented by eleven police departments located in individual communities.

Fire protection is primarily provided on a volunteer basis in the region through fourteen fire districts. Grand Junction is the only community with a full-time fire department. Health service in the three counties is provided through nine general hospitals with a capacity of 438 beds. Ambulance and emergency service is available in the communities along the Colorado River and Meeker and Colbran.

Educational facilities in the region are provided by eight school districts. The school districts serve approximately 20,000 students, with the Mesa County District serving almost 14,000 of those. Growth in Mesa and Garfield Counties have exerted steady pressure for expansion of school district facilities. Rio Blanco has experienced a decline in population and assessed valuation and the schools in the county are suffering financially. Higher education is provided by three, two-year colleges located in the region. These include: Mesa College in Grand Junction, Colorado Mountain College in Glenwood Springs, and Rangely College located just outside of Rangely.

Sanitation facilities are provided through a number of sewer and water districts serving the region. There are 28 separate sewer systems, 31 water systems, and 17 solid waste facilities to serve the three county population of about 82,000 persons. Many of the communities utilize the Colorado River and its tributaries for their water supply as well as to discharge their wastes.

MINERALS

The following map, depicting the mineral deposits in the three county area, is primarily concerned with the location of oil shale and coal deposits. The most extensive high-grade oil shale deposits known in the United States are in the Green River Formation of the Rocky Mountains. The Green River Formation is an

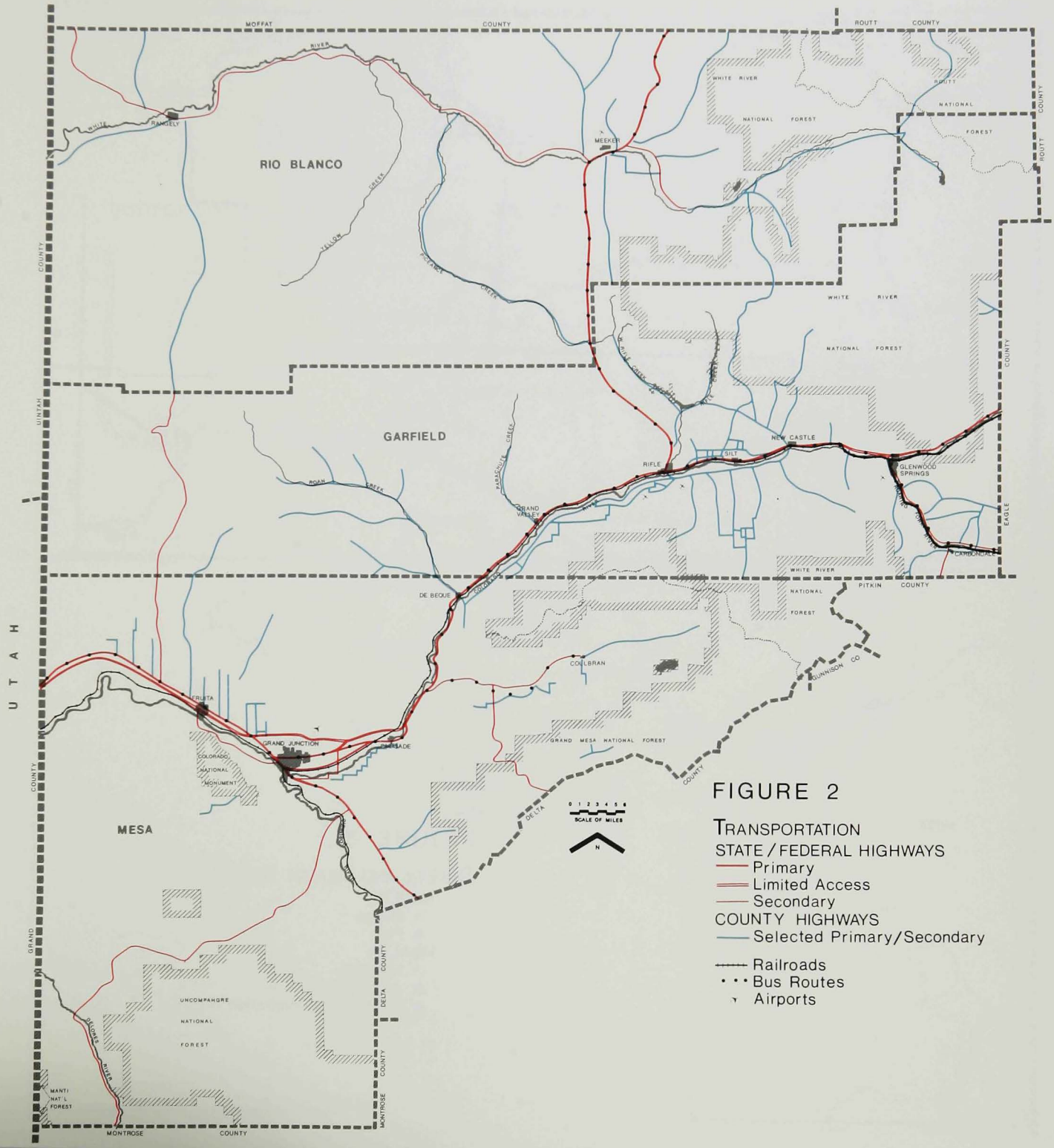


FIGURE 2

TRANSPORTATION

STATE / FEDERAL HIGHWAYS
- Primary
- Limited Access
- Secondary

COUNTY HIGHWAYS
- Selected Primary/Secondary

- Railroads
- Bus Routes
- Airports

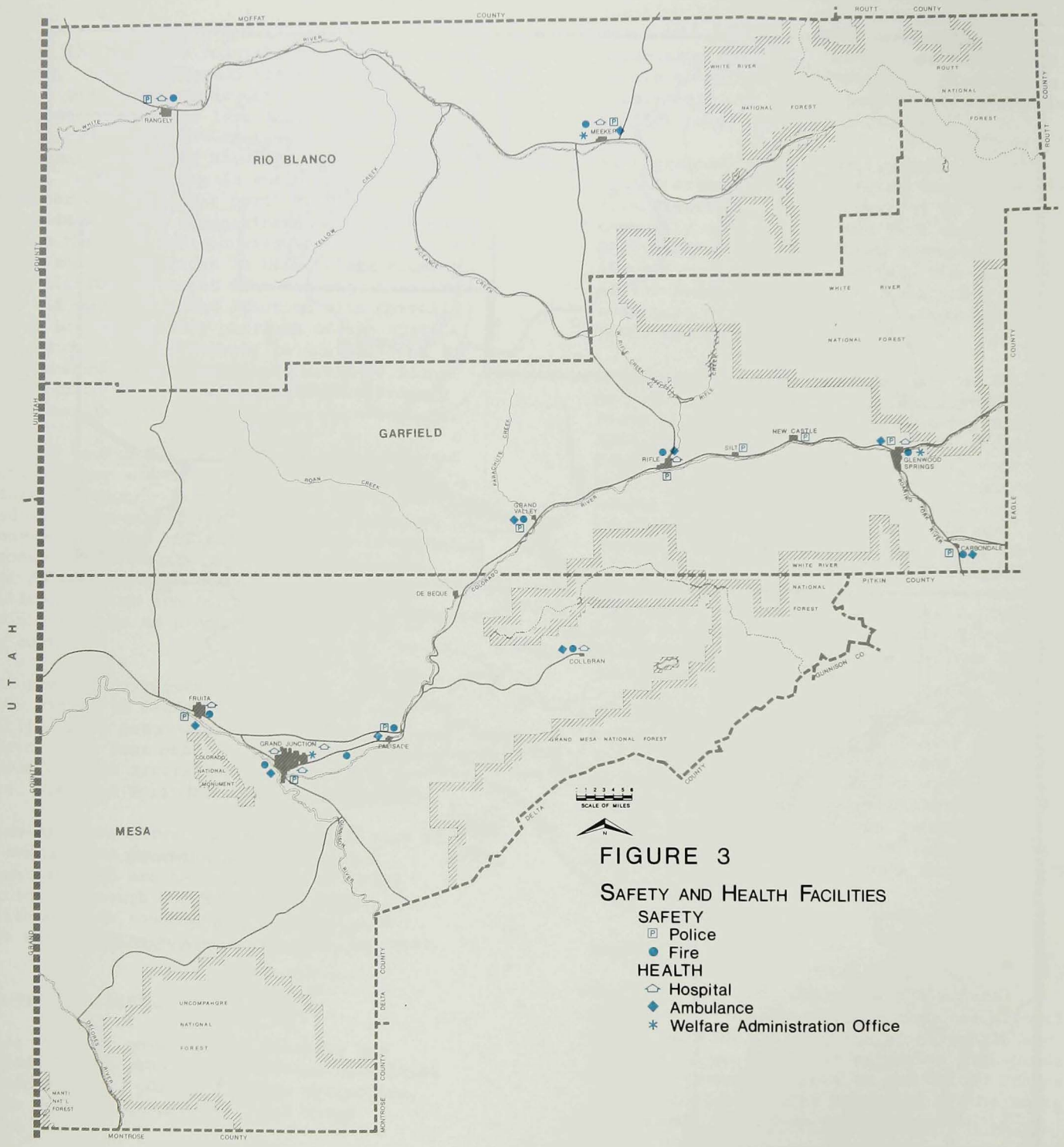


FIGURE 3

Safety and Health Facilities

SAFETY
- Police
- Fire

HEALTH
- Hospital
- Ambulance
- Welfare Administration Office

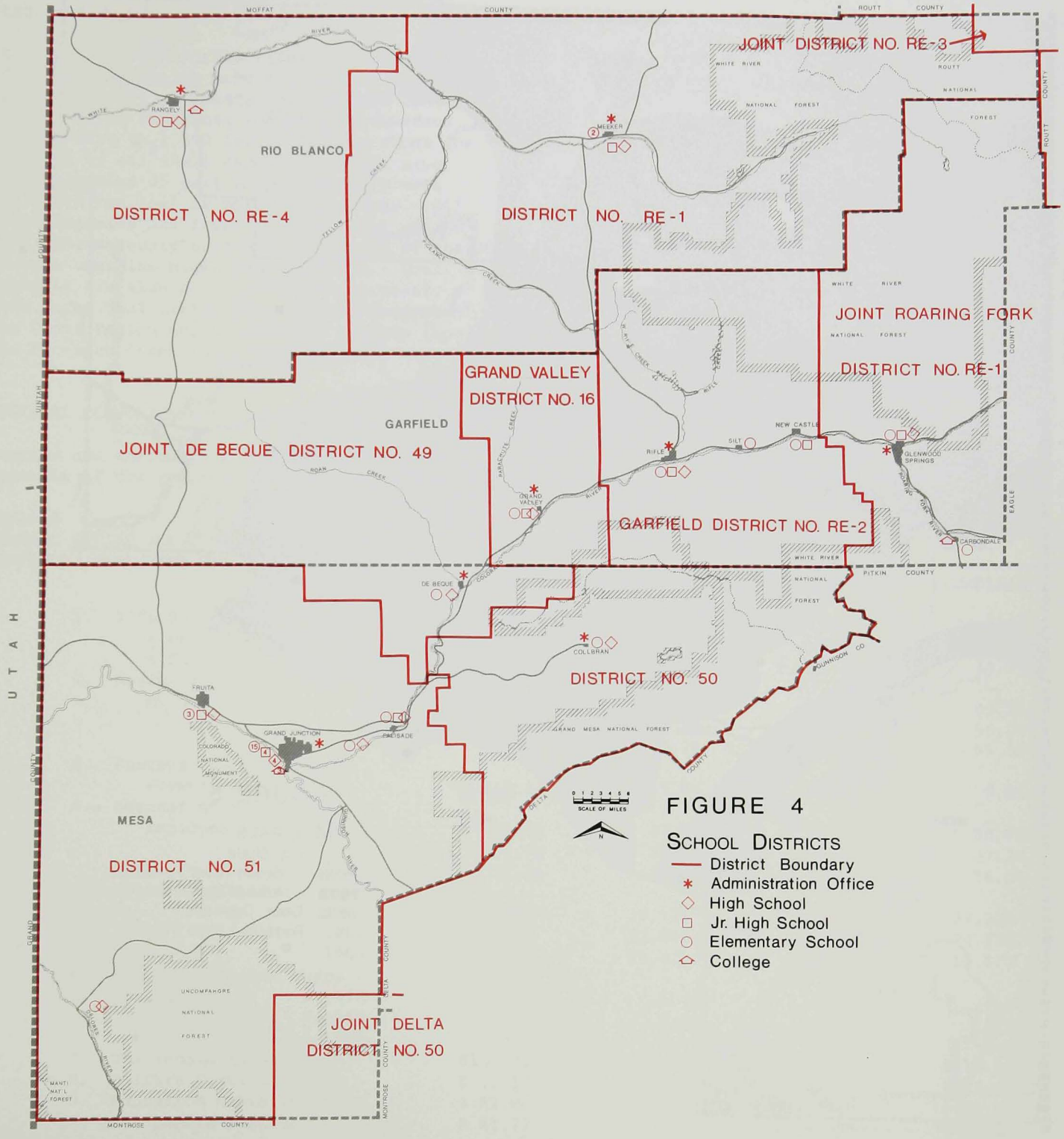


FIGURE 4

SCHOOL DISTRICTS

- District Boundary
- Administration Office
- High School
- Jr. High School
- Elementary School
- College

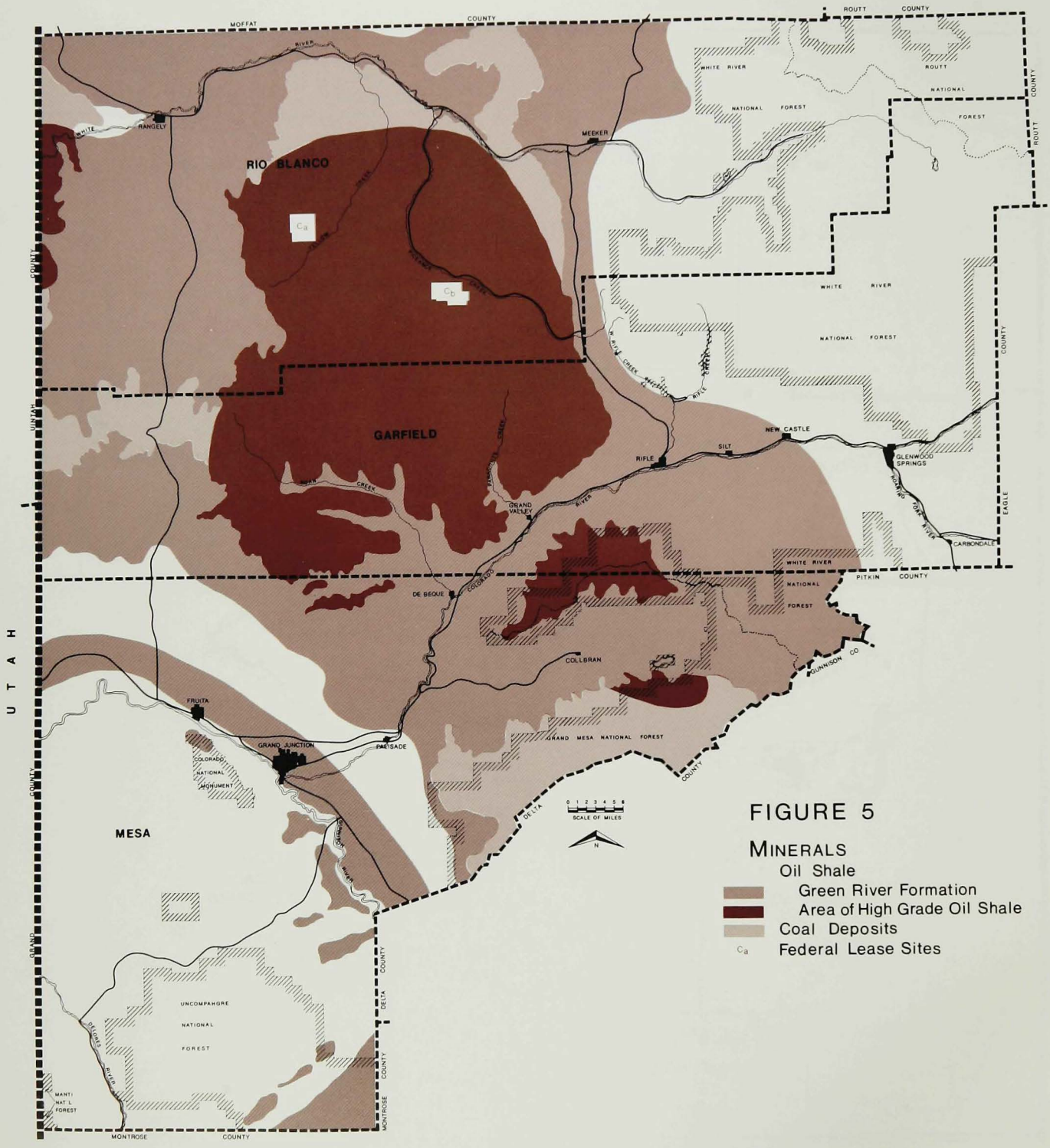


FIGURE 5

MINERALS

Oil Shale

Green River Formation

Area of High Grade Oil Shale

Coal Deposits

Ca Federal Lease Sites

area of over 25,000 square miles extending through portions of the States of Colorado, Utah, and Wyoming.

It is estimated that the Piceance Creek Basin of Colorado contains some 480 billion barrels of syncrude oil in strata varying from ten to 2,000 feet in thickness and with overburdens of from zero to 1,600 feet. The map shows the location of oil shale deposits and the area which contains 25 gallons per ton or richer oil shale ten feet or more in thickness. Oil shale deposits are found in 29 percent of the total three county area and 17 percent of the 29 percent contains high-grade deposits. Coal deposits are also found in the three county area. The coal fields in the area are part of the Uinta Region which generally extends from the Piceance Creek Basin westerly into Utah.

REGIONAL ECONOMIC BASE

Tourism and agriculture are the two major segments of the regional economy of Garfield, Mesa, and Rio Blanco Counties. Next comes construction (that part of construction representing net capital investment from sources outside the region), then mining and manufacturing. The individual counties have quite different patterns of support as shown below:

Table 2
IMPORTANCE OF ECONOMIC FUNCTIONS

	Garfield	Mesa	Rio Blanco	Three County Region
Agricluture	3	1	2	1
Mining	4		1	4
Construction	1			3
Manufacturing		2		4
Tourism and Trade (includes services)	2	2		1

These rankings are derived by comparing the quantities of basic income generated in these sectors from wage, salary, and proprietorship income. General social and economic data for the three county area is presented in the following table:

Table 3
GENERAL SOCIAL AND ECONOMIC DATA FOR GARFIELD, MESA, AND RIO BLANCO COUNTIES

		Garfield	Mesa	Rio Blanco	Combined
1.	1970 Population	14,821	54,347	4,842	74,037
	% Change 1960-70	+ 23.3%	+ 7.2%	- 6.0%	18.3%
	% Change 1950-60	+ 3.4%	+ 30.1%	+ 9.1%	14.2%
2.	Median Income as Percent of State Average 1970	87.7%	84.4%	83.8%	85.3%
	1960	90.3%	92.9%	101.9%	95.0%
	1950	90.4%	86.2%	110.9%	95.8%
3.	Percent Families Below Poverty Level	8.4%	11.4%	10.1%	9.9%
4.	Percent of Population Employed 1970	39.6%	37.0%	40.2%	38.9%
	1960	37.5%	35.2%	39.1%	37.2%
	1950	37.8%	34.5%	37.2%	36.5%
5.	Actual Employment 1970	5,865	20,125	1,946	27,936
	1960	4,501	17,841	2,013	24,355
	1950	4,389	13,427	1,754	19,570
6.	Percent of Labor Force Unemployed 1970	4.8%	5.4%	2.1%	4.1%
	1960	7.7%	6.0%	4.2%	5.9%
	1950	3.1%	5.4%	4.3%	4.2%
7.	Tax Income to State	$138.22	$110.17	$ 89.45	$112.61
8.	Welfare Costs to State	$ 13.57	$ 22.10	$ 9.09	$ 11.89
9.	Education Costs to State	$ 62.88	$ 59,18	$ 35.19	$ 52.42
10.	Per Capita Surplus	$ 61.77	$ 28.89	$ 45.17	$ 45.28

Employment as a primary measure of the economic activity in the three county area is based on the 1970 Census of Population and locates employed persons in the county where they live (not the county where they work). Table 4 summarizes the changes in employment for each county during the period of 1950 to 1970.

Agricultural employment in Garfield County declined significantly during the 1950 to 1970 period. Employment in agriculture, and more specifically livestock, declined almost 50 percent during the 1950 to 1960 period and declined further in 1970. Mining employment in coal and uranium first rose sharply, fell slightly in the 1960's, and fell further in the 1970's. Tourism and education showed the most substantial growth in the 1960's.

Mesa County's diversified agricultural employment declined to half its 1950 level. A uranium boom which was present in the 1950's dwindled, and railroad employment was reduced by 50 percent. Not withstanding this, there has been solid growth in manufacturing and in regional, social, health, and educational services to maintain a healthy economy.

In Rio Blanco County, oil and gas employment held up well enough in the 1950's to support growth in the face of declining livestock production employment. Agricultural employment continued to decline in the 1960's, coupled with a fall-off in gas and oil employment, caused a slight decline in the overall county employment picture in spite of rapid increases in education and health services employment.

Table 4
INDUSTRY EMPLOYMENT
(Percent of Total)

	Garfield			Mesa			Rio Blanco		
	1970	1960	1950	1970	1960	1950	1970	1960	1950
1. Agriculture	9.5	17.1	30.1	7.3	11.4	22.0	15.1	16.4	26.3
2. Mining	6.7	11.6	5.3	2.3	5.5	2.0	14.3	19.9	21.8
3. Construction	11.5	8.3	9.0	6.2	7.6	9.2	7.8	7.7	9.3
4. Manufacturing	2.8	2.7	3.9	10.1	6.7	4.7	2.1	2.3	2.1
5. Transportation	6.8	5.7	6.4	9.8	9.7	12.6	4.8	7.7	6.3
6. Trade	23.7	20.3	17.4	21.3	21.5	20.1	13.9	12.2	12.8
7. Services (including logding and finance)	16.8	12.8	12.3	13.3	13.3	12.4	12.3	13.8	10.4
8. Health Services and other services	9.6	6.2	3.5	12.6	9.0	5.8	9.5	4.2	1.7
9. Education	7.8	5.7	4.0	10.0	6.5	4.4	11.9	5.3	4.0
10. Public Administration	4.3	4.8	4.1	5.2	5.8	4.6	7.8	4.0	4.4

RESIDENTS CHARACTERISTICS

Personal interviews were conducted in 1973 in 200 randomly selected households in each of the three counties to determine the life styles and attitudes of residents. In addition, 100 public officials were interviewed in the area. Some of the findings of the survey are presented on the following pages.

Urban-Rural Residence

The known urban-rural population distribution in the region corresponded closely with the urban-rural split achieved in the sample. Estimates based on previous studies in Garfield and Mesa Counties, and upon discussions with the State Division of Commerce and Development regarding Rio Blanco County, indicate that 23.5 percent of the population of the three-county area would be classified as rural. In the total survey sample 22.1 percent of the respondents resided in rural areas, a deviation of less than two percent. The proportion of rural residents in

the sample was identical to that which exists in Mesa County, somewhat higher for Rio Blanco County, and slightly lower for Garfield County.

Length of Residence

Rio Blanco County residents had the greatest longevity in the area (median length of residence equaled 19 years) whereas Mesa County inhabitants had spent an average of 12 years in the area. The typical Garfield County resident more nearly resembled a Rio Blanco inhabitant in his longevity characteristics. Overall, the median length of residence in the region is 13.3 years. Inhabitants in Meeker and Rifle were likely to have spent more than 20 years in the area. Glenwood Springs and Grand Junction residents, however, were often newer to the area, having spent an average of slightly under 14 years there.

Average Household Size

The average household size in the region was 3.3 individuals. Mesa County tended to have slightly larger households that did either Garfield or Rio Blanco Counties. Households in Mesa County also had a slightly higher number of young children (i.e., age five or younger) than did homes in the other two counties.

Property Ownership

Nearly 85 percent of the residents of the three county area owned their own homes or trailers, while the remaining 15 percent rented homes or apartments. Home ownership was highest in Mesa County (82 percent) and lowest in Rio Blanco County (60 percent). In the latter location, residence patterns were quite varied; 17 percent reported that they rented homes, another six percent rented apartments, and nine percent owned trailers.

Slightly more than one-fourth of the respondents owned property other than their homes. Property ownership in addition to the place of residence was most extensive in Rio Blanco County (where nine percent of the inhabitants indicated ownership of more than 500 acres) than in any other location.

Sex, Race, and Age

The overall median age of respondents was 44.1 years. The youngest individuals were interviewed in Glenwood Springs (i.e., median age equals 41.6 years) and the oldest respondents lived in Rifle (i.e., median age equals 54.8 years).

Table 5
SUMMARY OF RESIDENCE CHARACTERISTICS

	Total Sample	Garfield	Mesa	Rio Blanco
Percent Rural Residence	22 %	22 %	23 %	16 %
Median Length of Residence in Area (in years)	13.3	17.2	12.1	19.1
Mean Household Size	3.3	3.2	3.4	3.2
Percent Owning				
House	79 %	75 %	82 %	60 %
Townhouse	-- %	1 %	-- %	-- %
Trailer	4 %	5 %	4 %	9 %
Other	-- %	1 %	-- %	4 %
Percent Renting				
House	11 %	14 %	10 %	17 %
Apartment	4 %	3 %	5 %	6 %
Townhouse	1 %	3 %	-- %	-- %
Trailer	-- %	1 %	-- %	-- %
Other	-- %	1 %	-- %	5 %
Owner of Property Other than Home (%)	27 %	33 %	24 %	47 %

Income Levels

Compared with extrapolations from the 1970 Census (assuming a five percent increase per year over the three year period), the annual family incomes as reported in the resident survey were high by about 16 percent. The median annual family income for the total sample was $10,915, ranging from a low of $9,860 for Rio Blanco residents to a high of $10,995 for inhabitants of Mesa County. Fourteen percent of the total sample had annual incomes of less than $5,000 while five percent classified themselves in the over $25,000 category.

The income levels varied dramatically by city. For example, the median income of $6,740 reported by individuals in Rifle was less than half that reported by Glenwood residents (median income equals $13,695). The median incomes of Meeker and Grand Junction inhabitants fell about midway between those two extremes ($9,600 and $11,900 respectively). Income levels rose sharply with age, reaching a peak of $13,883 in the 35 to 49 age category, and then declining just as dramatically to a low of $5,040 among the people 65 and over.

Education

The general public reported a median education level of 12.9 years (where completion of high school equals 12.0 years), compared with a figure of 12.3 years for the region as reported in the 1970 census. The slightly higher level of educational attainment in the survey sample would be expected to parallel the higher income levels reported above. The median educational level of the public officials was nearly identical to that of their constituents.

Approximately, one-third of the individuals indicated that they had ended their schooling as a result of some sort of personal obligation (e.g., marriage, other family reasons). Nearly as many respondents stated that they interrupted their educations because they wished to begin work at that time. Lack of financial resources accounted for the incomplete schooling of about one in six individuals. Over half of the people reported having no regrets about not furthering their education, an opinion expressed even more frequently by the public officials. However, many individuals, including public officials, reported that lack of further schooling had impeded their later financial advancement, either by limiting their job opportunities or by slowing their progress in their present employment.

RESIDENT ATTITUDES

In addition to verifying social and economic characteristics available from secondary sources the household survey asked questions about the quality of life in the three county area. A summary of the responses is provided here.

Quality of Life in the Three County Area

Although the principal advantage of living in the area was seen as the climate, "people factors" were regarded as very important, especially by public officials. A large number of residents were impressed by the general friendliness of people in the area, the casual atmosphere, and the small communities. In keeping with those charms was the lack of congestion in the region. The climate and the

Table 6
SUMMARY OF DEMOGRAPHIC CHARACTERISTICS

	Total Sample	Garfield	Mesa	Rio Blanco
Median Age (in years)	44.3	44.8	44.0	43.5
Marital Status (percent married)	86 %	86 %	87 %	77 %
Median Family Income in 1972	$10,905	$10,895	$10,995	$ 9,860
Median Number of Years Schooling	12.9	12.8	12.9	12.7

general character of the communities in the area were responsible for most residents preferring Western Colorado over any other location as a place to live.

When asked to describe their day-to-day life the three most commonly used words were "happy", "conservative", and "easy". Comparisons with the Harris Alienation Index indicated that residents perceived themselves as having much more control over their immediate environment than does the average U. S. citizen.

The favorite leisure time activities were fishing, working around the house, and reading -- either the Grand Junction Sentinel or periodicals such as the Readers Digest, Time, and National Geographic. Other common pursuits were gardening and watching television.

The complaints about the day-to-day life varied by location. Glenwood Springs and Grand Junction residents criticized the high cost of living. In the latter community there was some apprehension about low wages and a general shortage of employment opportunities. The citizens of Meeker were less distraught about economic conditions, and instead complained of a lack of shopping and entertainment facilities. Those perceived disadvantages were seen by both the general public and the public officials.

The greatest fears of the future involved the potential negative effects of extremely rapid growth. Uncontrolled growth was a source of anxiety for both residents and public officials. Both groups also feared the consequences of inadequate planning for the future. Future air and water pollution were also sources of concern, while the public officials expressed some anxiety about possible water shortages.

The principal local priority areas were viewed as the local economy and education. Those two areas were also regarded as important by the public officials, although that group of individuals gave education a higher priority than that assigned to the local economy. The need for thoughtful planning and zoning was twice as important to the local officials as it was to the general public.

Reactions to Specific Aspects of Life in the Area

1. *Employment*

   Nearly half of the households in the region found both husband and wife employed. Generally, the employed residents were younger, better educated, and more affluent than were the unemployed individuals.

   Two thirds of the residents indicated that it was difficult to find employment in the region. However, that dire employment outlook was not shared by public officials.

   Many residents complained of the low wage scale in the area, stating that wages in the region were lower than were found elsewhere, particularly in the larger metropolitan areas.

   One out of five families had seen a family member leave the area in order to find employment. In many instances the exodus was the result of a lower wage structure rather than an absolute shortage of employment opportunities.

2. *Public Schools*

   The quantity, as well as the quality, of the local educators generally met with approval. However, the public schools were seen as doing a better job of preparing children for college than they were in preparing them for a specific vocation or to cope with problems of the present day world. Public officials were more charitable in their ratings of the local educational system than were the members of the general public. The primary area of improvement was seen as the provision of better vocational training in the local schools.

3. *Transportation and Roads*

   There was general agreement that highway and street maintenance needs to be improved in the area. The perceived need for public transportation varied from county to county. There was some need for public transportation expressed in Mesa and Rio Blanco Counties, but little support for such facilities in Garfield County.

4. *Police, Fire Protection, and Sanitation Services*

All three service areas were rated highly. However, public officials expressed some anxiety about future water conservation.

5. *Retail Facilities*

Shopping facilities were rated as more than adequate by Mesa County residents, as well as by public officials in that county. The most critical retail situation occured in Rio Blanco County, where residents had to travel greater distances for many items.

6. *Health Services*

Citizens of Mesa and Garfield Counties rated the availability of doctors and dentists higher than did the public officials, who were somewhat concerned with a shortage of trained medical personnel.

7. *Local Government*

In every location, the local city council was seen as the most responsive governmental body. Planning commissions, on the other hand, were rated the lowest in responsiveness even by public officials. The local school boards fell somewhere between those two extremes, although they received lower ratings from parents with children in school than from other residents.

8. *Housing*

There was definitely a perceived housing shortage in the area. That shortage was most acute in Rio Blanco County, but was also a major problem in Garfield County. Lack of housing was a major concern of the public officials in the region.

There was an expressed need for more middle and low income housing, generally in the $15,000 to $20,000 range. More rental units, mostly in the $100 per month range, were advocated by citizens in Garfield County.

There were no objections voiced to planned mobile home parks. Such parks were especially desirable to the residents of Meeker.

9. *Quality of the Environment*

Residents of the area were alarmed about the present levels of water pollution. Air pollution was also seen as a problem area, particularly by residents of Mesa County.

Tighter land use regulations were supported in Garfield and Mesa Counties, but were opposed by Rio Blanco County. That pattern was also true for public officials in those three counties.

The general public, as well as the public officials, differed with regard to the desirability of clustered housing with shared open space. The general public opposed such developments, whereas public officials often supported them.

Most residents desired some degree of population growth versus a maintenance or decrease in present population levels. They also opposed the imposition of curbs on population growth. However, the maximum desirable growth expressed by most urban residents in the area ranged from 34 to 89 percent. Such growth levels would probably not alter the present life styles of the residents to any measurable extent.

III. DEVELOPING THE OIL SHALE RESOURCE

The oil shale deposits found in the Piceance Creek Basin of Western Colorado are one of the nation's major resources. The extensive marlstone beds contain trillions of barrels of kerogen which can be converted into a substitute for naturally-flowing crude oil and fed into conventional petroleum refineries. The shale oil available in the richest of the shales (30 gallons or more per tone of shale) totals over 130 billion barrels. Although the kerogen is recoverable using existing mining, retorting, and up-graded technology, the amount of shale oil that can be considered an energy reserve, i.e., economically recoverable under existing competitive market conditions, cannot be estimated until the current technology has been tested under commercial conditions. So, for the moment, the oil shales of the basin remain a resource possessing a value that is potential rather than real.

The development of any new industry or technology follows a fairly predictable pattern. A innovative idea for a new product or process is tested on an extremely small-scale laboratory basis. If laboratory results are encouraging, as is the case with oil shale development, the technology is then tried in a small pilot plant handling a few barrels or tons per day. Given another favorable performance, the technology is then ready to be tested at the 50,000 barrels per day level. Each of these steps involves expanding the size of the operation substantially because experience with a smaller quantity is never representative of what will be encountered on a larger scale. Moreover, each escalation in size sharply accelerates the total cost.

The development of shale oil is now at the final experimental stage -- an increase to a plant size which is needed to operate commercially. For shale oil, the minimum commercial size is considered to be a plant of 50,000 barrels per day -- comparable to a medium size oil refinery. Until this final step is taken, the future of oil production from shale cannot be judged with any precision.

For the individual company contemplating an entrance into oil shale operations there are the unknowns of a new technology plus all of the uncertainties that face any new business enterprise. However, it is assumed that based on the state of technology, the size of the investment, the risks involved, and the energy alternatives available there is sufficient incentive to justify the investment in a 50,000 barrels a day syncrude plant.

If we assume very little, if any, governmental funding to reduce the risk and the magnitude of private investment, what will happen after this plant is built and operated for a sufficient period of time to evaluate its technical and economic performance? The following four patterns represent the most likely range of events.

At one extreme is the possibility that the first plant constructed and put into operation will prove to be both technologically and economically incapable of continued operation. This would lead to a temporary construction and operating period lasting four to five years with only a transient economic impact on the oil shale region. There is little purpose in expanding further upon the economic and planning implications of this pattern of events.

At the other extreme is the profile proposed by the U. S. Department of the Interior in its draft environmental impact statement. This is the best representation of the pattern of activity that would occur during the fourteen year period if the prototype plant soon proved to be a commercial success. If the first plant is successful, Interior assumes that availability

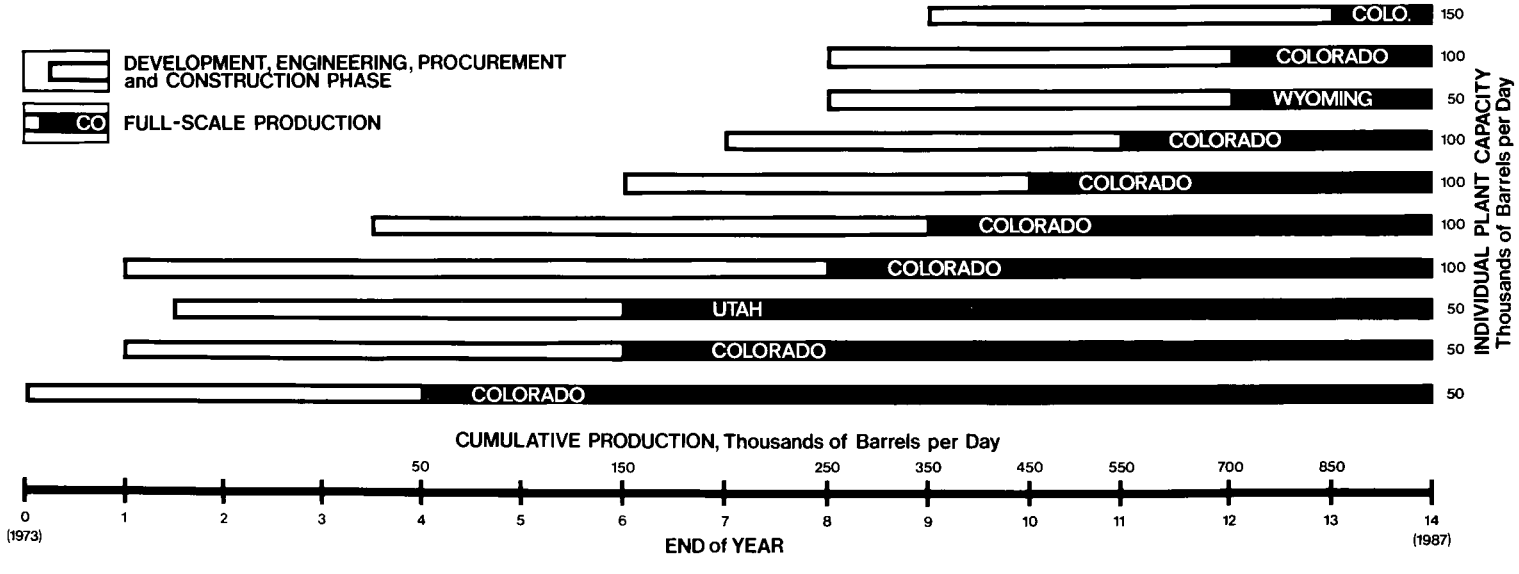
of public land and water would allow development of plants having a capacity of one million barrels per day by 1985. A more conservative view in a recent report of the National Petroleum Council suggests a 750,000 barrels per day industry by 1985.

A maximum case between these views with a "sliding" starting date is most useful. Therefore, for the State of Colorado, the growth pattern shown in Figure 6 is considered to be a realistic profile in planning for the future. This shows a total industry of 850,000 barrels per day in existence after fourteen years with approximately 750,000 barrels per day of that in Colorado. The addition of more plants in any one of the three oil shale states in the final years or the modest expansion of the plants built in Utah must be accounted for in Colorado planning because of the proximity of the Utah oil shale deposits to Rangely and the potential for impact on western Colorado communities and facilities.

Two intermediate circumstances are suggested as being logical. One would be a situation where the first plant is not sufficiently promising to trigger the construction of additional plants, but does generate sufficient income to warrant its continued operation, since the capital investment is irretrievable and some return is better than none. In this case, the plant would operate for a number of years as a marginal venture. Under these circumstances, no particular planning effort beyond that involved for any new one-plant venture seems required.

Another possibility is one of moderate success. Complex technology or changing economic factors are reasons requiring that this possibility be considered. The National Petroleum Council assumes that the most likely future for oil shale is an industry of approximately 400,000 barrels per day by 1985. If this projection is correct, for planning purposes it can be assumed that this activity would be concentrated in Colorado. The pattern of development would be essentially the same as in the first five years

Figure 6
PROJECTED RATE OF SHALE OIL PRODUCTION -- INTENSIVE DEVELOPMENT



of the "successful" pattern but thereafter plants would appear only half as fast in years 6 through 14. As a consequence, Colorado would have 400,000 barrels per day of capacity by year 14 and Utah would have 50,000 barrels per day.

Again assuming no significant federal involvement, this moderate case probably best reflects the "real world" possibility. The United States does have a number of other energy alternatives, such as further development of conventional oil resources, importation of oil, greater reliance on coal or nuclear power, or the conversion of coal to oil, gas, or electricity. The moderate projection seems most likely because in addition to these competitive energy sources, there are the unavoidable and unforeseen delays involved in developing a new technology, the unknowns of water supply, possible legal delays, the need to satisfy transportation and labor requirements, and the relative isolation of the oil shale region from the major energy markets. Collectively, these factors can very well slow the pace of oil shale development in the early years of development where unknowns are numerous and patterns indistinct.

For planning purposes, sufficient precision is not possible at this stage to be definitive concerning the relative importance of private versus public land development, the number of surface mines versus underground, or the exact location of the first ten plants. Planning should proceed on the assumption that a number of combinations are possible and the various possibilities should be recognized with respect to the pace of development. Planning should be based on the potential impact of an industry of at least 750,000 barrels per day in Colorado and at least 50,000 barrels per day in Utah after a period of 14 years. However, public and private commitments in the region that may be sensitive to delays in development should be equally prepared for an industry growing at only half that pace.

OIL SHALE BASE MODELS

An oil shale operation has three major variables that can affect the investment, costs, manpower, land utilization, material inputs, and outputs, and the flow of dollars accompanying the operation. These three factors are:

1. The method of extracting the kerogen from the ground;

2. The type and degree of processing; and

3. The capacity of the operation.

Some extractive methods are not sufficiently well-understood at this point in time to permit a detailed examination here. Among these are the various methods of in situ recovery and the simultaneous extraction of sodium minerals along with the oil shale. Although a distinction is made between surface and underground mining of the shale, the variation in inputs and outputs are not large enough to warrant distinguishing between various <u>forms</u> of surface and underground mining.

Although there are various methods of processing oil shale, an assumption has been made that the distinction will not significantly affect the accuracy of this model. Further, although the scale of oil shale operations and market opportunities could justify processing the shale oil to final products, it has been assumed that in the early stages of oil shale operations the industry will produce a synthetic crude that can be shipped by pipe line and processed without major problems by conventional oil refineries.

Two oil shale plant base models were developed for this study's purposes:

1. An oil shale plant which would produce 50,000 barrels a day of syncrude oil using an underground mining operation; and

2. A 100,000 barrels a day retort facility which would process the shale from an open pit surface mine.

Technical criteria and assumptions have been developed for each oil shale plant model and the resultant inputs and outputs are described. Both models anticipates five major areas of need or INPUT for a successful operating oil shale plant. These include:

1. <u>Resources</u>; raw shale, water and power are in this category;

2. <u>Land</u>; for the plant site and mines, for spent shale disposal site for off-site utility corridors and roads;

3. Financing; in terms of (a) the capitalization needed for plant facilities, working capital and land acquisition and (b) operating costs;

4. Manpower; needed for both the initial construction periods of the plant as well as their permanent operating work forces; and finally

5. the Accessibility requirements needed to service the plant.

The results or OUTPUTS of these oil shale plants are described as follows:

1. The Products include the amount of shale oil syncrude, by-products such as sulfur, ammonia and coke, the amount of spent shale which would have to be disposed of, the resultant sulfur and nitrogen oxides and the particulates which would be generated by the plant operation;

2. The Salaries and Wages distributed to employees of the operation;

3. The Taxes to be attributed to the property and improvements of the operation, as well as personal and corporate income taxes; and

4. The Rents and Royalties which could be expected to be paid by an oil shale plant operation.

THE REGIONAL IMPACT OF OIL SHALE DEVELOPMENT

The final step in assessing the development of the oil shale industry was to determine the various impacts through time on the oil shale region. This was accomplished by combining the inputs and outputs of the two oil shale models with the projected growth rate of oil shale production which was previously described. For illustrative purposes it has been assumed in the profile that certain combinations of size and types of mining will occur. The summation of various inputs and outputs for oil shale plants in Colorado over a fourteen year period using both the "intensive" and "moderate" profiles are presented in the following tables.

The nature of projecting the future is by necessity wrought with numerous fears of omission. There are, for example, numerous technological variables which could be important but have not been reflected in this study. These include; power requirements, improving technology and economics of scale, upgrading the shale oil, in-situ recovery and multiple mineral recovery. These aspects are not included because in some cases the quality of data for less well developed technologies was not comparable to that available for better known processes, and their use would lower the reliability of the models. In other cases, the judgemental factors involved are significant and are best discussed spearately. Finally, there is the problem of over-refinement of the models leading to complexity in use that is not warranted.

Table 7
INTENSIVE PROFILE

Year	# of Colorado Plants and Capacity in bbls/day	Raw Shale 000 Tons	Syncrude 000 bbls	Plant and Mine Acreage	Spent Shale Disposal Acreage	Spent Shale 000 Tons	Construction Employees Number	Construction Salaries 000 $'s	Plant Employees Number	Plant* Salaries 000 $'s	Total* Taxes 000 $'s	Royalties 000 $'s
1												
2							450	6,979			1,120	
3							1,650	26,496			4,253	
4							1,050	17,454			2,801	
5	1- 50,000	23,652	16,425	150	730	20,038	1,650	28,384	915	10,930	6,522	2,838
6	1- 50,000	23,652	16,425	150	730	20,038	1,450	25,721	915	11,307	16,648	2,838
7	2-100,000	47,304	32,850	300	1,460	40,077	3,450	63,285	1,830	23,405	27,587	5,676
8	2-100,000	47,304	32,850	300	1,460	40,077	5,900	112,335	1,830	24,233	48,269	5,676
9	3-200,000	94,608	65,700	1,900	1,660	84,154	5,400	106,576	3,300	45,061	55,114	11,353
10	4-300,000	141,912	98,550	2,200	3,102	124,231	5,400	100,392	5,130	72,610	84,471	17,029
11	5-400,000	189,216	131,400	2,500	4,580	164,308	5,850	123,674	6,960	101,996	120,173	22,706
12	6-500,000	236,520	164,250	2,800	6,040	204,385	7,500	164,095	8,790	133,361	164,350	28,382
13	7-600,000	283,824	197,100	3,100	7,500	244,462	8,100	183,438	10,620	166,816	207,899	34,059
14	8-750,000	354,780	246,375	3,550	9,690	304,577	8,100	189,889	13,365	217,367	253,671	42,574

* Increased for anticipated productivity gain of 3-1/2% per annum.

Table 8
MODERATE PROFILE

Year	# of Colorado Plants and Capacity in bbls/day	Raw Shale 000 Tons	Syncrude 000 bbls	Plant and Mine Acreage	Spent Shale Disposal Acreage	Spent Shale 000 Tons	Construction Employees Number	Construction Salaries 000 $'s	Plant Employees Number	Plant* Salaries 000 $'s	Total* Taxes 000 $'s	Royalties 000 $'s
1												
2							450	6,979			1,120	
3							1,650	26,496			4,253	
4							1,050	17,454			2,801	
5	1- 50,000	23,652	16,425	150	730	20,038	1,650	28,384	915	10,930	6,524	2,838
6	1- 50,000	23,652	16,425	150	730	20,038	1,450	25,721	915	11,307	16,650	2,838
7	2-100,000	47,304	32,850	300	1,460	20,077	2,550	46,708	1,830	23,405	24,926	5,676
8	2-100,000	47,304	32,850	300	1,460	20,077	2,600	49,403	1,830	24,233	3-,167	5,676
9	3-200,000	94,608	65,700	1,900	1,660	84,154	3,300	65,130	3,300	45,061	48,462	11,353
10	3-200,000	94,608	65,700	1,900	1,660	84,154	2,100	42,906	3,300	46,648	69,409	11,353
11	4-300,000	141,912	98,550	2,200	3,120	124,231	3,300	69,765	5,130	75,132	107,131	17,029
12	4-300,000	141,912	98,550	2,200	3,120	124,231	2,100	45,946	5,103	77,756	135,941	17,019
13	5-400,000	189,216	131,400	2,500	4,580	164,308	3,300	74,734	6,960	109,261	159,369	22,706
14	6-400,000	189,216	131,400	2,500	4,580	164,308	1,200	28,132	6,960	113,085	162,046	22,706

* Increased for anticipated productivity gain of 3-1/2% per annum.

IV. THE MAGNITUDE AND IMPACT OF GROWTH

NORMAL GROWTH

Growth is occuring in the oil shale region (Garfield, Mesa, and Rio Blanco Counties) at the present time. Present trends suggest a population of 90,600 in 1977 without oil shale development. With an accelerating growth rate, primarily based on expanding tourism and recreation, the 1987 population could reach 121,900 if one assumes a 3 percent annual rate of growth, and 147,600 if a 5 percent annual growth rate is assumed. Since growth creates a "snow balling" effect, the 5 percent annual rate of growth may be more likely from about 1978 on into the future. Table 9 shows these population estimates for the three county area. These population increases could occur without the development of an oil shale industry.

The realization of these projections would constitute a mild boom for the entire region. It could be a genuinely uncomfortable rate of growth for the eastern part of Garfield County (near Aspen and Vail) which may bear the greatest burden.

OIL SHALE DEVELOPMENT

Oil shale development will be in addition to the normal growth. Two patterns of oil shale development are possible: an intensive effort leading to rapid development (hereafter called the intensive profile), and a moderate profile of development. Since both begin with one plant at a time, it will be difficult to determine which profile is underway during the first five to seven years.

Subsequently, development fitting the intensive profile would accelerate rapidly, building toward a million barrel a day oil shale industry. Assuming that three-quarters of this million

Table 9
POPULATION ESTIMATE FOR THREE COUNTY AREA
(Garfield, Mesa, Rio Blanco)
(Without Oil Shale Development)

Year	3 Percent Projected Annual Increase	5 Percent Projected Annual* Increase
1970	74,000	
1971	75,400	
1972	78,200	
1973	80,600	
1974	82,300	
1975	85,500	
1976	88,000	
1977	90,600	
1978	93,400	95,100
1979	96,200	99,000
1980	99,100	104,900
1981	102,000	110,100
1982	105,100	115,600
1983	108,300	121,400
1984	111,500	127,500
1985	114,800	133,900
1986	119,300	140,500
1987	121,900	147,600
1988	125,500	155,000
1989	129,300	162,700

* As the economy of the area grows and becomes more complex, the multiplier between basic industries and service industries will grow. Therefore, it is assumed that population will increase at the rate of 5 percent (5%) per year after 1977 rather than the 3 percent (3%) rate.

barrels a day production is in Colorado, within fifteen years 160,000 additional people would have been added to the three county region by an oil shale industry -- in addition to the 147,600 already estimated for 1987. This population increment would result from the added basic employment -- plant construction and subsequent mining and processing -- and resulting local service employment.

The moderate profile of oil shale development would add only about 61,000 people to the region in the same fifteen year period. However, this might be an uncomfortably erratic rate of growth for local government. Building fewer plants in the region would cause steep rises and declines in the construction force and population.

The year-by-year growth in population resulting from the intensive and the moderate development profiles is graphed in Figure 7 and tabluated in Tables 10 and 11. Year zero is the year of announcement of plant construction, the succeeding years show the build-up of basic employment, local service employment, income, and population. The graph assumed announcement in 1973.

Population Assumptions

These population figures assume that all of those requiring housing would find it, in the form of permanent housing or mobile homes. The estimates are also vulnerable to major changes in oil shale mining and processing technology, which would reduce basic employment, local service employment, and population.

It is difficult to estimate the exact rate of build-up in local service employment; some lag is provided in the estimates for early years, but it is hard to predict this aspect of development during the later, extreme growth years. Housing construction alone would generate about 22,000 man years of local service employment between years three and sixteen; it is difficult to tell how rapidly this would build up. All of these factors could reduce population growth, or more likely, cause it to lag.

The actual course of oil shale development may fall somewhere between the two curves. However, a maximum effort oil shale development, born of response to a domestic energy crisis, might cause an even greater increase in oil shale related population than the intensive profile. The impacts of any significant oil shale development are profound.

THE DEMAND FOR HOUSING

Housing a major share of the influx of population in permanent housing located in viable communities will be a major challenge. If permanent housing were available for all of those seeking it, as many as 45,000 new units might be occupied by 1989 as a result of intensive oil shale development. Another

Figure 7
POPULATION OF THE THREE COUNTY AREA

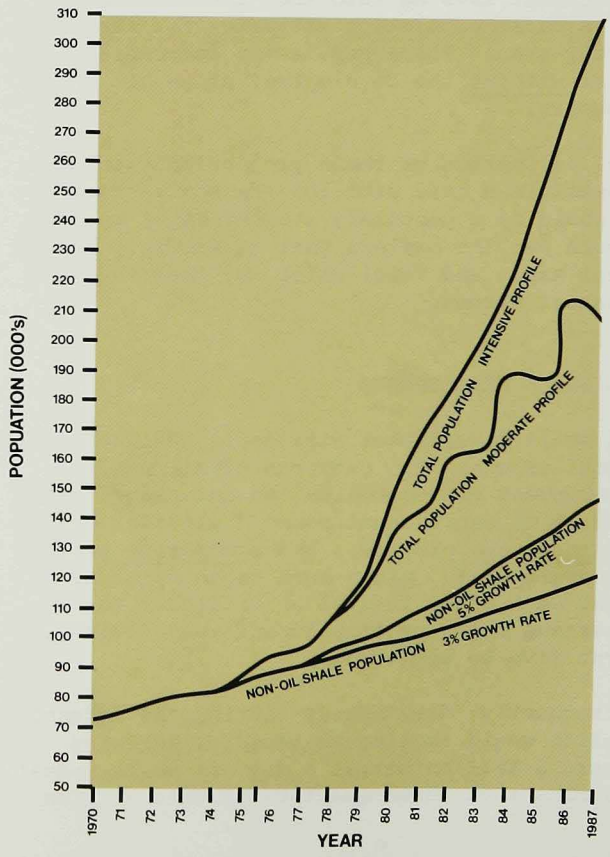


Table 10
POPULATION RESULTING FROM OIL SHALE DEVELOPMENT
Moderate Profile*

Year	Basic Employment	Total Income ($000)**	Local Service Employment	Local Service Income ($000)**	Total Employment	Total Income ($000)**	Total Population
0	--						
1	--						
2	450	$ 5,374	50	$ 368	500	$ 5,742	1,250
3	1,650	20,402	850	6,494	2,500	85,346	6,250
4	1,050	13,440	900	7,125	1,950	26,896	4,875
5	2,565	31,474	3,000	24,612	5,565	56,086	13,913
6	2,365	29,755	4,730	40,162	7,095	69,917	17,738
7	4,380	56,562	8,760	76,983	13,140	133,545	32,850
8	4,430	59,367	8,860	80,591	13,290	139,958	33,225
9	6,600	89,803	13,200	124,265	19,800	214,068	49,500
10	5,400	74,089	10,800	105,244	16,200	179,333	40,500
11	8,430	119,836	16,860	170,016	25,290	289,852	63,225
12	7,230	103,803	14,460	150,919	21,690	254,722	54,225
13	10,260	153,691	20,520	221,657	30,870	375,348	76,950
14	8,160	121,175	16,320	182,458	24,480	303,633	61,200

* 2.0 multiplier.
** 3-1/2% per annum increase in real income.

Table 11
POPULATION RESULTING FROM OIL SHALE DEVELOPMENT
Intensive Profile*

Year	Basic Employment	Basic Income ($000)**	Local Service Employment	Local Service Income ($000)**	Total Employment	Total Income ($000)**	Total Population
0	--						
1	--						
2	450	$ 5,374	50	$ 368	500	$ 5,742	1,250
3	1,650	20,402	850	6,494	2,500	26,896	6,250
4	1,050	13,440	900	7,125	1,950	20,565	4,875
5	2,565	31,474	3,000	24,612	5,565	56,085	13,913
6	2,365	29,755	4,730	40,162	7,095	69,917	17,738
7	5,280	69,324	10,560	92,801	15,740	162,125	39,350
8	7,730	107,825	15,460	140,624	23,190	248,449	57,975
9	8,700	121,717	17,400	163,804	26,100	285,521	65,250
10	10,530	148,901	21,060	205,186	31,590	354,087	78,975
11	12,810	184,988	25,620	285,352	30,430	443,340	96,075
12	16,290	243,708	32,580	340,037	48,870	583,745	122,175
13	18,720	288,048	37,440	404,427	56,160	692,475	140,400
14	21,465	337,493	42,930	479,937	64,395	817,450	160,988

* 2.0 multiplier.
** 3-1/2% per annum increase in real income.

10,000 mobile homes might be in use. Assuming an average constant dollar price of $22,000 per unit (both single and multi-unit) or permanent (or site) housing, and $7,000 per mobile home (80 percent of which is assessable), this will be a large contribution to tax base (30 percent of value).

If less permanent or site housing is available, more mobile homes will be required. Table 12 shows the possible absorption rates for housing, assuming that site housing would be available when people are ready to buy or rent it.

THE DEMAND FOR EDUCATION FACILITIES

A rapid growth in population resulting from oil shale development will demand public services before an ad valorem tax base has been generated. Even if the tax base eventually catches up, it may not be in the same jurisdiction as the people using the services. This is particularly true for schools because of the alignment of the school districts in the three county area in relation to possible oil shale plant sites and probable areas of urban growth.

While the requirements of a full range of public services are discussed in the latter sections of this report in relation to increments of population added to a given area, schools are deemed to be of such importance that the total school room requirements resulting from oil shale development warrant additional brief discussion. As a public service, schools require both substantial capital investment and sizable operating costs. The number of school age children added and the number of classrooms required because of oil shale development is estimated in Table 13.

THE IMPACT ON AGRICULTURAL, TOURISM, AND MANUFACTURING

Oil shale development would require recruitment of much greater quantities of construction workers than are locally available and this would absorb much local labor, hiring it away from regional agriculture and construction activities. Oil shale wage rates would generally be higher than those locally paid; wages for men would be driven up.

As men come into the region to fill construction and plant jobs, members of their families will also be available for work. There would probably then be a surplus of employable women. This could be a resource for attracting some types of manufacturing (e.g., electronics assembly, needle trades), and some specialized clerical operations (e.g., insurance or governmental accounting). This labor surplus would also be available to fill some local service and tourism job slots.

Some beneficial effects of oil shale development might include the creation of several machine shops servicing plant operations, and also housing construction (e.g., sheet metal, door assembly). Investment capital may be more available as large housing projects bring loan and mortgage agencies into the region. On the other hand, existing resorts in and near the region might become more crowded with the sheer mass of population added by the development, and the country might lose some of its remote and primitive quality.

Oil shale operations will require large quantities of electricity; the commonest source of new electrical generating capacity in this region is coal-fueled steam power plants. Wherever such plants and mines are located, they may interfere with existing agricultural operations. On the other hand, shale plants may generate much of their own electric power, with their own fuel. It is difficult to make judgement on which of these options will prevail.

It is also difficult to estimate the development of oil shale-related manufacturing within the region using oil shale syncrude as a feedstock. It is presently assumed that oil shale plant outputs will be transported elsewhere for further processing; this assumption should be constantly reviewed.

The most serious impact, if it occurs, would be the diversion to oil shale processing and expanded community needs of enough water presently used for irrigation to seriously reduce agricultural activity and employment. This would damage the present diversity of the region's economy and could degrade the aesthetic values upon which tourism depends. Similar effects might result from reallocation of land, particularly irrigated land, to housing. Unlike the other impact mentioned, these are amenable to action by local government.

Table 12
TOTAL HOUSING DEMAND

INTENSIVE DEVELOPMENT PROFILE

Year	Site Housing		Trailer/Mobile Home Space	
	Requirement	Incremental Requirement	Requirement	Incremental Requirement
0	--	--	--	--
1	--	--	--	--
2	19	19	456	456
3	402	383	1,674	1,218
4	442	40	1,058	616(s)**
5	1,538	1,096	1,910	236
6	2,219	681	1.894	16(s)**
7	5,777	3,558	4,165	2,255
8	8,645	2,868	6,197	2,032
9	10,217	1,572	6,190	7(s)**
10	11,325	1,108	6,280	83
11	16,027	4,702	7,123	843
12	21,412	5,385	7,699	576
13	25,490	4,078	9,479	1,780
14	29,168	3,678	10,673	1,194
15*	36,337	7,169	--	--
16	45,359	9,022	--	--

MODERATE DEVELOPMENT PROFILE

Year	Site Housing		Trailer/Mobile Home Space	
	Requirement	Incremental Requirement	Requirement	Incremental Requirement
0	--	--	--	--
1	--	--	--	--
2	19	19	456	456
3	402	383	1,674	1,218
4	442	40	1,058	616(s)**
5	1,455	1,013	1,993	319
6	2,142	692	1,966	27(s)**
7	4,705	2,558	3,438	1,445
8	4,884	199	3,358	80(s)**
9	7,637	2,753	4,570	1,132
10	6,692	945(s)**	3,115	1,455(s)**
11	10,919	3,282	4,705	135
12	9,419	1,500(s)**	3,805	900(s)**
13	13,948	3,029	5,338	633
14	11,218	2,730(s)**	3,868	1,470(s)**
15	15,916	1,968	--	--
16	15,916	0	--	--

* No attempt has been made to estimate the total housing demand after year 14, except for years 15 and 16. These reflect the 3 year lag in plant employee purchases.

**(s) -- surplus of rooms

Table 13
SCHOOL CHILDREN AND SCHOOL ROOM REQUIREMENTS RESULTING FROM OIL SHALE DEVELOPMENT

INTENSIVE DEVELOPMENT PROFILE

Year	Total Children In Three-County Region	School Rooms Needed 30 Children/Room	Incremental School Rooms Needed
0	--	--	--
1	--	--	--
2	161	5	5
3	917	81	26
4	761	25	6(s)*
5	2,667	89	58
6	3,464	116	27
7	8,671	289	173
8	12,566	419	130
9	15,813	527	108
10	19,821	661	134
11	26,300	877	216
12	33,425	1,114	237
13	38,467	1,286	172
14	44,579	1,486	200

*(s) -- surplus of rooms

Assumptions:
1. 1.5 school age children per family
2. Construction employees: Up to 20% would bring families in first 6 years
3. Plant employees: 50% would bring families first 4 years, and up to 80% later.
4. Local service employees: 33% would bring families

MODERATE DEVELOPMENT PROFILE

Year	Total Children In Three-County Region	School Rooms Needed 30 Children/Room	Incremental School Rooms Needed
0	--	--	--
1	--	--	--
2	161	5	5
3	917	31	26
4	761	25	6(s)*
5	2,667	89	58
6	3,464	116	27
7	6,858	229	113
8	6,929	231	2
9	10,494	350	119
10	8,766	292	58(s)*
11	14,174	472	122
12	12,266	409	63(s)*
13	17,358	579	107
14	13,779	459	120(s)*

*(s) -- Surplus of rooms

Assumptions:
1. 1.5 school age children per family
2. Construction employees: Up to 20% would bring families in first 6 years.
   Up to 30%, as above, in years 7-10.
   Up to 40%, as above, in later years.
3. Plant employees: 50% would bring families years 5-10, and up to 80% later
4. Local service employees: 33% would bring families

RESIDENTIAL AND COMMUNITY FACILITY REQUIREMENTS

Population growth in the three county area, whether it occurs as the result of a developing oil shale industry or normal economic trends, will demand that additional open land be devoted to housing and commerce and that urban services be provided for the new inhabitants. These land area and service requirements are estimated here on the basis of a 1,000 person increment in population growth. Costs attributed to growth will be offset by certain revenues. These are discussed on this same incremental basis.

This "incremental" approach to growth was taken because of the near impossibility of making accurate population projections for specific communities or areas for any given year. The variables of oil shale development are too numerous and the conditions under which development might take place too ill defined to permit more than informed speculation in this regard. The area and cost models developed here, however, will allow communities to judge the impact of different levels of growth wherever it might occur.

Land Area Requirements

The amount of land area which will be necessary to accommodate future population growth in the three county area depends upon the intensity of development which present or future land use regulations will allow and how these regulations are applied to the land. The greatest demand for land will be for residential areas to house the increased population.

Residential neighborhoods seldom exist in a pure state -- that is with no use of the land other than residential. Streets to service individual lots typically make up 20 percent to 25 percent of a subdivision. Also included in large subdivisions are sites for schools, parks, fire stations, churches, and other community facilities. The relationship between these components of a residential area and the amount of land area involved at different residential densities is shown in Table 14.

In order to determine the land area that might be needed to accommodate the total projected population in Mesa, Garfield, and Rio Blanco Counties it is necessary to make some assumptions about the mix of housing types which might occur. It is unlikely that all new inhabitants in a given area will be housed at a single density. Incoming families and individuals will seek the type of housing most appropriate to their needs.

There are recognized hazards involved in making assumptions about living preferences and life styles on the Western Slope over a ten to fifteen year period. Those hazards are compounded when the impact of two levels of oil shale development are considered along with normal economic growth. Living styles are also changing. Because of the rising cost of permanent housing, mobile homes and multi-family units are making up increasing proportions of the housing inventory. Assumptions on density patterns should, therefore, be continuously reviewed against changing circumstances.

What will happen in the three county area at different rates of population growth? Table 15 shows a possible density mix for the three county area at the end of fourteen years for the three different rates of growth outlined earlier.

These figures assume that families will continue to prefer single family housing and that new housing will continue to be available to meet the demand at a price the consumer can afford. There will also be an absolute increase in the number of mobile homes and multi-family housing units and they will also increase their present share of the market.

If and as oil shale develops, mobile homes may constitute as high as 70 percent of the new housing during the early years, tapering down to about 25 percent of the total housing demand by the fourteenth year, even if substantial permanent housing is made available. That 25 percent figure for mobile homes is included for both the moderate and successful rates of growth along with other assumptions on the relationship between single family and multi-family housing.

After fourteen or fifteen years, if oil shale proves to be a stable industry, the percentage of single family housing might increase somewhat as population moved from mobile homes and apartments into more permanent housing. Figures for Colorado cities and national trends

Table 14 [1]
LAND AREA NEEDS BY RESIDENTIAL DENSITY
(1,000 Incremental Population)

Land Use	Persons/ D.U.	D.U.'s/ Acre	Net Residential Acres	%	Streets Acres	%	Community Facilities Acres	%	Totals Acres	%
Single Family (Acreage) [2]										
(5 acre sites)	3.7	0.2	1350	93	85	6	12	1	1447	100
Single Family (Rural) [2]										
(2 acre sites)	3.7	0.5	540	90	50	8	12	2	602	100
(1 acre sites)	3.7	1.0	370	87	43	10	12	3	425	100
Single Family (Urban) [2]										
(12,000 sq. ft. sites)	3.7	3.6	75	70	20	19	12	11	107	100
(9,000 sq. ft. sites)	3.7	4.8	56	65	20	22	12	13	88	100
(7,500 sq. ft. sites)	3.7	5.8	47	61	18	24	12	15	77	100
(6,000 sq. ft. sites)	3.7	7.3	37	57	16	25	12	18	65	100
Mobile Homes	2.7	8.0	46	62	14	19	14	19	74	100
Multi-Family	2.4	14.0	30	58	7	14	14	28	51	100
Multi-Family	2.0	25.0	20	52	4	11	14	37	38	100

1
Does not include land area needs for commercial and industrial use.

2
Household density is expected to vary significantly with residential density -- the household density of 3.7 persons per D. U. used here represents an average single family density. Average household size for other densities as shown.

Table 15
REGIONAL HOUSING COMPOSITION
14 Year Level at Various Rates of Growth

Rate of Growth	Mobile Homes	Multi-Family	Single Family	TOTAL
Normal Economic Trends	10%	30%	60%	100%
Moderate Oil Shale Development	25%	30%	45%	100%
Intensive Oil Shale Development	25%	25%	50%	100%

suggest, however, that the percentage of single family homes to total dwelling units might not return to the 70 percent to 80 percent level that is now present for Grand Junction, Rifle, and Meeker -- 60 percent would be more likely.

Commercial and industrial areas are also on integral part of most communities. The size of a commercial center increases as the area which it services is enlarged. For purposes of definition, neighborhood centers -- the major function of which is the sale of convenience goods and personal services -- average five to twenty stores with a service radius of approximately one-half mile. Community centers -- the major function of which, in addition to neighborhood center functions, is shopping goods -- average fifteen to forty stores with a service radius of approximately two miles.

Regional centers -- combining the functions of neighborhood and community centers -- include the sale of general merchandise, apparel, furniture, etc., and average forty to eighty stores with a service radius of four miles.

In applying these definitions to the three county area, downtown Grand Junction probably constitutes the only regional shopping area. Business uses there are larger and more varied than in any other area of the region. It will probably continue to play that role. Growth in the region will probably mean the gradual increase of special, regionally oriented uses in Grand Junctions.

The downtown areas of the several smaller towns serve as community shopping centers. Their trade area extends out into the surrounding rural areas. These downtown areas will add retail space as the community grows.

Table 16
SUMMARY OF COMMERCIAL AND INDUSTRIAL FACILITY NEEDS
(1,000 Population)

	Neighborhood Shopping Center (Minimum Site Size of 4 Acres)	Community Shopping Center (Minimum Site Size of 10 Acres)	Regional Shopping Center (Minimum Site Size of 30 Acres)	Total Cumulative Requirements for All Types
Site Requirements/ 1,000 Population	0.56 Acre	0.32 Acre	0.29 Acre	1.17 Acre
Average Gross Leasable Area Requirements/1,000 Population [1]	5,973 Sq Ft	2,143 Sq Ft	2,000 Sq Ft	10,116 Sq Ft
Average Parking Area Requirements/ 1,000 Population	11,946 Sq Ft	8,571 Sq Ft	8,000 Sq Ft	28,517 Sq Ft
Average Circulation Service, Etc., Requirements/1,000 Population	6,453 Sq Ft	3,333 Sq Ft	2,428 Sq Ft	12,214 Sq Ft

[1] As a function of average population served.

	Light Industry	Heavy Industry	Total Industry
Site Requirements for Industry/ 1,000 Population	2 Acres	10 Acres	12 Acres

Only Grand Junction and Glenwood Springs are experiencing neighborhood shopping centers at this point in time. These small shopping areas follow growth with convenience goods. They will become more prevalent as Western Slope communities increase in size to the 5,000 to 10,000 population category.

Land Area Requirements for Growth

Based on the density mix shown in Table 15 and assuming a possible range of densities it is now possible to speculate on the amount of land which will be required to support the fourteenth year (say 1987) level of growth under the three conditions:

1. No oil shale development,
2. Moderate oil shale development, and
3. Intensive oil shale development

This is summarized in Table 17.

The Table assumes that single family development will average about five dwelling units per acre, that mobile home development will average eight units per acre and that multi-family development will average about fourteen dwelling units per acre. The Table could be reconstructed with different density assumptions and different percentage relationships between the types of residential uses.

The area figure for no oil shale development should be added to either of the other two columns for oil shale development to arrive at a total land area requirement since it is expected that oil shale growth will be in addition to normal growth. The Table indicates then that an additional 9.1 square miles will be required for development without oil shale, an additional 14.9 square miles will be required for moderate oil shale development, and an additional 26.0 square miles will be required for intensive oil shale development. The land actually devoted to oil shale plants and ancillary facilities are not included in these estimates.

Table 17
LAND AREA REQUIREMENT
Based on 14th Year (1987) Level of Population and Housing Projections

Land Use	No Oil Shale Development (70,000 Population Increase)	Moderate Oil Shale Development (61,000 Population Increase)	Successful Oil Shale Development (161,000 Population Increase)
Residential	3,541 Acres	2,140 Acres	6,500 Acres
Single Family	(2,760)	(1,350)	(4,000)
Multi-Family	(493)	(321)	(1,250)
Mobile Homes	(288)	(469)	(1,250)
Community Facilities	290	191	505
Streets	1,080	587	1,744
Commerce	82	71	188
Industry	840	732*	1,932*
TOTALS	5,833 Acres 9.1 Square Miles	3,721 Acres 5.8 Square Miles	10,869 Acres 16.9 Square Miles

* Does not include lands devoted to oil shale plants and ancillary facilities necessary to serve those plants.

COMMUNITY FACILITIES

Community facilities are those governmental services which add to the quality of life in an area. Demands for public facilities increase as an area expands, as population grows and as living standards and expectations rise. As populations become more sophisticated their demands for traditional community facilities, such as water and sewer lines, not only increase but a need for other services such as health clinics or Junior Colleges also becomes apparent. A service or facility that a few years ago was a luxury may come to be regarded as a necessity.

An analysis of community facility needs and services which would result from population increase of 1,000 persons is summarized in Table 18. The Table describes the services provided (education), its physical manifestation (elementary school), its site requirements (size and land cost), its physical plant requirements (facility size and cost) and total cost for providing the service.

The costs given in Table 18 represent only initial acquisition and construction costs. Yearly operating expenditures are discussed later and will be in addition to these capital costs. It should be noted that the construction of some facilities is more dependent on service radius than population served. In the case of these facilities, density and proximity to existing facilities is more likely to influence needs than standards for population per facility.

Also, ideally, new community facilities will be built as existing facilities reach capacity. In many situations though, new residential growth is able to utilize excess or slack capacity in a community facility, thus disguising its burden on the community until that facility reaches capacity and a new one is required. The information in Table 18 should aid in judging the impact of population growth on the public facilities of a community.

EXPENDITURES AND REVENUES

Expenditures

The capital costs which have been detailed in the preceding section represent only a portion of the costs of supporting a given increment of population growth. In addition to new physical plant, there will be continual costs incurred in administering to and providing services to the additional population. These are the operating expenditures incurred by local government.

In the long run, operating expenditures may have a more significant financial impact than capital costs. While capital needs will make a tremendous early impact, the cost of the physical plant thus acquired may be spread out over a ten to twenty year period of time and the facility may have a useful life of a longer period. Operating costs will increase gradually to new levels and will need to be paid from this point forward. On this basis, capital costs might represent only a fraction of the total cost of growth to local government.

In 1976, capital outlay by local government in the three county area ranged from 13 percent to 17 percent of total general expenditures. In a period of higher than normal growth rates, however, the pressure for additional facilities could generate capital costs which would represent 20 percent to 30 percent of direct local government expenditures.

An analysis of 1967 Census of Governments data indicates that, based on the 62 counties (including over 1,200 units of local government) of Colorado, per capita expenditures for all items of local government exhibit a tendency to decrease slightly with population increase (county-size). Total per capita expenditures for individual county governments and school districts have a similar relationship. On the other hand, as population of a municipality increases beyond 5,000, per capita costs have a tendency to increase. The increase is slight in municipalities less than 100,000 population, but becomes considerable in municipalities exceeding 100,000 population.

Table 18
PUBLIC FACILITIES
SITE AND PHYSICAL PLANT NEEDS
(Incremental Population of 1,000)

SERVICE	FACILITY	SITE			PHYSICAL PLANT			
		Site Requirements	Totals	Site Costs (without Improvement)	Physical Plant and Facilities	Initial Capital Costs	Totals	Total Site & Plant Cost Per Service
Education	Elementary School	2.8 Acres		$ 5,600	0.2 Elementary School	$ 577,590		
	Jr. High School	1.5 Acres		3,000	0.06 Jr. High School	286,350		
	Sr. High School	1.7 Acres	6.0 Acres	3,400	0.04 Sr. High School	336,300	$1,200,240	
					1.8 School Buses	20,000		$1,232,240
Parks and Recreation	Playgrounds	1.5 Acres		$ 3,000	Improvements	$ 43,125		
					0.3 SB Field	6,210		
	Neighborhood Parks	2.0 Acres		4,000	Improvements	10,580		
					0.2 Tennis Courts	2,070		
	Playfields	1.5 Acres		3,000	Improvements	43,125		
					0.6 BB Field	17,250		
	Community Park	2.0 Acres		4,000	0.1 Swimming Pool	6,900		
					0.2 Community Building	4,600		
					0.3 Golf Holes	6,040		
	District Park	3.0 Acres	10.0 Acres	2,400			$ 139,900	$ 156,300
Libraries	Main or Branch	0.14 Acres	0.14 Acres	$ 350	0.14 Library (700 sf)	$ 24,320	$ 24,320	$ 24,670
Hospitals	District Serving	0.25 Acres	0.25 Acres	$ 625	4.0 Hospital Beds	$ 192,610	$ 192,610	$ 193,235
Fire Protection	Fire Station	0.07 Acres	0.07 Acres	$ 175	0.1 Fire Station	$ 9,370		
					0.1 Pumper	5,520		
					0.1 Truck	6,480	$ 24,370	$ 21,545
Police Protection	Police Station	0.06 Acres	0.06 Acres	$ 150	0.08 Station	$ 10,305	$ 10,305	
					0.4 Vehicles	1,325	$ 1,325	$ 11,780
General Control	Government Offices	0.003 Acres	0.003 Acres	$ 10	124 Square Feet	$ 6,620	$ 6,620	$ 6,630
Financial Admin.	Government Offices	0.001 Acres	0.001 Acres	$ 5	80 Square Feet	$ 4,270	$ 4,270	$ 4,275
Public Works	Garage	0.03 Acres	0.03 Acres	$ 60	400 Square Feet/	$ 7,820	$ 7,820	
					Vehicles	20,250	20,250	$ 28,180
Water Supply	Supply Development				To insure 200 acre feet/ 1,000 population	$ 200,000		
	Treatment Plant	1.0 Acres		$ 2,000	500,000 gallon additional capacity	125,000		
	Distribution		1.0 Acres		Storage, mains, hydrants	450,000	$ 775,000	$ 777,000
Sewer System	Treatment Plant	1.0 Acres		$ 2,000	(No advanced treatment)	$ 100,000		
	Collection System		1.0 Acres			$ 450,000	$ 550,000	$ 552,000
	TOTALS		18.55 Acres	$33,775			$2,974,030	$3,007,805
Streets		18.3 Acres	18.55 Acres		Total Improvement Plan			$1,368,000

* Generally, Streets and Street Improvements in new residential developments are provided by the developer and costs are reflected in property costs.

Table 19 shows the operating expenditures from all units of government in the three county area in terms of an incremental population of 1,000. Expenditures are shown for each county to indicate differential operating expenditures. The costs shown in the table for Rio Blanco County are uncommonly high, reflecting the county's small population base and high per capita costs for services. As Rio Blanco County gains population, its per capita costs for services will tend to decline and more nearly reflect the pattern of other Colorado counties of its size. Garfield County, on the other hand, will probably be required to increase services as it grows beyond its present size. Its per capita expenditures will probably rise to bring it more nearly in line with other counties of similar size.

Based on recent Colorado data, it is reasonable to project local government operating expenditures in the three county area in the range of $400 to $500 per capita. This would result in a $400,000 to $500,000 annual cost to service an incremental population of 1,000 persons. This figure assumes that all physical

Table 19
DIRECT GENERAL LOCAL GOVERNMENT EXPENDITURES*
OTHER THAN CAPITAL OUTLAY
(Annual Operating Expenditures)
1,000 Incremental Population

	Rio Blanco County	Garfield County	Mesa County
Direct General Expenditures Other Than Capital Outlay	$ 811,670	$ 392,780	$ 466,360
Education	356,790	201,520	281,630
Highways	95,620	53,880	29,870
Public Welfare	39,540	53,030	74,550
Hospitals	124,290	--	--
Health	110	1,810	4,100
Police Protection	19,710	10,400	9,900
Fire Protection	800	800	6,790
Sewerage	11,590	2,520	1,540
Sanitation Other than Sewerage	--	5,560	4,190
Parks and Recreation	19,190	4,490	6,540
Natural Resources	9,480	2,650	11,010
Housing and Urban Renewal	--	--	--
Correction	1,160	600	820
Libraries	1,690	2,440	1,880
Financial Administration	11,890	5,610	6,460
General Control	26,660	15,570	11,960
General Public Buildings	9,770	17,130	4,420
Interest on General Debt	54,790	6,080	8,340
Other and Unallocable	38,400	12,750	24,930
Water Supply Expenditure	15,050	16,570	28,120

* 1967 data converted to 1973 dollars.

NOTE: Columns may not add due to rounding

plant is in place and staffed. In actuality, all of the projected 1,000 population would not settle in at one time, nor would all staff and service personnel arrive at once. This level of spending would be reached over a period of time.

The above figures do not include any of the capital costs discussed in Table 18. The addition of direct capital outlays and debt service could raise per capita expenditures to the $600 level or higher depending upon what time period major capital expenses are amortized over.

Revenues

While new growth in the three county area will require land for housing and money for public facilities and governmental services, it will also produce revenues to local government in the form of ad valorem and sales taxes, fees, and intergovernmental transfers. These revenues will at least partially offset costs for services. Of importance, however, is the fact that real estate taxes will lag in their collection from one to two years behind the demand for services. Sales taxes and point-of-employment collection of income taxes, on the other hand, are collected more quickly and are therefore more responsive to the need for services.

It is possible to generalize on the amount of revenue which might be generated by an incremental population increase of 1,000 persons for some unspecified location in Western Colorado. This estimate is shown in Table 20. The Table accounts for only the commercial and industrial expansion that would normally accompany population growth. The establishment of an oil shale industry is not considered. Revenues from such an industry would be in addition to the figures shown.

Table 20
INCREASES IN ANNUAL REVENUES/
1,000 Increase in Population

Property Taxes		
Residential	$ 162,250	
Commercial	19,590	
Industrial	5,000	
TOTAL		$ 186,840
Sales Taxes		$ 18,420
Intergovernmental Transfers		$ 168,868
Charges for Current Services and Other Revenues		$ 54,482
TOTAL		$ 428,610

The general estimate of revenues in the previous table is not intended as a substitute for a more sophisticated and more accurate public finance model. Such a model is not possible for an unspecified location given the varying fee structures, tax rates, income levels, and growth rates which exist. The table represents a statement of possibilities. Many assumptions were made concerning the per capita incomes of the incoming population, the average value of new homes, the mil levy, and present revenues from fees. The same methodology could be used to arrive at some useful estimates for a specific jurisdiction by using that jurisdiction's tax rates and other figures.

A comparison of estimated revenues and costs outlined above indicates that potential revenues are not as large as possible expenditures. Revenues may cover annual operating expenses, but the large outlays needed for capital improvements tip the balance unfavorably. This is a typical pattern for rapidly growing areas.

There are some mitigating factors. These "normal" revenues do not include any revenues from an oil shale industry, nor do they assume any extraordinary commercial or industrial

development related to oil shale. Ad valorem taxes on an oil shale plant; increased industry; state or federal contributions; unforeseen secondary industry development as a result of oil shale; or new taxes would all improve the revenue picture. Taxing units with an oil shale industry and very little population may have a very favorable revenue picture. Over the entire region, however, the major problem will be the financing of capital improvements at the time they are needed.

The following table shows the range of costs and revenues which might be generated over the next fifteen years for the three different rates of growth based on the figures already developed. Assuming that local governments can adjust revenues to cover the major part of operating expenses, the magnitude of the capital costs are very important.

Expenditure and revenue comparisons preclude the consideration of some of the more qualitative aspects of growth. An expenditure/revenue analysis needs to be placed in the perspective of overall community goals. Revenues generated by new growth should not necessarily be narrowly construed as "benefits" nor can all expenditures be coldly dismissed as "costs". In a qualitative sense, some costs will be necessary to maintain and improve the quality of life in the region. The difference between revenues and expenditures is, therefore, only one measure of different courses of action.

Table 21
COSTS AND REVENUES*
15 Year Period

Growth Condition	Capital Costs	Operating Costs	Revenues
Normal Growth (70,000 Population Increase)	$210 million	$208 million	$178 million
Moderate Oil Shale Development (131,000 Population Increase)	$393 million	$435 million	$372 million
Intensive Oil Shale Development (231,000 Population Increase)	$693 million	$611 million	$524 million

* Costs and revenues for local government and school district only. Does not include costs to service oil shale plants nor revenues from those plants.

ATTITUDES TOWARD OIL SHALE DEVELOPMENT

The pending development of an oil shale industry in the three county area has received much publicity in the local news media. Many of the long-time residents of the area have been aware of the possibility of an industry developing for years. The previously mentioned survey of residents sought to take advantage of this general awareness in order to elicit attitudes and opinions toward the development of an oil shale industry in the region. General reactions are noted here.

More than 70 percent of the residents advocated encouraging additional industry in the area. Such a stance was most pronounced in Mesa County and least popular in Garfield County. The public officials agreed with their constituents regarding the desirability of new, small industry. Individuals generally agreed that heavy industry should be discouraged, but that retail businesses, shopping facilities, and non-polluting small industry should be encouraged.

Among the general public there was a somewhat negative reaction to increased growth in the tourist industry, whereas public officials regarded such type of activity as desirable.

The overall reaction to the prospects of oil shale development was positive. Development was viewed as helping the region, particularly

by residents in Mesa and Rio Blanco Counties. Public officials were more inclined to support oil shale development unequivocally than were the residents at large. Officials foresaw an improvement in the local economy. In addition, they indicated that even substantial growth would be beneficial, in that it would lead to an overloading of existing services and thus bring pressure for their improvement and enhancement.

The benefits of oil shale development were perceived as correcting the major deficiencies in the region. For example, development would produce more jobs in Mesa County and improved community facilities in Rio Blanco County.

The negative potential of oil shale development was downplayed. The two most feared consequences were over-crowding and increased pollution. Those individuals who opposed development expressed anxiety about the potential for greater complexity in their lives due to growth and over-crowding.

Three out of five residents predicted no negative environmental consequences resulting from oil shale development. The greatest concern, among both residents and public officials, was expressed in Garfield County. Residents of that area were particularly concerned about future population growth. The general public appeared to be more anxious regarding population increases than did the public officials. However, many of the latter individuals anticipated fewer than 10,000 new arrivals in the region during the first five years of development.

Public officials advocated some type of growth regulation, such as strict zoning and appropriate planning. There was a definite feeling among most individuals interviewed that the potential negative effects of oil shale development could be thwarted by intelligent planning.

V. AREAS AND ALTERNATIVES FOR GROWTH

DEVELOPMENT CRITERIA

In determining the suitability of land in the three county area for urban development, four principal factors were considered. They are discussed below:

1. *Slope*
   Slopes of less than 15 percent are considered optimum for urban development. They permit maximum flexibility in planning and in developing residential and supporting uses such as streets, drainage, and utility systems. In areas of 15 percent to 20 percent slope, development should be limited to small scale, low density development. Slopes greater than 20 percent are generally undesirable due to limitations on planning and development, relatively high development costs, and higher incidence of usable or marginally usable land.

2. *Soil Characteristics*
   Through appropriate soils analysis, factors such as permeability, shrink-swell potential, corrosivity, water table conditions, natural runoff, flood hazards, and subsidence due to withdrawal of fluids can be determined. Each of these is important in determining development suitability, and contributes to evaluating the development potential of an area.

3. *Alternative and Competing Uses for Land*
   In this three-county area, there are significant uses already being made of the land. These include irrigated and dry agricultural land, Bureau of Land Management (BLM) land, National Forest land, floodplain areas, and areas of groundwater recharge.

The productive agricultural land plays an extremely important part in the economy of the Western Slope. The agricultural areas around Grand Junction and Meeker are very productive. In these areas, agriculture contributes significantly to the economy as well as to the social and cultural patterns of the region. Disruption of these areas might result in undesirable modifications to the existing economy and living patterns.

BLM and National Forest land also constitutes a significant competing use. These areas are used primarily for grazing and recreation. They are generally located in higher and steeper areas, which contain scenic views, wilderness, unique features, and unique flora and fauna. With the advent of more residential and industrial development in this three county area, maintenance of these protected open spaces is of vital importance to the social and cultural being of the existing and new residents.

Floodplain areas and areas of groundwater recharge are the most significant competing uses for otherwise developable areas. The floodplain is subjected to hazardous floods and any man-made obstructions on the floodplain can be partially or totally destroyed. The low, flat areas along the Colorado and White Rivers are particularly vulnerable to urban development since these two valleys also contain major transportation routes. Urbanization would increase the rate of runoff from urbanized land and increase the exposure of persons and structures to the heightened hazard.

Areas of groundwater recharge are also significant competing uses. These areas are the original sources of water supply for all

uses. Any development in these areas will reduce and possibly pollute this important source -- an undesirable situation which must be prevented.

4. *Logistical Problems*
Although slope, soil, and land use characteristics of an area may make it suitable for urban development, other constraints related to the area's general location and siting must be considered. Specific logistical problems associated with development include high elevations, difficulty of access, air pollution, wind erosion, and difficulty of excavation.

Areas of high elevation -- greater than 7,000 feet -- suffer from numerous problems. In the winter months, the amount of snow and the period of time the ground is covered becomes a major constraint. This in turn effects temperatures, soil erosion, and spring runoff.

Access to high areas is a problem in the winter due to the snow and may remain a limitation during the hotter months because of terrain. Establishing major access requires cutting and filling, particularly along the steeper escarpments leading to the high lying mesas. In addition to inducing slope instability, the road cuts will have to be a special nature to compensate for the adverse effects of the underlying clayey soils -- the extreme stickiness, and high shrink-swell potential when wet. Additional problems of induced landsliding and wind and water erosion also place tight constraints on establishing major access.

Air pollution within narrow valleys is another logistical problem in the study area. Development within these narrow valleys will change the present quality of the air by introducing chemical pollution and particulate matter. Due to the adjacent steeply rising mountains, this pollution will be unable to disperse. Rather, it will settle in the narrow confines of the valley resulting in adverse conditions of air pollution, possible temperature inversions, and aesthetic pollution.

Should bedrock occur too close to the surface of the land and should the bedrock be a very hard nature; blasting may be required for development. Such a method of excavation, however, is extremely expensive and thus becomes a significant development constraint.

In addition to the above mentioned physical limitations, social, and cultural limitations must also be considered. New urban communities should be located in areas having enough suitable land to permit the establishment of a community of a reasonable size. There are no universally accepted standards for optimum city size. The figures most often quoted, however, is 50,000 to 100,000 people. Of prime planning importance in determining the size of new communities are those attributes of urban areas generally considered to be desirable such as:

1. A functional local government capable of economically providing necessary services (including effective growth control) and utilities,

2. Commercial areas offering comparison shopping and quality selection,

3. A school system providing a broad range of academic pursuits,

4. A balanced and sound tax base,

5. Civic and cultural facilities such as libraries and museums, and

6. Cohesive and identifiable neighborhoods within the community.

Consideration must also be given to the expansion of existing communities that are capable and desirous of growth.

Urban development must be located in reasonable proximity to basic employment generators to avoid excessive home to work travel -- particularly where travel must occur in or through areas subject to air pollution.

LAND AREA ANALYSIS

The maps and charts which are a part of this section reflect the results of an analysis of the three county area based on the above criteria. A rating system, utilizing each of the four criteria, was developed for application of the three county area. The rating system classifies lands from best to worst in one of five categories. Following is a brief description of the rating categories:

I. *Areas Most Suitable for Development*
These areas are most tolerant of urban type uses and have few hazard characteristics. They generally have slopes of less than 20 percent and have slight soil and geologic limitations. There is no significant competition from other uses for these areas and no significant logistical problems. While these areas are generally the most suitable for development there are within them isolated questionable areas which require careful examination prior to any development.

II. *Lands Alternatively Suitable for Development*
These lands possess many of the positive aspects of slope, soils, and competing uses that were characteristics of Class I lands. However, there are significant logistical problems in that these areas may be isolated from major access roads, and/or difficult to service with utilities.

III. *Lands Marginally Suitable for Development*
These lands are marginal in that there is an identifiable competition for use of the land. Aspects of slope, soils, and logistics are generally positive. Competition is the use of this land for farming and agricultural purposes.

IV. *Lands Least Suitable for Development*
Although these lands have positive slope and soil characteristics there is significant competition for the use of the land as well as identifiable logistical problems.

V. *Lands Not Suitable for Development*
The primary reason these areas are not suitable for development is their questionable soils characteristics. Because of this factor, competition and logistics have been discounted.

The table on the following page shows the results of applying this rating system to the three county area.

Figure 10 makes two major development problems immediately apparent. Expansion of existing communities -- particularly those in the Colorado River Valley -- will (1) occur largely on land suitable for agriculture, and (2) increase the potential for serious air pollution problems since most of these communities are located in natural basins of varying size. These communities probably cannot freeze their population and area at the present level in favor of diverting all new growth to a new area not yet selected, nor perhaps is such a course of action even desirable. An awareness of the problem can, however, be reflected in the communities' approach to development patterns and growth policies.

Table 23 summarizes the amount of developable land by analysis category. These figures are placed in proper persepctive by noting that the communities in the three county region presentlv occupv only 14.4 square miles, and to accommodate normal increases plus intensive oil shale development, this report has projected the need for an additional 26.0 square miles. Most importantly, these figures indicate that:

1. There is indeed suitable land to support a substantial growth in population, and

2. There is lattitude for carefully considered choices to be made on where that growth will occur.

Further urbanization will require that many value judgements be made by local decision makers. Local policies will need to be developed and tied closely to regional and State policies. These policies should address the issue of which lands should be developed. Some of the Category I lands, for instance, are now used for moderately productive dry land farming and grazing. Category II lands are the best irrigated arqicultural lands. Category IV lands are difficult to develop. So, while all of the land area shown in Table 23 is developable -- 916.3 square miles -- this amount should be reduced substantially by policies and decisions designed to insure that only the most appropriate land is developed for urban use.

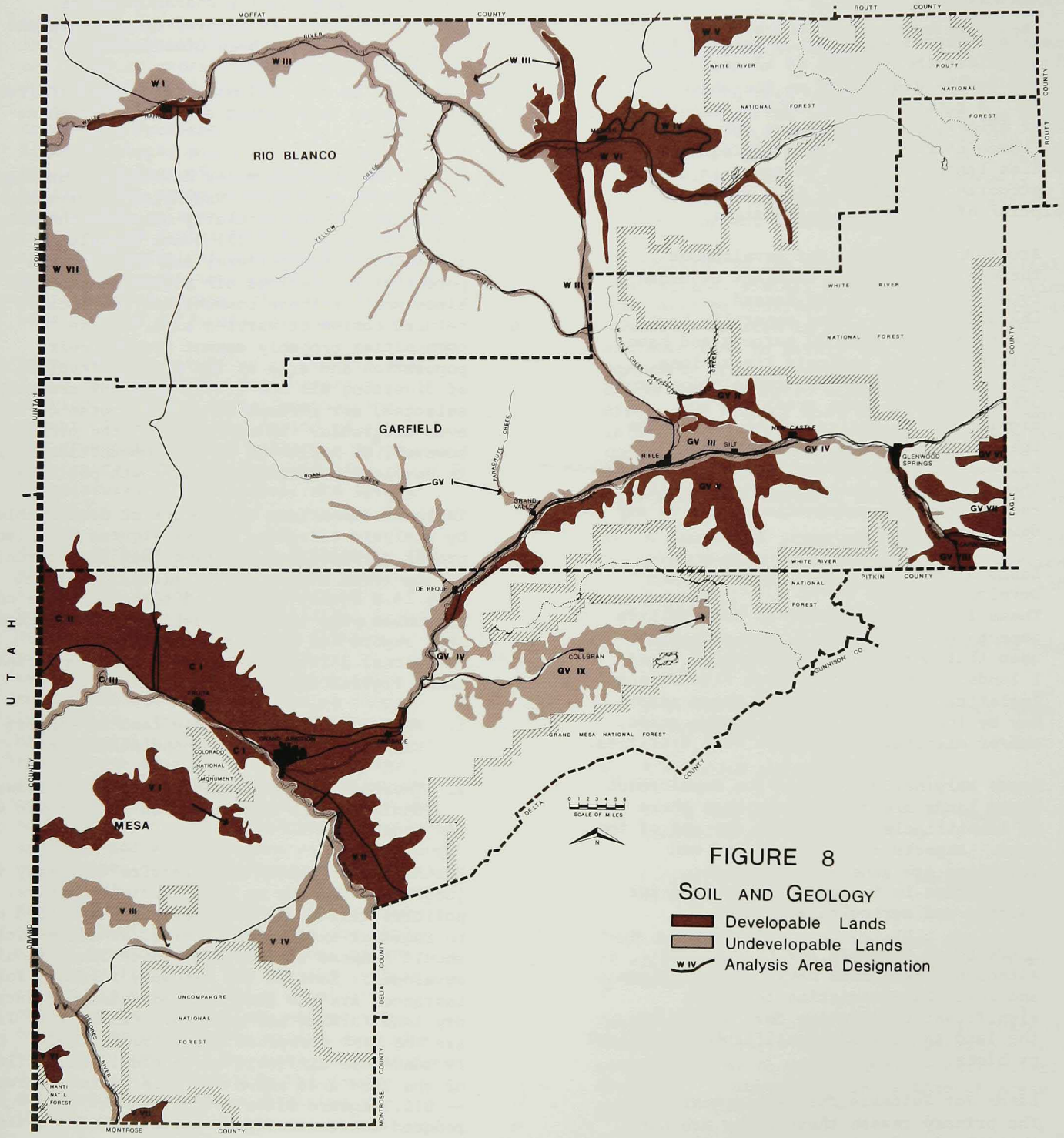


FIGURE 8

SOIL AND GEOLOGY

Developable Lands

Undevelopable Lands

W IV Analysis Area Designation

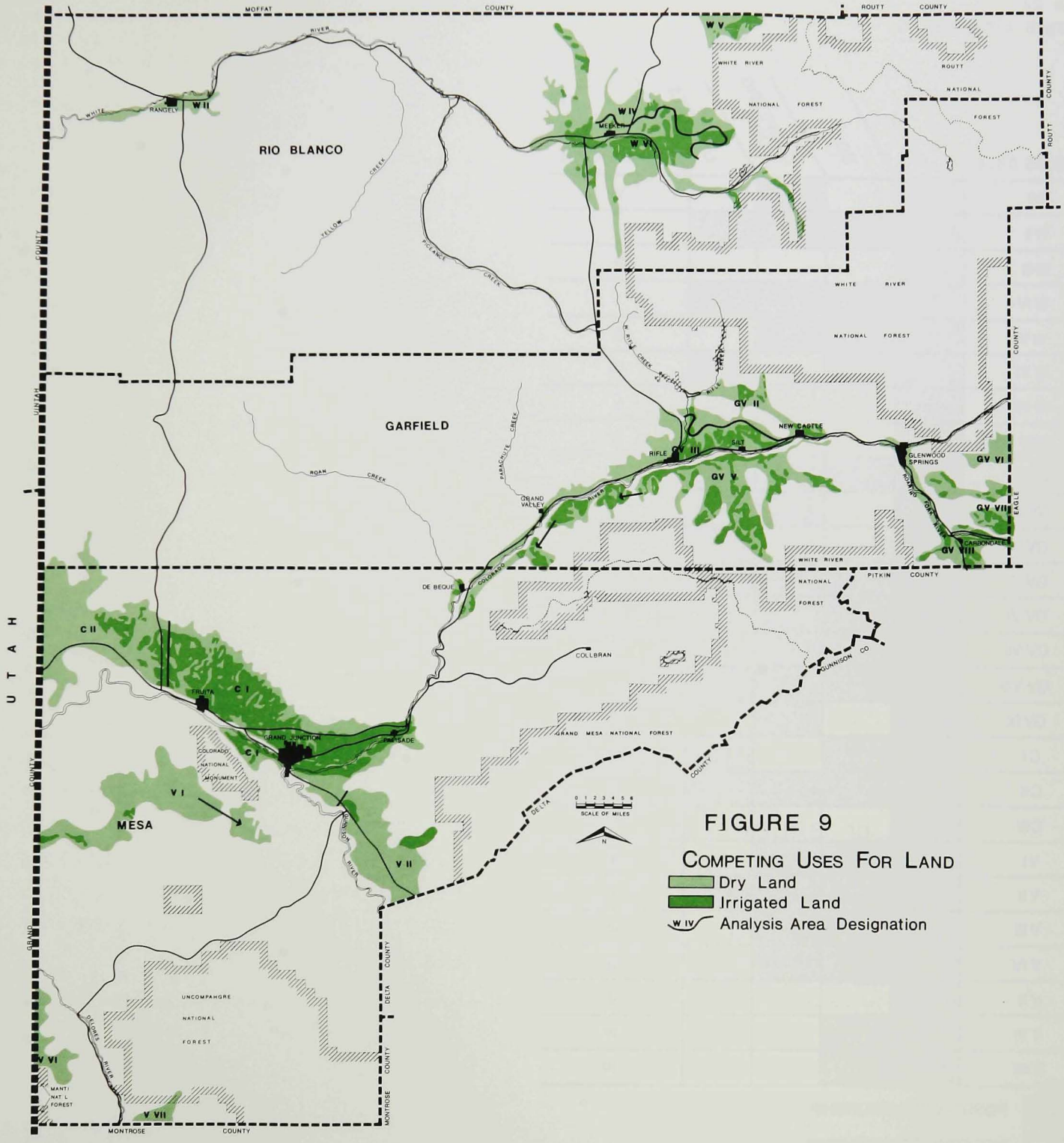


FIGURE 9

COMPETING USES FOR LAND

Dry Land

Irrigated Land

W IV Analysis Area Designation

Table 22
ANALYSIS AREA RATING

ANALYSIS AREA	SLOPE	SOILS	COMPETING USES	LOGISTICS	FINAL RATING
W I	■		■		V
W II	■	■	■	■	I
W III	■				V
W IV	■	■	■	■	I
W V	■	■	■		II
W VI	■	■		■	III
W VII	■				V
GV I	■				V
GV II	■	■	■	■	I
GV III	■		■	■	V
GV IV	■			■	V
GV V	■	■	■	■	I
GV VI	■	■	■		II
GV VII	■	■	■		II
GV VIII	■	■	■	■	I
GV IX	■		■		V
C I	■	■		■	III
C II	■	■	■	■	I
C III	■				V
V I	■	■	■		II
V II	■	■	■	■	I
V III	■	■	■		III
V IV	■	■	■		III
V V	■				V
V VI	■	■			IV
V VII	■	■			IV

■ POSITIVE RELATIONSHIP

NEGATIVE RELATIONSHIP

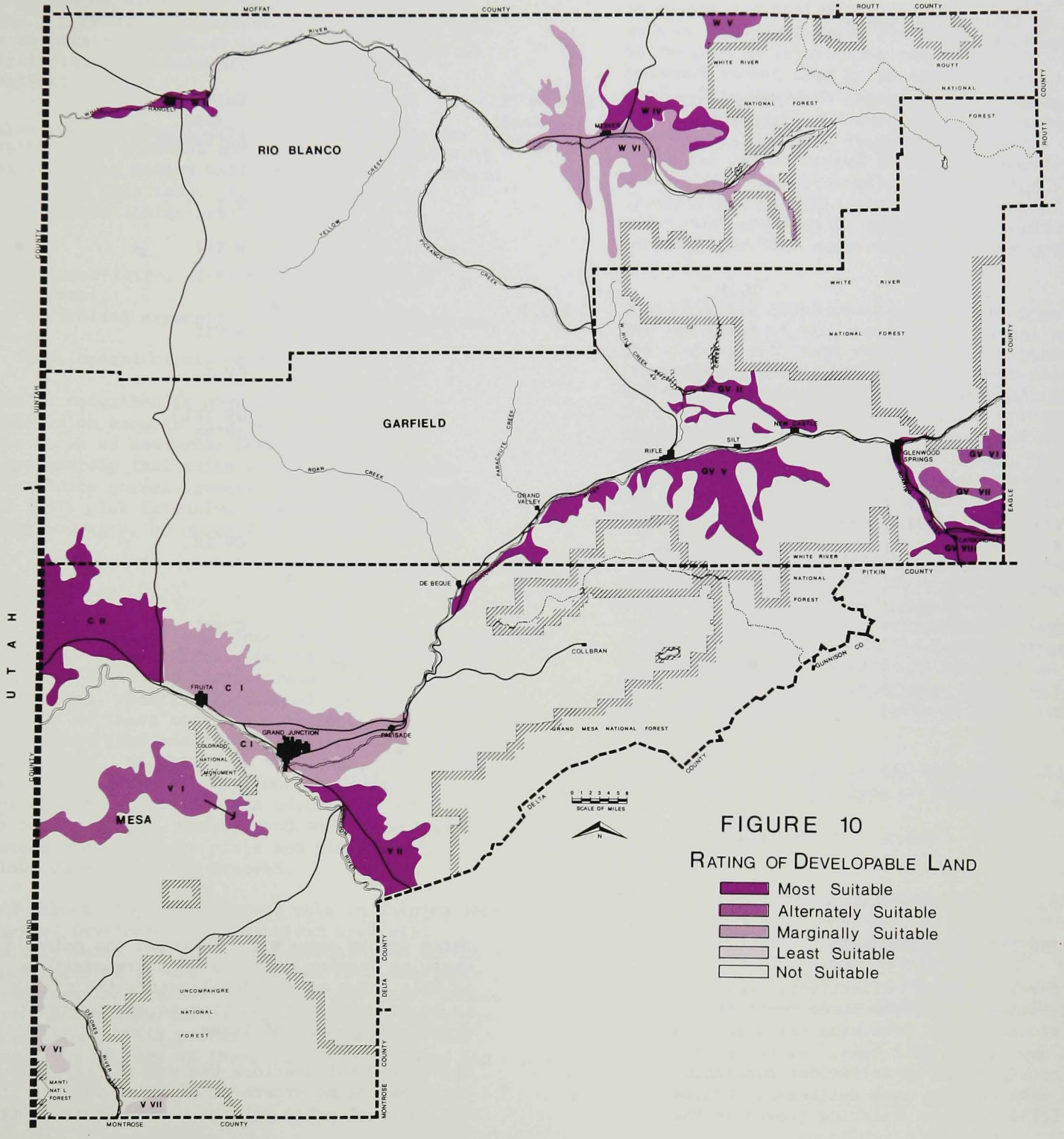


FIGURE 10

RATING OF DEVELOPABLE LAND

- Most Suitable
- Alternately Suitable
- Marginally Suitable
- Least Suitable
- Not Suitable

Table 23
AREA OF DEVELOPABLE LANDS
In Square Miles

Analysis Area	Rating I (Most Suitable)	Rating II (Alternately Suitable)	Rating III (Marginally Suitable)	Rating IV (Least Suitable)	Rating V (Not Suitable)
W I					W I
W II	17.1				
W III					W III
W IV	36.0				
W V		16.2			
W VI			142.2		
W VII					W VII
GV I					GV I
GV II	24.3				
GV III					GV III
GV IV					GV IV
GV V	113.4				
GV VI		9.9			
GV VII		16.3			
GV VIII	44.1				
GV IX					GV IX
C I			195.3		
C II	116.1				
C III					C III
V I		91.8			
V II	69.3				
V III					V III
V IV					V IV
V V					V V
V VI				17.1	
V VII				7.2	
	420.3	134.2	337.5	24.3	

ALTERNATIVE URBAN PATTERNS

The three counties collectively and the communities within the three counties individually must determine the direction that new growth will take. As has been indicated, there is sufficient available land area so that some deliberate choices can still be made. Existing growth in the three county area has not passed the point where no further modifications are possible. At this stage of its development, the region is in an excellent position to shape future growth along desired lines.

One should not overlook the possibility that there may be no growth at all. In that event, the regional urban pattern would remain as it

presently is with whatever minor modifications time may bring. In reviewing the forces at work in the State in general and western Colorado in particular, that does not appear to be an available choice.

Three general growth patterns are possible for the region. The policies and growth philosophies of the governing bodies will determine which pattern new growth will take. Broadly described, three possibilities are:

1. Laissez-faire, (little or no control of growth),
2. Controlled expansion of existing communities, or
3. Development of new communities

Each is described in more detail below and depicted on maps in this section. The land mass shown as new urban development is approximately that which would be required to accommodate normal economic growth for 15 years (to 1987) plus intensive development of an oil shale industry, or about 230,000 new citizens.

Laissez-faire

This is an all too prevalent type of urban growth. It is applied graphically to the three county area in Figure 11. This pattern results when urban development, reacting to economic demand, follows the path of least resistance. The location of flat developable land and transportation routes shape this growth. In this type of growth, the public accepts the responsibility only to administer the minimum regulations for the purpose of protecting the public health, safety, and welfare and to process the necessary plats and plans which allows development to proceed.

Land values play an important role in shaping this growth. Development of any given area will probably raise the value of adjacent land to the point where it is cheaper for the next developer to acquire land farther out along the major access routes and develop there, thus bypassing the higher priced land. This process is repeated over and over again as long as there is available land and good access.

Densities are typically low, both because areas without municipal water and sewer may be forced to develop on larger lots and because the bypassed vacant land keeps overall densities down. This approach takes more land to house a given number of persons than a different development approach at a higher density. Low densities and scattered development causes heavy reliance on the automobile as the method of transportation. This could be a source of additional problems in an era of increasing concern over fuel conservation and air pollution control.

This possible development pattern represents the sum total of many private individual actions and choices with each individual or organization responding according to their own self-interest and their interpretation of market conditions. This pattern represents very little effort on the part of public decision makers, yet a very definite urban form would be produced. A decision on the part of local decision makers not to act is nevertheless a positive action with recognizable results.

This pattern of elongated development along major transportation corridors and drainage basins would be inhibited only by market forces, topography, and perhaps air pollution regulations. The vast public land holdings in the three county area would have little effect on shaping an urban form, since much of the land along the major roads is still in private ownership.

Listed below are some of the advantages and disadvantages of this type of development:

Advantages

1. In the short run, it represents the least administrative cost for the responsible public agency. Government need only determine that legal requirements are met for platting and that basic protection of the public health, safety, and welfare is achieved.

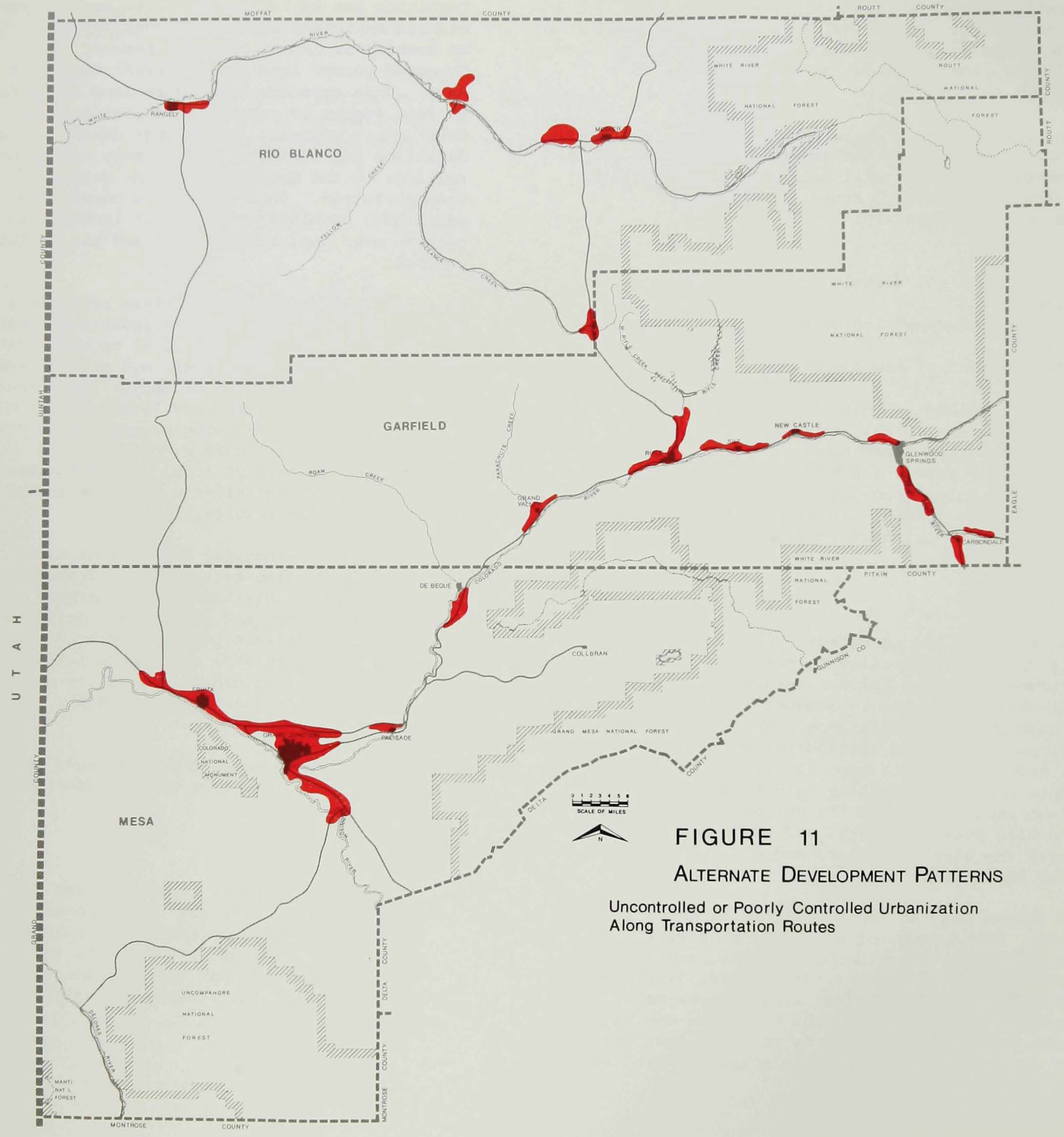


FIGURE 11

ALTERNATE DEVELOPMENT PATTERNS

Uncontrolled or Poorly Controlled Urbanization
Along Transportation Routes

2. It represents the maximum freedom of action for individual land owners and developers. They need to be responsive only to market conditions and available water.

3. Few new transportation routes would be needed into developing areas since growth would take place along existing routes.

Disadvantages

1. Even scattered development, as it became more intense, would begin to require a full range of urban services (water, sewer, fire protection, police protection, schools, libraries). Because of the development pattern, these would be difficult and expensive to provide. At the time any particular service were demanded by an already existing population, the start-up costs to provide that service would be prohibitive. To provide the needed services, there would evolve a plethora of competing and overlapping special service districts which are a poor substitute for a responsive, all purpose, local unit of government.

2. The total costs for services provided by many special districts is likely to be higher to the individual homeowner than if provided by a local government.

3. A "sense of community" would be difficult to maintain in this type of development pattern, making it difficult for local government to function.

4. Much of this development would take place on irrigated agricultural lands to the detriment of the region's economy. An individual owner or developer whose attention is focused on a specific property is the least qualified person to make broad value judgements about the city-wide, county-wide, or regional impact of changing land from one use to another.

5. Frequent access points would be required on major transportation routes to serve adjacent development. This would increase congestion and traffic friction along these routes.

Controlled Expansion of Existing Communities

Another possible development pattern would require that all new growth take place within or adjacent to existing communities. For most communities this would mean the acceptance of slightly higher densities, the filling in of vacant land within existing town boundaries, and the annexation of suitable new lands for additional growth. The amount of growth which would take place in any given community would directly relate to the future of an oil shale industry.

Figure 12 shows this type of settlement pattern for an intensive oil shale development program. The pattern assumes that all of the existing communities will share in the growth, although not necessarily equally, and that all of the existing communities are capable of, and willing to, accept additional growth. Because of access to transportation routes, the Colorado River Valley again is the focus for a major share of the new development. The advantages and disadvantages of such a development pattern are listed below:

Advantages

1. Urban services that will be needed for new population can be provided more efficiently and at less expense if growth is concentrated. Long runs of utilities to reach scattered urban development can be avoided. Community facilities can be provided within or easily accessible to the areas they serve.

2. New growth areas can more readily be incorporated into an existing municipal governmental structure rather than remaining unincorporated or incorporating as a new, inexperienced municipality.

3. Planned major access points can be provided from I-70 and other important routes to areas of population concentration rather than creating a multiplicity of minor access points for scattered population.

4. Compact growth centers lend themselves more readily to efficient service by public transportation, an important consideration in an area of rapid population growth and potential auto induced air pollution.

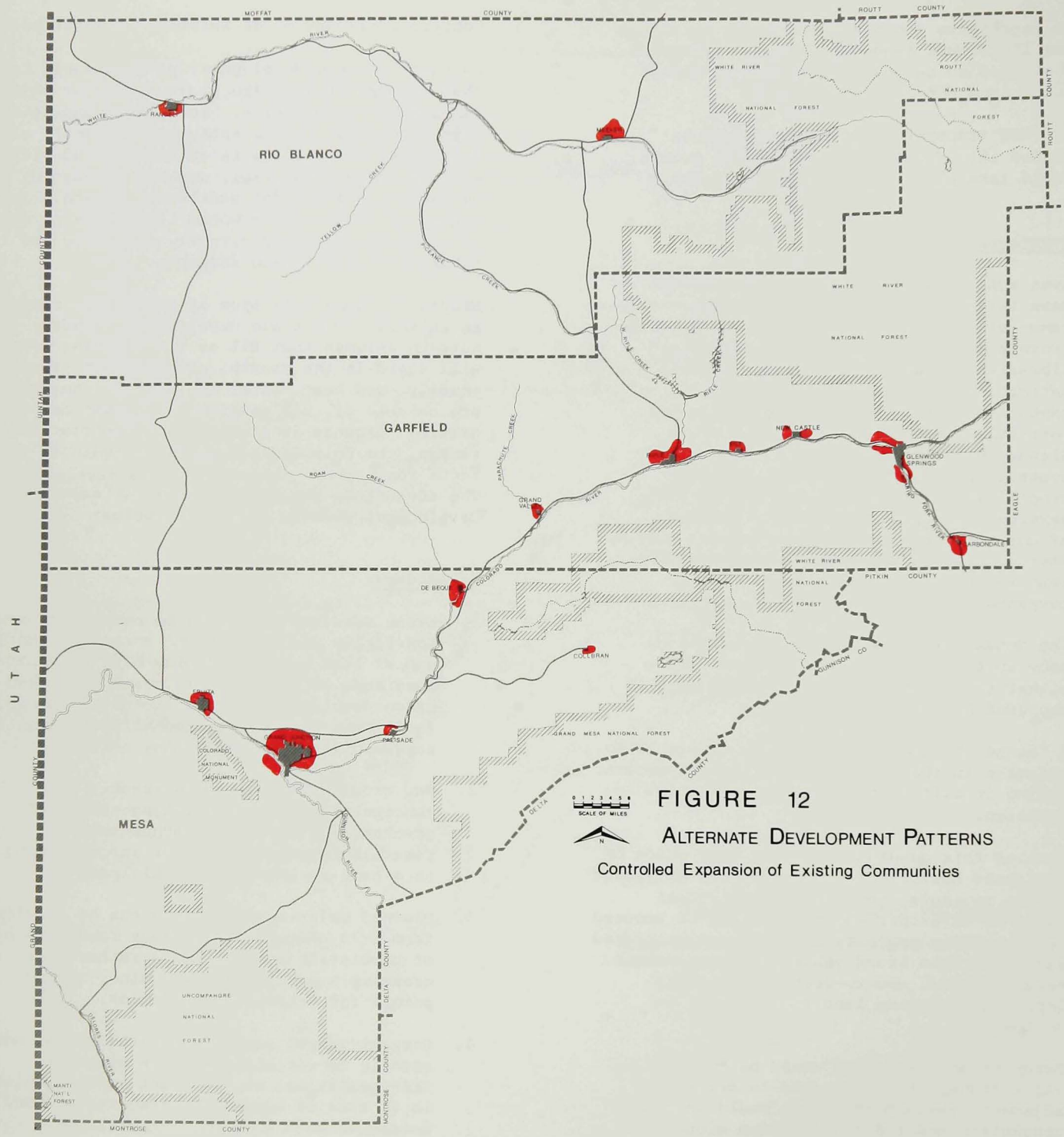


FIGURE 12

ALTERNATE DEVELOPMENT PATTERNS

Controlled Expansion of Existing Communities

5. Control of growth also affords an opportunity for providing a diversity of housing types to meet a wide range of demands.

6. Concentrated growth reduces the amount of land which would be taken out of productive agricultural use.

7. Communities would develop and maintain a true identity which would not be possible with scattered development.

Disadvantages

1. Existing units of local government would need to "tool up" both administratively and in terms of physical plant to accommodate new growth. This would result in increased capital and operating costs. In the absence of any federal or State programs which would off-set these costs, this "front end" expenditure to get ready to receive new growth would have to be borne by existing units of local government at a time when they are ill prepared to do so.

2. Increased populations which may double or triple the size of existing small towns will also alter the existing social fabric.

3. Owners of vacant land near existing towns may be in a location to benefit financially from the contiguous, outward growth of the community while land owners in more remote locations will not have that opportunity.

4. This growth pattern requires a conscious, continuing cooperative effort on the part of both county and municipal government to bring about. It also implies the existence of and adherence to a regional plan with well developed and agreed to regional growth policies. To achieve this will mean that each participating unit of government will need to forego a certain amount of independent action.

New Towns

The accomplishment of this development pattern also implies a great degree of land use control. It calls for directing growth into certain specified areas which would include selected existing communities and new towns. A consensus on which existing towns might be expanded and the location for new town sites should come only after appropriate investigations and deliberation by the Colorado West Area Council of Governments as the responsible regional planning agency. The findings of such investigations should be dissemminated widely to achieve public understanding and acceptance.

Grand Junction, Rifle, Glenwood Springs, Meeker, and Rangely are obviously candidates for expanded centers. Investigations by COG and these communities should center on suitable and sufficient land area for growth, provision of adequate utilities and services, and adequacy of local government organizations to accommodate growth. A willingness on the part of the townspeople and governmental officials to deal adequately with growth is also important.

New town locations would need to be selected with care and would require considerable cooperation between the sponsoring organization and county officials who would ultimately be responsible for zoning the land and securing access to the new town site. Investigations leading to the selection of a new town site should include at a minimum:

1. Soil characteristics
2. Slope
3. Access for the entire new population
4. Water availability
5. Sewer discharge areas
6. Solid waste disposal
7. Microclimate of possible areas
8. Adaptability to different kinds of urban land use
9. Location in respect to other communities and employment

Development of entire new communities to accommodate future population growth is probably most feasible if oil shale development is successful. Growth projected to occur as a result of normal economic trends, while significant, is still manageable and can probably be accommodated by existing communities. Substantial growth occuring as a result of oil shale development, particularly if it comes about rapidly, will severely strain the capability of existing areas to handle it. One or two new towns might then become a necessary safety valve.

Development of a new town does not occur by selecting a site and directing new growth to that area. The new town site must be carefully planned to provide for a full range of urban land uses. Support systems such as water, sewer, fire protection, police protection, and overall management must be created to begin operating with the arrival of the first inhabitants. This type of effort requires a sponsoring agency or organization and the expenditure of a considerable amount of "front end" money before there is any return on the investment.

Investigations of soils and slope indicate that two general areas are appropriate for new town development. These are the mesas lying generally south of the Colorado River between Silt and DeBeque and and area lying east of Meeker along the White River. More detailed future investigations may pin-point additional locations.

The possible new town site lying east of Meeker lies too close to an existing community for good geographic distribution of population. A better choice might be to expand existing Meeker to considerable size rather than establish a new community a few miles away. It is shown there because of favorable slope and soil conditions. Better geographic distribution of population and traffic patterns would be obtained if a new town were located somewhere near the confluence of Piceance Creek and the White River. Preliminary investigations of this location indicate poor soil conditions for urbanization. More definitive investigations should be undertaken to determine the seriousness of the problem. A new town site here, expansion of existing communities and a possible new town on the mesas south of Grand Valley would result in excellent regional population distribution.

New communities should be planned for at least 50,000 people. This size will support a full range of urban services and is large enough to create its own identity in the region. A new community of this size or larger may be required to absorb its share of the projected future population. Considering the amount of organization and lead time required to bring a new community into being, it appears obvious that the existing communities will need to absorb the first several years of incremental growth.

A regional pattern showing the growth of selected existing communities and the establishment of two new towns is shown on Figure 13. Advantages and disadvantages of this regional development pattern are listed below:

Advantages

1. As in the previous alternate pattern, urban services are more cheaply and efficiently provided to concentrated populations.

2. Controlled expansion of selected existing communities and careful selection of new town locations would guarantee the best use of land for the region. Agricultural land would be preserved from urban sprawl and urban expansion would take place around existing centers.

3. This pattern of planned and concentrated population could be serviced more easily by public transportation than scattered growth.

4. A community identity would be maintained in the existing towns and an identity would likely be established in the new towns.

5. The development of two new communities would allow the testing and utilization of new materials and concepts which might serve as examples for the further development of existing towns.

6. Having new communities as a part of the development pattern would relieve pressure on existing areas to accommodate all of the projected growth.

Disadvantages

1. The deliberate allocation of population to selected areas will be controversial and will require a strong regional planning body and excellent cooperation between separate units of local government.

2. Guiding the rapid development of an existing community or judging the merits of a major new town proposal requires a level of knowledge and experience not now available in most of the units of government in the

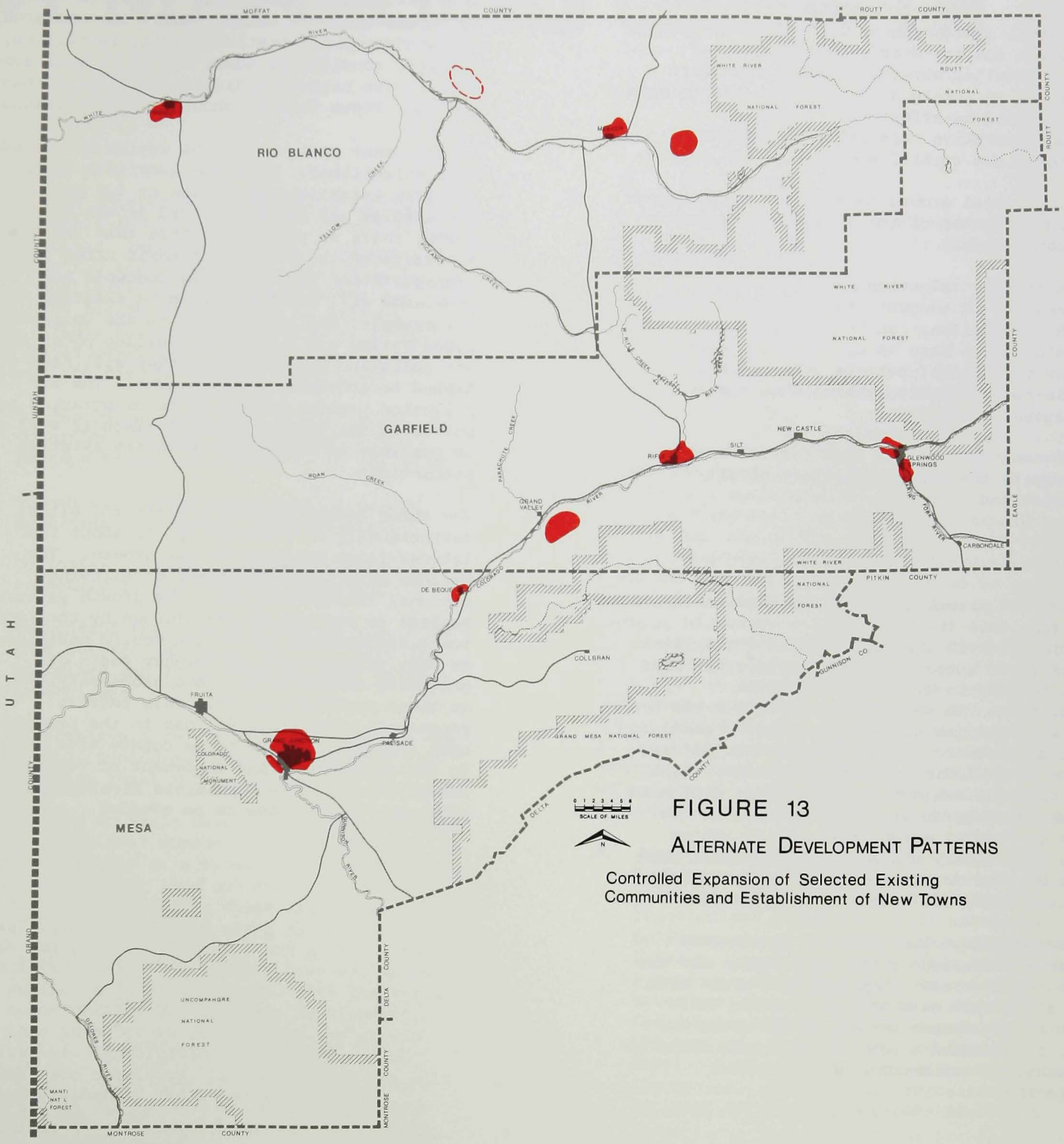


FIGURE 13

ALTERNATE DEVELOPMENT PATTERNS

Controlled Expansion of Selected Existing Communities and Establishment of New Towns

region. A danger exists that an effort to control growth can be handled badly with a result not too different from that of uncontrolled growth. Communities where growth is likely to occur will need to make a tremendous effort to provide for administrative capability in advance of growth and capital needs as growth occurs.

3. Substantial growth could drastically change the character of the selected existing communities.

4. Deliberate selection of growth areas requires an adequate information base on which decisions can be based. That information base is of dubious quality now and may not yet be adequate for pin-point decision making when growth begins to occur.

5. Directing growth in this fashion would require the sustained effort of all concerned.

OVERVIEW

Substantial growth is coming to western Colorado at a time when there is still a vacuum in growth policies at both the national and State level. Considerable interest in the subject has been shown both by Congress and the State legislature. To date, however, little has been adopted which can serve as a specific guide to local government. In the foreseeable future, Region 11 including the three counties which have been the subject of this study, will need to make choices in growth without clear cut State or federal guidelines. While taking these preliminary steps, the Region will need to be attuned to developing State and national policies which will affect its decisions.

A combination of the last two development patterns discussed is the best choice for the three county area. This approach would mean that all of the existing communities would share in the future growth of the area, and that, in addition a new town or towns would be necessary to accommodate the projected population.

This does not mean that all of the existing communities should share equally in this growth. Circumstances of location, public facilities, climatic conditions, water and soils make some communities better candidates for growth than others. These factors should guide decisions.

A settlement pattern for the region is already well established. With the exception of the possible establishment of one or two new communities and the controlled growth of existing towns, there is probably little that can be done to rearrange the present historic urban and transportation pattern. New concepts and knowledge will be compromised by existing fact. For example, the communities in the Colorado River Valley are subject to serious potential air pollution problems, yet they will need to expand to accommodate new growth. The air pollution problem will need to be attacked and solved on the technical level since it will not be possible to completely relocate existing populations.

The three county area cannot afford, either aesthetically or financially, to adopt the laissez-faire approach to new growth. The obvious short run advantages of allowing personal freedom and being the growth pattern easiest to accomplish are clouded by the long run disadvantages for future public officials as they grapple with the higher costs of providing administration and urban services to these scattered areas. This pattern represents a substantial loss to the present open character of the three county area and to the convenience and enjoyment of future inhabitants. It is a possible development pattern, however, one to be avoided.

VI. MANAGING GROWTH

To achieve consistency in decision making, a set of goals should be adopted for the region. Once adopted, they should receive widespread distribution and constant discussion as to their applicability and appropriateness. Then, the region should begin to evolve institutions and methods for addressing them. Five broad goals are suggested here as appropriate for the region. They are:

1. To develop a capability at all levels of government to deal with growth -- and perhaps temporary decline -- in the region.

2. To achieve a manageable rate of growth sufficient to counter economic decline.

3. To foster a diversified growth which is economically and socially balanced.

4. To control the rate and type of growth so that adverse public and social costs are minimized and a suitable regional pattern is achieved.

5. To preserve a choice of life styles in the region, including the maintenance of the existing rural and small town way of life.

In addition to goals developed at the regional level, individual communities will need to develop specific objectives for growth before they can identify long and short range solutions for achieving those objectives. These objectives should serve as a continuing guide for planning, policy, and action. These objectives, will mean little, however, unless the public is first acquainted with the threats and opportunities of oil shale development, and then involved in determining the growth objectives. Information and advice may be sought from outsiders, but objectives can only be established by the community.

To achieve these goals and address some of the issues in the region, the following specific recommendations are offered:

ORGANIZATION FOR GROWTH

There is a legitimate planning function at three levels in western Colorado: (1) regional (2) county and (3) city. In viewing the present situation, immediate emphasis should be given to expanding the planning function at the regional and county levels. Staffs at these higher levels should lend assistance to the towns and cities until a local planning staff is warranted by either the size of the community or the complexity of its problems. The roles of the various planning agencies should be defined as clearly as possible as staff expansion occurs.

The Colorado West Area Council of Governments is in an excellent position to immediately sponsor this type of discussion. A clear definition of functions would eliminate costly duplication of effort and would insure that planning programs at the three levels compliment each other and not compete. These functions, once defined, should be supported by the elected officials. The following division of responsibility is suggested:

1. *Council of Governments*
   Formulate regional growth and development policies, distribute them widely for citizen reaction and education, adopt consensus policies as a guide for future planning. Develop, interpret, distribute, and maintain a regional comprehensive plan. Assist local governments in their planning programs. Coordinate federal and State programs for the region. Analyze the need for and develop State legislation which would help the region. Serve as the repository for regional information and make pertinent

material available to local governments. Monitor and comment on regional growth and development. Develop a public information program to explain area problems and opportunities. Serve as the translator of State policies to the region and local needs to the State.

2. *County Planning Function*
Formulate county growth objectives and policies as input to the development of regional policies. Develop a county Comprehensive Plan compatible with regional growth policies and in cooperation with the communities of the county. Develop and administer county land use and development regulations for the unincorporated areas of the county. Upon request, develop and assist in the administration of adequate regulations and plans for the communities. Devise and administer the county capital improvements program directed at meeting the demands of growth. Coordinate planning efforts with regional and local units of government.

3. *City Planning Function*
(where appropriate in growing communities) Formulate development policies for the community for public discussion and eventual adoption. Prepare and maintain the City Comprehensive Plan, recognizing both regional and county growth policies and plans. Develop and administer city land use regulations. Collect and interpret information which will lead to better local decision making on development. Develop and administer the city capital improvement program including an examination of ways to pay for growth. Carry on a public information program designed to make the public aware of current development problems. Coordinate city programs with county and regional planning agencies.

The separation of roles described above can be achieved only if adequate staffing exists at all three levels. In the immediate future this will probably not be the case in the three counties. While adequate capability is developing, expertise should be sought wherever it exists. Small communities should logically turn to the county planning staff for assistance and advice. As COG develops expertise in certain areas, this staff too should render assistance to the region's counties and communities. Communities that are destined to remain small may need to rely entirely for policy guidance and technical help on the county or regional staff. In these instances, the local city council and planning commission will be performing the local planning function with the assistance of county or regional staff.

During these initial efforts, it is important that the developing planning process be closely tied to the legislative and political process. City councils and county commissions alike will need to recognize the action on individual zoning, subdivision, annexation, or utility extension matters are basic development decisions which shape the form and nature of the community and should be considered in that context. Legislative bodies should early determine the goals of the community and shape a planning process.

While unlike counties and cities, COG is not a single political entity. COG can exercise considerable control if it wishes to. It can do this in the review of federal funding for projects which would spur development and by having individual COG members support COG policies at their local level. For the good of the entire region, the making of some hard decisions will be required of the COG governing board.

The task forces which were set up by the Oil Shale Regional Planning Commission should continue to have a function with COG but in a slightly different role. The persons on each committee should be reduced to a workable number who have a direct responsibility in that particular function in the region. These committees would then become Technical Advisory Committees in that subject to COG. COG should appoint these members. These technical advisory committees should make no pretense at being broadly based citizens committees. Citizen input to COG recommendations will come through different channels, although the members of the committees should certainly be sensitive to the broader implications of their recommendations. The deliberations of these committees should be open to public scrutiny as should the actions of COG.

DEVELOPMENT PATTERNS

Immediate future growth in the three county area should be accommodated by controlled expansion of existing communities, to be augmented at a later date by the possible development of a new town site or sites. The resulting pattern is preferable to one formed by approving individual requests for scattered development throughout the region. This approach will require the arresting and reversal of an urbanization process which is already underway in the Grand Valley from Fruita to Palisade and, to some extent, in the Glenwood Springs area.

Existing communities already have a substantial investment in physical plant and provide amenities which give them an advantage over a new town site in attracting and servicing the initial influx of new residents. New towns sites are made ready for residents only after the expenditure of considerable time and effort. The first residents to arrive at a new town must immediately have access, housing, community facilities, and urban services. It, therefore, appears that initial growth must be accommodated in existing towns.

Suggesting the growth of existing communities does not imply that all existing communities should share equally in this growth. Investigations should be undertaken immediately by the Council of Governments to ascertain which of the existing communities have conditions most favorable for urbanization. Possible unacceptable levels of air pollution which might accompany the growth of Grand Valley, for example, is only one of the factors that should be looked into. Suitable land area for development is another important consideration. These and other factors may dictate that some areas grow faster, or to the exclusion, of others.

In considering new town possibilities, county governments should not be content to consider an isolated subdivision on a sewer system as a new town. A true community is more than a collection of dwelling units. Before giving the necessary approvals, counties should assure themselves that conditions are such that a major development proposal has a good chance of becoming a total new community. In the development of a new community, counties should not hesitate to evaluate and try new development techniques which may become examples for better development of existing communities.

County governments should respect and reinforce the cities role as the focus of growth and adopt regulations and follow policies which will help accomplish the recommended pattern of growth. For example, a county zoning decision which would allow a major development to occur at the edge of a community in contradiction to the community's Comprehensive Plan or its ability to serve would seriously jeopardize any effort to control development. Colorado's Front Range is replete with examples of counties competing with cities in the race to urbanize and the resulting conflicts. To avoid this, Region 11 should at the outset adopt a policy that proclaims that all that is urban should be municipal.

Cities, too, will need to exercise restraint by refraining from illogical and wandering annexation and development patterns. Cities should first look inward at present land use. An increase of existing densities should be considered before expansion. This will involve the filling in of vacant land and the redevelopment of older, low density, structures near the center of the community into commercial uses or multiple units. This will not happen automatically. Cities will need to bring their many powers to bear to help these changes occur and, in fact, act as a change agent in many cases.

INTERCOUNTY AND INTERREGIONAL PLANNING AND COORDINATION

In addition to formalizing the planning process within Region 11, cooperation is essetnial with other regions and between units of government within the region. The economics of the various districts, counties, and regions are intimately interwoven. Therefore, a high degree of integration will be necessary.

A major area of intergovernmental cooperation should involve the school districts. Faced with the probability that the impact on each of the districts may vary in intensity, districts less impacted may need to share capital plant and services with more seriously affected districts. If mobile classrooms are used, this may entail switching the classrooms from district to district to meet changing needs. Since school planning is an important part of providing for the needs of incoming population, the school district superintendents

should comprise one of the major Technical Advisory Committees to the Council of Governments. In this position they could keep the Council aware of developing problems in education and suggest solutions to be acted upon the Council.

The Council of Governments will also need to establish a working relationship with the State and federal government. The Council's function should be to establish regional priorities and translate regional needs to the higher levels of government. Initial approaches by the State and federal government appear promising, however, a more effective continuing relationship will need to be established.

Both the State and the federal government will need to rethink their traditional assistance programs to local government. The categorical matching grant program is only partially helpful because of the inability of some units of local government to raise the local share and because of problems in securing the grant in a timely manner to meet the need. Revenue sharing, on the other hand, offers a little bit for everyone and does not focus the money on any single area of need. It is also generally inadequate to meet the problems facing western Colorado.

TRANSPORTATION

Under the direction of the Council of Governments, a regional transportation study should be undertaken for Region 11 with mass transit as a major area of investigation. The study should recommend a transportation system based on anticipated growth and settlement patterns. Major participants in such a study will need to be the cities and counties, the Colorado Department of Highways, Denver and Rio Grande Western Railroad, the airlines serving Walker Field, buslines and independent airport operators.

Because of the relationship between land use and transportation, development of such a system will force decisions relating to land use. An efficient transportation system cannot be devised to accommodate a whimsical regional settlement pattern. It is imperative therefore, that the development of land use policies and the preparation of a land use plan go hand in hand. This transportation system will need to deal not only with new and expanded communities but also the scattered oil shale industries.

The study should be geared for completion within two years -- sooner if possible for the benefit of decision makers faced with immediate problems. It should address:

1. The future of existing or already programmed improvements.

2. The need and location of new facilities -- mass transit, highways, airports.

3. Advance acquisition of right-of-way for new facilities.

4. Interfacing of the various modes of the system.

5. Costs and scheduling of a proposed system.

6. Administration of a regional transportation system.

Another facet of the transportation study should consider how a regional transportation system, once conceived, should be implemented and administered. One approach is to carry on as at present with each existing transportation organization responding to a perceived need and interfacing with each other as best they can. COG could serve in a coordinating role by pointing out problems and opportunities to the agencies and carriers. This course of action is adequate only under conditions of slow growth. Rapid growth will require a more positive approach to transportation problems.

As a part of the transportation study, the question of costs and how they are to be met should be addressed. An assignment of responsibility for costs for different types of streets could be examined. A prevalent practice concerning local and collector streets in newly developing areas is to assign the total cost of initial construction to the development. This sometimes includes special facilities such as bikeways and parts of existing major streets which need to be improved because of the new development. An adoption of a policy such as this by the communities in the

region would relieve local government to a degree that they could focus more money on transportation elements of importance to the entire community.

Some immediate action could be taken to alleviate transportation problems and gain experience with the transportation systems. This would involve buses, buses between communities and buses to oil shale plants. This could be accomplished by cooperation between local communities and existing bus lines in arranging schedules and pick up points. An expanded regional bus system would be the cheapest and most flexible transportation system in the early days of accelerated growth.

LAND USE PLANNING AND REGULATION

Effective control of development will come about through the enactment of regulations at the county and city level. The Council of Governments should support this local effort. An adequately staffed COG might draft model legislation for use in the region, and then coordinate the efforts of the various jurisdictions so that regulations throughout the region are similar and complimentary.

The time during which regional growth policies can be formulated and regulations drafted or revised to reflect those policies is relatively short. Assuming an announcement of the beginning of a successful oil shale operation, substantial numbers of new people could begin arriving in the region in about three years. The area should be prepared to accept them at this time. At best, regional and local growth policies are difficult to develop. In Region 11 they will need to be forged quickly under the pressure of imminent growth. The handling of the first major development to take place may set the pattern for those which follow.

The minimum regulations for implementing a county or a city's comprehensive plan or stated growth policies include:

1. A zoning ordinance,
2. Subdivision regulations,
3. A building code, and
4. An annexation policy statement

Traditionally, these have been separate ordinances or resolutions. Recent attempts have been made with varying degrees of success to combine some or all of these into a single development code for a given community.

The development of land use regulations implies that they will be consistently used and judiciously administered. This will require the attention of specific public officials and will have an impact on operating budgets. It is important that qualified persons be assigned the task of looking after the community's interest on a regular basis.

While the exercise of the police power (zoning, subdivision regulations, building codes, housing codes) are less than perfect in controlling growth and will need to be supplemented by other governmental action, they can be used with much more effect than they have been in the past. Lackadaisical adherence to stated goals and comprehensive plans has added to the problems of many cities and promoted urban sprawl in Colorado and elsewhere.

AGRICULTURAL LANDS

To retain prime agricultural lands in the three county area it is recommended:

1. That prime agricultural, orchard, and grazing lands be immediately identified and mapped as a part of the COG information service. If agricultural lands could be rated according to productivity, then policies could be formulated which would allow non-agricultural development of marginally productive lands before those which were highly productive.

2. That local government refrain from "leap frog" development which catches farm land between subdivisions for housing and raises the agricultural land value to the point where farming is no longer feasible. Clearer demarcations should be maintained between urban and rural uses.

3. That counties should develop zone districts specifically for agriculture with farm and ranch housing as an accessory use. This would eliminate the possibility that tract

housing (2, 5, 10, or 20 acre tracts) might occur in an agricultural area. Large tracts, under the pressure of urbanization are frequently broken down into smaller tracts once the foothold has been gained.

4. With specific agricultural zones in place develop policies with the county assessor for assessing agricultural lands based on their agricultural value rather than their speculative value for urban development.

5. That counties and cities consider the acquisition of development rights for threatened agricultural lands that should be kept open. An earmarked sales tax or small mil levy might be the means for financing such a program.

6. That COG should investigate and suggest changes to State and federal legislation which encourages the conversion of agricultural lands to more economic uses.

7. That the conversion of water rights from agricultural to industrial use should be legally resisted when that conversion would eliminate the use of prime agricultural land.

INFORMATION BASE

The following information is essential to the planning process. COG should secure, interpret and disseminate such material.

1. *Base Maps*
The four county regional map already available should be supplemented with good maps at a suitable scale of each of the communities in the region with sufficient surrounding area included to allow development decisions to be made in the vicinity of existing towns. Aerial photos of the region at one or two appropriate scales would also be extremely useful.

2. *Census*
COG should become the Census "Key Person" for Region 11 prior to the 1980 census. As such, they would have a voice in adjusting census tract boundaries and be the repository of Census information. This wealth of data should be further broken down and interpreted by the COG staff for use by local planning agencies and citizens.

3. *Economic Data*
COG should be the repository of regional economic data such as employment, sales tax revenues, and income. These should be available by community, county, and region.

4. *Land Use*
It is vital in a growth situation, that the regional planning agency know in some detail how land is presently used in order to better anticipate changes over the years. Individual communities and counties should report land use changes to the regional agency with the COG staff lending assistance to smaller communities.

SPECIAL STUDIES

As the region proceeds with planning for growth, several additional investigations should be undertaken. These are studies which would explore the problems in a specific subject area. A tentative list includes the following:

1. *Soils and Hazard Areas*
The planning agencies of the region should develop jointly with the Soil Conservation Service a mapping system that would be meaningful to planners and local officials, and follow that discussion with a formal request to SCS to include the making of regional soils maps conforming to the system a part of an early work program and budget. A similar procedure and request should be followed to secure hazard maps from the State Geologist. Of utmost importance would be a more precise delineation of prime agricultural lands, buildable land, and hazard areas.

2. *Transportation*
A special transportation study should be undertaken for the region with a strong investigation of possible new modes of transportation.

3. *Recreation and Open Space*
The recreation and open space inventory and standards should be expanded into a regional recreation and open space study. The study

should examine recreational and open space facilities that are of a regional, national, and international nature and recommend those steps that will be needed to serve a growing urban population.

4. *Public Facilities*
The adequacy of and the planning for public facilities will be a continuing concern. The existing public facilities inventory should be expanded to include more precise information, an effort to judge quality, a scheduling of need and costs.

5. *Floodplains*
Since floodplains may affect development patterns, these should be established more accurately for the area's major drainage ways. In addition to the Colorado and White Rivers, floodplain studies should be instituted on significant drainage areas within or adjacent to existing communities. Additional urbanization will mean additional runoff. The effects of this runoff should be anticipated by communities in making development decisions.

PUBLIC AWARENESS

In addition to the information generated by the Council of Governments for its own use and the use of member jurisdictions, there needs to be a continuing discussion throughout the region on general growth and development problems. COG will stimulate this discussion to a certain extent by its actions and in presentations to public groups by its staff and members. This limited approach may or may not develop an adequately informed citizenry.

More effectively, one of the newspapers in the region -- probably the Daily Sentinel -- could feature a weekly column by a well-informed writer on the general subject of growth and development. This would be in addition to regular news articles about oil shale or other newsworthy subjects. Contrary to a regular news item the article would analyze, explain, criticize, and otherwise deal with a topic of current interest in the region. It would be written from the point of view of an informed and interested onlooker and would use terms familiar to the average citizen.

FUND TRANSFERS BETWEEN LOCAL GOVERNMENTS

In reviewing possible industrial living patterns for the three county area, it is apparent that industrial tax base, notably oil shale plants, may not be located in the same county or school district as potential employees. Some means must, therefore, be found to transfer any monies generated to the point of impact. At least the following two possiblities should be explored for feasibility and conformance with State law.

The first of these involves direct contracts between adjacent units of government. Can Rio Blanco County, which might be the focus of a large oil shale industry, collect taxes from the industry and pay Garfield and Mesa Counties, through contract, to provide services for oil shale employees who might live in Rifle or DeBeque? This would require a separate accounting of oil shale funds, and records of services by administering jurisdictions.

A second possibility would involve the collection of taxes generated by oil shale plants at the regional or State level with a pay back to local units of government, including school districts, based on the number of oil shale employees in that jurisdiction. State income tax records would be the basis for determining employment and address.

Other equitable arrangement will need to be explored. At best the process will be cumbersome, but the prospect of large inequities in tax base will require that the problem be confronted.

LEASE STIPULATIONS

The U. S. Department of Interior includes stipulations in its land leases which require lessees to accept certain obligations as conditions of leasing. The stipulations proposed for oil shale land leasing are to be set (or revised) " . . . . to make the Lessee's activities under the lease as free from environmental damage as practicable".

On additional future lease sites, stipulations requiring the lessees to ameliorate these environmental impacts might be requested by local government. Since ameliorative efforts

would cost the lessees money, the lease bidding competition might be modified. Candidate firms seeking leases might compete with their proposed measures to minimize or ameliorate environmental (including social and economic) impacts, instead of merely competing with money bids.

Related to the leases, is the use of the lease bid funds. At the present time, the Mineral Leasing Act of 1920 provides that the State's share of these funds be used for roads and schools. COG should continue to press for an amendment to this act so that the funds could be used for broader purposes.

COMPLEX SOURCES REGULATION

Complex sources of air pollution are facilities which may or may not themselves emit pollutants but which attract or concentrate automobiles or other sources of pollutants. Shopping centers, freeways, and high density residential subdivisions are examples. Recent legislation has given local (or regional) planners and decision makers new responsibilities and new authority. They will find it necessary to identify (probably with State assistance) air pollution hazard areas and then to divert growth away from those areas. This suggests that new economic activity, dense traffic, and housing should be located away from the floor of narrow valleys, or other areas of limited air circulation. COG and local planners will need to integrate this tool with their other regulations as an additional means of directing growth.

HOUSING

Both the oil shale industries and the communities will benefit from timely availability of permanent housing. Labor recruitment and stability are generally believed to be fostered by encouraging family residence in permanent housing. Also, it may be very roughly estimated that a permanent housing unit will furnish four times the ad valorem tax base as a mobile home ($7,000 vs. $1,700 in 1971 dollars).

Although a major influx of mobile homes is probably inevitable, the more housing that is ready at times of large in-migration, the fewer mobile homes. This will require careful planning, advance provision of utilities, and some new means of generating "front end" money. The provision of permanent housing on a timely basis will be a major challenge to all concerned -- local government, oil shale employers, and housing manufacturers. A broad mix of housing prices will also be important, since oil shale development will see the arrival of many relatively low income people employed in low paying trades and services jobs.

GOVERNMENTAL ASSISTANCE FOR DIVERSIFICATION

A specialized economy dependent on one industry, i.e., oil shale, is extremely vulnerable to disruption from change in that industry or in competing industry. Therefore, it may be desirable to minimize the specialized dependence of the region on oil shale (if intensive development takes place) and, even with the burden of accepting additional population, to maintain the present diversity of the regional society and economy. This will call for an active effort by local and regional government, and the Colorado Division of Commerce and Development, and may depend on use of public revenues extracted from the oil shale development tax flow. Taxation to raise such funds has already been disucssed; it may also be necessary to seek legislation for a Colorado Development Corporation which is authorized to use public funds for the public purpose of reducing economic vulnerability by maintaining or seeking diversification.

TAX REVENUE

In the United States, extraction of minerals is conventionally taxed by a gross production tax per unit of production or value (a severance tax), by an ad valorem tax levied on some part of the value of production, and by an income tax on profits from production and other operations. Royalties paid to governmental owners of leased extraction sites also go into public revenues. In other countries, governments impose their participation in ownership or require taxes to be paid in oil.

Colorado oil shale production will generate direct revenues for local government through the ad valorem taxes levied by counties, school districts, and other districts. Some royalty money will flow back to the locality of production. State and federal income taxes may eventually support spending programs in the production locality.

If growth born of oil shale development shows signs of straining local government revenues, additional sources of tax or fee revenue should be studied. One such source, readily identifiable from the tax laws of other fuel producing states, is the severance tax. If study shows this tax to be equitable and efficient, authorization for it might be requested of the State legislature by the Council of Governments. Specifically, this could be tax authorized and levied by the State and returned to the area impacted by development.

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