J. E. Hall

LAND PLANNING AND CLASSIFICATION REPORT

AS RELATED TO THE PUBLIC DOMAIN LANDS

IN THE

GLENDO AREA

WYOMING

A MISSOURI RIVER BASIN INVESTIGATION

(FOR ADMINISTRATIVE USE ONLY)

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
REGION III
BILLINGS, MONTANA

OCTOBER 1951

PRESENT STATUS OF BUREAU OF LAND MANAGEMENT STUDIES IN THE MISSOURI RIVER BASIN (LAND CLASSIFICATION)

Land Planning and Classification Report of the public domain lands in the

GLENDO AREA

Wyoming

A sub-area of the North Platte River Basin

A Missouri River Basin Investigation

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DEPARTMENT OF THE INTERIOR
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BILLINGS, MONTANA

October, 1951

This study is a feature of the program of the Department of the Interior for the development of the resources of the Missouri River Basin.

TRANSMITTAL AND ACKNOWLEDGMENTS

This report has been prepared as a feature of the comprehensive program of the Department of the Interior for the development of the resources in the Missouri Basin. The data here presented are based primarily upon field examination of the federally-owned lands administered by the Bureau of Land Management and such adjoining areas as influence their use and management. All agencies of the Department concerned with the development and administration of the resources in the study area have furnished data. Other Federal agencies, states and local governmental units, corporations operating in the area, and local livestock operators have contributed valued information. Valuable information relating directly to the existing problems was supplied by the members of the Agricultural Conservation Associations of Carbon, Converse and Natrona Counties. The Converse and Natrona County Stockgrowers Associations took an active part in the analysis of the stock driveway needs and problems.

This report was prepared by H.H. Hoyt and C.R. Peteler, Range Conservationists. The maps were prepared under the supervision of William C. Anderson, Engineering Draftsman. This study was under the direction of R.D. Nielson, Regional Chief, Division of Land Planning. The report has been improved by the valued assistance in field work and preparation generously given by Area Manager Lester R. Brooks and his staff of Wyoming Area II.

Submitted October 30, 1951

Albin D. Molohon
Regional Administrator, Region III
Billings, Montana

PREFACE

Detailed study and classification of the public domain land in the Glendo area is a feature of the Department of the Interior's comprehensive program for the development of the resources of the Missouri River Basin. The area was selected for intensive study due to the findings of the Preliminary Land Planning and Classification Report for the North Platte River Basin. That report, published by the Bureau of Land Management in 1950, states that the most acute problems from the standpoint of watershed management and sedimentation control are found in the Glendo area. One of the purposes of this study is to determine feasible methods of reducing sediment production and rehabilitating the watershed. Such methods will protect the extensive and expensive improvements within the area and will produce the maximum benefits for downstream agriculture and economy. It is desired to secure these results by methods which will necessitate the least possible curtailment of use by grazing livestock and with a minimum amount of interference to other present land use in the area.

Another purpose of this study is to determine the use suitability of public lands, and to determine how these lands can contribute their maximum share to the development of the Missouri River Basin program. The best use for all lands in the area was determined by considering the various land uses and the extent to which such uses have modified the original basic resources of the area. Forage cover, water, timber, and other surface resources were inventoried. The existing and proposed improvements of the Bureau of Reclamation within the area, and those improvements associated with the area in operation or utility, particularly the Guernsey Dam and Lake, and the proposed Glendo Unit development, are concerned in this study.

Relationships between publicly-owned rangelands and other classes of landownership and tenure in the area were studied. Effects of these relationships upon the accomplishment of necessary range and watershed rehabilitation measures were given special consideration. Detailed studies were limited to the western portion due to the prevalence of critical erosion, sedimentation, and range management problems existing there and also due to the concentration of publicly-owned lands in this portion. Much of the sediment accumulating in Guernsey Reservoir is believed to originate in this critical portion of the area. This accumulation of sediment is so unduly rapid that the continued prosperity of the established agricultural economy of the lower North Platte River Basin is jeopardized.

Existing conditions and problems with their proposed adjustments in the critical western portion of the area are shown on the four maps included in this report as appendix IV. Vegetative cover types, mapped in the field are shown on the Vegetation Type Map. Symbols used on

this map denote the three principal species in each type. The meaning of these symbols is given in table 10, page 79. Land use capability and resource condition were mapped in the same way in accordance with descriptions and definitions given in tables 7 and 8, pages 76 and 77, and are shown on the Land Use Capability Map. Soil erosion conditions and the location of proposed improvements were mapped in the field in accordance with descriptions and definitions in table 9, page 78, and are shown on the Erosion Condition and Proposed Improvements Map. The Land Use Suitability and Proposed Adjustments Map shows land use suitability and the proposed adjustments in management, ownership and use. These adjustments and improvements are believed to be essential to the continued prosperity of the livestock industry in this portion of the area.

Continuation of intensive downstream irrigation agriculture and the further expansion of commerce, industry and culture in that vicinity is fundamentally based upon the water and power resource development of the North Platte River. Production of beans, potatoes, grain, hay, milk, beef, pork, and poultry in the North Platte River Valley below the Guernsey Dam is largely dependent upon the improvements proposed as the Glendo Unit development by the Bureau of Reclamation. The proper functioning and life extension of Guernsey Reservoir and of the proposed Glendo Reservoir will be benefited by activation of the proposals contained in this report of the Glendo area. These benefits will extend to the downstream irrigated lands and economy and onward into the entire Missouri River Basin and into the national economy. Two of the vital problems disclosed are the need for land use adjustment to protect watershed values and the necessity for devising means of compensating present landowners for desirable changes in their present use.

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SUMMARY

The report area includes 5,513 square miles tributary to the North Platte River between Guernsey and Alcova Dams in east central Wyoming. Sharp variations in topography, geology, and soils and accompanying variations in elevation, precipitation, and vegetation are typical of the Glendo area. About 70 percent of the average 10 to 15 inch annual precipitation occurs during the growing season. Summer storms are frequently torrential in character and often cause severe damage to the sparsely vegetated, unstable and poorly developed soils in the western portion of the area. Parent material of most of these poor soils and badlands is the clays of the White River formation. These soils combine with the climate to produce a biotic condition which is in delicate balance.

Range and watershed conditions are critical or severe on much of the area. A minor disturbance of the vegetative soil complex results in accelerated soil erosion and promotes silt production. In the past, the delicate biotic balance of the area has been seriously disturbed and severe erosion was caused with resultant critical present day conditions. Historically this was due to the presence of most desirable summer range in the Shirley Mountains and on the Laramie Plains in the vicinity. This excellent range attracted itinerant sheep operators. Many of these operators wintered in the delicately balanced Bates Hole area, and utilized it early in the spring, causing severe damage to the watershed.

Economic development in the area, with the exception of the large iron mines at Sunrise, was originally based almost exclusively upon the livestock industry and its attendant shipping and supply facilities. Rapid expansion of petroleum refining and production since 1915 has had a marked effect. Cultural developments are centered at Casper and Douglas. In the western portion of the study area where detailed studies were made, 29 percent of the land area is federally-owned land administered by the Bureau of Land Management. About 96½ percent of the land in the area is used for grazing, 2½ percent is cropland, and 1 percent for industrial purposes.

Indicators of maladjustments in land-use and management in the study area are sedimentation, impairment of watersheds and rangelands, and a complex ownership and operating unit pattern. The sedimentation problem is evident in Guernsey Reservoir and in silt filled stock-water reservoirs of the western portion. Watershed and range impairment and a complex ownership and operating unit pattern are also largely confined to this portion. The correction of existing conditions requires proper balancing of watershed and range uses and watershed rehabilitation by means of proper land management and effective restoration of waterways. Proper land management may be attained by applying sound land management plans which must provide for proper use by livestock as to amount, season,

class, and distribution. Effective waterway restoration can be assisted by preventing concentration of runoff and by delaying its movement. Complete healing is dependent upon the establishment of vegetation in waterways.

Reconciliation of conflicting watershed and range use may be facilitated by increased range forage production, elimination of trespass use, and increased use of supplemental and cropland feed or forage. The effectiveness of a watershed and range rehabilitation program is dependent upon the proper location, operation and maintenance of all range improvements and treatments, and subsequent adequate control of use by livestock. Considerable modification of the existing landownership and operating unit pattern may be necessary to assure such adjustments and control. It may be attained by exchange of title, cooperative agreement, or purchase where other means are ineffective. A requisite for improvement in watershed and range condition in critical areas is enforcement of proper stocking and other features of good land management.

Actual accomplishment of the proposed adjustments in land-use and management involves the orderly development of the following programs in the western portion of the study area:

1. Application of sound management plans as outlined in this report.

2. Development and application of a complete conservation program. This will require resurveys where lines cannot be established because the original corner monuments are missing. It will also require the cooperative efforts of all interested individuals and Government agencies.

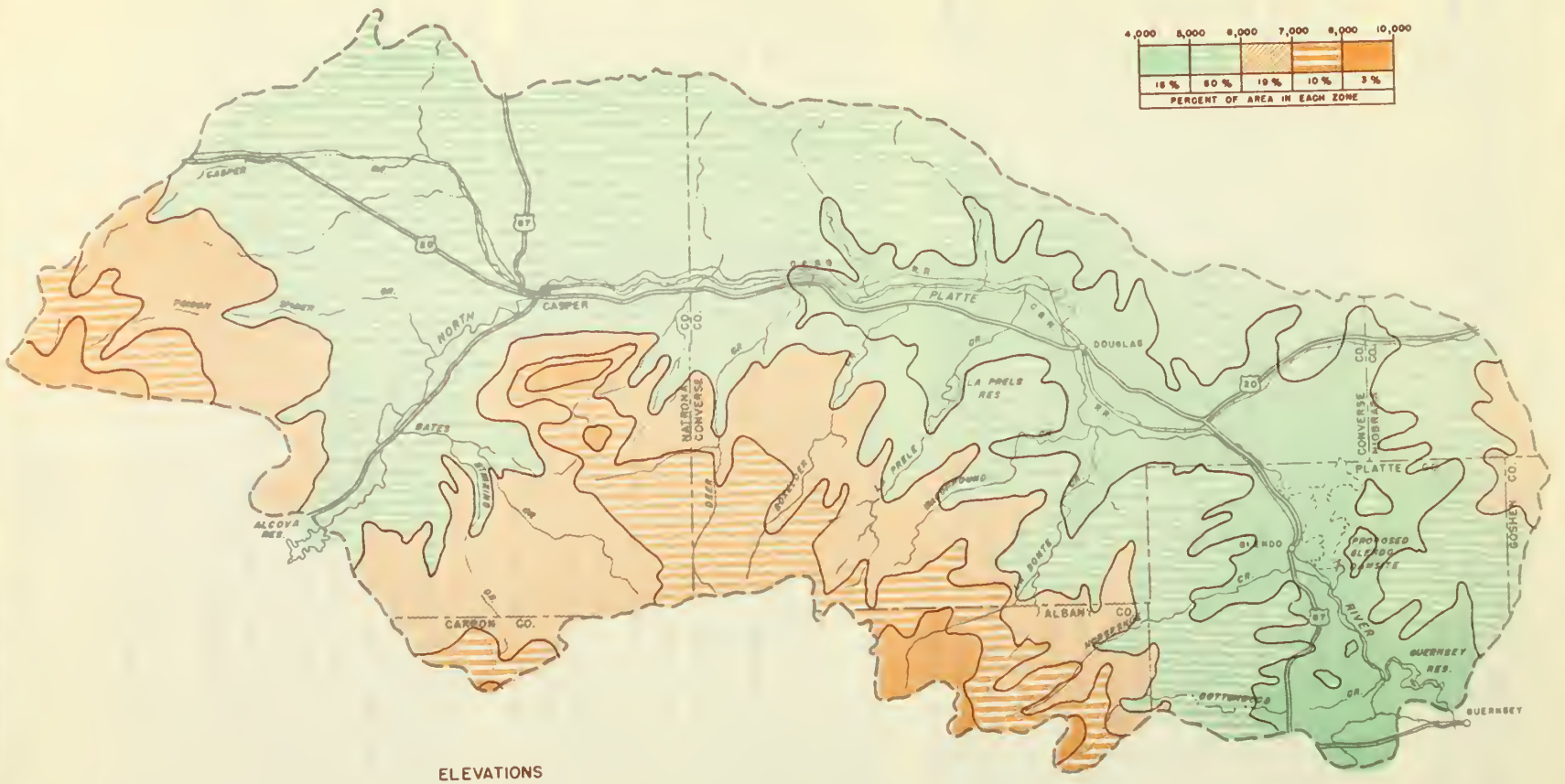
3. Adjustment of the existing ownership and operating unit pattern. Accomplishment of these programs can be facilitated by inclusion of the proposed management area within an organized grazing district, by extension of the Kendrick Soil Conservation District, and by proper functioning of the Guernsey-Glendo Conservation Committee or of a similar organization to accomplish a well coordinated effort for watershed protection.

In the critical western portion of the study area, over 35 percent of the lands in the proposed management area are public domain lands administered by the Bureau of Land Management. In the disposal area less than six percent of the land area is public domain. Approximately half of this has no serious watershed or management problems and has negligible public use values and is proposed for disposal by exchange or public sale. A small part of the eastern portion of the area is located in a sand dune area. This dune area includes about 29 percent of public domain lands. It is proposed to include these lands in the management area. The dune formation and much of the adjacent sandy area is in delicate balance biotically. Any removal of cover tends to promote sand movement. It is necessary to control use of the vegetative land resource to assure

stabilization. It may become advisable to exclude use, in which event the area could not support taxation on a range use basis. Adjustments in ownership are proposed along the Orpha Stock Driveway to improve its usability.

Approximately 4,000 acres of public domain lands in the eastern portion are used in connection with livestock operations in the Laramie and Seminoe sub-areas of the North Platte River Basin. Public management is proposed for these lands pending completion of detailed studies. About 3,000 acres of public domain lands include desirable sites for silt or flood control dams. Retention is proposed for these lands to facilitate ultimate flood control developments. Over 5,000 acres of forest-covered lands adjacent to the Medicine Bow National Forest in the eastern segment are proposed for administration in conjunction with the national forest due to their primary watershed and timber values. All remaining public domain lands administered by the Bureau of Land Management in this eastern portion of the study area are proposed for disposal by exchange or public sale. There are approximately 47,500 acres of such lands located in Albany, Converse, Goshen, Niobrara, and Platte Counties.

Continuation of intensive downstream irrigation agriculture and the further expansion of its dependent economy and culture is directly concerned with the developments proposed in this report. The efficiency and durability of the storage capacities of Guernsey Reservoir and of the proposed Glendo Reservoir are in a large measure dependent upon the watershed areas considered in this report. The limitations necessary for grazing and other land use as proposed herein will make requisite additional public ownership of land in critical areas as the land could not support taxation. Another solution of this problem would be a subsidy to the owners for controlled use of their lands for the ultimate benefit of downstream landowners. To be effective, details of such proposals must be evolved by all concerned, especially the landowners, the soil conservation districts, and the Production and Marketing Administration. The service rendered to the watershed for the benefit of downstream users should be borne by a subsidy or land purchase financed by the Federal Government. The Federal Government necessarily becomes the acting agency because the lands involved are in different states and because the cost of the improvements concerned has been, or will be, borne by Federal funds. Watershed values of critical portions of the Glendo area are much greater than the on-site grazing value. This is an additional factor favoring Federal ownership or subsidy of lands which will be unable to support taxation because of their limited carrying capacity under proper watershed management.



ELEVATIONS
(IN FEET)
WITHIN THE GLENDO SUB-AREA
OF
THE NORTH PLATTE RIVER BASIN
WYOMING
1951

U S COAST & GEODETIC SURVEY AERONAUTICAL CHART

GENERAL DESCRIPTION

Glendo is a bustling bit of the Wyoming West, replete with oil wells, cattle, sheep, and hay ranches. Here is Casper, oil capital of the Rockies, center of petroleum refining, administration, supply and finance. The Glendo area is located in east central Wyoming and includes all of the drainage tributary to the North Platte River between Alcova Dam and Guernsey Dam, as shown on the maps with this report. Most of the area is in Converse and Natrona Counties, with small portions in Albany, Carbon, Goshen, Niobrara, and Platte Counties. The Glendo area is about 40 miles wide and 140 miles long, and includes approximately 5,513 square miles or 3,528,400 acres.

Outstanding topographic feature is the rugged terrain which forms a roughly semi-circular borderland between the river and the high Laramie Plains Plateau to the south. It is dominated by the northern extremities of the Laramie Mountains and the smaller Deer Creek and Haystack Ranges and terminates in Muddy and Casper Mountains. Across the river from Casper Mountain and at the extreme western end of the area are the Sweetwater Plateau and the Rattlesnake Range. Northeastward from this range, rolling sagebrush plains, sand dunes, and grasslands from 10 to 40 miles wide lie between the river and the Powder and Cheyenne River Basins. In the northeastern portion of the area adjacent to the Niobrara River Basin, rolling grasslands are more or less broken by low pine-covered hills. West and southwest of Muddy and Casper Mountains is a large natural depression known as "Bates Hole." It is sharply rimmed on the south and southwest by a westward extension of the Laramie Plains Plateau.

North Platte River flows eastward from Alcova Dam as shown on the maps included in this report. Adjacent to the river on the south are benchlands of varying extent sharply dissected by the streams rising on the periphery of the area. These tributary streams traverse the rugged bordering terrain through deep canyons often flanked by precipitous escarpments of sandstone or limestone. Altitudes range from 4,350 feet at Guernsey to 10,274 feet on Laramie Peak, about 40 miles west. Sixty-eight percent of the area is below 6,000 feet in elevation, 19 percent between 6,000 and 7,000 feet, and 13 percent above 7,000 feet, as shown on the Elevation Map, figure 1.

Drainage basin areas of 16 tributary streams and watercourses have been measured, totaling 3,240 square miles. Eight of these, including 1,811 square miles, have gaging station records. These produce an average flow of approximately 327,800 acre-feet per year, largely derived from the rugged mountainous portion of the area. Stream flows, drainage areas, irrigated land and runoff data for the eight streams are shown in table 1, page 2. Wide variations in annual stream flow reflect the variable precipitation. Figure 2, page 3, illustrates graphically the varying relationship between drainage area and flow from the eight streams. Other tributary drainages furnish only minor flows. Water in sufficient

Table 1. Stream flows and drainage run-off, Glendo Area, Wyoming, record years to 1948 1/

Creek	Drainage Area square miles	Area irrigated 1939 Acres	Annual Gaging Discharge for Period of Record in acre-feet Maximum	Minimum	Average	Average Discharge Prior to Oct. 1, 1944	Number of Years	Restored Native Flow acre-feet	Gaging Record Average Annual Runoff-inches	Average Total Estimated Runoff inches
Bates	377	3,500	169,600	2,430	26,063	36.0	17	36,963	1.296	1.84
Boxelder	202	2,500	65,490	7,610	37,646	52.0	19	45,146	3.494	4.19
Cottonwood	159	1,200	50,100	536	6,950	9.6	16	10,550	.82	1.24
Deer	216	8,000	87,200	12,900	49,230	68.0	18	73,230	4.273	6.36
Horseshoe	203	3,400	58,000	1,500	24,615	34.0	19	34,515	2.274	3.22
La Bonte	302	4,300	90,200	6,470	48,506	67.0	18	61,406	3.012	3.81
La Prele near Douglas 2/	146	2,300	47,900	5,800	30,624	42.3	25	37,524	3.32	4.82
La Prele near Orpha	227	10,700	30,500	1,570	12,742	17.6	14	46,842	1.082	3.87
Wagonhound	125	2,300	37,000	218	11,045	16.5	13	18,545	1.792	2.83
Total	1,811	35,900	608,090	33,234	217,697	300.7		327,797	2.254	3.37

1/ Adapted from gaging station records in the Missouri River Basin, Geological Survey Water Supply Paper 1077, December, 1948. Maximum and minimum annual discharge records from the Missouri River Basin Annual Water Supply Papers for the record years. Conversion factor: cfs flow times 1.98347 equals acre-feet per day. Average runoff is a weighted average; the others are mathematical means. Native flow has been estimated by adding annual flow of three acre-feet for each irrigated acre listed, 2,000 acre-feet for the La Prele Reservoir, and 400 acre-feet for Bates Creek Reservoirs.

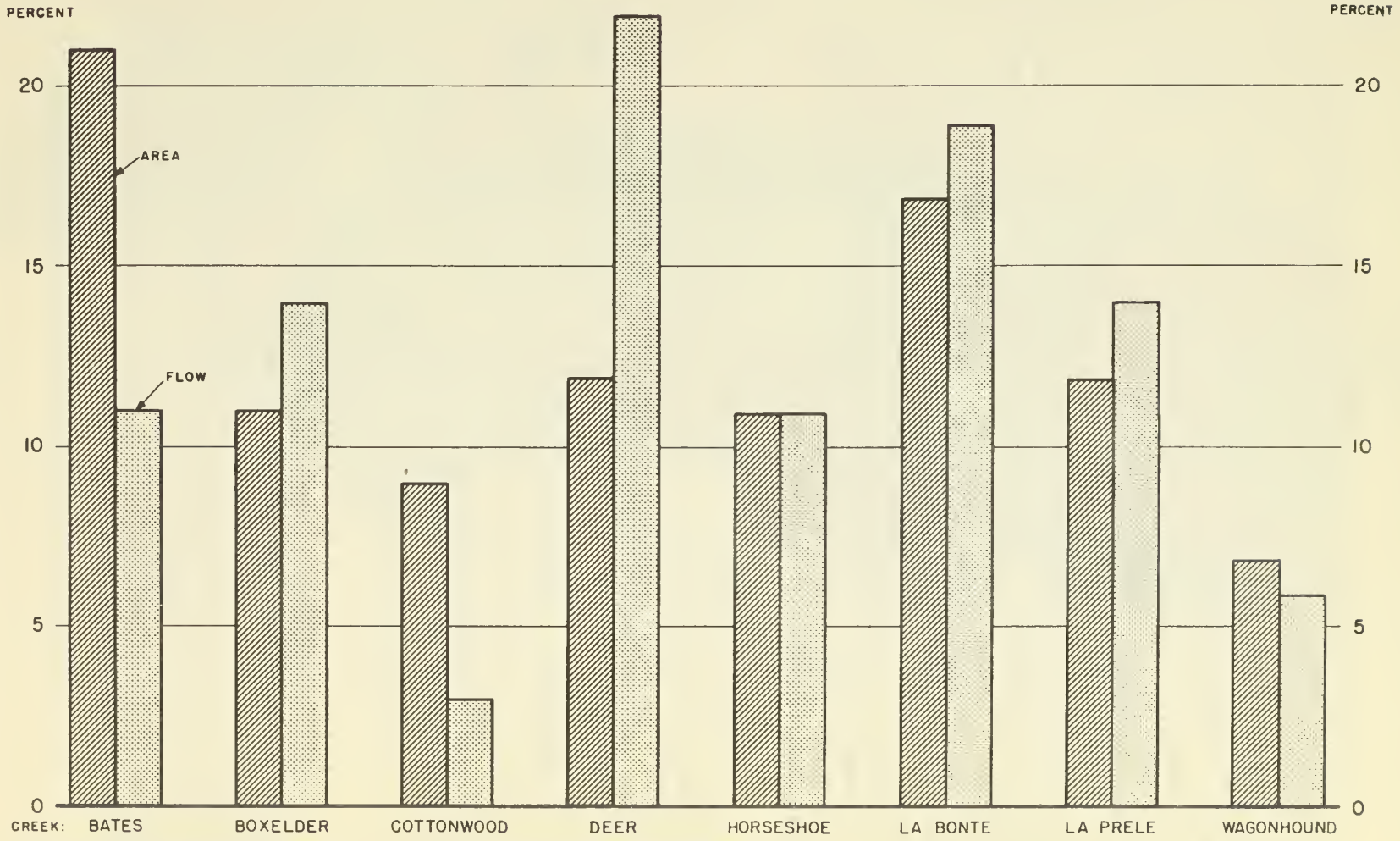
2/ Area and other data for La Prele Creek near Douglas are also included within La Prele Creek near Orpha. The near Douglas figures are not included in the totals.

amount and suitable quality for livestock and domestic use has been obtained from wells of reasonable depth over most of the eastern portion of the area. In the western portion subsurface strata are predominantly very thick shale beds from which there is little possibility of procuring water. There are some exceptions where underlying sandstones might supply good water at a moderate depth.

Geologic structure of the study area is very complicated, due to the intermittent faulting and folding of the various strata and the succeeding erosion which has exposed pre-Cambrian formations in many portions of the higher mountains. Interspersed are mountain tops capped by terrace materials including boulders, gravel and sand. Stream channels may be bordered by precipitous escarpments or by alluvial deposits ranging from fine clay to small boulders. Shales, clays and sandstones of such Tertiary formations as the White River, Fort Union, Wind River and Lance are dominant over much of the area. In other portions of the area there are the older Cretaceous formations, also predominantly sandstones and shales, including Dakota, Thermopolis, Benton, Cloverly, Morrison, Carlile, Niobrara, Steele, and Mesaverde formations. Older formations include Sundance, Chugwater, and Deadwood.

FIGURE 2

COMPARISON OF DRAINAGE AREA & AVERAGE ANNUAL RESTORED NATIVE FLOW OF THE MEASURED STREAMS IN THE GLENDO AREA, WYOMING*



*COMPILED FROM DATA IN WATER SUPPLY PAPER NO. 1077 U.S. GEOLOGICAL SURVEY, DECEMBER 1948

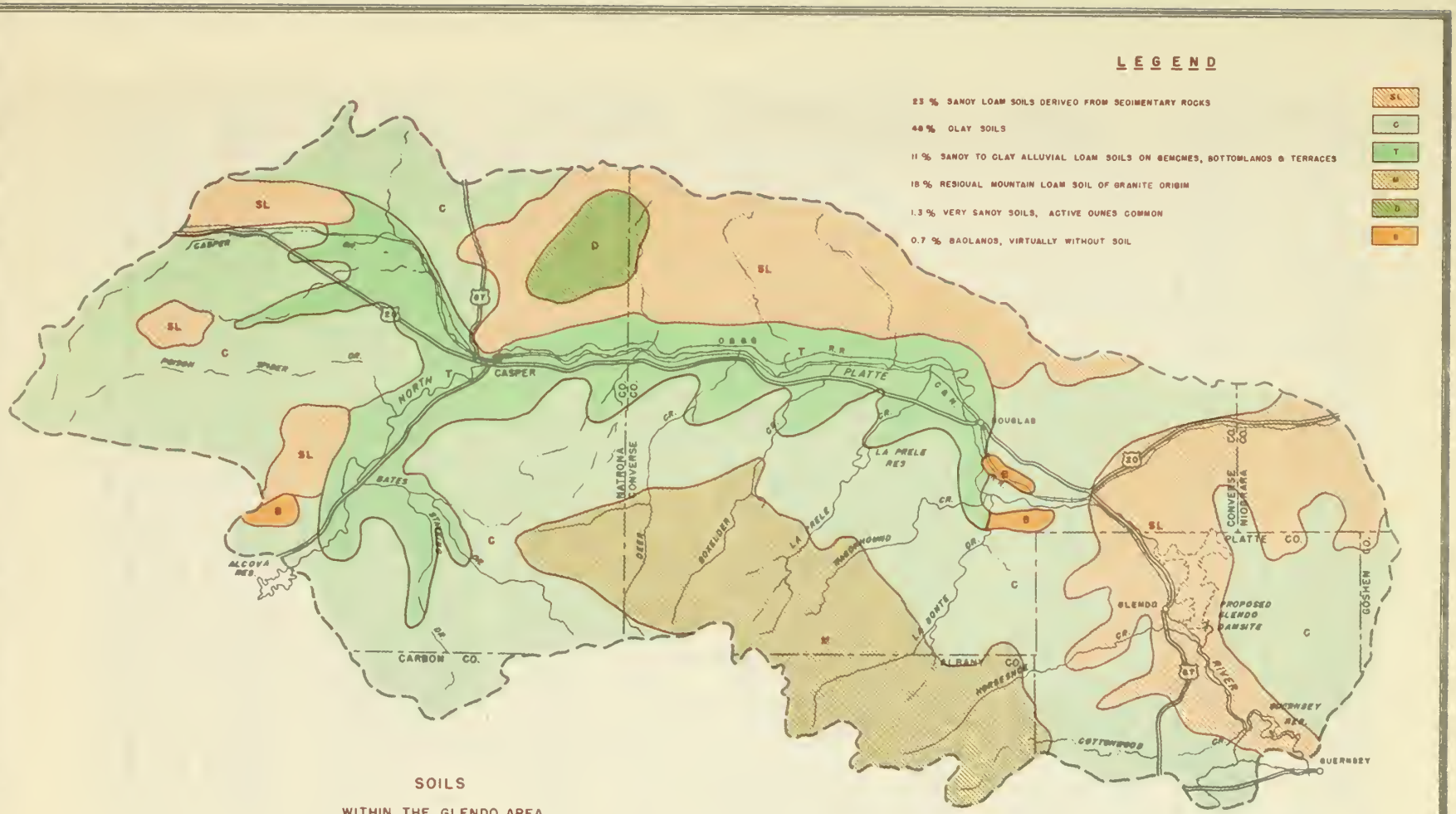
CLIMATE

Climate is generally semi-arid with sharp variations in both temperature and rainfall due to the correspondingly sharp variations in altitude which are typical of the North Platte River Basin. The outstanding feature of climate is the extreme variation and unreliability of precipitation which results in wide variation of cover, soil protection, and erosion hazard. Climatic and soil conditions combine to favor sediment production on a large portion of the area. Extreme temperatures range from 43 degrees below zero to 106 degrees above zero along the river valley where Weather Bureau stations are located. Annual precipitation varies from 10 to 15 inches along the river valley and over the plains section. In Bates Hole the average annual precipitation is estimated to be only 8 inches, and in parts of the Laramie Mountains, the estimated amount exceeds 30 inches. Nearly 70 percent of the precipitation occurs during the growing season from April through September with the maximum amount in May. Seasonal snowfall averages about 50 inches over the plains and valley section and about 130 inches in mountainous portions over 8,000 feet in elevation. Storms occur frequently during July and August in the mountains, while the plains and valley sections are comparatively free of such storms during these months. Such storms as do occur in the summer are frequently torrential in character and often cause severe erosion damage on sparsely vegetated, unstable soils.

Climate in the mountain section changes abruptly toward sub-humid in contrast with the semi-arid climate of the plains section at lower elevations. Snow persists all winter in tree-covered areas and at higher elevations. Strong westerly winds usually follow or accompany winter storms, causing severe drifting of snow in open areas. Below 6,500 feet elevation snow does not usually cover the ground for more than a few days after each storm except that drifts may persist all winter. In years of low precipitation, the plains area has an arid climate. Frost-free periods vary from 129 days along the valley and over most of the plains sections north and east of the river, to 60 days in the Laramie Mountains. Precipitation is barely sufficient for limited production of dry-land hay and small grain in the eastern portion of the area. Area climate is such that most of the crops are produced under irrigation.

SOILS

Soils in the study area vary from residual mountain soils of granite origin to very sandy and clay soils derived from sedimentary rocks. Extent and location of six different soils of the area are shown on the Soils Map, figure 3, page 5. Clay soils derived from sedimentary rocks cover 48 percent of the area. Sandy loam soils cover 23 percent of the area, mostly in the eastern portion. Residual mountain soils cover about 16 percent of the area and are the least susceptible to erosion damage due to their shallow, stony character and also due to their protective vegetative cover. Sandy to clay



SOILS

WITHIN THE GLENDO AREA

OF

THE NORTH PLATTE RIVER BASIN

WYOMING

1951

BASIC DATA TAKEN FROM U S DEPARTMENT OF AGRICULTURE AND THE UNIVERSITY OF WYOMING AS MODIFIED BY FIELD STUDIES OF THE BUREAU OF LAND MANAGEMENT.

loam alluvial soils cover bottom lands, benches, and terraces on 11 percent of the area. Very sandy soils cover a little over 1 percent of the area and include many active sand dunes. Badlands occur on less than 1 percent of the area.

Important parent rocks from which the soils in this area have been formed are shales, clays, sandstones, conglomerates, and granites. In some places the parent rock has not been thoroughly decomposed and in many places it underlies a very thin soil. Some of the thin soils lie on salty shales and may become saturated with alkali salts in a short time if they are brought under irrigation. In other places, the soil is deep, well-drained, and productive when irrigated, or when the annual precipitation is adequate and favorably distributed. In many localities the soils are too stony, gravelly, or thin for cultivation. Soils are rather low in organic matter, but are well supplied with lime, potash and most of the essential minerals. The supply of phosphorus and nitrogen is only fair. Because of their small supply of organic matter they are largely light in color, a light brown predominating.

Much of the western portion of the area, notably Bates Hole and the drainage basins of the tributary watercourses rising at the edge of the Sweetwater Plateau and at the eastern end of the Rattlesnake Range, is covered by the poorly developed, saline, unstable residual clay soils derived from the Steele and closely related Niobrara shales. The more fully developed of these soils are found along the streams and usually support a mixture of sagebrush, greasewood, saltgrass, and other plants. The less developed soils occur on the adjoining slopes and are normally covered by a scanty growth of saltbush.

The sandy loams occupy areas of residual soils derived from sandstones, conglomerates and sandy shales. They are generally of good texture and productive under favorable climatic conditions. A considerable part of this land in the eastern part of the Glendo area has been dry farmed with some success. However, due chiefly to the scant precipitation and its unfavorable distribution, dry farming is a hazardous venture and cannot be considered as a permanent and stable form of agriculture. Shallow, stony loams are found mainly on the more rolling and shallow plains and valley lands, which are restricted to grazing because of their uneven surface, the prevalence of rocks and the usually thin mantle of soil.

The mountain soils are found in the Laramie Mountains and their offshoots and the Rattlesnake Range bordering the area on the southwest. Where covered with timber or brush, the soils are generally shallow, light brownish-gray loams or sandy loams with more or less stone and gravel. The grassland areas of the mountain valleys, as well as of the larger basins and the more level ridges, have soils that are darker in color and contain less stone than the timbered areas.

The bottom lands along the streams, terraces and benchlands are occupied by grayish-brown bench and brown bottom soils. These soils are mixed sandy to clayey in character with gravelly or sandy subsoils. The bottom lands are subject to occasional floods and may have a high water table. Good drainage on the benches and terraces is assured by the underlying beds of sand and gravel. The brown bench and bottom soils make up the principal farming lands in the area, constituting substantially all of the lands now under irrigation.

The very sandy soils are located on an area northeast of Casper. Most of this area is covered with sand dunes, many of which are active, causing a serious erosion and management problem. Most of the dunes are fairly well stabilized but blowouts are easily caused by breaking of the surface cover and are quite common at various points along the roads and trails.

Badlands are characterized by steep, barren slopes of unstable sedimentary materials and true soil has little chance of forming. Badland areas are located southeast of Douglas on both sides of the river and north of Alcova at the edge of the Sweetwater Plateau. The badlands have been largely derived from the clays of the White River formation. Large areas of this formation occur along the southern border of the area below the mountains. Large areas of the formation also extend northward from the mountain granites to Douglas, covering an area nearly 60 miles in length, and up to 30 miles in width.

There are two small areas of red soils. The larger of these extends from Bessemer Mountain across the river and up Madison Creek. Beyond Madison Creek the main body is located on Red and Bates Creeks with narrow fingers extending across Casper and Muddy Mountains on to the tributaries of Muddy Creek. The second area crosses the river from the east at Alcova and extends about six miles northwest toward the head of Eagle Creek. The red soils are unstable and are quite severely eroded.

Runoff varies with soil type, topography, and cover. Ten percent of the area is considered to be non-contributing due to sandy soil and because drainages are blocked by sand dunes. Sixteen percent of the area has very low runoff because of sandy or gravelly soils. Twenty-one percent of the area furnishes moderate runoff due to permeable bedrock formations combined with well developed surface drainage. Fifty-three percent of the area has a high runoff potential due to impermeable bedrock formations with a well developed surface drainage pattern. Much of the soil has a low infiltration rate due to its texture, low organic content and poor cover.

VEGETATION

Intensive studies of vegetative cover were confined to the western portion of the study area, due to the concentration and large area of public domain lands in Natrona and Carbon Counties. The Vegetation Type Map of the western portion of the study area shows the distribution and extent of the eleven vegetative types occurring there, with symbols indicating the principal forage species. These symbols and species are listed in table 10, page 79. Grazing capacity of each type is shown by a figure indicating the number of surface acres required in each type to supply one animal unit month of feed. Extent of each vegetative type and the proportionate importance of each within the critical western portion of the area are shown in table 2 on the following page. Estimated animal unit months of feed supplied by each type and the approximate number of surface acres required for one animal unit month of feed are also shown.

Sagebrush, grassland, and forest are the principal vegetative types which make up the cover of the western portion of the area. The sagebrush type is most prevalent in the western part of the area. Here big sagebrush (Artemisia tridentata) is dominant, but the type includes most of the sagebrush species, as well as shadscale saltbush (Atriplex confertifolia), spiny hopsage (Grayia Spinosa), antelope bitterbrush (Purshia tridentata), bud sagebrush (Artemisia spinescens), and many of the grasses. On the poorly drained soils of this type along watercourses, black greasewood (Sarcobatus vermiculatus) takes the place of big sagebrush. Black greasewood usually has an undergrowth of inland saltgrass (distichlis stricta). Less important sagebrush species making up minor parts of the type composition are: silver sagebrush (Artemisia cana), fringed sagebrush (Artemisia frigida), and black sagebrush (Artemisia nova). Other plants occurring in minor amounts are rabbitbrush (Chrysothamnus spp.), eriogonum (Eriogonum spp.), and common winterfat (Eurotia lanata). The last named plant is highly valued, especially as a winter feed for sheep. Gardner saltbush (Atriplex gardneri) is predominant on clay soils and on areas of badland topography where it has not been uprooted by erosion. In some places this persistent species, a very desirable range feed, has been so depleted by over-use and accelerated erosion that only barren slopes and rounded knolls remain. It often occurs in pure stands over fairly extensive areas.

The grassland type is predominant in the northern and eastern parts of the area. Grass species in this type include blue grama (Bouteloua gracilis), bluestem wheatgrass (Agropyron smithi), prairie junegrass (Koeleria cristata), Sandberg bluegrass (Poa secunda), needleandthread (Stipa comata), red threeawn (Aristida longiseta), sixweeks fescue (Festuca octoflora), and Idaho fescue (Festuca idahoensis). Threadleaf sedge (Carex filifolia) is also common in this type. Scattered plants of sagebrush, together with other species occurring in that type are frequently intermixed with the grass, often giving it a sagebrush aspect, although the volume of the latter species may be greatly in the minority. Elsewhere within the

Table 2.- Area and grazing capacity of vegetation types within the western portion of the Glendo area, Wyoming, 1951. 1/

Vegetative Cover Type	Area acres	Percent of Total percent	Carrying Capacity animal unit months	Acreage Requirement per animal unit month acres
1. grass	187,316	12.7	48,223	4
2. meadow	8,227	0.6	9,759	1
4. sagebrush	1,041,405	70.9	170,332	6
5. mountain brush	14,192	1.0	1,935	7
6. coniferous	54,424	3.7	7,811	7
7. waste	6,933	0.5		
8. barren	11,598	0.8		
9. juniper	13,496	0.9	1,127	12
10. aspen	12,080	0.8	1,097	11
13. saltbush	35,016	2.4	2,687	13
14. greasewood	57,377	3.9	8,676	7
Total Range	1,442,064	98.2	251,647	5.7
Cities and Industrial Areas	15,130	1.0	1,045	
Cropland	11,858	0.8	70,908	
Total	1,469,052	100.0	323,600	

1/ Compiled from field inventories of the area for all classes of landownership made by the Bureau of Land Management, Region III, Billings, Montana. See the Vegetation Type Map in appendix IV.

grass type big sagebrush may predominate in volume as well as in aspect. Areas with disturbed soils show rather recent invasions of cheatgrass brome (Bromus tectorum), which is on the increase according to local stockmen.

Poisonous plants occurring in both grassland and sagebrush types are meadow deathcamas (Zigadenus venenosus) and larkspur (Delphinium spp.). They are not numerous, but their presence is important economically because they do occasion some livestock losses. Other undesirable plants found on both types, usually in overgrazed or disturbed areas, are plain pricklypear (Opuntia polyacantha) and broom snakeweed (Gutierrezia sarothrae).

Exotic species such as crested wheatgrass (Agropyron cristatum) and yellow sweetclover (Melilotus officinalis) have been introduced particularly on formerly dry farmed lands and as soil binders near airfields. These plants have done well under existing moisture and soil conditions and give promise of success that could be achieved under proper reseeding methods over a considerable portion of the Glendo area.

The forest type is composed of a number of minor types including coniferous woodland, mountain brush, juniper, aspen, and waste range. Coniferous and mountain brush species, aspen, and sagebrush are the principal species of the forest type. This type occurs mainly at the higher elevations of the Laramie Mountains, Casper Mountain, and the intervening plateaus. In order of their relative abundance, tree species of this type are: ponderosa or western yellow pine (Pinus ponderosa), lodgepole pine (Pinus contorta), quaking aspen (Populus tremuloides), Rocky Mountain juniper (Juniperus scopulorum), limber pine (Pinus flexilis), and common douglasfir (Pseudotsuga taxifolia). Lodgepole pine often occurs in such dense stands that grazing or other use is impossible. Rocky Mountain juniper and scrubby ponderosa or western yellow pine occupy many of the lower slopes. Eastern poplar or cottonwood (Populus deltoides) and willows (Salix spp.) grow along many of the water-courses northward from the Laramie Mountains. In the upper reaches of this type, the streams are often flanked by narrow strips of mountain meadows.

The mountain brush type is a minor type which occurs mostly on the rugged slopes and foothill areas below the ponderosa pine. It often has herbaceous undergrowth consisting of brome grasses (Bromus spp.), alpine timothy (Phleum alpinum), Idaho fescue (Festuca Idahoensis), giant wildrye (Elymus condensatus), pinegrass (Calamagrostis rubescens), and numerous forb species. Among the prevalent mountain brush species are true mountain-mahogany (Cercocarpus montanus), serviceberry (Amelanchier spp.), skunkbush sumac (Rhus trilobata), wax currant (Ribes cereum) antelope bitterbrush (Purshia tridentata), big sagebrush (Artemisia tridentata), and silver sagebrush (Artemisia cana).

AREA ECONOMY

Estimated population in the Glendo area for January 1, 1950, was 41,000, which is over 27 percent of the total for the North Platte River Basin. Rural population, including small communities, comprises only about six percent; Guernsey, Sunrise and Glendo four percent, and the cities of Casper, Douglas, and Glenrock make up the remaining ninety percent. The towns are all located within a few miles of the North Platte River and have adequate transportation, communication, educational, and social facilities. Casper and Douglas, county seats of Natrona and Converse Counties respectively, have hospital facilities, fairgrounds, and county or state offices of various Federal agencies.

Hydroelectric power plants at Guernsey, Kortes, and Seminoe Dams and an auxiliary steam-electric plant at Casper supply electric energy to the inter-connected network of transmission lines serving the area. Seminoe Dam, 35 miles upstream from Alcova, was designed to generate electric power and to provide flood water storage for the Kendrick project. Kortes Dam was built to generate electric power and has very little storage capacity. It is located a few miles above the head of the lake created by Pathfinder Dam. No electric power is generated at Pathfinder or Alcova Dams. All cities and towns in the area are provided with natural gas. The area is well serviced by U. S. Highways No. 20, 26, 87, and State Highways No. 59 and 220. Two railroads, the Chicago, Burlington, and Quincy, and the Chicago and Northwestern, cross the area. Motor freight lines and passenger busses operate on the highways. The American and Robinson Bus Lines serve the area. Western and Frontier Airlines schedule stops at Casper.

Oil refining is the largest industry in the area. Casper is known as the "Oil Capital of the Rockies," three large refineries being located there. Standard of Indiana has a 15,200 barrel plant, Texaco owns a 12,000 barrel capacity refinery and Socony-Vacuum operates a 6,000 barrel plant. All of these refineries have catalytic cracking units. Continental Oil Company operates a 3,400 barrel refinery at Glenrock. The Douglas Refining Company has a 100 barrel still at Douglas. Casper is the headquarters of many companies engaged in petroleum exploration, drilling, production, supplies, refining, and transportation. Oil is produced in 17 fields within the area, and is transported to the refineries by pipelines extending into Montana.

Large iron ore deposits on the eastern border of the area have been developed by the Colorado Fuel and Iron Corporation for use in their Pueblo Mill. Coal, vermiculite, and sodium sulphate are mined in small quantities in the area. Copper occurs in spot deposits and has been extensively mined. Industrial employment in the area in 1947 was estimated at approximately 7,000, of which 2,600 were employed in the petroleum and associated industries. Mines and railroads together are the second largest employers of industrial workers. Other workers are employed in various urban services.

Agriculture contributes largely to the economy of the area. Most of the land is used for grazing. Relatively small areas are used for irrigation and dry-land farming. Most livestock shipments out of the area are made by rail to the Denver, Sioux City, or Omaha markets, which are approximately 300, 570, and 600 miles respectively, from Casper. In 1946, meat and meat products equivalent to the 1,700 carloads of livestock were shipped by the Casper packing plant. In addition 2,332 carloads of livestock were shipped from the area by individual operators. There is also considerable movement of livestock by truck, mostly local, with some to the Denver market.

Rangeland values in the study area have reached an all-time high. Rangelands are appraised to permit loans of $1.50 to $3.00 per acre. An additional $1.00 per acre has been loaned for leased lands in an operating unit. Sales prices of land vary from $3.00 to $6.00 per acre. Three specific sales made during 1947 were at $5.00, $7.00, and $11.00 per acre. Hay lands are appraised at $10.00 to $20.00 per acre according to their productive capacity. Land values on the Kendrick Irrigation project near Casper have been set by the Bureau of Reclamation at the 1935 prices of $1.50 to $18.00 per acre, depending upon estimated development costs and productivity.

Sheep grazing on some of the better range in the western portion of the Glendo area. Location is along the north fork of Casper Creek, northwest of Casper, Wyoming.

DEFENSE POTENTIAL OF THE GLENDO AREA

Primary values of the Glendo area for defense are petroleum production and processing, iron ore production, and the contribution of the watershed and storage facilities of the area to power production and downstream agriculture. Also of prime importance are the livestock and crops produced within the area. There are large deposits of coal in the area. Copper, sodium, sulphate, and vermiculite are available. The proposed Glendo Reservoir will aid in flood control, firm up power and stabilize downstream irrigated agriculture.

An outline of the defense potential of the Glendo area is as follows:

1. Regulation of average annual stream flow of 1,400,000 acre feet for the irrigation water supply of one-half million downstream acres in Nebraska and Wyoming which produce beans, potatoes, sugar, grain, beef, pork, milk, butter, lamb, and many other products. This irrigation supports a rich economy and society which is an important segment of national welfare.

2. With the development of the proposed Glendo Unit, the North Platte River system hydroelectric plants of the Bureau of Reclamation will produce 692,709,756 kilowatt hours of electric energy each year valued at $4,730,484. Glendo Dam will make possible the production of 313,100,000 of these kilowatt hours valued at $2,132,000, as it will permit the year-round operation of upstream power plants.

3. Glendo area has 17 oil fields with extensive reserves and an annual production of 2,559,233 barrels in 1950, valued at $5,118,466.

4. Annual production of 700,000 tons of iron ore valued at $3,250,000, utilized to make all steel products from nails to rails at the Pueblo Mills of the Colorado Fuel and Iron Company.

5. Five petroleum refineries with three catalytic crackers and a total production capacity of 36,700 barrels daily.

6. Grazing land area of 3,387,264 acres providing feed for 70,000 animal units of cattle and sheep.

7. Cropland area of 55,400 acres of irrigated land and 17,860 acres of dry farm land and an additional 40,000 acres of potentially irrigable land. This land produces hay and grain for livestock feed, and a small amount of other crops.

8. Meat and wool production from approximately 50,000 beef cattle and 300,000 sheep on the area.

9. The wholesale and retail trade, marketing, finance, transport and petroleum industry supply, processing and administration center that is the City of Casper.

Table 3.- Landownership and tenure in the Glendo area, Wyoming, by counties, 1950 1/

Ownership	Carbon 2/	Natrona	Albany	Converse	Goshen	Niobrara	Platte	Total
Bureau of Land Management								
Unreserved Public Domain	29,023	3/ 355,619	3,557	55,552	2,973	600	19,390	466,714
Stock Driveway Withdrawal	2,187	4/ 41,975		8,987				53,149
Public Water Reserve	80	1,391		160				1,631
Total Bureau of Land Mgt.	31,290	398,985	3,557	64,699	2,973	600	19,390	521,494
Reclamation Withdrawal		8,142					8,521	16,663
National Forests		8,960	141,531	110,411			1,920	262,822
U. S. Army Air Base		3,280						3,280
Total Federal	31,290	419,367	145,088	175,110	2,973	600	29,831	804,259
State Lands	4,551	155,688	4,570	189,797	680	10,784	64,042	430,112
Private Lands	12,746	845,410	22,279	925,782	20,417	87,681	379,714	2,294,029
Total State and Private	17,297	5/ 1,001,098	26,849	1,115,579	21,097	98,465	443,756	2,724,141
TOTAL ALL CLASSES	48,587	1,420,465	171,937	1,290,689	24,070	99,065	473,587	3,528,400

1/ Compiled from official records of the Bureau of Land Management, Region III, Billings, Montana, and Wyoming State and County records. Carbon and Natrona Counties comprise the western portion; the remaining counties comprise the eastern portion.

2/ All in Wyoming Grazing District No. III (Divide)

3/ Includes 21,024 acres in Wyoming Grazing District No. II (Wind River)

4/ Includes 2,040 acres in Wyoming Grazing District No. II (Wind River)

5/ Includes 14,712 acres in Wyoming Grazing District No. II (Wind River)

LANDOWNERSHIP

Ownership of the 3,528,400 acres included in the Glendo area is divided into three principal classes: privately-owned land 2,294,029 acres, federally-owned land 804,259 acres, and state-owned land 430,112 acres. Of the federally-owned land 521,494 acres are administered by the Bureau of Land Management, 262,822 acres by the Forest Service, 16,663 acres by the Bureau of Reclamation, and 3,280 acres by the Department of Defense. Lands administered by the Bureau of Land Management comprise approximately 15 percent of the total area and as a class are exceeded only by the 65 percent in private ownership. State-owned land is 12 percent of the area, the Forest Service about 7 percent, and the Bureau of Reclamation administers about 1 percent. Acreages of each class of ownership and tenure are shown by counties in table 3. Eighty-two percent or 430,275 acres of the public domain lands are located in the critical western portion in Carbon and Natrona Counties, eighteen percent or 91,219 acres are located in the eastern portion. Public domain lands in the western portion comprise 29 percent of the total land area. In this portion privately-owned lands comprise nearly 59 percent, state-owned lands about 11 percent, and federally-owned lands administered by the Bureau of Reclamation and the Forest Service 1 percent of the total.

Only 13 percent or 54,354 acres of the public domain lands administered by the Bureau of Land Management is located in established grazing districts. There are 375,921 acres (87 percent) of public domain lands outside of grazing districts. These public domain lands consist of 1,391 acres in public water reserve, 39,935 acres in stock driveway withdrawal, and 334,595 acres of unreserved, unappropriated public domain. Classes of landownership and grazing district boundaries in the western portion of the area are shown on the four maps in appendix IV.

In the eastern portion of the area, federally-owned lands administered by the Bureau of Land Management comprise only about four percent of the total, while nearly thirteen percent are administered by the Bureau of Reclamation or the Forest Service. State-owned lands make up over 13 percent of the total and privately-owned lands nearly 70 percent. Lands administered by the Bureau of Land Management in this portion include 160 acres in public water reserve, 8,987 acres in stock driveway withdrawal, and 82,072 acres of unreserved, unappropriated public domain. With few exceptions these public domain lands are in such small blocks and so widely scattered that efficient management and administration by the Bureau of Land Management is precluded. Relative amounts of the principal classes of landownership are shown graphically for both portions of the study area in figures 4 and 5 on the following page. Location of lands administered by the Bureau of Land Management in the eastern portion is shown on the map for that part on page 63.

FIGURE 4.

DISTRIBUTION OF TYPES OF LAND OWNERSHIP IN THE WESTERN PORTION OF THE GLENDO AREA WYO.

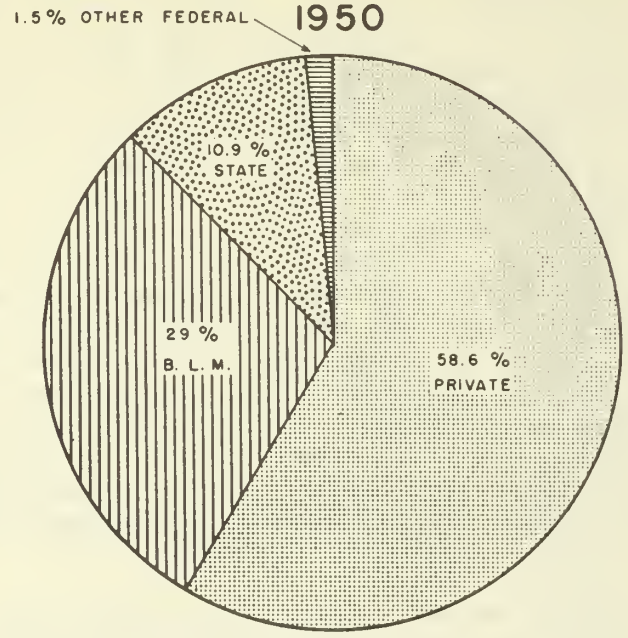
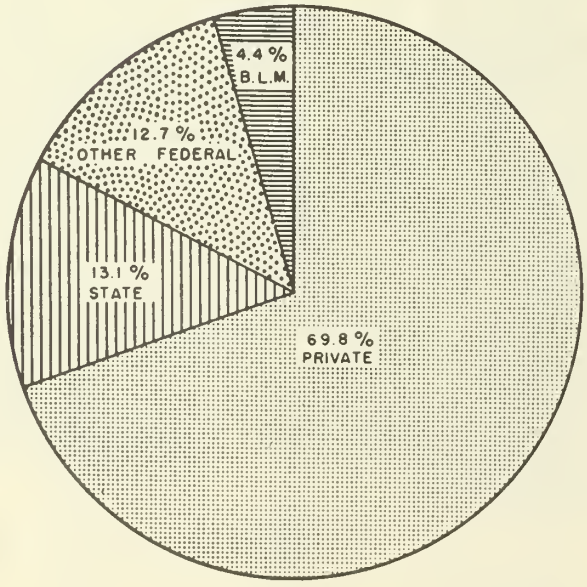


FIGURE 5.

DISTRIBUTION OF TYPES OF LAND OWNERSHIP IN THE EASTERN PORTION OF THE GLENDO AREA WYO. 1950



LAND USES

Livestock grazing is the principal land use in the report area. Approximately 96 percent of the area is rangeland. Included with this rangeland is the area of the Medicine Bow National Forest which comprises seven percent of the total. The National Forest land is utilized as summer range. It also includes some timber, but its principal values are for watershed and grazing. Balance of the area is two percent cropland, one percent potential cropland, and one percent industrial, urban, and transport. Suitability of land in the western portion of the area for these various uses is shown on the Land Use Suitability Map in appendix IV of this report.

Livestock Operations

Livestock operations in the study area vary from small farms or ranches where livestock are of secondary importance to large sheep or cattle outfits where crop production is supplemental to the livestock enterprise. About three-fourths of the area is below 6,500 feet elevation and can be used as yearlong range by either sheep or cattle. Due to the relatively high protein and mineral content of browse feed which predominates over most of this area, supplemental feeding during the winter months is normally necessary only for relatively short periods. Such periods may total from one to six weeks ordinarily except in unusually severe winters such as 1948-49, when feeding was necessary for ten or twelve weeks. Some of the cattle and most of the sheep move to summer range in adjoining areas. Most livestock operations graze either sheep or cattle exclusively, while others combine both classes of livestock. Cattle operations are most common in the eastern portion of the study area, primarily due to the more extensive grasslands. Public domain lands in this portion of the area are leased for grazing purposes under Section 15 of the Taylor Grazing Act.

Detailed studies of livestock operations were limited to the critical western portion which includes all or parts of 99 livestock operations. Forty-six of these graze sheep exclusively, 35 exclusively cattle and 18 both sheep and cattle. These operations have been segregated into six different size groups according to the number of animal units in each as shown in table 4 on the following page. The 15 smallest operating units are farms or small ranches with less than 100 animal units of livestock. On some of these crop production is of paramount importance to the operator. On all others crop production is only supplemental to the livestock enterprise. There are 76 operations which have from 100 to 1,400 animal units and include 35,207 animal units of the 61,371 animal unit total. The eight largest operations range in size from 1,400 to 6,400 animal units, totaling 25,540 animal units. Minor portions of their total operations are in the Glendo area, with the exception of one operation. It is significant to note that the 76 operators grazing from 100 to 1,400 animal units, have an average of from 7.5 acres to 8.3 acres of public domain lands under lease for each animal unit in the operation.

Table 4.- Classification of livestock operations in the western portion of the Glendo area, Wyoming, 1950

Size of Operation in Animal Units	Number of Operators				Animal Units of Livestock			Acres of Public Domain	
	Sheep	Cattle	Combined	Total	Sheep	Cattle	Total	Total per	Animal Unit
Under 100	1	14	0	15	10	614	624	8,560	13.7
100-300	11	15	3	29	2,505	3,019	5,524	46,020	8.3
301-600	18	3	7	28	10,628	2,010	12,638	95,000	7.5
601-1,400	13	2	4	19	14,720	2,325	17,045	133,800	7.8
1,401-2,600	3	1	1	5	8,040	2,600	10,640	19,500	1.8
2,601-6,400	0	0	3	3	8,240	6,660	14,900	60,160	4.0
TOTALS	46	35	18	99	44,143	17,228	61,371	363,040	5.9

This should provide about one-sixth of their forage requirements for the year. Only 15 operating units in the western portion of the study area include no public domain lands.

Crop Production

Both dry-land and irrigated crops are produced in the area as shown below:

County	Acres of Cropland		Total
	Dry-land	Irrigated	
Converse	4,420	41,380	45,800
Goshen	500		500
Natrona		11,860	11,860
Niobrara	2,500		2,500
Platte	10,440	2,160	12,600
Total	17,860	55,400	73,260

The above figures do not include 2,160 acres of abandoned dry-farm lands in Converse County. Both tame and native hay lands are included with irrigated lands. Irrigated lands in Converse County include approximately 9,000 acres in the La Prele project on La Prele Creek. Irrigated lands in Natrona County include approximately 5,000 acres in the Kendrick project near Casper. The balance of the irrigated land is supplied with water from private ditches and by pumping.

Potential increased irrigated acreages and crop production on these two projects is estimated as follows:

Project	Acres	A.U.M's.
La Prele	12,000	58,100
Kendrick	28,000	148,620
Total	40,000	206,720

Most cropland is utilized for the production of small grain, grain hay, alfalfa, and native hay for livestock feed, but some cash crops such as potatoes, beans, and beets are produced on the better soils under irrigation. Hay aftermath and other crop residue are utilized for short feeding of stock from the Glendo and adjoining areas. The feeding period is usually from four to six weeks after which shipment is made to market. Additional feeding in transit is customary in adjoining portions of the North Platte River Basin. With the further development of the Kendrick project and other irrigated areas, much of the land will be more intensively used. Dairying, poultry, and other enterprises will

Table 5.- Oil production in the Glendo area, Wyoming 1/

Field	Date of Discovery	Proven Area 1945	Public Domain Included	Production Year 1950	Total Production through 1945	Royalties to U.S. in 1945	Remarks
	(Year)	(Acres)	(Acres)	(Bbls)	(Bbls)	(Dollars)	
Big Muddy	1916	2,640	1,080	666,022	29,257,203	1,610	Oil and Gas
Bolton Creek	1920	120	120		43,335		Inactive
Brenning Basin	1902	40			7,052		Production resumed
Cole Creek	1938	1,650	120	445,851	2,379,505	41,748	
Deer Creek	1950			7,633			New field
Glenrock	1950			504,068			New field
Iron Creek	1917	80	80	3,567	57,027	768	
Midway	1931	280	280	40,000	129,603		Inactive 1945
North Casper Creek	1925				9,384		Inactive
Oil Mountain	1945						No production
Pine Mountain	1914				6,345		Gas only now
Poison Spider	1917	480	480	65,566	1,195,115	6,018	Oil and Gas
Sage Spring Creek	1950			151,058			New field
Shawnee	1936	20			1,337		New activity
South Casper Creek	1919	600		213,473	3,621,857	14,644	Oil and gas
South Cole Creek	1948			384,950			
Spindle Top	1944	80	80		53,742	344	New activity
TOTAL		5,990	2,240	2,559,233	36,761,514	65,132	

1/ Progress Report for 1945, Geological Survey, Conservation Branch, Oil and Gas Leasing Division, and the Rocky Mountain Oil Reporter, May, 1951.

develop with the growth of Casper and other communities in the area. The amount of supplemental feed in the area available for livestock utilizing the grazing lands will be correspondingly reduced.

Mineral Products

Leasing of lands within the study area for oil and gas exploration has been active since 1920. Leases for such purposes are made by the Bureau of Land Management covering not only public lands under its administration, but also patented lands on which mineral rights have been reserved to the Federal Government. When such exploration results in actual production of either gas or oil, further administration of the lease, including the supervision of production and development activities, is assumed by the Geological Survey. Interference with grazing use by livestock due to oil operations is not serious. Provisions of the gas and oil exploration leases safeguard the owners or lessees of surface resources from undue damage or injury due to exploration, production, or development activities. There are 17 oil fields in this area as shown in table 5. Royalties paid to the Federal Government from the six fields which were active in 1945 amounted to $65,132. Total production of all fields to December 31, 1945 was 36,761,514 barrels. Total production of the eight fields active during 1949 was 1,554,232 barrels. Three new fields were developed in 1950, and production increased to 2,559,233 barrels, valued at $5,118,466.

The copper and iron deposits of the Hartville area are the largest metallic mineral deposits in the State of Wyoming, having produced nearly 90 percent of the total reported $60,000,000 worth of such minerals in the state. The Sunrise mine near Guernsey, owned by the Colorado Fuel and Iron Corporation, is the largest mine in this area, having operated steadily since about 1900. Approximately $1,500,000 worth of copper were produced prior to 1919. Production at present is at an average rate of 700,000 to 800,000 tons of iron ore per year. Peak annual production during World War II was 1,000,000 tons and production during fiscal year 1947 was 800,000 tons. Originally open pit mines, all mining is now underground. Ore is shipped to Pueblo, Colorado, for smelting. Known deposits are estimated to be sufficient for 25 years at the present rate of production.

Coal mines near Glenrock and Casper produced approximately 2,300 tons of sub-bituminous coal in 1946. Quality of the coal is quite comparable to Sheridan coal. Coal-bearing formations underlie most of those portions of Converse and Natrona Counties within the study area lying east of the Casper Creek drainage and north of the river. They also underlie a strip from one to six miles wide south of the river between Casper and Douglas and the area north and east of Douglas in the Shawnee Creek and part of the Lost Creek drainages. The largest outcrops occur principally north of the river on Sand Springs Draw and on Cole, Sand, and Sage Creeks.

Smaller outcrops occur on both sides of the river between Casper and Douglas and on Shawnee and Lost Creeks. Gas, electricity and fuel oil have replaced coal as a fuel, so there is no mining in the area at present.

A sodium sulphate plant has been operating at Pratt, just east of Casper for about 16 years and another began operation at Natrona, 28 miles northwest of Casper, in 1947. The refined product is used as an ingredient of commercial stock feeds. A bentonite processing plant operated in Casper during 1950. There are two vermiculite mines and three prospects about 10 miles south of Glenrock between Boxelder and Deer Creeks. The larger of the two mines produced 1,539 tons from 1938 through 1943 while the smaller mine had produced a total of 450 tons at the close of 1943. The three prospects are located on adjoining properties. With the exception of oil and gas, all minerals are produced on private land.

Forest Products, Recreation, and Wildlife

Saw timber of merchantable quality occurs on only 240 acres of public domain lands outside of the national forest. The small commercial value of timber products and the limited extent of the stands precludes profitable operation except in conjunction with stands of greater extent and generally higher quality on adjacent national forest lands. Posts and poles as well as saw timber are produced on national forest and private lands in the area.

Recreational use, except for big game hunting, is limited to well-defined and quite restricted areas. Largest of the recreational areas is the Laramie Peaks Division of the Medicine Bow National Forest, occupying approximately 262,860 acres of the higher portions of the rugged terrain which borders the Laramie Plains Plateau. A few guest or "dude" ranches in the more accessible locations capitalize on the fishing, hunting, and mountain scenery of this locality.

The Casper Mountain City Recreational Area, eight miles south of Casper, is used yearlong by the urban dwellers of Casper. The principal attractions are summer cabins, camping, picnicking, hiking, and skiing in the winter. Some civic groups maintain summer camps there. Of the public domain lands in this vicinity, 580 acres have been classified for summer homes and cabin sites under the small tract act of June 1, 1938. Leases have been granted or application made to lease practically all of the available tracts and considerable development of summer cabins is in progress. An additional 230 acres are being considered for similar classification and development.

Picnic grounds, boating facilities, and a scenic drive have been provided in the state park at Guernsey Reservoir. A small, scenic natural bridge just below La Prele Reservoir is the chief attraction in the Converse County Park. Johnson Lake, 25 miles northwest of Casper, provides trapshooting and a limited amount of migratory waterfowl hunting. Deer and antelope hunting in most of the area attracts numerous hunters from the urban communities of this and adjoining portions of the North Platte River Basin. Antelope inhabit about 60 percent of the study area and mule deer about 35 percent. Numbers of both species are kept within reasonable limits through the control exercised by the Wyoming Fish and Game Commission in adjusting seasons and hunting areas to effect a reduction of numbers as needed. Six species of small fur bearers occupy portions of the area. Bobcats are found over about 40 percent of the area and coyotes inhabit nearly all of it.

LAND CLASSIFICATION

Range and forest lands in the western portion of the study area have been segregated into capability classes V to VIII inclusive. Land-use capability classes I to VIII are defined and described in table 7, page 76. Intensive studies were limited to the western portion included in Carbon and Natrona Counties due to the prevalence of severe watershed and range deterioration and to the concentration of federally-owned lands administered by the Bureau of Land Management in this portion. Land classification in the eastern portion was restricted to the public domain lands. Results of these studies are shown on the four maps of the western portion included in appendix IV. Condition of the land resource is shown on the Land Use Capability Map where it is indicated by the capitalized first letter of the four condition classes, excellent, good, fair, and poor. This letter follows the Roman numeral indicating the capability class. Land resource condition classes are described and defined in table 8 on page 77. Classification of land use capability and condition for the western portion of the area is summarized as follows:

Capability Class	Excellent	Good	Fair	Poor	Total	Percent of Total
III		45,336			45,336	3.
V	420	4,940			5,360	.4
VI	97,352	471,235	168,103	8,071	744,761	52.
VII		302,908	274,250	47,736	624,894	43.
VIII				23,051	23,051	1.6
Total	97,772	824,419	442,353	78,858	1,443,402	100.

The above tabulation does not include 8,960 acres in the Laramie Peaks Division of the Medicine Bow National Forest, 13,800 acres of cropland,

FIGURE 6

DISTRIBUTION OF TYPES OF RANGE LAND OWNERSHIP IN CAPABILITY CLASSES VI AND VII IN THE WESTERN PORTION OF THE GLENDO AREA, WYOMING 1950

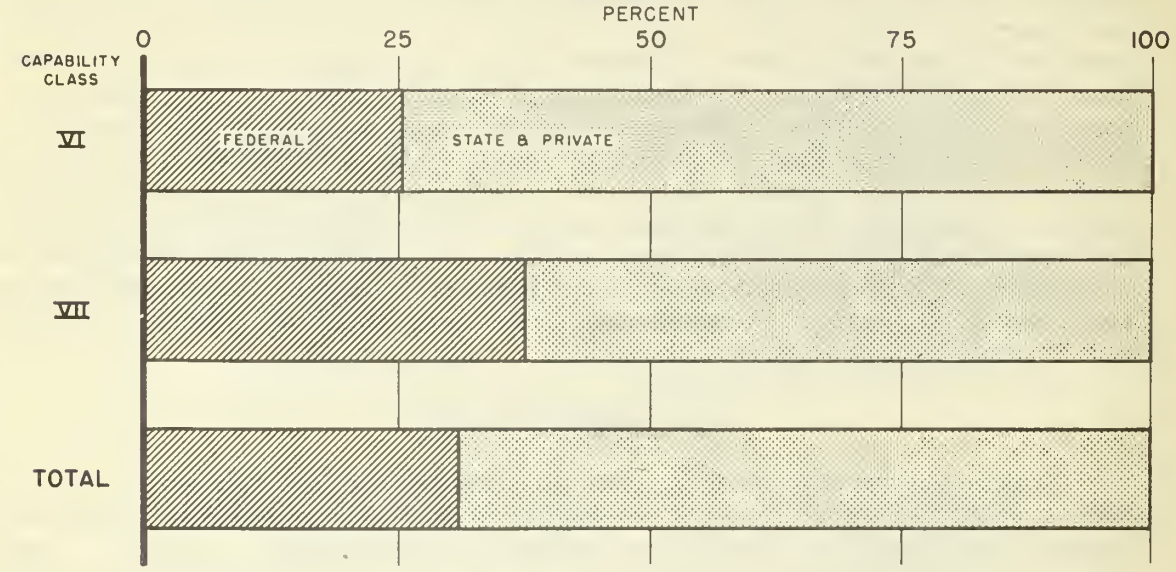
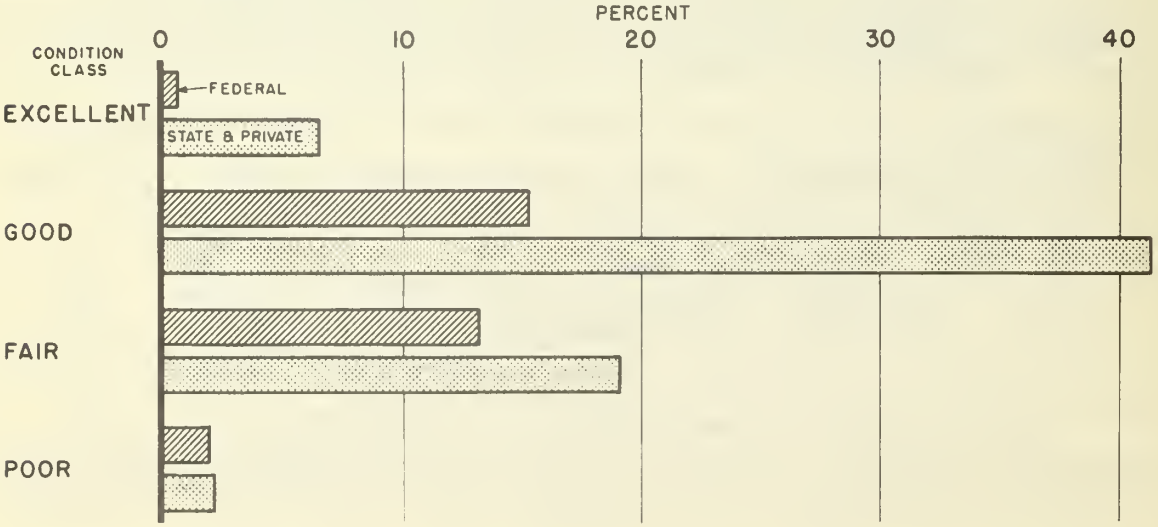


FIGURE 7

DISTRIBUTION OF TYPES OF RANGE LAND OWNERSHIP IN CAPABILITY CLASSES VI AND VII ACCORDING TO RESOURCE CONDITION CLASS IN THE WESTERN PORTION OF THE GLENDO AREA, WYOMING 1950



nor 2,890 acres in the City of Casper, Wyoming. The 45,336 acres of capability class III croplands are within the Kendrick Soil Conservation and Irrigation Districts and are mostly exclusively in state or private ownership. Sixty-four percent (871,495 acres) of the class VI and VII grazing lands in the western portion are in good or excellent condition, thirty-two percent (442,353 acres) are in fair condition, and four percent (55,807 acres) are in poor condition. Class V lands are in good or excellent condition.

Relationship of Federal ownership to state and private ownership of range and forest lands in capability classes VI and VII in the critical western portion of the study area is shown graphically in figure 6. Relationships of these ownerships for each condition class of range and forest lands in capability classes VI and VII in this portion are shown in figure 7 and are summarized as follows:

Land Class	Condition	State and Private		Public		Total	
		acres	percent	acres	percent	acres	percent
VI	Excellent	88,437	9.4	8,915	2.1	97,352	7.1
	Good	350,958	37.1	120,277	28.3	471,235	34.4
	Fair	112,006	11.8	56,097	13.2	168,103	12.3
	Poor	3,527	.4	4,544	1.1	8,071	.6
Subtotal		554,928	58.7	189,833	44.7	744,761	54.4
VII	Good	214,047	22.7	88,861	20.9	302,908	22.1
	Fair	150,002	15.9	124,248	29.3	274,250	20.0
	Poor	25,857	2.7	21,879	5.1	47,736	3.5
Subtotal		389,906	41.3	234,988	55.3	624,894	45.6
	TOTAL	944,834	100.	424,821	100.	1,369,655	100.

The condition of rangelands in the western portion of the study area is evidently not related to their ownership except for special use classes such as stock driveways. Special consideration is given to the problems presented by the rangelands of the western portion later in this report.

In the eastern portion of the study area, rangelands are generally in good condition. Detailed classification was limited to the federally-owned lands administered by the Bureau of Land Management. These public lands cover 91,019 acres, or four percent of the eastern portion.

Classification and condition of the public lands in the eastern portion of the study area is shown below:

County	Class VI		Class VII		Class VIII	
	Excellent and good (Acres)	Fair and Poor (Acres)	Excellent and good (Acres)	Fair and Poor (Acres)	(Acres)	Total (Acres)
Albany	640		2,917			3,557
Converse	9,663	120	44,978	7,850	2,088	64,699
Goshen	850			1,973	150	2,973
Niobrara	120		300		90	600
Platte	3,083	320	14,719	871	197	19,190
Total	14,356	440	63,004	10,694	2,525	91,019

More than 97 percent or 88,494 acres of these lands are in capability classes VI and VII. Over 87 percent or 77,360 acres of these class VI and VII lands are in good or excellent condition, with 12½ percent or 11,134 acres in fair or poor condition. Class VIII lands having no usable productive capacity for either grazing or timber are not classified according to condition. They are mostly badlands where steep slopes, high gradient of watercourses, extremely sparse or totally lacking vegetative cover, and highly unstable soils and parent materials combine to produce a maximum of heavily sediment-laden runoff following any considerable amount of precipitation. Such areas are not considered to be man made problem areas, but nevertheless must be given special treatment since they contribute large quantities of sediment. There are 2,525 acres of federally-owned lands administered by the Bureau of Land Management in this capability class in the eastern portion of the study area. In addition there are somewhat over 20,000 acres of privately-owned lands in the same class much of which lies adjacent to U. S. Highways No. 20 and No. 87, southeast of Douglas.

INDICATORS OF MALADJUSTMENTS IN LAND USE

Livestock grazing is the primary land use in the study area and it is seldom precluded by other uses except in certain well-defined localities. Sedimentation and watershed impairment are so severe that there is significant conflict between livestock grazing and the maintenance of essential watershed values in some localities. Expansion of the livestock industry brought about increased competition and occasionally open conflict among

operators over the use of the public domain lands or open range. Withdrawals of vacant, unappropriated public domain lands were made for stock driveways to facilitate the movement of livestock to and from seasonal ranges and to shipping points, and for public water reserves to prevent monopolizing of public range by the larger operators. Competition and dispute over use of the public domain lands continued and occasionally caused hardship to some operators as well as severe damage to the lands. All public lands were affected by Executive Order 6910 of November 26, 1934, which provided that public lands must be classified before they could be entered or sold. The Taylor Grazing Act of June 28, 1934, provided for regulation and administration in order to stop injury to the public grazing lands, to provide for their orderly use, improvement and development, and to stabilize the livestock industry dependent upon the public range. The Taylor Act provided for proper land use through the organization and operation of grazing districts. Two grazing districts organized under provisions of the Taylor Act include small parts of the western portion of the study area. Within the grazing districts control by ownership or written lease of sufficient ranch or base property as well as actual prior use of the public range involved is requisite to the receiving of permits for grazing privileges under Section 3 of the Act. Outside of such districts similar control of contiguous property is requisite to the leasing of public rangelands under Section 15 of the Act. These provisions have effectively eliminated the transient livestock operator who formerly conducted a virtually tax-free enterprise on public rangelands. Livestock operations have become relatively well stabilized and range disputes and abusive use have been greatly reduced.

Primary indicators of maladjustments in land use in the study area are sedimentation, watershed impairment, land resource deterioration, complexity of ownership and operating unit pattern, and improper seasonal range use. The degree of land resource deterioration and watershed impairment establish the land resource condition. Degrees of this condition are good, fair, and poor as shown on the Land Use Capability Map in appendix IV.

Sedimentation

Sedimentation is evident in sediment-filled stock-water reservoirs, deposits along the main river channel, and in Guernsey Reservoir. Guernsey Reservoir is the final point of deposition of sediment derived from the entire drainage area, except such as may be held by sediment traps on the main river or de-sedimentation reservoirs on tributary watercourses and the finer particles that remain in suspension. Due to the excessive sedimentation of Guernsey Reservoir, extreme measures are necessary in order that the life and utility of the reservoir may be protected and that the agricultural economy dependent thereon may be perpetuated. This reservoir regulates stream flow for the irrigation of

cropland in Nebraska and Wyoming, which comprises more than 90 percent of the cropland of the entire North Platte River Basin. Guernsey Reservoir also stores runoff below Pathfinder Dam which amounts to 235,600 acre-feet per year. Electric power generation capacity of 4,800 kilowatts is of secondary importance. Sediment contribution of tributary watercourses are deposited temporarily in the pools and on the rocks of the main channel in the fall after the need for irrigation water is past and the low winter flow is insufficient to transport the sediment any considerable distance. When the flow of 3,500 cubic feet per second for irrigation purposes is released from Alcova Reservoir, these deposits are picked up and moved downstream to the reservoir. Sediment contributions of tributary watercourses and the products of erosion along the cut banks of the main channel move directly to the reservoir whenever stream flow is augmented by runoff or irrigation water release.

Original capacity of Guernsey Reservoir in 1927 was estimated to be 73,810 acre-feet. Sediment accumulation was evident by 1931 when a survey indicated a serious loss of storage capacity. A second survey in 1944 indicated the continuation of serious losses. The most recent survey made in 1947 showed that sedimentation had reduced the original storage capacity by 33.41 percent or 24,660 acre-feet. Construction cost of the dam itself was $1,881,036 or $25.48 per acre-foot. At this rate the loss of 24,660 acre-feet as shown by the 1947 survey has cost $628,336.80. This cost would be much larger if replacement estimates were based on present day construction costs, or if based on benefit value of the storage capacity.

Serious impairment of the utility of the reservoir has begun and will become more serious with each passing year. At the time of the 1947 survey sediment had accumulated to a point only $4\frac{1}{2}$ feet below the power intake sill. Water passing through the power intake at present contains much more sediment than formerly and the amount will steadily increase as the sediment level rises. While this does not seriously hinder the production of power, it does cause more rapid wear of power installations. The real seriousness of the situation is evident when consideration is given the fact that the loss of an additional 33 percent of the original storage capacity would virtually terminate the usefulness of the reservoir as a regulating agent for irrigation water released from Pathfinder and Alcova Reservoirs and for inflow and flood water originating in the 5,500 square mile Glendo area. Estimating silt accumulation at the same average rate as for the 1927-1947 period would indicate 1967 as being the end of the useful life of Guernsey Reservoir for water storage and regulation. However, the trap efficiency of a reservoir decreases as the reservoir fills with silt and if other factors were unchanged the usefulness of Guernsey Reservoir might continue for some years after 1967.

The extreme variability of sediment contributions emphasizes the urgent necessity for the application of effective remedial measures to the tributary drainage area. One storm in the Glendo area, such as covered most of the Bighorn and Powder River Basins from September 27 to 29, 1923, might completely fill the reservoir with sediment. This possibility is of improbable occurrence, but it should be considered in evaluating the urgency of initiating measures to reduct sediment production. Sediment production in the area threatens the agricultural production and existent economy of the North Platte projects, and the developing Kendrick project near Casper. Water rights for the normal flow of the river are held by the North Platte project. The Kendrick project has flood water rights only. Alcova Reservoir serves as storage for flood waters and as a diversion. Guernsey Reservoir serves as storage for flood waters, regulates stream flow for irrigation and produces power. The proposed Glendo Reservoir with 800,000 acre-feet capacity will store flood water, decrease the rate of sediment accumulation in Guernsey Reservoir, produce power, and provide other benefits. Sediment storage capacity of the proposed Glendo Reservoir is 115,000 acre-feet. Present rate of sediment accumulation in Guernsey Lake is 1410 acre-feet per year. Estimated rate of accumulation after construction of Glendo Dam is 250 acre-feet per year.

Benefits to be derived from construction of Glendo Dam will include material lengthening of the useful life of Guernsey Reservoir, protection of Guernsey Dam from probable floods in excess of its spillway capacity, additional storage of glood waters which may be credited to the Kendrick project, storage of return flows from the Kendrick project which may also be credited to that project. Other benefits include power generation from 24,000 kilowatts capacity, and regulation of flow so that upstream power plants may be operated constantly. The proposed Fremont Canyon Power Plant, a part of the Glendo Unit, will have an installed capacity of 48,000 kilowatts. This generation and regulation of power production will permit the additional system production of 312,100,000 kilowatt hours of electric energy annually, valued at $2,132,000. Glendo Dam will permit firming-up and other improved characteristics in power production for the North Platte River system. In addition to the two Glendo Unit plants, Alcova power plant is also scheduled for construction at Alcova Dam, with an installed capacity of 36,000 kilowatts. Seventeen other hydroelectric power developments with a total installed capacity of 108,000 kilowatts are proposed by the Bureau of Reclamation. Five of these are on the North Platte River, and twelve are on tributaries in the area as shown in Appendix I-A.

Glendo Unit development will increase present average monthly minimum flow of less than 90 second feet at Casper to 1,057 second feet. This increased flow at Casper will decrease the hardness of the water there by about one-third, saving an estimated $37,000 per year in soap and water softener costs to the present population. This is only a portion of total savings to be made possible because of soft water. A maintained flow of 1,000 second feet in the North Platte River will permit development of a fishery valued at $50,000 annually, according to the

report of the Fish and Wildlife Service. An abstract of the proposals for development of the Glendo Unit by the Bureau of Reclamation is presented in appendix I.

Sediment Sources

Sedimentation stations have been established by the Geological Survey on the river at Goose Egg Bridge, Mystery Bridge, Douglas Bridge, and Cassa, at the request of the Bureau of Reclamation and of the Bureau of Land Management. Records from these stations will indicate the amount, frequency, and relative importance of sediment originating in the various groups of tributary watercourses. Goose Egg Bridge station will measure the sediment contribution of Ledge, Bear, Bolton, Stinking, Bates, Coal, Eagle, Lone Tree, and Poison Spring Creeks; Mystery Bridge station will show the amount of sediment originating in Poison Spider and Casper Creeks; Douglas Bridge station will provide sediment readings for Cole, Sand, Sage, Antelope, Muddy, Deer, Boxelder, and La Prele Creeks; Cassa station will give figures showing the amount of sediment coming from Shawnee, Lost, Muddy, Willow, Wagon Hound, La Bonte, and Elkhorn Creeks.

Streams measured at the Goose Egg Bridge drain an area of approximately 435,000 acres, or one-eighth of the entire Glendo Area, and include all of the drainage area between Alcova Dam and Bessemer Bend. Approximately 42 percent of this drainage area is federally-owned land administered by the Bureau of Land Management. Investigations indicate that these drainages are probably the source of the major portion of the sediment derived from the entire Glendo area. Watershed deterioration is evident to a marked degree in Bates Hole within this drainage. Vegetative deterioration is apparent on many slopes. Watercourses formerly supporting a tangled growth of willow, cottonwood, greasewood, rose, and chokecherry have become raw, vertically-walled gullies 5 to 30 feet in depth and several times as wide. On the other side of the river, Eagle, Lone Tree, and Poison Spring Creeks originate in or flow through the unstable soils and parent materials of the "red beds" or of typical badlands below the rim of the Sweetwater Plateau to the west.

Poison Spider and Casper Creeks, tributary to the Mystery Bridge station, drain 541,440 acres in which the percentage of federally-owned lands administered by the Bureau of Land Management is relatively high. Sediment contributions are not believed to be serious except for the first 10 miles above the mouth of Poison Spider Creek and a similar portion of Iron Creek. There is little public domain in these portions of the drainage areas. These portions are almost entirely included in the Kendrick Irrigation and Soil Conservation Districts. Control of sediment production by waste water and drainage will become important.

From the standpoint of sediment movement, Sand Creek and Muddy Creek appear to be the largest contributors of the watercourses tributary to the Douglas Bridge station. Sediment movement in Sand Creek, except after unusually heavy precipitation, is believed to be quite low, due

to generally sandy soils and low gradient. Antelope and Sage Creeks in this same group carry some sediment. All four of these streams should be given further study by some other agency to determine what control measures may be needed. There is very little federally-owned land administered by the Bureau of Land Management in these drainages. None of this land contributes appreciably to the sediment problem, and no suitable sediment control dam sites were located.

Shawnee and Elkhorn Creeks, tributary to the Cassa station, contribute considerable amounts of sediment. Horseshoe, Bear, and Cottonwood Creeks enter the river below the Glendo Dam site and Broom Creek empties directly into Guernsey Reservoir. The amount of federally-owned land administered by the Bureau of Land Management that is tributary to watercourses entering the river above Douglas Bridge and Cassa stations is very small, and since it does not contribute appreciably to the sediment problem, examinations by this Bureau in those drainages were strictly of a reconnaissance nature. Further studies on flood control in this portion of the study area are contemplated by the Soil Conservation Service.

Construction of the proposed Glendo Dam is only a partial answer to the problem of sedimentation since the 115,000 acre-feet capacity to be set aside for sedimentation would be filled in about 100 years at the present average rate of sediment contribution from the tributary drainage area, and probably in much less time because of heavy storm contributions over a long period. Virtually the same rate of sedimentation would affect any other sediment retention reservoir constructed on the river above the proposed Glendo Reservoir. On most of the tributary drainages the sedimentation rate would vary as outlined above.

Extreme variations in both the annual flow and in the flow per unit of area of tributary streams is typical of the study area. Examples of these variations are shown in table 1, page 2. The drainage area and average annual native flow of the eight measured streams are shown graphically in figure 2, page 3. Bates Creek is the only measured flow stream in the western portion of the area. The total drainage area of Bates Creek is 377 square miles including 138 square miles in the tributary drainage area of Stinking Creek. Normal flow in Bates Creek is clear water, but during such years as 1924 when its total flow of 189,600 acre feet was more than twice the maximum previously recorded for any of the streams in the area, immense quantities of sediment must have been eroded from the watershed.

Watershed Impairment

Watershed impairment and land resource deterioration are most evident in Bates Hole, but more or less localized areas were found on various other tributary watercourses. The primary indicators of watershed impairment are vegetative deterioration and the resultant

"accelerated" or man-caused erosion. Vegetative deterioration is primarily due to improper seasonal grazing and over-use by livestock. Initial plant growth in the spring is provided by plant foods stored in the roots. This initial plant growth produces a certain amount of green foliage which becomes the factory for the conversion of soil nutrients and water into plant tissue which furnishes grazing for livestock. If this factory is removed by too early grazing it never gets a chance to produce and eventually the plant dies. The best and most nutritious plants succumb to such abuse first, less desirable plants and invaders increasing in the vegetative stand. This changed composition results in lowered carrying capacity for livestock, increased rate and amount of runoff and increased susceptibility of the soil to erosion. Increased rate and amount of runoff decreases percolation of moisture into the soil and thereby decreases the amount of plant growth. In the western portion of the study area vegetative deterioration consists mainly of the replacement of bluestem wheatgrass by cheatgrass brome and other annual grasses and weeds. This deterioration is indicated by the land resource condition as shown on the Land Use Capability Map in appendix IV.

Complexity of Ownership and Operating Unit Pattern

The complex ownership and operating unit pattern existing in the western portion of the study area is due to the semi-transient nature of the original sheep operations from which many present-day operations have developed. This pattern often interferes significantly with the accomplishment of watershed and range rehabilitation measures and with the application of improved management practices. It also indicates the relatively unstable condition of those operations which persist in attempting to secure major portions of needed forage while trailing between various properties.

Improper Seasonal Range Use

Stocking of the critical western portion of the study area has been largely on the basis of using the 70 percent of rangelands below 6,500 feet elevation to its full capacity during the 6 months winter season. This has led to improper seasonal use and severe over-use of the limited spring-fall and summer ranges. Supplemental feeding during the more severe winter storms and movement of livestock to summer ranges in adjoining areas has offset this condition to some extent, but has not relieved the pressure on spring-fall range. Development of water in many areas formerly grazed only by sheep in the winter on snow, and increasing use of the range by cattle has increased the pressure on yearlong ranges. This in turn has increased the pressure on spring-fall ranges as well as on summer ranges. Over-stocking of winter ranges forces use of spring-fall ranges and summer ranges during the critical period of initial plant growth, prior to the time when they should be grazed. Too early use of a range seriously reduces its productivity and soil protective efficiency and also forces earlier use of the succeeding seasonal range.

Driveways

Trespass along stock driveways, originally due to the increasing competition among livestock operators over the use of public domain lands or open range, has persisted in certain localities and has become symptomatic of the basic conflict between forage and watershed uses in the area. Unused forage on rangelands is abhorrent waste in the eyes of some who fail to grasp the vital necessity of maintaining such a cover on areas of unstable soils as a safeguard to watershed values and to the productive capacity of the rangeland. Withdrawals of public domain lands for stock driveway purposes made adequate provision for movements of livestock within the study area and to seasonal ranges in adjoining areas. Actual use of some driveways as such has virtually ceased, due to improved transportation routes and facilities as well as to greater consolidation and stabilization of livestock operations. Further reduction in use of other driveways is probable as consolidation of operations and improvement of roads continues.

There are three driveways in this study area which are likely to continue to be of primary importance. Their location and extent are shown on the Land Use Adjustment Map. Features of the three driveways, namely, length, capacity, grazing use, and excess or deficiency of available forage are as follows:

Driveway Name	Length Miles	Feed Demand Animal Unit Months	Feed Acres	Available AUM's 1/	Excess or Deficiency	
					AUM's 1/	Percent
Orpha	20	653	8,627	1,447	+794	122
33 Mile	10	1,542	4,048	646	-896	58
Bolton Creek:						
Segment 1	30	1,049	4,918	550	-499	48
Segment 2	16	1,007	6,058	643	-364	36
Segment 3	24	973	8,903	1,479	+506	52
Subtotal	70	3,029	19,869	2,672	-357	12
Total	100	5,224	32,544	4,765	-459	9

1/ Animal Unit Months.

There are 25 operators running 9,700 cattle and 25,800 sheep in the 450,000 acre service area of the Orpha driveway. The operations in this service area are almost all set up on a single site yearlong ranch basis and use of the driveway is consequently almost entirely by market stock trailing to the shipping point at Orpha. Only 20 percent of the estimated use is by cattle although there are nearly twice as many animal units in cattle as in sheep in the service area. Trespass on the driveway is prevalent since much more feed is available than is needed by trailing stock. It is proposed to lease portions of this driveway for grazing. Fenced holding areas will be retained for driveway use.

The 35 operators in the 750,000 acre service area of the Thirty-three Mile driveway run 4,540 cattle and 90,700 sheep. Only 15 percent of this service area is within the study area. Some of the operations in this service area are also on a single site yearlong ranch basis or in place, but most of the sheep are trailed 50 to 75 miles or more to summer range in the Bighorn Mountains. Use on this driveway is a complex combination of trailing to and from seasonal range and to the shipping point at Bucknum by market stock. Three and one-half percent of estimated use is by cattle. Animal units in sheep outnumber those in cattle four to one in the service area of this driveway. The indicated deficiency of forage on the small portion of this driveway within the study area was further intensified by the practice of some sheep operators who trailed their entire herds to the shipping point before separating the market stock. This practice approximately tripled use of the driveway at this time by these operators, and was inexcusable. A trail rider has worked in this area since 1949 and many former abuses have been corrected.

The Bolton Creek driveway and its service area of 500,000 acres with 1,142 cattle and 29,500 sheep, lies entirely within the study area. This driveway has been divided into three segments due to differences in the problems existing in each segment. This segmentation is shown in the preceding table. The first segment extends from the shipping point at Bishop approximately 30 miles across portions of the Kendrick Irrigation District and Soil Conservation District, through yearlong foothill range to the North Platte River bridge 10 miles downstream from Alcova. The second segment extends 16 miles from this bridge in a southeast direction across lower Bolton and Stinking Creeks to the foot of Bates-Stinking Creek divide. The third segment consists of the Shirley Basin, Medicine Bow, and Deer Creek branches which cross summer range with a total length of 24 miles.

Indicated deficiencies of forage along the first segment will be virtually eliminated upon the completion of proposed adjustments. These adjustments include the revocation of some First Form Reclamation Withdrawals. Subsequent withdrawals will be made as stock driveway, or exchanges negotiated for patented lands needed for stock driveway purposes.

The development of water below the stock pens in sections 9 and 10, Township 33 North, Range 81 West, will provide a nearly adequate driveway. There is no apparent deliberate trespass. Supplemental feed for trailing livestock will be increasingly abundant as the irrigation and soil conservation districts develop.

Trespass problems along the second segment will doubtless be of slight importance since recent consolidations of operating units in this vicinity will prevent former range competition. Completion of a land acquisition program as shown on the Land Use Adjustment Map is necessary to provide driveway continuity and sufficient forage to meet the indicated deficiency. Fencing of the driveway is also necessary to eliminate possibilities of future trespass. Fencing projects have been proposed and cooperative agreements completed with range operators. Considerable fence will be constructed along this driveway in 1951.

The third segment of the Bolton Creek driveway traverses summer range and has more forage than is needed by driveway stock. There appears to be a possibility that adjustments in seasonal use might utilize this excess feed to lighten the use on lower ranges where curtailment may be necessary. Present use of this driveway by sheep is estimated to be only one-fifth of the former maximum use and use by cattle and horses is now only four-fifths of their former use. Combined present use is estimated at one-fourth of the maximum former use by both classes of livestock. Average time used by sheep in crossing the second and third segments is eight days. Sheep traverse the first segment in five days. Any specific problems existing along other driveways are of minor importance and can be resolved in the process of adjustments proposed in land use and management.

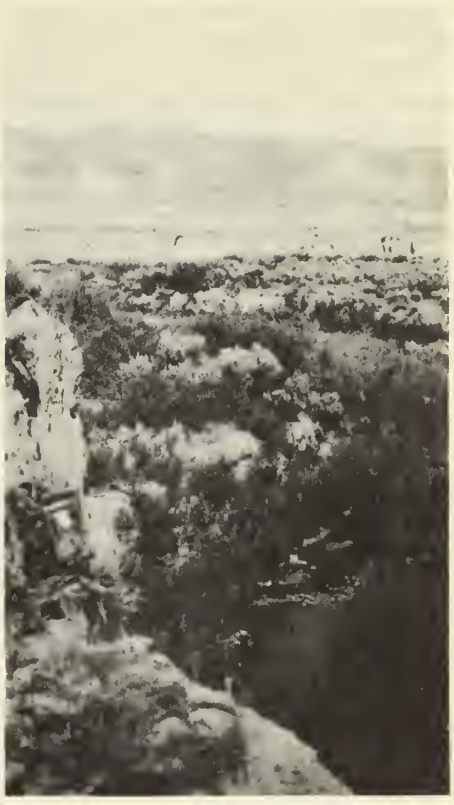
Bates Hole Problems

Severe erosion is very evident in the deep, vertically-walled gullies and widespread sheet erosion so prevalent in Bates Hole. Vegetative cover of the gumbo slopes in this locality is normally very scant. It is difficult to determine just where normal or geologic erosion stops and accelerated or man-caused erosion begins. Improper seasonal grazing and over-use in the past combined with the burning out of woody growth which formerly stabilized many of the waterways were no doubt primary contributing factors to present conditions. Excessive trailing of livestock due to inadequate or poorly distributed water supplies and constant competition for forage were also contributing factors. These practices resulted in poor distribution of livestock and lack of uniformity of use. Severe over-use along waterways often occurred. Processes of range and watershed deterioration which were caused by the unquestioned former abusive use have continued practically unabated in Bates Hole. Damage wrought by past abusive use is further aggravated by the readily erodible soil, poor vegetative cover and steep slopes combined with a dry climate and infrequent heavy rains.

Channel of Stinking Creek showing sediment contributions made by caving banks and sparsely vegetated hills.

Elk Creek above junction with Stinking Creek showing natural healing. Heavy growth of willow, white sweetclover, sagebrush, giant wildrye, and other grasses have stabilized this creek.

Cut bank rising 20 feet above channel of Stinking Creek showing 14 foot root of a relatively small sagebrush.



Beaver dam on Elk Creek near junction with Stinking Creek.

The degree to which misuse of the range is responsible for existing conditions in Bates Hole may be questioned. The livestock industry cannot be entirely to blame. It could be more fitting to accuse the Federal Government of failing to influence the individual operators who were responsible for burning of the woody vegetation along watercourses, improper seasonal use, and extreme over-use of many critical areas. Intensive grazing of well sodded waterways and their use by livestock trailing to and from water were of particular importance in this connection. Trails made by camp wagons frequently developed into gullies. Prior to the enactment of the Taylor Grazing Act itinerant sheep operators used the Laramie Plains and Shirley Mountains for summer range. These operators concentrated in Bates Hole during the winter, causing excessive overstocking and heavy over-grazing during the winter and spring. At that time the Federal Government lacked both a constructive policy for public domain lands and a conservation program for private lands.

The question of where the blame lies for existing conditions is immaterial to the purpose of this report. The damage has been done. Stinking Creek, once a shallow, meandering watercourse, protected by cottonwood, willow, chokecherry, rose, and other shrubs, and flanked by greasewood and salt sage flats, has become a barren, dry wash with vertical walls from five to thirty feet high. In places these walls show the outline of silt-filled former meanderings exposed in cross section by the deeper cutting of successive years. Many areas of formerly productive rangelands in capability classes VI and VII have deteriorated to such an extent that they are now approaching badland conditions. Most watercourses have deteriorated into barren gullies with vertical walls and extensive tributary gullies cutting ever deeper and wider into the remaining vegetated rangelands.

While conditions on Stinking Creek are probably the least desirable in the entire study area, the differences are in degree and Stinking Creek may be taken as symbolic of such watershed impairment wherever it occurs in the area. Pictures on page 36 show typical conditions on Stinking Creek.

Stabilization of Elk Creek by natural healing has been due to the perennial flow of the stream combined with the effects of good land management practices as administered by the Divide Grazing District, Wyoming No. 3. Severe cutting occurred here when the channel of Stinking Creek was cut to its present depth, probably during the heavy runoff of 1920.

Present conditions in Bates Hole are due primarily to the lack of good land management in the past which could have maintained the vegetative cover of rangelands and waterways intact. Land Management must consider the relative values of all land uses in any given area. Each use must be considered as to its effect upon the basic resource as well as upon other uses in the area. In the western portion of the study area range use has been given sole consideration until recent years.

Those who did grasp the true situation were powerless to act beyond the limits of their own deeded lands, some of which were poorly delineated by inadequate surveys. Also they were often forced by economic pressure to use practices which they knew to be harmful. In the western portion of the area watershed values have been definitely and seriously impaired by vegetative deterioration due to improper use by grazing livestock. Here range management must provide adequate protection of essential watershed values. Maximum sustained utilization of the forage crop may be secured by providing for the uniform use of rangelands according to their carrying capacity at seasons which will inflict the least injury on the vegetative cover. Such use will in no way injure the watershed, but over-use or improper use, if continued, will cause further watershed and range deterioration. This is exactly what has happened in Bates Hole. The prevalence of unstable soils in this area has merely hastened the process and made it more spectacular.

Unfortunately, damage to rangelands and watersheds has progressed to a point in Bates Hole where proper land management which could have prevented the damage, cannot repair it. Each succeeding year only adds to the ultimate cost of repair and to the total damage already inflicted on watersheds, rangelands, and downstream water storage and distribution facilities.

Sand Dunes and Badlands

Active sand dunes are common throughout an area of about 80 square miles northeast of Casper. This area begins just across the river from Casper and extends northeastward to the Cheyenne River Divide in the eastern portion of the study area. The dune area rises to a high point along the Natrona-Converse County line and completely blocks ordinary runoff in Cole Creek. In the central part of the dune area there is one large block of public domain land covering about 24 square miles, mostly in Natrona County, but partly in Converse County. Additional smaller blocks and isolated tracts of public domain are scattered throughout this sandy area.

The sand dunes present a serious problem although their active area is small. Most of the surrounding area is sandy to very sandy soil which is quite well stabilized by vegetation. Prairie sandreed grass, (Calamovilfa longifolia), Indian ricegrass (Oryzopsis hymenoides) and dock (Rumex spp.) cover all but the most active portions of the dunes. These plants are unable to hold the shifting sand in place. Blowouts along roads, trails, and other disturbed spots are common. This could be a productive range area if some method of stabilization can be utilized which is capable of resisting the cold, dry, southwesterly winter winds which blow so persistently in this portion of the study area. The photographs on page 40 show typical conditions in the dune area.

Large blowout in sand dune area between Sand Springs Draw and Cole Creek near Powder River Divide.

Blowout on top of dune in sand dune area northeast of Casper. Other dunes can be seen in the background. Casper Mountain is visible in the distance.

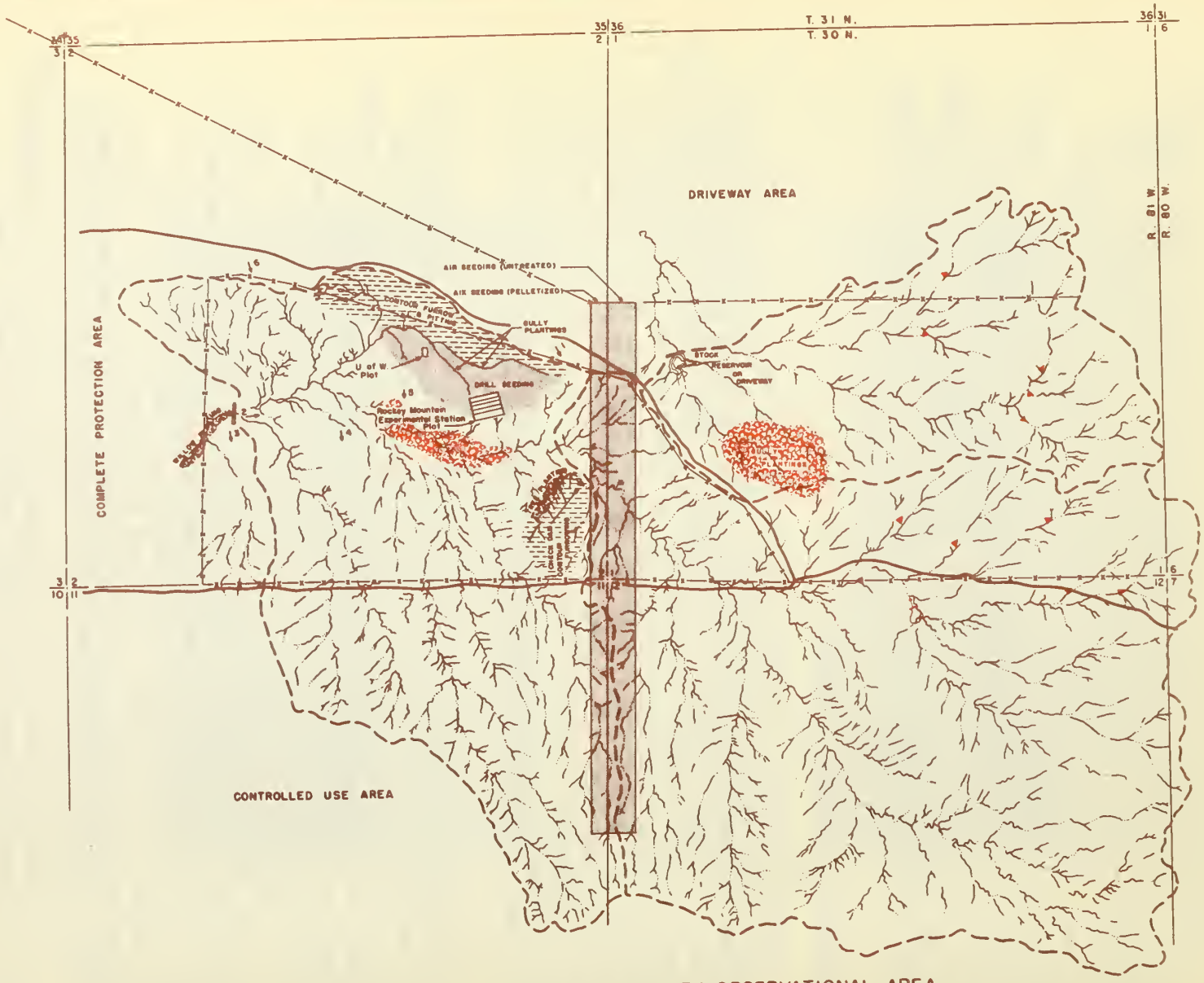
Badland areas are large contributors of sediment, but very little is definitely known regarding sediment control thereon. Steep slopes and high gradients of watercourses usually make construction of dams impractical due to excessive cost in relation to the capacity of the reservoir created. Sediment produced from badland areas is usually best kept out of stream channels by the construction of detention reservoirs for sediment traps in the nearest feasible location. Beneficial effects of total exclusion of livestock from badland areas are not definitely known as to overall effectiveness. In many instances cattle penetrate the lower portions of badlands and over-use the limited areas of forage along waterways. Badlands are highly valued for the winter shelter they provide for livestock; the limited amount of forage is often severely depleted because of over-use.

Public Recognition of Problems

In recognition of the vital importance and broad scope of the problems outlined and the necessity for finding a practicable solution for them, a meeting of all interested agencies, both public and private, was held at Casper, Wyoming, on February 8, 1947. This meeting was followed by others which resulted in the formation of an organization known as the Guernsey-Glendo Conservation Committee. Organization was completed and by-laws adopted in February, 1948, to govern objectives, membership, meetings, procedures, and activities. The committee has been instrumental in guiding various phases of the investigation which extend beyond the scope of any single agency or group. The by-laws of this organization are appended to this report as appendix II.

The Bolton Creek Observational Area was selected by representatives of the various participating agencies early in the formative period of the committee in 1947. An area very typical of many of the "problem areas" of the Glendo watershed was selected which encompasses a complete drainage unit and which is susceptible to several different types and intensities of management and improvement. It is located in Township 30 North, Range 81 West, sections 1, 2, 11, and 12, and includes a total of approximately 1,200 acres tributary to Bolton Creek, as shown on the map of the Bolton Creek Observational Area, figure 8, page 42. Highly erodible gray clay or gumbo soils covered by a scanty vegetative growth are predominant. It includes some patented lands as well as public domain lands under grazing lease, and stock driveway lands. Observations were to be made regarding precipitation, runoff, erosion, and response to reseeding under various intensities of management ranging from virtually uncontrolled use to complete exclusion of livestock.

An agreement has been made with Thomas Anda, owner of the patented lands and lessee of the public domain lands under grazing lease, to manage the controlled use area. The proposed management will provide for the greatest possible improvement of vegetative cover which can be attained by the application of proper management practices without actual



BOLTON CREEK OBSERVATIONAL AREA

PLAN PREPARED BY

GUERNSEY — GLENDO CONSERVATAION COMMITTEE

rehabilitation improvements. On the complete protection area intensive rehabilitation measures are planned so that results may be observed and determination made as to relative and total benefits to be derived from the various types of improvements.

A cooperative experimental aerial broadcast seeding of approximately 180 acres on the observational area with 400 pounds of crested wheatgrass and 200 pounds of yellow sweetclover, not pelletized, was carried out in April, 1947. The Bureau of Land Management seeded an additional 40 acres adjoining by airplane in March, 1948, using about 50 pounds of crested wheatgrass and 10 pounds of yellow sweetclover in 1,600 pounds of pellets. This experimental aerial broadcast seeding has failed to produce any positive results. Willow plantings have been made in gullies at several places in the total protection area, in the main draw below the dam and on the dam. Three acres along the driveway road have been contour furrowed, as indicated on the map of this area. Contour furrows widely spaced have also been made on about 10 acres south of the draw.

The Geological Survey has initiated studies to determine the rate of sedimentation in relation to precipitation and runoff on the driveway use part of the area. A water level gauge has been established and soundings are made annually to determine the amount of sedimentation in the small stock-water reservoir in section 1. Three rain gauges have also been established either on or near this area in order to determine amounts of precipitation. Precipitation for this area for 1947, 1948, and 1949 averaged only five inches. One storm of about four hours duration in July, 1949 produced over two and one-half inches of precipitation. It was mostly in the form of hail, but runoff was severe. A number of bridges were washed out and extensive cutting of gully walls and channels resulted.

Photographs showing conditions on the Bolton Creek Observational Area are shown on pages 44, 45 and 46. The six photographs were taken at six sites with corresponding numbers on the map of the Bolton Creek Observational Area. Most of the area has a rolling surface, much of it being steeply rolling. In addition to the erosive force of rapid runoff induced by slopes on the site, sparse vegetation and readily erodible soils also contribute to erosion and sediment production. Soils are shale derived clays which are liable to erosion both from their physical make-up and chemical constituency. The sparse vegetation gives but scanty protection to the erosion susceptible soil. The dry climate, with most of the very limited precipitation usually in the form of heavy, sudden showers or storms, further contributes to erosion. The photographs and description of the Bolton Creek area are typical of a considerable segment of the western portion of the Glendo area.

Topography and vegetative cover typical of the Bolton Creek Observational Area. This photograph on site one shows the extremely sparse vegetative cover and severe sheet and gully erosion common throughout the area.

Main Draw of Bolton Creek Observational Area. This photograph taken on site two shows saline deposits beside the water from melting snow in the channel below the undercut 30 feet vertical banks.

Sparse vegetative cover of Gardner saltbush and bud sagebrush on hummocks. Scattered bluestem wheatgrass plants are also visible on the spongy clay soil of site three.

Vegetation on site four is more dense than that on site three, but erosion is equally severe. Potential sediment production from the unstable sparsely vegetated soils on rolling sites shown in these pictures is great.

South fork of main draw from site five. Severe erosion is evident in the extensive, sharply-cut gullies and in the numerous rills on steep slopes.

Lower portion of Bolton Creek Observational Area drainage basin from site six.

LAND USE PROBLEMS

Present critical conditions of erosion, watershed impairment, land resource deterioration, and sediment production in the western portion of the study area are due largely to conflicting watershed and range uses. Conflicts between watershed and range uses are due mainly to the development of the present highly competitive livestock industry from the original pioneer trailing enterprises under an almost total lack of administrative policy regarding the lands involved. Correction of these existing critical conditions requires adequate watershed and range rehabilitation and reconciliation of conflicting uses.

Adequate watershed and range rehabilitation are dependent upon proper land management and an effective rehabilitation and improvement program. Proper land management will provide for the maximum sustained utilization of the forage crop consistent with adequate protection of essential watershed values. This may be accomplished under a range management plan providing for uniform distribution of livestock according to the carrying capacity of the range during seasons which will inflict the least injury on the vegetative cover and by the class or classes of livestock which will derive the most good from such use. Up to the present time the Bureau of Land Management has lacked sufficient funds and also has lacked personnel in adequate numbers to provide for proper management.

Livestock Distribution

Adequate provision of stock-water as to location, seasonal availability, amount, and quality is essential to uniform distribution of either class of stock. Such provision has been made over much of the western portion of the study area under the Production and Marketing Administration program for Natrona County by constructing dams, drilling wells, and by providing windmills with troughs. Locations of proposed stock-water developments are shown on the Erosion Condition and Proposed Improvement Map in appendix IV. Maximum uniformity of range use by sheep can be attained by the use of fenced pastures. If fencing is not practicable, open-herding and bedding-out methods should be employed. Pasture-grazing for sheep is not recommended for the western portion of this area except for some operations which involve no trailing. Future consolidation of other sheep operations may make conversion to pasture-grazing possible. Determination of which operations might be converted profitably to pasture grazing involves a detailed study of many individual operations and is beyond the scope of this report. Maximum uniformity of range use by cattle may be attained by division of rangelands into fenced units. Where fencing is not practicable adequate water developments will aid materially in the favorable distribution of livestock necessary for proper use of the range. Proposed fencing as shown on the Erosion Condition and Proposed Improvements Map is mainly on range division lines separating individual operations. Considerable fencing activity was prevalent in the area during 1951.

Proper stocking rates are necessary if maximum sustained forage utilization is to be attained. Allowance of a five percent safety margin below estimated carrying capacities as shown on the Vegetation Type Map is recommended for all lands in good or excellent condition. For capability class VI lands in fair condition allowance of a 25 percent recovery margin below estimated carrying capacities is recommended. Livestock should be temporarily excluded from capability class VI lands in poor condition and from capability class VII lands in either fair or poor condition.

Seasonal Use

Seasonal use of rangelands in the study area should be so adjusted that early spring use may be as light as possible and its location rotated from year to year to avoid undue injury to the vegetative cover. Sufficient portions of the yearlong range should be set aside to supplement the deficient spring-fall and summer ranges. Winter use should be from November 1 to April 30 on rangelands below 6,000 feet elevation. Spring-fall ranges between 6,000 and 7,000 feet elevation may be used to best advantage in this area May 1 to June 15 and September 15 to October 31. Summer ranges above 7,000 feet elevation should not be used prior to June 15 and their use after September 15 is often hazardous.

Practically all of the western portion of the Glendo area is best suited to dual use by both sheep and cattle, in order to avoid overgrazing. Former use was restricted largely to sheep due to the absence of stock-water on much of the sagebrush ranges. Areas and carrying capacities of seasonal ranges and croplands within the western portion of the Glendo area are as follows:

Seasonal Range	Area Acres	Percent of Total Area	Carrying Capacity A.U.M's
Winter and yearlong range below 6,000 feet elevation	810,490	55	139,750
Cropland	11,900	1	67,000
Spring-fall ranges between 6,000 and 7,000 feet elevation	440,850	30	76,250
Summer range above 7,000 feet elevation	205,812	14	35,600
Total	1,469,052	100	318,600

There are about 40,600 animal units of livestock and big game which use the western portion of the study area. Range livestock make up 39,500 of these units and 1,350 units are big game animals. Total feed requirements of these animals are 487,200 animal unit months of range forage and cropland or supplemental feed. These feed requirements are distributed seasonally in the following table:

Animal Units	Class	Season	Requirements A.U.M's
39,250	Livestock	5-months, winter	196,250
39,250	Livestock	1-month, crop or supplement	39,250
39,250	Livestock	3-months, spring-fall	117,250
39,250	Livestock	3-months, summer	117,250
1,350	Big Game	12-months, yearlong	16,200
40,600	Total		487,200

These total requirements of 487,200 animal unit months are 168,600 animal unit months in excess of the total estimated production of 318,600 animal unit months of feed on both range and cropland in this portion of the area. The 168,600 animal unit months of feed required in excess of the total estimated production of the area is supplied under existing operations by livestock movement to summer range in adjoining areas, by supplemental feed shipped into the area, and by over-use of rangelands in the area. Improper seasonal use of rangelands in the area, especially of the spring-fall ranges, is frequent.

Present seasonal use of range and cropland feed in the western portion is shown below:

Seasonal Use	Percent of Area	Elevation Feet	Total A.U.M's Required	Available	Other Source 1/
Winter & yearlong	70	Below 6,500	252,650	177,900	
Winter cropland feed	1	Below 6,500	39,250	67,000	
Subtotal			291,900	244,900	47,000
Spring-fall & yearlong	21	6,500-7,500	105,150	53,370	51,780
Summer	8	Over 7,500	90,150	20,330	69,820
Total	100		487,200	318,600	168,600

1/ Over-use, supplemental feed or outside range.

Suggested seasonal use of range and cropland feed is as follows:

Seasonal Use	Percent of Area	Elevation Feet	Total A.U.M's Required	Available	Suppl. or Outside Range
Winter & Yearlong	55	Below 6,000	250,280	139,750	
Winter cropland	1	Below 6,000	39,250	67,000	
Subtotal			289,530	206,750	82,780
Spring-fall & yearlong	30	6,000-7,000	105,150	76,250	28,900
Summer	14	Over 7,000	92,520	35,600	56,920
Total	100		487,200	318,600	168,600

Present and proper seasonal use of rangelands in the western portion are shown graphically in figures 9 and 10 on page 51. The elevation map, figure 1, shows the location of seasonal range areas. Comparison of the present use and proper use data given above shows that present use which includes severe over-use on spring-fall ranges is almost twice as great as it would be under proper use. No outside spring-fall range is available and cropland or supplemental feeds are not normally used at this season of the year. The result is pre-season utilization of the spring range, over-use of driveways too early in the spring, and use of summer range prior to proper plant development. Fifteen percent of the area between 6,000 and 6,500 feet elevation is used improperly as winter and yearlong range. This results in rather uniform heavy use of this entire portion of the area year after year during the critical early spring growing season, causing undue injury to the vegetative cover.

The use of ranges up to 7,500 feet elevation in spring and fall restricts summer range over 7,500 feet elevation to eight percent of the area and requires use of 69,820 animal unit months of summer range feed outside of the area. Under proper use with areas over 7,000 feet elevation reserved for summer use, only 56,920 animal unit months, or one-fifth less, of summer range feed outside of the area would be required. Under proper use winter grazing would be restricted to ranges below 6,000 feet elevation. This would create the greatest need for cropland or supplemental feed during the winter while livestock are located on portions of the range which are most accessible for such feed development or supply. Increased cropland production in the area could supply these needs and in addition could decrease the amount of outside summer feed required. Potential increased production under full development of the Kendrick project is estimated at 148,620 animal unit months as shown on page 52.

FIGURE 9

PRESENT SEASONAL USE OF RANGE LANDS IN THE WESTERN PORTION OF THE GLENDO AREA WYOMING 1950.

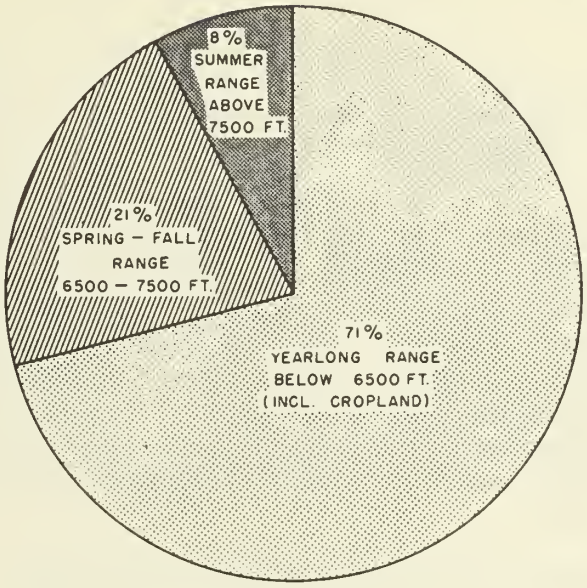
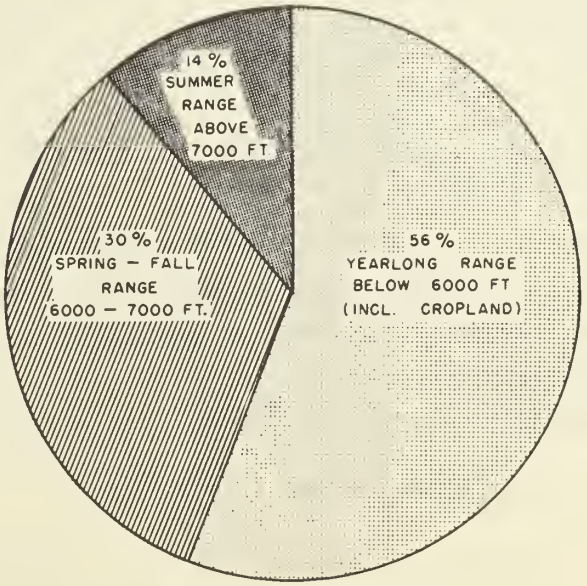


FIGURE 10

PROPER SEASONAL USE FOR RANGE LANDS IN THE WESTERN PORTION OF THE GLENDO AREA WYOMING.



Present and potential production, Kendrick project:

		Acres	A.U.M's
Estimated production 1950	(Hay	3,200	19,200
	(Grain	1,800	7,740
	Total	5,000	26,940
Estimated potential increased production	(Hay	16,600	99,600
	(Grain	11,400	49,020
	Total	28,000	148,620

Increased production is estimated for potentially irrigable lands on the basis of present yields of similar lands in the area. Potential increases of forage production on rangelands have not been estimated because it is believed that all such possible increases are needed to permit withdrawal of certain of the poorer lands from grazing use. It is proposed to withdraw these lands with no greater actual reduction in numbers of livestock on the range than necessary to prevent further range deterioration and to provide for maximum service from ranges as well as watersheds.

Additional use of cropland irrigated pastures or supplemental feed during the critical early spring growing season would be very beneficial to the vegetative cover of the range and to production, quality, and gains in the livestock so fed. Whenever mild climatic conditions have made the use of available supplies of supplemental feed unnecessary during the winter, they should be used during the early spring. Use of crested wheatgrass pastures on suitable dry farmed or irrigated sites will provide early spring feed which will relieve demand on spring range and result in increased benefits to livestock. Continued competition for the use of feed along stock driveways leading to summer ranges and the generally poor condition of these driveways, as well as the expense and risk involved in trailing operations should tend to discourage trailing. As increased production from the Kendrick project becomes available it can be absorbed as follows:

Additional winter feed requirements under proper use	82,780 A.U.M's
Additional spring-fall requirements under proper use	28,900 A.U.M's
Additional summer requirements under proper use	56,920 A.U.M's
Total requirements under proper use	168,600 A.U.M's
Estimated potential increased production	148,620 A.U.M's
Net additional needs in the area	19,980 A.U.M's

Much of the hay and grain produced on the Kendrick project will be used for dairy cattle, poultry and hogs and will not be available for supplemental feed for range livestock. Feed shortage in the area will therefore actually be greater than shown in the tabulation. Additional summer feed requirements can be supplied by livestock moving out of the area to summer range in adjoining areas as long as such range is available. This would indicate a potential surplus of 36,940 animal unit months of feed. There is an estimated need for over 100,000 animal unit months of feed in adjoining portions of the North Platte, Wind River, and Powder River Basins which are normally supplied by feed shipped in through Casper. Local finishing or fattening of livestock for slaughter at Casper also creates a considerable demand for such feed. Availability of additional forage supplies from the Kendrick project should encourage conversion of present-day herd and trail range sheep operations to consolidated pasture grazing operations. Development of crested wheatgrass pastures to be used for lambing purposes will aid materially in reducing losses at lambing time and will result in decreased pressure on spring-fall ranges. Crested wheatgrass will provide green forage with a high protein content about three weeks earlier than any of the native grasses. Increased production of forage induced by water spreading, contour furrowing, and other practices will decrease the need for use of supplemental or cropland forage in the Glendo area. Areas suitable for these practices are shown on the Erosion Condition and Proposed Improvements Map in appendix IV.

Protection of Watershed Values

Protection of watershed values in the western portion of the area will require curtailment or even temporary elimination of grazing use on certain areas where such use is detrimental to the restoration and maintenance of a protective vegetative cover for rangelands and waterways. Such a cover is necessary to protect the soil from the destructive effects of raindrop splash and sheet erosion; to retard runoff, thereby decreasing sheet, rill, and gully erosion; and to increase percolation of moisture into the soil, thereby increasing plant growth. Prior to significant damage to soil or waterways, restoration of an optimum vegetative cover may be accomplished by proper land management. Following damage to soil or waterways, watershed rehabilitation becomes increasingly difficult as such damage progresses. It then becomes necessary to practice increasingly restrictive management augmented by such special practices and treatments as seeding, contour furrowing, water spreading, and restoration of waterways. This advanced, acute stage of watershed deterioration exists on a substantial part of the western portion of the area as shown on the Erosion Condition and Proposed Improvements Map.

Proper use necessary to permit watershed restoration and range rehabilitation to prevent undue sediment contribution will severely limit capacity on much of the area. Some lands should be withdrawn from grazing use. It will be necessary that lands in these categories

be acquired from private owners by a Government agency or subsidized to permit their restoration, as they cannot support taxation for watershed purposes. Benefits from siltation control and watershed improvement will accrue principally to downstream water users, mostly in Nebraska. Storage reservoirs in the area constructed and proposed by the Bureau of Reclamation will benefit from watershed improvement by a decreased rate of sedimentation, which will prolong their useful life and efficiency. Since benefits largely accrue to structures and services administered by the Federal Government and to downstream water and power users, it is advisable that some agency of the Federal Government acquire or subsidize lands which cannot support taxation under a watershed restoration program.

Proposed Improvements and Conservation Practices

Experiments with aerial pelletized reseeding of rangelands have been made on the Bolton Creek Observational Area and also in the Wind River Basin. No favorable results have been obtained to date by any form of aerial seeding except where some method of seed-bed preparation and seed implantation has been employed. Some form of aerial seeding would be the most feasible method on most of the public domain lands in this area due to their generally inaccessible character. Some practical method of seed-bed preparation should be employed such as burning of sagebrush lands. Seed implantation, such as trampling by sheep, should also be utilized.

Seeding of crested wheatgrass and yellow sweetclover has been very successful on many of the better sites in the area. Many formerly dry-farmed lands have been seeded by drilling and now afford excellent grazing. Extensive seeding adjacent to highway 20 and to runways of the former Army Air Base, 10 miles northwest of Casper, was also very successful. Such seeding is of great importance at the present time in retarding the rapid spread of halogeton, a new poisonous range plant of Russian origin, which thrives on any disturbed soil area.

Adequate restoration of protected waterways can be accomplished by preventing the concentration of runoff in waterways and by delaying its movement by means of check dams, detention reservoirs, and water spreaders. Tree and shrub plantings, wherever adequate moisture is available, are essential to the complete healing of waterways and to the restoration of their former moisture retention, soil building, and wildlife habitat values. Concentration of runoff in waterways results in increased sheet erosion and rapid cutting of waterways not adequately protected by a vegetative cover. Loss of moisture which might otherwise precolate into the soil and be available for plant growth also occurs. Raw cut waterways drain away soil moisture and decrease feed production.

Concentration of runoff in drainages can be greatly retarded, and in many cases prevented, by contour furrowing on rangelands that are suitable for such treatment. Suitable lands should have relatively smooth slopes

generally not over three percent. Steeper slopes may be used where off-site benefits are of sufficient importance to justify expenditures not commensurate with expected increased returns from on-site grazing benefits. In such cases contouring may be justifiable on slopes up to 15 percent. Range forage production is often doubled by contour furrowing. Properly constructed contour furrows have been estimated to have a storage capacity of 80 acre-feet per section or one-eighth acre-foot per acre. In the western portion of this area, reduction of sediment production alone will amply justify contour furrowing and other erosion preventative measures.

Water spreading by means of systems of dikes will be useful to retard and spread runoff which has concentrated in waterways. This method can be used on slopes of less than three percent. Storage capacities of water spreading systems designed and employed by the Bureau of Land Management range from 300 to 700 acre-feet per section. On site benefits of water spreading are: Retention of water on the ground until it has time to percolate into the soil and so become available for plant growth; prevention of soil losses due to sheet and gully erosion, and increased storage of water in the soil. Water spreading produces an increase of six or seven times in forage production per acre. Forage production was increased from 200 to 800 percent on the Hale project spreading system near Alzada, Montana, according to definite records covering a 10 year period.

Total off-site benefits to be derived from contour furrowing, water spreading, and other proposed improvements on the western portion of the study area may be of greater importance than on-site benefits, due to the reduction in the rate of sedimentation of Guernsey Reservoir. Check dams are proposed for waterways in the area in which serious cutting has not yet occurred in order to decrease the velocity of runoff thereby greatly reducing its cutting power. They are also proposed for the same purpose in gullies with steep gradient or other unfavorable conditions which make reservoir construction too costly.

Detention reservoirs are proposed in the area wherever necessary and practicable for temporary flood water storage. They will prevent the occurrence of destructive flood crests and distribute the total runoff over a much longer period of time. This will facilitate the establishment of vegetation along waterways below the reservoirs. Slowing of runoff by check dams and detention reservoirs results in reducing sediment in runoff water and increased percolation of moisture into the soil, thus increasing plant growth. These benefits are principally limited to the reservoir areas and waterways.

Effectiveness of the range and waterways rehabilitation program is dependent upon proper accomplishment and maintenance of the proposed structures and practices. All structures, improvements, practices, and

treatments should be located in accordance with the existing conditions of soil, vegetation, and topography without regard to ownership, control, or present use. The improvement and rehabilitation program must be accompanied by sustained adequate control of use by livestock, including total exclusion wherever necessary. Without such control the results of an otherwise adequate program can be effectively retarded, if not completely nullified. Where watershed impairment has approached complete destruction as in considerable portions of Bates Hole, the removal of any forage growth is definitely detrimental and can effectively retard the improvement of watershed and range conditions. Livestock must be temporarily excluded from all planted and reseeded areas in order that an adequate vegetative cover may be established. Effective control of stock driveway use is also essential and may be attained through the use of a permit system augmented by fencing and adequate patrol and inspection. Limited progress on this program was achieved by the trail rider after 1950. Financing and actual accomplishment of the rehabilitation program requires definite knowledge of the locations of all improvements and practices in order that ownership may be established. Completion of horizontal control by means of cadastral resurveys is therefore necessary prior to initiation of the program. Locations of proposed rehabilitation improvements, treatments, and practices in the western portion of the study area are shown on the Erosion Condition and Proposed Improvement Map in appendix IV. Estimated construction and maintenance costs and benefit values to be derived from these proposed improvements are shown in table 6, page 57.

Improvements, practices and management proposed for the critical western portion of the area have been developed to effectively control sediment production from the area. Reduced sediment production will protect the existing and proposed reservoirs in the area. Water stored in these reservoirs is primarily of value to downstream agriculture, especially in Nebraska. Power produced by operation of the reservoirs benefits both Wyoming and Nebraska and the total power grid to which it contributes. The proposals made herein have allowed for continued livestock grazing use of the area. Proposed improvements have considered costs and economic return limitations. More elaborate structures could be utilized and possibly justified if higher valuations can be placed on storage capacity in the reservoir than those given for costs as shown in appendix I.

Proposed Management and Landownership Adjustments

Reconciliation of conflicting uses in the western portion of the study area is dependent upon a proper understanding of the immediate effects of the rehabilitation program upon the livestock industry in relation to its overall objectives. Considerable curtailment, and in some cases temporary elimination of grazing use, will be necessary in certain localities. These restrictions may be largely offset within a very few years through increased forage production induced by reseeding, sagebrush eradication, rodent control, contour furrowing, and

Table 6.- Proposed conservation improvements and practices, western portion of the Glendo area, Wyoming

Classification Number	Type of Project	Unit	Number of Units	Estimated Life Years	Estimated Cost		
					Construction	Annual Maintenance	Annual Benefits
	Water Developments						
122	Reservoirs (two acre-feet and over)	each	11	15	$ 15,000	$1,000	$ 3,000
171	Reservoirs (one-half to two acre-feet)	each	22	15	6,150	750	1,200
146	Wells	each	5	20	7,500	200	1,150
159	Spring developments	each	2	15	300	50	100
	Range Facilities						
131	Fences	miles	50	15	40,000	1,500	6,000
150	Corrals	each	2	15	4,000	200	1,000
	Revegetation						
802	Range revegetation	acres	14,329	40	57,316		4,000
1005	Experimental plots	each	3	40	8,000		500
1006	Brush removal	acres	12,640	10	37,920		3,000
	Soil and Moisture Activities and Range Rehabilitation						
1017	Rodent control	acres	15,710	20	1,571	200	300
303	Large diversion dams and detention	each	9	20	64,550	4,000	15,000
323	Water spreaders	acres	1,305	40	4,655	400	1,000
319	Contour furrows	acres	960	20	3,080	200	750
307	Tree plantings	each	500,000	40	25,000	100	2,500
304	Permanent check dams	each	94	10	19,195	1,000	4,000
305	Temporary check dams	each	30	5	1,700		400
908	Desilting area enclosures (fences)	each	15	20	18,000	200	2,200
	TOTAL				$313,937	$9,800	$46,100

water spreading on the better rangelands. Development of irrigated pastures and increased crop production in the study area will also offset restricted range use. Better distribution of livestock, proper stocking rates, proper seasonal and class use as provided in the management plan, and the elimination of unauthorized or trespass use are also equivalent to increased forage production. Where such measures are not adequate to insure protection of essential watershed values, use may be further decreased by a shorter season of use or by reducing the number of stock allowed.

Modification of the existing ownership and operating unit pattern may be necessary where its complexity interferes unduly with accomplishment of a watershed and range rehabilitation program. Such modification may be attained by exchange of title, cooperative agreement, or purchase. The best opportunities for exchange would involve isolated tracts and some fairly large blocks of public domain lands which have no problems of watershed rehabilitation or range management. These may be offered in exchange for state-owned lands located in critical watershed areas where acquisition by the managing agency is desirable. Cooperative agreements may be entered into by the managing agency with other Federal, state, or private agencies to assure the desired modification of use or treatment necessary to the successful prosecution of an adequate program of watershed restoration and protection.

Outright purchase of patented lands within certain operating units may be necessary to provide adequate watershed protection. The individual livestock operator cannot be expected to forego the use of a resource upon which his livelihood is dependent merely because of abstract or specific damage to rangelands, watersheds, or downstream agricultural economy caused by former abusive use, even though rehabilitation may be prevented by any continued use. The complex ownership and operating unit pattern existing in the western portion of the study area is typical of such situations. It effectively precludes watershed and range rehabilitation until such time as sufficient modification may be attained to assure proper location of improvements and practices followed by adequate control of grazing use. A program for modification of the existing ownership and operating unit pattern has been suggested for the western portion of the study area and is shown on the Land Use Suitability and Proposed Adjustment Map in appendix IV.

Details of the controlled use of the watershed for the benefit of downstream landowners must be evolved by the owners of the land, livestock operators, and all agencies concerned, especially the soil conservation districts, and the Production and Marketing Administration. The service rendered to the watershed by control of sediment production should be borne by a subsidy or land purchase financed by the Federal Government. This is necessary because the downstream lands to be benefited are mostly in Nebraska, while the watershed is in Wyoming.

Watershed values of critical portions of the Glendo area are much greater than the on-site grazing values. This condition also favors federal aid to, or purchase of, lands which will be unable to support taxation because of their limited carrying capacity under proper watershed management. Such lands include all class VIII lands and all class VII lands in poor condition. They may also include class VII lands in fair condition and class VI lands in poor condition depending upon their extent and upon their degree of deterioration. Other factors affecting purchase of such lands are the economic ability and willingness of the landowners involved to carry out an adequate improvement and rehabilitation program on their own lands at their own expense. These lands are shown on the Land Use Capability Map in appendix IV.

Objectives and Methods

Objectives of the proposed adjustments in land use and management are: prevention of further range depletion and watershed deterioration, restoration of optimum range productivity and watershed values, and reconciliation of conflicting uses by adjustments wherever necessary. Effective accomplishment of the proposed adjustments in land use and management involves the orderly prosecution of the following programs in the western portion of the study area:

1. Application of a sound range management plan based on the proposals presented in this report.

2. Adjustment of the existing ownership and operating unit pattern as necessary to provide for effective range and watershed rehabilitation. Cooperation of the State of Wyoming should be solicited in securing necessary control of grazing use on such state-owned lands as may be within temporary exclusion areas as delineated in the management plan.

3. Development of a complete conservation program for watershed and range rehabilitation. This involves the completion of cadastral resurveys to facilitate the determination of ownership of lands on which improvements or other management practices are to be located.

Cadastral resurveys are needed in the western portion of the Glendo area as follows:

Township - North	Sixth Principal Meridian	Ranges - West
28		79, 80, and 81
29		81 and 82
30		79
31		79
32		83, 85, and 87
36		77, 78, 79, and 80
37		78 and 82

Inclusion of the "Management Area" as outlined on the Land Use Suitability Map within an organized grazing district for administration under the Taylor Act would materially facilitate the accomplishment of these programs. The advantages of a grazing district in administering public domain are:

1. Greater degree of control over livestock numbers and seasonal use.
2. Services of an advisory board of resident livestock operators.

3. More management can be applied because of larger area administered and because of exchanges of use which are not possible under section 15 leases. This management is more flexible than is possible under the small areas and more fixed provisions of leases for each parcel under section 15.

Lands within the proposed management area as shown on the Land Use Suitability Map for the western portion include the following:

	Acres
Public lands administered by the Bureau of Land Management	350,152
Public lands administered by the Bureau of Reclamation	5,302
State and private lands	612,292
Total	967,746

Extension of the Kendrick Soil Conservation District to include the surrounding tributary drainage area and the dune area northeast of Casper would also be very helpful. Proper functioning of the Guernsey-Glendo Conservation Committee could greatly facilitate the integration of these programs with the programs of the Wyoming State Extension Service and of the County Agricultural Conservation Committees in Carbon, Converse, and Natrona Counties.

Outside of the proposed management area in Natrona County is one small area on Casper Mountain in which public domain lands are to be retained in public ownership pending further development for recreational uses. This area is designated "R" on the Land Use Suitability and Proposed Adjustment Map in appendix IV. There are approximately 810 acres of public domain lands and 4,960 acres of state and private lands in this area.

Public domain lands administered by the Bureau of Land Management in another small area are primarily valuable for timber and watershed and should be administered in conjunction with National Forest lands. The area is designated as "F" on the Land Use Suitability and Proposed Adjustment Map and includes the following lands:

Lands within the boundaries of the Medicine Bow National Forest.	8,960 acres
Public domain lands administered by the Bureau of Land Management outside of national forest.	3,160 acres
State and private lands outside national forest	9,000 acres
The total area designated "F"	21,120 acres

Remaining portions of Natrona County are shown as area "D", which includes the following lands:

Public domain lands administered by the Bureau of Land Management	21,799 acres
Public lands administered by the Bureau of Reclamation	2,840 acres
Public lands administered by the Department of Defense	3,280 acres
State and private lands	360,134 acres
Total	388,053 acres

Public domain lands administered by the Bureau of Land Management in area "D" which should be retained in public ownership due to the presence of range or watershed management problems are listed below:

Township - North	Range - West	Located in Sections	Area Acres
30	78	6, 7, 18, 19, and 30	920
31	78	21, 28, and 29	720
32	78	15, 17 - 22, 28, and 29	2,420
31	79	1, 3, 11, 12, 14, and 23	1,000
32	79	33, 34, and 35	560
35	79	14, 15, 22, and 23	880
32	80	3, 7 - 10, 17, and 18	1,640
32	81	15	120
33	81	3, 10, 14, 15, 23 - 26	2,080
		Total	10,340

It is proposed that the remaining 11,459 acres of public domain lands in area "D" be listed for selection by the State of Wyoming in

exchange for state-owned lands within the proposed management area. Lands not so selected would be disposed of by public sale.

Proposed Adjustments in the Eastern Portion

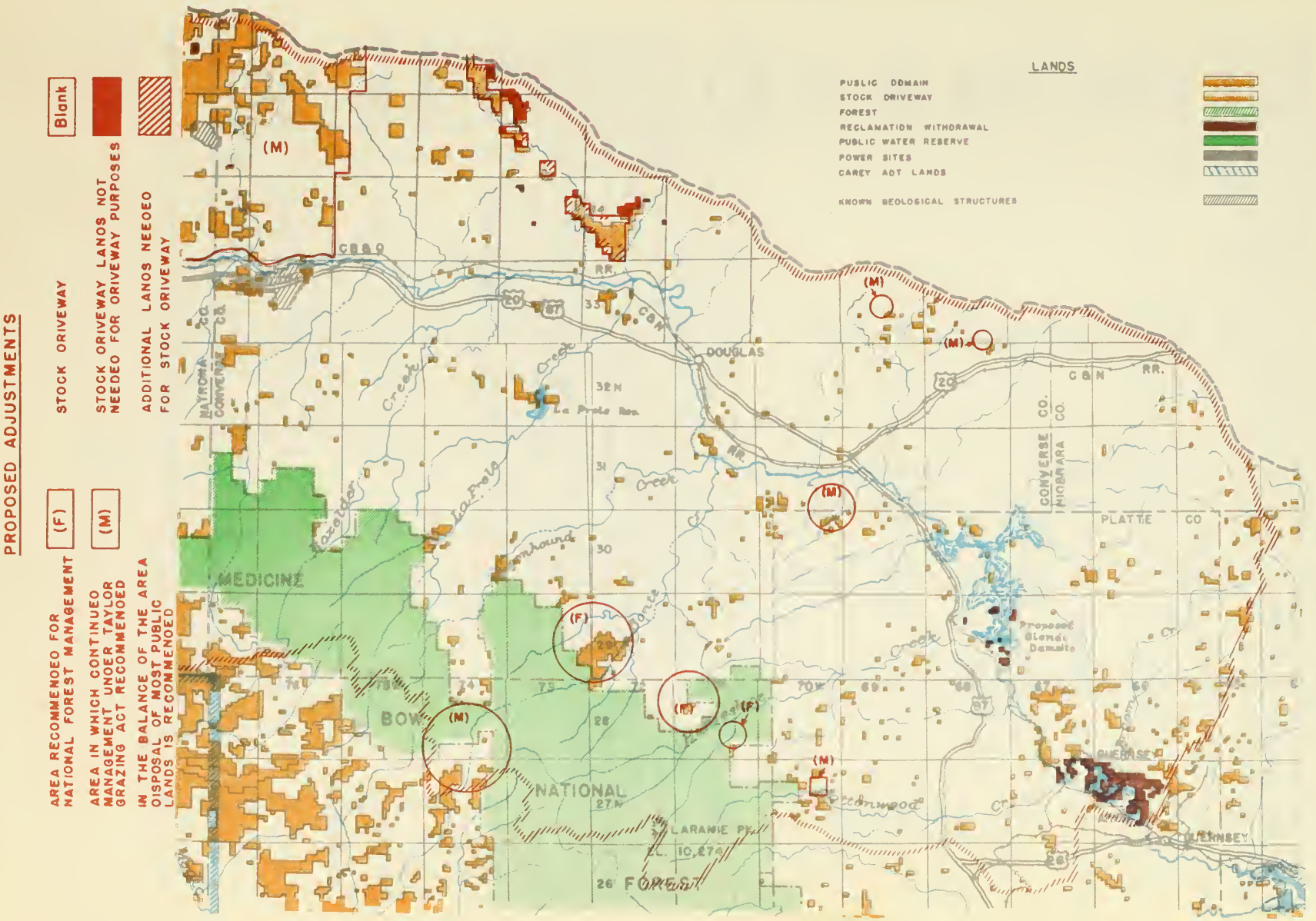
Federally-owned lands administered by the Bureau of Land Management in the eastern portion of the study area comprise an area of 91,219 acres. They are generally in such small blocks and so widely scattered that efficient administration by this Bureau is precluded. Certain areas in the eastern portion should be retained in Federal ownership. Critical wind erosion conditions, sandy soil, and the presence of active dunes create a problem area north of Glenrock. Retention in public ownership is proposed for approximately 22,500 acres of public domain lands in this vicinity. These lands include about 30 square miles of dune area and about 5 square miles of a large block of public domain extending into this portion of the area from the western portion. They also include other blocks of public domain lying along the divides on each side of Sand Creek. This part of the area is included in the proposed management area as shown on the Land Use Adjustment Map of the eastern portion of the Glendo area on page 63. It is proposed that this area be included in an organized grazing district for administration under the Taylor Act. The principal problem on these lands is the stabilization of sand dunes in the upper part of the Cole Creek drainage. The entire area is included in the Glenrock Soil Conservation District and remedial action may be determined and accomplished by active cooperation of the managing agency with this district.

The large area of badlands near Douglas and small formations south and west of Casper require special management and study for sedimentation control. Badlands are highly valued for the winter shelter they provide for livestock, so they are often grazed at times when livestock trampling creates excessive erosion and damage to the limited vegetation. Experimental work should be initiated relative to the establishment of vegetation and control of erosion on badlands areas. Measurements of sediment production should also be made. There has been no work of this nature on these areas which can be used as a guide by land managers in these problem areas.

Public lands which are not needed for stock driveway purposes along the Orpha Driveway in Converse County should be used to improve usability of the driveway or be exchanged or sold. Stock driveway withdrawal lands which are not needed for the Orpha driveway are listed below:

Township 34 North, Range 72 West, Sections 15, 21, 22,	520 acres
Township 34 North, Range 73 West, Section 12,	80 acres
Township 35 North, Range 73 West, Sections 5,6,8, 18 and 20,	1,560 acres
Township 36 North, Range 74 West, Section 25,	320 acres
Total	2,480 acres

LAND USE ADJUSTMENT MAP OF THE EASTERN PORTION, GLENDO AREA



State or privately-owned lands which are needed for stock driveway use along the Orpha driveway are as follows:

Township - North	Range - West	Located in Sections	Acres
33	72	4	320
34	72	19	160
		20	120
		30	160
		32	480
		33	160
34	73	3	40
		13	240
		24	160
		34	520
35	73	20	240
		17	40
35	74	1	80
		2	80
		Total	2,800

Public domain lands in this study area in Albany and Converse Counties, which are south of the Medicine Bow National Forest, are used in connection with livestock operations in the Laramie and Seminoe sub-areas of the North Platte River Basin and should be retained in public ownership pending completion of detailed studies in those areas. These lands are listed herewith:

County	Township - North	Range - West	Located in Sections	Acres	Creek
Albany	27	74	2, 4, 7 - 11 15 and 17	1,990	LaBonte
Albany	28	74	26	40	LaBonte
Converse	29	76	29 and 30	280	Boxelder
Converse	29	77	4, 10, 11, 13 14, 21, 23 25 - 28	1,640	Deer
			Total	3,950	

Retention in public ownership is also proposed for all lands possessing possible sites for sediment retention or flood control dams pending completion of flood control plans by other interested Federal agencies. Sediment control sites located in the eastern portion of the study area are listed below:

County	Township - North	Range - West	Located in Sections	Acres	Creek
Platte	30	69	6	40	unnamed
Platte	27	70	14, 23, and 24	600	Cottonwood
Platte	30	70	1, 2, 11, and 12	760	unnamed
Converse	32	68	2	120	Lost Creek tributary
Converse	33	69	22 and 27	160	Shawnee Creek tributary
Converse	31	71	22	100	La Bonte
Converse	31	77	1, 2, 3, and 11	1,280	Deer
			Total	3,060	

Public domain lands which are primarily valuable for timber and watershed, adjacent to the Medicine Bow National Forest, should be retained and administered in conjunction with the national forest. Lands to be retained for timber and watershed are as follows:

County	Township - North	Range - West	Located in Sections	Acres
Albany	28	71	17, 18, 20 and 35	400
	28	72	6	400
Converse	29	72	17 - 21 and 28 - 32	2,800
	29	73	24 and 25	760
	30	74	24 and 25	800
			Total	5,160

It is proposed that all other public domain or public water reserve lands administered by the Bureau of Land Management in the eastern portion of the study area be listed for selection by the State of Wyoming in exchange for state-owned lands within the proposed management areas in either portion of the Glendo study area.

The approximate area of lands to be listed for selection by the State of Wyoming distributed by counties are shown below:

Albany County	727 acres
Converse County	25,245 acres
Goshen County	2,973 acres
Niobrara County	600 acres
Platte County	17,990 acres
Total	47,535 acres

Disposal by public sale is proposed for any such lands not selected by the State of Wyoming.

APPENDIXES

APPENDIX I

SUMMARY OF THE GLENDO UNIT DEFINITE PLAN REPORT, BUREAU OF RECLAMATION

This appendix is a brief summary of the proposals presented in the Glendo Unit Definite Plan Report, Bureau of Reclamation, Region VII, Denver, Colorado, May, 1951.

This plan proposes three major structures; the Glendo Dam, to create a reservoir of 800,000 acre-feet storage capacity; Glendo Power Plant of 24,000 kilowatt capacity; and the Fremont Canyon Power Plant of 48,000 kilowatt capacity to be located below Pathfinder Dam near the backwaters of Alcova Reservoir. The coordinated operation of these improvements will have the following multiple purposes: hydroelectric power generation; flood control; sedimentation control; improved municipal water supplies; and pollution abatement with enhancement of recreational and fish and wildlife resources. Value of the irrigation water storage and other inherent values of Glendo Dam are dependent upon agreement between the states of Colorado, Nebraska, and Wyoming. Features of the Glendo Unit, based on October, 1950 prices are analyzed and listed as follows:

Glendo Dam and Reservoir costs	$18,655,000
Power plant and substation costs	6,718,000
Structures and improvements	.700,000
Glendo total costs	$26,073,000
Fremont Canyon Power Plant and Substation	15,604,000
Structures and improvements	396,000
Fremont Canyon total costs	$16,000,000
Glendo Unit total costs	$42,073,000
Annual benefits, Glendo Unit:	
Power	$ 2,132,200
Flood Control	229,000
Fish and Wildlife and Recreation	52,900
Municipal Water	37,000

Total annual benefits	$ 2,451,100
Benefit-cost ratio	1.6 to 1.0
Power, installed capacity, kilowatts	72,000

Glendo Dam will serve to re-regulate and integrate releases from the upstream power plants permitting their year-around operation, and will also protect Guernsey Dam and preserve its functions. The spillway capacity of Guernsey Dam is inadequate to protect the dam from probable floods. Glendo Dam operation would control flood releases to a maximum feasible for the safety of Guernsey Dam. The present average monthly minimum flow of 89.4 second feet at Casper will be increased to 1,057 second feet with the operation of Glendo. Present average hardness of the water at Casper of 18.4 grains per gallon will be reduced to 12.4 grains per gallon. This reduction in hardness will reduce soap consumption seven pounds per person per year, and will effectuate a saving of $37,000 per year in soap and water softener costs to the present population of the city. This figure is only a minor portion of the total savings attributed to softer water such as reduction of wear on clothing and improved durability and efficiency of plumbing.

Features of the proposed Glendo Reservoir are as follows:

Location: 4.5 miles southeast of Glendo, Wyoming, on the North Platte River.

Earthfill dam, maximum structural height 203 feet.

Sediment capacity, 100 years,	115,000	acre-feet
Flood control capacity	275,000	acre-feet
Power storage capacity	410,000	acre-feet
Total capacity	800,000	acre-feet
Surcharge flood capacity	288,000	acre-feet
Total capacity when routing spillway design flood	1,088,000	acre-feet
Annual flood control value, 1949 prices		$189,000
Additional annual value to Guernsey Dam		72,000

Present annual inflow of sediment to Guernsey Reservoir	1,410 acre-feet
Annual inflow of sediment to Guernsey Reservoir with Glendo	250 acre-feet
Spillway capacity	62,300 second feet
Drainage area	15,500 square miles
Annual runoff, average 36 years	1,390,000 acre-feet
Annual runoff, maximum 1917	2,470,000 acre-feet
Annual runoff, minimum 1934	574,000 acre-feet
Peak discharge	30,000 second feet
Minimum discharge	5 second feet
Inflow design flood volume 15 days	998,000 acre-feet
Inflow design flood peak discharge	228,000 second feet

From the figures given on costs and benefits of the Glendo Unit in the definite plan report, the following values of storage capacity in Glendo Reservoir have been calculated by the Bureau of Land Management.

Cost value per acre-foot of storage capacity, Glendo Dam total costs divided by 800,000	$32.59
Annual value per acre-foot of storage, annual unit benefits divided by 800,000	$3.06
Capitalized benefit value per acre-foot of storage capacity, at $2\frac{1}{2}$ percent	$122.40
Duration of returns valuation per acre-foot of storage, $3.06 times 100 years	$306.00

APPENDIX I-A

EXISTING AND POTENTIAL HYDROELECTRIC POWER DEVELOPMENTS IN THE GLENDO AREA, WYOMING

Guernsey Power Plant is the only existing Federal hydroelectric plant in the area. Located on the North Platte River, it serves the Upper Platte power market area with an annual generation of 88 million kilowatt-hours from an installed capacity of 4,800 kilowatts generated by a static head of 88 feet. In addition to the Fremont and Glendo Power Plants of 72,000 kilowatts installed capacity, which are features of the Glendo Unit scheduled for construction by the Bureau of Reclamation, a hydroelectric power development of 36,000 kilowatts installed capacity is scheduled for construction at Alcova Dam. A reconnaissance survey of the Bureau of Reclamation titled, "Power Resources, Requirements, and Supply, Missouri River Basin," prepared by Regions 6 and 7, July, 1951, also proposes hydroelectric developments at 17 additional sites in the area. Data regarding the three plants scheduled, and the seventeen newly proposed plants, are as follows:

Ref. No.	Name	Stream	Stat. Head (Ft.)	Install. Capacity (KW)	Average Ann'l Generation (Million KWH)
		Existing			
E-7	Guernsey	N. Platte R.	88	4,800	28.0
		Scheduled			
S-15	Fremont Canyon	N. Platte R.	294	48,000	205.0
S-16	Alcova	N. Platte R.	160	36,000	124.0
S-17	Glendo	N. Platte R.	140	24,000	76.0
	Total scheduled			108,000	405.0
		Potential			
7	Bessemer Bend	N. Platte R.	135	14,000	72.0
8	Poison Spider	N. Platte R.	20	1,400	12.0
9	Douglas	N. Platte R.	120	8,000	70.0
10	Upper Glendo	N. Platte R.	60	4,000	35.0
11	Guernsey Add.	N. Platte R.	80	10,000	31.0
27	Bates Cr. Plant	Bates Creek	1400	2,400	6.0
28	Deer Creek #1	Deer Creek	256	3,400	8.0
29	Deer Creek #2	Deer Creek	200	2,600	6.0
30	Deer Creek #3	Deer Creek	200	2,600	6.0
31	Deer Creek #4	Deer Creek	240	3,100	8.0
32	Up. Boxelder	Boxelder Cr.	120	1,000	3.0
33	Lo. Boxelder	Boxelder Dr.	90	1,000	3.0
34	La Prele	La Prele Cr.	240	2,200	5.0
35	Up. La Bonte	La Bonte Cr.	128	1,000	2.0
36	Lo. La Bonte	La Bonte Cr.	176	1,500	4.0
37	Horseshoe	Horseshoe Cr.	1,200	4,000	10.0
38	Cottonwood	Cottonwood Cr.	1,000	1,700	4.0
	Total potential			63,900	285.0
	Total existing, scheduled, and potential			176,700	778.0

APPENDIX II

BY-LAWS OF THE GUERNSEY-GLENDO CONSERVATION COMMITTEE

Through the cooperative efforts of agencies and groups interested in the conservation of the land and water resources of the drainage area tributary to the Guernsey Reservoir on the North Platte River and below the Alcova Reservoir dam on the same river, a committee has been formed. This committee shall be known as the Guernsey-Glendo Conservation Committee. This committee shall consist of representatives of the following agencies and local groups:

Each interested Federal agency.
Each interested State agency.
Each interested County agency.
Each interested local group and individual.

Each agency, group or individual shall make its interest known to the remainder of the committee by written notice of intention to participate and shall be entitled to one vote. A quorum shall consist of representatives of the committee in attendance at any regular scheduled meeting of which all members representatives have been duly notified.

This committee shall have as its officers one Chairman, one Vice-Chairman and one Secretary. These officers shall be nominated from the floor and elected by popular vote of the committee at the February meeting of each year and shall take office immediately following the February meeting. They shall serve for a term of one year. The committee shall meet regularly on the second Thursday of the months of February, May, August and November, or as near that time as practicable, and at such other times as deemed necessary by the committee.

The purposes and objectives of this committee are to promote full cooperation between the respective agencies and interests concerned with and engaged in the conservation of natural resources of the Guernsey Reservoir watershed below the Alcova Reservoir. It shall (1) strive to promote effective cooperation and integration of the respective conservation programs; (2) strive to develop ways and means of accomplishing objectives of common interest through cooperative investigations and studies; (3) provide for exchange of information pertinent to the mutual problems and (4) strive to promote a fuller understanding of the meaning and significance of conservation, particularly as it relates to land, water and human resources. Each of the agencies and interests represented on this committee agrees to participate in the furtherance of these purposes and objectives to the extent of existing limitations.

Matters which come before the committee which are beyond the scope of its activities shall be referred to the agency or agencies involved for resolution or for referral to the Missouri Basin Inter-Agency Committee for consideration.

Proposed cooperative enterprises which may involve expenditure of funds or excessive time of agencies, groups or individuals, may be handled under a cooperative agreement which shall set forth in specific terms the contributions of each participating agency, group or individual.

An annual report of accomplishments of the member agencies, groups or individuals for the previous calendar year shall be submitted to the committee for its consideration at its November meeting, and a work plan for the ensuing calendar year shall be similarly submitted for consideration at the regular February meeting of the committee.

These by-laws may be amended by a two-thirds vote of the members present at any regular meeting, provided that the proposed amendment shall be circulated to all members of record at least thirty (30) days prior to the regular meeting at which time the amendment is to be considered.

These by-laws were duly adopted by the committee at its regular meeting held at Casper, Wyoming on the 26th day of February, 1948, after being circulated to all members for their consideration.

(S) R. D. Nielson	(S) Arthur V. Hay	(S) Norman H. French
Chairman	Vice-Chairman	Secretary

.....

Minutes of the Guernsey-Glendo Conservation Committee Meeting held at Casper, Wyoming, February 26, 1948, stated that: The following departments, agencies, groups and individuals are considered members of the Guernsey-Glendo Conservation Committee:

Soil Conservation Service
Bureau of Land Management
Forest Service
Rocky Mountain Forest and Range Experiment Station,
Fort Collins, Colorado
County Commissioners, Converse County
Bureau of Reclamation
Fish and Wildlife Service
Production and Marketing Administration
State Extension Service
County Agents at Douglas and Casper
State Engineer's Office, Cheyenne
U.S. Geological Survey
Farm Home Administration
County Commissioners, Natrona County
University of Wyoming
Natrona County Trail Committee

APPENDIX III

Four tables explaining the terminology and classification of land use capability, land resource condition, soil erosion, and vegetation as employed on three of the maps in appendix IV.

Table 7.- Description and definition of land use capability classes.

Table 8.- Description and definitions of land resource condition classes.

Table 9.- Description and definitions of soil erosion condition classes utilized on the Erosion Condition and Proposed Improvement Map.

Table 10.-Symbols on the Vegetation Type Map representing plant species, with their scientific and common names, Glendo area, Wyoming.

Table 7.- Description and definitions of land-use capability classes 1/

Class	Suitable for	Topography		Characteristic Native Vegetation	Soil Characteristics						Vulnerability to Erosion	Requisite Special Practices
		Slope (percent)	Character of Surface		Texture	Depth	Relative Salinity	Fertility	Productivity	Drainage		
I	Best type of farming land	0 to 2	Level or nearly level	Tall and mid-grasses, thrifty sagebrush, deciduous trees	Medium; Friable	12" or more; subsoil 36" or more	Negligible	High	Good to High	Good to Excellent	Low	None to minor
II	Farming with simple conservation practices	0 to 10	Irregular	Tall, mid, and short grasses; big sagebrush, deciduous trees	Light to Heavy; Friable	8" or more; subsoil 36" or more	Negligible to slight	Good to High	Moderate to High	Good	Slight to moderate	Minor to simple practices
III	Farming with complex conservation practices	0 to 10	Irregular	Tall, mid, and short grasses; big sagebrush, rabbitbrush, greasewood, coniferous, and deciduous trees	Light to Heavy; Friable	6" or more; subsoil 24" or more	Slight to moderate	Fair to Good	Moderate to High with management	Often poor; may be needed	Moderate to High	Complex practices essential
IV	Limited or occasional cultivation; best for permanent hay or pasture	0 to 15	Irregular or stony	Tall, mid, and short grasses; big sagebrush, rabbitbrush, greasewood, coniferous, deciduous trees, saltbush, winterfat	Sandy to Clay; porous or tight	6" or more; may have shallow hardpan	Negligible to critical	Poor to Good	Poor for row crops; best for hay and pasturs	Not justifiable if needed	Moderate to High	Complex and intensive practices with good management
V	Range or woodland; farming only if irrigation water becomes available	0 to 5	Smooth to irregular; may be stony	Tall, mid, and short grasses; big sagebrush, rabbitbrush, greasewood, coniferous, and deciduous trees Density .3 or more	Light to Heavy; Friable	Good permeability to 24" depth	Negligible to moderate	Good to High	Moderate to High; not over three acres per A. U. M.	Usually not a problem	Low	None to minor
VI	Range and woodland only	0 to 20 (greater only on good soils)	Irregular to rough or rocky	Tall, mid, and short grasses; big sagebrush, rabbitbrush, greasewood, coniferous, deciduous trees, saltbush, winterfat Density .3 or more	Very Light to Heavy	Shallow to moderate; permeability excessive to poor	Negligible to moderate	Fair to Good	Light to Moderate; 3-10 acres per A.U.M.	Not practicable if a problem	Moderate	Proper management with simple restrictions
VII	Range and woodland with severe restrictions	0 to 100	Rough, rocky, or eroded	Tall, mid, and short grasses; big sagebrush, rabbitbrush, greasewood, coniferous, deciduous trees, saltbush, winterfat, mountain browse and annuals Density under .3	Any: May be tight clay or open sand or gravel	Often shallow, poorly developsd	Negligible to critical	May be Poor	Poor to Light; over 10 acres per A.U.M.	Seldom a problem or not practicable	High	Proper management with complex restrictions and intsnsive practices
VIII	Watershed, wildlife and recreation	Generally steep	Extremely rough, barren or inaccessible	Often only annuals or scanty perennials; may be dense coniferous timber	Usually poorly developed	Very shallow or nil	May be excessive for plant growth	Usually very low	Usually very low or nil	Oftsn poor; not justifiable if a problem	High (unlsss a swamp)	Complete protection

1/ Adapted from Soil Conservation Service Standards, U. S. Department of Agriculture. Any one of the factors listed may classify a soil, factors determining classification singly, not necessarily in combination.

Table 8.- Description and definitions of Land Resource Condition Classes 1/

Condition Class and Map Symbol	Principal Characteristics Affecting Condition of Range Resource				
	Soils		Vegetation		
	Fertility	Erosion	Presence or absence of inferior species	Vigor	Relative Productivity
Excellent "E"	Good soil, limited by climatic conditions.	No apparent accelerated soil erosion by wind or water and no recent accumulation of silt or debris.	An absence of "invader" species of inferior utility.	Vigorous condition and good reproduction of the more valuable native vegetation.	Maximum (optimum) or near maximum production of high quality vegetation during normal years.
Good "G"	Slightly reduced soil fertility and loss of organic matter and tilth.	Only very minor accelerated sheet and shoe-string erosion or possibly some blowing and minor accumulations.	Slightly increased abundance of inferior species and "invader" plants.	Slightly reduced vigor and reproduction of desirable native vegetation; decreased density of vegetative cover.	Reduced production to between 75 and 90 percent of optimum.
Fair "F"	Moderately to severely depleted soil fertility; poor tilth.	Advanced accelerated erosion evidenced by some gullies, moderate sheet erosion and topsoil loss.	Predominance of less desirable plants. Decided increase of "invader" species.	Moderately reduced vigor and abundance and little or no reproduction of more desirable native vegetation; generally decreased density of perennial cover.	Reduced productivity to between 50 and 75 percent of optimum.
Poor "P"	Severely depleted soil fertility, poor tilth.	Excessive rapid run-off with heavy silt loam, greatly accelerated soil erosion evidenced gullying; topsoil may be lost, subsoil exposed.	Predominance of inferior perennial species or annual vegetation.	Greatly reduced vigor and density of perennial vegetation; most desirable native species may be absent or have high mortality; reproduction absent.	Productivity reduced below 50 percent of optimum.

1/ Under proper range management a high good condition would be the maximum condition attained. Excellent condition is limited to undergrazed, inaccessible and relict areas.

Table 9.- Description and definitions of soil erosion conditions classes

Erosion Class	Description of degree of erosion	Sheet Erosion 1/	Wind Erosion 1/	Gully Erosion 1/
1	None to Slight	0-10 percent of topsoil removed. Little apparent evidence of surface erosion and then only localized areas too small to delineate into Class 2. Vegetation often climax type. Generally smooth to gently undulating plains and forested lands; dominantly 0-3 percent slopes.	None to only local evidence of slight soil drift or surface soil removal. 0-10 percent of topsoil removed. Soil usually well protected by sod or plant litter.	No evidence of active gullying. All waterways well established.
2	Slight to Moderate	10-25 percent of topsoil removed, but with little evidence of vegetation breaking up. Slopes generally moderate; characterized by climax type of vegetation with few annual weeds and of usually lower density than vegetation in Class 1 above.	Local evidence of slight to moderate soil drifting and surface soil removal and/or accumulation. Most soil types, particularly the silty and fine sandy textured soils under certain conditions of culture and drought combined with high winds, are subject to this form of soil deterioration.	Occasional active gullies which are usually shallow, occuring primarily along main watercourses at intervals of more than 100 feet. In open areas and where slopes permit, little difficulty in traversing the area in a car.
3	Moderate to Severe	25-50 percent of topsoil removed. "Cat steps" and terraces noticeaole on slopes which may be moderate to steep. Bare spots are quite common. Undesirable weeds and plants are beginning to dominate the vegetation with climax types more often scattered than dominant. Perennial woody plants frequently pedestalled. Subsoil rarely exposed except in localized areas.	Bare spots common and areas generally more consistently subject to damage by soil blowing. Soils often removed to depths of 1 to 4 inches and drift accumulations and hummocks noticsable. Sod grass deterioration and plant pedestals in evidence and plant cover is insufficient for soil protection. Subsoil occasionally exposed and soils containing gravel show pavement appearance.	Occasional gullies shallow or deep occuring at intervals of more than 100 feet apart. Concentration of run-off and drainage channeling generally due to steepness of slope. Main water courses deeply channeled, generally U-shaped with tributaries usually V-shaped. Moderate difficulty in traversing area in car, ordinarily having to "head" gully in crossing. Generally associated with extensive shoe-string or rill gullying.
4	Severe to Critical	50-100 percent of topsoil removed and subsoil may be exposed in many places and is being removed to varying depths. Bare spots and trampled out areas common and plant pedestalling and erosion pavement highly evidenced. Loss of surface soil may be complete, associated with active gullying and high mortality of climax species of vegetation. Annual and perennial invaders may dominate the vegetation.	Majority of topsoil may be removed; usually accompanied by destructive accumulations in form of hummocks and dunes particularly along such obstructions as fences and edges of drainageways. Perennial vegetation often scanty and extensively pedestalled.	Frequent, usually shallow, gullies occuring at intervals of less than 100 feet apart. Main waterways deeply channeled and undergoing active gullying, usually U-shaped. Areas often incised by shoestring gullies and rills but are not generally so numerous or deep as to destroy the land completely but dissection permits rapid drainage of surface water. Corduroyed surfacs makes car travel impossible.
5	Critical to Extreme	Usually all the surface soil has been removed and utility and productivity of land has been largely destroyed by advanced stages of gully erosion which usually continues and retirement from use is, therefore, mandatory. Barren wastelands are often in this class. Desirable perennials never have occupied the area or have been practically obliterated and low density of annuals usually predominates.	Represents a condition of soil deterioration amounting to essential destruction. Retirement from further use is mandatory and artificial treatment is often essential to soil stabilization. Constantly shifting dunes are common. Deep fine sandy soils usually predominate in areas so classified.	Frequent and deep gullies. Generally represents maximum destruction by erosion. Complete and rapid drainage of surface water and soil moisture effected through intricate dissection of soil by gullies. Deeply channeled waterways with edges broken and caved in. Gully banks, slopes and bottoms in active erosion stage.

1/ The erosion condition and proposed improvement map utilizes three numbers in series to show the degree of erosion in each of the three types of erosion in this order; sheet, wind, gully. An example would be 3 - 2 - 1.

Table 10.- Symbols on the Vegetation Type Map representing plant species with their scientific and common names, Glendo area, Wyoming 1/

Symbol	Scientific Name	Common Name	Class of Plant
Aca	Atriplex canescens	fourwing saltbush	shrub
Aex	Artemesia cana	silver sagebrush	shrub
Afr	Artemesia frigida	fringed sagebrush	shrub
Anu	Atriplex gardneri	Gardner saltbush	shrub
Apa	Atriplex pabularis	upright saltbush	shrub
Ape	Artemesia pedatifida	birdfoot sagebrush	shrub
Asm	Agropyron smithi	bluestem wheatgrass	grass
Asp	Agropyron spicatum	bearded bluebunch wheatgrass	grass
Atr	Artemesia tridentata	big sagebrush	shrub
Bca	Bromus carinatus	Mountain brome	grass
Bgr	Bouteloua gracilis	blue grama	grass
Bte	Bromus tectorum	cheatgrass brome	grass
Cfi	Carex filifolia	threadleaf sedge	sedge
Clo	Calmovilfa longifolia	prairie sandreed	grass
Cpv	Cercocarpus montanus (parvifolius)	true mountain mahogany	shrub
Fid	Festuca idahoensis	Idaho fescue	grass
Foc	Festuca oetoflora	sixweeks fescue	grass
Jsc	Juniperus scopulorum	Rocky Mountain juniper	tree or shrub
Kcr	Koeleria cristata	prairie junegrass	grass
Ohy	Orizopsis hymenoides	Indian ricegrass	grass
Ppe	Phleum pratense	timothy	grass
Ppo	Pinus ponderosa	ponderosa pine	tree
Pse	Poa secunda	Sandberg bluegrass	grass
Pte	Populus tremuloides	quaking aspen	tree
Sco	Stipa comata	needleandthread	grass
Sor	Symphoricarpos oreophilus	mountain snowberry	shrub
Sve	Sarcobatus vermiculatus	black greasewood	shrub
Svi	Stipa viridula	green needlegrass	grass

1/ Symbols listed above and those on the vegetation map are in accordance with the list accompanying the manual of "Instructions River Basin Land Classification and Planning, Bureau of Land Management," September, 1946. Nomenclature is from the book, "Standardized Plant Names," Second Edition, Harlan P. Kelsey and William A. Dayton, J. Horace McFarland Company, 1942.

APPENDIX IV

Four folded maps in pocket attached to back cover of the report.

Maps of inventories and conditions in the critical western portion of the Glendo area printed on a base showing land status, drainage, administrative areas and culture. An inventory and study of the western portion of the basin was made on a detailed basis covering all of the lands. These maps cover the portion of Natrona and Carbon Counties, Wyoming, which are located within the Glendo drainage basin. The titles of these four maps are as follows:

Land Use Capability Map

Vegetation Type Map

Land Use Suitability and Proposed Adjustment Map

Erosion Condition and Proposed Improvement Map

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIVISION OF LAND PLANNING

GLENDO SUB - AREA

OF THE

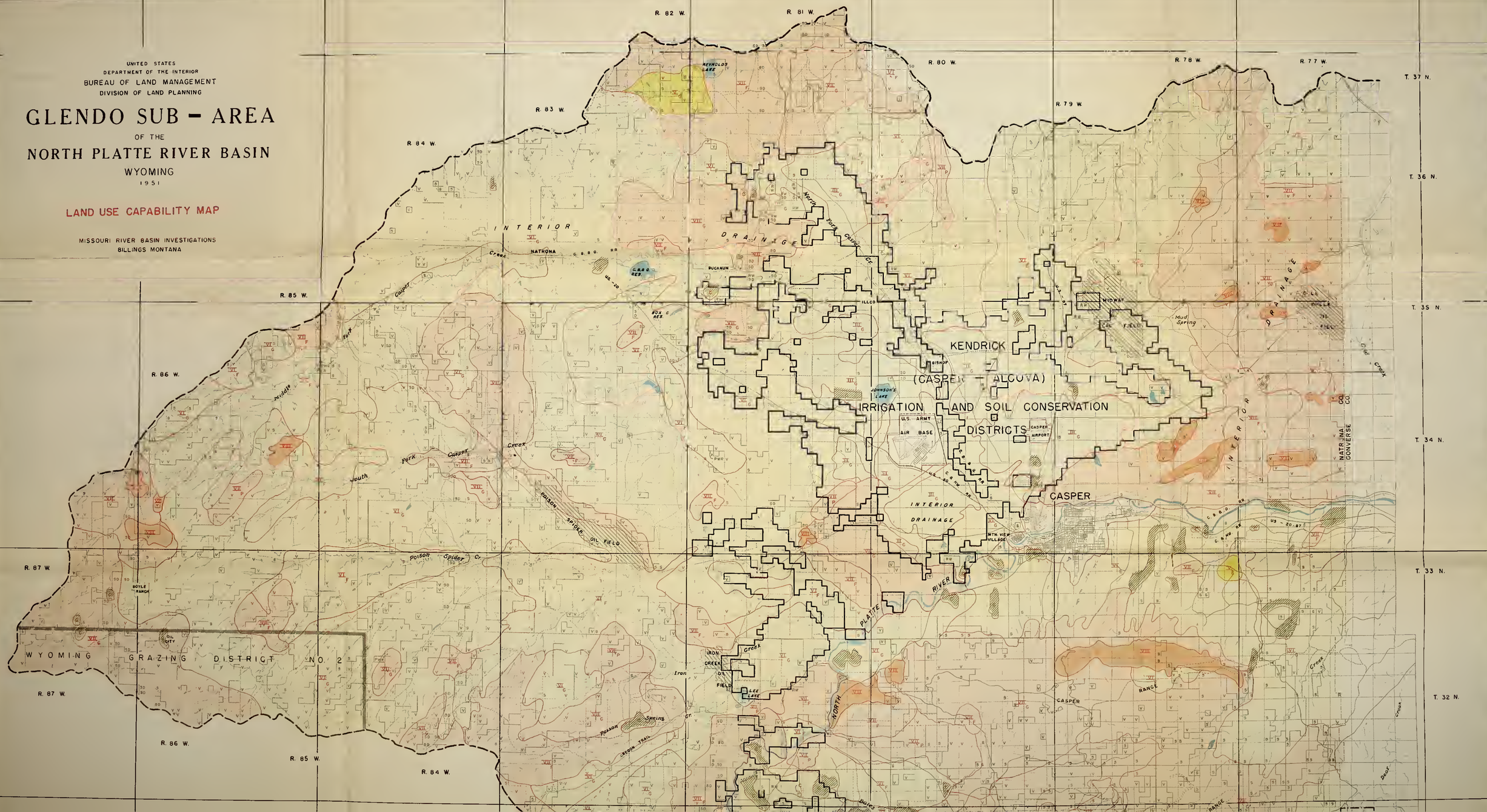
NORTH PLATTE RIVER BASIN

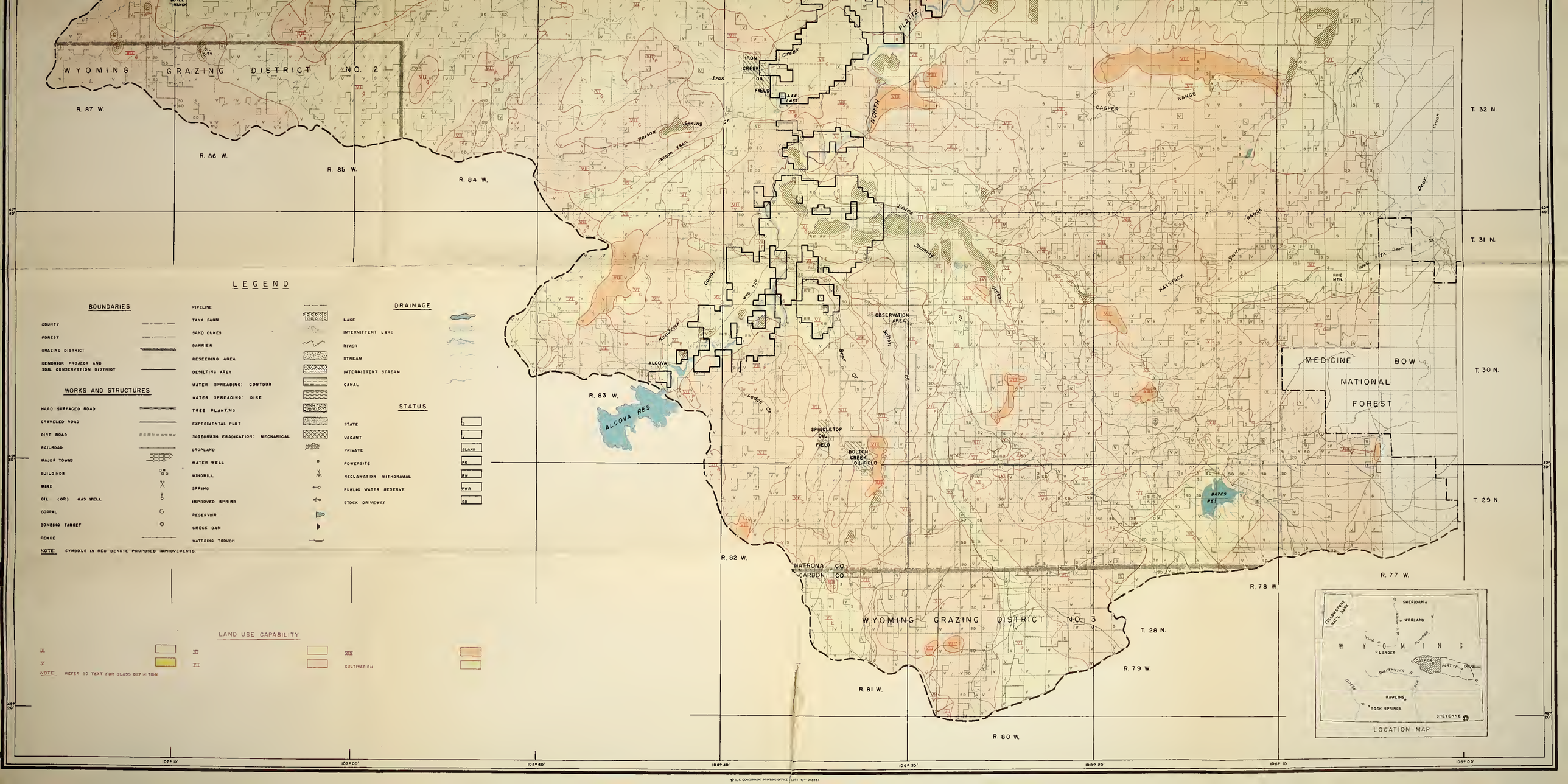
WYOMING

1951

LAND USE CAPABILITY MAP

MISSOURI RIVER BASIN INVESTIGATIONS
BILLINGS MONTANA





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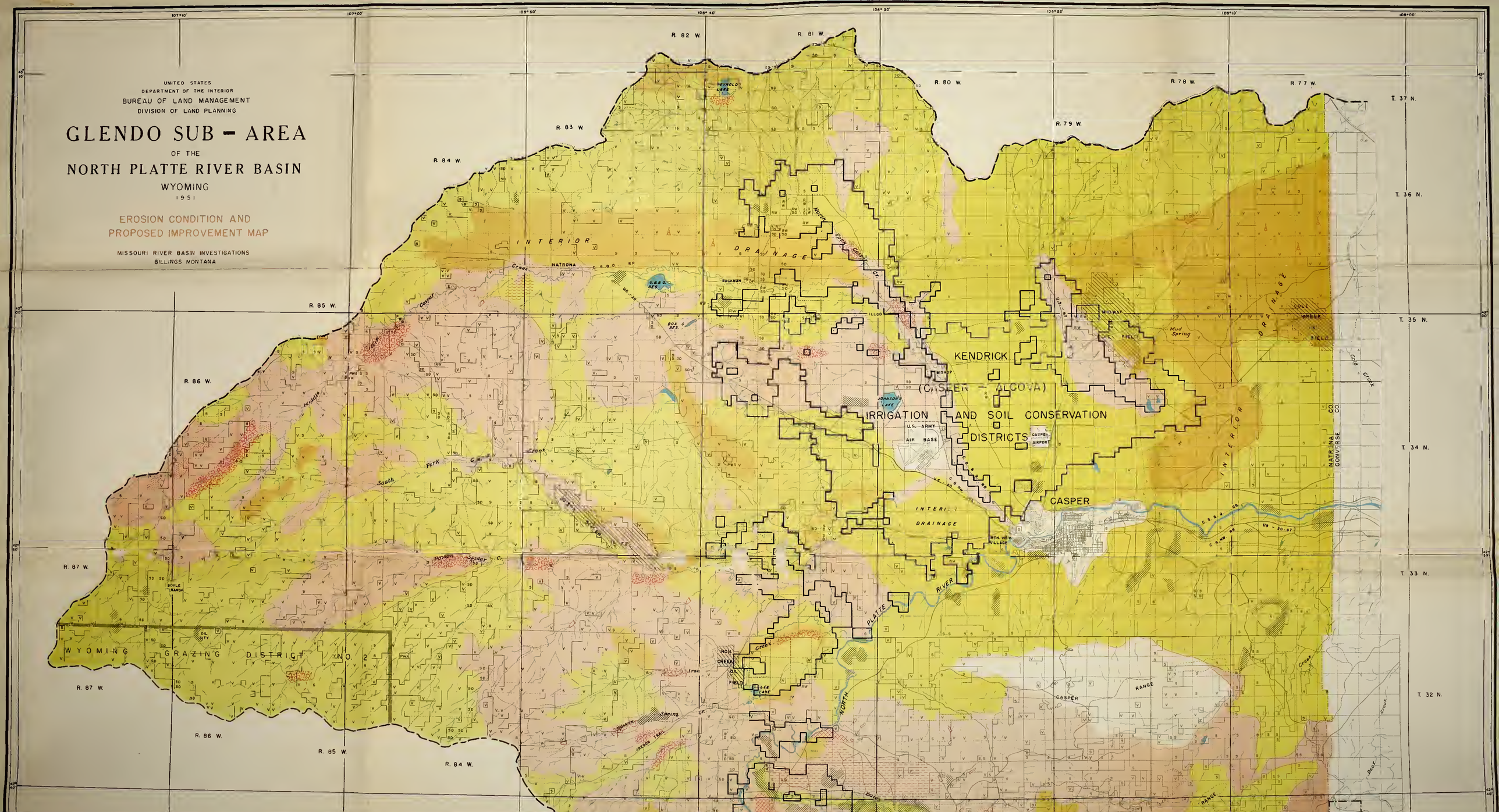
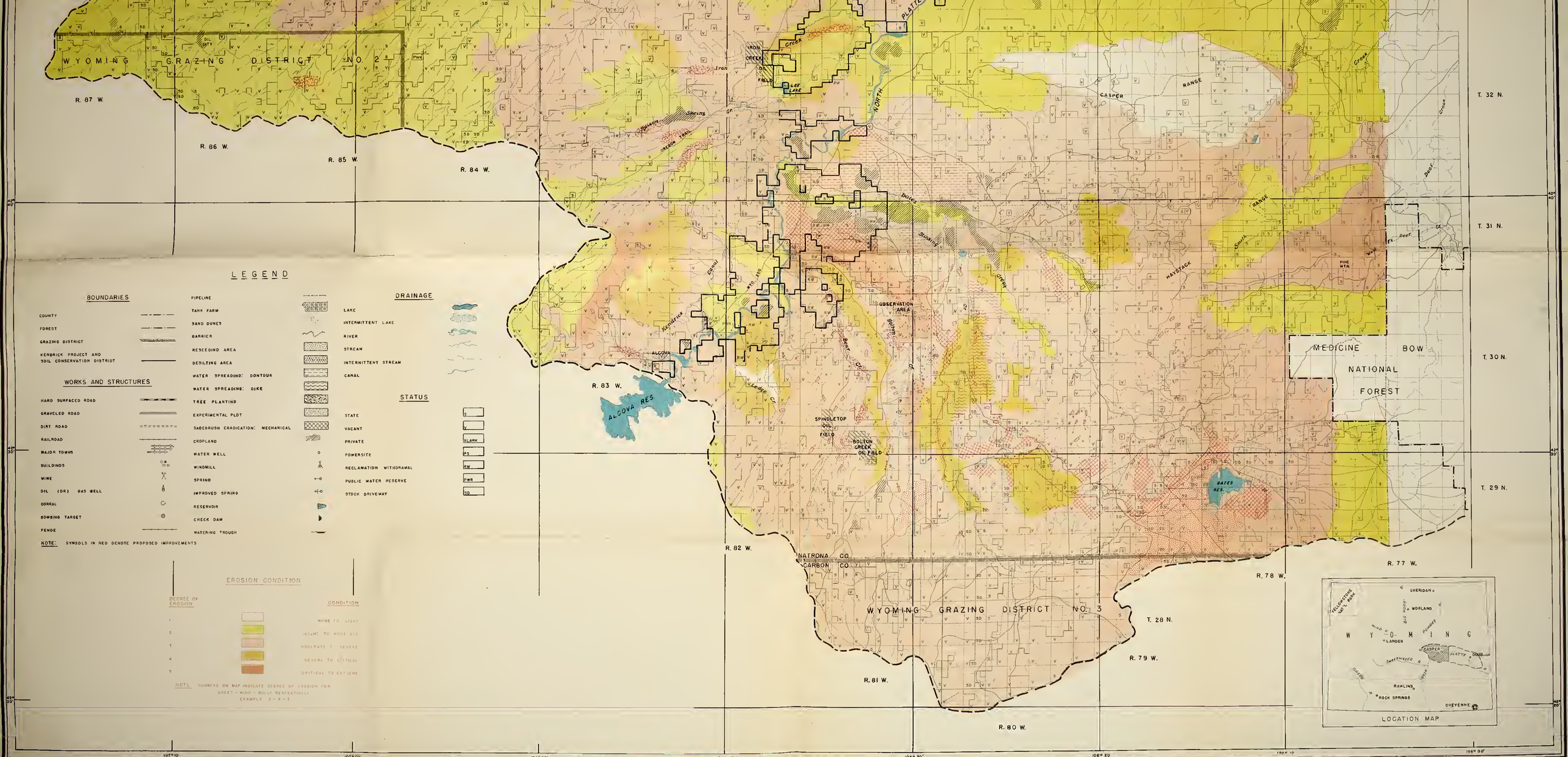

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIVISION OF LAND PLANNING
GLENDO SUB - AREA
OF THE
NORTH PLATTE RIVER BASIN
WYOMING
1951
EROSION CONDITION AND
PROPOSED IMPROVEMENT MAP
MISSOURI RIVER BASIN INVESTIGATIONS
BILLINGS MONTANA
KENDRICK
(CASPER - ALCOVA)
IRRIGATION AND SOIL CONSERVATION
DISTRICTS
CASPER
WYOMING GRAZING DISTRICT NO. 2
INTERIOR DRAINAGE
NATRONA CO.
CONVERSE CO.
R. 82 W.
R. 81 W.
R. 80 W.
R. 79 W.
R. 78 W.
R. 77 W.
R. 84 W.
R. 85 W.
R. 86 W.
R. 87 W.
R. 83 W.
T. 37 N.
T. 36 N.
T. 35 N.
T. 34 N.
T. 33 N.
T. 32 N.
NATRONA
SUCKNUN
MIDWAY
Mud Spring
COLE CREEK OIL FIELD
IRON CREEK OIL FIELD
LEE LAKE
REYNOLD LAKE
JOHNSON'S LAKE
BOX G RES.
C.B.&Q. RES.
BOYLE RANCH
OIL CITY
CASPER AIRPORT
U.S. ARMY AIR BASE
NORTH PLATTE RIVER
Cole Creek
Deer Creek
Poison Spider Cr.
Poison Spring Cr.
OREGON TRAIL
RANGE



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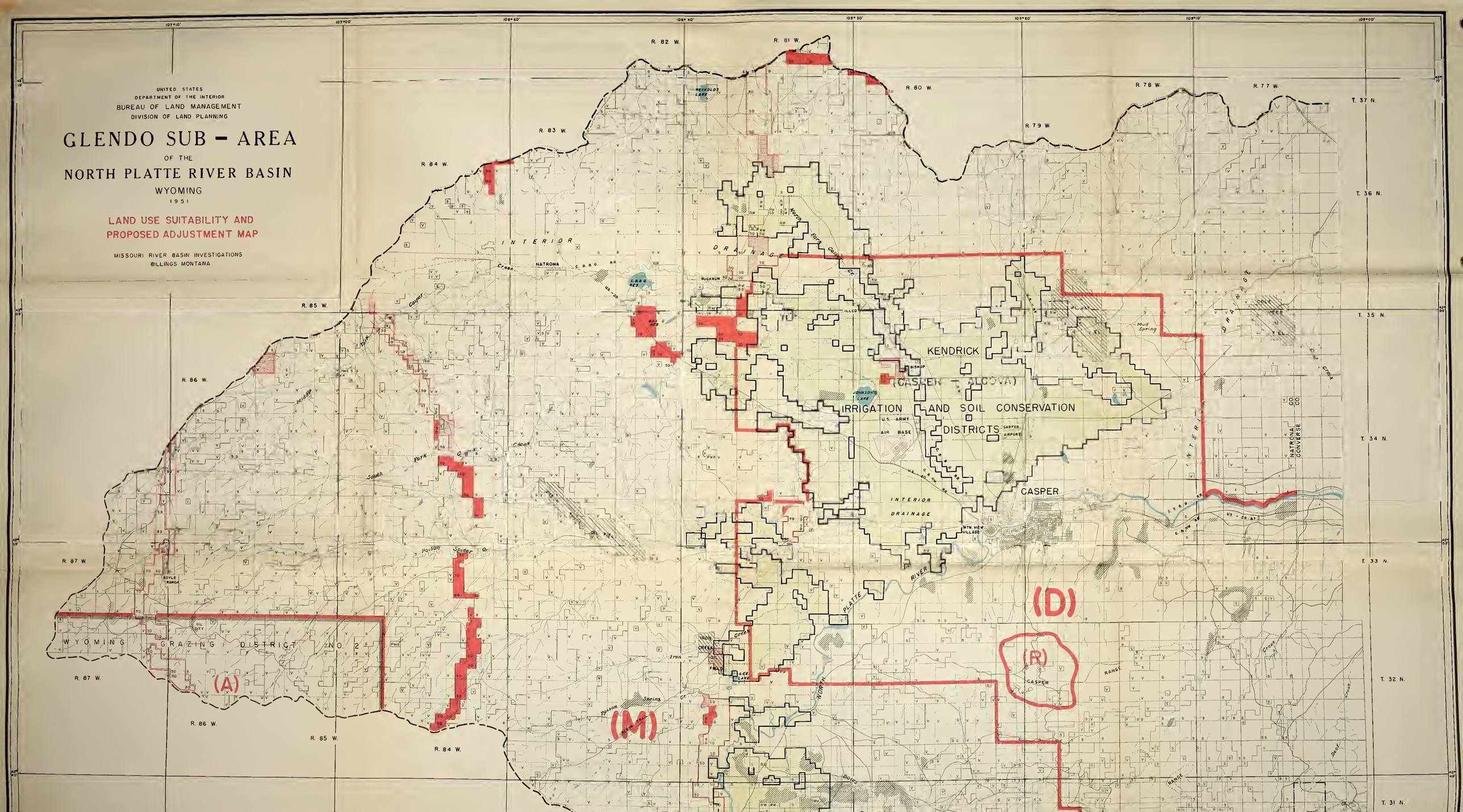
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIVISION OF LAND PLANNING
GLENDO SUB - AREA
OF THE
NORTH PLATTE RIVER BASIN
WYOMING
1951
LAND USE SUITABILITY AND
PROPOSED ADJUSTMENT MAP
MISSOURI RIVER BASIN INVESTIGATIONS
BILLINGS MONTANA
KENDRICK
(CASPER - ALCOVA)
IRRIGATION AND SOIL CONSERVATION
DISTRICTS
CASPER
INTERIOR DRAINAGE
WYOMING GRAZING DISTRICT NO. 2
(A)
(M)
(D)
(R)
NATRONA
CONVERSE
R. 87 W.
R. 86 W.
R. 85 W.
R. 84 W.
R. 83 W.
R. 82 W.
R. 81 W.
R. 80 W.
R. 79 W.
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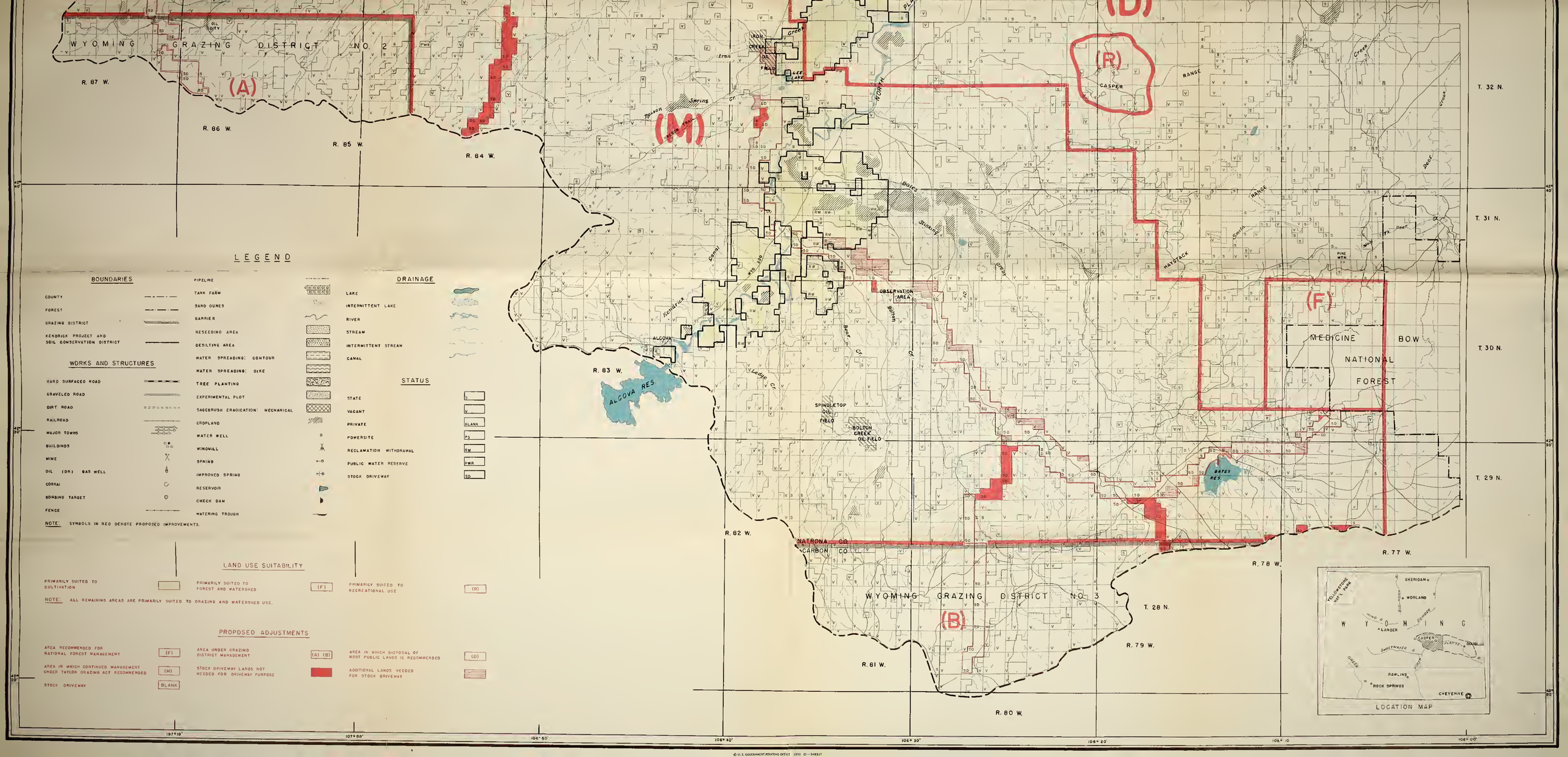
T. 31 N.



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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIVISION OF LAND PLANNING
GLENDO SUB - AREA
OF THE
NORTH PLATTE RIVER BASIN
WYOMING
1951
VEGETATION TYPE MAP
MISSOURI RIVER BASIN INVESTIGATIONS
BILLINGS MONTANA
KENDRICK
(CASPER - ALCOVA)
IRRIGATION AND SOIL CONSERVATION
DISTRICTS
CASPER
INTERIOR DRAINAGE
WYOMING GRAZING DISTRICT NO. 2
POISON SPIDER OIL FIELD
NORTH PLATTE RIVER
NATRONA
CONVERSE
R. 87 W.
R. 86 W.
R. 85 W.
R. 84 W.
R. 83 W.
R. 82 W.
R. 81 W.
R. 80 W.
R. 79 W.
R. 78 W.
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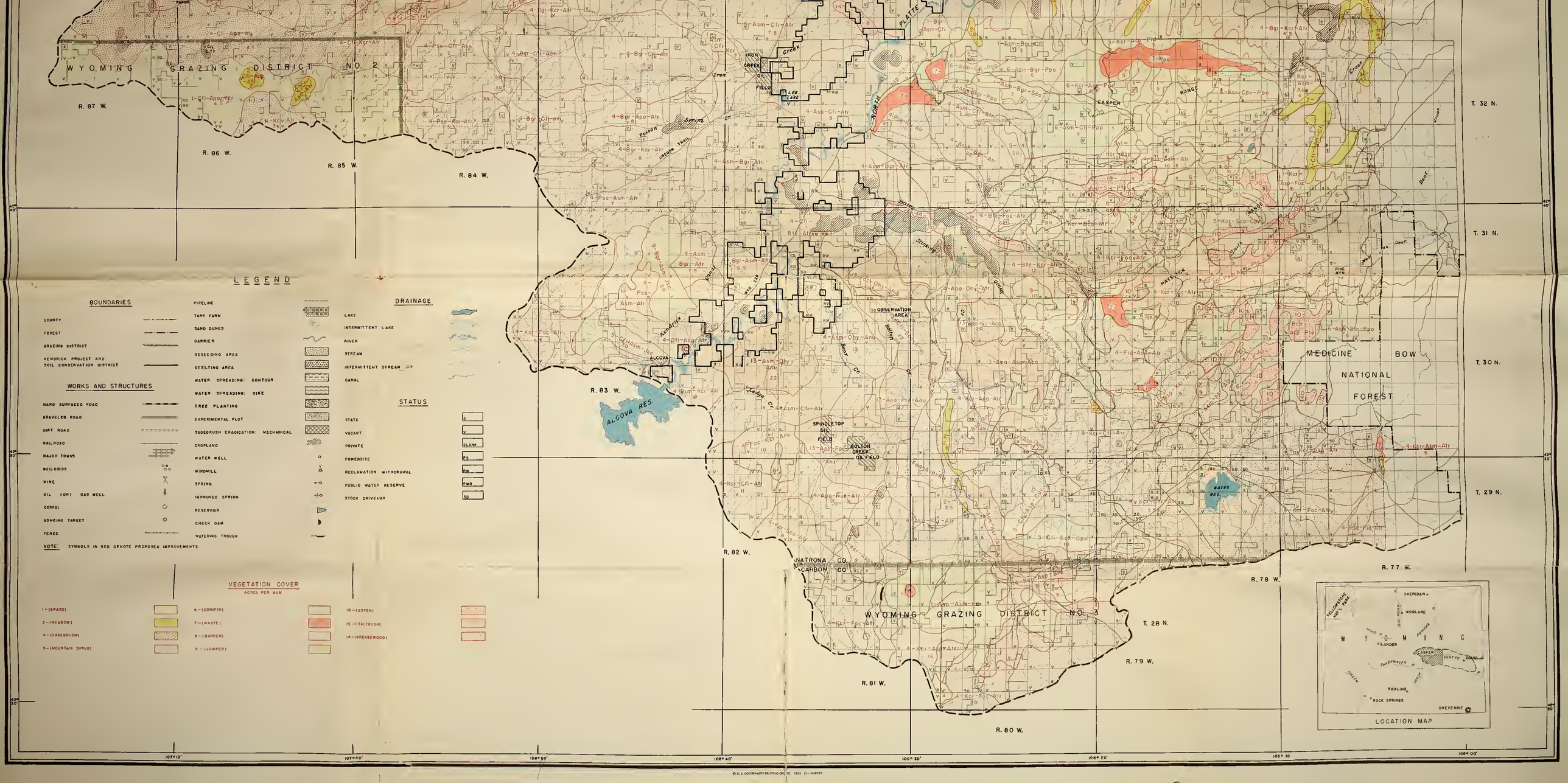
T. 32 N.



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LEGEND

BOUNDARIES

- COUNTY
- RESERVATION

WORKS AND STRUCTURES

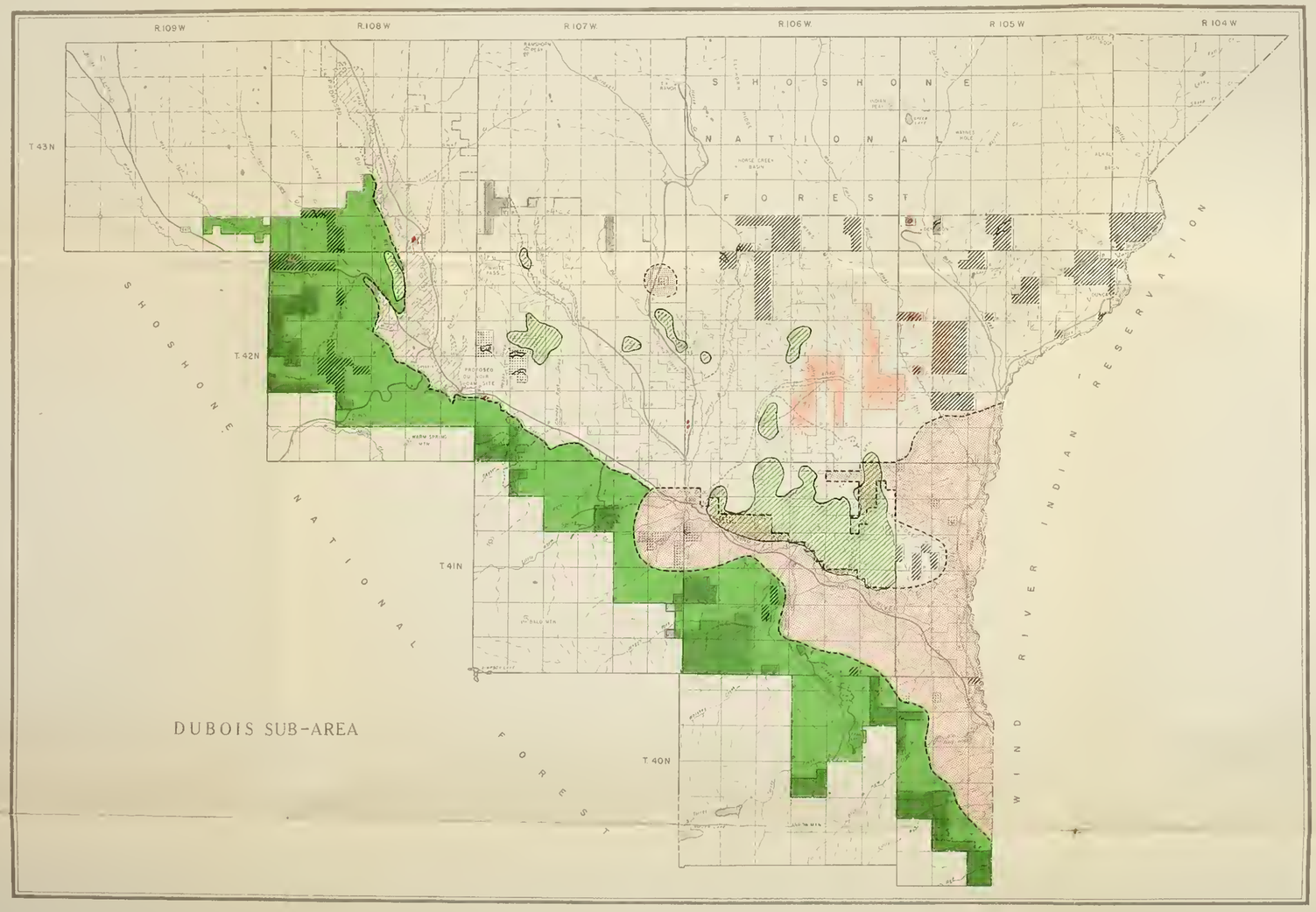
- HARD SURFACED ROAD
- GRAVELED ROAD
- IMPROVED DIRT ROAD
- UNIMPROVED DIRT ROAD
- TOWNS
- HOUSE
- ABANDONED
- SCHOOL
- POWER PLANT
- CEMETERY
- MINE
- ABANDONED
- OIL OR GAS WELL
- WATER WELL
- ARTESIAN WELL
- CORRAL
- LANDING FIELD
- WINDMILL
- SPRING
- DEVELOPED
- RESERVOIR
- CHECK DAM
- CANAL
- CROPLAND
- CATTLE GUARD
- BARRIER
- RESEEDING (RE 100 A)
- FIRE TOOL CACHE
- DESILTING BASIN
- CONTOUR FURROWING
- RAILROAD FENCED
- WATER SPREADING
- FENCE
- POWER TRANSMISSION LINE
- PIPE LINE
- RAILROAD
- TELEPHONE LINE

DRAINAGE

- STREAMS
- INTERMITTENT STREAM
- RIVER
- LAKE
- PROPOSED RESERVOIR

STATUS

- S—STATE
- V—VACANT
- P—PRIVATE
- PS- POWER SITE
- RW—RECLAMATION WITHDRAWAL
- PWR—PUBLIC WATER RESERVE



T42N

T41N

T40N

T39N

T38N

T37N

T36N

T35N

T5N

T4N

T3N

T2N

R104W

R6E

PAVILION

SOIL CONSERVATION DISTRICT FREMONT COUNTY WIND RIVER GRAZING DISTRICT

PAVILION SOIL CONSERVATION DISTRICT

PAVILION WIND RIVER CONSERVATION DISTRICT

ZONING DISTRICT

WIND RIVER INDIAN RESERVATION

WASHAKIE NATIONAL FOREST

WIND RIVER

R 101 W | R 100 W | R 99 W | R 98 W | R 97 W | R 96 W | R 95 W | R 94 W

T 35 N | T 33 N | T 32 N | T 31 N | T 30 N | T 29 N

T 31 N R 95 W

T 30 N R 96 W

T 29 N R 97 W

R 98 W

R 99 W

R 100 W

R 101 W

SUITABILITY

PRIMARILY SUITABLE FOR CULTIVATION.

PRIMARILY SUITABLE FOR FOREST AND WATERSHED.

PRIMARILY VALUABLE FOR WATERSHED, WILDLIFE AND RECREATION.

NOTE: ALL REMAINING AREAS ARE PRIMARILY SUITABLE FOR GRAZING AND WATERSHED.

PROPOSED ADJUSTMENTS

AREAS WHERE PUBLIC LANDS HAVE NEGLIGIBLE PUBLIC VALUES AND ARE BEST SUITED FOR PRIVATE MANAGEMENT.

PUBLIC LANDS BEST SUITED FOR PRIVATE OWNERSHIP.

REMAINING AREAS WHERE PUBLIC INTERESTS PREDOMINATE AND WHERE PUBLIC LANDS ARE BEST SUITED FOR PUBLIC MANAGEMENT

PUBLIC LANDS SUITED FOR MANAGEMENT UNDER STATE PROGRAMS.

PUBLIC LANDS BEST SUITED FOR FOREST AND WATERSHED MANAGEMENT.

ADDITIONAL LANDS NEEDED FOR PUBLIC STOCK DRIVEWAY PURPOSES.

STOCK DRIVEWAY LANDS NOT NEEDED FOR PUBLIC STOCK DRIVEWAY PURPOSES.

SCALE 4 MILES

YELLOWSTONE NATIONAL PARK

CODY

THERMOPOLIS

LOCATION

BRADFORD-ROBINSON PRINTING CO.

WIND RIVER GRAZING

R 96 W
R 95 W
R 94 W
R 93 W
R 92 W
R 91 W
R 88 W

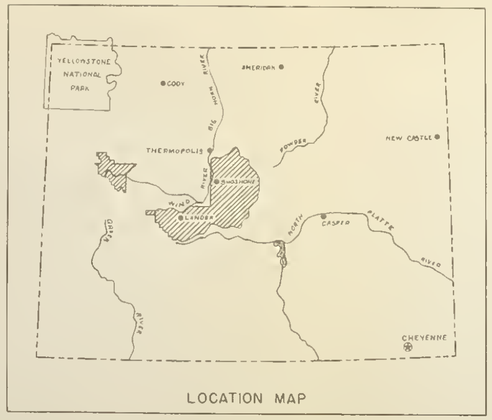
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N

T 32 N
R 90 W

T 32 N
R 89 W

T 34 N
R 88 W

T 35 N



LOCATION MAP

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
DIVISION OF PLANNING

WIND RIVER SUB-AREA

WYOMING

LAND-USE SUITABILITY
and
PROPOSED LAND OWNERSHIP ADJUSTMENT MAP

MISSOURI RIVER BASIN INVESTIGATION
BILLINGS, MONTANA
MARCH 1949

BILLINGS DRAFTING OFFICE

MAP NO. 5 OF 5

LEGEND

BOUNDARIES

COUNTY

RESERVATION

V—VACANT

P—PRIVATE

PS—POWER SITE

RW—RECLAMATION WITHDRAWAL

PWR—PUBLIC WATER RESERVE

DUBOIS S