VINTAGE COLORADO CELLARS
3553 E Road
Palisade, CO 81526

PETITION

Petition to the Bureau of Alcohol, Tobacco and Firearms to establish The Grand Valley of Colorado, a grape growing region, as a viticultural area to be named "Grand Valley".

The petition includes:

(a)Evidence that the name of the proposed viticultural area is locally and/or nationally known as referring to the area specified in the petition;

(b) Historical or current evidence that the boundaries of the viticultural area are as specified in the petition;

(c) Evidence relating to the geographical features (climate, soil, elevation, physical features, etc.) which distinguish the viticultural features of the proposed area from surrounding areas;

(d) a description of the specific boundaries of the viticultural area, based on features which can be found on United States Geological Survey (U.S.G.S.) maps of the largest applicable scale; and

(e) Copies of the appropriate (U.S.G.S.) maps with boundaries prominently marked.

(a) Historical and current usage of the name "Grand Valley" is supported by the following:

(1) The Geographic Names Information System (G.N.I.S.) State of Colorado, Alphabetical Finding List, dated 25 February 1981, (attachment #1) lists "Grand Valley, Feature Class, ppt, State County 08045, Coordinate, 392707N1080308W.

(2) " The Valley of the Grand - The Place for You" Issued by the Chamber of Commerce Grand Junction, Colo. Historic Catalog circa 1907 (attachment #2) details "Specimens of Grand Valley Grapes".

(3) The Grand Junction Chamber of Commerce map/brochure, dated 1988, (attachment #3) describes, under the section titled "History of Grand Junction", a brief history of the area beginning with "The isolated barren Grand Valley was traveled by a mere handful of hardy pioneers prior to 1879."-----

(4) The Geological Survey Professional Paper 451, titled "Geology and Artesian Water Supply, Grand Junction Area, Colorado" (attachment #4), states "The present Colorado River above Grand Junction was known as the Grand River at least as early as 1842. The city of Grand Junction was so named because of its position at the junction of the Gunnison and Grand Rivers. The Green and Grand Rivers united in eastern Utah to become the Colorado River. The Grand River was renamed Colorado River by act of the Colorado State Legislature, approved March 24, 1921, and by act of Congress approved July 25, 1921. In addition to Grand Junction, the name still remains in the Grand Valley between Palisade and Mack; in Grand Mesa, which stands more than a mile above the Grand and Gunnison Valleys; and in Grand County, Colorado."

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(5) Soil Survey of the Grand Junction Area, Colorado Series 1940, No. 19, Issued November 1955 (attachment #5) frequently refers to the Grand Valley, particularly on the fold out pages 6 and 7. (b) and (c) are combined, to a great extent, in that the reader will find reference to both categories in the attachment #5, Soil Survey of the Grand Junction area".

To briefly summarize (c) we submit the following:

The Grand Valley viticultural area is located in Mesa County, Colorado. Elevations rise from 4500' at the western end near Fruita to 4573' at Grand Junction, and 4729' at the eastern end of the valley near Palisade. This valley, carved in the Mancos Shale formation by the Colorado and Gunnison Rivers and their tributaries, is surrounded, for the most part, by steep mountainous terrain: Deep canyons flank the valley to the south west; a sharp escarpment known as the Book Cliffs rises to 7000' above the valley to the north and north east; The Grand Mesa stands more than a mile above the eastern edge of the valley; and rough broken and steep, hilly land borders the high terraces and mesas to the south.

The climate is considered arid, with a high percentage of bright, sunny days. Air drainage is governed by the currents which are stabilized as the Colorado River exits the steep, narrow Debeque Canyon on the north east edge of the Grand Valley.

Air movement during the daytime is easterly turning to westerly in the evening. This movement affords a more limited daily range in temperatures and less danger from frost, particularly at the eastern end of the Grand Valley where the majority of the vinifera plantings are located.

Summer temperatures occasionally rise above 100 degrees and the night temperatures remain cool. Winter temperatures are mild and relatively constant - seldom dipping below zero. The average humidity is low, and the average frost free growing season is 190 days.

The average annual precipitation is 9.06" a year, and the ground is free from snow most of the winter.

In addition to the cliffs and mesas to the north and east of the valley, the surrounding areas to the north west, west and south are comprised of three areas of different "soil associations". For the most part, these areas are not irrigated and are suitable only for livestock grazing. They are rocky, oft-times steeply sloped, and the soils are classified from fair to poor, to non-existent. Large areas to the south, along the Gunnison River and Colorado Highway 50, show extensive evidence of excessive salts and alkalinity.

More complete data regarding (c) above may be found in our major source of information publication, the enclosed copies made from "Soil Survey Grand Junction Area, Colorado", attachment #5.

(d) The boundaries of the proposed viticultural area, using landmarks and points of references are as follows:

(1) Starting at the point where the Orchard Mesa Siphon joins the Government Highline Canal Tunnel No. 3, immediately west of I-70 and

the Colorado River moving ESE, under the Colorado River and I-70 to the

(2) Orchard Mesa Canal. Southward along that Canal which parallels the 4800' elevation and the base of the mesa wall on the east of the canal. Then following the

(3) base of the mesa wall southward to its intersection with

(4) Watson Creek , in the Blowout. Then in a direct WNW line, over Horse Mountain, to the

(5) Jeep Trail. Then northward along the jeep trail to its intersection with

(6) Orchard Mesa Canal No. 2 Then WSW along Canal No. 2 to its junction with the

(7) Gunnison River. Then northward along the Gunnison River to its junction with the

(8) Colorado River. Again northward to the

(9) bridge where County Road 340 crosses the Colorado River. Then WSW to

(10) the intersection of County Road 340 and

(11) Monument Road. Southwest along Monument Road to the boundary of

(12) The Colorado National Monument. There North and West along that boundary to the intersection with

(13) County Road 340 (Broadway), northward to the city of

(14) Fruita where County Road 340 becomes

(15) Cherry Street. North on Cherry Street to its intersection with

(16) K Road. Due east on K Road, and extending in that same line to the intersection with

(17) The Government Highline Canal. There Southeast to its intersection with

(18) U.S. Interstate 70 and eastward along I-70 to that point east north east of the city of Palisade, where the Government Highline Canal enters

(19) Tunnel No. 3, passes northward under I-70 and NNW underground to the point of beginning.

(e) The appropriate maps for determining the boundaries of the Grand Valley Viticultural Area are seven U.S.G.S. maps. The maps are titled:

(1) Cameo Quadrangle Colorado-Mesa County 7.5 minute series

(2) Palisade Quadrangle Colorado-Mesa County 7.5 minute series

(3) Clifton Quadrangle Colorado-Mesa County 7.5 minute series

(4) Grand Junction Quadrangle Colorado-Mesa County 7.5 minute series

(5) Colorado National Monument Quadrangle Colorado-Mesa County 7.5 minute series

(6) Fruita Quadrangle Colorado-Mesa County 7.5 minute series

(7) Corcoran Quadrangle Colorado-Mesa County 7.5 minute series

VINTAGE COLORADO CELLARS
3553 E Road
Palisade, CO 81526

#1

NAME	FEATURE CLASS	STATE COUNTY	COORDINATE	BGN	ELEV FT	SOURCE	MAP
Granada Ditch	canal	08099	[illegible]				[illegible]
Granada Santa Fe Trail	trail	08099 08071	372910N1025920W				1478 1479 1422 1423
Granby	ppl	08049	400510N1055620W		7939		0425
Granby Dam	dam	08049	400856N1055202W		8230		0369
Granby Ditch	canal	08029	385803N1080016W				0921 0922
Granby Mesa	summit	08049	400451N1055318W		8708		0425
Granby Pump Canal	canal	08049	401209N1055140W				0369
Granby Pumping Plant	other	08049	401055N1055245W				0369
Granby Reservoir No 7	tank	08029	385933N1080238W				0921
Granby Reservoir No 9	tank	08029	385938N1080200W				0921
Granby Reservoir No. 1	tank	08029	390035N1080052W				0864
Granby Reservoir No. 11	tank	08029	385957N1080207W				0864 0921
Granby Reservoir No. 12	tank	08029	385954N1080225W				0864 0921
Granby Reservoir No. 2	tank	08029	390022N1080105W				0864
Granby Reservoir No. 3	tank	08029	390021N1080116W				0864
Granby Reservoir No. 4	tank	08029	390005N1080134W				0864
Granby Reservoir No. 5	tank	08029	390004N1080137W				0864 0921
Granby Reservoir No. 8	tank	08029	390002N1080128W				0864 0921
Granby Reservoirs	tank	08029	390019N1080131W				0864 0921
Granby, Lake	tank	08049	400853N1055155W	1957	8280		0363 0369 0426
Grand Bay	bay	08049	400950N1054934W				0369
Grand Canyon Hills	range	08043	382701N1051856W				2026
Grand Ditch	canal	08049	402510N1055148W				0254 0255 0311
Grand Hogback	ridge	08045 08103	393707N1074515W		7254		0581 0638 0639 0640
Grand Island	locale	08013	395815N1053610W				0485
Grand Junction	ppl	08077	390350N1083300W	1943	4597		0860
Grand Lake	ppl	08049	401508N1054921W				0312 0369
Grand Lake	tank	08049	401412N1054811W	1932			0312 0369

*** J01 *** *** J01 ***

GEOGRAPHIC NAMES INFORMATION SYSTEM (GNIS)** PAGE 217
STATE OF COLORADO
ALPHABETICAL FINDING LIST
25 FEBRUARY 1981

NAME	FEATURE CLASS	STATE COUNTY	COORDINATE	BGN	ELEV FT	SOURCE	MAP
Grand Lake Cemetery	cem	08049	401537N1055017W				0312
Grand Lake Entrance Rocky Mountain National Par	locale	08049	401533N1055004W				0312
Grand Mesa	ppl	08029	390225N1075657W		10125		0865
Grand Mesa	area	08077 08029	390400N1075610W				0809 0810 0866 0865
Grand Mesa Christian Association	locale	08029	390208N1075710W				0865
Grand Mesa National Forest	forest	08077 08029	390353N1074838W				0809 0866 08670695
Grand Republic Mine	mine	08013	400203N1052237W				0429
Grand Speedway	other	08077	390417N1083155W				0860
Grand Tunnel Ditch	canal	08045	393421N1074644W				0638
Grand Turk	summit	08111	374636N1074142W		13148		1437
Grand Union Mine	mine	08047	395449N1053227W				0485
Grand Valley	ppl	08045	392707N1080308W				0693
Grand Valley Canal	canal	08077	390510N1083050W				0801 0802 0803 0860
Grand Valley Diversion Dam	dam	08077	391121N1081654W		4784		0805
Grand Valley School	school	08089	375857N1034258W				1412
Grand View	locale	08077	390525N1084330W				0859
Grand View Ditch	canal	08029	384208N1073836W				1038 1039
Grand View Ditch	canal	08051	383638N1072843W				1040 1097
Grand Vrew Mesa	summit	08029	384159N1074100W		6518		1038
Grande, Rio	stream	08003 08021	*PRIMARY COORD*	1954		374752N1073216W	1623 1680 1681 1852
Grandma Canyon	valley	08071	370013N1033829W			370144N1033749W	1811
Grandview	ppl	08067	371339N1074935W				1721
Grandview Cemetery	cem	08069	403515N1050644W				0204
Grandview Cemetery	cem	08085	382703N1075243W				1150
Grandview Ditch	canal	08043	382600N1051000W				1172
Grandview Estates	ppl	08035	393237N1044914W				0662
Grandview Resort	locale	08035	391440N1051358W				0830
Grandview Rock	pillar	08041	385047N1045824W				[illegible]03
Grandview School	school	08025	382342N1040109W				1181
Grandview Shaft	mine	08065	391736N1062338W				0763
Graneros Creek	stream	08101	375701N1044635W			375328N1050122W	1401 1402 1403
Graneros Flats	flat	08101	375644N1044218W				1404
Graneros Gorge	valley	08101	375652N1044636W			375456N1044917W	1403
Graneros School	school	08101	375611N1[illegible]305W				1404
Granger Bridge	bridge	08105	374131N1063052W				1503
Granite	ppl	08015	390237N1061546W		8928		0878
Granite Adit	tunnel	08097	391606N1063311W				0762
Granite Basin	basin	08051	384749N1065012W				0988
Granite Canyon	valley	08071 35007	365842N1044538W			365950N1044739W	2046
Granite Cemetery	cem	08015	390245N1061651W				0878
Granite Country	area	08043	381631N1052255W				1171
Granite Creek	stream	08051	384726N1065220W			384755N1064928W	0988
Granite Creek	stream	08077 49019	384741N1090945W			385032N1085554W	2010 0971
Granite Creek	stream	08097	391607N1063340W			391314N1063400W	0762 0819
Granite Creek	stream	08107	402940N1064138W			403052N1063938W	0191 0248
Granite Falls	falls	08049	401907N1054617W				0312
Granite Gulch	valley	08043	381734N1052203W			381650N1052250W	2026
Granite Lake	lake	08053	373647N1072014W				1554
Granite Lakes	lake	08097	391410N1063415W				0819

*** K01 *** *** K01 ***

GEOGRAPHIC NAMES INFORMATION SYSTEM (GNIS)** PAGE 218
STATE OF COLORADO
ALPHABETICAL FINDING LIST
25 FEBRUARY 1981

NAME	FEATURE CLASS	STATE COUNTY	COORDINATE	BGN	ELEV FT	SOURCE	MAP
Granite Mountain	summit	08015	38562[illegible]N1062817W		12848		2011
Granite Mountain	summit	08051	383520N1062350W	1954	12598		2017
Granite Pass	gap	08069	401628N1053618W	1911			0314
Granite Peak	summit	08053	372808N1072439W		12147		1610
Granite Peak	summit	08053	373616N1072027W				1554
Granite Peak Guard Station	locale	08053	373554N1072059W				1554
Granite Peak Ranch	locale	08067	372723N1072925W				1610
Granite Springs	spring	08037	393323N1064115W				0647

VINTAGE COLORADO CELLARS
3553 E Road
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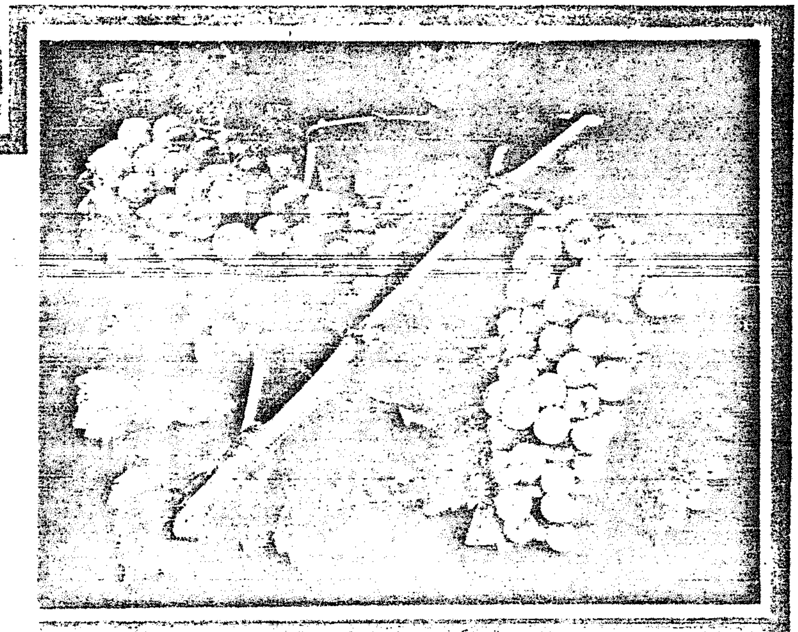
The Valley of the Grand

The Place for You.

Issued by the
Chamber of Commerce
Grand Junction, Colo.

Ca. 1907



SPECIMENS OF
GRAND VALLEY GRAPES

GRAND VALLEY FOREIGN TABLE GRAPES

WHILE much is being said, and justly so, about peaches, pears and apples, and all other kinds of tree fruits, we must not forget the Foreign Table Grapes. This most beautiful and luscious of all fruits deserves first place on the list of products that can be grown successfully and profitably in this, the Valley of the Grand. However, it has not received the attention it so richly deserves, as most people have been giving their time and attention to the planting of orchards.

This is due largely to the fact that we have a great many settlers from the Eastern states, coming here and locating and who are familiar with tree fruits and Native or American Grapes, but not with Foreign Table Grapes. Also, partly because this is a new country and up to a very few years ago it was not known what varieties of grapes would be adapted to our climate and soil conditions, and what varieties would be the most profitable to raise. Those who have led the way in experimenting have demonstrated to their satisfaction, and to the surprise of many Eastern fruit buyers, that we can and do grow a table grape that for color, general appearance and quality, cannot be surpassed by any grown in California, and when we remember that there is not another section in the entire United States where these grapes have been grown successfully outside of California and the Grand Valley, we wonder why the people in general have been overlooking one of the grandest fruits grown, and one that is sure to bring quick and as large returns than any other fruit.

When one considers the limited area where these grapes thrive and succeed, and the nearness of our markets, one cannot help but see the prospects and possibilities in store for the man who plants a vineyard, that cannot be duplicated with any other kind of fruit.

There is also an unlimited market for Fancy Late Table Grapes, as nearly all summer fruits are gone by the time the grapes are ready for market. It is also easier to obtain help for picking and packing, as the rush of the peach gathering is over; and last but not least, the prices are generally good, owing to the scarcity of other fruits at this season of the year.

A few facts about the returns on an acre of Flame of Tokay or Black Cornichon Grapes, planted in a good location and well cared for, would be in order here.

Planted 8 x 8 feet would give 680 vines per acre, which should produce at three years of age an average of ½ crate to the vine or 340 crates to the acre; at $1.00 per crate would give us $340.00.

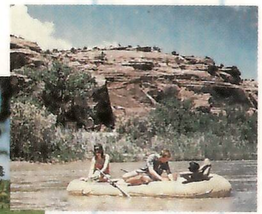
At four years of age the product should be double; or $680.00; while it is possible to realize more than this for the fifth or sixth year and succeeding years, it is well to take a conservative figure, and even though vines should never be allowed to bear more than a crate per vine on an average, we have plenty of instances where 40 or 45 lbs. of grapes have been taken off a single vine five or six years old, and prices have ranged from $1.25 to $1.75 per crate.

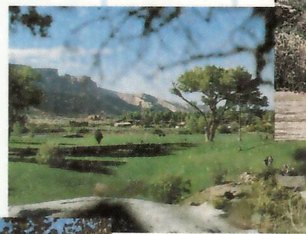
Individual bunches have been found to weigh five pounds each.

These are facts which proves what climate, soil and irrigation can produce in the line of Foreign Table Grapes.

Map/Brochure 50¢

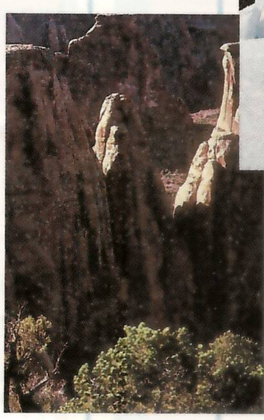
VINTAGE COLORADO CELLARS
3553 E Road
Palisade, CO 81526





DISCOVER THE BEST OF COLORADO

Grand Junction



Complete Area Information Is Available From The
GRAND JUNCTION CHAMBER OF COMMERCE
360 Grand Av., P.O. Box 1330
Grand Junction, CO. 81502 (303) 242-3214

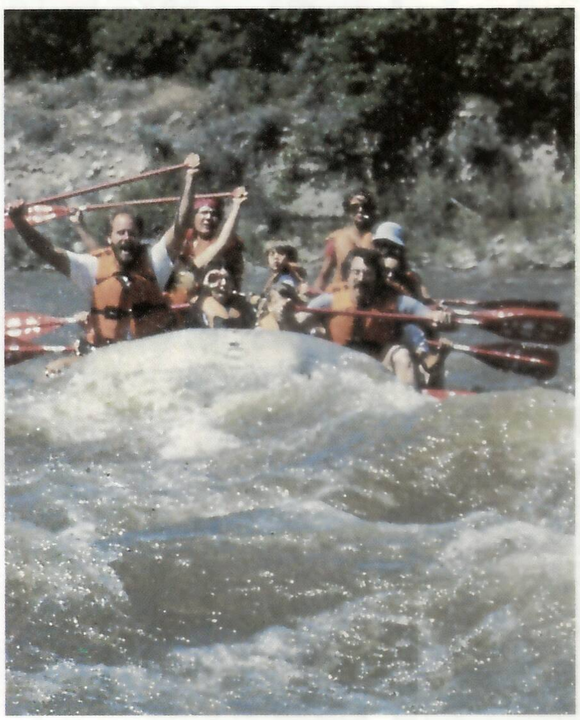
HISTORY OF GRAND JUNCTION

The isolated barren Grand Valley was traveled by a mere handful of hardy pioneers prior to 1879. In that year, the Ute Indians were moved to Utah, after being forced to cede 100,000 square miles of their Western Colorado lands.

J. Clayton Nichols, William McGinley, and O.D. Russell staked their claims on the south bank of the Grand River (later named the Colorado) at its junction with the Gunnison River. These men sold other settlers on their stories of the area's unsurpassed scenery and possibilities for irrigating orchards. George Crawford, former governor of Kansas, joined Nichols and McGinley in their claims. Crawford was looking for a place on the old Ute Reservation to lay out a new town.

The first settlers had to build roads, trails, bridges, and cabins—everything needed to establish their town. Although it was a hard life, they were tough people.

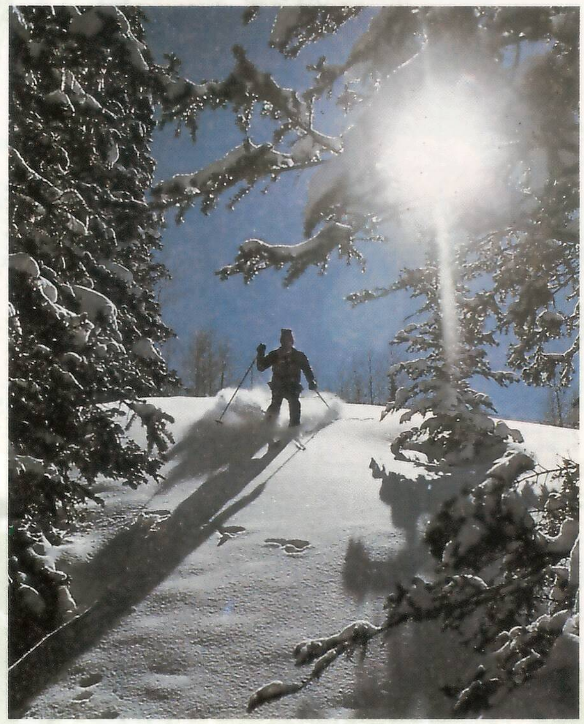
In 1881, the town of Grand Junction (named for its location at the junction of the state's two largest rivers)was incorporated. The town grew. Soon railroad service crews were at work in the area, and irrigation waters were bringing rich harvests. The later discovery of Uranium made Grand Junction a center for this vast, new mining industry. Finally in 1963, Grand Junction was named an "All-American City."



RECREATIONAL AND CULTURAL FACILITIES

Excellent year-round recreational facilities can be found in and around Grand Junction.

There are numerous places to boat, fish, and hunt, including the areas of Vega Dam Reservoir, Blue Mesa Reservoir, Highline Lake, Grand Mesa National Forest and Glade Park Recreation Area. Grand Junction has easy access to many of the major ski areas such as Powderhorn, Aspen Snowmass, Aspen Mountain, Aspen Highlands, Buttermilk, Sunlight, Vail and Telluride. All of these are within a few hours of Grand Junction.



Snowmobiling areas such as Glade Park and Grand Mesa are as close as 20-40 miles from the City. The City also supports football, baseball, basketball, and softball leagues as well as several annual major recreational events. These events include the National Junior College World Series Baseball Tournament; Colorado Stampede Rodeo; Coors International Bicycle Classic; annual Air Show; Lands End Hill Climb; quarter horse racing and horse shows; and stock car racing.

Grand Junction has excellent cultural activities including art exhibits, theater performances, symphony performances with guest artists, community concerts, and museums.

Cindy

Geology and Artesian Water Supply Grand Junction Area Colorado

GEOLOGICAL SURVEY PROFESSIONAL PAPER 451

Prepared in cooperation with the Colorado Water Conservation Board

U. S. DEPARTMENT OF THE INTERIOR
March 3, 1849

The samples from the Entrada Sandstone or the Entrada and Wingate Sandstones were soft sodium bicarbonate water, most of which had a hardness of less than 50 ppm (parts per million) and some of which had a hardness of 10 ppm or less; three samples had a hardness ranging from 100 to 124 ppm. Samples from the Morrison were soft sodium bicarbonate-sodium sulfate water. These waters are of good quality for domestic use, but contain high percentages of sodium and may be harmful to certain plants or crops. No samples were obtained from the Burro canyon Formation or Dakota Sandstone, but reports from well drillers and owners indicate that the water generally is brackish or salty.

In all the water analyzed, the relative softness is attributed to natural softening by base exchange, whereby calcium and magnesium ions in the water are exchanged for sodium ions in certain minerals in the aquifers and thus remove part or most of the hardness-producing calcium and magnesium from the water. Petrographic and X-ray examinations of samples of the Entrada and Wingate Sandstones indicate that clay minerals cause the softening. There is an almost linear decrease in hardness of water in the Entrada with increased distance from the recharge area.

Most of the artesian water in the Grand Junction area is used for domestic purposes, either by the owner alone, by the owner and nearby homes connected by pipeline, or by hauling to homes equipped with storage tanks or cisterns. From 1 to as many as 30 tank-loads (1,100-gallon tanks) per day are hauled from 13 of the wells. Some of the water is used for watering livestock, filling a swimming pool, supplying a meat-packing plant, or watering small plots of lawn or shrubs.

Declines in artesian heads and flows indicate that the principal aquifer—the Entrada Sandstone and to a lesser extent the Wingate Sandstone—have been overdeveloped in parts of the Grand Junction area, but two relatively large areas are undeveloped or only slightly developed and would yield additional water to wells, preferably spaced more than a mile apart. One area comprises the southwest side of the Grand Valley and the Redlands, in and northwest from the northwestern part of the area. The other area comprises the southwestern side of the Grand Valley, parts of Orchard Mesa, and the lower part of the Gunnison River Valley in and southeast from the eastern part of the area.

Grand Junction and Fruita have municipal water supplies piped from distant surface-water sources. The Colbran Project of the U.S. Bureau of Reclamation will supply water for irrigation and power in Plateau Creek valley north of Grand Mesa and to the Ute Conservancy District for piping to several cities and towns and most rural residents in the Grand Valley, including those of the Redlands and Orchard Mesa. Completion of this water system should greatly reduce the draft on the artesian wells in in the Grand Junction area. This reduction should arrest the decline of the artesian head or should allow the head to recover gradually. Because of the small rate of recharge, however, the recovery in head will take considerable time.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

An investigation of the geography, geology, and artesian water supply of the Grand Junction area, Mesa County, Colo., was begun in 1946 as a part of the program of cooperative ground-water investigations being made by the Colorado Water conservation Board and the U.S. Geological Survey. The study was the outgrowth of a request from the late Mr. Frank C. Merriell, a widely known water engineer of Grand Junction to the late Judge Clifford H. Stone, former Director of the Colorado Water Conservation Board, concerning the degree of interference between flowing artesian wells in the Grand Junction area and the danger of even greater overdevelopment. The purpose of the study first was to determine the locations, depths, and yields of the wells, hydrologic properties of the aquifers, chemical quality of the water, and degree of interference between wells. Later, the investigation was broadened to include studies of the recharge conditions and areas of outcrop of the several aquifers, which required a detailed study of the geology of the area.

The Grand Valley, which includes the northeastern part of the area studied, is underlain largely by the thick Mancos Shale, which is nearly devoid of usable ground water. For this reason, rural domestic water has to be hauled either from the few towns having water-supply systems or from some of the artesian wells described in this report. The wells are along the southwestern side of the Grand Valley, mainly in tracts known as Orchard Mesa and the Redlands. As the population and water needs grew, more and more wells were drilled and the draft on each well increased, as did attendant interference between wells and lowering of the artesian head. The demand for artesian water was accelerated during and after World War II owing to the exploration for and development of uranium in areas southwest of Grand Junction, which served as headquarters for many of these operations and, hence, increased in population. Information gained during this investigation has been requested by many well owners, drillers, engineers, geologists, lawyers, and others ever since the work began and has been very helpful in solving some of the water problems. It is hoped this report will augment the assistance already given to some by making the information available to all who need it. The investigation was under the direct supervision of S. W. Lohman, T. G. McLaughlin, and E. A. Moulder, successive district supervisors in charge of cooperative ground-water investigations in Colorado,

LOCATION AND SIZE OF AREA

The Grand Junction area, as referred to in this report, comprises about 332 square miles in the west-central part of Mesa County, in central-western Colorado. It lies between lat 38°47½′ and 39°12½′ N., and long 108°25′ and 108°47½′ W. The location of the Grand Junction area and of other areas in Colorado in which cooperative ground-water studies have been made or are in progress is shown in figure 1.

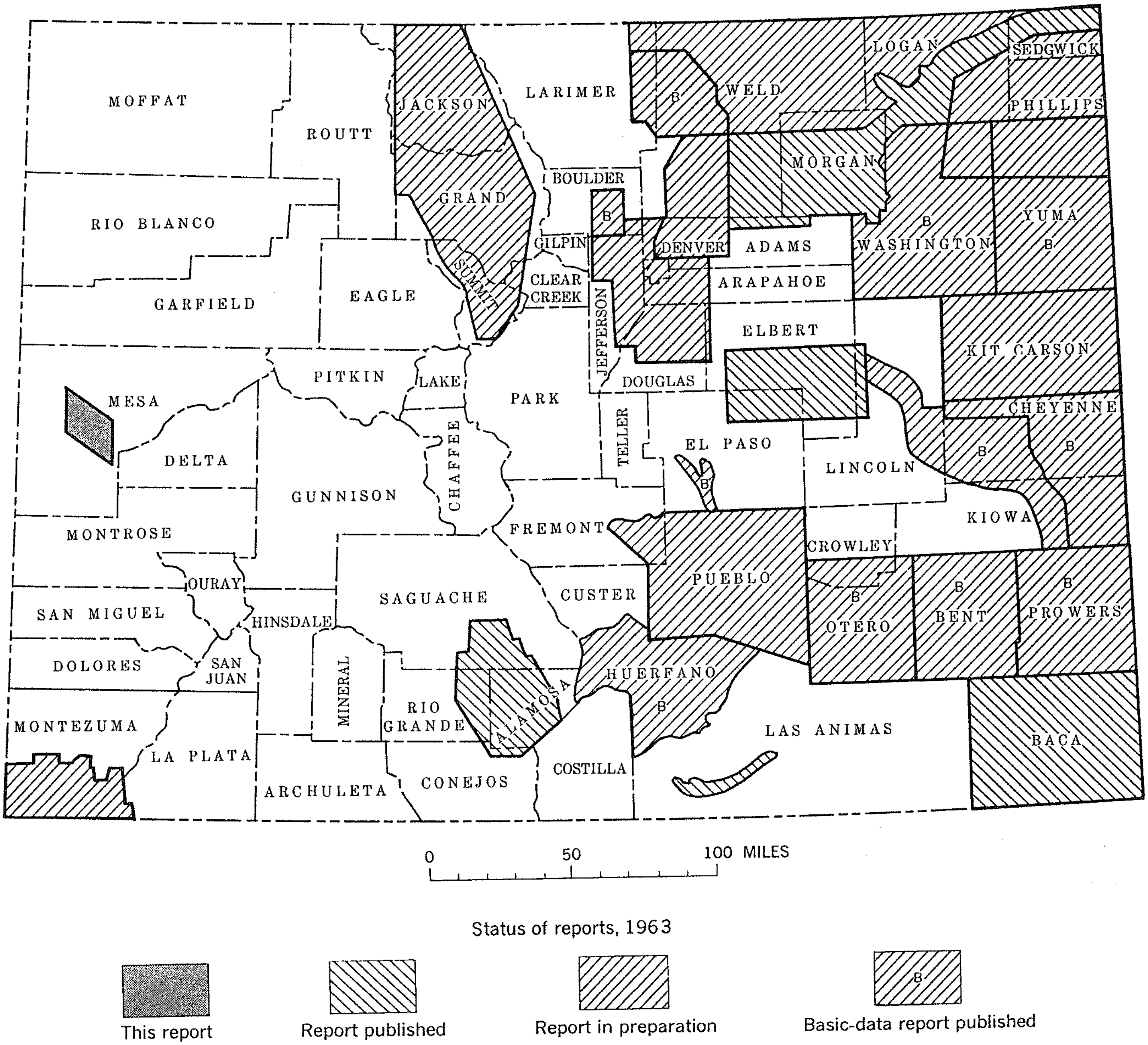


FIGURE 1.—Index map of Colorado showing area described in this report and other areas in which ground-water studies have been made or are in progress.

The Grand Junction area includes all the Colorado National Monument, the boundaries of which are shown in plate 1.

PREVIOUS INVESTIGATIONS

The first topographic and geologic maps of the Grand Junction area and of Colorado were the result of work by the U.S. Geological and Geographical Survey of the Territories (Hayden, 1877b). The topography and geology of the Grand Junction area were studied and mapped by those masters of reconnaissance, Henry Gannett and A. C. Peale, respectively, in 1875 and 1876—long before there were any white settlers or towns. In his report on the Grand River District, Peale (1877) made many observations on the geology. In a 28-page letter of transmittal of the progress report for 1875, Hayden (1877a, p. 26) said: "When [the survey is] finished, Colorado will have a better map than any other State in the Union, and the work will be of such a character that it will never need to be done again. Colorado will never support so dense a population that a more detailed survey will be required." Nevertheless, by 1913 the growth of the State and the completion of more detailed geologic studies of the major mining districts led to the publication of a new geologic map of Colorado (George and others, 1913).

For the 1913 geologic map of Colorado, that part of the Grand Junction area southwest of the Grand [Colorado] and Gunnison Rivers was taken from the geologic map of the Hayden survey, but the parts northeast of these rivers were taken from coal studies by Richardson (1909) and Lee (1912) of the U.S. Geological Survey.

In 1935 a more detailed geologic map of Colorado on a revised base was prepared by the U.S. Geological Survey in cooperation with the Colorado Metal Mining Fund. Changes shown in the geology of the Grand Junction area included more detailed geology of the Book Cliffs and a part of the Grand Valley by Erdmann (1934), of parts of the Gunnison and Grand Valleys by Campbell (1922), of parts of the Gunnison River valley by Weeks (1925), and changes in nomenclature and some revisions in geologic contacts of the area southwest and west of Grand Junction by C. H. Dane and C. B. Hunt, done in connection with an investigation in Grand County, Utah (Dane, 1935). The 1935 geologic map of Colorado includes considerable revisions in southwestern Colorado based upon the geologic mapping of Coffin (1921), but his geologic map does not extend far enough north to touch the Grand Junction area.

Several reports of the U.S. Geological Survey on areas in eastern Utah, published in the twenties and thirties, had an important bearing on the stratigraphic units now in use in the Grand Junction area, notably those of Gilluly and Reeside (1928) and Baker, Dane, and Reeside (1936). The sudden demand for uranium during World War II prompted detailed studies of known and potential uranium-producing areas and formations of southwestern Colorado, southeastern Utah, and adjacent parts of Arizona and New Mexico by the U.S. Atomic Energy Commission, the U.S. Geological Survey, and private parties. These studies provided a wealth of geologic information on the area to the southwest of the Grand Junction area, and some of the general studies included geologic sections measured within the latter area.

The only previous ground-water reports on the area are that of Weeks (1925), which discusses the occurrence of ground water in what are now called the Morrison and Burro Canyon Formations and Dakota Sandstone in the southeast corner of the area, and that of Jacob and Lohman (1952), which briefly describes the artesian aquifers and gives a new method for determining hydrologic properties of artesian aquifers from flow tests of wells.

Several road logs containing information on the geology and artesian water-supply of part of the area have been published (Lohman 1956; 1959; 1960a; Lohman and Donnell, 1959, 1960; Borden, 1960), and br descriptions of the geology of parts of the area ha been published (Lohman, 1960b, 1961a).

HISTORY AND METHODS OF INVESTIGATION

In the fall of 1945, Mr. Frank C. Merriell took ı on a trip through the Grand Junction area, duri which time all or most of the flowing artesian we were visited and well owners and well drillers we interviewed. The geology of the recharge areas of t several artesian aquifers also was observed briefly.

The brief inspection of the area indicated that, as first step toward a better understanding of some of t problems of declining artesian head and interferen between wells, it would be necessary to measure t shut-in head of as many wells as possible and to perfor pumping or flow tests on selected wells. During t winter of 1945–46, I designed and built an ink-w mercury gage [1 2] for accurately measuring not on static shut-in head but also slowly recovering head aft a period of flow; as a result the recovery method al could be used in determining the transmissibility the aquifers. A method was developed (Jacob an Lohman, 1952) for determining the coefficients of bo transmissibility and storage from a flow test on single artesian well. The depths of the wells, whic ranged from 500 to more than 1,600 feet, precluded th practicability of drilling observation wells, and existin wells were too far apart for use of multiplewell method

During the summer of 1946, head and flow tes were made on eight of the artesian wells, records wer obtained for other wells, and a reconnaissance was mad of the geology of the area. This reconnaissance ir dicated the need for a more detailed study of th geology to determine the location and nature of th recharge areas, the effect of folding and faulting on th recharge areas, and the lateral changes in character an thickness of the strata. Because most of my time wa devoted to administrative matters and because virtuall all the funds available for cooperative ground-wate studies in Colorado were required for investigations o higher priority in eastern Colorado, fieldwork in th Grand Junction area was carried on intermittentl from a week to several weeks each year through 195 Samples of water were collected from representativ wells for chemical analysis in the laboratories of th U.S. Geological Survey, at Albuquerque, N. Mex., an and at Salt Lake City, Utah. Samples of sandston were collected from the two principal artesian aquifer for determination of physical and hydrological proper ties in the survey's hydrologic laboratory by W. H

[1] Lohman, S. W., 1947a, Ink-well gage for measuring artesian head: U.S. Geolo ical Survey, 6 p., mimeographed.

[2] ——1947b, Ink-well mercury gage for measuring artesian head, improved b the use of stainless steel valves: U.S. Geological Survey, 1 p., mimeographed.

Lohman and R. A. Speirer, for petrographic examination by H. A. Tourtelot, and for X-ray determination of the clays by V. J. Janzer, all of the Geological Survey, at Denver, Colo. Measurements of shut-in artesian head were made on certain wells almost annually through 1952 but, because of the increased use of the water, the number of wells for which permission could be obtained for shutting off the flow overnight decreased each year, and after 1952 it was considered impracticable to continue the measurements.

Field mapping of the geology was done on stereo pairs of aerial photographs obtained from the U.S. Soil Conservation Service. The photographs were made in 1937 at a scale of approximately 1:21,000. Parts of the area were accessible by automobile or jeep, but large areas were covered on foot, and much of the Gunnison River Canyon was accessible only by a rail motor car rented from the Denver and Rio Grande-Western Railroad Co.

The geologic and hydrologic data thus obtained sufficed to help many well owners and well drillers in solving water-supply problems and to assist the Mesa County District Court in handling litigation between well owners.

After field mapping of the geology was completed, high-altitude aerial photographs made in 1954 and 1955 became available from the U.S. Army Map Service; these photographs were used by other Survey geologists in preparing photogeologic maps of areas immediately to the south. In order to reconcile the photogeologic mapping and my field mapping, Donald G. Wyant, of the Survey had the geology of the Grand Junction area replotted by Kelsh plotter. The replotting was done by Charles H. Marshall with my part-time assistance. Small inaccessible or relatively inaccessible areas, mostly along the Gunnison River valley in the southeastern part of the area, were mapped photogeologically by Mr. Marshall and me, but most of the resulting map (pl. 1) closely follows my original field mapping. The stereoscopic model scale was about 1:12,000, reduced by pantograph to 1:24,000; this scale was in turn reduced to 1:31,680 during final compilation. Most of the township and section lines and the place and stream names on plate 1 were taken mainly from planimetric base maps prepared by the U.S. Soil Conservation Service, scale 1:31,680, but some were taken from township plats of the U.S. Bureau of Land Management and from maps of the U.S. National Park Service. The roads and drainage were plotted by Mr. Marshall at the time the geology was plotted.

Soon after the Grand Valley and Gunnison River valley were opened to settlement in 1881, a group of townships was surveyed by the General Land Office and referred to the locally established Ute principal meridian and base line. Later, when surveys referred to the sixth principal meridian and base line reached and surrounded the area, the two surveys did not fit properly. As shown on plate 1 the junction of the two surveys follows an irregular boundary and causes some confusion.

The wells on plate 1 and in table 7 are numbered consecutively from 1 to 48 in order by township and section from east to west and from north to south. Within each section the wells are numbered by quarter section in a counterclockwise direction; and a similar system is used within each quarter-quarter section. Locations based on the earlier survey are followed by "Ute P.M." throughout this report.

I was assisted at various times in running flow tests by Thad G. McLaughlin and William J. Powell, U.S. Geological Survey; Charles C. Williams and William R. Smith, formerly with the U.S. Geological Survey; Mahmood Hussain, of Madras Province, India; and by my son, William H. Lohman. I was assisted in the geologic mapping during the summer of 1947 by W. J. Powell, during the summers of 1948 through 1953 by W. H. Lohman, and during the summers of 1955 and 1956 by my sons, James T. and Robert M. Lohman. W. R. Smith also determined the altitudes of measuring points on some of the wells by plane table and alidade.

ACKNOWLEDGMENTS

I am indebted to the many well owners who supplied information on their wells and gave permission for head or flow tests or both, to the several well drillers for logs and other information on wells in the area, and to others in the area who supplied information concerning artesian wells. Special acknowledgment is given to the late Frank C. Merriell for his foresight in making known to the Colorado Water Conservation Board the need for a study of this critical water-supply problem and for his assistance and continued interest during the course of the investigation.

I am indebted to B. R. Finch, Russell Mahan, Homer Robinson, and F. G. Bussey, successive Superintendents, and Dwight L. Hamilton and Pat H. Miller, successive Chief Park Naturalists, of the Colorado National Monument, for assistance in supplying information and in providing access to parts of the Monument not open to the public. Several members of U.S. Geological Survey formerly stationed at Grand Junction provided information on the geology of the area, and I am particularly indebted to Richard P. Fischer, Lawrence C. Craig, J. C. Wright, F. W. Cater, F. G. Poole and Clifford N. Holmes for providing copies of data or geologic sections measured in the area and for many discussions of geologic problems. Mr. Craig also reviewed the section on geology and

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made many helpful comments. I am greatly indebted to H. A. Tourtelot of the Survey for microscopic and X-ray examination of sandstone and clay samples, and for reviewing parts of the manuscript. I am indebted to V. J. Janzer of the Survey for X-ray and microscopic examination of clay samples. E. B. Leopold, J. H. Irwin, G. E. Lewis, R. A. Scott, S. A. Schumm, D. R. Shawe, R. W. Stallman, F. W. Cater, Ogden Tweto, J. R. Donnell, D. G. Wyant, P. L. Williams, W. R. Hansen, and J. C. Wright, of the U.S. Geological Survey, and W. C. Bradley, of the University of Colorado, read parts of the report and made many helpful suggestions.

I am indebted to the commanding officer of Lowry Air Force Base, U.S. Air Force, Denver, Colo., for authorizing an aerial photographic mission over the Grand Junction area in response to my written request of March 30, 1960, and to Master Sergeants M. M. Friedman and C. M. Fetterman for taking a series of excellent low-angle oblique aerial photographs of the area, two of which are included in this report as figures 29 and 35.

I am greatly indebted to my sons and to my wife, Ruth H. Lohman, who accompanied me during most of the fieldwork, for their assistance and encouragement.

GEOGRAPHY

The Grand Junction area is in the northeastern part of the Canyon Lands section of the Colorado Plateaus province (Fenneman, 1928), the province being more generally referred to simply as the Colorado Plateau. The Canyon Lands section terminates against the Book Cliffs, which form the northeastern wall of the Grand Valley, northeast of which is the Uinta Basin section. The Canyon Lands section is an upwarped plateau containing several large folds, laccolithic mountains that rise above the plateau surface, generally deeply incised drainage, and an intricate set of deep canyons (Hunt, 1956a, p. 2). The Grand Junction area, as defined in this report, contains examples of all these features except laccolithic mountains; but the nearest of these, the La Sal Mountains, are in eastern Utah only about 35 miles to the southwest.

Most of the Grand Junction area is on the northeastern flank of the Uncompahgre Plateau or uplift, but it includes parts of the Grand Valley and the lower Gunnison River valley. The area includes the city of Grand Junction, the town of Fruita, and the villages of Appleton, Whitewater, and Glade Park. A tract of almost flat terrace land south of the Colorado River above the mouth of the Gunnison River is called Orchard Mesa. A rolling and somewhat hilly area south of the Colorado River and between the mouth of the Gunnison River and Fruita is called the Redlands.

When the Gunnison expedition traversed the area in 1853, the present Gunnison River was known by its Spanish name "Rio Javier" or by its Indian name "Tomichi" (Hafen, 1927, p. 269), but Beckwith (1854, p. 57), who wrote the report of the Gunnison expedition, incorrectly referred to what is now named the Gunnison as the Grand River and to what is now named the Colorado River above Grand Junction as the "Blue River" or, as the Indians called it, the "Nah-un-kah-rea." The present Colorado River above Grand Junction was known as the Grand River at least as early as 1842, however (Fremont, 1845, p. 284). The city of Grand Junction was so named because of its position at the junction of the Gunnison and Grand Rivers. The Green and Grand Rivers united in eastern Utah to become the Colorado River. Sometime after the death of Captain Gunnison in the fall of 1853, the Rio Javier was named the Gunnison River in his memory. The Grand River was renamed Colorado River by act of the Colorado State Legislature approved March 24, 1921, and by act of Congress approved July 25, 1921; but, in addition to Grand Junction, the name Grand still remains in the Grand Valley, between Palisade and Mack; in Grand Mesa, which stands more than a mile above the Grand and Gunnison Valleys; in the town of Grand Valley, 46 miles upstream from Grand Junction; and in Grand County, Colo., and Grand County, Utah.

NAME SUBSEQUENTLY CHANGED

TOPOGRAPHY

Before 1917 the only topographic map of the Grand Junction area was that made by Henry Gannett during the Hayden survey (Hayden, 1877b) at a scale of 1:253,400 and a contour interval of 200 feet. In 1917 a topographic map of the Grand [Colorado] River below Grand Junction, scale 1:31,680, contour interval 25 feet, was published by the U.S. Geological Survey (Herron, 1917, pls. 27–32). In 1942 a topographic map of the Colorado National Monument (pl. 1), scale 1:31,680, contour interval 20 feet, was published by the U.S. Geological Survey. This map was reprinted in 1948, and a shaded-relief edition was published in 1958. In 1948 a topographic map (2 sheets) of the Whitewater Reservoir site on the lower Gunnison River, scale 1:24,000, contour interval 5, 10, and 20 feet, was published by the U.S. Geological Survey. It includes a stretch of the Gunnison River valley from a few miles above Grand Junction to Escalante, in Delta County, and shows the topography from river level up to the proposed pool altitude of 4,800 feet. These were the only topographic maps available during the fieldwork and until 1959, when the U.S. Army Map Service published topographic maps of the Grand Junction and Moab, Colorado-Utah sheets, scale 1:250,000, contour interval 100 and 200 feet. The entire area of this report is included on these two maps, which were made from high altitude aerial photographs taken in 1954 and 1955. If 7½-minute topographic quadrangle maps had been available for the Grand Junction area to serve as a base for plate 1, greater accuracy of the structure contours would have been possible, and the maps would have been very useful, in conjunction with the structure contours, in estimating the depths to the several artesian aquifers.

That part of the Uncompahgre Plateau northwest of Unaweep Canyon is known as Piñon Mesa; its highest altitude is 9,545 feet, just a few miles southwest of the mapped area. Piñon Mesa includes the Fruita Division of Grand Mesa National Forest. The highest part of the area shown on plate 1 is about 2 miles northwest of North East Creek, where several mesas have altitudes of more than 8,200 feet. From Piñon Mesa the area slopes northeastward generally at about 2° to 3°, but in places the slope is 3° to 7° and along some of the folds the local dip of the rocks and slope of the land surface is as much as 80°. Much of this sloping surface, particularly in the southeastern part of the area, is on the Dakota Sandstone (pl. 1), but in other parts it is on older rocks. The Colorado River leaves the northwest corner of the area at an altitude of less than 4,430 feet, and the area as a whole has a relief of more than 3,700 feet.

The northeastward-sloping surface is cut by a series of deep canyons that trend generally northeastward. Many of these canyons are more than 500 feet deep, and No Thoroughfare and North East Creek Canyons are 1,000 feet deep in places. Many of the canyon walls, particularly in the Colorado National Monument (fig. 2), are sheer cliffs of the Wingate Sandstone, but in some places even higher vertical or nearly vertical

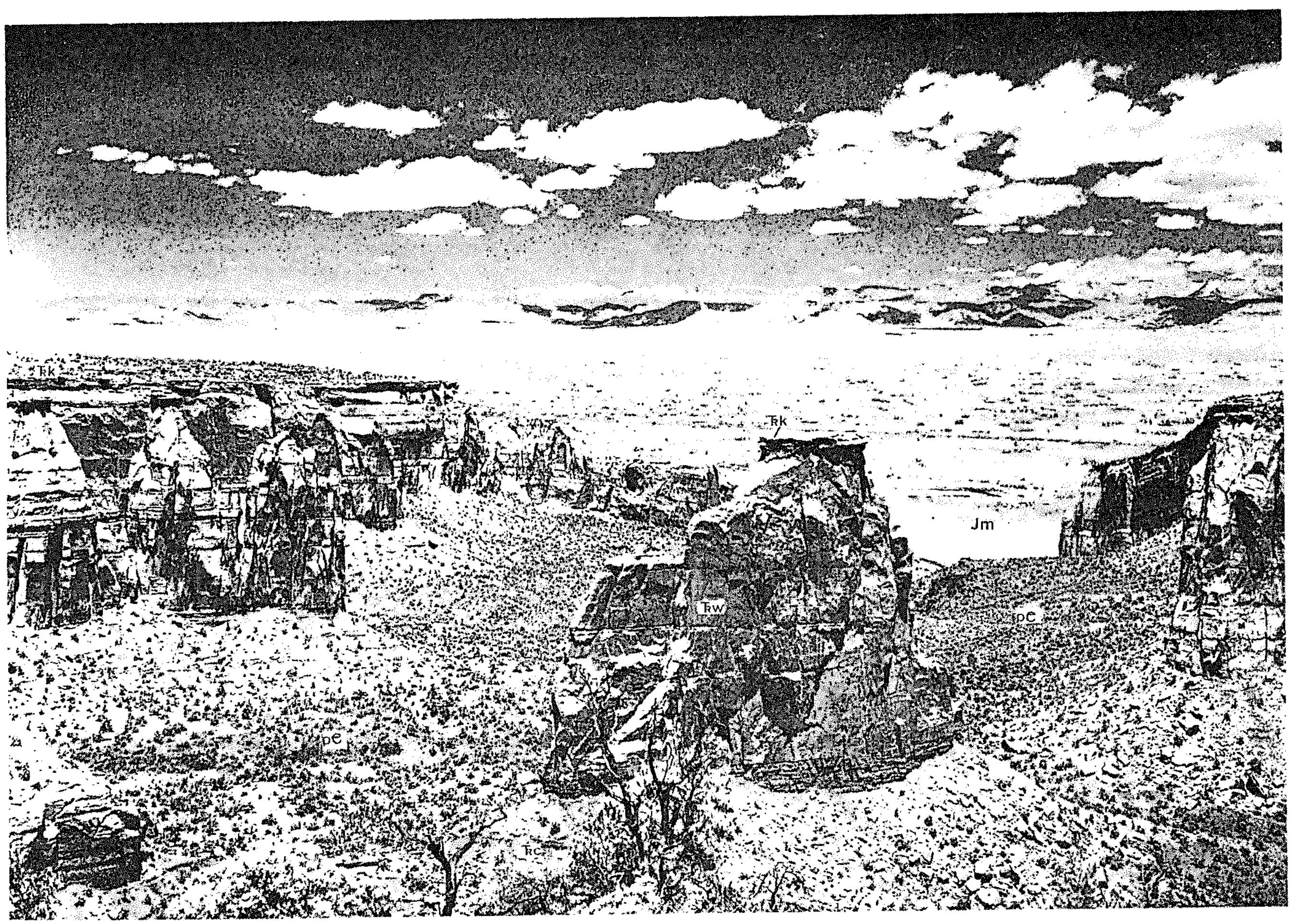

FIGURE 2.—Independence Monument, separating North and East Entrances of Monument Canyon, in Colorado National Monument. Looking north down North Entrance from Grand View Point; Colorado River, Grand Valley, and Book Cliffs in distance. Roan Cliffs are white cliffs at extreme distance on right skyline. p€, Precambrian schist, gneiss, and granite; Ꞧc, Chinle Formation; Ꞧw, Wingate Sandstone; Ꞧk, Kayenta Formation; Jm, Morrison Formation. Note how thin capping of resistant sandstone of Kayenta Formation protects underlying Wingate Sandstone from erosion. Where this protective capping has been eroded away, as from the left part of Independence Monument and from the Pipe Organ at left, Wingate erodes to rounded domes and spires. Note also smooth exhumed erosion surface on top of Precambrian rocks and monocline in middle background. Top of Independence Monument is nearly 450 feet above floor of canyon. Infrared photograph.

By E. W. KNOBEL, United States Department of Agriculture, in Charge, and R. K. DANSDILL and M. L. RICHARDSON, Colorado Agricultural Experiment Station

Area inspected by A. T. STRAHORN, Soil Survey

United States Department of Agriculture in cooperation with the Colorado Agricultural Experiment Station

CONTENTS

[1] Field work for this survey was done under direction of the Division of Soil Survey while it was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

THE GRAND JUNCTION AREA is in the Grand Valley of Colorado near the western edge of Mesa County. Grand Junction, the largest city in Colorado west of the Continental Divide, is approximately at the center of the Area. The climate is clear, sunny, and semidesert. The agriculture depends on irrigation. Some 70 years ago the area supported only a sparse cover of desert shrubs. Now it is vitalized by a network of irrigation ditches and produces high-quality orchard fruits, vegetables, and field crops.

At the risk of oversimplification, the critical problem always has been that of applying water at the time and place and in the amount that will obtain the best production without damaging the soils. Farmers must guard against the accumulation of seepage water and salts in the soils; the overirrigating or underirrigating that damages or kills orchard trees; and the planting of crops on a soil that will not tolerate the kind of irrigation those crops must have.

This soil survey, made cooperatively by the United States Department of Agriculture and the Colorado Agricultural Experiment Station, is designed to aid farmers of the Grand Junction Area in determining the suitability of various crops grown in the Area to their particular soils. It describes the soils of the Area and tells something about their use and management in 1940, the date when field work was completed. The survey will serve as a reliable source of information about soils for many years to come. It is not intended as a substitute for the up-to-date, detailed information on management and crop varieties that can be obtained from the county agricultural agent, the local Soil Conservation Service representative, the State experiment stations, or similar sources.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

The Grand Junction Area is located in the western part of Mesa County near the Colorado-Utah State line. Grand Junction, the largest town and county seat, is 195 miles southwest of Denver and 200 miles west of Colorado Springs (fig. 1). The area surveyed covers approximately 121,600 acres, or 190 square miles.

PHYSIOGRAPHY, RELIEF, DRAINAGE, AND GEOLOGY

Physiography.—The area covered by this survey is located in the Canyon Lands section of the Colorado Plateau physiographic province (*3*).[2] It occupies part of the floor of a deep pocket, or valley, known as the Grand Valley of Colorado (pl. 1, *A*). This valley, carved in the Mancos Shale formation by the Colorado and Gunnison Rivers and their tributaries, is surrounded for the most part by steep mountainous terrain (fig. 2). Deep canyons flank the valley to the southwest; a sharp escarpment known as the Book Cliffs rises above it to the north and northeast; foot slopes of the Grand Mesa lie to the east; and rough broken and steep hilly land that borders high terraces or mesas lies to the south.

[2] Italic numbers in parentheses refer to Literature Cited, p. 118.

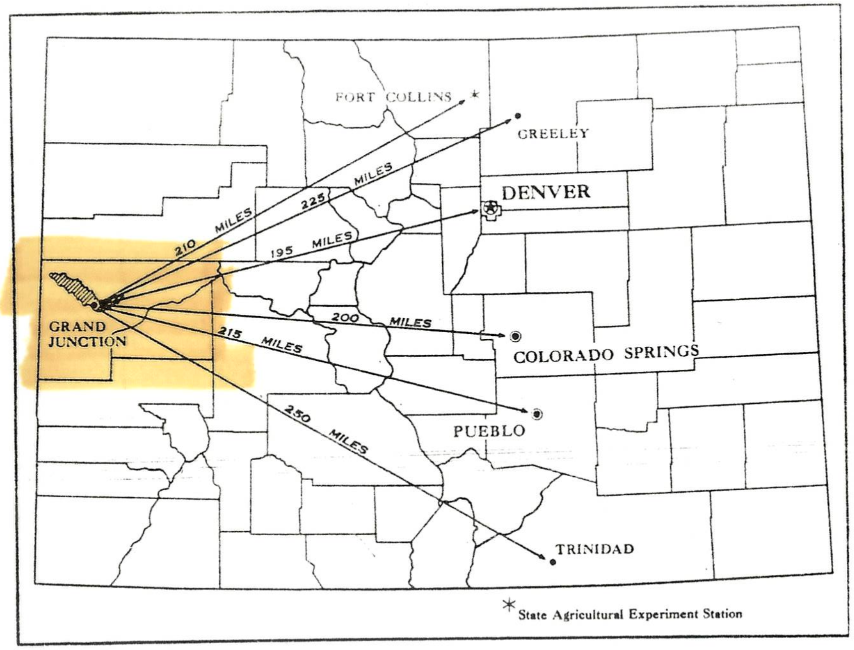

FIGURE 1.—Location of the Grand Junction Area in Colorado.

For convenience the surveyed area can be divided into three general physiographic sections:[3] (1) A recent alluvial plain consisting of broad coalescing alluvial fans and stream flood plains; (2) older and higher lying alluvial fans, terraces, or mesas; and (3) rolling to steep land occurring as terrace escarpments, high knobs, or remnants of former mesas.

Relief.—Each of the three general physiographic sections in the area has a typical kind of relief. The recent alluvial plain consisting of broad coalescing alluvial fans and stream flood plains is broad and slopes very gently eastward and northwestward from Grand Junction.

The older and higher lying alluvial fans, terraces, or mesas have gentle slopes toward the Colorado River, but their otherwise smooth surface is fringed by narrow steep rims that mark the drop from a higher to a lower bench, or by a few steep-sided arroyos running toward the Colorado River. Orchard Mesa, south of the Colorado River, is typical of this pattern of relief.

[3] Various areas within the survey have commonly used local names that are used in this report. That part of the survey lying southeast of Palisade is known as the Vinelands; the long high terrace, or mesa, south of the Colorado River to the southeast of Grand Junction is called Orchard Mesa; and the smooth gently sloping area southwest of the Colorado River and west of Grand Junction is named the Redlands.

Some of the more distinctive soils and soil areas also have local names. The gray, moderately fine textured to fine textured alluvial soils on the young alluvial plain north of the Colorado River are called adobe. Soils on the higher benches or mesas northwest of Grand Junction are referred to as red sandy land or red heavy land, depending on their texture. The rather sharply uneven soils formed in place over shale are known as shale land.

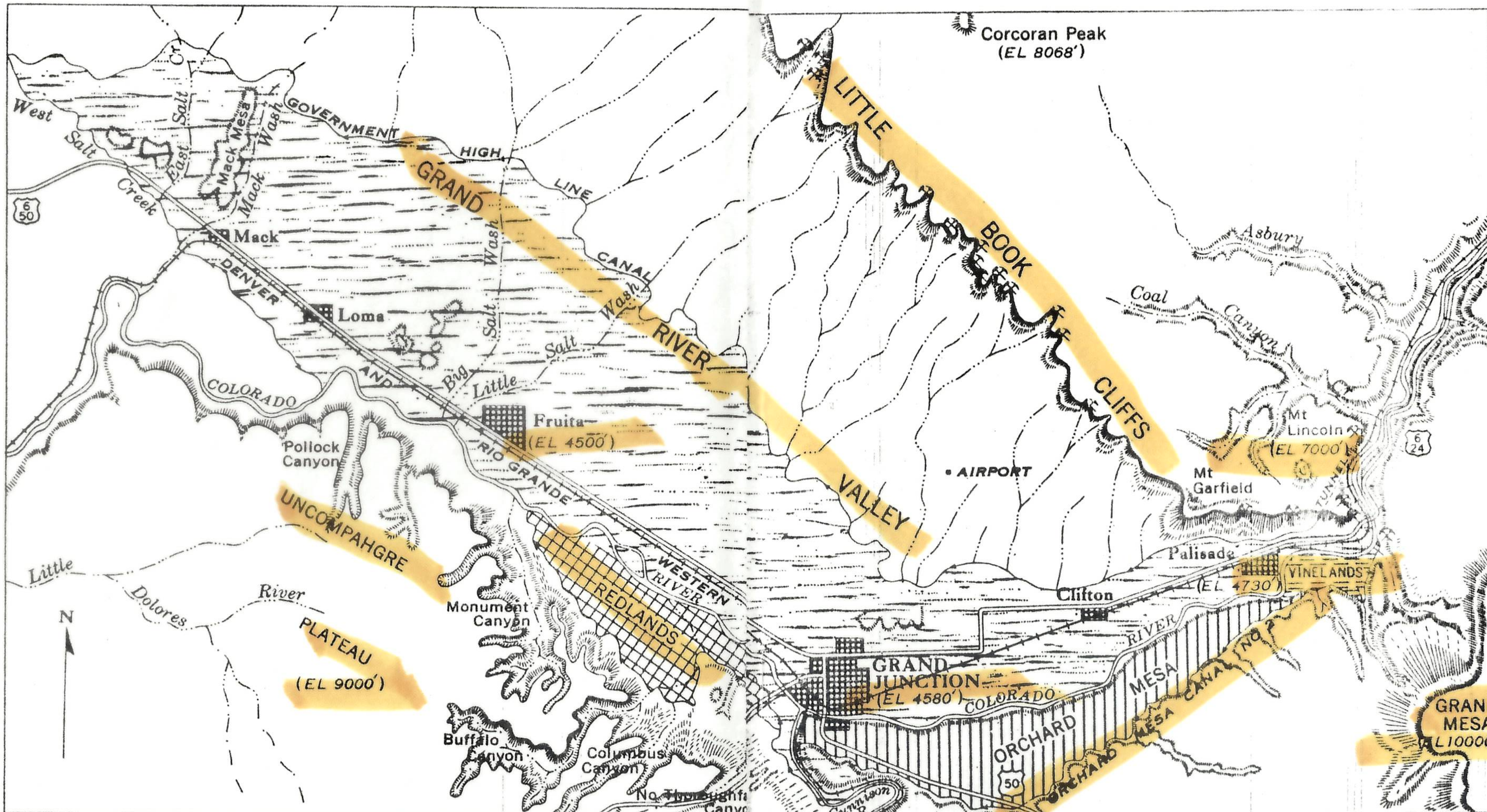

FIGURE 2.—Geographic, physiographic, and cultural features of the Grand Junction Area, Colorado.

the Redlands. This uplift, after ages of severe geologic erosion, has caused the exposure of several of the upheaved geological formations that before the uplift normally were situated far below the thick, 4,000-foot, Mancos shale bed. From the top downward, in respect to their former position below the Mancos shale, these formations include Dakota, Morrison, Summerville, Entrado, Kayenta, Chinle, and the lower pre-Cambrian. These give rise to the sandy soils of the Redlands.

CLIMATE

The climate of the Grand Junction Area is similar to that of most of the intermountain areas west of the Continental Divide in its aridity, wide range of daily temperatures, high percentage of bright sunny days, and high evaporation rate. Where the climate differs, the differences apparently are caused by protective mountain barriers.

In the extreme eastern part of the Area, the Colorado River enters the Grand Valley through a steep narrow canyon that tends to stabilize air currents in the valley. During the day, the air tends to move up the slopes that confine the valley at its eastern end. Then, at night, the air moves down again. This peculiar movement, spoken of as air drainage, affords a more limited daily range in temperature and less danger from frost in the proximity of Palisade than elsewhere in the valley. Hence, the eastern section of the valley, to a distance of about 3 or 4 miles west of Palisade, has a climate particularly suitable for orchard fruits.

Aside from the difference already mentioned, climatic conditions at Grand Junction are representative for the area. Normal monthly, seasonal, and annual temperatures and precipitation compiled from records of the United States Weather Bureau station at Grand Junction are given in table 1.

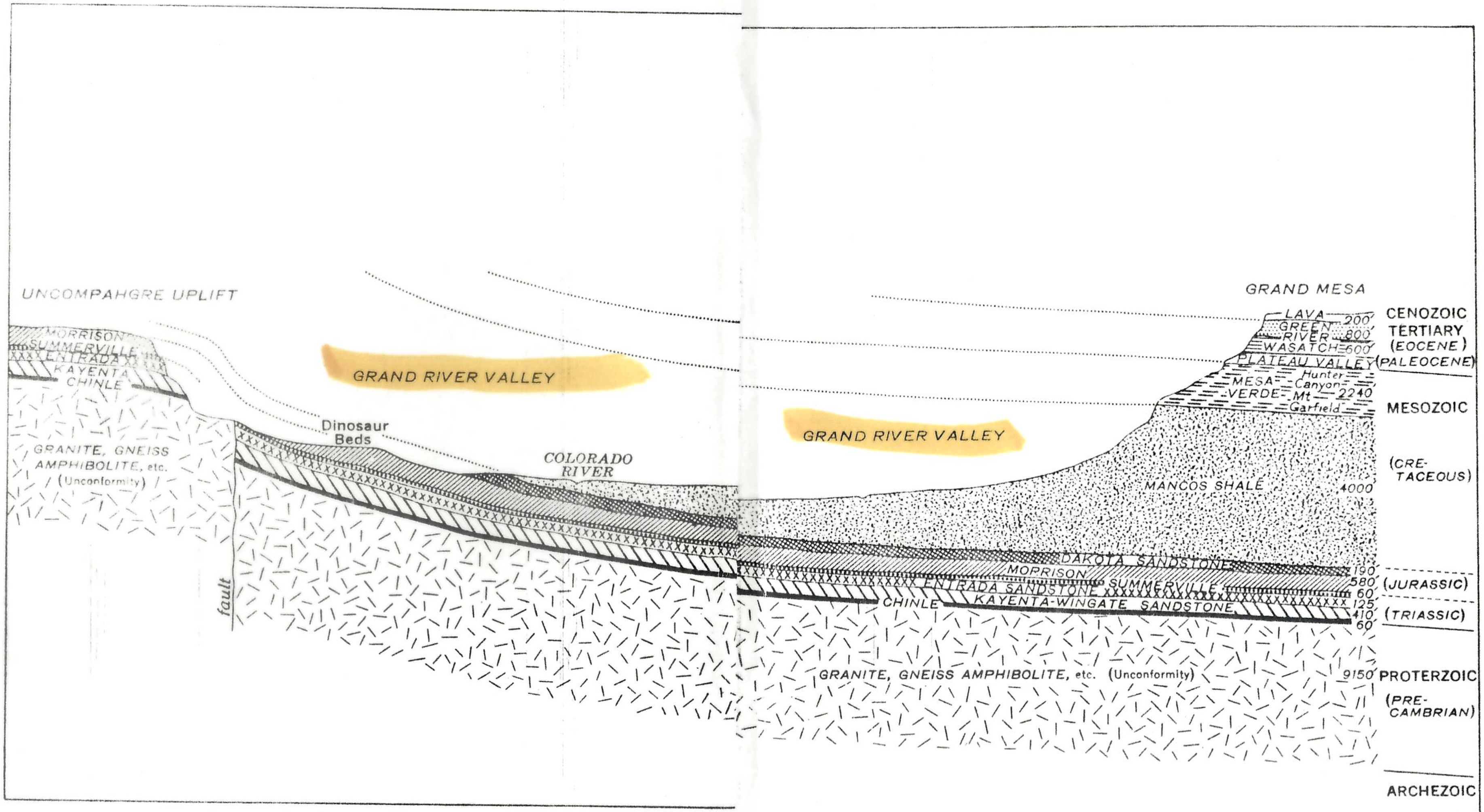

FIGURE 3.—Northwest-southeast cross section of the Uncompahgre uplift and the principal Grand Junction Area showing the tilt caused by the formations giving rise to the soils.

As shown in table 1, summer temperatures rise to a maximum of about 105° F. Several days in summer may have temperatures above 100°. The nights are cool, however. The winters are mild. Temperatures are usually above zero, though an absolute minimum of −21° has been recorded. The average humidity is low, so zero weather does not seem so cold nor the summers so hot as in States where the humidity is higher.

The average date of the last killing frost in spring is April 14, and the first in fall is October 21. The average frost-free, or growing season is 190 days. Occasionally, late spring or early fall frosts do some damage to fruits and vegetables on the bottom lands and recent flood plains. On the mesas or higher terraces, frost damage is slight. Frost is especially rare in the climatically protected areas around Palisade and along the bluffs bordering the Redlands.

High winds are unusual, and cyclones are unknown. Light thundershowers are common during summer. Hail damage is localized and usually slight. Summer showers are frequently more detrimental than beneficial, especially those that come during the harvesting season for alfalfa, cantaloups, pinto beans, and peaches. In some seasons a few days of damp drizzly weather during peach harvest stop work and may allow part of the crop to become overripe and unfit to be shipped by rail.

The average annual precipitation at Grand Junction is 9.06 inches per year. This precipitation is well distributed throughout the year but is not sufficient to permit successful dry farming. The soils support only a scant growth of native grasses and shrubs if they are not irrigated. The average snowfall is 22.0 inches. The snow usually melts within a few days after it falls. The ground is free of snow most of the winter.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Grand Junction, Mesa County, Colo.*

[Elevation, 4,849 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Total for the driest year	Total for the wettest year	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	28. 5	66	−21	0. 68	(3)	0. 49	5. 4
January	24. 0	62	−19	. 60	0. 14	. 77	5. 8
February	32. 0	70	−15	. 63	. 14	. 93	4. 8
Winter	28. 1	70	−21	1. 91	. 28	2. 19	16. 0
March	41. 2	81	7	. 87	. 13	1. 70	2. 6
April	51. 8	85	14	. 75	1. 26	1. 31	. 7
May	62. 1	94	29	. 68	. 06	1. 03	. 1
Spring	51. 7	94	7	2. 30	1. 45	4. 04	3. 4
June	71. 2	104	35	. 45	. 04	. 78	0
July	78. 2	105	47	. 79	. 09	. 35	0
August	75. 6	103	47	1. 20	. 19	1. 51	0
Summer	75. 0	105	35	2. 44	. 32	2. 64	0
September	67. 3	98	28	1. 02	1. 18	2. 90	0
October	54. 4	86	16	. 84	. 14	2. 73	. 3
November	38. 6	74	4	. 55	. 27	. 26	2. 3
Fall	53. 4	98	4	2. 41	1. 59	5. 89	2. 6
Year	52. 1	105	−21	9. 06	[4] 3. 64	[5] 14. 76	22. 0

[1] Average temperature based on a 64-year record, 1890 to 1953; highest and lowest temperatures from a 39-year record, 1892 to 1930.

[2] Average precipitation based on a 65-year record, 1889 to 1953; wettest and driest years based on a 62-year record, 1892 to 1953; snowfall on a 39-year record, 1892 to 1930.

[3] Trace. [4] In 1900. [5] In 1941.

WATER SUPPLY

Water for the city of Grand Junction is obtained mainly through a 25-mile gravity pipeline that brings snow water into the area from near Granby Lakes on Grand Mesa. Part of the water supply, mainly that used to fill cisterns outside Grand Junction, comes from several artesian wells south and southwest of the city. Ordinarily, artesian water is obtained at depths ranging from 800 to 1,200 feet.

In most parts of the valley, water from comparatively shallow wells is unfit to drink. This is especially true north of the Colorado River, where the water has a high content of salts derived from the underlying Mancos shale formation. A few springs exist in this part of the valley but they are unfit for drinking purposes. Farmers have their domestic water supply trucked from artesian wells to the farm and

stored in cisterns. Water for livestock may be obtained directly from the Colorado or Gunnison River, irrigation canals leading therefrom, small ponds, and in some cases from the artesian wells.

Irrigation water, essential to agriculture in this area, is obtained from both the Colorado and Gunnison Rivers. The main diversion canal from the Colorado River, which supplies water for the Government High Line Canal and Orchard Mesa Canals Nos. 1 and 2, has a capacity of 1,525 cubic feet a second.

The largest irrigation canal, the Government High Line Canal, takes water out of the main diversion canal about 8 miles N.E. of Palisade and carries it through a canal, flume, and approximately a mile of concrete tunnel to the valley. This irrigation system, completed in 1914, furnishes water for the greater part of the irrigated land north of the Colorado River. The Kiefer Extension, Grand Valley Canal, and Independent Ranchmens Ditch are supplementary systems operating on the north side of the Colorado River.

Orchard Mesa, in the southeastern part of the area, is irrigated by Orchard Mesa Canals No. 1 and No. 2, which are independent of the Government High Line Canal. The Orchard Mesa pumping plant lifts water 195 feet from the main diversion canal to the upper Orchard Mesa canal (Canal No. 2).

The Redlands are irrigated by a canal that originates at the Redlands Dam on the Gunnison River about 2½ miles south of Grand Junction. The Redlands pumping plant, located approximately a mile west of Grand Junction, lifts water about 300 feet to the main canal. Two other pumps, 4 and 5 miles west of Grand Junction, respectively, complete the lifts required for flow in the higher canals.

Ample irrigation water for all the canals is normally available. Occasionally, during the latter part of summer, the supply of water for the Redlands becomes low.

VEGETATION

IN NON-IRRIGATED AREA OUTSIDE OF GRAND VALLEY WILL NOT SUPPORT FRUIT

The Grand Junction Area, before settlement and irrigation, had a cover of desert brush. A few scattered trees grew along the larger rivers and drainageways. A large part of the area consists of gently sloping alluvial fans and flood plains along streams that originate in the Grand Valley proper. The native cover was chiefly greasewood, rabbitbrush, saltgrass, and bordering the larger intermittent creeks and washes, scattered cottonwoods. Greasewood dominated on most of the alluvial flats that were derived largely from redeposited Mancos shale. Greasewood, a salt-tolerant shrub, is a fairly accurate indicator of Ravola and Billings soils, which developed mainly from Mancos shale material and frequently contain quantities of salts injurious to crops.

At levels directly above the greasewood flats are the gently undulating to sharply rolling uplands, which are derived from Mancos shale and are subject to continual erosion. These support a moderate to scant cover consisting chiefly of saltbush, rabbitbrush, shadscale, and galletagrass.

The older higher terraces or mesas support a cover consisting dominantly of shadscale, but some sagebrush and pricklypear cactus are common.

ply of manure, or possibly none at all. Some fruit growers use a mixed fertilizer. Many others apply 10 to 15 tons of barnyard manure an acre for peach orchards where the trees are large, and, in addition, grow a legume cover crop.

Some potato growers near Fruita use mixed fertilizer. If it is available, most of the farmers producing truck and garden crops use heavy applications of manure. If manure is not available they use commercial fertilizer similar to that applied for potatoes.

CROPS

The main crops now grown in the Grand Junction Area are peaches, alfalfa, corn, dry beans, oats, wheat, barley, sugar beets, clover, and potatoes, in approximately that order of importance. The acreage in Mesa County of these and other leading crops is given in table 3 for stated census years. These acreages are representative, but it is to be considered that they include some land in Mesa County that is outside the Grand Junction Area.

TABLE 3.—*Acreage of principal crops and number of fruit trees and grapevines of bearing age in Mesa County, Colo.*

[Figures in this table are not entirely representative for the Grand Junction Area, because Mesa County includes large acreages outside the irrigated valley. Nevertheless, these figures indicate in a general way the relative proportion of the various crops in the Grand Junction Area and the shifts in acreage that have taken place in the past 30 years]

Crop	1919	1929	1939	1949
	Acres	*Acres*	*Acres*	*Acres*
Corn for grain	4, 449	7, 282	6, 322	6, 856
Small grains threshed:				
Oats	3, 116	2, 976	2, 228	5, 281
Wheat	5, 406	6, 069	3, 059	3, 793
Rye	105	37	171	161
Barley	667	1, 431	2, 202	3, 734
Dry beans	219	5, 752	18, 486	6, 469
Irish potatoes	1, 619	1, 363	1, 197	[1] 706
Sugar beets	2, 632	1, 343	812	1, 251
All hay	39, 726	39, 734	33, 116	36, 234
Alfalfa	35, 868	36, 274	30, 893	32, 118
Timothy and clover	773	1, 170	574	1, 236
Grains cut green	1, 814	1, 899	978	769
Wild grasses	149	187	492	1, 275
Other hay cut	1, 122	204	179	836
Coarse forage	3, 864	796	634	774
All vegetables, except potatoes, for sale	([2])	1, 174	1, 359	1, 305
Strawberries	20	53	36	31
	Number [3]	*Number* [3]	*Number* [3]	*Number* [3]
Peach trees	242, 200	285, 754	445, 462	636, 354
Pear trees	115, 525	139, 114	71, 504	59, 654
Apple trees	477, 800	108, 950	20, 269	13, 885
Apricot trees	([2])	3, 725	12, 248	24, 338
Cherry trees	9, 639	3, 763	8, 514	14, 996
Plum and prune trees	4, 565	3, 356	5, 638	7, 231
Grapevines	18, 390	38, 375	19, 104	33, 937

[1] Does not include acres for farms with less than 10 bags harvested.
[2] Not reported.
[3] Number in the census year, which is 1 year later than the crop year given at

The acreage in sugar beets, small grains, and tree fruits has fluctuated considerably over a period of years. Some areas formerly used for growing such crops have become too saline and have been shifted to irrigated pasture. In contrast, some saline areas have been drained and improved to the point where irrigated pasture has been plowed under and intertilled crops planted.

ORCHARD FRUITS

Tree fruits require a deep and permeable soil, but it need not be high in organic-matter content. So far as suitability of the soils is concerned, the acreage of tree fruits in this valley could be doubled, or brought to a total of about 28 square miles. Danger of frost damage keeps the acreage of tree fruits to about its present extent. Tree fruits in unprotected parts of the valley might be satisfactory or partly satisfactory for a number of years, but the low recorded temperature of —21° F. at Grand Junction indicates the risk involved in planting orchards in areas that have not been proved climatically suitable.

The acreage of tree fruits reached a maximum before 1910, when they were grown mainly near Fruita and east of Grand Junction. Risk of loss through winterkilling, difficulty in controlling the coddling moth, prevalence of blight and other disease, high fixed costs, and increasing acreages affected by poor underdrainage and salinity forced abandonment of most of the orchard fruits. The land was planted to alfalfa, corn, pinto beans, small grains, potatoes, and other field crops. Fruit growing in the Fruita section has been almost completely discontinued.

Today, tree fruits, especially peaches, are grown mainly on the Redlands, Orchard Mesa, the Vinelands, and from Palisade west to Clifton. These areas have proven dependable for tree fruits. Good net returns from peaches have greatly increased the acreage in that crop in the last 10 to 15 years. The same is true for plums, cherries, and apricots. The acreage in pears and apples declined until about 1943 but has increased recently.

The acreage in grapes was highest during the period between 1900 and 1910. Long distance to markets and low net income have discouraged grape growing. Most of the grapes are now grown in small home vineyards. UNTIL RESURGANCE IN 1970'S —

Peaches.—Growing of peaches is the most important farming speciality in the Grand Junction Area. Yields fluctuate, but a fair annual average is 350 bushels an acre. This would total 6,300 bushels an acre for the average life of a peach orchard, which is about 20 years (4). Some of the older peach orchards near Palisade are more than 50 years old, however, and are still producing high yields. Commercial production of peaches is confined mainly to the climatically better situated parts of the valley—the Redlands, the western part of Orchard Mesa, the Vinelands, and from Palisade west to Clifton. The probable average life of a peach orchard in these areas considerably exceeds 20 years. The number of bearing peach trees in Mesa County increased about 40 percent between 1939 and 1949.

The chief varieties of peaches grown are Elberta, J. H. Hale, Salway, Carman, Halehaven, Orange Cling, Sungold, and Rochester. Approximately 93 percent of the trees are Elberta; 4 percent J. H.

The principal varieties of sweet or semisweet cherries grown are Mavillo, Royal Anne, Bing, Lambert, Napoleon, Oxhart, Republican, Black Tartarian, and Windsor. The last two varieties are good pollenizers, especially for the Bing and Lambert, if bees are scarce. The Royal Anne is a large white cherry; the others are of the red variety.

Comparatively few sour cherries are grown. The main varieties are the Montmorency, English Morello, and Royal Duke.

The proper spacing for sweet red cherries is about 30 feet, but 20 feet is satisfactory for sour cherries.

The cherries produced in this area are of exceptional quality. A considerable part of the crop is canned for commercial and home use. The largest part, however, is packed in 15-pound boxes and sold through local shipping organizations.

Apples.—The number of apple trees has decreased steadily since 1919 because of low returns. Most of the acreage now in apples is confined to the same general areas as those where peaches are grown. Formerly, large acreages near Fruita and Clifton were in apple orchards, as well as areas between Grand Junction and Clifton. Apple growing has been almost entirely abandoned in the Fruita district, and for the most part in the areas between Grand Junction and Clifton.

The tillage and irrigation methods used for apple trees are much the same as those for peach orchards. Young trees are normally set out between March 1 and April 15. The trees are spaced about 30 feet apart, though some growers prefer 40 feet. Frequent cultivation is not so essential for apple as for peach trees, especially when the trees become large. Consequently, some growers cut the cover crop in apple orchards and let it lie as mulch.

Part of the apple crop is sold, canned, or dried locally. Most of the better quality fruit is graded and shipped. Local marketing organizations do most of the shipping, but some of the crop is trucked to outside markets. The principal varieties are Jonathan, Delicious, Winesap, Rome Beauty, and Starking, a red sport of the Delicious (*7*).

Apricots and plums.—The number of apricot and plum trees has increased rapidly since 1939 (table 3), but neither crop is extensively grown in the Grand Junction Area. The orchards, not large and widely scattered, are in the same areas as the peach orchards and on the same kinds of soils.

The trees are usually planted in spring. Spacing, tillage, and irrigation methods are almost identical to those used for peach trees. The commonly grown varieties of apricots are Smiths, Tiltons, Moorpark, Mount Ganot, Wenatchee Moorpark, Chinese or Colorado, and Riland. The plum varieties are Santa Rosa, Duarte, Japanese, and Japanese hybrid. In addition there is a small acreage of plums that bloom later and are classed as prunes.

A comparatively large part of the apricot and plum crops is sold or canned locally. The quantity shipped to outside markets probably will increase as many of the younger trees come into production.

Grapes.—There is a considerable acreage of grapes in Mesa County, but most of it lies outside the Grand Junction Area northeast of Palisade. Within the surveyed area, grapes are grown in small plots of 1 or 2 acres or less. The vines do well, however, and the fruit is of high quality.

Grapes are adapted to the medium textured to sandy Fruita, Genola, Ravola, Mesa, Thoroughfare, and Mack soils, especially where these soils are in areas climatically adapted to peaches.

A large part of the grape crop is sold locally. The most important varieties are Concord, Van Buren, Fredonia, Golden Muscat, Caco, and Portland.

Strawberries, raspberries, and blackberries.—The acreage in berries is small. The berries are of good quality, and most of the crop is sold locally. Berries grow best on the Mesa, Ravola, Thoroughfare, and Fruita soils or other deep, well-drained, salt-free soils in the valley that do not have a fine texture.

The common strawberry varieties are Marshall and Utah Centennial; the red raspberries, Latham, Indian Summer, and Newburgh; and the black or purple raspberries, Bristol, Potomac, and Sodus.

FIELD CROPS

The principal field crops, in order of importance, are alfalfa, corn, dry beans, oats, wheat, barley, and sugar beets. Potatoes, clover, and rye are also grown. All of these crops are irrigated. Wet, misty weather lasting several days may seriously affect yields of dry beans, potatoes, clover, and alfalfa, but complete crop failures are almost unknown.

Alfalfa.—This always has been and still is the most important hay crop in the valley. It is grown on almost all the tillable soils throughout the valley. Alfalfa is rarely planted on soils of the Chipeta and Persayo series and occupies only a small acreage on the Billings silty clays. It is a deep-rooted crop that requires good underdrainage. On well-suited soils, such as the Fruita, Mesa, Ravola, and Thoroughfare, yields of 4 or 5 tons an acre are common.

Alfalfa is normally seeded in spring with a companion crop of oats or barley. The seed is ordinarily drilled ½ to 1 inch deep at the rate of 8 to 10 pounds an acre. The varieties most commonly used are Meeker Baltic, Nebraska Common, Colorado Common, Hardistan, Grimm, Cossack, Ladak, and Utah Common (*6*). In recent years the tendency has been toward more frequent seeding, or about every 4 years. More frequent seeding suppresses weeds, decreases wilt and weevil infestation, and improves the quality of the hay.

The small-furrow method of irrigation is used. The furrows range from 1 to 3 feet apart. Water is normally applied before and immediately after each cutting. The soil is given ample time to dry out before the alfalfa is cut. Three, and frequently four, cuttings are obtained each year (pl. 2).

The hay is normally stacked or baled directly from the windrow. Much of it stands unprotected from the weather in piles of bales or haystacks until sold or fed. Some farmers have barns or alfalfa sheds. The common practice is to bale the hay during the daytime, when the dryness of the air causes some loss of the fine leaves. Some alfalfa hay is trucked outside the valley but most of it is fed on the farm or sold locally.

Corn.—This crop is second to alfalfa among the field crops grown in the valley. The acreage fluctuates from year to year. The annual and alluvial fans. The Fruita gravelly loam soil of the unit occurs on the brow of the mesa escarpments, and the Ravola gravelly loam lies farther down the slope. In both locations the porous soil mantle consists of either gravelly clay loam or of clay, sand, gravel, cobbles, and stones. Except in a few places where there are gravel beds—as for example ¼ mile north of Mack and 2 miles north of Fruita—the mantle varies from 3 to 6 feet deep over the Mancos shale.

The Fruita soil of this unit is light brown and has a moderate accumulation of visible lime in the subsoil. The Ravola soil is pale brown and has practically no visible lime in the subsoil.

Practically all of this unit is now used for grazing. The scant growth of vegetation consists of shadscale, rabbitbrush, pricklypear cactus, scattered bunchgrass, and a few other shrubs that afford a little browse. With considerable leveling, some of the areas now uncultivated could be planted to orchard fruits, berries, and grapes or used for irrigated pasture.

Genola clay loam, 0 to 2 percent slopes (GA).—This inextensive soil occurs southwest of Palisade on Orchard Mesa; it is associated with the Mesa soils. It differs from Genola loam, 2 to 5 percent slopes, in having less slope, a slightly grayer surface soil, and a finer textured and generally shallower alluvial mantle overlying Mesa soil material and cobblestones.

Apparently the soil has developed from comparatively recent alluvium washed down from the small arroyos that extend back to the higher mesas to the south. This alluvium has been more or less modified by local material washed from the more sloping or rolling areas of Mesa soils to the south, where there are few if any exposures of shale.

The 8- or 10-inch surface soil, a light yellowish-brown or very pale-brown heavy loam to clay loam, is underlain by similar subsoil material. In some places the subsoil is relatively loamy but in most places it is a light clay loam. Slight lime segregation occurs in the subsoil in places but is not so distinct as in Mesa clay loams. In some places at depths of about 3½ feet the soil material resembles the subsoil of Mesa clay loam, but in others it is relatively uniform to a depth of about 5 feet.

Surface runoff is slow, but underdrainage is adequate for successful production of all the common irrigated crops. The soil has about the same crop suitability range as Mesa clay loam, 0 to 2 percent slopes. It is easily tilled and irrigated. The moderately permeable profile permits easy penetration of air, water, and plant roots. This allows successful production of all deep-rooted crops climatically suited to the locality. Practically all of the soil is cultivated. Owing to the favorable climate, it is planted chiefly to tree fruits, especially peaches.

Genola clay loam, 2 to 5 percent slopes (GB).—Aside from its greater slope and some scattered cobbles and gravel on the surface, this soil differs very little from Genola clay loam, 0 to 2 percent slopes, the soil with which it is associated. Its good drainage, friability, and moderate permeability give it a wide suitability for crops. Most of the soil is used for growing peaches, a crop that does particularly well under the climate prevailing in the eastern part of this locality.

REMEMBER THE OLD SAYING, "WHERE STONE FRUIT GROWS SO GROWS THE GRAPE."

or color is noticeable with increase in depth, but in some areas the soil material becomes sandier at depths of 24 to 36 inches and may contain a considerable amount of cobblestones and gravel. Light-gray indistinct specks and spots indicate a very slight concentration of lime or the presence of gypsum. Ordinarily, the lime is well disseminated throughout the profile. At depths of 4 to 5 feet, very pale-brown to pale-yellow very fine sand to loamy fine sand is common. The quantity of cobblestones and gravel increases with depth. The substratum consists largely of acid igneous cobbles, gravel, stones, and sandy material like that underlying the Mesa soils.

Included with this soil is approximately 30 acres of Genola loam having slopes of 5 to 10 percent. This area occurs about 2 miles southeast of Clifton (NE¼ sec. 18, T. 1 S., R. 99 W.).

Use and management.—Because of its good drainage, favorable texture, and moderately permeable subsoil, this soil is easily worked and has a wide range in crop suitability. More than 90 percent of the acreage is in peach orchards. The soil is also well suited to berries, grapes, and melons, tomatoes, potatoes, and other truck crops. It produces yields of corn, alfalfa, and peaches as good as those on the Mesa soils, and where well managed, may outyield the Mesa soils when planted to crops such as grapes, berries, and melons.

Prevention of erosion is probably the most difficult problem in the areas used for orchards. The soil must be irrigated carefully, and a cover crop of red clover, alfalfa, or oats should be growing between the trees during the irrigation season. Many peach growers apply large amounts of stable manure and grow legume crops to maintain organic matter and fertilize the trees. These practices may not give full benefit if the grower fails to apply water carefully. Overirrigation of this soil is common.

Genola very fine sandy loam, deep over gravel, 0 to 2 percent slopes (GG).—Except for its very fine sandy loam surface soil and loam-textured subsoil this soil has about the same characteristics as Genola fine sandy loam, deep over gravel, 0 to 2 percent slopes. It is deeper to the underlying Mancos shale, however, and therefore has better internal drainage and greater suitability for peaches. The soil is used largely for peach orchards.

Green River clay loam, deep over gravel, 0 to 2 percent slopes (GH).—This soil occurs mainly along the Colorado River in the Vinelands southeast of Palisade. The areas slope gently toward the river. The soil has developed chiefly from overflow deposits left by the Colorado River, but in places it is influenced by admixtures of shale and sandstone materials such as those from which the Ravola clay loam soils were formed.

The surface soil is pale-brown to light brownish-gray clay loam. The color is influenced to some extent by admixture of Ravola clay loam soil materials that have been washed from the drainageways to the southeast. The subsoil, in most places, has the pale-brown color and the noticeable mica scales that are characteristic of Green River soils.

Included with this soil are a few areas north of Palisade bridge that developed in gravelly alluvium derived largely from igneous rock.

Included with this soil are a few small strips with a clay loam surface texture. These strips adjoin the higher lying Billings soils and were included with this Green River soil because they were too small to be mapped separately.

Use and management.—If they were properly drained, many areas of this Green River soil could be used for the ordinary field crops, chiefly corn, alfalfa, clover, and sugar beets. Tomatoes, cabbage, onions, and several other truck crops also could be grown successfully. Undrained areas of this soil remain in natural pasture consisting largely of saltgrass.

Green River very fine sandy loam, deep over gravel, 0 to 2 percent slopes (GM).—This soil occurs along the Gunnison and Colorado Rivers, but for the most part at higher levels than the other Green River soils. Its better position makes it less susceptible to flooding or occasional high water tables. It can be cropped successfully, especially after it has been ditched to provide adequate underdrainage.

The surface soil, a pale-brown or light brownish-gray very fine sandy loam, contains numerous small fragments of mica. Below depths of 10 to 12 inches, the very fine sandy loam has a brighter pale-brown or very pale-brown color, and at depths of 24 to 30 inches it grades into similarly textured soil material that shows light-gray and reddish-brown specks or very small spots. Below depths of 3 or 4 feet textural variations are common, but fine sandy loam is dominant.

When moist, this soil is friable. Well-disseminated lime is present from the surface downward, but the organic-matter content is low. Workability and tilth are exceptionally favorable for irrigation and cultivation, but some places need ditches that will lower the water table. A few narrow lower lying seepy places are indicated by small marsh symbols on the map.

Use and management.—Nearly 70 percent of this soil is cultivated. All the climatically suited crops, including truck crops and general field crops, produce high yields. Berries, grapes, and orchard fruits also thrive in the areas east of Clifton, which are better situated climatically.

The highest yields are obtained by making heavy applications of barnyard manure (10 to 15 tons an acre) or by using commercial fertilizer liberally. Farmers often plant this soil to truck crops after plowing out an old stand of alfalfa or alfalfa and clover mixed, or after they have turned under a heavy stand of red clover or some other legume. Some farmers use about 150 pounds of commercial fertilizer to the acre.

Hinman clay, 0 to 1 percent slopes (HA).—This soil occupies nearly level areas mainly on Orchard Mesa. The soil material consists largely of deposits of finer clay particles settled from backwaters during former high flood stages of the Colorado River. The alluvium, 7 to 10 feet or more thick, overlies a cobbly stratum, which, in turn, overlies Mancos shale. The alluvium is derived largely from acid igneous materials.

The 8- or 9-inch surface soil consists of pale-brown or yellowish-brown clay that is low in organic matter. Despite its calcareous nature, this layer is hard and somewhat blocky when dry. Even when systematically cropped, this layer is more cloddy than the corresponding one in Hinman clay loam soils. At a depth of 14 to 16 inches, the

ments of sandstone. Variation in the various alluvial layers is apparent, but not so pronounced as in the areas north of Palisade. Several peach orchards bordering the bluffs east of Palisade contain sandstone boulders 5 to 15 feet in diameter. Most of the smaller rocks and boulders have been removed from these orchards. About 30 acres northeast of Palisade has slopes of 5 to 10 percent.

Considering this soil as a whole, it is moderately permeable to plant roots, air, and moisture but low in water-holding capacity. The successive soil layers are friable and moderately calcareous.

Use and management.—Practically all of this soil lying below the irrigation canals is cultivated. About 99 percent of it is in peaches. In a few places where shale is within 4 or 5 feet of the surface, the trees are not uniform in size, and some have had to be replaced. Although yields generally compare favorably with those from the Ravola soils, the average yield is lower. Considering the favorable climate, peach growing is one of the best uses for this soil.

Mesa clay loam, 0 to 2 percent slopes (Mc).—This soil occupies a former flood plain or high terrace immediately south of the Colorado River. It is largely derived from acid igneous soil-forming materials the streams have brought down from a higher watershed.

In cultivated fields the 8- or 10-inch surface soil consists of very pale-brown, pale-brown, or light-brown calcareous clay loam. It merges with a reddish-yellow to light reddish-brown calcareous clay loam showing white or pinkish-white segregations of lime. Below depths of 12 to 14 inches, the reddish-yellow to light-brown clay loam exhibits numerous white streaks or splotches that have a comparatively vertical or jagged outline along road cuts. A few scattered cobbles and pieces of gravel are common. Beginning at depths of 3 or 4 feet or in places below 6 or 7 feet, about 40 to 50 percent of the soil mass is made up of pieces of gravel, cobbles, and stones derived largely from granite and basalt but to some extent from lava and sandstone. Most of the sandstone is crumbly or partly disintegrated. Mancos shale underlies the gravel-and-cobble substratum in most places at depths below 8 to 12 feet. In some places, however, the shale may be as near the surface as 4 or 5 feet, and in others as far down as 20 feet.

The high lime content of this soil doubtless offers some resistance to penetration of water and plant roots but the entire profile is friable when moist. Judging from many orchards and alfalfa fields, its permeability to deep-rooted crops is sufficient to permit healthy and vigorous plant growth. Underdrainage is adequate; harmful concentrations of salt are negligible.

Because a considerable part of this soil consists of material washed from higher places, the depth to the noticeably lime-splotched zone is variable. Generally, however, the depth ranges from 1½ to 3 feet. Leveling of the soil also accounts for part of the variation in depth to lime splotching. On the whole, the variations in depth to lime have little, if any, agricultural significance.

Use and management.—About 97 percent of this soil is cultivated. It is highly productive and much of it is well-suited to fruit growing. At least 40 percent of the acreage is in orchard fruits, mainly peaches. About 20 percent is in alfalfa, 15 percent in corn, 10 percent in beans, and 8 percent in truck crops, including cantaloups, melons, and tomatoes. The rest is used for small grains and other field crops.

These percentages show the relative importance of the various kinds of crops, though the area used for field crops fluctuates from year to year.

Many of the orchards have been planted in the past 15 years. If well cared for and not severely injured by low temperatures, they should give good yields until the trees reach 30 or 40 years of age. A few orchards more than 50 years old are still producing good yields. The areas having the best climatic location for orchard crops begin south and southeast of Palisade and extend 5 or 6 miles southwestward. Under practices designed to increase the organic-matter content and to control erosion, this soil should remain productive indefinitely.

Mesa clay loam, 2 to 5 percent slopes (Mb).—Except for its greater slope and the appearance of lime splotches nearer the surface, this soil is very similar to Mesa clay loam, 0 to 2 percent slopes. The lime splotches normally are 10 or 15 inches from the surface. Small quantities of gravel and cobblestones strewn over the surface in most places indicate that there is a slight continuous removal of the surface soil by sheet erosion. Tilth and workability are good. In most places the soil is underlain by shale at depths of 6 to 20 feet.

Use and management.—The area of this soil occurring below the irrigation canals is about 87 percent under cultivation. It is a productive soil, and practically all field crops of the area can be grown successfully. About 32 percent of the acreage is in orchard fruits, mainly peaches but also some sweet cherries and pears. The fairly large percentage in orchard fruits is accounted for mainly by several rather large areas south and southwest of Palisade that are within a climatic zone well suited to tree fruits. Not including these specialized fruit areas, the proportion of the soil in various crops is about the same as for Mesa clay loam, 0 to 2 percent slopes. Yields are also about the same, but in a few small areas shale occurs at depths of 3½ to 4 feet and yields from deep-rooted crops such as orchard fruits and alfalfa may be slightly lower over a period of years.

If erosion is controlled and the soil is planted to legumes to build up its supply of organic matter, it should be productive indefinitely. In some fields the content of organic matter already has decreased appreciably from that in the virgin soil.

A few small areas (about 12 acres) of this soil located just below Orchard Mesa irrigation canal No. 2 are not suited to deep-rooted field crops or tree fruits. In these areas, Mancos shale is at depths between 2 and 3½ feet and the soil does not have a porous gravelly layer over this shale. Beans, wheat, barley, and oats probably are as suited to these areas as any other crops that could be selected.

Mesa gravelly clay loam, 2 to 5 percent slopes (Mc).—This soil is derived from old alluvium deposited on Orchard Mesa. The alluvium consists mainly of materials weathered from acid igneous and mixed igneous rocks, largely granite and basalt, but includes smaller quantities of material from sandstone and shale. The alluvial mantle, for the most part, ranges from 5 to 8 feet deep but it is deeper in places.

The 8- or 10-inch surface soil in cultivated fields is light brown when dry and brown when moist; its organic-matter content is very low. The subsurface layer is light-brown or pale-brown clay loam containing a considerable amount of cobblestones, rounded pieces of gravel, and

MORPHOLOGY AND GENESIS OF SOILS

Soils are formed by the forces of the environment acting upon soil materials deposited or accumulated by geological agencies. The characteristics of a soil at any particular place are determined by (1) the climate under which the soil material has accumulated and has existed since accumulation; (2) the physical and mineralogical composition of the parent material; (3) the relief, or lay of the land, which influences drainage, moisture content, aeration, susceptibility to erosion, and exposure to sun and the elements; (4) the biological forces acting upon the soil material—the plants and animals living in and on the soil; and (5) the length of time the climatic and biological forces have acted upon the soil material.

CLIMATE AND VEGETATION

Climate and vegetation profoundly influence soil formation in more humid areas but have minimum influence in a desert environment such as that of the Grand Junction Area. The area occupies a moderately narrow part of the Grand Valley, which is in the Gray Desert soil zone. The average yearly precipitation, about 9.1 inches, supports sparse semidesert vegetation consisting of desert shrubs, a few flowering plants, scattered grasses, and a few trees on the bottom lands along the Colorado River. Owing to the desert environment, the soils have certain general characteristics in common with most soils of other intermountain valleys of western Colorado and eastern Utah. Some of them classify as zonal, or normal, soils of the region. These are the older soils on the high mesas; they are light colored, low in organic matter, highly calcareous, well drained, and sufficiently permeable to meet the requirements of the climatically suited field and orchard crops.

In contrast, many soils of the Grand Junction Area are azonal, or not typical or normal for the region they occupy. Because of their youth or conditions of parent material or relief, they have not developed profile characteristics normal for the environment in which they occur. These soils, especially those of the Billings and Green River series, generally contain salts, alkali, or both in quantities detrimental to ordinary field crops grown under irrigation, unless both surface drainage and underdrainage are sufficiently free to prevent the rise of harmful quantities of salts. As a rule, if surface drainage and underdrainage are adequate, the salts have little harmful affect after the first 2 or 3 years of cultivation.

RELIEF AND TIME

Relief, or physiographic position, is an important factor in soil development. It may greatly influence erosional activity, as well as surface and internal drainage. Because of differences in relief, some soils have been subjected to soil development a much greater length of time than others. The soil materials on the mesas of this area have been developing a much greater length of time than those on the lower slopes or alluvial flats. Consequently, the soils at these higher levels are older and their horizons are more differentiated. The materials on the lower alluvial fans and flood plains have been

COLORADO CELLARS, Ltd.
3553 E. Road Palisade, Colorado 81526
(303) 464-7921

Mr. Robert White
Chief, Wine & Beer Branch
Bureau Alcohol, Tobacco & Firearms
1200 Pennsylvania Ave., Room 6241
Washington, D.C. 20226

November 17, 1990

Mr. White:

In response to our telephone conversation of November 7, 1990, I am submitting the following information and attachments to our petition to establish the Grand Valley of Colorado, a grape growing region, as a viticultural area to be named "Grand Valley".

Attachment # 1 - Climatography of the United States No. 86-5
Decennial Census of United States Climate -
CLIMATIC SUMMARY OF THE UNITED STATES -
Supplement for 1951 through 1960
COLORADO
Washington, D. C.: 1964

This document provides the following data:

1) The Mean Daily Maximum temperatures for Fruita, Grand Junction, and Palisade;
2) The Mean Daily Minimum temperatures for Fruita, Grand Junction, and Palisade;
3) A temperature summary for Fruita;
4) A temperature summary for Palisade.

This data should adequately substantiate the comments in the petition regarding the change in temperature as one moves progressively westward through the Grand Valley. Please keep in mind that Grand Junction is approximately 11 miles West of Palisade, Fruita is another 10-11 miles west of Grand Junction, and Loma and Mack are another 5 to 8 miles west of Fruita.

Attachment # 2 - Letter from Charles E. McKim, Mesa County Irrigation District

Attachment # 3 - Contract No. 9-07-40-R0700

Attachment # 4 - By Laws of Mesa County Irrigation District

These should adequately answer your questions as to why grapes cannot be planted north of Interstate 70 in the Palisade and Clifton areas. Simply put, there is no water available.

Attachment # 5 - Soil Survey
Grand Junction
Area, Colorado
Series 1940, No, 19
United States Department of Agriculture
Soil Conservation Service
In cooperation with the
Colorado Agricultural Experiment Station

As stated on the telephone, this is the only known copy of this document, and we ask that **you return it, in its' entirety, as soon as possible.** From this portfolio, you should be able to determine the differences in soil between those areas where vineyards are currently planted and areas outside of the proposed viticultural area boundaries.

This portfolio was used, initially, by Warren Winiarski (Principal at Napa Valley's Stags Leap Wine Cellars) when he assisted in the implementation of viticultural practices in the Grand Valley. I find it interesting to note that Sheet No. 1 shows no effects of having been used at all, whereas Sheet No. 3, the one which encompasses a number of the current vineyard sites, shows that the sheet has been well used. You will also note that Warren (we presume) marked an area on both sheets No. 2 and 3. which parallels both the Colorado and Gunnison Rivers. I assume that this was to designate those areas which would not be suitable for viticulture due to problems with high water tables.

In order that you better understand the significance of the Soil Survey data, I have copied a portion of Sheet # 3,

Attachment # 6

marking it in red to show the location of all but 6 of the known vineyard plantings in the Grand Valley, (The remaining 6 are divided between the Redlands area and an area east of Fruita - all on "Tb" or "Rb" soil types.)

I have also copied a large sheet titled "Principal Characteristics and Present use of the Soils of the Grand Junction Area, Colorado"

Attachment # 7

which does not belong to us. This sheet will be of invaluable assistance in pointing out the fact that vineyard locations, without fail, are on soil noted for Orchard Fruit production whereas the predominent soils in the Loma and Mack areas only occasionally are planted to orchard fruits.

Note that vineyard sites are planted on Ra, Mh, Me, Mc, Hb, Md, Gf, Mc, Mb, Tb, and Rb. On the other hand, the Loma and Mack soils are generally Ce, Fn, Pb, Ft, Bc, Fg, Fh, and Ma.

I hope that all of the above will substantiate our comments regarding the proposed boundaries, and that your review of the petition can speed along toward a final conclusion in the very immediate future.

Thank you for your interest and cooperation, and, thank you for remembering to return the Soil Survey portfolio as soon as humanly possible. (It is our "bible" when visiting with prospective growers.)

Sincerely,
ANN SEEWALD

ent #1

U. S. DEPARTMENT OF COMMERCE
LUTHER H. H[illegible]S, Secretary
WEATHER BUREAU
ROBERT M. WHITE, Chief

CLIMATOGRAPHY OF THE UNITED STATES NO. 86-5

DECENNIAL CENSUS OF UNITED STATES CLIMATE—

CLIMATIC SUMMARY OF THE UNITED STATES

SUPPLEMENT FOR 1951 THROUGH 1960

COLORADO

Washington, D.C.: 1964

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 45 cents

MEAN DAILY MAXIMUM TEMPERATURE

STATION		NO. OF YEARS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
JULESBURG	PER	9	42.8	46.5	50.8	65.2	74.5	85.5	92.4	91.2	83.6	70.3	53.1	44.9	66.7
	REC	46	40.7	45.1	52.5	64.1	73.4	83.3	90.9	88.9	80.5	68.5	52.5	42.2	65.2
KASSLER	PER	10	48.7	50.8	53.7	63.5	72.4	84.6	88.2	86.8	81.1	69.7	56.3	50.5	67.2
	REC	47	47.2	50.6	55.1	63.7	71.9	82.7	87.6	86.0	79.8	69.4	56.7	48.9	66.6
KAUFFMAN 4SSE	PER	9	41.2	43.2	48.5	59.6	69.5	81.4	87.5	86.8	79.1	66.2	49.7	43.9	63.1
	REC	23	40.0	43.9	49.1	60.6	69.5	79.8	87.7	87.2	78.5	66.6	50.8	44.0	63.1
KIT CARSON	PER	5	44.2	48.1	53.6	65.3	75.1	87.8	92.1	90.8	84.2	71.5	-	48.2	-
	REC	14	43.4	48.1	54.3	65.8	74.7	85.6	91.5	90.3	83.3	71.5	55.3	48.2	67.7
LA JUNTA FAA AP	PER	10	46.0	49.2	54.9	66.3	77.2	90.1	94.0	92.7	84.9	71.8	55.3	48.6	69.3
	REC	15	45.4	49.5	55.6	67.8	76.9	89.1	93.8	92.3	85.0	72.5	54.9	49.4	69.4
LAKE MORAINE	PER	7	34.2	34.8	36.1	43.7	53.1	65.2	69.4	66.6	63.3	53.3	41.2	36.0	49.7
	REC	62	31.2	31.9	35.1	41.9	50.5	61.6	65.9	64.4	59.5	49.9	39.8	33.2	47.1
LAMAR	PER	10	45.6	49.6	55.2	67.0	77.0	88.9	93.3	91.5	84.4	72.1	55.8	48.3	69.1
	REC	65	46.9	51.4	59.9	69.8	77.5	89.3	94.3	93.2	86.0	73.8	58.4	47.6	70.7
LAS ANIMAS 1 N	PER	10	48.5	52.1	59.2	70.8	80.3	92.2	95.4	94.2	87.4	73.9	57.6	50.7	71.9
	REC	73	46.2	48.4	60.7	70.3	79.6	90.6	94.4	91.4	85.7	73.4	59.1	48.0	70.7
LEADVILLE	PER	8	29.1	30.6	33.9	42.4	55.0	66.9	72.1	69.6	64.6	52.6	37.1	30.5	48.7
	REC	53	30.3	32.5	36.5	44.6	55.0	66.0	71.7	69.7	63.8	52.5	39.9	31.9	49.5
LIMON 10 SSW	PER	10	43.3	45.0	49.3	60.1	70.3	83.4	88.1	86.5	79.5	66.8	50.9	45.5	64.1
	REC	50	40.8	43.8	50.4	60.3	69.5	80.8	86.7	84.7	77.5	66.0	51.6	42.2	62.9
LIMON	PER	10	43.0	45.2	48.4	58.8	69.3	81.5	86.4	84.9	78.1	65.9	50.6	45.3	63.1
	REC	13	41.8	45.1	48.4	59.7	69.3	81.0	86.1	84.8	77.9	66.5	51.2	45.5	63.1
LITTLE HILLS	PER	9	39.3	41.6	47.2	58.6	68.0	80.3	86.4	82.8	77.3	65.3	48.6	41.1	61.4
	REC	13	38.3	41.8	47.4	59.1	68.8	79.5	86.3	83.4	77.8	65.0	48.8	41.2	61.5
LONGMONT 2 ESE	PER	10	43.2	45.5	50.0	60.2	70.9	83.4	88.5	86.8	79.9	67.2	51.7	46.4	64.5
	REC	54	42.6	45.4	52.3	62.1	71.1	82.0	87.8	86.6	78.5	66.5	52.8	44.2	64.3
MANASSA	PER	8	39.0	42.6	49.6	59.4	67.8	79.1	82.0	80.2	76.4	65.3	48.7	39.4	60.8
	REC	50	36.2	42.0	49.2	58.4	66.8	76.3	79.8	77.8	72.9	61.8	49.4	38.1	59.1
MEEKER	PER	10	38.1	40.3	46.8	58.6	68.9	80.6	86.4	83.1	77.7	65.2	48.6	39.4	61.1
	REC	49	36.2	40.2	47.3	59.0	69.2	79.5	85.4	82.9	75.5	63.2	48.9	37.1	60.4
MESA VERDE NATL PARK	PER	10	41.7	44.0	50.0	60.9	70.8	83.2	87.3	84.4	80.1	66.5	50.6	42.5	63.5
	REC	37	40.6	44.4	50.5	61.2	71.1	82.6	87.3	84.8	77.5	65.5	51.3	42.2	63.3
MONTE VISTA	PER	10	36.7	40.0	48.2	58.0	66.5	76.8	79.6	77.7	74.5	63.4	46.4	37.7	58.8
	REC	21	34.4	39.7	48.3	58.9	67.6	77.0	80.9	78.8	74.6	63.3	47.1	37.3	59.0
MONTROSE NO 2	PER	10	41.1	43.5	51.9	62.5	72.7	85.5	90.6	86.7	81.3	67.7	50.0	40.6	64.5
	REC	67	37.2	43.2	52.5	62.4	72.3	83.3	88.6	85.6	78.3	65.6	50.3	39.2	63.2
MONUMENT 2 WSW	PER	8	44.3	45.5	47.8	56.9	66.7	78.3	84.2	82.3	76.6	64.8	51.2	46.6	62.1
	REC	46	41.7	43.2	47.4	55.7	65.0	75.9	82.1	80.2	73.8	63.1	50.9	44.2	60.3
NORTHDALE	PER	10	38.1	40.3	47.4	59.7	69.5	81.9	87.3	84.2	78.3	65.0	48.1	38.8	61.6
	REC	30	36.4	40.1	47.6	59.6	69.0	80.1	86.6	83.6	76.2	63.7	48.5	39.3	60.9
NORWOOD	PER	9	36.9	39.1	46.1	57.4	67.8	79.5	83.7	80.1	74.1	61.7	44.9	37.1	59.0
	REC	26	37.0	40.8	47.8	58.5	68.3	78.6	84.0	81.0	74.6	62.8	47.7	39.1	60.0
OURAY	PER	10	39.6	40.6	45.6	55.1	64.5	76.7	80.6	77.6	73.6	61.5	46.9	40.6	58.5
	REC	12	38.9	40.6	45.1	55.3	64.6	76.1	80.2	77.5	73.3	61.9	47.3	40.7	58.5
PAGOSA SPRINGS	PER	8	39.1	41.7	48.4	59.4	67.8	80.2	83.0	81.7	77.1	65.6	49.6	39.9	61.1
	REC	26	39.1	43.3	50.9	59.8	68.5	79.2	83.3	81.2	75.6	64.1	50.7	39.0	61.2
PALISADE 1S	PER	10	41.7	46.2	56.0	67.2	77.3	89.3	94.3	91.0	84.9	71.5	52.8	42.8	67.9
	REC	45	38.8	45.8	55.7	67.1	77.4	88.5	94.2	91.1	83.2	69.9	53.8	42.1	67.3
PARADOX	PER	9	43.4	47.6	55.2	65.7	75.7	87.8	92.8	88.9	83.6	70.6	52.9	42.8	67.3
	REC	16	42.5	48.2	55.4	66.5	75.6	87.2	93.0	89.3	84.1	71.3	54.2	43.8	67.6
PARKER 9 E	PER	10	43.6	46.0	49.2	59.1	69.1	82.0	87.2	85.0	79.3	66.7	51.9	45.6	63.7
	REC	28	42.3	44.8	49.4	59.4	68.1	80.1	87.0	85.4	78.5	67.0	52.7	46.0	63.4
RANGELY	PER	8	33.2	39.2	50.3	63.6	74.9	86.5	93.0	89.3	83.5	68.8	49.5	37.0	64.1
	REC	9	33.2	39.2	50.3	63.6	74.9	86.5	93.0	89.3	82.9	69.3	49.8	37.0	64.1
RED FEATHER LAKES	PER	5	35.5	37.4	38.6	47.1	57.9	70.0	77.0	74.7	69.4	59.1	40.5	37.3	53.7
	REC	10	33.0	35.2	38.6	47.3	56.6	69.2	76.7	75.4	68.1	58.5	42.6	37.2	53.2
RIFLE 2 ENE	PER	9	37.4	41.6	51.1	63.2	73.4	84.7	90.4	86.8	81.0	68.6	49.8	38.0	63.8
	REC	56	36.1	42.2	51.8	63.9	73.3	83.9	89.8	87.4	79.5	67.1	51.8	39.0	63.8

MEAN DAILY MINIMUM TEMPERATURE

STATION		NO. OF YEARS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
JULESBURG	PER	10	14.4	17.5	22.1	33.1	45.4	55.0	60.6	59.4	48.1	35.7	23.0	17.8	36.0
	REC	47	12.8	15.6	22.3	33.3	43.9	53.8	59.7	57.9	47.2	34.6	22.3	15.3	34.9
KASSLER	PER	10	18.7	20.3	24.1	33.8	44.6	53.3	59.2	58.6	50.0	39.6	26.1	22.0	37.5
	REC	47	16.9	19.7	24.8	34.1	43.3	52.1	58.9	57.9	49.2	38.7	26.4	19.2	36.8
KAUFFMAN 4SSE	PER	9	12.3	14.6	17.5	27.5	39.2	47.0	51.7	51.1	41.3	31.4	19.5	16.7	30.8
	REC	23	11.6	14.1	19.0	28.8	38.6	46.7	52.3	51.4	42.3	32.3	20.5	16.1	31.1
KIT CARSON	PER	5	11.6	16.7	21.2	32.7	44.4	53.9	58.3	56.9	46.8	35.2	-	15.4	-
	REC	14	10.2	15.5	20.9	32.6	43.0	52.2	57.4	56.2	46.3	34.3	20.3	14.3	33.6
LA JUNTA FAA AP	PER	10	17.0	20.5	25.9	37.0	48.4	58.8	63.5	62.5	53.1	40.7	25.8	19.6	39.4
	REC	15	16.0	20.2	25.9	37.8	47.9	58.2	63.0	61.9	53.2	40.7	25.1	19.7	39.1
LAKE MORAINE	PER	7	11.3	10.5	11.8	20.1	28.8	38.1	41.7	40.6	35.8	26.9	15.2	11.8	24.4
	REC	62	9.6	9.8	13.3	20.7	28.8	37.6	41.7	41.0	35.5	26.3	16.9	10.8	24.3
LAMAR	PER	10	13.6	18.5	24.0	35.8	47.8	58.6	63.1	62.0	51.1	37.7	22.7	16.9	37.7
	REC	65	14.2	18.1	26.3	37.1	47.3	57.5	62.5	60.8	51.3	37.8	24.1	16.6	37.8
LAS ANIMAS 1 N	PER	10	13.5	17.6	23.6	35.0	46.4	56.6	60.5	59.2	49.0	36.5	22.2	16.6	36.4
	REC	72	11.6	15.9	24.0	34.8	44.8	54.7	59.9	57.7	48.4	35.1	21.4	13.7	35.2
LEADVILLE	PER	8	8.3	6.3	9.6	18.9	28.7	37.1	42.1	40.7	34.6	25.5	13.5	8.4	22.8
	REC	53	5.4	6.4	10.6	19.4	27.7	35.2	40.6	39.7	33.4	24.4	13.9	7.3	22.0
LIMON 10 SSW	PER	10	13.5	15.3	19.5	29.4	40.7	49.9	54.7	54.4	44.7	33.8	21.0	16.7	32.8
	REC	50	13.0	17.9	21.5	30.5	40.0	49.3	54.9	54.0	45.4	34.4	22.2	15.3	33.2
LIMON	PER	10	11.0	14.4	18.5	29.1	40.8	50.4	55.0	54.1	43.3	32.2	18.8	13.6	31.8
	REC	13	9.7	13.9	18.2	29.4	40.5	50.2	54.8	53.6	43.6	32.2	19.0	13.2	31.5
LITTLE HILLS	PER	9	7.0	7.6	16.1	24.0	32.6	38.4	45.1	44.3	34.2	23.3	13.2	6.7	24.4
	REC	13	5.0	7.8	16.6	24.5	32.3	37.9	44.4	43.7	34.2	23.7	13.7	7.7	24.3
LONGMONT 2 ESE	PER	10	12.6	15.7	21.2	31.3	42.6	50.4	54.9	53.5	44.0	33.5	20.7	16.3	33.1
	REC	54	11.0	14.9	22.0	31.8	41.4	49.1	54.1	52.6	43.4	32.6	21.2	13.2	32.3
MANASSA	PER	8	3.7	7.9	15.6	23.7	33.3	41.4	44.2	41.9	34.9	24.7	11.6	3.4	23.9
	REC	50	1.7	8.9	17.1	25.2	33.7	40.7	45.2	44.9	37.2	26.1	13.8	3.6	24.9
MEEKER	PER	10	9.5	11.0	19.7	28.0	35.5	41.9	47.6	45.7	36.7	27.8	17.1	10.6	27.6
	REC	50	5.4	9.8	19.5	27.8	33.9	39.8	46.0	45.1	36.7	27.5	17.6	8.3	26.5
MESA VERDE NATL PARK	PER	10	20.7	21.2	25.3	33.6	42.5	52.5	57.4	55.9	50.9	40.1	26.8	20.9	37.3
	REC	38	18.7	22.1	26.3	34.2	42.3	52.3	57.3	55.9	49.4	38.9	27.3	21.0	37.1
MONTE VISTA	PER	10	0.7	6.2	14.9	22.9	31.7	38.5	44.0	43.0	33.2	24.4	11.6	2.1	22.8
	REC	21	0.4	6.5	15.7	25.3	33.6	39.7	45.4	44.3	35.9	26.0	13.0	3.8	24.1
MONTROSE NO 2	PER	10	17.0	19.0	25.5	34.1	43.0	51.2	56.8	54.4	46.1	35.6	22.7	15.4	35.1
	REC	67	12.9	19.5	26.6	34.1	43.2	49.4	55.3	53.4	45.7	34.8	23.3	15.1	34.4
MONUMENT 2 WSW	PER	8	16.4	16.8	18.8	27.3	37.8	46.4	51.9	51.1	43.2	33.4	21.5	19.3	32.0
	REC	46	13.8	15.5	19.5	27.7	36.7	45.0	50.7	49.6	42.1	32.3	21.4	15.8	30.8
NORTHDALE	PER	10	12.2	13.6	20.1	27.5	35.0	42.1	49.7	48.9	39.7	30.1	18.9	11.9	29.1
	REC	29	8.5	13.1	21.0	28.0	35.0	41.4	49.5	48.8	40.5	30.4	18.6	12.5	28.9
NORWOOD	PER	9	12.9	13.4	20.1	28.7	36.4	44.5	49.4	48.0	41.5	32.2	18.8	12.3	29.9
	REC	25	9.0	13.1	20.3	28.6	35.4	43.3	49.5	48.5	41.8	32.1	18.9	12.2	29.4
OURAY	PER	10	16.7	16.6	21.1	29.6	37.7	45.2	50.4	49.5	43.9	34.8	22.7	17.5	30.7
	REC	12	16.0	16.7	21.1	29.9	37.8	44.8	50.1	49.2	44.0	35.0	22.9	17.6	32.1
PAGOSA SPRINGS	PER	8	2.8	4.6	13.7	22.0	30.6	36.5	44.2	44.1	35.6	26.4	14.2	5.1	23.3
	REC	26	0.5	4.5	14.2	24.0	29.5	35.8	44.8	43.9	36.3	25.7	14.0	3.3	23.0
PALISADE 1S	PER	10	21.7	24.1	31.1	40.5	49.3	57.7	63.5	61.2	54.4	43.0	29.5	21.8	41.5
	REC	46	16.3	23.7	31.0	39.8	47.8	55.8	62.2	60.1	52.1	40.3	28.8	20.7	39.9
PARADOX	PER	9	16.3	18.6	23.0	30.6	38.9	46.8	52.9	51.6	41.6	32.0	21.1	14.9	32.4
	REC	17	13.7	17.9	23.1	31.2	39.0	46.9	53.9	52.7	43.1	32.9	21.2	15.2	32.6
PARKER 9 E	PER	9	13.1	15.5	19.8	28.9	39.7	48.6	54.7	53.4	44.0	33.4	19.1	15.9	32.2
	REC	27	10.3	13.5	19.3	29.2	38.4	47.2	53.2	52.1	42.9	31.9	18.9	14.2	30.9
RANGELY	PER	8	3.6	8.2	20.1	31.2	40.2	47.4	54.2	51.5	41.2	29.5	17.2	7.1	29.3
	REC	9	3.6	8.2	20.1	31.2	40.2	47.4	54.2	51.4	41.5	29.7	17.5	8.2	29.4
RED FEATHER LAKES	PER	6	12.1	13.5	13.3	22.1	31.3	38.5	44.0	44.2	36.6	27.6	16.6	14.3	26.2
	REC	11	8.9	10.1	13.0	22.4	31.2	38.5	44.3	44.2	35.6	27.2	15.9	12.2	25.3
RIFLE 2 ENE	PER	9	12.1	14.8	22.5	30.5	38.1	43.7	49.6	48.8	39.2	30.1	19.1	10.6	29.9
	REC	56	10.1	16.2	24.0	32.1	39.0	45.6	52.1	50.6	41.9	31.7	21.3	12.9	31.5

MEAN DAILY MAXIMUM TEMPERATURE

STATION		NO. OF YEARS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
DILLON 1 S	PER	10	34.8	36.0	40.5	48.7	60.4	70.7	74.7	73.2	70.1	59.1	42.1	36.5	53.9
	REC	48	31.4	33.9	38.8	48.1	59.2	69.4	74.0	72.8	67.4	55.8	41.4	33.2	52.1
DURANGO	PER	10	43.9	46.6	53.5	62.8	71.8	82.6	86.4	84.9	80.2	68.5	53.8	44.6	65.0
	REC	66	39.4	43.8	51.4	60.7	69.6	80.0	84.2	82.6	76.4	64.9	52.8	41.1	62.2
EADS	PER	10	45.5	49.3	55.2	67.5	76.7	89.6	93.3	91.7	84.7	71.3	55.1	48.3	69.0
	REC	45	43.7	48.5	55.9	66.2	75.8	86.7	92.1	90.5	83.5	70.3	55.7	44.9	67.8
EAGLE FAA AP	PER	10	34.9	38.6	45.8	57.9	69.7	81.1	86.8	83.5	78.1	65.1	46.4	35.4	60.3
	REC	23	35.0	39.3	46.7	58.2	68.0	78.6	85.1	82.9	77.0	64.5	48.3	36.1	60.0
EDGEWATER	PER	8	47.2	50.0	53.1	62.3	72.1	85.4	90.7	88.6	82.2	70.2	55.7	49.2	67.2
	REC	49	45.6	47.8	53.4	62.6	71.8	83.2	88.9	87.1	79.4	67.3	54.9	46.2	65.7
ESTES PARK	PER	10	38.7	40.0	43.2	52.5	62.3	73.7	78.6	76.8	71.6	60.4	46.3	41.1	57.1
	REC	43	36.8	39.4	43.6	52.6	62.1	72.5	78.3	76.0	69.7	59.4	46.1	39.7	56.4
EVERSOLL RANCH	PER	6	49.6	51.8	59.1	70.3	80.9	92.3	95.0	93.2	87.5	74.3	59.5	53.7	72.3
	REC	10	49.4	52.1	60.3	71.5	81.0	90.9	94.3	92.3	86.9	75.1	60.2	53.0	72.3
FORT COLLINS	PER	10	41.8	44.1	48.8	59.3	69.1	81.2	86.4	84.5	77.5	65.5	50.3	45.3	62.8
	REC	65	40.4	42.7	49.5	59.6	68.2	78.5	84.4	83.4	75.5	64.2	51.1	42.3	61.7
FORT LEWIS	PER	9	37.8	39.6	44.5	54.7	64.2	75.8	79.7	77.2	72.6	60.8	46.8	39.2	57.7
	REC	42	37.0	40.1	45.6	55.8	64.7	75.4	79.8	77.5	71.7	60.6	47.8	39.7	58.0
FORT LUPTON	PER	8	44.3	45.9	52.4	64.8	74.7	86.4	91.3	88.8	82.3	68.9	52.8	45.7	66.5
	REC	38	40.1	44.0	51.5	62.8	72.5	84.1	90.5	87.9	78.8	66.0	51.5	42.6	64.4
FORT MORGAN	PER	10	39.9	43.6	49.2	60.6	71.8	84.0	89.2	87.6	79.5	66.6	49.5	42.4	63.7
	REC	62	38.6	43.1	51.3	61.9	71.2	82.2	88.8	86.6	78.0	66.1	51.5	40.7	63.3
FRASER	PER	10	29.7	32.4	36.8	46.4	59.0	69.8	74.9	72.7	67.8	55.6	39.1	31.1	51.3
	REC	49	28.8	31.8	36.9	46.7	57.7	68.2	73.3	71.7	65.8	53.9	39.4	30.5	50.4
FRUITA 2 N	PER	10	39.4	44.6	55.8	67.9	77.6	89.3	94.0	90.0	84.0	70.3	50.8	39.7	67.0
	REC	58	37.3	44.9	56.9	67.6	77.5	87.9	93.4	90.5	82.8	69.7	53.3	40.0	66.8
GEORGETOWN	PER	10	37.3	38.6	42.0	51.0	61.6	74.0	78.5	76.4	71.1	59.5	44.4	39.3	56.1
GLENWOOD SPRINGS 1 N	PER	10	36.9	40.9	49.7	61.3	72.3	84.3	89.8	86.3	79.7	67.2	48.4	37.6	62.9
	REC	55	37.2	42.2	50.8	61.8	72.1	82.3	88.3	85.9	78.7	67.0	50.6	38.9	63.0
GRAND JUNCTION WB AP	PER	10	38.1	42.3	52.2	64.2	74.8	87.3	92.6	88.3	81.8	67.7	49.1	39.1	64.8
	REC	15	36.7	42.3	52.6	65.0	74.9	86.5	92.4	88.5	81.9	67.7	49.1	39.4	64.8
GRAND LAKE 1WNW	PER	10	30.9	32.9	37.8	47.5	58.8	70.0	75.3	73.7	69.8	57.6	40.5	32.5	52.3
	REC	19	30.0	33.9	38.9	48.8	59.7	70.4	76.1	74.7	69.7	57.6	40.8	32.8	52.8
GRAND LAKE 6 SSW	PER	10	27.9	30.2	36.2	46.7	58.6	69.6	74.9	72.5	67.2	55.6	39.2	29.6	50.7
	REC	12	27.7	30.6	36.6	47.2	58.5	69.4	74.7	72.7	67.5	56.1	39.5	29.9	50.9
GREAT SAND DUNES NM	PER	10	36.0	39.4	46.2	55.6	65.1	77.5	81.0	78.1	73.7	60.8	44.5	36.8	57.9
	REC	10	36.0	39.4	46.2	55.6	65.1	77.5	81.0	78.1	73.2	61.5	45.1	37.4	58.0
GREELEY	PER	10	39.7	43.0	49.1	59.8	71.1	83.5	89.6	87.4	79.8	65.9	49.1	42.1	63.3
	REC	65	40.3	43.6	51.9	62.5	71.8	82.9	89.1	87.7	79.3	66.9	52.2	41.5	64.1
GREEN MOUNTAIN DAM	PER	10	32.4	35.0	42.2	53.8	64.9	76.4	81.1	78.8	74.0	61.7	43.5	33.4	56.4
	REC	21	31.3	35.7	42.4	54.1	64.5	74.7	80.4	78.5	73.1	61.4	44.2	34.7	56.3
GROVER 10 W	PER	8	41.7	43.2	47.5	58.9	69.1	81.5	87.4	85.9	78.5	65.5	48.5	44.4	62.7
	REC	46	39.6	42.6	48.5	59.1	68.5	79.9	87.3	85.5	77.1	65.1	50.7	41.6	62.1
GUNNISON	PER	10	29.3	32.3	40.6	55.7	67.6	79.2	82.9	80.5	76.0	64.1	45.0	30.4	57.0
	REC	64	25.7	30.8	41.0	56.3	66.8	76.4	80.9	79.1	73.3	62.6	45.8	29.9	55.7
HAYDEN	PER	9	32.3	35.2	42.4	56.8	68.8	79.3	85.7	82.9	76.3	63.3	44.6	34.2	58.5
	REC	40	31.6	36.1	43.6	56.9	68.4	79.1	85.9	83.6	75.3	63.3	45.9	34.4	58.7
HERMIT 7 ESE	PER	10	32.3	35.7	40.8	48.7	59.5	71.3	75.6	72.8	69.4	58.8	42.1	33.3	53.4
	REC	48	31.1	35.6	40.8	49.2	61.0	69.3	73.8	71.7	66.7	56.9	44.1	32.9	52.8
HOLLY	PER	9	46.4	50.2	55.9	68.5	78.5	90.9	94.9	93.4	86.6	73.1	57.5	48.3	70.4
	REC	55	46.9	51.1	59.7	69.3	77.8	88.2	93.1	92.1	85.2	74.0	59.4	47.6	70.4
HOLYOKE	PER	10	42.4	45.2	49.9	63.0	72.9	85.1	91.4	90.7	82.6	68.9	52.3	44.6	65.8
	REC	50	41.6	43.8	51.9	63.2	72.7	83.1	90.6	89.0	80.4	68.6	53.8	43.1	65.2
IDAHO SPRINGS	PER	8	40.2	42.8	45.9	54.7	62.7	75.5	80.3	78.5	73.0	62.2	47.7	42.8	58.9
	REC	53	38.1	40.4	45.3	53.5	61.6	73.0	77.2	76.0	70.0	59.1	46.8	39.6	56.7
IGNACIO 1 N	PER	8	41.2	44.4	52.1	62.7	71.9	83.7	87.7	84.4	80.2	67.2	51.7	42.0	64.1
	REC	44	39.1	44.0	52.2	62.2	71.6	82.2	86.4	83.9	77.7	66.4	52.6	42.1	63.4
JOHN MARTIN DAM	PER	10	45.4	49.5	56.2	67.4	78.2	90.6	94.6	92.5	85.6	71.9	55.0	47.2	69.5
	REC	19	44.5	49.0	56.0	67.3	76.6	88.2	93.3	91.5	84.3	71.7	55.5	46.6	68.7

MEAN DAILY MINIMUM TEMPERATURE

STATION		NO. OF YEARS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
DILLON 1 S	PER	10	-0.2	0.4	5.2	15.5	24.4	29.9	35.1	33.7	25.5	18.2	7.6	0.5	16.3
	REC	48	-3.1	-0.9	4.6	16.0	24.5	29.4	35.7	34.1	26.8	18.2	7.2	-0.8	16.0
DURANGO	PER	10	12.3	14.6	20.6	27.7	34.3	41.1	48.2	47.7	38.3	29.7	19.1	12.5	28.8
	REC	66	10.7	15.9	22.7	29.5	35.5	41.7	49.8	48.9	40.9	31.5	21.2	12.9	30.1
EADS	PER	9	16.2	19.8	24.4	34.5	45.7	56.4	61.2	59.8	50.1	38.2	23.9	19.3	37.5
	REC	44	14.4	19.0	25.9	34.5	45.5	55.8	61.0	59.3	49.8	37.7	24.1	16.7	37.0
EAGLE FAA AP	PER	10	2.7	5.7	16.2	24.6	32.6	38.1	44.4	43.6	33.3	24.2	11.8	2.2	23.3
	REC	23	3.1	7.4	18.2	25.2	32.3	37.3	43.6	42.9	34.0	24.3	13.8	3.8	23.8
EDGEWATER	PER	8	19.2	21.1	24.2	33.4	42.8	51.7	56.7	54.8	45.4	35.5	24.8	21.6	35.9
	REC	48	16.3	19.0	24.4	33.0	41.5	50.3	56.0	54.6	45.5	34.9	24.6	18.0	34.8
ESTES PARK	PER	10	17.5	17.1	18.6	26.3	34.7	41.2	45.5	44.8	37.2	29.5	21.7	19.8	29.5
	REC	44	14.6	16.3	19.4	26.1	33.3	40.0	45.6	44.7	37.2	29.7	22.1	18.4	29.0
EVERSOLL RANCH	PER	6	18.8	22.7	28.4	39.2	50.3	60.4	65.0	63.4	53.6	41.4	27.4	22.2	41.1
	REC	10	18.7	22.4	28.9	39.5	49.5	59.3	64.5	62.7	53.8	41.9	27.1	21.4	40.8
FORT COLLINS	PER	10	13.8	16.8	21.6	31.3	42.5	51.0	55.8	54.3	44.5	34.0	21.6	17.6	33.7
	REC	65	12.1	14.8	22.2	31.9	41.0	49.2	54.5	53.1	44.1	33.1	21.7	14.3	32.7
FORT LEWIS	PER	9	10.5	10.1	16.8	25.3	32.3	39.4	46.5	45.8	38.7	30.3	17.9	10.7	27.0
	REC	42	8.5	12.3	18.5	26.8	33.4	40.5	47.9	46.5	39.7	30.1	19.2	11.6	27.9
FORT LUPTON	PER	8	15.3	16.9	22.6	32.4	42.7	51.3	56.9	55.2	45.0	34.6	22.2	17.5	34.4
	REC	37	13.8	17.8	23.3	33.0	42.5	51.0	56.7	55.2	45.9	35.3	23.2	15.9	34.5
FORT MORGAN	PER	10	10.6	15.4	21.9	32.7	44.6	54.0	58.7	56.8	46.4	35.0	20.3	14.4	34.2
	REC	62	9.0	13.6	21.9	32.6	42.4	51.5	57.3	55.5	45.7	33.6	20.6	11.4	32.9
FRASER	PER	10	-3.5	-3.2	3.5	14.9	24.6	29.7	33.8	32.0	21.5	15.0	4.1	-4.2	14.0
	REC	49	-4.4	-0.6	5.6	16.4	24.3	29.7	34.9	32.7	25.2	17.2	6.4	-2.4	15.4
FRUITA 2 N	PER	10	14.3	17.9	24.0	32.8	42.4	49.4	55.5	53.3	43.5	32.6	21.0	13.7	33.4
	REC	58	10.4	18.1	26.5	34.4	42.5	49.7	57.2	55.4	45.4	34.1	22.0	13.5	34.1
GEORGETOWN	PER	10	17.5	17.0	19.1	26.2	34.9	43.3	49.2	48.6	41.3	33.2	22.8	19.2	31.0
GLENWOOD SPRINGS 1 N	PER	10	15.2	16.7	23.7	32.1	39.7	45.6	52.0	50.5	42.3	33.7	22.0	15.0	32.4
	REC	55	10.7	15.7	24.2	31.5	38.1	43.6	49.9	49.0	41.3	31.9	21.9	13.0	30.9
GRAND JUNCTION WB AP	PER	10	19.8	22.5	29.4	39.0	48.6	58.1	64.5	61.3	53.7	42.0	27.5	19.7	40.5
	REC	15	17.3	21.5	29.7	39.6	48.4	57.2	63.9	61.0	53.7	41.7	27.4	19.8	40.1
GRAND LAKE 1WNW	PER	10	1.9	1.9	7.8	17.7	26.1	30.9	34.8	34.9	27.0	20.3	8.8	1.9	17.8
	REC	19	0.2	1.9	8.3	18.5	26.5	31.0	36.0	35.6	28.3	21.5	10.6	3.4	18.5
GRAND LAKE 6 SSW	PER	10	1.9	1.9	8.8	20.2	29.8	36.3	41.5	41.3	32.9	25.3	14.2	5.3	21.6
	REC	12	0.8	1.4	9.3	20.0	29.4	35.6	40.8	40.0	32.5	24.4	14.0	4.7	21.1
GREAT SAND DUNES NM	PER	10	11.3	13.4	19.4	27.7	36.8	46.1	50.4	48.9	41.7	32.2	19.1	12.3	29.9
	REC	10	11.3	13.4	19.4	27.7	36.8	46.1	50.4	48.9	41.8	32.6	19.4	12.8	30.1
GREELEY	PER	10	9.8	14.2	21.1	31.8	43.1	52.0	56.6	54.8	44.4	32.5	18.9	13.6	32.7
	REC	65	9.1	13.1	21.6	32.0	41.8	50.6	55.5	53.7	43.7	31.4	19.5	10.9	31.9
GREEN MOUNTAIN DAM	PER	10	7.4	7.3	13.9	24.5	33.2	39.8	44.8	43.6	36.5	28.1	15.9	-8.0	25.3
	REC	21	4.4	6.9	13.6	24.3	32.3	38.1	43.5	42.3	35.5	26.7	14.8	8.0	24.2
GROVER 10 W	PER	8	14.5	15.9	19.1	28.7	39.8	48.6	53.8	52.8	44.5	34.6	21.3	18.3	32.7
	REC	46	12.2	14.9	20.5	29.5	38.7	47.6	53.6	52.2	43.7	33.2	22.3	15.3	32.0
GUNNISON	PER	10	-4.2	-2.2	9.4	21.3	28.9	35.6	42.2	40.4	30.8	21.9	8.7	-3.0	19.2
	REC	64	-7.8	-2.7	10.4	22.7	29.2	37.2	42.4	40.8	31.8	21.3	9.9	-3.5	19.3
HAYDEN	PER	9	4.5	5.8	15.1	25.6	33.8	39.7	45.1	44.3	35.4	26.4	14.5	7.4	24.8
	REC	40	2.7	6.4	15.5	26.9	33.7	39.8	46.1	45.0	36.4	27.5	16.3	7.4	25.3
HERMIT 7 ESE	PER	10	-4.7	-2.9	5.0	18.0	25.3	31.4	37.4	37.3	27.2	19.2	6.2	-2.9	16.4
	REC	49	-6.5	-4.2	3.7	16.8	24.8	30.3	37.1	36.2	28.5	19.7	6.8	-4.7	15.7
HOLLY	PER	9	16.6	20.6	26.3	37.9	49.6	60.4	64.0	62.9	52.5	39.0	24.7	18.6	39.4
	REC	55	14.4	18.4	25.7	36.3	47.5	57.8	62.9	60.2	52.1	38.0	24.2	16.3	37.8
HOLYOKE	PER	10	14.3	16.9	20.6	31.6	43.7	53.1	58.5	57.4	46.4	34.7	22.2	17.6	34.8
	REC	46	12.9	14.8	22.0	32.6	42.9	52.4	58.8	57.2	46.5	34.4	22.2	15.1	34.3
IDAHO SPRINGS	PER	8	15.0	15.2	17.8	25.4	33.3	40.3	45.6	44.3	36.9	29.1	20.0	17.0	28.3
	REC	53	14.9	15.6	20.0	27.1	34.4	42.0	47.8	46.8	39.4	30.7	22.1	16.6	29.8
IGNACIO 1 N	PER	9	9.1	11.7	18.9	26.6	33.4	41.3	49.3	48.0	37.8	30.3	17.6	10.5	27.9
	REC	45	6.2	13.1	20.5	27.6	34.2	41.3	49.7	48.3	40.0	29.8	17.8	10.7	28.3
JOHN MARTIN DAM	PER	10	17.0	20.9	26.7	38.0	48.9	59.1	63.6	62.2	52.4	39.7	25.4	[illegible]	39.5
	REC	19	16.0	20.7	26.5	38.4	48.0	58.1	62.8	61.7	52.1	39.9	25.6	[illegible]	[illegible]

3. METHODS AND PROCEDURES — Explanation of Graphs and Tables

Detailed temperature summaries were developed for each of the 148 selected weather stations in Colorado using all available digital records (available on the Colorado Climate Center computer database) of daily maximum and minimum temperatures from the beginning of record through 1987. Digital records were assumed to be accurate (an expedient but not always valid assumption), and no attempt was made to fill in estimates for missing values.

The first computation was the calculation of daily averages and extremes. For each day of the year, including February 29, all values of the daily maximum temperatures and daily minimum temperatures were processed. The arithmetic mean was computed (sum of all non-missing values divided by the total number of non-missing values). The extreme values for each date were retained, and two parameters describing how the values were distributed about the mean were computed — a standard deviation and the upper and lower limits of the inner 50% of the values. Most of this information was then plotted graphically as shown in the example in Figure 1. These are excellent visualizations of the general temperature climate of a specific location but are difficult to read if precise information is required for a specific day. For those who require more detailed information a separate output format was developed (Table 1). Due to obvious page limitations, it was not practical to publish all of this information for all stations. However, for those with special interests, these summaries are available on request (cost reimbursable) from the Colorado Climate Center and will be updated each year.

To accompany the graphs, tables of temperature-related variables were then produced (Figure 2). For each station, monthly mean values of daily high and low temperatures were computed. Values of the standard deviation of monthly mean maximum and minimum temperatures were computed to give readers an idea of how much variation can be expected in monthly values from year to year. A number of monthly average degree days were then generated. "Degree days" is a somewhat misleading name for a fairly simple concept.

Heating and cooling degree days, temperature-derived variables that are related to energy requirements for heating or cooling buildings, were each computed for 5 base temperatures. Heating and cooling degree days are computed by taking the difference between the mean daily temperature (daily maximum plus daily minimum divided by 2) and a constant base temperature. When the mean daily temperature is below the base temperature, heating degree days occur. When the temperatures rise above the base temperature they are then called cooling degree days. These daily differences (degrees F) are accumulated for each day of the month to produce monthly totals. Monthly averages are simply determined by averaging the monthly totals for all available months.

Traditionally, 65°F has been used for the base temperature both for heating and cooling purposes. When the mean daily temperature was less than 65°, it was assumed that some supplemental heat would be necessary to maintain a constant comfortable indoor temperature. Likewise, when the mean temperature exceeds 65°, some cooling may be required. For poorly insulated structures housing low-tolerance residents, these assumptions are reasonable, but as insulation is increased, structures are less responsive to outdoor temperatures. Likewise, if residents can tolerate some indoor temperature fluctuations, no additional energy consumption may be required. But as it gets hot or cold enough, any occupied structure will eventually require heating or cooling. Therefore, the use of other base temperatures in addition to 65° may become more appropriate in some situations.

Growing degree days are derived from mean daily temperatures exactly like cooling degree days. When the mean daily temperature exceeds the specified base temperature, growing degree days are accrued. The purpose for computing growing degree days is to relate plant growth to temperature. The assumption here is that plants grow and mature faster with warmer temperatures. Some plants, such as cool-weather grasses grow under very cool conditions. Other plants, like beans, tomatoes and peppers require much warmer temperatures. Therefore, similar to heating and cooling degree days, several different thresholds are used in order to accomodate a variety of potential plant species.

A special definition of growing degree days was developed a number of years ago specifically for corn. It is well known that corn grows best during hot weather and does not grow as well when temperatures are cool. But as temperatures get extremely hot, growth rates also slow. Therefore, some additional conditions were added to the basic degree day computation. The corn formulation uses a lower threshold of 50°F and an upper value of 86°. Whenever the maximum temperature exceeds 50° but the minimum temperature is less the 50° the minimum is set equal to 50°. If either the maximum or minimum temperature exceeds 86° they are set equal to 86°. Therefore, the maximum number of corn growing degrees that can occur in a given day is 36 — that being when the high temperature is at least 86° and the low is 86°. Monthly averages of corn growing degree days are shown directly beneath the other growing degree day table. The label is abbreviated "Corn GDD."

Growing season information is presented in the bottom half of the table of the "Temperature Summary" information for each station (see example in Figure 2). Probability tables are shown for total growing season length (number of days between the latest spring occurrence and the earliest autumn occurrence of a specified minimum temperature) and also separately for spring and autumn frost dates. Six different temperature thresholds are shown at 4 degree Fahrenheit intervals from 36° down to 16°. In computing these dates, missing data can create some difficulties. Therefore, anytime there were any missing days during the growing season when frosts could have been possible, data for that season was simply discarded. Readers can determine how much data were discarded by comparing the "Yrs." column to the right of the growing season data with the "Period of Record" on the right hand side of the header information at the top of each table. In a few cases, much of the available data were discarded due to frequent missing values. Where probabilities are based on less than 20 years of data, the computation may not be terribly accurate. Keep this in mind as you use these results.

A few assumptions were made in computing frost probabilities and growing season length. First, July 20 was selected as the date for the middle of the summer. This decision has no bearing on most calculations but does influence computations for those high mountain stations with very short growing seasons. December 31 is used as the begin and end point for the year. This makes computations simple, but it creates some assymetries for a few of Colorado's warmest locations for fall and spring periods at the coldest threshold temperatures. February 29 temperatures were not used. The final and perhaps most significant assumption was that the data are normally distributed. This assumption was tested on several long-term stations and was found to be appropriate. Mean and median dates were almost always identical. Therefore, for each station, means and standard deviations were computed for each variable. Probabilities were then derived based on the statistical normal distribution. The use of median values along with the width of the distribution between specified probabilities (e.g. between the 0.80 and 0.20 dates of nonexceedance) is an excellent method for determining how much year-to-year variation can be expected in frost dates and growing season length.

Temperature Summary for FRUITA 53146 Prepared by: Colorado Climate Center

Latitude: 39 10 Longitude: 108 44 Elevation: 4510 Period of Record: 40 years ending in 1987

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max.	37.6	45.8	55.8	67.2	77.1	87.8	93.0	90.1	82.5	69.6	52.4	40.3	66.6
Std. Dev.	5.9	6.0	3.7	3.8	3.5	3.2	1.9	2.2	3.4	4.4	4.0	4.9	
Mean Min.	11.8	18.2	25.5	33.3	42.6	49.6	56.4	54.4	44.6	33.3	22.7	14.8	33.9
Std. Dev.	6.5	6.0	3.0	2.0	1.9	2.4	1.9	2.9	2.8	2.8	3.0	4.4	
Num. Yrs.	38	37	37	38	37	37	38	37	38	39	37	38	

Heating Degree Days

Base	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
50	772	498	286	79	8	0	0	0	2	62	366	685	2758
55	926	638	432	166	31	1	0	0	9	142	515	839	3700
57	988	694	493	212	46	3	0	0	15	186	575	900	4112
60	1080	778	585	289	79	8	0	0	30	264	665	993	4769
65	1234	918	738	431	171	29	0	3	86	412	815	1146	5984

Cooling Degree Days

Base	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
55	0	0	1	33	187	417	616	536	271	41	0	0	2102
57	0	0	0	19	141	359	555	475	217	23	0	0	1789
60	0	0	0	7	83	274	462	383	143	8	0	0	1359
65	0	0	0	1	22	147	308	232	50	1	0	0	761
70	0	0	0	0	2	54	159	101	9	0	0	0	324

Growing Degree Days

Base	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
40	1	14	98	318	614	863	1078	997	707	369	55	3	5118
45	0	2	33	191	462	714	924	843	559	229	14	1	3973
50	0	0	7	94	317	565	770	690	413	115	1	0	2973
55	0	0	1	33	187	417	616	536	271	41	0	0	2102
60	0	0	0	7	83	274	462	383	143	8	0	0	1359
Corn GDD	4	29	112	258	415	540	654	618	477	307	78	6	3500

Growing Season

Probability length will be less than

Threshold	Shortest	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	Longest	Yrs.
36	96/1951	99	106	110	115	118	122	126	131	138	154/1963	27
32	100/1973	120	128	134	139	144	149	154	160	169	176/1949	25
28	143/1971	149	156	161	165	170	174	178	183	190	200/1981	25
24	165/1951	171	178	182	186	190	193	197	202	208	218/1957	25
20	192/1967	196	204	210	215	219	224	228	234	242	257/1981	24
16	196/1960	209	220	227	233	239	244	251	258	268	287/1972	20

Probability last spring frost will be before

Threshold	Earliest	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	Latest	Yrs
36	4/27/1952	5/ 8	5/14	5/18	5/21	5/24	5/28	5/31	6/ 4	6/10	6/19/1973	27
32	4/17/1949	4/24	4/30	5/ 4	5/ 8	5/12	5/15	5/19	5/23	5/29	6/19/1973	25
28	4/ 6/1981	4/14	4/19	4/22	4/25	4/28	4/30	5/ 3	5/ 6	5/11	5/28/1973	25
24	3/28/1964	4/ 4	4/ 9	4/12	4/15	4/18	4/21	4/24	4/27	5/ 2	5/11/1953	25
20	3/ 4/1949	3/17	3/22	3/26	3/29	4/ 1	4/ 4	4/ 7	4/11	4/16	4/21/1967	24
16	2/ 2/1968	2/25	3/ 5	3/11	3/16	3/21	3/25	3/30	4/ 5	4/13	4/17/1960	20

Probability first autumn frost will be before

Threshold	Earliest	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	Latest	Yrs
36	9/ 2/1962	9/ 7	9/11	9/15	9/17	9/20	9/22	9/25	9/28	10/ 3	10/14/1963	27
32	9/12/1951	9/19	9/24	9/27	9/30	10/ 3	10/ 6	10/ 9	10/12	10/17	10/23/1972	25
28	9/18/1971	9/29	10/ 4	10/ 8	10/11	10/14	10/17	10/20	10/24	10/29	11/ 1/1963	25
24	9/19/1971	10/11	10/15	10/19	10/22	10/25	10/27	10/30	11/ 3	11/ 7	11/ 9/1953	25
20	10/16/1952	10/23	10/28	10/31	11/ 3	11/ 6	11/ 9	11/12	11/15	11/20	11/28/1965	24
16	10/30/1960	10/31	11/ 5	11/ 8	11/11	11/14	11/17	11/20	11/24	11/29	12/17/1965	20

Temperature Summary for PALISADE 56266 Prepared by: Colorado Climate Center

Latitude: 39 7 Longitude: 108 21 Elevation: 4800 Period of Record: 40 years ending in 1987

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max.	39.7	47.2	56.2	66.9	77.1	88.5	94.6	91.7	83.4	70.6	53.7	42.3	67.6
Std. Dev.	5.4	5.7	4.1	4.0	3.5	3.7	1.8	2.4	3.6	4.4	3.9	4.4	
Mean Min.	18.4	24.5	32.1	40.3	49.1	57.7	63.9	61.8	53.3	42.3	30.6	21.4	41.3
Std. Dev.	5.6	5.0	3.2	2.5	2.2	2.3	2.1	2.0	2.7	2.4	2.7	4.2	
Num. Yrs.	38	38	38	38	38	38	37	38	39	39	38	38	

Heating Degree Days

Base	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
50	639	392	206	54	5	0	0	0	1	30	243	556	2126
55	793	531	336	118	21	1	0	0	6	74	377	711	2967
57	855	586	393	152	32	2	0	0	9	102	435	773	3338
60	947	670	483	214	57	4	0	0	16	154	524	866	3934
65	1102	810	635	340	122	15	0	1	42	269	673	1021	5029

Cooling Degree Days

Base	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
55	0	0	9	83	276	545	747	679	411	126	2	0	2881
57	0	0	5	57	226	487	686	618	354	92	1	0	2526
60	0	0	2	30	158	400	595	525	272	51	0	0	2032
65	0	0	0	6	69	263	442	371	148	12	0	0	1311
70	0	0	0	0	17	143	290	222	57	1	0	0	731

Growing Degree Days

Base	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
40	7	47	183	417	718	990	1206	1143	854	517	136	15	6233
45	0	13	90	282	565	841	1053	989	705	370	60	3	4972
50	0	2	34	168	415	693	900	834	556	236	17	1	3856
55	0	0	9	83	276	545	747	679	411	126	2	0	2881
60	0	0	2	30	158	400	595	525	272	51	0	0	2032
Corn GDD	7	36	121	260	444	621	759	727	539	326	92	12	3946

Growing Season

Probability length will be less than

Threshold	Shortest	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	Longest	Yrs.
36	120/1971	133	141	147	152	157	162	167	173	181	189/1962	24
32	133/1968	158	167	173	178	183	188	193	200	208	216/1985	24
28	181/1986	193	201	206	210	214	218	223	228	235	247/1962	22
24	193/1950	206	216	223	230	236	242	248	255	266	296/1968	19
20	233/1987	231	241	249	255	261	267	274	281	291	325/1980	16
16	240/1955	236	253	266	276	286	296	306	318	335	365/1980	11

Probability last spring frost will be before

Threshold	Earliest	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	Latest	Yrs
36	4/21/1987	4/22	4/28	5/ 1	5/ 5	5/ 8	5/11	5/14	5/18	5/23	6/13/1976	24
32	4/ 5/1985	4/ 6	4/11	4/14	4/17	4/20	4/23	4/26	4/29	5/ 4	5/21/1971	24
28	3/16/1962	3/23	3/28	3/31	4/ 3	4/ 6	4/ 9	4/12	4/16	4/21	4/30/1950	22
24	2/ 4/1968	2/27	3/ 6	3/12	3/17	3/21	3/26	3/30	4/ 5	4/13	4/30/1950	19
20	2/ 1/1968	2/16	2/22	2/27	3/ 3	3/ 7	3/10	3/14	3/19	3/25	3/30/1987	16
16	0/30/1980	1/18	1/30	2/ 7	2/15	2/22	2/28	3/ 8	3/16	3/28	3/21/1955	11

Probability first autumn frost will be before

Threshold	Earliest	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	Latest	Yrs
36	9/17/1968	9/24	9/30	10/ 4	10/ 8	10/12	10/15	10/19	10/24	10/30	11/ 8/1983	24
32	9/17/1968	10/ 1	10/ 8	10/12	10/16	10/20	10/24	10/28	11/ 2	11/ 8	11/13/1987	24
28	10/12/1986	10/25	10/29	11/ 1	11/ 4	11/ 6	11/ 9	11/11	11/14	11/19	11/19/1953	22
24	10/27/1970	10/30	11/ 3	11/ 7	11/ 9	11/12	11/14	11/17	11/20	11/24	11/27/1968	19
20	11/10/1950	11/ 8	11/13	11/17	11/20	11/23	11/26	11/29	12/ 2	12/ 7	12/31/1980	16
16	11/10/1950	11/13	11/20	11/26	11/30	12/ 4	12/ 9	12/13	12/18	12/26	12/31/1980	11

Attachment # 2

MESA COUNTY IRRIGATION DISTRICT

P.O. Box 970
Palisade, CO 81526

*"Water is Precious —
Use it Wisely"*

8 August 1990

To Whom it May Concern

Subj: Delivery of Irrigation Water to Landowners on the North Side of the Mesa County Irrigation District Ditch(Stubb Ditch)

With the advent of the Salinity Control Program improvements to the canal and the need for formal, recorded easements in lieu of our established prescriptive easements some property owners have inquired about the possibility of receiving water on their lands on the north side of the canal.

In accordance with the provisions of Contract Ilr467 between the District and the Bureau of Reclamation, dated June 10, 1918 and revised 29 December 1988(Contract No. 9-07-40-R0700, Copy attached), Paragraph 7, page 6, specifically prohibits the District from delivering water to lands other than those embraced in the District as established and existing on January 1, 1918.

[redacted]

Charles E. McKim
Secretary/Treasurer
Mesa County Irrigation District

Attachment # 3

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

GRAND VALLEY PROJECT, COLORADO

CONTRACT AMONG THE UNITED STATES,
THE MESA COUNTY IRRIGATION DISTRICT, AND
THE GRAND VALLEY WATER USERS' ASSOCIATION,
PROVIDING FOR
THE CARRIAGE OF NON-PROJECT WATER THROUGH
THE GOVERNMENT HIGHLINE CANAL

THIS CONTRACT is made this 29th day of December, 1988, pursuant to the Act of June 17, 1902 (32 Stat., 388), and acts amendatory thereof and supplemental thereto, particularly the Act of February 21, 1911 (36 Stat., 925), among the UNITED STATES OF AMERICA, hereinafter referred to as the United States, acting through the Bureau of Reclamation; the MESA COUNTY IRRIGATION DISTRICT, an irrigation district organized and existing under the laws of the State of Colorado with its principal place of business at Palisade, Colorado, hereinafter referred to as the District; and the GRAND VALLEY WATER USERS' ASSOCIATION, a corporation organized and existing under the laws of the State of Colorado, with its principal place of business at Grand Junction, Colorado, hereinafter referred to as the Association.

WITNESSETH THAT:

WHEREAS, the United States has constructed the Grand Valley Project, for irrigation and other purposes, in Mesa County, Colorado; and

WHEREAS, the United States and the District entered into Contract No. Ilr 467, dated June 10, 1918, for the purpose of the carriage and delivery of District water through the Government Highline Canal; and

WHEREAS, The District claims, by virtue of mesne conveyances and appropriations, forty (40) cubic feet of water per second of time, from the

6. The United States or its assigns shall not be liable for failure to supply water under this contract caused by insufficient supply in the river, hostile diversions or drought, and the United States or its assigns shall not be liable for damages caused by floods, acts of hostility, unavoidable accidents, or causes beyond the control of the United States or its assigns.

7. The District shall not deliver any water to lands other than those embraced in the District, as established and existing on January 1, 1918, and entitled as by right conferred by law to receive the same, except that the District may supply water to any lands heretofore entered subject to the act of June 17, 1902 (32 Stat., 388), known as the Reclamation Act, lying below the distributing canal of the District and above the Government Highline Canal of the Grand Valley Project, until such time as provision is made by the United States for supplying said lands with irrigation water.

8. As a part consideration for the benefits to be derived by the said District, and repayment of costs expended by the United States to enable it to carry the irrigation water aforesaid, the said District hereby authorizes the United States to carry in its canals, and to use for the benefit of the lands in the District as provided for in this contract, and for use on or for lands in the Grand Valley Project and in connection therewith and for other purposes, all the waters claimed, owned or decreed to the said District especially including herein all waters claimed, owned, or decreed to the said District for power purposes hereinbefore described, and excepting only that necessary for the proper irrigation of the irrigable lands of the District as aforesaid, not exceeding forty (40) cubic feet per second of time.

9.(a). The District agrees to annually pay for the delivery of water as hereinbefore provided a charge of $4,800, and, in addition thereto, a charge of $2 per acre per year for each acre of land entered under the Reclamation

Attachment # 4

BY LAWS

OF

Mesa County Irrigation District

The officers of the Mesa County Irrigation Disrict will be comprised of three (3) directors. One director to be elected each year for a term of three (3) years. Voting will be limited to the users of the Mesa County Irrigation District, also known as the Stubb Ditch. Votes will be counted on a per acre basis-one vote per acre.

The election will be held on the first Tuesday in December. After the election, the elected members will be designated as: President, Vice President, and Secretary-Treasurer.

The Board of Directors may appoint such employees as might be necessary to properly operate the dispersal of irrigation water. The Secretary-Treasurer shall direct the activities of said employees and have full charge of all tools, implements, and property.

2

WATER SERVICES

Water shall be turned into the canal at the most convenient time in April and shut off at the end of the irrigation season in November. Water is designated for agricultural and horticultural only and NO water is to be used for domestic purposes.

The flow turned in shall be in sufficient quantity to furnish every acre under the districts management x042 of an inch of 0.42 water, providing the pumpingplant and canal can handle this amount.

The Board of Directors shall determine the rates to be charged. Rates shall be established on a per-acre basis, with a one acre minimum charge per user.

All gates shall be furnished and installed by the district. All gates shall be under the direct supervision of the ditch rider as employed by the Board of Directors.

No drops or obstructions of any kind will be allowed in the canal. No bridges shall cross the canal except by the consent of the Board of Directors. Any bridges the Board of Directors may permit to cross said canal shall be constructed to the Directors strict specifications, and the ditch rider or Secretary shall supervise the construction.

No fences will be allowed across the banks of the canal, except with the approval of the Board of Directors. Any gates thus approved shall be easily opened and wide enough to give access for cleaning equipment and the ditch rider's vehicle. The easement claimed for the maintenance of the canal shall be thirty five (35) feet from the center line of said canal on both sides.

No person or persons shall be allowed to open any head gate when said gate is closed by the ditch rider. Any infringment on this order could result in the gate being locked closed, and the person responsible liable to prosecution. This rule will be rigidly enforced.

No person or persons will be allowed to pump, pipe, flume, or otherwise convey water outside the boundaries of the district.

All persons are notified they shall not remove any earth from the canal banks. Such acts will be considered a misdemeanor and are subject to the penalty of the law.

No new head gates will be allowed in the ditch when the land for which another head gate is desired can be watered from an existing head gate. No new gates will be installed without the approval of the Board of Directors.

The above By Laws, rules, and regulations have been read and approved by the Board of Directors on this date 1-5-82.

President [redacted]

Vice President [redacted]

Secretary-Treasurer [redacted]